above usually decreases with increasing voltage; at the same time the luminous bell becomes larger and ultimately splits off from the anode into one or more striæ. On increasing the voltage further, there is another sudden increase in the discharge current, and the luminosity shifts to the cathode, round which it forms a very fuzzy halo. The spectrum of this consists mainly of Balmer's series down to ι, but the secondary spectrum is also well marked. At the higher voltages (50-60) there is no trace of the continuous spectrum in this glow. That present in the spectrograms of this discharge at the lower voltages may be due to stray light from other parts of the discharge. This type of discharge is stable and characterised by a falling current with rising voltage.

Provided the cathode is sufficiently hot there is a third type of stable discharge at the lowest pressures (0·05-0·1 mm.) on a range of voltage higher than either of the preceding. This is characterised by a glow filling the whole volume of the bulb, and its spectrum consists of a large number of lines with the continuous spectrum almost absent.

We have also made a few experiments with a gauze at the same potential as the anode plate a few millimetres in front of the hot cathode. With this arrangement, provided the pressure is not too low, a feebly luminous discharge sets in at 23 volts. This is very close to the potential attributed by Horton and Davies (*Phil. Mag.* November 1923, vol. 46, p. 895) to the ionisation of molecular hydrogen ($H_2 \rightarrow H_2^+ + e$).

We hope to publish a more complete account of these experiments elsewhere.

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January 29.

Problems of Hydrone and Water.

CLERK MAXWELL used to say that it was a sign of progress when we began to overhaul the foundations of our science and return to the very beginnings. Prof. Armstrong is calling upon us to do this in electricity. All I want to suggest to him at present is that he is rather over-emphasising the rôle of electrolysis and conduction generally, and not recognising the full value of electric *displacement*, so much emphasised by Faraday and Maxwell. Conduction necessarily involves some dissipation of energy, something analogous to friction; it does not store energy, and it gives no recoil. A pure dielectric dissipates no energy, and it recoils perfectly. A dielectric slab brought near a charged body becomes polarised, positive on one face, negative on the other: there has been a displacement of electricity through it, but not by conduction. It may even be worth while to ask Prof. Armstrong to refer back to an ancient paper of mine in the *Phil. Mag.* for November 1876, in which I design models to illustrate Maxwell's theory. This paper, I was delighted to find, pleased Clerk Maxwell sufficiently to induce him to write me a most interesting letter about it—humorously suggesting, I recollect, lubrication with Canada balsam as suitable for § 10 of that paper,—a letter which, to my long-standing regret, has suffered from "moving accidents" and got itself lost. If the elastically supported buttons or beads on the cord of that model slip on the cord, there is conduction; but if they grip it tight, they represent a dielectric.

As to the meaning of electric charge, it was one of the complaints of the late Prof. Cornu that after a perusal of Maxwell he rose quite uncertain as to what an electric charge was. Since his day we had hoped that the discovery of the electron supplemented in a useful manner the necessarily vaguer views of old time; but far be it from me to say that we have nothing still to learn about the frictional machine. To separate the charges—to increase their distance apart—we do require something more than displacement; we require a transfer, and that does involve either conduction or convection, or both. It is familiar knowledge that the rubber must be connected to the ground if a charge is to be continuously and freely drawn from the prime conductor. The machine generates a current. But surely neither impurities nor aquosity need be pressed into the service in this case! If Prof. Armstrong can show experimentally that nothing else will serve, and that the inefficiency of a "dry" machine can be remedied by no other conductor than water, then that would be a fact worthy of consideration. But I am quite sure that a dry electroscope will behave as usual.

For contact E.M.F. generally, even as powerfully displayed in the frictional machine, I am all for the chemical strain (not chemical action or combination) theory; and Armstrong's residual chemical affinity is one mode of expressing that, and is useful in cohesion too; though, there, magnetic as well as electric attraction has to be taken into account.

OLIVER LODGE.

January 26.

Earthworms and the Cluster Fly.

IN his little book on earthworms and their allies (1912), Beddard expresses the opinion that the northern regions of America possess no indigenous earthworms. This refers to large areas in Canada and the Northern United States. In the mountainous district of Colorado, and the adjacent upland plains, it appears that earthworms were formerly absent. Old settlers assure us that when they first came there were none. This seemed almost incredible, but in recent years Prof. Frank Smith of the University of Illinois has collected earthworms in Colorado, and found only the widespread presumably introduced types. There are indeed a few small native oligochætes in the mountains, but these (Enchytræids) are not pertinent to the present discussion. Beddard infers that the earthworms came from the south, but the Lumbricidæ are evidently of long standing in the Palæarctic region, and as one species (*Eisenia nordenskioldi*) extends to the Anadyr region in the extreme north-east of Siberia, it is surprising that we find no endemic genera or species in the far north of America. In the more southern parts of North America, apparently including all of the Eastern United States, there is a rather scanty indigenous fauna of Lumbricidæ. These American species are so closely allied to those of the Palæarctic region as to leave no doubt that they are derived from a common source, and we may reasonably assume that their ancestors came by way of Eastern Asia. Thus the present distribution corresponds in a general way with that of certain groups of plants and other organisms which have evidently died out in a large part of North America.

The cluster fly, *Pollenia rudis*, is a native of the Palæarctic region, where it is parasitic on the native earthworms, as Keilin has shown. This fly was introduced many years ago into the United States, and has become abundant in Colorado since the European types of earthworms were brought in with plants. The combination, brought about unwittingly through human agency, has resulted in a veritable plague of flies at Longmont, Colorado. Mrs. M. G. Wadsworth, sending flies for examination, reports that for at least eight years past houses in her vicinity