and discharges up to nearly half an ampere were obtained. Some of the published photographs are very remarkable. One of them showing the electric corona and streamers round the magnetised globe might easily be mistaken for a genuine photograph of a typical solar eclipse. Many of the phenomena of sunspots are also very strikingly imitated in the experiments.

Birkeland proceeds to discuss the cause of the general magnetic field of the sun, the fact of the existence of which has been established by Hale. He attributes it to induced currents circulating in the interior of the rotating mass, which, he argues, can only have a comparatively feeble electric conductivity. He says (*loc. cit.* p. 540):—

"We know that electric currents circulating in large globes formed of good electric conductors are of great persistence. Lamb found that for a globe of copper as large as the earth, ten million years would elapse before the currents fell to $1/\epsilon$ of their former intensity. The induction effects produced by electric rays emanating from sunspots may therefore give rise to currents of long duration if circumstances permit. It is probable that as regards the sun, we shall be obliged to suppose a somewhat feeble conductivity of the gaseous interior, to the intent that the electric currents created and circulating within it are reduced with a fairly high rapidity and are transformed into heat."

In a recent communication to the Royal Astronomical Society,[2] the writer brought forward some evidence deduced from laboratory experiments, which led to a contrary conclusion, namely, that the gaseous matter composing the sun must be a highly conducting medium. The experiments of Kaye[3] and the writer showed that carbon and a number of metals emit on heating ionisation currents of a relatively very high order of magnitude, and this in absence of any external applied potential and at atmospheric pressure. The currents are almost certainly carried by swarms of negatively charged particles of relatively considerable mass, the emissivity of the emitting surface increasing very rapidly with increase of temperature.

In the interior of a carbon-tube resistance-furnace heated by alternating current, the apparent gaseous resistance of the order of megohms at 1400° C. fell at the highest attainable temperature to a small fraction of an ohm, due to the emission from carbon alone. In one series of experiments where temperature measurements were made, the conductivity increased exponentially nearly two hundred-fold for each rise of 1000° C. Impurities such as iron and silicon, which are generally present in ordinary samples of carbon, may further increase the conductivity four or five fold during the first heating of a new furnace. Though influenced somewhat by the surrounding gas, the emissivity appears to be invariably present in neutral or reducing media. The experiments of King, briefly referred to by Hale in his paper in the current number of *The Astrophysical Journal*, show that though the emissivity of carbon falls with increase of pressure, it is still apparent at 20 atmospheres.

Seeing that the temperature of the sun is probably between 5600° and 6000° abs. and that of those elements shown to possess an appreciable electric emissivity, carbon, and iron at any rate are present in the solar atmosphere in considerable quantity, it is difficult to avoid the conclusion that the degree of ionisation, and consequently of electric conductivity, must be very high; probably at least as good as that of the globe of copper considered in Lamb's computation.

The bearing of these conclusions on Birkeland's solar theory seemed worthy of some consideration.

J. A. HARKER.

Teddington, September 16.

[2] Harker, "On the Origin of Solar Electricity." Monthly Notices of the Royal Astron. Soc., June, 1913.

[3] Harker and Kaye "On the Emission of Electricity from Carbon at high Temperatures." Proc. Roy. Soc. A. vol. lxxxvi, 1912, pp. 379 to 396. "On the Electric Emissivity and Disintegration of Hot Metals." Proc. Roy. Soc. A. vol. lxxxviii, 1912, pp. 522 to 538.

A New Aquatic Annelid.

ABOUT the middle of September I received from Dr. H. F. Parsons, of Croydon, a fresh-water Annelid which had been found in the water supply of Ringwood, Hants, and sent to the Local Government Board for identification. It proved to be an immature but very beautiful specimen of *Rhynchelmis limosella*, Hoffm., a member of the Lumbriculidæ. It is of peculiar interest, inasmuch as it confirms a suspicion expressed by Beddard in 1895. He remarks ("Monograph of the Order Oligochæta," p. 215) that "the genus Rhynchelmis is, so far as our present knowledge goes, confined to the fresh waters of Europe. . . . I have seen a specimen from some part of England, but cannot give any details. I believe this specimen to be in the Oxford Museum. There is every probability that it is a native of this country."

I have collected annelids in almost every part of the British Isles, but hitherto have never had the good fortune to come across the species here named. It is, therefore, very gratifying to be able to record it as a new addition to our Annelid fauna.

HILDERIC FRIEND.

Pocklington, York, September 20.

MODERN ELECTROMETERS.

RECENT research on the electron and radioactivity has necessitated so many refined electrostatic measurements that much attention has been directed to the design of electrometers, and several different instruments distinguished by their sensitiveness and convenience in working have been devised. Two types have served as the starting-points for modern improvements, the first being the gold-leaf electroscope, and the second the quadrant electrometer of Lord Kelvin; great progress has been made by bettering the insulation, the sensitiveness, and the accuracy and ease of observation, and further by important modifications of design. Polished amber or ambroid, a substance made from compressed fragments of amber, is now generally used as insulating substance, and for the first type of instrument the deflection is now measured with a reading microscope; for the second the mirror and scale is employed.

The gold-leaf instrument is used in many forms. In a modification by Exner a leaf is fastened on either side of a narrow, vertical, insulated metal plate, while opposite each leaf is a metal plate the distance of which from the central plate can be adjusted, thus controlling the sensitiveness; for potentials of some hundred volts this is a convenient form. For higher potentials of thousands of volts Braun's pattern, with a light rigid needle pivoted a short distance above its centre of mass, is much used. For very sensitive measurements C.T.R. Wilson has recently modified the gold-leaf electroscope in his so-called "tilted electrometer." In this instrument a single hanging gold leaf is attracted out of the vertical by an inclined insu-