"The Forces Acting on a Charged Condenser moving through Space." By Professor F. T. TROUTON, F.R.S., and H. R. NOBLE, B.Sc., University College, London. Received June 11,—Read June 18, 1903.

(Abstract.)

If a charged condenser be placed with its plane in the direction of the æther drift, then on the assumption that a moving charge develops a magnetic field, there will be associated with the condenser a magnetic field perpendicular to the lines of electric induction, and to the direction of the motion. If N be the electrostatic energy of the condenser, the magnetic energy produced when moving with velocity w through the æther with its plates parallel to the motion is N $(w/v)^2$, where v is the usual velocity of propagation. But when the plates of the condenser are perpendicular to the direction of motion, the effects of the opposite charges will neutralise each other, and there will be no magnetic field produced. Thus if we have a condenser freely suspended with its plates making an angle ψ with the direction of the æther drift, the magnetic energy is N $(w/v)^2 \cos^2 \psi$. The couple tending to increase ψ is $-d\text{E}/d\psi$, which is N $(w/v)^2 \sin 2\psi$. By utilising the Earth's motion through space, we can arrange (generally) the experiment so that $\psi = 45^\circ$ and w is the total velocity of the Earth through space. The couple is then a maximum equal to 10^{-8} N for the orbital velocity alone, and to $2{\cdot}3 \times 10^{-8}$ N when we include the Sun's proper motion.

A condenser was suspended by a fine wire and charged. The charges were let into the plates of the condenser by means of this suspending wire, and by a wire which hung from beneath dipping into a liquid terminal. Observations were made at different times in the day when the plane of the condenser made various angles with the direction of the drift.

The final form of the apparatus is as follows:—The suspension is a phosphor bronze strip 37 cm. long, the finest that could be obtained. This was soldered at its lower end A to a copper cap, fixed to the condenser protecting the projecting tin foil tags and making contact with them by means of fusible metal. The upper end of the suspension was wound on a small windlass which was insulated by a mica plate fixed to an annular wooden ring, forming the lid to the inner zinc vessel. A small glass bell jar covered the windlass, contact being made by a wire passing through the small cork at the top. A small brass tube shields the upper part of the suspension, and a thin metal cylinder protects the point of support. The condenser is inserted in a celluloid ball, to diminish the effect of convection currents. Two cylindrical zinc vessels protect the apparatus, the interspace being

packed with cotton wool; these were earthed together with the ball containing the condenser. A plane mirror was attached to the condenser, this was viewed by means of a telescope and scale, through small mica windows in the zinc coverings. The potential was maintained by a Wimshurst machine, to the terminals of which was attached a Kelvin–White voltmeter.

The best conditions under which to make the experiment are calculated. These include considerations as to the time of day and time of year, and azimuth of the plane of the condenser. This calculation is made for both the orbital motion and the proper motion of the solar system.

The following table gives the final results obtained. These were observations taken after many months of experience with the apparatus and were considered by us as conclusive against there being any such effect as we were seeking :—

Date.	Time.	Potential in volts.	Deflection calculated (annual motion).	Deflection calculated (annual + proper).	Deflection observed.
			cm.	cm.	cm.
March 9	12.15 P.M.	2100	−2·6	−6·8	−0·35
,, ,,	6.0 ,,	,,	+0·8	0	−0·12
,, 10	12.0 (day)	,,	−2·6	−6·8	−0·34
,, ,,	3.0 P.M.	,,	−1·2	−3·4	−0·23
,, ,,	6.0 ,,	,,	+0·8	0	−0·26
,, 12	12.0 (day)	,,	−2·6	−6·8	−0·36
,, ,,	3.0 P.M.	,,	−1·2	−3·4	−0·25
,, ,,	6.0 ,,	,,	+0·8	0	−0·32
,, 13	5.30 ,,	,,	+0·8	0	−0·34
,, ,,	6.30 ,,	,,	+0·8	0	−0·18
,, 18	3.0 ,,	2000	−1·2	−3·4	−0·02

The largest observed deflection 0·36 cm. barely exceeds 5 per cent. of the calculated deflection 6·8 cm.

There are also other observations on the electrostatic effects to show that the deflection observed was a purely capricious action and could in no way be attributed to the relative motion of the earth and the æther.

There is no doubt that the result is a purely negative one, as in other cases of possible interaction between æther and matter that have been examined. As the energy of the magnetic field, if it exists (and from our point of view we must suppose it does) must come from somewhere, we are driven to the conclusion that the electrostatic energy of a charged condenser must diminish by the compensating amount $N(u/v)^2$, where N is the electrostatic energy, when moving with a velocity u at right angles to its electrostatic lines of force.