"Polarised Röntgen Radiation." By CHARLES G. BARKLA, D.Sc., B.A., King's College, Cambridge, Oliver Lodge Fellow, University of Liverpool. Communicated by Professor J. J. THOMSON, F.R.S. Received January 21,—Read February 16, 1905.

(Abstract.)

Experiments on secondary radiation from gases and light solids subject to X-rays showed that the character of this radiation differs only very slightly from that of the radiation producing it, and that the energy of this radiation is proportional merely to the quantity of matter through which a beam of Röntgen radiation of definite intensity passes, being independent of the kind of matter.

These results, and the agreement between the energy experimentally determined and that calculated, led to the conclusion that this radiation is due to what may be called a scattering of primary X-rays by the corpuscles or electrons constituting the molecules of the substance.

On the hypothesis that Röntgen rays consist of a succession of electro-magnetic pulses in the ether, each electron in the medium through which these pulses pass has its motion accelerated by the intense electric fields in these pulses, and consequently is the origin of a secondary radiation, which is most intense in the direction perpendicular to that of acceleration of the electron, and vanishes in the direction of that acceleration. The direction of electric intensity at a point in a secondary pulse is perpendicular to the line joining this point and the origin of the pulse, and is in the plane passing through the direction of acceleration of the electron.

On this theory, a secondary beam whose direction of propagation is perpendicular to that of the primary, will be plane polarised, the direction of electric intensity being parallel to the pulse front in the primary beam. If the primary beam be plane polarised, the secondary radiation from the charged corpuscles or electrons has a maximum intensity in a direction perpendicular to that of electric displacement in the primary beam, and zero intensity in the direction of electric displacement.

The secondary radiation from light substances was too feeble to allow accurate measurement of the intensity of the tertiary radiation.

A consideration of the method of production of primary Röntgen rays in an X-ray tube, however, leads one to expect partial polarisation of the primary beam proceeding from the antikathode in a direction perpendicular to that of propagation of the impinging kathode rays, for there is probably at the antikathode a greater acceleration along the line of propagation of the kathode rays than in a direction at right

angles; consequently in a beam of X-rays proceeding in a direction perpendicular to that of the kathode stream there should be greater electric intensity parallel to the stream than in a direction at right angles.

Such a beam was therefore used as the primary radiation, and the intensity of secondary radiation proceeding in a direction perpendicular to that of propagation of the primary beam from a radiator placed in that beam, was studied by means of electroscopes.

In the final form of apparatus the intensity of secondary radiation was measured in two directions perpendicular to that of propagation of the primary radiation and to each other, while the intensity of the primary beam was measured by a third electroscope.

Using paper, aluminium, or air as the radiator, as the bulb was turned round the axis of the primary beam studied, the intensity of a secondary beam was found to reach a maximum when the direction of the kathode stream was perpendicular to that of propagation of the secondary beam, and a minimum when these two were parallel, one electroscope recording a maximum rate of deflexion when the other recorded a minimum. Many experiments were made which proved the evidence of partial polarisation conclusive.

When heavier metals, such as copper, tin, and lead, which emit a secondary radiation differing considerably in character from the primary producing it, were used as radiators, no variation in intensity of secondary radiation was observed as the bulb was rotated.

This result was not found to be affected by a considerable variation in the penetrating power of the primary radiation.

Experiments were made with several X-ray tubes.