



XLVIII. Note on a spectrum of the Röntgen rays from a focus tube, and the relatively selective absorption of Röntgen rays in certain metals

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XLVIII. *Note on a Spectrum of the Röntgen Rays from a Focus Tube, and the relatively Selective Absorption of Röntgen Rays in certain Metals.* By JOHN MEAD ADAMS*.

[Plate XIV.]

IN the course of a research† upon the transmission of Röntgen rays through metallic sheets, it became necessary to test by direct experiment Röntgen's theory that an ordinary beam of Röntgen rays is heterogeneous and that substances show selective absorption toward the different kinds of rays; and furthermore, to ascertain whether the selective absorption, if it exists, follows the same law for all substances, in other words whether the absorption of different substances is relatively selective.

To obtain a direct answer to these questions a spectrum of Röntgen rays was sought by the following method:—A Röntgen-ray tube (see fig. 1, Pl. XIV.) was prepared, like an ordinary focus-tube in all essential respects except for the target. The target consisted of a strip of platinum 6·3 cms. long by 1·3 cms. wide, bent into a circular arc of 5 cms. radius and placed in the tube in the position indicated by T in the figure. A thick lead screen was set up in front of the tube (that is, facing the concave side of the target) in a plane parallel to the axis of the tube, and about 18 cms. distant from it. At a point opposite to the target this screen was pierced by a small hole about 0·15 cm. in diameter, with bevelled edge. A photographic plate or a fluorescent screen could be placed parallel to the lead screen and about as far in front of it as the axis of the tube was behind it. When the tube was in operation under these circumstances, an observer at the fluorescent screen perceived a bright spot upon it—the image of the spot on the target where the cathode discharge from the electrode C focussed, formed according to the principle of the pin-hole camera. A magnetic field was then applied to the tube in the neighbourhood of the electrode C, in direction perpendicular to the plane of the paper, and of such magnitude that the cathode discharge was spread into a spectrum‡ along the concave surface of the target. The bright spot upon the fluorescent screen was now drawn out into a band, and it was to be expected that the Röntgen rays

* Communicated by Professor J. Trowbridge.

† Adams, Proc. Amer. Acad. xlii. p. 671 (1907).

‡ Birkeland, *Comptes Rendus*, cxxiii. p. 492 (1896).

at different points along this band would show different properties, since they were produced by cathode particles which differed from one another, presumably in velocity.

That a more or less complete separation of the Röntgen rays into a spectrum was actually effected was made plain by dividing the band into halves lengthwise, and photographing it while one-half was covered by a sheet of copper 0.0044 cm. thick, the other half being uncovered. Fig. 2 shows a photograph thus obtained. The width of the band was limited by brass strips with bevelled edges about 0.3 cm. apart. The Röntgen rays produced by the least deviated cathode particles are at A, those produced by the most deviated cathode particles at B. The difference in absorbing power of the copper at the two ends of the band is plain. The variations in intensity along the uncovered half of the spectrum give a rough idea of the distribution of the different kinds of rays.

The existence of relatively selective absorption in the case of one pair of metals, aluminium and silver, was shown by photographing one half of the spectrum through a sheet of one metal, the other half through a sheet of the other. The aluminium was 0.16 cm. thick, the silver 0.002 cm. Fig. 3 shows a set of these photographs. In that figure, CD is a comparison spectrum, photographed without the interposition of any metal. In the photograph EF, the silver was on the left and the aluminium on the right. The thicknesses of the two sheets were so chosen that the rays at E, corresponding to the least deviated cathode particles, were equally absorbed in them. Under these circumstances, the rays at F were transmitted by the silver in much greater quantity than by the aluminium. To show that this effect was not to be explained by a difference in thickness of either sheet at different points along the spectrum, the sheets were turned in their own plane through two right angles, and the photograph GH was then made, showing the effect unchanged. Secondary radiation from the sheets was not present in appreciable quantity at the photographic plate; for if it had been, it would have resulted in a blurring of the boundaries of the shadows on the plate, the distance between the latter and the sheets being about 2 cms.

Another pair of metals, aluminium and tin, has been found to show relatively selective absorption to some extent, but the effect has not yet been obtained sufficiently well marked for reproduction.

The conclusions to be drawn from these experiments are the following :—

- (1) The beam of Röntgen rays from a focus-tube which yields a magnetic cathode spectrum is heterogeneous.
- (2) A metallic sheet shows selective absorption of the different rays.
- (3) This selective absorption does not follow the same law in all metals : in certain pairs of metals the absorption is relatively selective.

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XLIX. *The Rate of Recovery of Residual Charge in Electric Condensers.* By FRED. T. TROUTON, F.R.S., and SIDNEY RUSS, B.Sc.*

[Plate XV.]

THE analogy between the phenomenon of residual charge in Leyden jars and the recovery from elastic overstrain in solids has often been pointed out. The theoretical investigations of Boltzmann and the experiments of Kohlrausch and Hopkinson have thrown considerable light on the subject.

In view, however, of recent work done by Mr. A. O. Rankine†, and subsequently confirmed by Mr. Phillips‡, on the recovery of solids from overstrain by a method in which the strain was kept constant while the stress disappears, it seemed desirable to experimentally examine the relations governing the rate at which residual charge makes its appearance in a discharged condenser under conditions analogous to those of their experiments.

The explanation of the phenomenon of residual charge has been referred§ to a heterogeneity in the structure of the dielectric due to its consisting of parts having diverse conducting and dielectric properties, all however subject to simple linear laws. This hypothesis leads to an exponential expression for the rate of recovery of the residual charge. This

* Communicated by the Physical Society : read March 8, 1907.

† Phil. Mag. [6] vol. viii. 1904, p. 538.

‡ Phil. Mag. [6] vol. ix. 1905, p. 513.

§ Maxwell, vol. i. p. 414.

FIG. 1.

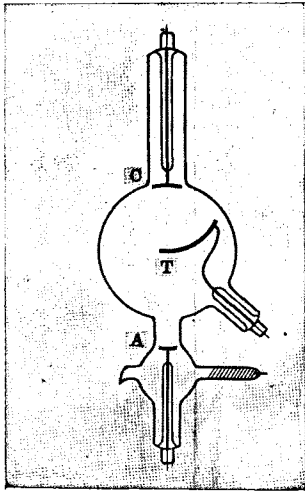


FIG. 2.

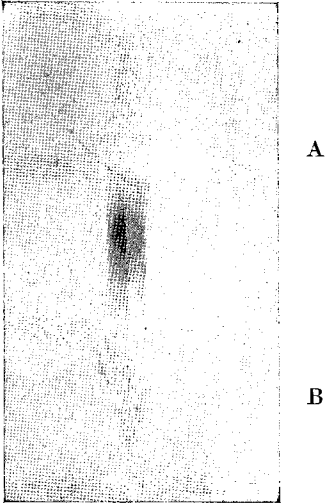


FIG. 3.

