Fluorescence of Pure Salts of the Rare Earths

INVESTIGATING the connexion between the emission spectra in colourless materials[1] and the absorption spectra of the ions of the rare earths[2] we have found that the pure salts of the rare earths can also exhibit a fluorescence of a surprising brightness. Up to the present, this fact was still very doubtful[3]. Under excitation with violet and ultra-violet light, europium sulphate in particular shows a brilliant red fluorescence. Terbium sulphate fluoresces also very strongly with a pale greenish colour. The luminosity of the sulphates of samarium and dysprosium is weaker. Our samples of the sulphates of holmium and erbium showed no perceptible emission. The spectra emitted are very sharp, especially at lower temperatures.

Conclusive proof that the emission is to be ascribed to the pure salts and not to any impurities is given by comparing these spectra with the phosphorescence spectra, when the same ion (in a small amount of about 0·1 per cent) is embedded in a colourless salt by heating. The agreement between the particular groups in the spectra of a given ion shows at the first glance[4] that the fluorescence is due to the ion of the pure salt. Therefore this emission is of the same type as that of the uranyl salts and also the duration of the fluorescence is of the same order.

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[1] NATURE, 130, 740; 1932.
[2] *Z. Phys.*; 1933.
[3] Geiger-Scheel, "Handb. d. Phys.", 2nd ed., vol. 23, 1, p. 276; 1933.
[4] Details and illustrations are being published in the *Physikalische Zeitschrift*.

New Evidence for the Positive Electron

THE experiments of Anderson[1] and of Blackett and Occhialini[2] on the effects produced in an expansion chamber by the penetrating radiation strongly suggest the existence of positive electrons—particles of about the same mass as an electron but carrying a positive charge.

Some observations of the effects produced by the passage of neutrons through matter, and the experiments of Curie and Joliot[3] in which they observed retrograde electron tracks in an expansion chamber, led us to consider the possibility that positive electrons might be produced in the interaction of neutrons and matter, and we have recently obtained evidence which can be interpreted in this way.

A capsule containing a polonium source and a piece of beryllium was placed close to the wall of an expansion chamber. On the inside of the wall was fixed a target of lead about 2·5 cm. square and 2 mm. thick. This lead target was thus exposed to the action of the radiation, consisting of γ-rays and neutrons, emitted from the beryllium. Expansion photographs were taken by means of a stereoscopic pair of cameras. A magnetic field was applied during the expansion, its magnitude being usually about 800 gauss.

Most of the tracks recorded in the photographs were, from the sense of their curvature, clearly due to negative electrons, but many examples were found of tracks which had one end in or near the lead target and showed a curvature in the opposite sense. Either these were due to particles carrying a positive charge or they were due to negative electrons ejected in remote parts of the chamber and bent by the magnetic field so as to end on the lead target. Statistical examination of the results supports the view that the tracks began in the target and therefore carried a positive charge.

Strong evidence for this hypothesis was acquired by placing a metal plate across the expansion chamber so as to intercept the paths of the particles. Only a few good photographs have so far been obtained in which a positively curved track passes through the plate and remains in focus throughout its path, but these leave no doubt that the particles had their origin in or near the lead target and were therefore positively charged. In one case the track had a curvature on the target side of the plate, a sheet of copper 0·25 mm. thick, corresponding to a value of $H\rho$ of 12,700; on the other side the curvature gave a value $H\rho = 10{,}000$. This indicates that the particle travelled from the target through the copper plate, losing a certain amount of energy in the plate. The change in the value of $H\rho$ in passing through the copper is roughly the same as for a negative electron under similar conditions. The ionising power of the particle is also about the same as that for the negative electron. These observations are consistent with the assumption that the mass and magnitude of the charge of the positive particle are the same as for the negative electron.

The manner in which these positive electrons are produced is not yet clear, nor whether they arise from the action of the neutron emitted by the beryllium or from the action of the accompanying γ-radiation. It is hoped that further experiments now in progress will decide these questions.

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[1] Anderson, *Science*, 76, 238; 1932.
[2] Blackett and Occhialini, *Proc. Roy. Soc.*, A, 139, 699; 1933.
[3] Curie and Joliot. "L'Existence du Neutron". Hermann et Cie, Paris.

Summer Thunderstorms

THE annual record of thunderstorms occurring in the six summer months is being continued during 1933.

A note of the place, date and time of the occurrence of thunder, lightning or hail, in any part of the British Isles, between April 1 and September 30, with the direction in which the lightning was seen, especially at night, will be extremely useful. In the case of actual thunderstorms, information as to the time of first observation of thunder or lightning, time of commencement of very heavy rain or hail, or approximate time of nearest approach of storm, and approximate time of final observation of thunder or lightning will be valuable.

It is essential that the position from which the observation is made should be specified, and that the standard of time used should be stated. More data are particularly required from rural and moorland districts and from thinly populated areas generally.

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