LETTERS TO THE EDITORS

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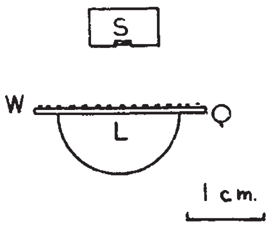
Chemical Effects in Liquids due to α-Particle Irradiation

A CONSIDERABLE amount of research has been carried out on the chemical effects which are produced by alpha-particles in liquids. So far, no satisfactory theory has been proposed to account for the fundamental processes involved in these reactions. From early studies, extended by recent work in this Department, of the ionization currents which can be collected from liquids, it is clear that the vast majority of ions recombine almost immediately. Jaffé[1] has shown in his 'column theory of ionization' that in liquids the half-life for recombination is 10^{-7} sec., due to diffusion alone. It has been pointed out by Kramers[2] that, due to the intense electrostatic fields which must exist in such columns of ionization, the half-life should be substantially reduced. It therefore appears impossible to explain the main features of the chemical experiments simply in terms of the production of ions, especially in view of the independence of chemical yield upon concentration of the reactants.

It has already been reported that quanta are emitted from thin films subjected to α-particle bombardment[3], and we considered that the chemical effects might be due, at least partly, to quantum emission associated with the intense ionization. As in the experiments with thin films, this radiation would be readily absorbed by the parent material, possibly producing free radicals within the solvent. While the radiation length is small compared with the bulk of the liquid, it is large compared with the estimated diameter of the ion columns. In this manner, the production of free radicals can be distributed over a comparatively large volume, hence increasing the probability of producing chemical effects remote from the ionic column and independently of ionic recombination. Such a basic process would provide a mechanism for the independence of concentration of reactants and the chemical yield. Experiments were therefore conducted with the view of testing such a theory.



The experiments took the form of irradiating a thin film of water with α-particles. A sample of a suitable aqueous solution was exposed to the quanta which might be liberated from the thin film. The diagram shows the experimental arrangement. The source S, about 20 millicuries of polonium, was placed about 0·5 cm. above a quartz slide 1 mm. thick. A film of water, of a thickness less than the equivalent range of the α-particle, was maintained on the upper surface of the slide. A reaction vessel, L, containing about 1·5 c.c. of solution, was placed immediately below the slide. The solutes investigated were ferrous ammonium sulphate, chloracetic acid and sodium iodide; in each case the solvent was water. Colorimetric methods were used for determining the yields of ferric, chlorine and iodine ions respectively. The water films were subjected to α-particle irradiation for periods of up to eleven days. Control experiments were performed to determine the amount of chemical change due to other conditions and due to the irradiation of the quartz by α-particles. Such control effects were in general negligible. Experiments were also carried out in which similar solutions were irradiated directly by α-particles.

A comparison of the results showed that chemical effects, between a twentieth and a twenty-fifth of the yield obtainable from direct bombardment, were found when the thin water films were irradiated. Recent improvements of the measurements reported previously[3] have provided an estimate of the absorption length of the quanta in the thin films. It appears that the ratio of the numbers of quanta emerging from the thin films in the above chemical experiments to the total number of quanta produced by the α-irradiation is of the same order of magnitude as the above ratio of the two chemical yields. These results suggest that the bulk of the chemical effect produced by α-particles in liquids can be explained by secondary effects of quantum emission arising from the primary ionization.

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[1] Jaffé, G., *Ann. der Phys.*, **42**, 303 (1913).
[2] Gerrison, A. N., Com. K. Onnes Lab., 275 (1948).
[3] Richards, E. W. T., and Cole, J. F. I., *Nature*, **167**, 286 (1951).

Surface Cells of Feather Barbs

FROM Strong's[1] drawings it is evident that those cells of the cortex of the feather barb which lie nearest to the surface are flattened. No author, however, has directed attention to the fact that these cells differ in structural detail from the rest of the cortical elements. The surface cells of the feather barbs appear to form a pattern similar to some of the cuticular scale patterns seen on animal hairs. It was found that this pattern could be shown by making casts of the barbs in the same way as casts of animal fibres are made.

These casts were made in polyvinyl acetate; a thin layer of a 20 per cent solution of polyvinyl acetate in benzene was spread on a microscope slide and heated to drive off the benzene. Feather barbs were then placed on the plastic layer and another slide placed on top; these slides were then placed on an electric hot-plate and pressure applied (the load applied was approximately 6 lb. over the whole slide). A small piece of polyvinyl acetate was placed on another slide adjacent to the first slide and used as a temperature guide; when it had softened the current was switched off, the slides were allowed to cool while still under pressure, and the barbs afterwards removed from the slides and the casts exam-

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