LETTERS TO THE EDITORS

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Action of Fast Hydrogen Ions on Lithium Chloride

WE have bombarded targets of various light elements in the course of experiments on nuclear resonances ($p-\gamma$ reaction), and have noticed an interesting phenomenon with lithium chloride targets.

These targets were prepared by fusion of the hydrated salt (m.p. 490–600° C.) on to molybdenum surfaces. During bombardment with hydrogen ions ($^1H^+$ and $^2H^+$ in roughly equal proportions) at current strengths up to 100 microamp. and voltages up to 600 kv., the white colour of the targets changed to purple in the regions struck by the beam. The intensity of coloration increased with increasing current density, and in the centre of the bombarded region the target was black. The effect was confined to the surface as the coloured part could be scraped off the target. On exposure to the atmosphere the colour reverted gradually to white in about 3–5 minutes.

We considered that the phenomenon was possibly due to the formation of finely divided lithium, by reduction of the chloride, which would presumably be changed to the hydroxide on continued exposure to moist air. The appearance of blue rock salt, stated by some authorities to be due to the presence of colloidal sodium, seemed to support this view. Mellor's chemical treatise[1] refers to this matter with reference particularly to cathode ray bombardment[2], and mentions also the alkaline subchlorides, for example Li_2Cl, some of which are coloured, although their composition seems uncertain. The protonic range in the target was probably less than 6×10^{-4} cm., so diffusion of air into the target might be expected to be rapid in the region occupied by products resulting from the action of the beam. The possibility of some chemical reaction with the molybdenum backing plate was unlikely. The purple coloration was not found with lithium hydroxide or oxide targets, the former turning grey on bombardment.

These experiments suggest that the purple coloration was due to the formation of a subchloride. Experiments with another halide, calcium fluoride, also led to the production of purple targets on bombardment. In this case, the colour persisted for four days, after which the target was destroyed. The effect of oil vapour from the pumps used to evacuate the acceleration tube may be ignored. It was suggested to us that the effect was due, not to the primary positive ion beam, but to secondary electrons arising at the target. This is considered an improbable process, as the energy of most of these electrons would only be ~ 100 ev. Also, the fact that the coloured areas were fairly sharply defined, and limited to the part of the target struck by the primary beam, suggests that the secondary electrons were not responsible for the effect.

In view of the fact that there is no immediate prospect of continuing the experiments, it seemed that publication of a note, even at this stage of the work, would be of interest.

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Oct. 8.

[1] Mellor, "A Comprehensive Treatise on Inorganic and Theoretical Chemistry".
[2] Thomson, "Conduction of Electricity through Gases", 2, 4 (1933).

Penetrating Non-Ionizing Cosmic-Ray Particles

THE main part of the non-ionizing component of cosmic radiation near sea-level consists of photons[1] and neutrons[2]. A rough survey carried out by Rossi and his co-workers[3] at sea-level did not give any evidence of penetrating neutral particles. Experiments of the same type by Rossi and Regener[4] at 4,300 m. above sea-level, however, show the existence of a small number of penetrating neutral particles. We have carried out similar experiments at sea-level with positive results.

The experimental arrangement is reproduced schematically in the accompanying illustration. The threefold coincidence set *BCD* and the absorber *s* are surrounded on all sides except the bottom by an anticoincidence system *A* consisting of 76 counters in parallel. To avoid anticoincidences due to photons, the arrangement is surrounded by 5 cm. of lead. Some of our observations are given in the table below.

Σ	*BCD-A* (corrected for random coincidences *BCD*, *A*)		*BCD*	
Lead (cm.)	Time (hr.)	Rate (c./hr.)	Time (min.)	Rate (c./min.)
5·0	469·1	0·533 ± 0·039	251	11·86 ± 0·22
12·5	445·8	0·451 ± 0·036	250	11·03 ± 0·21
25·0	407·7	0·283 ± 0·030	313	10·27 ± 0·18
5·0 + 30·0 cm. Al	427·3	0·362 ± 0·034	323	10·72 ± 0·18

An anticoincidence *BCD-A* may be due to any one of the following effects: (1) A non-ionizing agent emerging from Σ, which produces an ionizing secondary in *s*; (2) a particle which travels upwards, gives rise to coincidence *BCD*, and is afterwards stopped in *s*; (3) an ionizing particle which leaks through *A*. The rate of anticoincidences due to (2) is not affected by Σ, while that due to (3) is no