Letters to the Editor

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NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 341.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Attempts to Produce Helium 3 in Quantity

WITH reference to the results published by Harnwell, Smyth and Urry¹ in which there is an apparent production of helium of atomic weight 3 in considerable quantities (10^{-5} c.c.) in a discharge run in heavy hydrogen, we should like to mention some experiments which we have made during the past year on similar lines. Our apparatus resembles that used by Rutherford and Oliphant², a beam of positive rays being directed on to a target containing heavy hydrogen, the positive rays being produced by an auxiliary discharge in heavy hydrogen gas. The voltage applied to the rays was about 150 k.v., the auxiliary discharge carried about 8 milliamp. and the current in the beam was of the order of 100 microamp., but probably only a small proportion of this consisted of ions of heavy hydrogen.

After running for one hour, the gas was pumped into a glass reservoir which was then sealed off and the gas analysed by the micro-method of Paneth and Peters. A number of such bombardments were made and in all cases the hydrogen contained helium and neon, the ratio of helium to neon being greater than that in ordinary air. We consider that this gas was derived from the walls of the glass cylinder used for the discharge, and that the enhanced proportion of helium is due to the fact that any glass in contact with air adsorbs and dissolves helium in preference to neon³. The release of this helium is facilitated by the presence of hydrogen.

Our reasons for preferring this explanation are two. First, the yield of neutrons, which should accompany the production of helium 3, was measured and found to be only equivalent at best to a source of 60 millicuries of (radon + beryllium); the helium corresponding to this yield of neutrons would not exceed 10^{-10} c.c. in the hour, while 10^{-8} – 10^{-7} c.c. of helium were commonly observed. Secondly, interferometric analysis of the helium spectral lines carried out by Mr. C. V. Jackson showed no sign of any extra doubling of the lines such as might be expected if any considerable proportion of the helium had a mass of only 3. For this analysis the helium + neon samples from five bombardments were united; the mixture consisted of about 1×10^{-7} c.c. neon and 3.6×10^{-7} c.c. helium, of which at least 90 per cent was ordinary helium of mass 4. It would not have been possible to detect less than 10 per cent of helium of mass 3 on account of the difficulty of photographing fringes with so small a quantity of gas.

A short recent communication by Smyth, Harnwell Bleakney and Lozier⁴ appears to throw doubts on the interpretation of the evidence from the mass-spectrograph described in the earlier paper. They state, however, that their spectroscopic evidence for

the production of helium remains entirely unexplained. We venture to suggest that their results may be explained in the same way as the very similar ones which we have obtained.

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¹ G. P. Harnwell, H. D. Smyth and Wm. D. Urry, *Phys. Rev.*, **46**, 437; 1934.

² M. L. Oliphant, P. Harteck and Lord Rutherford, *Proc., Roy. Soc., A*, **144**, 692; 1934.

³ F. Paneth and K. Peters, *Z. phys. Chem.*, B, **1**, 253; 1928.

⁴ H. D. Smyth, G. P. Harnwell, W. Bleakney and W. W. Lozier, *Phys. Rev.*, **47**, 800; 1935.

Radioactivity of Potassium

SEVERAL hypotheses have been put forward¹ to explain the extremely long life-period of potassium, which conflicts with the theories of β -decay as well as with Sargent's empirical rule. Klemperer², however, has shown by an investigation in detail that none of the processes suggested really exists. He concludes from his experiments that an unknown, relatively rare isotope, $^{40}_{19}\text{K}$, is responsible for the β -activity of potassium, and similarly an unknown isotope $^{86}_{37}\text{Rb}$ in the case of rubidium.

On general principles, it can be said that β -decay will be possible, if the difference in the energies of the initial and final nucleus, ΔE , fits the relation:

$$(1) \quad \Delta E > (m + m')c^2,$$

where m , m' are the masses of the two particles involved in the process. Hence, in the case of $^{40}_{19}\text{K}$, one would expect both positive and negative electrons leaving the nucleus, due to the processes

$$(2) \quad ^{40}_{19}\text{K} \rightarrow ^{40}_{20}\text{Ca} + e^- \text{ or } (2a) \quad ^{40}_{19}\text{K} \rightarrow ^{40}_{18}\text{A} + e^+.$$

Both $^{40}_{20}\text{Ca}$ and $^{40}_{18}\text{A}$ are well-known, stable nuclei; and $^{40}_{18}\text{A}$ is relatively the most frequent isotope of argon. This means that the binding energy of the nucleus $^{40}_{18}\text{A}$ must be sufficiently low, and the relation (1) would scarcely be violated for the process (2a), if it is valid for the process (2).

Experiments hitherto have not shown any proof of an emission of positrons from potassium. I have also tested the radiation of potassium in a cloud-chamber, without finding any track of positively-charged particles. My experiments will be continued, and the results published in the *Zeitschrift für Physik*, but it does not seem to be very probable that any β^+ -emission will be found.

On the other hand, a simple β -decay of $^{41}_{19}\text{K}$ cannot be expected. The final product of this process, $^{41}_{20}\text{Ca}$, does not accord with our general knowledge of the system of stable isotopes³. Besides, the decay constant for this process would be lowered by a factor