Letters to the Editor.

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The Transmutation of Elements.

IN a letter to NATURE of January 30, 1926, Dr. Davies and Prof. Frank Horton give some considerations about the transmutation of mercury and lead which agree completely with those given by me in a lecture delivered in Amsterdam on January 29, 1926.

I considered the two possibilities of transmutation by absorption of electrons or by disruption of the atomic nucleus. Since I thought the latter more probable in the cases mentioned above, I laid most stress upon this possibility and gave the following considerations:

Aston found the atomic weights of the isotopes of mercury to be 202, 209, 199, 198, 201, 204. Assuming that, for example, the isotope 201 suffers a transmutation into gold by disruption of the nucleus, this process can be indicated by the following equations:

or

In the case of the transmutation of lead into mercury, the inactive isotopes having the atomic weights 206, 208 and 210, we may assume, for example, that the isotope 206 suffers a transmutation giving an isotope of mercury:

But we may also assume that the other isotopes 208 and 210 undergo a transmutation. In that case we obtain:

and

In the case of the transmutation of lead into thallium we can assume, for example, the following process:

We see that of the different transmutation possibilities, (3) is most simple. Moreover, I suspected this process could be expected first, as lead is the end-product of the spontaneous radioactive transformations.

In connexion with these considerations I pointed out that the best method of learning the nature of the transmutation is to examine spectroscopically whether the process is accompanied by the formation of helium or hydrogen, and to determine the atomic weight of the heavier products.

With a new apparatus which promised to enable us to study the problem successfully, my co-worker Dr. Karssen and I carried out a series of new experiments. While using the old quartz-lead lamp, negative results were obtained only if the current strength was lower than 15 amperes, but now, with our

new lamps of somewhat different dimensions, spectroscopically negative results were found even using ± 60 amperes. The lamp showed distinctly different properties in burning and sparking. This proves that the phenomena taking place in the quartz-lead lamp depend on influences unknown until now, so that the transmutation in the quartz-lead lamp is not so easy to reproduce as we expected.

In connexion with this subject we are studying now the quartz-lead lamp more closely, and in the meantime we are applying our second sparking method, which we intend to extend to still higher voltage and higher current-densities.

Though we have already secured quantitative data, we prefer to publish the results later. A. SMITS.

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April 3.

Potassium and the Heat of the Earth.

IT has been widely recognised that the disintegration of the uranium and thorium in rocks has exerted a profound and probably controlling influence on the earth's thermal history. Hitherto, however, it has not been realised that potassium as an emitter of radiothermal energy is in the aggregate of the same order of importance as uranium or thorium. This surprising result has emerged in the course of a joint inquiry into the geological significance of the radioactivity of potassium and rubidium. The latter element is negligible geologically on account of its extreme rarity, despite the fact that its total activity is greater than that of an equal amount of potassium. Nevertheless, we have included rubidium in our discussion, since measurements of the activity of potassium have usually been compared with those obtained with rubidium, and our preliminary estimate of the amount of heat generated by the potassium in rocks depends on that comparison.

The β -rays emitted by rubidium are fairly homogeneous; their velocity has been estimated from experiments on their deflexion in a magnetic field (Bergwitz), and by comparison of their absorption coefficient with those of radioactive rays of known velocity (Hahn). These experiments point to a velocity of $0.60c$, the corresponding kinetic energy of a β -ray from rubidium being 2.04×10^{-7} ergs. In the case of potassium, Hahn has concluded that the average velocity of the β -rays cannot differ much from $0.90c$. We probably make adequate allowance for the heterogeneous nature of the potassium rays by assuming for them the value $\mu = 20 \text{ cm.}^{-1}$ aluminium. Using this result in conjunction with Lenard's curves of absorption of β -rays of different velocities, we obtain for the average velocity of the potassium rays the value $0.85c$, a result in substantial agreement with that of Hahn. The average kinetic energy of a β -ray from potassium is thus 7.30×10^{-7} ergs.

We next require the half-periods or the disintegration constants of rubidium and potassium. Hahn and Rothenbach compared the activity of the β -rays from rubidium with that of the β -rays from UX_1 , and thus found for rubidium a half-value period of 0.7×10^{11} years, this result being uncorrected for the different values of the number of ions per cm. and the Loschmidt numbers (per gm.) for the substances compared. Applying the necessary corrections, we find $T_{\text{Rb}} = 1.4 \times 10^{11}$ years. Hoffmann also has compared the activity of rubidium and of potassium with that of uranium, using two different methods, and he concludes that his results are in agreement with that of Hahn and Rothenbach, though slightly lower. Correcting Hoffmann's results to take account of the