LETTERS TO THE EDITOR.

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The Reflection of γ Rays from Crystals.

IN some recent investigations Prof. Rutherford and Mr. H. Richardson have analysed the γ radiations emitted by a number of radio-active products. They have shown, for example, that radium B emits three distinct types of γ radiation, which are absorbed exponentially by aluminium with absorption coefficients $\mu=230$, 40, and 0·51 $(cm.)^{-1}$ respectively. On the other hand, radium C appears to emit essentially only one type of γ radiation, the absorption coefficient of which is $\mu=0{\cdot}115$ in aluminium.

Recently we have undertaken an examination of these types of radiation by the methods developed for X-rays by W. H. and W. L. Bragg, and by Moseley and Darwin, which consist in determining, either by the photographic or electric method, the intensity of the X-rays reflected from a crystal at different angles of incidence. In our experiments the source of γ radiation was a thin α-ray tube containing about 100 millicuries of emanation, the γ rays arising from the products of the emanation, radium B and radium C. A diverging cone of rays fell on a crystal of rock-salt, and the distribution of the reflected radiation was examined by the photographic method. The source and photographic plate were each about 10 cm. from the centre of the crystal. Suitable precautions were taken to reduce to a minimum the effect on the photographic plate of the primary and secondary β rays and penetrating γ rays. The source was first arranged so that the radiation made an average angle of about 9° with the face of the crystal.

It was calculated from the known data of the crystal that the radiation $\mu=40$ from the radium B, if homogeneous, should be strongly reflected at about this angle. A group of fine lines comprised between the angles 8° and 10° have been observed on the photographic plate in a number of experiments. Similar results have been observed with a crystal of potassium ferrocyanide, kindly loaned to us by Mr. Moseley. On examining the reflection for an angle of 2° another series of fine lines was obtained on the plate, probably resulting from the reflection of the more penetrating radiations from radium B and radium C.

The experiments indicate that the γ radiation for which $\mu=40$ is complex, and consists of several groups of rays of well-defined wave-length. Experiments are in progress to examine carefully the character of this reflected radiation, both by the photographic and electric method. It is hoped that in this way definite evidence will be obtained on the constitution and wave-length of each of the types of γ radiation which are emitted from radium B and radium C.

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The Piltdown Skull and Brain Cast.

NOW that my friend Prof. Keith has explained (NATURE, October 16, pp. 197–99) so lucidly his reasons for making a big brain-case of the Piltdown fragments it is possible to define precisely the point at issue between us.

I should say at the outset that any anatomist, working with the plaster casts but without reference to the actual fragments from which they were moulded, might solve the extraordinarily difficult problem of reconstruction of the cranium in the way Prof. Keith has explained so plausibly. But the bones themselves present features which make such a solution altogether inadmissible. Anyone who examines the left parietal and temporal bones cannot fail to recognise that there is no room for any doubt as to the relative positions of these bones the one to the other, which is not that claimed for them by Prof. Keith.

The right parietal fragment and the occipital can be put into their proper positions and the symmetry of the two branches of the lambdoid suture be restored without producing "any marked asymmetry of another kind," such as troubled Prof. Keith, and without the necessity of making any such liberal additions to the capacity of the cranium as he demands (see his Fig. 2).

The "marked asymmetry of another kind" that he could overcome only by the adoption of the most drastic measures was created wholly by his refusal to admit the possibility that the middle line in the parietal region, as determined by Dr. Smith Woodward, was a close approximation to the truth.

The determination of the precise location of the middle line in the frontal and parietal regions is one of quite exceptional difficulty, but a number of facts and considerations make it certain that it is not where Prof. Keith would place it.

The crux of our difference, then, is the criteria which Prof. Keith uses for determining the middle line in the posterior parietal region. He writes (*op. cit.*, p. 198 *et seq.*):—"In the skulls of all the higher primates, the longitudinal sinus, near the hinder end of the adjacent margins of the right and left parietal bones, is marked by a narrow deep groove with distinct edges; on the margin of the upper angle of the Piltdown fragment the edge or margin of this groove can be clearly recognised."

It must be remembered that the area in question (the "upper angle" of the quotation) is immediately above the middle part of the lambdoid suture, which is preserved upon the larger parietal fragment. Prof. Keith does not seem to have realised this fact, for he represents the lambdoid suture (in his Fig. 2) as a large arch (A, B, A, B) crossing the middle line a short distance below the larger bone fragment. If a series of human and simian cranial casts be examined it will be found that, contrary to Prof. Keith's statement, in a considerable proportion of them there is no trace whatever (in the place just above the lambda corresponding to that preserved in the Piltdown specimen) of "the narrow deep groove with distinct edges" on which Prof. Keith relies as his guide for the determination of the middle line. This is especially the case in the casts of the more primitive human and the simian crania, as Profs. Boule and Anthony have pointed out in their discussion of the Chapelle-aux-Saints and La Quina brain-casts.

On these grounds Prof. Keith "moved the left parietal bone outwards or rather tilted [it] upwards and outwards until it assumes a more vertical position" (p. 199). But in order to do this he had to get rid of one of "the peculiar features of the original brain-cast—the sharp bending inwards or kinking of the temporal lobe of the brain" (p. 199). If Prof. Keith had not opened out the angle between the left temporal and parietal bones the aperture of the ear would have been made to look towards the neck, when he "tilted the left parietal upwards and outwards"! But the precise relationship of the left temporal and parietal bones is not a matter of argu-