Letters to the Editor.

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The Intensity of X-ray Reflection.

IN a letter on "The Intensity of X-ray Reflection from Powdered Crystals" (NATURE, July 8, p. 38), Prof. A. H. Compton and Mr. N. L. Freeman have described some measurements which they have made on the reflection of X-rays by rock-salt, and have compared their results with figures published by us in the *Philosophical Magazine* for July 1921. Quantitative measurements of the amount of radiation reflected by the crystal are of great interest, since it is probable that an estimate of the way in which the electrons are distributed throughout the atom may be based on them.

In the case of the reflection by the (100) planes of rock-salt, they find a large discrepancy between our figures and theirs. The point at issue may be put as follows. By comparing the incident and reflected monochromatic X-ray beams, and applying formulæ calculated by Darwin and others, it is possible to estimate the amount of X-ray energy scattered by an atom in certain directions in terms of that scattered by a single electron under the same conditions. As the angle through which the rays are scattered is increased, the amplitude of the diffracted wave falls off, owing to interference between the waves scattered by the electrons distributed around the centre of the atom. In the case of the (100) reflection by rock-salt, we found that at the angle at which the reflection takes place the effect of the 28 electrons in a pair of sodium and chlorine atoms is reduced to an effect 20.1 times as great as that of a single electron (p. 7, *Phil. Mag.*, loc. cit.). The ratio 20.1/28 is that indicated by ψ in this note by Prof. Compton and Mr. Freeman.

We obtained an estimate for ψ^2 by measurements made with a single rock-salt crystal. Prof. Compton and Mr. Freeman determined the quantity by the powder method, measuring the amount of radiation diffracted by a layer of powdered rock-salt spread on a plate, irradiated by an X-ray beam made homogeneous by previous reflection. They obtain a value of ψ^2 , equal to 0.64, correct to 10 per cent., and quote our results as giving $\psi^2 = 0.43$, a much lower value.

It may well be that our estimate is too low, for the reasons given by Prof. Compton in his note, which have been fully discussed recently by Darwin (*Phil. Mag.*, May 1922). By using the powder method, the extinction effect, which increases the absorption of the rays passing through at the reflecting angle, is partly or wholly eliminated. We believe, however, that an error has been made in quoting our value for ψ^2 as being 0.43. We obtained

$$\psi^2 = \frac{20.1}{28} = 0.718,$$

$$\psi^2 = 0.515.$$

If this be the case, the discrepancy is not so great as Prof. Compton and Mr. Freeman believe. They used the molybdenum K_α line, of wave-length 0.708 Å.U., whereas we used the rhodium K_α line of wave-length 0.615 Å.U. The value of ψ^2 , however, is independent of the wave-length for a spectrum of given order.

Their estimate for the value of ψ^2 in the case of the

(100) reflection is of the very greatest interest. The measurements made with a single crystal are difficult to interpret for the strong reflections, on account of extinction, though they are probably accurate for the weaker ones. On the other hand, it is just these values for ψ^2 at small angles which are of the greatest importance, as indicating the distribution of electrons in the atom, particularly in its outer confines.

W. L. BRAGG.

R. W. JAMES.

Manchester University, July 13.

Geology and the Primitive State of the Earth.

I HAVE no wish to depreciate the importance of the work of those geologists who have examined the older known rocks of the earth's crust and decided that all of them have been altered since they first became solid; but I question whether their results afford the evidence concerning the primitive state of the earth that is suggested by Prof. A. P. Coleman and Prof. G. A. J. Cole (NATURE, June 17 and July 8). The deepest boring yet made is one of 2.5 km., and there are few over a kilometre in depth; that is the extent of the crust accessible to geologists. Yet the average thickness of sediments over the continents is probably some kilometres, and in many places it is practically certain that the thickness reaches tens of kilometres. In addition, we have vast thicknesses of intrusive and eruptive rocks. Would it be surprising if all rocks in their primitive state have been denuded away or buried to an inaccessible depth?

Even if it is considered that a piece of primitive crust, still unaltered, has had an appreciable chance of being discovered and examined, I do not see that the results actually found afford any evidence for the cold earth theory as against the hot earth theory. The primitive rocks formed by slow accretion of solid planetesimals would be in a perfectly characteristic and recognisable condition; no such rock has, so far as I have heard, been discovered, and therefore Prof. Coleman's arguments, if they are sound, would be just as injurious to the planetesimal theory as to the hot earth theory.

The temperature of the surface of the earth is at present maintained almost wholly by solar radiation, and not by conduction from the interior. The rate of conduction of heat from the interior is of order 2×10^{-6} cal/cm.² sec. The solar constant is about 3×10^{-2} cal/cm.² sec. Even if the earth had a solid crust only a mile thick, the surface temperature would still depend wholly on the sun's radiation. Thus it would become cool at the surface at a very early stage in the solidification, and it is not surprising that the oldest rocks should show evidence of water at the surface.

I have published in the Monthly Notices of the Royal Astronomical Society, vol. 77, 1916, pp. 84-112, and in the Proceedings of the Royal Society, vol. 100, 1921, pp. 122-123, arguments that I believe to be fatal to the form of the planetesimal hypothesis that attributes to solid planetesimals any cosmogonical importance, and postulates an earth that has always been solid. No supporter of this hypothesis has yet published any reply to, or acknowledgment of, these criticisms.

HAROLD JEFFREYS.

St. John's College,
Cambridge, July 10.

α -Particles as Detonators.

THE observation recorded by Mr. Henderson in a letter to NATURE of June 10, under the above heading, appears to involve possibilities of the greatest prac-