than those they have accepted as necessary in copper or nickel. If the view here advocated is the correct one, however, it appears that twins in silicon and germanium may have the relation of mirror-images in a common plane, through atom-centres, of the form {100}. This requires no abnormality in the least interatomic distances, and the twins can only be made one continuous crystal by rotation of either half through 90° about a normal to their common plane at a common atom-centre, or by a geometrically equivalent process. (In the case of twins on a {111} plane the corresponding rotation is through either 60° or 180°.)

L. W. McKEEHAN.

IN reply to the remarks of Mr. McKeehan regarding the paper which we have recently published, the point in question is whether twins of metallic crystals form a plane which passes through atom-centres. According to the hypothesis brought forward by us, the twinning of the face-centred cubic lattice takes place on the octahedral planes. Thus the two halves are arranged in a symmetrical position after a rotation of 180° about an axis normal to the octahedral plane. Obviously, in this case, the twinning plane does not pass through any atom-centres. In the face-centred cubic lattice the closest interatomic distance is $L/\sqrt{2}$. When twinned in the way mentioned above, however, the closest distance apart between atoms along the twinning plane is $L/\sqrt{3}$, where L is the lattice parameter in both cases. The change in the closest interatomic distance on twinning appears to be the cause of the local stress to which Mr. McKeehan refers, although, as he says, "there is no experimental evidence" regarding this point.

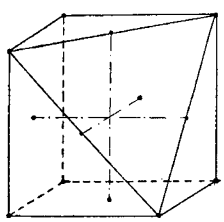

FIG. 1.

His view is apparently as follows: Two portions of two face-centred cubic lattices, both having the same geometrical form as in Fig. 1, are in contact with a plane of the octahedron passing through atom-centres so as to form the structure of mirror-images. The two portions thus share three corner atoms and three face-centred atoms in the octahedral plane. In this case, however, so far as the unit lattice form is concerned, the face-centred cube is not twinned but simply grouped in a reverse position.

With regard to the question of twinning in tetrahedral cubic crystals, Mr. McKeehan has suggested that a possible twinning plane is the cubic plane which passes through atom-centres. By a rotation of either half of the cube through 90° about an axis normal to that plane, mirror-images result, but the relations of the crystallographic axes do not change. The planes of densest atomic concentration are, however, the dodecahedral planes on which twinning does not occur. From this it would appear that the octahedral planes which possess the next densest atomic concentration are likely to be possible twinning planes. On the basis of this assumption, the closest interatomic distance of the twinned tetrahedral cubic lattice is $L/2\sqrt{3}$ instead of $\sqrt{3}L/4$, which is the closest interatomic distance of the tetrahedral cubic lattice. This is apparently the conclusion which Mr. McKeehan has considered improbable because of high local stress. It is suggested that, as in the case of the twinning of face-centred cubic crystals, if two parts of the tetrahedral cubic lattice (both having the same geometrical form) are in contact with a plane of the octahedron passing through atom-centres, the structure of mirror-images can be obtained without a change in the closest interatomic distance. These mirror-images, however, are not called twins of the tetrahedral cubic lattice. The crystallographic axis takes up a twinning position relative to the other, thereby resulting in the change of orientation. As a whole, the result is similar to that which we have assumed.

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The Scattering of Gamma Rays.

IN a letter to NATURE of December 4, Prof. J. A. Gray pointed out that a study of radiations of shorter wave-length than 0·02 Å.U. is complicated by the scattered radiations accompanying them, about which little is known. That gamma rays under certain experimental conditions appear to become less penetrating as they pass through matter was shown by Dr. Gray in 1913. Recently it has been shown by me (*Phil. Mag.*, Oct. 1926, p. 785) that the scattered radiations were considerably softer than the gamma rays producing them, and evidence was given of a comparatively soft radiation from air penetrated by gamma rays. Confirmatory experiments have since been made, a brief reference to which may not be without interest.

A given source of gamma rays was set up at different distances from an electroscope and, for each position of the source, a curve was obtained showing the apparent transmission of these rays through lead. With a lead electroscope of wall thickness 1·0 cm. the apparent transmission of lead was independent of the distance of the source from it. When the thickness of the wall was reduced to 0·17 cm. the slope of the transmission curves became less and less steep as the source was moved farther from the electroscope.

The curve, shown as Fig. 1, was obtained when a

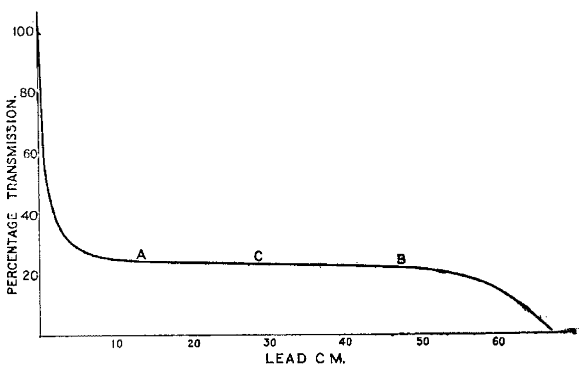

FIG. 1.

radon source equal to 127 millicuries was placed at 71 cm. from an electroscope of aluminium 0·005 cm. thick. Over the range AB of the curve the recorded ionisation is due almost solely to radiation scattered from the air around the electroscope. When the lead filters are so thick that they begin to screen this air from the direct primary rays, the ionisation decreases as shown by the curve. The transmission of the scattered radiation through aluminium was found for the experimental conditions represented by point C in Fig. 1, namely, the primary beam screened by nearly 30 cm. of lead. The scattered radiation