LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. They cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of Nature. *No notice is taken of anonymous communications.*

In the present circumstances, proofs of "Letters" will not be submitted to correspondents outside Great Britain.

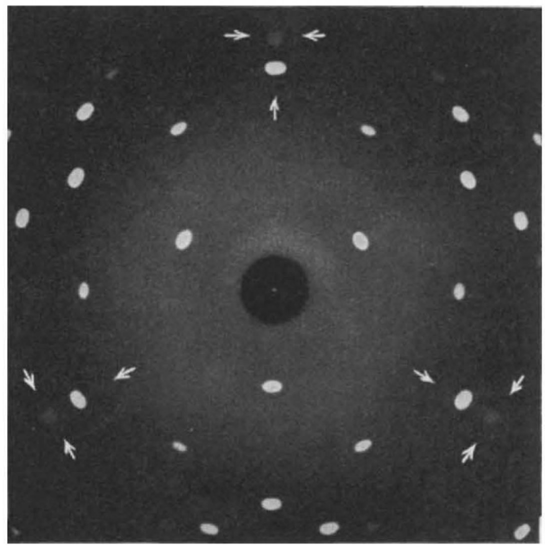
Notes on points in some of this week's letters appear on p. 673. Correspondents are invited to attach similar summaries to their communications.

Specular Reflection of X-Rays by High-Frequency Sound Waves

The principle that a regularly stratified medium selectively reflects a monochromatic beam of radiation incident on it at the appropriate angle is well known and forms the basis for the X-ray analysis of crystal structure. The spots appearing in a Laue diffraction pattern are, of course, due to such selective reflections of the incident X-rays by the periodic stratifications which represent the static structure of the crystal. A specular reflection of X-rays may, however, also result from stratifications of density which are not static but dynamic in character, and which may be considered as equivalent to stationary sound waves of very high frequency. We have observed and studied numerous examples of this special kind of X-ray reflection, but will content ourselves here with giving a single illustrative example chosen for its simplicity.

The accompanying reproduction represents the Laue pattern due to a crystal of diamond which has the form of a plate with faces parallel to an octahedral cleavage of the crystal, and through which passes a narrow pencil of X-rays from a tube with a copper anticathode and nickel filter. The pattern, as is to be expected, shows trigonal symmetry, the three spots marked with radial arrows in the figure being the reflections from the (111) planes, which are inclined to the trigonal axis at an angle of 19° 28′. Three other spots (indicated by tangential arrows) are also noticeable in the figure. The sharpness of these spots shows them to be specular reflections, but they are clearly not Laue spots, as is to be seen from the difference in their shape, as well as from the fact that there are no planes in the crystal which could give rise to reflections in the directions observed. These auxiliary spots must therefore be explained as arising from stratifications of density in the crystal which are of a dynamic nature.

The origin of these spots becomes clear when we consider the effect on the structure of the diamond of its characteristic internal vibration. This is a periodic movement of the two interpenetrating lattices of carbon atoms with reference to each other in any arbitrary direction and with a very high frequency corresponding to 1332 cm.$^{-1}$ in spectroscopic units. If this vibration has a direction normal or nearly normal to an octahedral cleavage face of the diamond, stratifications of density are induced which vary periodically with time and have a spacing equal to that of the (111) planes in the crystal, but with an orientation variable within wide limits. These stratifications are therefore in a position to give a selective reflection of the monochromatic copper K_α radiation present in the incident pencil of X-rays. The observed position of the spots is in agreement with that calculated from the known spacing and wave-length. The explanation indicated is further confirmed by the fact that, using unfiltered radiations, we get two spots in each case, corresponding to the copper K_α and K_β radiations, and occupying distinct positions, as is to be expected.



Laue pattern of diamond along a trigonal axis (copper K_α radiation).

We shall return in another communication to various other aspects of this new type of X-ray reflection.

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