LETTERS TO THE EDITORS

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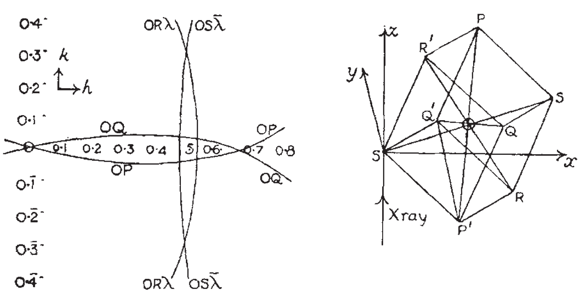
Diffuse Spots in X-Ray Photographs

IN a recent letter[1] Mrs. Lonsdale reports that the shapes of certain "diffuse spots" in the pattern due to mono-chromatic X-rays which have been scattered by sodium are in agreement with calculations made by Jahn, and points out that this is the more note-worthy because the calculations had to take into account the peculiar anisotropy of the elastic constants of sodium.

I have previously observed that simple diffraction formulæ provide an accurate position of the positions of the spots, and also of many of the peculiar forms which they assume[2]. These formulæ are independent of the elastic constants.

For example, one of the photographs attached to Mrs. Lonsdale's letter shows a four-square spot. The sodium cell is body centred. The four conditions that the centre of the cell shall be in phase (by means of integral differences of wave-length) with the corners can be stated in the form of equations, which describe the relations between the direction cosines of the diffracted ray. Four of these curves are found to intersect in four points close together (see the accompanying figure), and the positions of these points agree within experimental error with those of the corners of the four-square spot in the photograph. It follows that at each of these four points, the centre of the cell is in phase with two of the corners and very nearly in phase with the other two. The combination is strong, and the peculiar diffused spot may be supposed to be its consequence.



The figure on the right represents the body-centred cubic sodium cell. The points *SRS'R'* are in the plane of the paper: *PQ* and *P'Q'* are perpendicular to it, and so is the *y* axis to which they are parallel. The X-rays are parallel to the axis of *z*. The angle between *SR'* and the axis of *z* is 20·5°. The figure on the left shows the (*hk*) curves. For example, *OP* is the locus of those values of(*hk*) which the diffracted ray must have if the path by way of *O* is of the same length as that by way of *P*: along *OR*λ, the path by *O* differs by one wave-length from that by way of *R*.

The simple diffraction formulæ have so far predicted accurately all the positions of the diffuse spots, except that in a few cases spots are absent that might have been present according to calculation. If I apply the theory which ascribes the spots to the interaction of the structural periodicities of the crystal and the periodicities of elastic waves, I am not equally successful. It may be that I misunderstand the theory, which I would describe in the following way:

To take a simple case, let a wave be travelling along one of the principal axes of a simple cubic cell (such as that of potassium chloride). The velocity of the X-rays is so great in comparison with that of the elastic wave that the latter may be taken to be at rest while it is under consideration. The full period along the axis is now the least common integral multiple of the two wave-lengths. A super-lattice comes into existence. Waves of various lengths running in all directions provide an infinite number of these super-lattices, all of them integral multiples of the cell lattices.

When monochromatic rays fall on a perfect crystal there are no reflections. Laue photographs are blank. But when these conditions are only realized approximately (the possibility of the number of scattering centres being small is excluded from the theory under consideration) there may be accidental reflections. The multiplicity of super-lattices provides increased opportunities, and the diffuse spots are supposed to be the consequence.

One method of calculating results in a simple if approximate way is to assume only the one crystal cell, and to allow planes to have at least one fractional index. In every zone one such plane can be found to be a reflecting plane in the circumstances of the experiment. If the axes of the zones lie in the cubic face of the crystal on which the incident rays are striking almost normally as in the case described in NATURE[3], the calculated result is a network which agrees closely with observation for points near the origin but is seriously wrong farther out. If other zone axes are chosen, and there seems to be no reason for limiting them in the above way, indications are given which do not agree with observation.

It would be a strong support to the elastic wave theory if the calculations could correct this interpretation and show an agreement with the case quoted in the communication in NATURE to which I have referred.

W. H. BRAGG.

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Nov. 28.

[1] NATURE, 148, 628 (1941).
[2] *Proc. Roy. Soc.*, 179, 51, 94 (1940).
[3] NATURE, 146, 509 (1940); *Proc. Roy. Soc.*, A, 179, 54 (1940).

Influence of Temperature on Gel Formation

IT has been pointed out[1] that in the sol-gel change, gel formation should be more rapid the higher the temperature, in the absence of changes of solubility with temperature.