Letters to the Editor

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NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 686.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

A New Type of 'X-Ray Microscope'

A STANDARD method of X-ray analysis consists in measuring the strength of the diffracted beams corresponding to a series of reflections around a crystal zone (for example, the reflections with indices $h0l$ around the b axis), and then forming a double Fourier series with the amplitudes F as coefficients.

$$\Sigma\Sigma\ F(h0l)\cos\left\{\frac{2\pi hx}{a}+\frac{2\pi lz}{c}+\alpha(h0l)\right\}$$

The sum of this series gives the density of scattering matter at a point x,z when the contents of the unit cell are projected on the face (010). In the case of a centro-symmetrical projection $\alpha(h0l)$ is either 0 or π, and if there are sufficiently heavy atoms at the centre of symmetry, it is zero for all reflections. The present note describes a simple and rather striking optical method of effecting the summation for a case where $\alpha(h0l)$ is always zero.

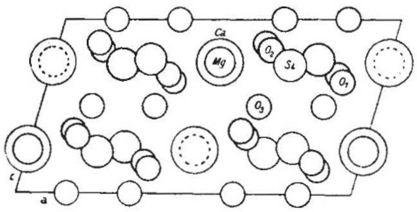

FIG. 1.

Holes are drilled in a thin plate of brass, one for each reflection $h0l$. The area of the hole is proportional to $F(h0l)$ and the holes are arranged in the positions of cross-grating spectra. The plate represents, in fact, a section through the reciprocal lattice containing all $h0l$ reflections. The plate is placed between a pair of good lenses, of about 6-ft. focal length. A point source of monochromatic light (a pin-hole in front of a mercury vapour lamp) is placed at the focus of one lens, and the image of the pin-hole at the focus of the other lens is viewed through a microscope. The diffraction of the light by the holes in the plate results in a very realistic image of the crystal structure being seen through the microscope. Each pair of holes $F(h0l)$ and $F(\bar{h}0\bar{l})$ forms a set of parallel diffraction fringes, and these sets have the right amplitude, spacing and phase to build up the double Fourier series given above.

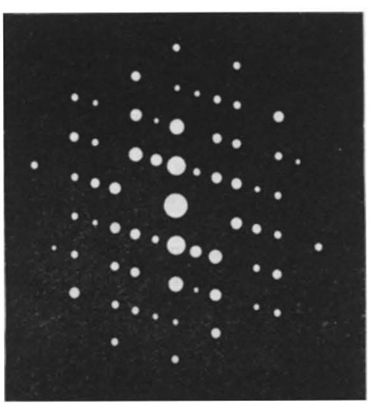

FIG. 2.

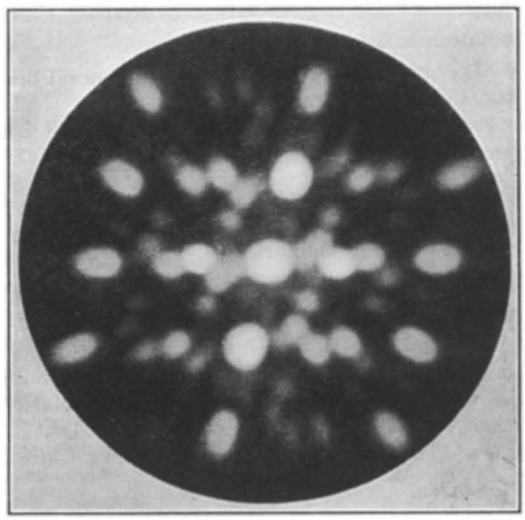

FIG. 3.

Fig. 1 shows the projection of diopside, $CaMg(SiO_3)_2$ [1], on the plane (010). The largest circles represent superimposed Ca and Mg atoms at symmetry centres of the projection, these atoms being so heavy that $\alpha(h0l)$ is zero for all reflections. The intermediate circles are silicon, the smallest are oxygen. Fig. 2 is twice natural size and is from a contact print of a brass plate drilled with holes to correspond to the $h0l$ spectra given by the crystal (see[2] Fig. 3b). Fig. 3 is a photograph of the diffraction image seen in the microscope when this plate is placed between the lenses as described above, and it will be seen that it is a faithful reproduction of the crystal structure shown in Fig. 1.

We are now searching for a device for dealing with the more general case of values of 0 or π for $\alpha(h0l)$, for example, a ready way of placing a film with a half-wave retardation over certain holes. If this can be found, the method may prove to be of practical use in crystal analysis.

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[1] *Z. Krist.*, **69**, 168 (1928).
[2] *Z. Krist.*, **70**, 475 (1929).