Two unconventional uses of a Weissenberg goniometer. By E. J. W. Whittaker, *Technical Division,*

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Although the essential feature of a Weissenberg goniometer is the coupling of crystal rotation with film translation, certain of its other characteristics can be used to considerable advantage in circumstances when an ordinary Weissenberg photograph is not desired or cannot be obtained.

The latter circumstance arises in the investigation of those fibrous materials which give a rotation photograph even when the specimen is stationary. Hitherto the diffraction data obtained from such materials have been limited to the region of reciprocal space which can be explored by means of a single rotation photograph, since it is not possible to obtain useful diffraction photographs by rotation or oscillation about any axis other than the fibre axis. By use of shorter wavelength radiation, it is of course possible to extend the volume of reciprocal space within the tore of reflexion at the cost of reduced resolution of the photograph, but even by this means the important central regions of the higher layers of the reciprocal lattice remain inaccessible in the hollow of the tore. The difficulty can be overcome by applying to the rotation photograph, the equi-inclination method which is well known in connection with Weissenberg photographs. Although all the refinements of a Weissenberg goniometer are not required for this purpose, it is a convenient instrument to use (without a layer-line screen) since an ordinary X-ray goniometer is not adapted for operation with the beam inclined to the camera axis.

The equi-inclination rotation photograph has two merits: it records the whole of the chosen layer line between $\xi = 0$ and the boundary of the limiting sphere, and for any given radiation it approximately doubles the number of layer lines which can be conveniently recorded. If the maximum inclination of the instrument is in the neighbourhood of 40° it is convenient to record layer lines up to $\zeta = 1.4$ whereas the practical limit with the normal-beam arrangement is $\zeta = 0.7$. The only structural alterations to a standard Weissenberg goniometer which are required for this purpose are the removal of the layer-line screen and the provision of a pivoted beam trap. The usual elongated slot is unsatisfactory for this purpose since it obscures too much of the photograph, but it is a simple matter to provide a cylindrical

beam trap which can be adjusted to be coaxial with the collimator after setting the inclination of the camera.

The second technique makes use of the fact that a Weissenberg goniometer has provision for oscillating the film holder over any desired distance. If this oscillatory motion is restricted to an amplitude of a few millimetres, and freed from its usual synchronism with the crystal oscillation or rotation, then each spot on the resulting photograph is drawn out into a short streak parallel to the camera axis and perpendicular to the layer line on which it lies. The central portion of this streak will be of uniform intensity in the direction perpendicular to the layer line, for precisely the same reasons as hold for the central region of a spot produced by an integrating Weissenberg instrument (Wiebenga & Smits, 1950). Accordingly it is possible to obtain true spot profiles in the direction of the layer line, using an ordinary microdensitometer. This technique has proved useful in studying the diffuse scattering along the layer lines in disordered fibrous structures such as chrysotile which could not be satisfactorily investigated by any other means. It could also be applied to single-crystal oscillation photographs, provided that the ratio of the period of oscillation of the crystal to that of the camera was made equal to the ratio of two sufficiently large relatively prime numbers. This semi-integrating technique therefore provides a method of obtaining instrumental intensity data from single crystals using only an ordinary Weissenberg goniometer and a microdensitometer. It is, of course, more time-consuming than the integrating Weissenberg technique, but has the merit of using apparatus which is more generally available.

It is scarcely necessary to add that the technique of the equi-inclination rotation photograph and the semi-integrating rotation photograph may be combined without losing any of the advantages of either.

Reference

WIEBENGA, E. H. & SMITS, D. W. (1950). *Acta Cryst.* **3**, 265.

The crystal structure of the intermetallic compound $Mg_6Si_7Cu_{16}$.[*] By GUNNAR BERGMAN and JOHN

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A ternary compound in the magnesium–silicon–copper system has been studied by Witte (1938) and given the approximate formula $Mg_6Si_7Cu_{16}$ by him. The X-ray investigation he carried out showed that the compound

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[*] Contribution no. 1733 from the Gates and Crellin Laboratories.

has a face-centered cubic structure with $a_0 = 11.67 \pm 0.01$ Å and with the calculated number of atoms per unit cube equal to 116. Witte also found the Laue symmetry to be O_h. He did not determine the position of the atoms.

We have now determined the crystal structure by the stochastic method, and have verified the structure with X-ray data obtained from single crystals. The space