gives flat plates formed on the (001) basal plane (see Fig. 3), the most drastic change of habit recorded in the whole series.

The whole character of the crystals changes with the introduction of the ammonium radical to the molecule (types 8–15 inclusive). One effect of growing ammonium Rochelle salt in the presence of cupric ions is to raise the inductivity in the (100) direction by 60 %, and to reduce its value in the (010) and (001) directions. This invites comparison with the effect in the (50KK.50KNa) tartrate, where there was an increase of 150 % in the (100) direction, and with ordinary Rochelle salt, where a fall of 2 % was recorded in the same direction.

The remaining results show how the inductivity fares when an increasing proportion of ammonium appears in the molecule of Rochelle salt. The smallest replacement occurs in compound (8), and the corresponding inductivity in the (100) direction is reduced to 19·2. The rate at which inductivity in the (100) direction falls with increasing substitution in (KNa)T becomes very much less when more than 10 % of ammonium is present, and the inductivity remains nearly constant after a 25 % substitution has been made. Although the crystal (10) is not strictly derived from (KNa)T, its properties fit the general shape of the relation between percentage substitution and value of inductivity, and the crystal (16) is an example of the replacement of potassium by both ammonium and rubidium, and, again, the relationship is observed.

It is likely that the Canada balsam used for joining the electrodes to the surfaces of the crystal had the effect of damping mechanical vibrations slightly, thereby causing a lower dielectric constant to be read than actually existed. This will account for the difference of about 6 % which exists between the values quoted here for (100) sections of pure Rochelle salt and those commonly published. Since all the measurements of dielectric constant were made well above resonance frequencies, the crystals did not undergo mechanical movement of large amplitude, and this damping did not become a serious consequence. The layer of balsam was about 0·01 mm. thick, sufficient to require the use of the correction mentioned earlier (p. 335). Each crystal was supported on its lower face only, and the support was at earth potential. The upper face carried the very small masses of the balsam and the electrode, and it is unlikely that stresses occurred in the crystal which would build up piezo-electric charges great enough to influence the results. It appears that the method of plating quartz crystals by sputtering (Spears, 1946) might be extended to Rochelle salt, although this substance readily loses water of crystallization under reduced pressure, and the dehydrated salt is of low inductivity.

One of us (J. H. T.) wishes to thank Dr H. E. Buckley for suggesting the problem, and Prof. P. M. S. Blackett for facilities and encouragement.

References

BUCKLEY, H. E. (1924). *Miner. Mag.* **20**, 159.
BUCKLEY, H. E. (1926). *Miner. Mag.* **21**, 55.
EVANS, R. C. (1937). *Phil. Mag.* **24**, 70.
MANDELL, W. (1928). *Proc. Roy. Soc.* A, **121**, 130.
MASON, W. P. (1942). *Electromechanical Transducers and Wave Filters.* New York: Van Nostrand.
SPEARS, R. A. (1946). *J. Brit. Instn Radio Engrs*, **6**, 50.
ZELENY, A. & VALASEK, J. (1934). *Phys. Rev.* **46**, 450.

Short Communications

Contributions intended for publication under this heading should be expressly so marked; they should not exceed about 500 words; they should be forwarded in the usual way to the appropriate Co-editor; they will be published as speedily as possible; and proofs will not generally be submitted to authors. Publication will be quicker if the contributions are without illustrations.

Acta Cryst. (1949). **2**, 337

X-ray collimator producing a beam of very small divergence and large intensity.*

By J. A. LELY and T. W. VAN RIJSSEL. *Philips Research Laboratories, Eindhoven, Netherlands*

(*Received* 11 *May* 1949)

Using the total reflexion of X-rays at very small glancing angles we have constructed a slit collimator for small-angle diffraction work. We used two slightly divergent plates 10–15 cm. long, leaving apertures of 5–20 μ at the end confronting the X-ray tube, and of 75–150 μ at the other end. The specimen is placed directly behind the wide aperture.

The divergence of the incident radiation is diminished nearly without loss of energy by reflexion from the two highly polished surfaces. The effective angular width α_0 of the incident beam is limited by the critical glancing angle η (Fig. 1).

$\alpha_0 = 2\eta + \beta$, where β is the angle between the polished surfaces. For glass and Cu $K\alpha$ rays $\eta = 14$–$15'$, so $\alpha_0 = 30$–$34'$ if $\beta = 2$–$4'$. The angular width of the emerging beam, α_e, depends on the dimensions of the apparatus and η, and may be easily brought down to 4–6′.

* Manuscript no. 1288 from the Philips Research Laboratories.

The device shows the following properties:

(1) A gain in intensity by a factor 3–5 can be achieved relative to the usual slit system producing a similar beam.

(2) The intensity and the angular distribution of the emerging beam are nearly uniform over its whole width.

(3) Adjustment in the X-ray beam can readily be done by hand, using a fluorescent screen.

(4) The halo close to the primary beam, which is caused by the uneveness of the surfaces, is little extended.

Using glass and Cu $K\alpha$ or Fe $K\alpha$, this scattering is limited to 12′ from the central ray, so spacings up to 350–400 A. may be measured with this collimator. The scattering appears to be nearly independent of the width of the slit, and therefore of the divergence of the emerging beam. It seems possible further to reduce this scattering by several minutes of arc by improving the quality of the polish of the mirrors.

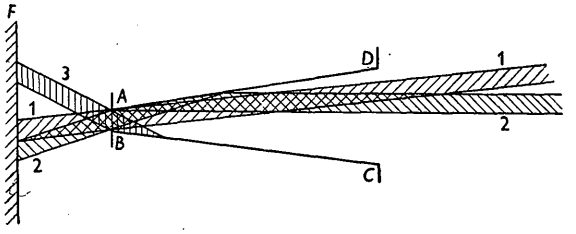

Fig. 1. Principle of the collimator. Three beams from the focus of the X-ray tube enter the narrow aperture AB of the collimator. The angle between the polished surfaces AD and BC is β; the critical glancing angle is η. Beam 1 passes unreflected. Beam 2 is reflected once. Beam 3 is absorbed because $\frac{1}{2}\alpha_0 > \eta + \frac{1}{2}\beta$.

(5) The collimator acts more or less as a monochromator. The critical angle being roughly proportional to the wave-length, the effective width of the incident beam and thus the intensity of the emerging beam are proportional to the wave-length, neglecting terms in β.

The construction of the collimator is easy (Fig. 2). Two glass bars (II and III) of the required length are assembled with their polished surfaces facing each other, a thin wire or foil of suitable thickness is placed between the ends of the bars, and these plates are cemented between two plates I and IV. After removal of the spacing pieces the apparatus is ready.

It is also possible to construct a (square) pinhole collimator by putting four polished plates together in the manner sketched in Fig. 3. The gain in intensity may in this case amount to a factor 10–30 over the usual pinhole system.

For the mirrors a material should be used showing a rather small critical angle $\eta_i \leqslant 15'$. With larger η the reflexion coefficient is not 100% below η, and the reflexion curve shows a long tail. Provided the reflexion coefficient is 100% below η, calculation shows it to be possible to obtain, by a suitable choice of dimensions, an emerging beam of a certain intensity and divergence independent of η.

We have constructed a slit wedge of glass 120 mm. long, 9 μ wide at the narrow side and 140 μ at the other end. $\eta = 14{\cdot}5'$. α_e, the divergence of the emerging beam, is 5·8′ (Cu K).

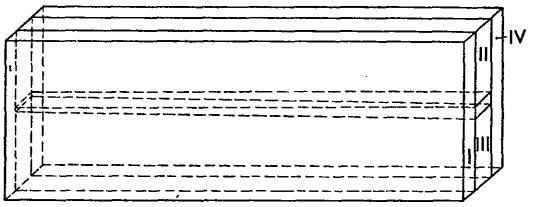

Fig. 2. Construction of a slit collimator.

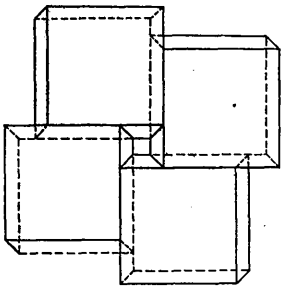

Fig. 3. Construction of a square pinhole collimator showing front view on the wide aperture.

With an X-ray tube of 1·2 × 1·2 mm.² apparent focal spot, run with 30 mA. at 30 kV., we made an exposure of wet collagen, 1 mm. thick. With a specimen–film distance of 200 mm. an exposure of 20 hr. was required for a good diagram containing the orders 2–25 of the long spacing of 660 A.

Calculation, verified by a few preliminary experiments, shows that a wedge 120 mm. long with apertures of 10 and 100 μ shows the same α_e of 6′. On account of the narrower beam, the film distance may be shortened to 140–150 mm. In this case exposures of 6–8 hr. only are required.

A paper discussing the geometrical relations, calculations on the intensity of the beam and some experiments on the nature of the scattering close to the primary beam will be published shortly.

Acta Cryst. (1949). **2**, 338

A method for the comparison of the intensities of X-ray reflexions using nuclear research emulsions.

By H. J. Wellard. *H. H. Wills Physical Laboratory, University of Bristol, England*

(*Received* 22 *June* 1949)

If the tracks produced by X-rays in a suitable electron-sensitive emulsion are counted, then the number of tracks, N, gives a measure of the intensity of radiation incident upon the area considered, subject to a statistical error of $\pm(\sqrt{N}/N) \times 100\%$, i.e. $\pm 3\%$ if $N = 1000$ or $\pm 1\%$ if $N = 10^4$. In order to test the method, Ilford G.5 emulsion 30 μ thick coated on to 0·005 in. cellulose acetate base was exposed in a circular camera to silver $K\alpha$ radiation