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The relations between the significant quantities governing asymmetric Bragg reflexion from perfect crystals (a correction to formulae given by M. Renninger).

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A correction is given to earlier consideration of asymmetric Bragg reflexion by Renninger. An error of sign, not affecting the main arguments, has made modification of some of the formulae and diagrams necessary.

In a paper given at the 1966 meeting on 'Advances in X-ray Analysis' at Denver, Renninger (1967) deals with the relations ensuing from the dynamical theory of asymmetric Bragg reflexion. When the formulae deduced by Renninger were used, an error of sign was noted which does not affect the main arguments of the paper but, as might be easily overlooked, necessitates a modification of the diagrams and formulae. The error concerns the sign of the angle φ between the crystal face and the reflecting lattice planes. φ is defined as *positive* for grazing *incidence*, which means that the glancing angle of the primary beam is *smaller* than that of the reflected beam and correspondingly negative for grazing emergence. This sign has been changed erroneously by Renninger in Zachariasen's quantity denoting the asymmetry, $b=\gamma_0/\gamma_H$, which in the Bragg case takes the form $b=-\sin(\theta-\varphi)/\sin(\theta+\varphi)$. The necessary correction therefore consists of replacing b by $1/b$. The relations between b and Renninger's quantity denoting the asymmetry, $\beta:=\mathrm{tg}\,\varphi/\mathrm{tg}\,\theta$, are consequently:

$$\beta=\frac{1+b}{1-b}\left(\text{instead of }\frac{b+1}{b-1}\right)$$

$$b=\frac{\beta-1}{\beta+1}\left(\text{instead of }\frac{\beta+1}{\beta-1}\right).$$

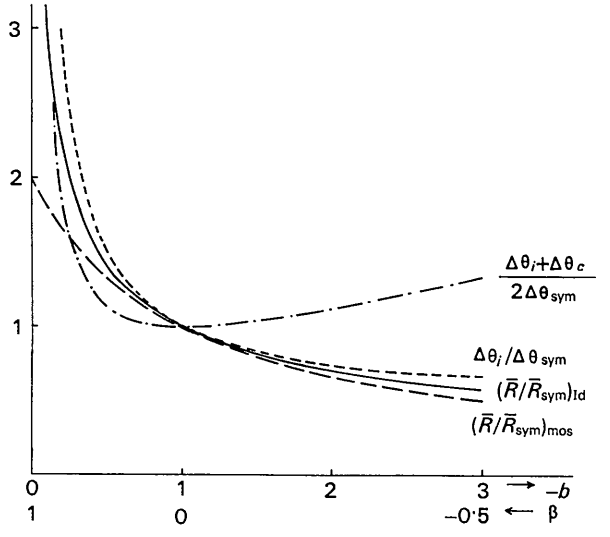

Fig. 1. Variation of different quantities with degree of reflexion asymmetry, related to the same quantities for symmetric reflexion, plotted against $b=\gamma_0/\gamma_H$.
- - - - - - - deviation $\Delta\theta_i$ of incident beam from Bragg angle θ_B,
– · – · – · – deviation $\Delta\theta_i+\Delta\theta_e$ of total deflection $\theta_i+\theta_e$ from double Bragg angle $2\theta_B$;
– – – – – integrated reflexion $\bar{R}$ of imperfect crystal;
———— angular width Δ_i of the diffraction pattern and integrated reflexion $\bar{R}$ for a non-absorbing perfect crystal.

Fig. 4(*b*) of Renninger's paper now takes the form shown in Fig. 1, and Renninger's Table 1 has to be replaced by the present Table 1.

The author wishes to express his gratitude to Professor Renninger for his agreement.*

* I am grateful to Dr Otto for giving this correction which is very overdue. I regret only that the pleasing symmetry between b and β present in the wrong formulae has disappeared in the corrected ones. M. Renninger.

Reference

Renninger, M. (1967). *Advanc. X-ray Anal.* **10**, 32.

Table 1. *Variation of different quantities with* β *and with* b, *related to their values of symmetrical reflexion* ($\beta=0$, $b=-1$)

Deviation of the glancing angle from Bragg angle	$\dfrac{\Delta\theta_i}{\Delta\theta_{\mathrm{sym}}}=\dfrac{1}{1-\beta}=\dfrac{b-1}{2b}$
Deviation of total deflection from double Bragg angle	$\dfrac{\Delta\theta_i+\Delta\theta_e}{2\Delta\theta_{\mathrm{sym}}}=\dfrac{1}{1-\beta^2}=-\dfrac{(1-b)^2}{4b}$
Integrated reflexion of imperfect crystal	$\left(\dfrac{\bar{R}}{\bar{R}_{\mathrm{sym}}}\right)_{\mathrm{mos}}=1+\beta=\dfrac{2}{1-b}$
Angular width of diffraction pattern and integrated reflexion of (non-absorbing) perfect crystal	$\dfrac{\Delta_i}{\Delta_{\mathrm{sym}}}=\left(\dfrac{\bar{R}}{\bar{R}_{\mathrm{sym}}}\right)_{\mathrm{Id}}=\left(\dfrac{1+\beta}{1-\beta}\right)^{1/2}=\left(\dfrac{1}{\lvert b\rvert}\right)^{1/2}$