the new growth the darkening is irregular and appears to spread in columns from points in the early stages of the growth. It has been found that a different darkening pattern is produced with a synthetic crystal containing arsenic, and it would appear that the nature of the darkening is closely related to the manner of growth of the synthetic crystal and the way this is modified by the nature of the foreign ion.

It is concluded from the results with irradiated synthetic crystals that the darkening in natural quartz may be associated with the presence of impurities, and that changes occurring during the growth of a crystal often produce corresponding changes in the susceptibility to X-ray darkening in the different parts of the crystal. It is noteworthy that quartz grown under the best conditions in the laboratory, and which is probably of high purity, does not darken. However, when the synthetic quartz is grown in less perfect conditions as in the alternative method referred to above, or when impurities are deliberately added, the resulting synthetic crystals are in these instances susceptible to darkening.

We wish to thank Mr. J. W. Ryde for helpful discussions in the course of this work. We are also indebted to Drs. Nora and W. A. Wooster for providing the synthetic crystals containing the added impurities.

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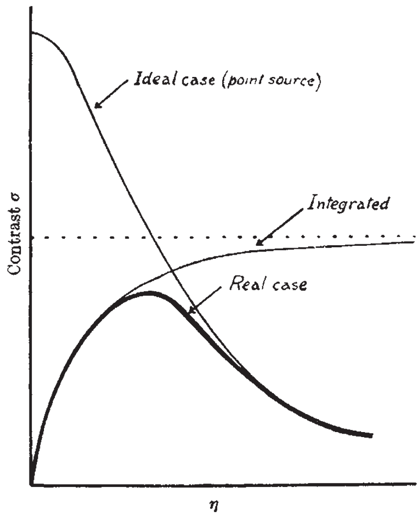
X-Ray Extinction in Type II Diamonds and Topaz

In the course of experiments on divergent-beam X-ray photography, we applied extinction theory to find how the contrast σ of deficiency lines against the background depends on η, the standard deviation of mosaic-block disorientation in the crystal. We obtained a curve (reproduced herewith) with a maximum for a value of η comparable with the angular subtense of the X-ray source at the film. For smaller values of η, σ depends chiefly on the integrated intensity of reflexion from the lattice planes concerned rather than on the ideal line profile; in consequence, as η decreases, the contrast must eventually suffer secondary extinction in the same way as single-crystal spots on rotation photographs. Instead of reaching the ideal maximum of $\frac{1}{2}$ ('Laue' case) or 1 ('Bragg' case), the curve near the origin, provided η is not too near the diffraction width, is given by the expressions:

$$\text{Laue case} \quad \sigma = \text{const.} \times \eta \sqrt{2 \ln \sqrt{\frac{2}{\pi}} \frac{Q' t'}{\eta}} \left(1 + \frac{0{\cdot}577 \ldots}{2 \ln \sqrt{\frac{2}{\pi}} \frac{Q' t'}{\eta}} + \ldots\right) \quad (1)$$

$$\text{Bragg case} \quad \sigma = \text{const.} \times \eta \sqrt{2 \ln \frac{Q' t'}{\sqrt{2\pi}\,\eta}} \left(1 + \frac{0{\cdot}577 \ldots}{2 \ln \frac{Q' t'}{\sqrt{2\pi}\,\eta}} + \ldots\right) \quad (2)$$

where Q' is volume reflecting power and t' is effective crystal thickness.



Full details together with some experimental results on organic crystals will be published elsewhere, but in the meanwhile two consequences of our investigations may be of interest.

Some earlier measurements by Lonsdale[1] for type II diamonds can be harmonized with theory by using only the single value of η (0·6 min. of arc) measured for one set of planes, without any *ad hoc* assumptions about the internal structure of the crystals. In this respect it would seem that type II diamonds are normal crystals with a rather small mosaic disorientation. It may be that type I diamonds are more perfect in having even smaller η (hence giving weaker lines) as well as perhaps having as large or larger blocks.

Similar considerations apply to integrated reflexion intensities whenever there is large secondary extinction; for example, the measurements by Bragg and West[2] on topaz. James[3] concludes that "no constant, or even approximately constant, property of the crystal slice is measured by experiments of this kind". We find, however, on the assumption that primary extinction is negligible throughout the crystal, that quantitative agreement with calculation for the (250) and (320) planes of topaz is obtained by assigning to η the value 0·07 min. of arc, which though small is still large compared with the probable diffraction-width.

It should be noted that for such small values the line-width does not vary as η but is proportionately greater, and would be of the order 0·3 min. at half maximum in this case.

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