TEXTURE OF CRYSTALS

Part II. (NH_4Cl, $NaClO_3$ and Alum)

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Abstract

Using the method of internal reflection, the texture of ammonium alum, ammonium chloride and sodium chlorate was examined. Ammonium chloride was found to be mosaic, while ammonium alum and sodium chlorate were highly perfect.

1. Introduction

Following the theoretical work of Ramachandran (1953) the author (Padmanabhan, 1953, 1954) developed a new method of studying the texture of crystals. The method has been successfully applied in the case of LiF, NaCl, KCl and MgO and it has now been extended to three typical laboratory grown crystals, namely, NH_4Cl, Alum and $NaClO_3$. The results are given below.

2. Experimental Details

All the three crystals NH_4Cl, $NaClO_3$ and alum were grown from aqueous solutions by the method of slow evaporation. In the case of NH_4Cl a small amount of urea was added to quicken the growth. Crystals of about $1 \times 1 \cdot 5$ cm. were easily obtained. The experimental arrangement was the same as that described in the earlier papers. A Shearer tube with Mo target was used as the source of X-rays. After passing through a slit and a series of apertures, the X-ray beam was allowed to fall on the wedge-shaped crystal. The internal reflection was photographed on an Ilford Ilfex film kept at a distance of about 4·0 cm. from the crystal. Photographs with the slit vertical as well as horizontal were taken for each crystal. In addition to the characteristic reflection a very faint outline of the whole crystal is also recorded, due to continuous radiation. The films obtained with the horizontal slit were run under a microphotometer and the curve so obtained was converted into a true intensity scale with the help of the standard intensity marks taken for each crystal. In all the cases symmetrical internal reflections were obtained from the 200 planes, and these planes were normal to the surface and vertical.

3. Results

Alum.—The thickness of the wedge employed for the study varied from 0·4 to 2·6 mm. The internal reflection was photographed with the crystal

etched and later after chilling treatment by dipping it in liquid air. During the chilling treatment a disturbing effect was noticed namely, that the crystal used to break off into fragments due to sudden cooling. A number of crystals were tried and the specimen which did not develop any crack inside (after chilling treatment) was used for the study.

As the F value is small in the case of alum for the particular reflection the internal reflection in general was very feeble in intensity. So long exposures were found to be necessary, while in the previous cases (LiF, NaCl, KCl and MgO) exposures of the order of 10 minutes were found to be sufficient to get reasonably intense photograph of internal reflection. As the thickness increases, the intensity was found to decrease in the case of an etched alum crystal. This would be the case if the crystal were perfect. This will be evident from the theoretical curve drawn in Fig. 1. The experimental points observed in the

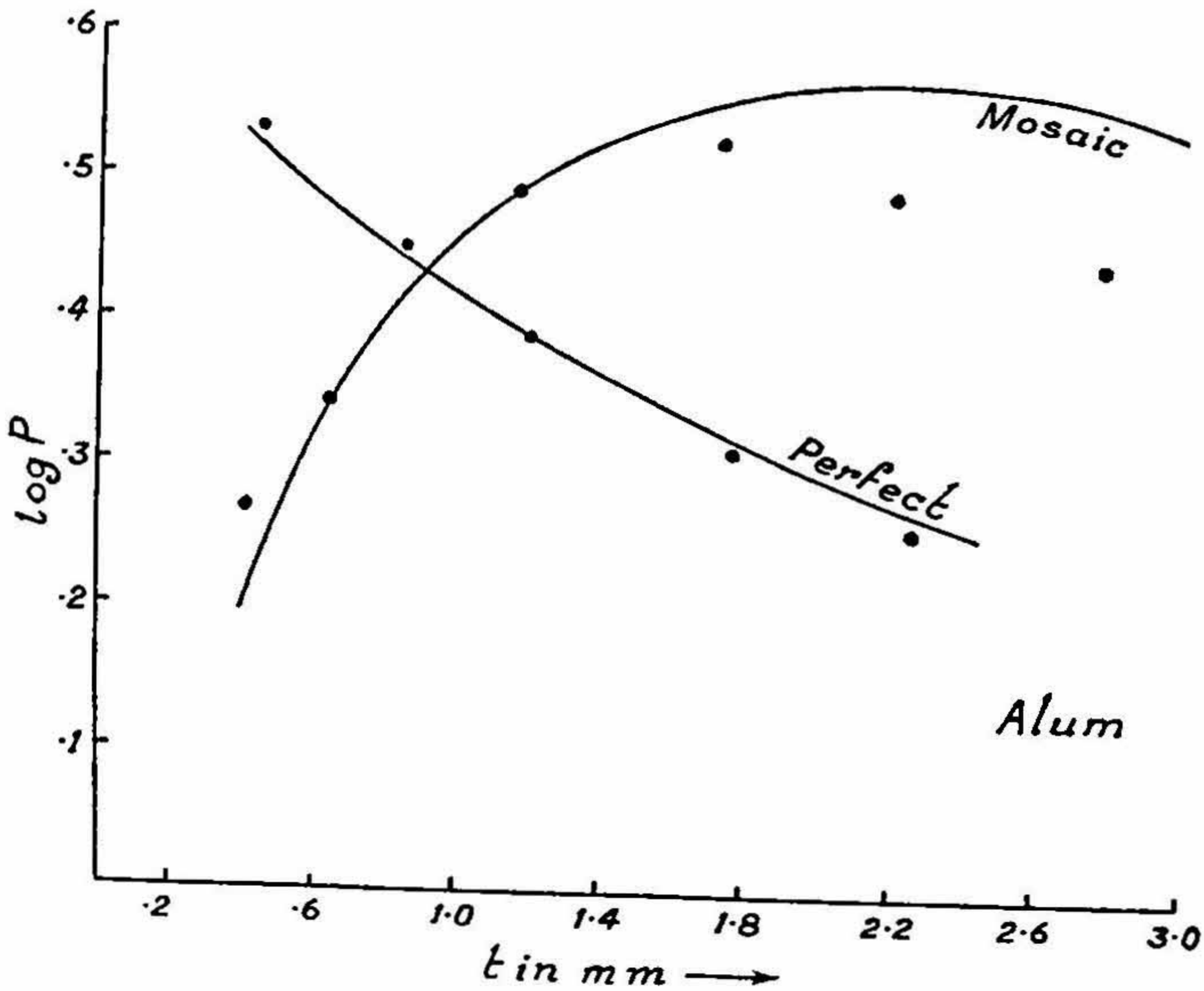

FIG. 1.

Log p–t curves, Continuous lines are drawn from theory; dots represent experimental points.

case of the etched crystal were plotted. It could be seen from Fig. 1 that in the etched case the experimental points fall nearly on the theoretical curve for a perfect crystal, indicating that the crystals of ammonium alum grown from solutions are perfect in texture.

After the chilling treatment as the thickness increases, the intensity of the internal reflection also increases reaching a maximum and then the intensity falls off. This is what is to be expected theoretically for a mosaic crystal (see Fig. 1). As the experimental points do not fall exactly on the theoretical curve, it may be inferred that the chilled specimen did not become fully mosaic.

Ammonium Chloride.—The crystal of ammonium chloride was ground in the form of a wedge with its thickness varying from 0·3 to 2 mm. The internal reflection of the etched crystal was found to be very intense. It was noted that the width of the reflected image on the film did not follow the relation $2 + \sin \theta$. After liquid air treatment, the intensity of the reflection was found to have increased considerably. The theoretical intensity distribution curves for the perfect and mosaic crystals are reproduced in Fig. 2 together with the experimental

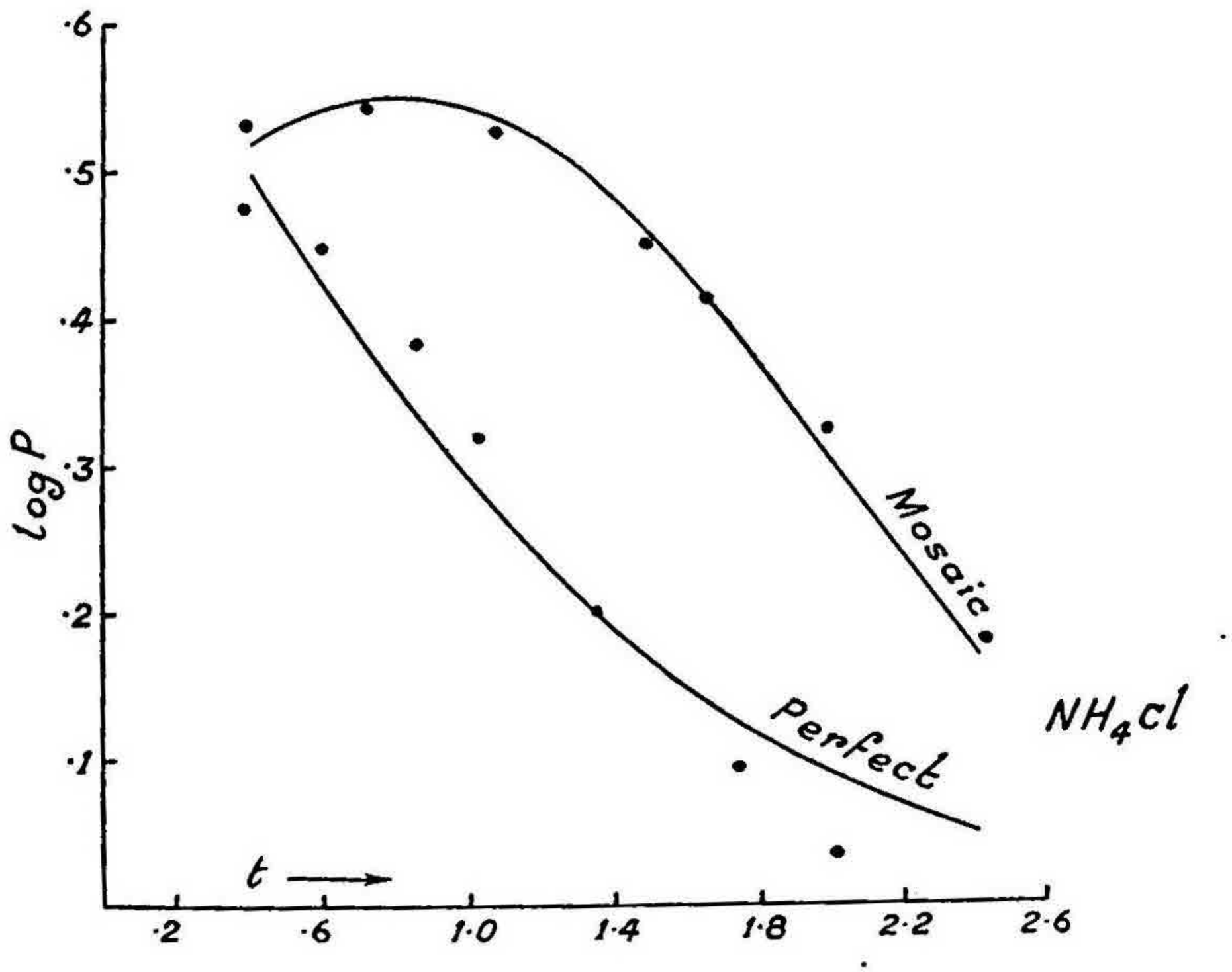

FIG. 2.

points for the etched and the chilled states. The experimental points of the etched crystal do not fall on the theoretical curve. These observations favour the conclusion that the ammonium chloride crystal was highly mosaic.

Sodium Chlorate.—A wedge of thickness varying from 0·4 to 2·2 mm. was used for the investigation. The theoretical log ρ curves for the mosaic and perfect crystal are reproduced in Fig. 3 along with the experimental points for the etched and chilled conditions for the 200 planes. The value was determined by

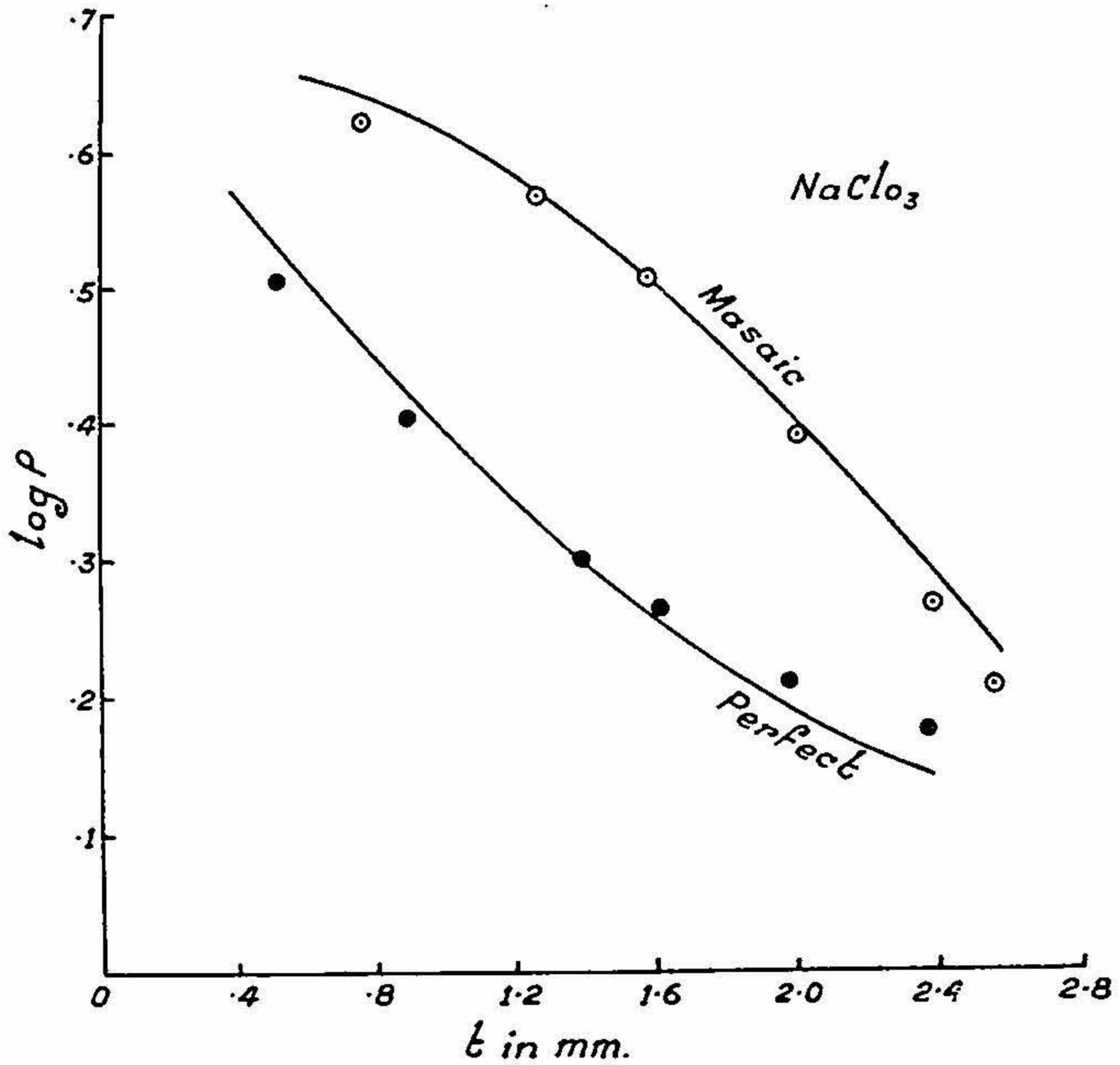

FIG. 3.

following the method adopted by Zachariasen (1949). When the specimen was dipped in liquid air it often broke into small fragments. There was no marked change between the photographs taken before and after chilling trea ment, except for a slight increase in the intensity for the chilled specimen. The experimental points for the etched crystal fall on the theoretical curve for a perfect crystal indicating thereby that the crystal is perfect.

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