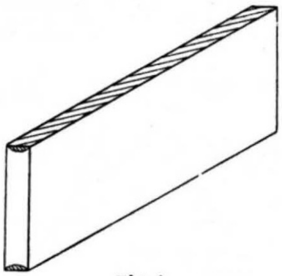

Fig. 1.

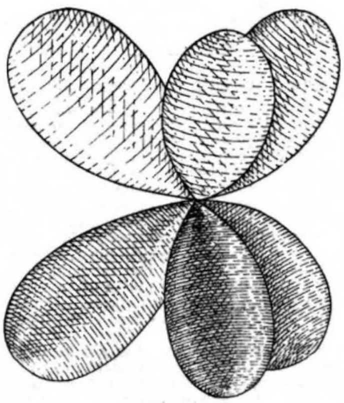

Fig. 2.

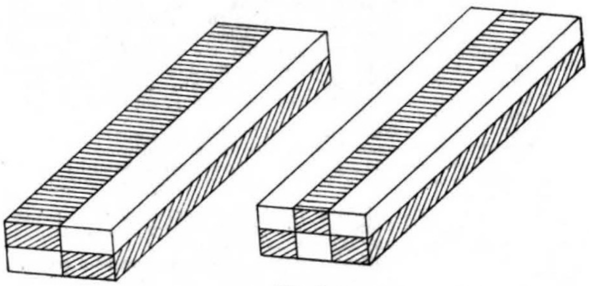

Fig. 3.

complete clearance, that is, freedom from twin boundaries, it was found that different loads were required for plates of different orientation; and with some cuts clearance could not be effected even with loads which were liable to cause fracture. The relation between the force required for what might be termed 'piezocrescence' and the direction relative to the crystallographic axes is shown in the solid figure in Fig. 2. Each radius vector of this surface is inversely proportional to the torque required to untwin the crystal and is drawn normal to the major surface of the plate. In this 'piezocrescent' figure the lighter lobes indicate where the orientation of the crystallographic axes x, y, u remains unchanged and the darker lobes where the polarity of these axes is reversed by the treatment. Only six lobes are shown, though twelve are really present, since from the method of definition it follows that a radius vector drawn in any direction must be of the same character and of equal amount to the radius vector drawn in the opposite direction.

Other experiments were performed applying bending stresses. These were found to give rise to characteristic twin patterns in certain cuts. Experiments carried out on bars subjected to a temperature gradient while cooling from a temperature above the transition point also produced patterns which were characteristic of the cut. Presumably these patterns arose as a result of stresses set up by differential cooling. Some of them are shown in Fig. 3, and it is interesting to compare them with the similar patterns obtained by Zinserling[3] using a completely different method.

This work, of which a fuller account will be published elsewhere, has been done in co-operation with the Research Laboratories of the General Electric Company, Ltd., Wembley, and we are grateful to the director for permission to publish.

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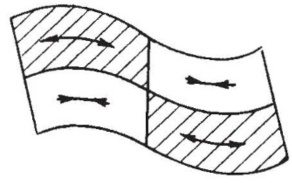
[1] Zinserling, E. V., and Laemmlein, G. G., *C.R. Acad. Sci. U.S.S.R.*, 33, 419 (1941).
[2] Schubnikov, A., and Zinserling, E. V., *Z. Kryst.*, 83, 243 (1932).
[3] Zinserling, E. V., Collected works, Institute of Crystallography, Moscow, 2 (1940).

USERS of quartz crystals for telecommunication purposes will be anxious to know the practical importance of the results described by Dr. and Mrs. Wooster on the untwinning of quartz plates. The most effective method, in which a steady torque is applied to the plate during heat treatment, can be used for most cuts of the rotated Y-cut class. These include the important BT cut, but exclude the Y-cut itself and the Z-cut. In applying the treatment, depending on the fulfilment of certain conditions which will be discussed elsewhere, the proportion of successes can be so high that the large-scale processing of quartz plates to remove electrical twinning is a practicable proposition. This method can thus be applied directly to the majority of the practical cuts with the noteworthy exception of the X-cut. The X-cut can be treated by other means which, however, are at present less effective.



The regular twin patterns obtained by Dr. and Mrs. Wooster are of more practical interest than might at first appear. For example, the production of artificial twins of the kind shown in their Fig. 3 has enabled oscillator plates of a novel type to be cut. By metallizing the major surfaces of such a plate and applying an alternating electrical potential to the electrodes so formed, it is possible to excite a second order flexural mode of vibration in the plane of the plate. This is illustrated in the accompanying drawing, the arrows showing the sense of the strain in each of the four regions during one half-cycle. The type of deformation obtained is exaggerated for clarity. To obtain a similar result with a single crystalline plate, specially divided metallized electrodes would have to be used.

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Osmotic Pressure of Rod-shaped Particles in Solution

IT has been pointed out by several workers, Dobry[1] and Wo. Ostwald *et al.*[2], that Van't Hoff's relationship between the osmotic pressure p and the concentration C of a dissolved substance

$$p = RTC$$

is a limiting law. Some substances such as the sugars obey this law up to relatively high concentrations[3], but high molecular substances, especially those the molecular shapes of which deviate greatly from the spherical, show considerable departures from the linear relationship between osmotic pressure and concentration.

The equation of Haller[4] derived thermodynamically gives a very good interpretation of the results of osmotic pressure measurements. The equation

$$p = \frac{RT}{V^0}\left(\frac{n_1}{n_0}\right)\left[1 + \left(\frac{\beta}{RT} - \frac{1}{2}\right)\left(\frac{n_1}{n_0}\right) + \left(\frac{2\gamma}{RT} + \frac{1}{3}\right)\left(\frac{n_1}{n_0}\right)^2 + \ldots\right] \quad \ldots \quad (1)$$

in which V^0 is the molar volume of the solvent, n_1 and n_0 the number of molecules of solute and solvent respectively and β and γ are constants. From the above equation it is evident that a first approximation to the osmotic pressure is

$$p = \frac{RT}{V^0}\left(\frac{n_1}{n_0}\right) + K\left(\frac{n_1}{n_0}\right)^2$$

in which K is a constant, and if still better approximations are required terms like

$$L\left(\frac{n_1}{n_0}\right)^3 \text{ and } M\left(\frac{n_1}{n_0}\right)^4$$

may be added.

From the above it is clear that the interpretation of osmotic pressure measurements depends on the determination of the constants K, L and M which vary with different substances.

In this communication an expression for the dependence of the osmotic pressure on the concentration for rod-shaped particles is given in terms of the ratio of the diffusion constant at a certain concentration, to the diffusion constant at infinite dilution.

A rod-shaped particle in solution, in the absence of other particles of its own type, will show Brownian motion of translocation as well as rotation round either of its axes. The translocatory motion can be expressed in terms of the diffusion constant by the following equation[5,6]:

$$D_0 = \frac{X^2}{2t} = \frac{1}{3}\,\frac{al^2}{2t} \quad . \quad . \quad . \quad . \quad (2)$$