propagated in the [010] direction, the c_{66} shear mode in crystals A and A' and the c_{44} shear mode may be related to the twinning dislocations present in all the crystals. The occurrence of thin [130] type twins during the crystal growth process is very difficult to prevent. The occurrence of high attenuation in intermediate temperature regions only, however, seems to be associated with certain features in the temperature dependence of certain elastic moduli and the correspondence is noted in the discussion to this paper.

With exception for the [010] direction, there was at least one mode for each direction of propagation for which velocity measurements could be made over the full temperature range, thus permitting direct evaluation of c_{11}, c_{33}, c_{44}, $\varrho V^2_{\mathrm{DS}}$, $\varrho V^2_{\mathrm{EL}}$ and $\varrho V^2_{\mathrm{FL}}$. The equations used for evaluating each of the nine stiffness moduli are given in table 2. The c_{22} modulus was evaluated directly over most of the temperature range and was derived from indirect data, involving five different wave modes, in those ranges where direct data were missing. In addition, cross-checks were available over most of the temperature range. The c_{55} shear modulus was derived directly over the whole range by combining the measurements from crystals A and C. Cross-checks for c_{55} were available over most of the range. Since direct measurements of c_{66} were missing above 340° K, it was necessary to resort to two different sets of indirect measurements to complete the data for this modulus. Cross-checks between the indirect measurements of c_{66} were available over a 450° K range.

Once the diagonal moduli, $c_{11} \ldots c_{66}$, were evaluated the cross coupling moduli, c_{12}, c_{13} and c_{23} were computed using the equations given in sec. 4.4 of [2]). These moduli are derived from the measured ϱV^2 of either the quasi-longitudinal or quasi-transverse modes of crystals D, E and F. For c_{12} and c_{13} the quasi-transverse mode velocities were used because of smaller errors introduced to the computations of the moduli, as described in [1]).

3. Results

3.1. External checks

A comparison of the present c_{11}, c_{22} and c_{33} measurements with those reported in [2]) for the temperature range 298° to 573° K offers a direct check on the treatment of the present data and the technique of temperature measurement, since those [2]) data were obtained using a silicone oil coupling and a silicone oil bath as a heating medium. Fig. 1 shows the basic data, $f_n/(f_n)_0$ of eq. (1), for the two sets of measurements in the 298° to 573° K temperature range. The data for c_{11} and c_{22} using the present arrangement show no significant disagreement with the previous data, thereby, confirming that the bracketed terms in eq. (1) could be neglected without introducing errors greater than 0.05 % in the basic data. The data for c_{33} do, however, show significant disagreements, especially in the range of 400° to 500° K where the difference

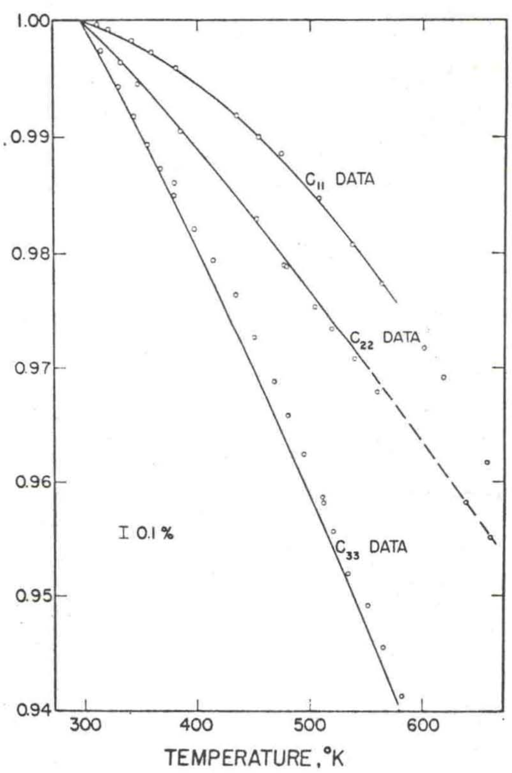

Fig. 1. Comparison of data obtained by present technique (o), with data obtained in silicone oil bath (——), ref. [2]).