the glass is being elastically compressed along the line AC'C while pressure is being applied. However, in addition to this compression, the glass is also capable of a continuous structural change in response to its new pressure–temperature environment. This change also involves densification, due to a rearrangement of the tetrahedra so as to use up some of the void space. At the given pressure, the structural change adjusts the density to a point corresponding to D. The kinetics of such a change are extremely rapid. Upon release of pressure, however, the structural change in the reverse direction is extremely difficult, and hence, the glass does not return from D to A: instead, the elastic compression which is stored in D is released and the glass returns to a position E. Finally, it is plotted as a point in graph of the type of Fig. 1 at the pressure of the run corresponding to B'. Figs. 1 and those like it, therefore, are generated by a sequence of points corresponding to B'.
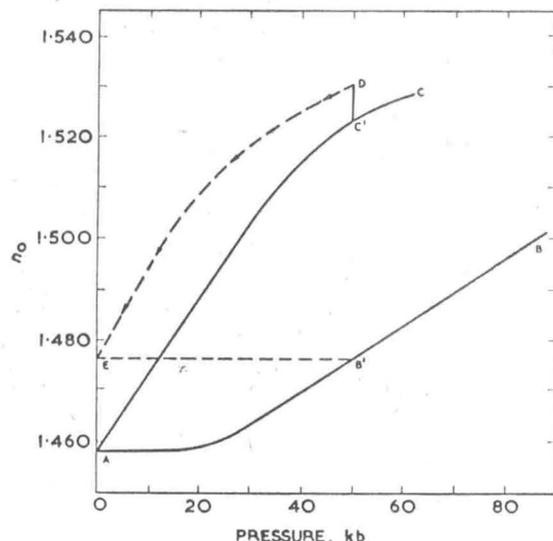

Fig. 4.   *Curve AB'B represents the measured index of refraction of quenched silica glass as function of pressure. Curve AC'C represents the calculated index of refraction of the glass under the applied pressure.*

The step C'D represents, schematically, the resultant structural change which may in fact have taken place across a more complex path from A to D.

Curve DE represents, schematically, the release of the compression of the densified silica glass when the external pressure is quenched

The index of refraction was calculated, from the compressibility data given by Birch *et al.*[5], from the molar refraction relation

Influence of temperature

From the fact that silica glass has an extremely low thermal expansion, it might have been predicted that the densification would not be increased if the temperature of the run was increased a few hundred degrees Celsius. The facts, however, prove to be quite different. The temperature of the run had a profound influence on the final density of the glass. This is shown in Fig. 2 where the density of the resultant silica glass has been plotted against temperature in isobaric runs. The results so far might suggest that temperature was merely serving to accelerate the reaction and bring the glass to its equilibrium value more quickly. This is true to a certain extent, and is illustrated by the inability to obtain a measurable change in the silica glass at room temperature at 10 kb, while at 7 kb and 675° an increase in refractive index to 1·467 was recorded. However, the main effect of temperature is quite different. It appears that at each pressure and temperature there is an equilibrium or pseudoequilibrium structure of the glass which is attained very rapidly and then hardly changes at all. One can hardly explain otherwise the fact that silica glass heated to, say, 200° at 60 kb comes to equilibrium in 1 or 2 min., and does not change thereafter, even in a period of days, while heating to 400° at the same pressure also gives a psuedo-equilibrium value within a minute or two which is distinctly higher. The structural state of the glass therefore appears to be a rather sensitive indicator of both its pressure and temperature environment.

Structural aspects of densification process

If the hypothesis is correct that the densification of the glass by high pressure is achieved at the expense of the rearrangement of the tetrahedra to use up void space in the structure, then it ought to be possible to check the hypothesis by a study of the influence of pressure on glasses in which the percentage of voids is different. A systematic study has been attempted by a thorough evaluation of three glasses of the compositions R_2O, $0·1$ MgO, $2·9$ SiO_2 with the alkali ion changing from lithium to potassium. The results of the measurements are shown in Figs. 5