are adaptable to studies[5] of the influence of continuous shearing stresses on reactions under pressure in a simple modification of our standard apparatus (Fig. 5). Shearing stresses are applied to the sample wafer by rotating the bottom anvil about its vertical axis back and forth through a maximum of 2° in 15 sec. This oscillating action is maintained mechanically for hours on samples under pressures up to 100 kb and temperatures up to 500° (for lower pressures). In an attempt to do something analogous by Bridgman[1], the same type of action was applied manually in a few alternate strokes each through 60° of arc in about 5 sec. (Drickamer & Larsen[6] and Griggs *et al.*[7] have made use of continuous shearing stresses due to slow rotation in one direction of one anvil against the other.) Under the conditions of our experiments heating due to friction is negligible, a conclusion also arrived at by Bridgman and by Drickamer & Larsen in their respective experiments.

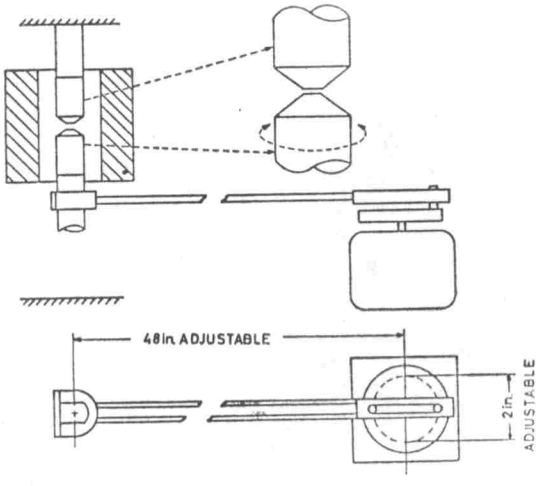

Fig. 5.

Sketch of the essentials of the shear modification of an assembly

The lower thrust bar is rotated back and forth 2° max. in 15 sec. while the sample is under pressure. No bearings or special clamps are required.

Sealed tube samples

One important feature of anvil apparatus is that the sample thickness which can be held by friction between the faces increases with the diameter of the faces. In a 400-ton unit where anvil faces are $\frac{3}{4}$ to $1\frac{1}{8}$ in. diameter, the thickness of sample will be 0·03—0·04 in. in the higher pressure range. However, it is possible to support even thicker samples at lower pressures (10—50 kb) by selecting a stacking of two to six 0·04 in. thick rings or even single rings 0·05—0·06 in. thick. The useful sample volume during such runs is about 0·5 c.c. and yields 1500 mg. of silicates. The distortion of the sample in runs of this type is indicated in Fig. 6 and one sacrifices accuracy of pressure measurement in these samples (see below).

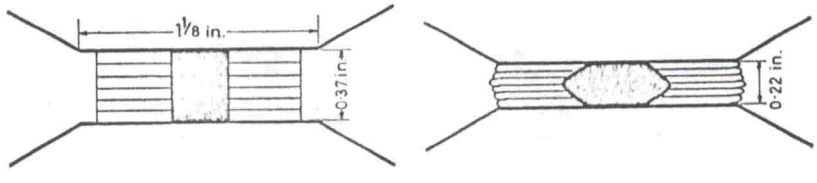

Fig. 6. *Example of distortion of a 'stacked' or thick sample*

The ability to hold thick wafers of silicates makes possible an extension of the hydrothermal techniques into the 50-kb range and higher. In a method being developed by E. Hryckowian in this laboratory, the sample assembly (Fig. 7) consists of a sealed platinum or gold tube containing the water or other volatile liquid and sample, embedded in pyrophyllite or similar medium, all being held in tough metal binding rings of nickel or stainless steel. The anvil–sample assembly is heated in the conventional manner by external heating to temperatures as high as 500°. Thus the *complete* reaction of quartz to coesite is effected easily, made possible at these temperatures only by the presence of water. Hydrous phases such as analcite and phillipsite will remain unchanged at 275° at 10—20 kb but will react completely to jadeite at 450° at the same pressure.