water pressures, as defined by the experimentally determined boundary curves.

(c) The modal quartz and plagioclase of the various samples are also plotted, and the line of best fit calculated. (It should be noted that the modes are in volume percent, and the calculated data in weight percent. However, in practice, the quartz and plagioclase occurring in the rocks

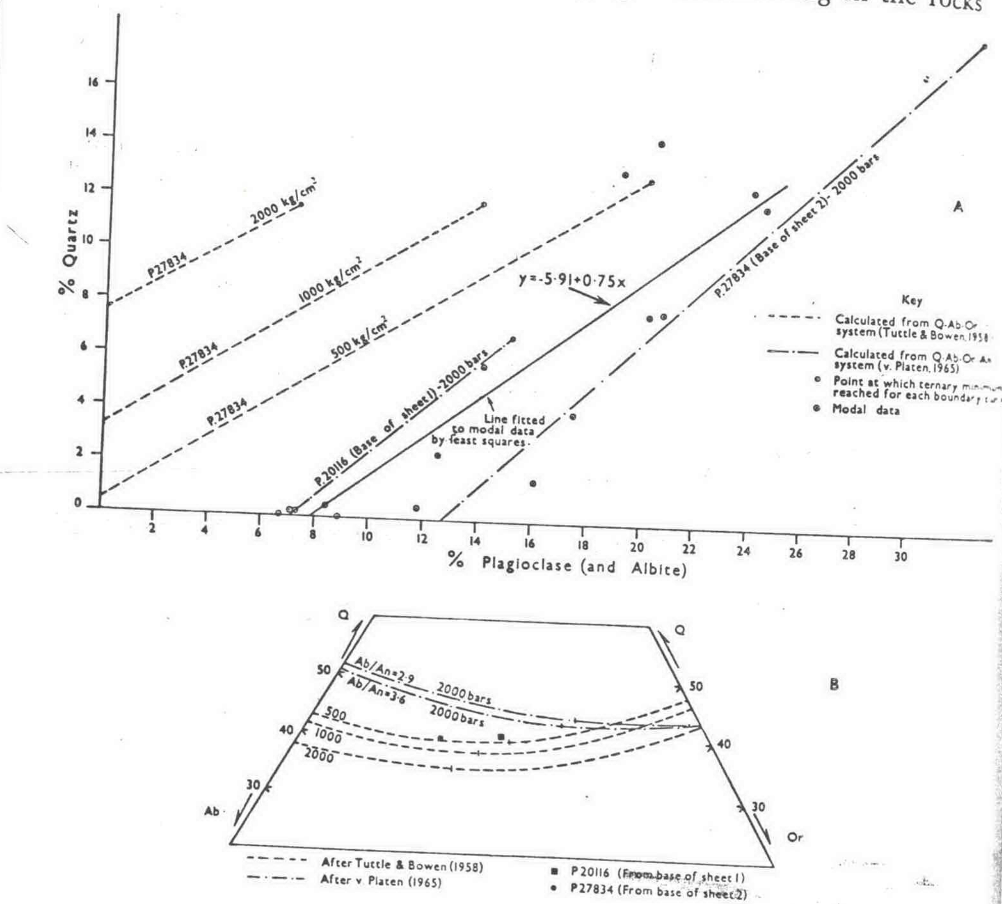

Fig. 2

A. Graph showing the calculated amounts of quartz and albite crystallizing under various water pressures compared to the modal (phenocrystic) quartz and plagioclase for the Whakamaru Ignimbrite. The amounts of quartz and albite were calculated (using the data of von Platen for the Q–Or–Ab–An system) from the normative data of two samples of the ignimbrite, which represent the extremes of chemical variation found in this ignimbrite (Ewart, 1965). The theoretical quartz and albite crystallizing from one of the samples (P. 27834) under various water pressures are also calculated for the data of Tuttle and Bowen (1958). Further details are given in the text.

B. The normative compositions of the two samples of Whakamaru Ignimbrite (P. 27834 and P. 20116) plotted in the ternary system Q–Or–Ab. The positions of the boundary curves (for different water pressures) used in the construction of the data for A are also shown. The minimum on each boundary curve is shown by a dash.

in question have similar specific gravities, and thus no correction was considered as warranted.)

Theoretically (even if not in practice), it should now be possible to ascertain the water pressure during crystallization of the magmas by visual comparison of the calculated and modal data. This makes the usual assumptions, for example, that the magma is saturated with respect to water.

Application to the Matahina Ignimbrite.—In figure 1, the method has been applied to the Matahina Ignimbrite. Although only two complete recent analyses are available (Ewart, Taylor, and Capp, in preparation), additional partial alkali analyses indicate only small chemical variations within the ignimbrite. The average normative composition (Q = 39.8, Or = 21.4, Ab = 38.8, Ab/An = 5.5) from the two complete analyses has therefore been used. The modal data has been obtained on 17 samples (r = + 0.71 for the correlation between modal quartz and plagioclase). From figure 1, it is obvious that the consideration of An in the quartz-feldspar system makes a tremendous difference to the interpretation of "apparent" water pressures. From figure 1, it could be concluded (bearing in mind the assumptions made) that the Matahina Ignimbrite magma crystallized at a water pressure slightly in excess of 2000 bars (using von Platen's data). This is higher than the values deduced by Lipman for the Nevada ash-flow magmas.

Application to the Whakamaru Ignimbrite.—In figure 2, the more complex example of the Whakamaru Ignimbrite is considered. This is composed of three distinct flow units. The stratigraphically lowest unit (designated as sheet 1) shows a very strong upward increase in phenocryst abundance and upward decrease in K_2O (details are given by Ewart, 1965), which are interpreted to be the reverse of the original condition in the magma chamber. The chemical and mineralogical variations through the overlying sheets 2 and 3 appear to be much less important. In figure 2, the calculations have been based on a sample from the base of sheet 1 (sample number P. 20116: Q = 40.0, Or = 29.0, Ab = 31.0, Ab/An = 3.6) and a sample from the base of sheet 2 (sample number P. 27834: Q = 39.4, Or = 20.5, Ab = 40.1, Ab/An = 2.9). These two samples essentially represent the limits of chemical variation (see figure 2B). The calculations have not been made for P. 20116 for Tuttle and Bowen's (1958) boundary curves, owing to the proximity of the analysis of this sample to the minima according to the simple ternary system. The modal data is also plotted in figure 2 (r = + 0.88 for the correlation between modal quartz and plagioclase). From figure 2, it is evident that the modal data is bounded by the two 2000 bars lines, representing the boundary curves for the two extreme compositions. This can be illustrated further by examining the calculated position of the P. 20116 boundary curve line with the position of the fitted line (from modal data), at which both intersect the plagioclase axis. There is a near coincidence which is significant as the sample P. 20116 and the lowest phenocryst contents coincide near the base of sheet 1. The data imply that