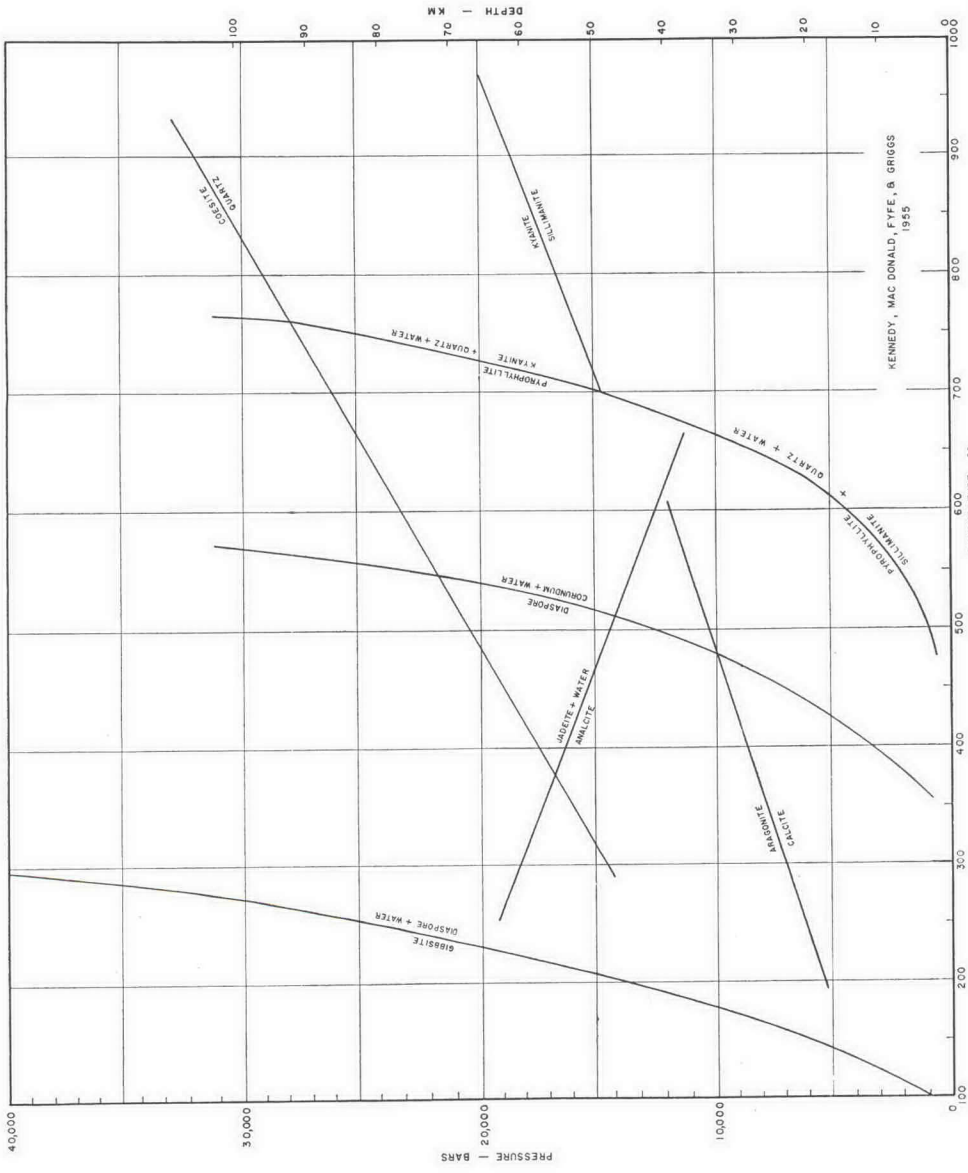

Fig. 8. Some phase boundaries determined with the squeezer. Each boundary is based on some fifty runs. Some of these results are tentative, subject to refinement, as work is still in progress. The dehydration curves are in all cases smooth extensions of boundaries determined below 2 kb in hydrothermal apparatus.

In our experiments to date, it has been found that any reaction which will go at all will usually go in one or two hours. We have, however, insufficient experience with long-term tests. If shear stress or strain is important in promoting reaction, one would expect that short-term tests would achieve nearly the same result as long-term tests in the squeezer, since there is a relaxation of shear stress with time. This effect will be tested explicitly in our new shearing apparatus.

UTILITY OF THE APPARATUS

Figure 3 shows the temperatures and pressures attained thus far. It is reasonable to expect that somewhat higher pressures may be attained in this apparatus in the future. Throughout the range of figure 3 satisfactory samples and equilibrium results have been attained except at low pressures. Below 5 kb, erratic results have been obtained with hydrous systems, indicating leakage of water.

Exclusive of auxiliary instrumentation, the apparatus itself is cheap—a few hundred dollars—or much less if a machine shop is available. It is extremely easy to use and requires little skill. Over 600 runs were made in our laboratory in the first year of operation.

The apparatus has been used to date mainly in determining equilibrium relations in solid-solid transitions and in hydration-dehydration reactions. Figure 8 shows some boundaries that have been explored at the time of this writing. The quartz-coesite and calcite-aragonite transitions were done by MacDonald (in press, 1956) in our laboratory. The former has been slightly modified in figure 8 as a result of further work by Kennedy from 600° to 900°C. The work on jadeite-analcite was done by Griggs, Fyfe, and Kennedy (1955). The work on gibbsite, diaspore, corundum, pyrophyllite, sillimanite, and kyanite was done by Kennedy. These studies will be described separately in publications to follow. Figure 8 is preliminary and may be revised by further work but indicates types of reactions which may be studied with the apparatus.

Based on Bridgman's findings, the accuracy of the pressure calculated from the observed force on the ram should be about 5 percent. No rigorous check has yet been made in our work. Two comparisons with other work have been made: MacDonald (in press) found that the pressure for the calcite-aragonite equilibrium as determined in our apparatus was about 1.5 kb lower than the value determined indirectly by Jamieson (1953). Kennedy's determination of the kyanite-sillimanite boundary (fig. 8) is almost identical with that found by Dr. Sydney Clark (personal communication) in Birch's hydrostatic apparatus.

Griggs, Fyfe, and Kennedy (1955) reported confirmation of the prior work of Robertson, Birch, and MacDonald (1955) on the jadeite = nepheline + albite equilibrium. Much subsequent work on this system by Kennedy indicates that our earlier results were in error owing to melting and that agreement can no longer be reported. Work on this is being continued and will be described later.

This apparatus is useful for rapid exploration of the stability fields of minerals at pressures and temperatures corresponding to those which are believed to exist in the outer 100-150 km of the Earth's crust and mantle in the normal Earth temperature gradient. The simplicity, ease of operation, and the short time required for each run should make it possible to expand greatly our knowledge of mineral stability at high pressure.