An AC method[13] was used to make the magnetic measurements on washer-shaped specimens, which were bifilar-wound to form the core of a transformer. These specimens were cut either from short rods cast from a mixture of MnP powder dispersed in epoxy cement, from slices of polycrystalline ingot, or from single-crystal ingots. The change with temperature of the initial permeability was observed at a series of fixed pressures by plotting the relative secondary voltage vs thermocouple output on an x-y recorder. Hydrostatic pressure measurements were made in a liquid cell with a mixture of iso-amyl alcohol and pentane. Quasi-hydrostatic pressure measurements were made with a girdle-die[14] using solid AgCl as the pressure transmitting medium. The lowest temperatures which could be attained were in the range 150 to 170°K, not low enough to follow the metamagnetic transition temperature.

Typical recorder plots of relative secondary voltage vs thermocouple voltage for transformers with MnP cores are reproduced in Figs. III-4 and III-5. The data in Fig. III-4 were obtained for a single crystal core in the liquid cell at pressures up to 25 kbar. Those in Fig. III-5 were obtained with a core cut from a powdered MnP-epoxy casting, measured in the liquid cell up to 30 kbar and in the girdle-die at 35 and 50 kbar. For both cores there is a strong increase in secondary voltage when the sample is cooled through T_c, although the slope at the transition becomes considerably less steep for the powder-epoxy core with increasing pressure. The small peaks in the curves for the powder-epoxy core observed just below T_c at the lowest pressures are due to the magnetic anisotropy of MnP. These peaks show that some preferred orientation of the MnP powder particles must have occurred during their dispersion and casting in epoxy cement at room temperature.

The T_c values determined from the secondary voltage curves are plotted against pressure in Fig. III-6. For the powder-epoxy cores, the temperature at the midpoint of the change in secondary voltage was taken as T_c. For the single crystal cores, the temperature of the sharp peak was taken as T_c. Up to 20 to 25 kbar, the T_c values for the two types of samples and for measurements in the liquid cell and in the girdle-die are in excellent agreement.

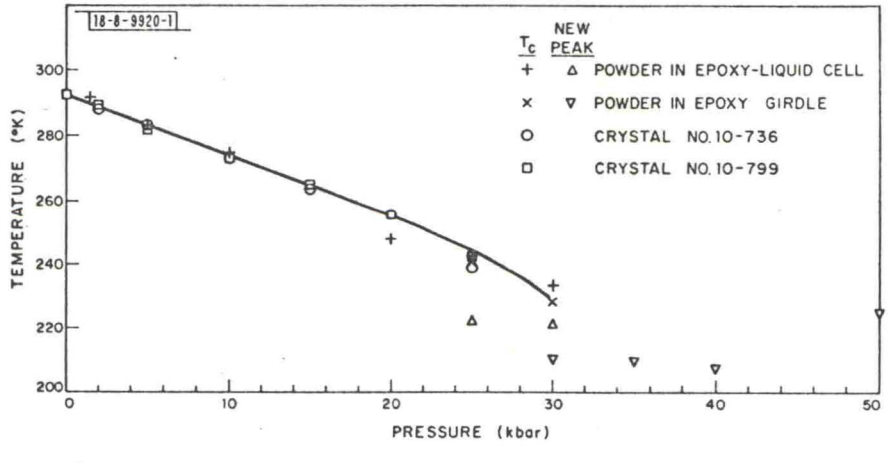

Fig. III-6. Magnetic ordering temperature (T_c) of MnP as a function of pressure. For 25 and 30 kbar, the temperature at the peak of the secondary voltage vs thermocouple voltage curve is plotted as well as T_c. At higher pressures, only the peak temperature is shown.