cone and to apply an alternating field along the axis of the clamp by means of a solenoid coaxial with it. The e.m.f. induced in the secondary coils is amplified, rectified and displayed on a micro-ammeter. Because of the large demagnetizing factor of a transverse disc, reasonably sharp transitions are to be expected only if the alternating field is of small amplitude. We have found also that it is not possible to make use of the increased sensitivity to be expected of high-frequency measurements because of skin effects in the material of the clamp. In consequence, most of the work has been done with alternating fields of amplitude about 0·1 gauss and frequency 30 c/s.

Preliminary investigations, made with clamps of various steels, indicated that the proximity of ferromagnetic materials complicated the transition of the superconductor and made accurate determination of T_c difficult. All the quantitative work to be described has therefore been carried out with a clamp of beryllium-copper—a material which remains weakly paramagnetic down to liquid helium temperatures. For experiments up to mean pressures of 16 000 atm., the circular area in contact with the specimen was about 5 mm in diameter, and the thickness of the specimen after compression was usually less than 0·01 mm. Some rough work up to higher pressures (about 40 000 atm.), has been carried out, using conical tips of smaller area, of ' Vibrac ' steel.

Because of the existence of a radial pressure gradient in the specimen it was expected that for most superconductors under pressure the outer part of the disc would become superconducting at a higher temperature than would the centre part, and it was thought that the superconducting rings thus formed might tend to mask the transition of the centre. To avoid this complication a small wedge of a metal, known to be not superconducting under the conditions of the experiments, is inserted into a suitable cut in the circumference of the disc before compression, to prevent the formation of complete superconducting rings in the periphery. Aluminium, normally a superconductor below 1·2°K, has been found suitable for use with the metals so far studied. (An independent test was carried out to ensure that aluminium did not become superconducting under pressure above 2°K—the lower limit of temperature of the present experiments.) This precaution was not, of course, necessary in the exploratory work on non-superconductors.

A Helmholtz pair located outside the cryostat, with the axis of its coils in the plane of the specimen, permitted transitions to be observed in known magnetic fields. The demagnetizing factor of the disc in this direction appears to be sufficiently small to be ignored, because the form of transition curve obtained—though not of course its location on the temperature axis—is not sensibly altered by varying the field (see fig. 4).

Temperature control in the region 2° to 4·2°K was effected by varying the pressure over a bath of liquid helium in which the clamp was immersed, the temperature being deduced from the value of vapour pressure. Above 4·2°K a charcoal desorption method was used and temperatures measured by means of a carbon resistance thermometer of the type described by Clement and Quinnell (1952).

§ 4. Experimental Results and Discussion

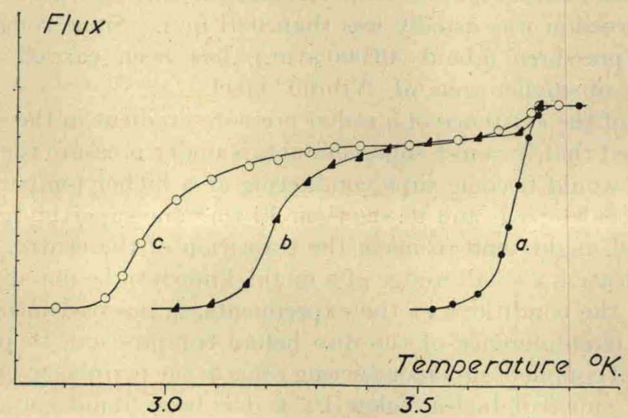
The results on the metals studied are now presented and discussed separately.

Tin

Tin, according to the Russian workers, shows the largest change in T_c under pressure. It is the most extensively studied superconductor, having its transition temperature in a range where very accurate control of temperature is possible, and it was therefore the obvious choice for a first detailed investigation.

Superconducting transitions were observed by cooling through the transition temperature under mean pressures of 1, 10 500 and 16 000 atm. The results are shown in fig. 2, where the alternating flux in the secondary

Fig. 2



Transitions of tin in zero field at differing pressures : (*a*) 1 atm., (*b*) 10 500 atm., and (*c*) 16 000 atm. mean pressure. Flux in arbitrary units.

coils is plotted, in arbitrary units, against temperature. The width of the curve at 1 atm. provides a reasonable measure of the limit of resolution of the method for a given alternating field, and we then interpret the spreading of the curves at high pressure as due to the pressure gradient in the specimen. Inspection of the curves suggests that over about three-quarters of the area the pressure is uniform within our limits of resolution (the small drop in flux at the high-temperature end of the curves is probably due to metal extruded beyond the area of the compressing cones). By assuming a linear gradient over the remaining area we can arrive at estimates of the maximum pressure in the specimen. For a mean pressure of 16 000 atm., for instance (curve c), we estimate that the pressure over the central three-quarters of the specimen lies between 16 000 and