Letters to the Editor

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Temperature, Current, Magnetic Field Phase Diagram of Superconductivity*

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MENDELSSOHN, Squire, and Teasdale[1] conclude from their measurements that the so-called "paramagnetic effect" studied by us[2,3] can be only a dynamical one. But the fluxmetric recording made by us has shown[4] that the increased flux can be maintained permanently if current, field, and temperature are constant. The experiments of Mendelssohn *et al.* also agree with our results concerning the minimum of current-strength necessary to get a flux increase. Figure 1 gives the minimum of current as a

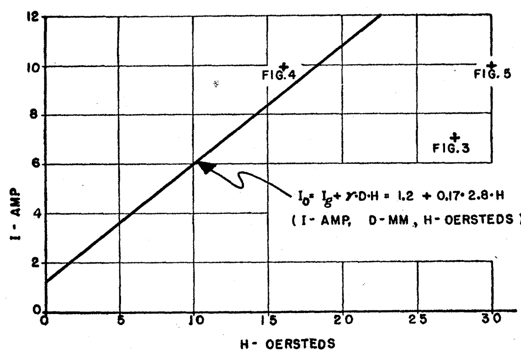

FIG. 1. Minimum current as function of the longitudinal magnetic field H for the Sn-sample used by Mendelssohn *et al.*

function of the longitudinal field for the Sn sample of Mendelssohn *et al.* The crosses represent the values of current and field for the beginning of the drop in the diagrams of Figs. 3, 4 and 5 of the paper in question. It may be seen that the paramagnetic effect is impossible for the observation represented in Figs. 3 and 5. In the case of Fig. 4, a small increase may be expected from our figure, if the right temperature is taken. Indeed, Fig. 4 shows a small increase of the flux, but it is taken as an experimental error by the authors. It should be taken into account that the temperature must be fixed to within about one thousandth of a degree to gain the maximum flux increase.

Furthermore, the following may be mentioned: Mendelssohn *et al.* intend to screen the magnetic field of the return lead of the current by a lead tube. However, the screening current flows on the inside of the lead tube in a direction opposite to that of the primary current. On the outside of the tube we have a current equal to the primary current, giving the same field on the outside of the tube as the primary current would give without the lead shield. It is best to use a tube containing the sample as the return lead, as we have done.

[1] Mendelssohn, Squire, and Teasdale, Phys. Rev. **87**, 589 (1951).
[2] Meissner, Schmeissner, and Meissner, Z. Physik **130**, 521, 529 (1951).
[3] Meissner, Schmeissner, and Meissner, Z. Physik **132**, 529 (1952).
[4] Reference 3, p. 531, lines 1 and 2.

The Paramagnetic Effect in Superconductors

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ON receiving the Letter of Meissner, Schmeissner, and Meissner,[1] measurements were made in a region where their note indicates that a large flux increase should be observed with our apparatus. A temperature was chosen such that the superconducting transition occurred for $I=11.5$ amp, and $H=5$ oersteds. (See Fig. 1 of reference 1.) Two modifications of the equipment described in our previous paper[2] were made: (1) following the suggestion of Meissner *et al.*, a brass tube concentric with the specimen was used as the return current lead; and (2) the current supplies were obtained from a bank of Edison cells. The first measurements indicate that the prediction of a flux increase in reference 1 is correct.

Figure 1 shows the galvanometer deflections as a function of the current in the sample. The temperature and external magnetic field are held constant. The deflections of the ballistic galvanometer (proportional to the flux in the tin) show a pronounced

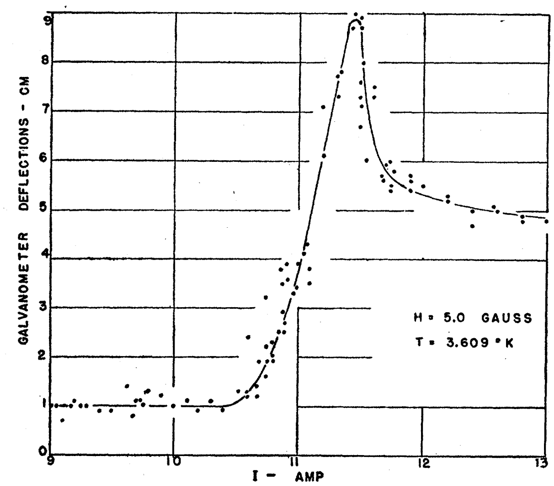

FIG. 1. Galvanometer deflection as a function of current in the specimen. The coil is dropped from the tin to the lead section of the sample.

increase before the transition into the superconducting state. In the immediate neighborhood of the peak in the curve, the galvanometer shows spontaneous fluctuations of 5 to 10 mm. These random deflections appear when the coil is held stationary around the tin. They do not occur at other points of the curve. In appearance they are similar to critical point fluctuations.

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[1] Meissner, Schmeissner, and Meissner, preceding Letter [Phys. Rev. **90**, 709 (1953)].
[2] Mendelssohn, Squire, and Teasdale, Phys. Rev. **87**, 589 (1952).

Annealing of Bombardment Damage in Solids

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IT has been found possible to obtain an analytical expression for the annealing of isolated interstitial vacancy pairs, N, which are presumably introduced by bombardment with particles having energies just slightly higher than threshold. This expression is neither exponential nor hyperbolic as has been previously suggested,[1,2] but is the sum of three different types of terms, $N=N_M+N_L+N_B$, as discussed below.

Under the influence of thermal excitation the interstitial will jump to adjacent interstitial sites with an average jump time