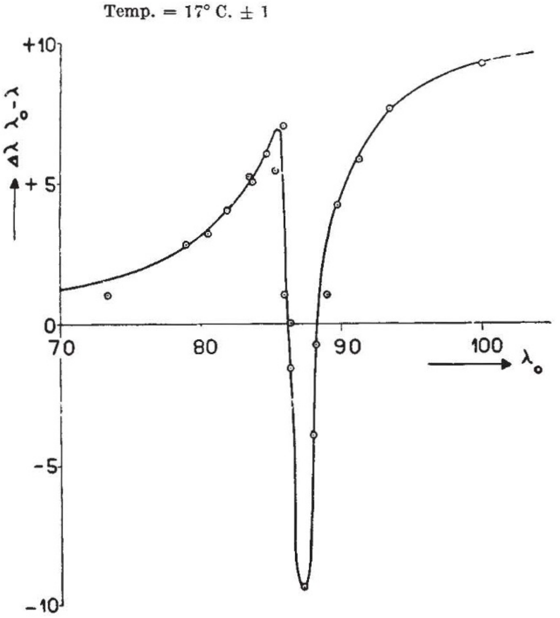
It can be shown mathematically that for a magnetic permeability μ greater than 1 of the ferromagnetic material, the wave-length λ for the ferromagnetic wire is smaller than the wave-length λ_0 for the copper wire. The results of the measurements in the interesting range are shown in the accompanying graph, the abscissa representing λ_0. which is practically equal to the wave-length *in vacuo*, while the ordinate signifies the difference $\Delta\lambda = \lambda_0 - \lambda$.



The graph resembles strikingly an anomalous dispersion curve. In a narrow interval, between $\lambda_0 = 86$ and 88 cm., the wave-lengths on the nickel–iron wire become considerably larger than those on the copper wire, which means that μ there is smaller than unity or even negative.

Similar experiments have been carried out previously in this Laboratory by J. Smidt[1] with a pure iron wire. This showed no anomalous behaviour except that the descent of the curve to zero near $\lambda_0 = 60$ cm. was much steeper than could be expected from theory[2]. A possible explanation would be that the wave-length for the anomalous behaviour of iron falls just in this region, the minimum of the curve being obliterated because the magnetic susceptibility of iron disappears below 60 cm.

It is expected that these and further experiments will reveal new information on the internal conditions of ferromagnetic materials.

A. WIEBERDINK

THE experiments just described can be interpreted in their essence by assuming that the magnetization induced in the material of the wire by a harmonically varying magnetic field is represented by a function of the frequency of the same type as that met with in the case of the electric polarization for a system subject to a harmonically varying electric field and possessing a resonance frequency.

As is well known[3], the magnetization in ferromagnetic substances in general is built up from three contributions: the irreversible displacements of the boundaries of the Weiss domains, the reversible displacements of these boundaries and the change in direction of the magnetic moments of such domains by the external field. At the frequencies and field-strengths here considered, the first cause is no longer operative[3]. The reversible motion of a boundary will, it is true, have a certain characteristic frequency of oscillation about its equilibrium position; but this will depend on local conditions such as stress, impurities, etc., and hence will vary from one boundary to another, thus not giving rise to a well-defined resonance frequency for macroscopic pieces of material. In its orientation, however, the resultant magnetic moment of a Weiss domain is bound to the crystal field, tending to give it preferential directions with respect to the crystal axes (while strong stress or the influence of a constant external magnetic field may supersede the crystal field). In consequence, the magnetic moment will precess about the preferential direction, and it is this precession frequency which acts as resonance frequency for the magnetization. In nickel the crystal field is equivalent to a magnetic field of about 100 oersted, whereas for iron the value is several times as large[3]. The double Larmor frequency in a field of that strength is about 3×10^8 Hz. In other words, it is located just in the proper frequency-range. As in the theory of electric polarization, an absorption will be associated with the anomalous dispersion, which can be described by a line-breadth. This is determined by the natural transition probability of the magnetic moment between its different stationary states in the crystal field, the transitions being brought about by the coupling of the magnetic moment with the conduction electrons and the lattice waves.

An investigation of the influence of stress and of a constant external magnetic field on the value of the resonance frequency will be very instructive and is being planned.

A more detailed discussion of the experiments as well as of the theory will be given in *Applied Scientific Research*.

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May 14.

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[1] Smidt, J., *App. Sci. Res.*, B, **1**, 127 (1948).

[2] van Leeuwen, H. J., *App. Sci. Res.*, B, **1**, 135 (1948).

[3] Becker, R., and Döring, W., "Ferromagnetismus" (Berlin, 1939).

Brief Light Pulses using Kerr Cells

IN connexion with certain studies of electrical discharges, we have found it necessary to develop an extremely fast shutter for photography. The electro-optic Kerr effect is used. Mounted 5·1 mm. apart in nitrobenzene in a glass Kerr cell, the electrodes are 12·7 mm. wide and 20·3 mm. long. Selected pieces of 'Polaroid *J*' film are placed outside the fused-on windows. The cells are subjected to single pulses of about 12,500 volts from a hydrogen thyratron and *RLC* pulse-forming network, thus admitting light to the lens of an ordinary camera. We have been photographing such intensely self-luminous objects as sparks and electrically exploded wires with exposures of a microsecond or less.

We report here a side-experiment designed to show directly the length of the segment of a light beam that we have been able to chop off with a Kerr cell.