E. VAN EVERDINGEN Jr., *Remarks on the method for the observation of the* HALL-*effect.*

In all the researches, that will be spoken of in the following communications, the method is used, described by Dr. A. LEBRET in Chapter VIII, § 6 of his inaugural dissertation [1]).

At first I used also the »by-current" [2]) to annul the secondary current in a zero magnetic field, caused by fastening the secondary electrodes not wholly in the right places. This however is liable to various difficulties.

1. It is often found, especially at high temperatures, that when the resistance in the by-current is well-chosen *before* an observation, *after* the observation in a zero magnetic field again a secondary current arises when closing the primary current. Nothing else remains then but rejecting the whole observation, since a continual change in the by-current causes an error as well in the result for the mean HALL-current, as in that for the dissymmetry, and the error cannot be calculated.

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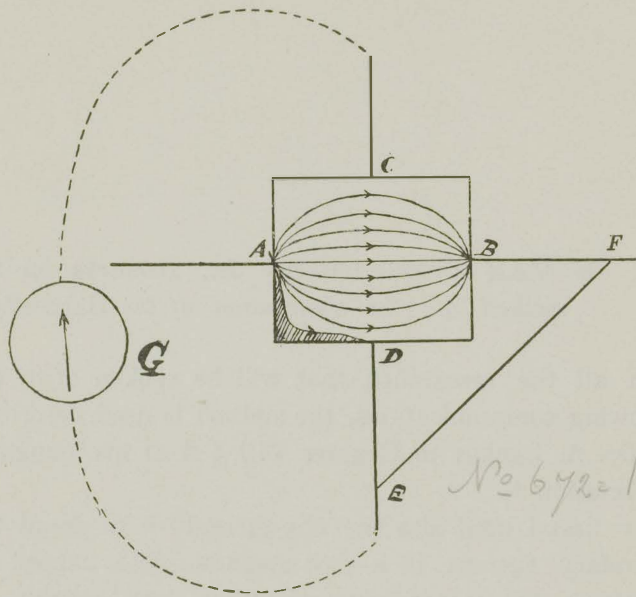
[1]) See also LEBRET, these Communications N°. 19, p. 24.

[2]) LEBRET, Dissert. Chapt. III § 1γ. Comm. N°. 19, p. 4 and 14.



2. Even if before and after the observation the by current has the right value, it is not certain that the observed secondary currents are due to the HALL-effect *only* [1]).

Let us suppose that the primary current travels through the plate from A to B, that the secondary electrodes C and D are connected through the galvanometer G, and the by-current is flowing along EF. If the resistance in this branch be so chosen, that the galvanometer shows no deflection on closing the primary current, C and E are æquipotential points.

[1]) The remarks of LEBRET on this source of errors on p. 85 and 86 of his inaug. diss. (Comm. N°. 19 p. 18) are not wholly correct.

The part of the primary current below the line of flow A D continues its way along D E F.

The whole may now be considered a Wheatstone's bridge; the four resistances are then ADE, ACD, CDF and EF. In the magnetic field, the resistance of bismuth increases. Only if the proportionality between the four resistances remained, the galvanometer would again be without current; as however the resistance of D E, E F and B F does not change, this is not likely to happen. So, already without the existence of a HALL-effect there might arise a secondary current in a magnetic field, which would show the same direction for both directions of magnetisation. In the presence of the HALL-effect, this error causes dissymmetry, the amount of which cannot be calculated.

If, on the contrary, the secondary current in the zero magnetic field (which we will indicate henceforth by S) is measured by means of the compensative current, the error appears as well, but a correction for the increase of resistance is possible. Indeed, as the resistance of the plate may be neglected against that of the whole primary circuit, the primary current does not change, and, for an increase of resistance of p perCt, all differences of potential in the plate depending on the resistance, also the difference at the secondary electrodes, increase with p perCt. So S_0 should be also increased with p perCt in order to obtain the secundary current, which would appear if the HALL-effect did not exist.

If we take moreover for S_0 the mean of the values, obtained before and after the observation, the first difficulty is also eliminated for the greater part.

The increase of the resistance of bismuth in the magnetic field differs for pure and impure bismuth and depends also on the treatment of this metal in casting it, etc. [1]) There remains therefore some uncertainty in the correction. I have always used the numbers, given by HENDERSON [2]), but at the same time taken care as much as possible, that S_0 should be small, and so the whole correction did not grow too large.

By means of the thus altered method a number of round plates are tested at different temperatures and in different magnetic fields. Here arises the question, if we are allowed to draw conclusions from these observations concerning mean HALL-current and dissymmetry in the same manner as with quadratic plates, and so to write for the difference of potential at the secondary electrodes: [3])

$$e = \left\{ H + \tfrac{1}{2} \sin 2\alpha (K_{11} - K_{22}) \right\} \frac{I}{d}.$$

In practice, some objections may indeed be made against this assumption.

Firstly, for equal values of magnetic force, temperature, strength of (primary) current (I) and thickness of the plate (d) the secondary currents are much weaker in the round plates than in the quadratic ones.

Then, it is difficult to reconcile with this formula an observed variation of the mean HALL-current after turning circular plates round the axis of the magnet.

[1]) See RIGHI, Atti della R. Acc. dei Lincei, Serie III, Memorie XIX, p. 576, 1884.

[2]) Wied. Ann. 53, p. 912, 1894.

[3]) See LEBRET, Diss. p. 108; Comm. N°. 19, p. 24.

Already during the experiments for the determination of the axes of symmetry on plate N° 1 it struck me, that for the mean HALL-current always larger values were found, if the secondary electrodes were at the ends of an axis of symmetry. Afterwards the plates N°. 2 and 3 were tested in 8 positions, differing by 45°, and also then always the same was observed.

Round plate N°. 2. M [1]) = 8600.

Position	1	2	3	4	5	6	7	8.
S [2])	9,89;	11,30;	10,12;	12,39;	$11,16^5$;	12,96;	11,35;	11,36.

Mean of 1, 3, 5, 7	10,63
„ „ 2, 4, 6, 8	12,00

Round plate N°. 3.

Position		1	2	3	4	5	6	7	8.
M = 8500	S	40,88;	50,70;	40,40;	44,55;	36,10;	47,27;	$37,97^5$;	51,40.
M = 5450	S	28,80;	33,93;	25,74;	31,23;	25,83;	33,12;	29,34;	35,82.

	8500	5450.
Mean of 1, 3, 5, 7	38,84	27,43
„ „ 2, 4, 6, 8	48,48	$33,52^5$.

In positions, situated between two consecutive ones of these series, always numbers were obtained between the corresponding values.

During the experiments of the last series a resistance of 10 Ohms was added to the secondary circuit, so that the possible variations of resistance in that circuit could not have much influence.

The observations may be represented tolerably well by an empirical formula, containing A $\cos n\pi$ and

$$B \cos \left(n \frac{\pi}{4} - \phi \right) \qquad (n = 1, 2 \; . \; . \; . \; . \; . \; 8)$$

[1]) Magnetic force.

[2]) Mean secondary current.

Since there cannot yet be given theoretical meaning to such terms, it was not thought necessary to mention the calculated values. The amplitudines were

N°. 2	A = 0,73	B = 0,84
N°. 3	A = 4,6	B = 2,96 [1])

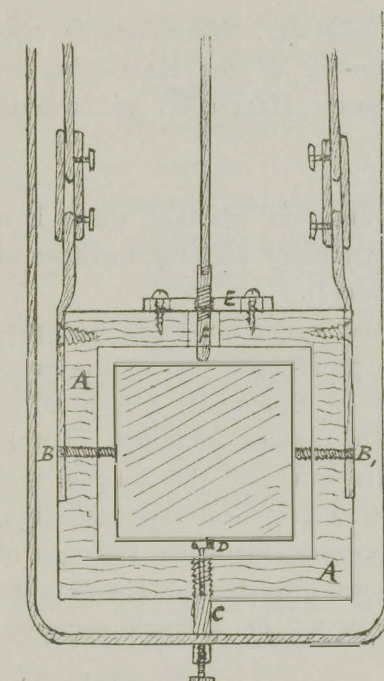
In order to obtain more certainty in this question, it would be necessary, for instance, to construct two differently situated quadratic plates out of the same round one, after determining the axes of symmetry; generally it will be desirable to repeat the experiments with quadratic plates.

For the present, however, I have continued to use the above mentioned formula.

The electrodes are fastened to the plate by means of a carrier, which, after several changes, is now composed as follows:

To the sides of a small wooden frame A copper strips are attached, which at the upper end are connected by means of screw-clamps with the wires of the primary current. At the middle of the sides screws B, B_1 penetrate the copper strips and the wood, between which the quadratic or round plate is clamped. At the middle of the lower side a screw C is placed, pierced at the lower end horizontally to admit the double wire of the secondary circuit, which is fastened in it by means of a small screw, and provided at the upper end

[1]) Obtained from a series, composed of the means of corresponding terms in the series for 8500 and that for 5450, reduced to a mean of 43,7.



№ 673 = № 888.

with a vertical bore, in which moves the screw D, serving as lower secondary electrode. To the upper side is fastened by means of two wood-screws the little plate E, which, together with the upper secondary electrode F, may be moved to and fro some millimeters in horizontal direction, allowing us to select a position, where S_0 is as small as possible.

This apparatus is convenient especially for the examination of round plates in different positions with respect to the primary or secondary electrodes. If the various screws are well pressed, the resistance, measured from the ends of the primary or secondary wires, remains always short of 0,05 Ohm.