WILD'S NEW METHOD FOR DETERMINING THE VARIATIONS OF MAGNETIC INCLINATION.¹

BY W. G. CADY.

This is one of the the most important contributions to the study of the Earth's magnetism since the invention of the Weber earth-inductor, of which it is a modification. The fact that the Weber inductor is always used with the zero-method, makes it unfit for use as a variation instrument. This defect has been entirely removed in the Wild inductor; a needle hung from a vertical suspension not only shows the same variations in a horizontal plane that a frictionless dipping-needle would experience in a vertical plane, but the absolute value of the total deflection is the same in each case.

If we have two equal coils of wire, the one turned about a horizontal, the other on a vertical axis with equal velocities, the two induced currents are:

$$I_z = Z.C \quad \text{and} \quad I_h = H.C'$$

respectively, H and Z being the horizontal and vertical components of the Earth's field, C and C' constants involving character of the coils, velocity, etc. If the two coils are exactly alike, $C = C'$ and we have for the inclination,

$$\tan i = \frac{Z}{H} = \frac{I_z}{I_h} \tag{1}$$

The currents from the two inductor coils are left off through commutators and passed through the two coils of a specially constructed galvanometer. These coils are placed with their planes vertical and cutting each other at right angles, the short galvanometer needle being at their common center. If the two coils are precisely alike in all respects, we shall have

$$I_z \cos v = I_h \sin v, \tag{2}$$

where v is the angle made by the needle with the axis of the galvanometer-coil in circuit with the inductor-coil whose axis is *vertical*.

Combining (1) and (2) we get

$$\tan v = \tan i.$$

Thus the galvanometer needle follows all the changes in inclination, and its direction depends only upon the ratio $I_h : I_z$, and not upon the

¹ Ueber eine neue Methode zur Bestimmung der Variationen der Inclination. Bull. Acad. Imp. Sciences, St. Petersburg, 1900, Dec. T. XIII, No. 5, pp. 509-515.

absolute value of the two currents. Practically, however, the current must be kept approximately constant, unless the suspension-fiber is so fine that the needle is not sensibly affected by torsion when the current is varied.

Instead of two single galvanometer-coils, Professor Wild uses two pairs of coils, the coils of each pair being placed according to Helmholtz on opposite sides of the needle. For each pair we have, with sufficient exactness, for the angular moment,

$$D = I \frac{n}{R} c \sin v,$$

n being the number of turns of wire on the coils and R their mean radius, and c a constant depending on the needle. Instead of equality between the coils, it is sufficient if the condition

$$\frac{n}{R} = \frac{n'}{R'}$$

be fulfilled. These coils, like those of the inductor, are tested by placing them on opposite sides of a unifilar magnetometer and sending a current through them in opposite directions. The number of turns n' is then altered until the magnetometer-needle shows no deflection.

Equation (2) assumes that no other force acts on the galvanometer-needle than that caused by the currents in the two coils. It is therefore necessary to employ an astatic needle-system, in order to remove the effect of the Earth's field. Two long, slender vertical magnets are used, after Weiss, their opposite poles together and on opposite sides of the axis of suspension. In this way each needle by itself is unaffected by the Earth's magnetism, and each pair of opposite poles acts as a short horizontal magnet. Galvanometer-coils can be placed both at the upper and lower ends of the needles, and the sensitiveness thereby increased.

The chief sources of uncertainty in this ingenious instrument seem to be two: the electrical contacts at the commutators, which are in danger of causing a variable resistance, and the difficulty in getting the two galvanometer-needles exactly vertical. If these problems can be successfully solved, the instrument bids fair to revolutionize the measurement of inclination variations at magnetic observatories.

C. & G. S. MAGNETIC OBSERVATORY, Cheltenham, Md.