secohmmeter, and increase or diminish one of the resistances, r_1, for example, by a small amount ρ, obtaining a steady deflection, d_2, of the galvanometer with the battery previously used; then

$$L = \frac{d_1}{d_2} \cdot \frac{r_3}{r_2} \cdot \frac{\rho}{8n} \text{ secohms approximately.}$$

For this test the relative positions of the two commutators is unimportant. They may be as in Figs. 2 and 3, in which case the

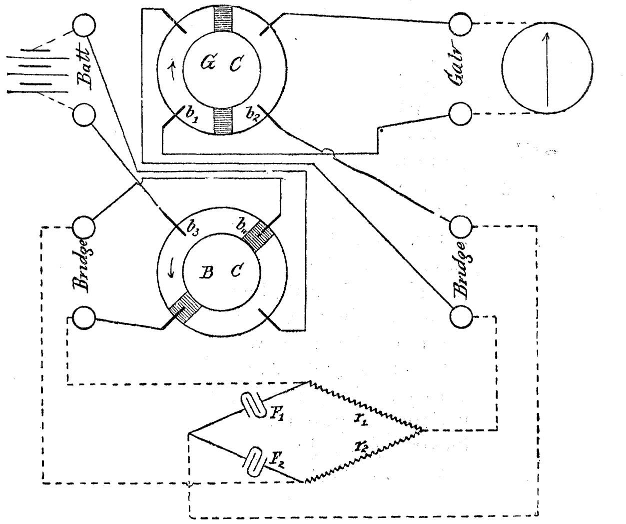

FIG. 3.—COMPARING TWO CAPACITIES.

reversal of the galvanometer occurs midway between two consecutive reversals of the battery; or they may be as in Fig. 4, in which case the reversal of the galvanometer just precedes the reversal of the battery. The greater the value of n, the greater will be the deflection d_1, and the more accurately can it be read; but the speed must not be too great to prevent the currents reaching their steady values between two consecutive reversals of the battery. Whether this condition be fulfilled or not, can be best ascertained

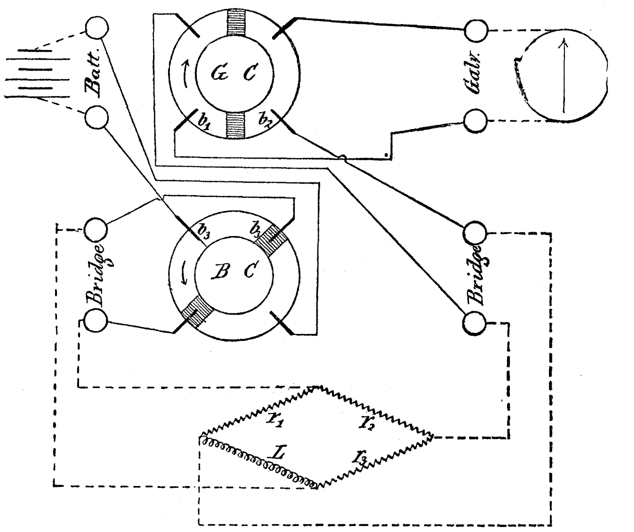

FIG. 4.—CO-EFFICIENT OF SELF-INDUCTION IN SECOHMS.

by seeing whether the same value is obtained for L, for a speed considerably smaller than n.

The sensitive zero method is as follows: Instead of obtaining two deflections, the resistances, r_1, r_2, r_3, are first adjusted to give balance with a steady current, and then one of them, say r_1, is altered by an amount σ ohms, so that there is still no deflection of the galvanometer when the commutator spindle makes, say, n revolutions per second; then

$$L = \frac{r_3}{r_2} \sigma \frac{k}{n} \text{ secohms approximately,}$$

where k is a constant depending on the relative position of the commutators. The value of the constant k is most accurately ascertained once for all, for a given relative position of the commutators, by experimentally determining the value of $\frac{r_3}{r_2}\sigma$, that produces balance for a known co-efficient of self-induction, when the commutator spindle is driven at some known number of revolutions per second.

For this latter test it is necessary that the commutators be so placed relatively to one another that the galvanometer is not reversed exactly midway between two consecutive reversals of the battery; since, with this latter adjustment, no variation in the resistance of any of the arms of the bridge can counterbalance the effect of the self-induction on rotating the secohmmeter handle: in fact, the more nearly the commutators are placed in the midway adjustment, the smaller will be the value of k, and therefore the larger the value of $\frac{r_3}{r_2}\sigma$, to produce balance for given values of L and n.

5. To measure the resistance of a polarizable electrolyte, replace the coil having self-induction in Fig. 4 by the polarizable electrolyte; adjust the commutators so that the galvanometer is reversed just before the battery; and, using the higher speed ratio for the gearing, rotate the secohmmeter at the highest convenient speed. Then, if x be the true resistance of the electrolyte,

$$x = \frac{r_3}{r_2} r_1$$

THE RATTLESNAKE'S RATTLE.

MR. S. GARMAN of the Museum of Comparative Zoölogy, Cambridge, Mass., has been investigating the rattle of the rattlesnake. The habit of sloughing is common to all serpents. A short time before the removal of the old skin takes place, the new epiderm makes its appearance beneath the old. The mode of growth of the new and the removal of the old is the same in all snakes, with the exception that in those with a rattle that portion of the slough that covers the tip of the tail is retained to form one of the rings of the rattle. The attachment is simply mechanical: the rings are merely the sloughs off the end of the tail. The terminal bone of the tail is formed of vertebræ that have coalesced, and changed in great measure their shape. In the different species the number of vertebræ included in this bone varies considerably, and sometimes it varies in individuals of the same species. With the purpose of indicating the manner of growth of the rattle, and as far as possible determining its origin, Mr. Garman has followed up its appearance in several species, full details of which, with figures, have been lately published. In the very young rattlesnake, while the vertebræ are still separate, there is no rattle; but about a week after birth a well-marked button is seen. With the first slough the first ring is set free, the button being pushed forward, and a third button is gradually perfected. In time the traces of the vertebræ in the terminal bone are almost obliterated. The bone becomes thickened, pushed forward at its edges, and otherwise enlarged. In a full-grown rattlesnake the hinder seven of the rings belong to the period of the snake's most rapid growth,—they form the "tapering rattle" formerly used in classification of the species,—while four of the rings and the button are formed while the gain in size was less rapid, and form the "parallelogrammic rattle" of the old classifiers. Many serpents besides those possessed of a "crepitaculum" are addicted to making a rattling noise by vibrations of the end of their tails. In illustration of the extent to which the tail has been modified in different cases, Mr. Garman figures the tails of several species, among others that of *Ancistrodon contortrix*, Lin., the copperhead of the United States. The tip of its tail is directed downwards as well as a little backwards. Most often the button has one or two swellings in a degree resembling those on a ring of the rattle. A living specimen of this snake, kept for a year or more, would take to rattling on the floor whenever it was irritated. The sound was made by the terminal inch of the tail, this part being swung from side to side in the segment of a circle, so that the tip might strike downward. The result was a tolerable imitation of the sound made by a small rattlesnake.