ART. XX.—*Brief Contributions from the Physical Laboratory of Harvard College.* No. XI.—*Increase of Magnetism in a bar of soft iron upon the reversal of the magnetizing current; by WILLIAM A. BURNHAM.*

IN testing the intensity of the magnetism induced in a bar of soft iron which forms the armature common to two electromagnets, according to the method described by Mr. Sears in the July number of this Journal for the present year, the galvanometer indicates an increase in intensity of the magnetic state of the bar on the first passage of the current through the magnetizing helices, after a reversal of the poles of the battery. This increase disappears upon subsequent magnetizations of the bar. Various observations were taken by placing the induction coil C (see paper by Mr. Sears in the July number of this Journal) at different distances on the bar which was magnetized. A bar of soft iron was experimented with in the first instance, the coil C being at a distance of five centimeters from the middle or zero point. A Thomson's reflecting galvanometer was used and the readings were taken when the circuit was made and also when it was broken. The following table shows the results with C at various distances upon the bar.

TABLE I.

Distances of C from the middle of the bar in centimeters.	5		6		7		8		9		10	
Constant deflections on making and breaking circuit.	+	—	+	—	+	—	+	—	+	—	+	—
	40	40	50	50	60	60	70	70	80	80	90	90
Deflection on the first passage of the current after changing the poles.	—	+	—	+	—	+	—	+	—	+	—	+
	90	50	110	60	130	70	150	80	170	90	190	100
Return to constant deflections on second and succeeding passages of the current.	—	+	—	+	—	+	—	+	—	+	—	+
	40	40	50	50	60	60	70	70	80	80	90	90

It will be seen by this table, that when the coil C stands at a distance of five centimeters from the zero point on the armature upon making the circuit, the galvanometer needle swings

to the left 40° , and upon breaking the circuit it is deflected 40° to the right. The signs in our table denote this change of direction. When the poles are reversed and the circuit made, it swings 90° to the right, and when broken 50° to the left, returning to the constant deflection of 40° upon the second and each succeeding passage of the magnetizing current while the poles remain the same. In the same manner, when the coil stands at 6, 7, 8, etc., the first swings of the galvanometer needle are respectively 50 to 50, 60 to 60, etc., increasing in regular proportion upon each reversal of the poles and returning upon each second and succeeding passages of the current to constant deflections. The following are the results when a bar of steel was substituted for the soft iron.

TABLE II.

Distances of C from the middle of the bar in centimeters.	5		6		7		8		9		10	
Constant deflections on making and breaking circuit.	+	-	+	-	+	-	+	-	+	-	+	-
	20	20	30	30	40	40	50	50	60	60	70	70
Deflections on the first passage of the current after changing the poles.	-	+	-	+	-	+	-	+	-	+	-	+
	40	25	50	35	60	45	70	55	80	65	90	75
Return to constant deflections on second and succeeding passages of the current.	-	+	-	+	-	+	-	+	-	+	-	+
	20	20	30	30	40	40	50	50	60	60	70	70

In the case of steel, when the coil C stands at a distance of five centimeters from zero, the galvanometer needle swings from $+20^\circ$ to -20° . Upon reversing the poles it is deflected $+40^\circ$ and -25° , and returns to 20° upon the second passage of the magnetizing current. By comparing Tables I. and II. it will be seen that the increase of magnetization after a reversal of the poles is not so great in iron as in steel, owing doubtless to permanent magnetism in the steel.