

IV. "On Electrotorsion." By GEORGE GORE, F.R.S. Received November 26, 1873.

(Abstract.)

This communication contains an account of a new phenomenon (of rods and wires of iron becoming twisted while under the influence of electric currents), and a full description of the conditions under which it occurs, the necessary apparatus, and the methods of using it.

The phenomenon of torsion thus produced is not a microscopic one, but may be made to exceed in some cases a twist of a quarter of a circle, the end of a suitable index moving through a space of 80 centimetres (=31 inches). It is always attended by emission of sound.

The torsions are produced by the combined influence of helical and axial electric currents, one current passing through a long copper-wire coil surrounding the bar or wire, and the other, in an axial direction, through the iron itself. The cause of them is the combined influence of magnetism in the ordinary longitudinal direction induced in the bar by the coil-current, and transverse magnetism induced in it by the axial one.

The torsions are remarkably symmetrical, and are as definitely related in direction to electric currents as magnetism itself. The chief law of them is—*A current flowing from a north to a south pole produces left-handed torsion, and a reverse one right-handed torsion* (i. e. in the direction of an ordinary screw). Although each current alone will produce its own magnetic effect, sound, and internal molecular movement, neither alone will twist the bar, unless the bar has been previously magnetized by the other. Successive coil-currents alone in opposite directions will not produce torsion, neither will successive and opposite axial ones.

The torsions are influenced by previous mechanical twist in the iron, by mechanical tension, and by terrestrial magnetic induction. The direction of them depends both upon that of the axial and of the coil-currents, but appears to be determined most by the former. A few cases occur in which the currents, instead of developing torsion, produce detorsion; but only two instances, out of many hundreds, have been met with in which torsion was produced in a direction opposite to that required by the law.

Single torsions vary in magnitude from 0.5 millim. to nearly 30 millims. of movement of the end of an index 47 centimetres long; the smaller ones occur when the two currents are transmitted alternately, and the large ones when they are passed simultaneously; the former generally leave the bar in a twisted state, the latter do not. Those produced by axial currents succeeding coil ones are nearly always much larger than those yielded by coil-currents succeeding axial ones, because the residual magnetism left by the coil-current is the strongest. The order of succession of the currents affects the torsions in all cases, altering their magnitudes, and in some few instances even their directions. In steel

all the torsional effects are modified by the mechanical and magnetic properties of that substance.

Each current leaves a residuary magnetic effect in the bar, amounting in iron to about one tenth of its original influence. The residuary magnetism of coil-currents is affected and sometimes reversed by axial ones; and that of axial currents is also removed by coil ones, and by a red heat. The condition left by an axial current is smaller in degree and less stable, in a vertical iron wire or one in the terrestrial magnetic meridian, than that left by a coil one, partly because of the influence of terrestrial magnetism; but in a position at right angles to that the effect is different.

The torsion produced by a coil-current may be used as a test, and partly as a measure, of the residuary effect of an axial one; and that produced by an axial current may be employed to detect, and to some extent measure, ordinary magnetism in the bar. As an opposite coil-current at once reverses the ordinary longitudinal magnetism of a bar of iron, so also an opposite axial one at once reverses its transverse magnetism.

Many instances have been met with in which the transverse and longitudinal magnetic states produced by the two currents coexisted in the same substance. The torsional influence of the excited helix is distributed equally throughout its length; so also is that of the current in the bar. All the torsions are closely related to the well-known electric sounds, and to particular positions and internal movements of the particles of the iron.

Signs of electrotorsion were obtained with a bar of nickel, but not with wires of platinum, silver, copper, lead, tin, cadmium, zinc, magnesium, aluminium, brass, or German-silver, nor with a thick rod of zinc, or a cord of gutta percha.

January 15, 1874.

JOSEPH DALTON HOOKER, C.B., President, in the Chair.

The following Paper was read:—

- I. "Preliminary Account of an Investigation on the Transmission of Sound by the Atmosphere." By JOHN TYNDALL, D.C.L., LL.D., F.R.S. Received January 1st, 1874.

This notice embraces the scientific results of an inquiry on Fog-signals, undertaken at the instance of the Elder Brethren of the Trinity House, and communicated with their friendly concurrence to the Royal Society.

The investigation was begun on the 19th of May, 1873, and continued till the 4th of July. It was resumed on the 8th of October, and con-