



The action of magnetism in motion on static electricity; inertia of static electricity

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to have written unless he had some discovery of his own to announce. Such announcements were made in language, if not always the most polished, yet certainly, to scientific minds, the most pleasing, because the most simple. On looking through his papers here collected, it seems that almost all his discoveries were crucial.

He was essentially witty, if by wit is meant nimbleness in correlating divers impressions. By viewing an idea from various sides and combining those views, he produced a discovery, a solid fact.

He never wrote for the sake of writing; nor did he regard physics as the application of mathematics to hypothetical matter. His mind was in unison with Nature. He seemed to feel that theorization should be the servant, not the master, of investigation; and hence his superiority in usefulness over most of his contemporaries.

The publication of this collection of memoirs by the Physical Society, in addition to its own 'Proceedings,' shows, as did the publication of Prof. Everett's C.G.S. system of physical data, that the energies of the Society are well directed. It is to be hoped that the scattered memoirs of many another physicist may be collected and published by the same means.

XXX. *Intelligence and Miscellaneous Articles.*

THE ACTION OF MAGNETISM IN MOTION ON STATIC ELECTRICITY;
INERTIA OF STATIC ELECTRICITY. BY G. LIPPMANN.

IT is known that previously to Ersted's experiment it was in vain attempted to connect magnetism with static electricity. Now-a-days we can be certain that such a relation really exists, and we can formulate the law of it even before making the experiment. A magnet in motion exerts at a distance a mechanical action upon a body at rest charged with free electricity. This action strictly results from the existence of the inverse phenomenon, which has been established by the experiments of Mr. Rowland*.

It will be remembered that Rowland showed experimentally that the motion of an electrized body acts on the magnetized needle as a current would: the direction of the action changes with the sign of the electric charge; and the action due to a given displacement of electricity is the same as if that displacement had taken place under the form of a current properly so called. Such are the results obtained by Mr. Rowland. On this ground I say that Mr. Rowland's phenomenon is necessarily reversible, and that its reversibility is a consequence of the impossibility of perpetual motion.

In fact, if we displace an electrized body so that each point in it describes a closed trajectory n times, resuming every time the same velocity at the same point, a magnetized needle near it is submitted during the movement to periodically variable forces, in virtue of Rowland's effect; this needle can therefore move under the action of those forces, and furnish a quantity of work which differs from

* Helmholtz, *Berl. Bericht*. 1876 (*Journal de Phys.* t. vi. p. 29); *Phil. Mag.* [5] vol. ii. p. 233.

zero, although it takes up again at each period its initial position. The work is not *nil*, because the forces producing it depend at each instant on the velocity of the electrized body, and not merely on its position. Therefore the magnetized needle furnishes a finite quantity of work, which becomes infinite with the number of the periods. Besides as the system travels along a closed cycle, this work is derived entirely from the forces which maintain the motion of the electrized body. That body is therefore itself submitted to resistant forces, which depend on the velocity of the magnetized needle. It is the existence of these last forces that we wish to demonstrate. If Rowland's effect is the analogue and as it were the complement of the phenomenon discovered by Ørsted, the inverse phenomenon here signalized corresponds in the same manner to induction. It is even found that moving a magnetic field produces, upon a small body charged with a unit of electricity, a mechanical force equal in amount and direction to the electromotive force at the same place; only we have here not an electromotive force without action on the masses, but a force properly so called.

From the preceding a curious consequence may be deduced; it is, that static electricity possesses a proper mechanical inertia, which is simply added to that of the electrized body. If, indeed, an electrized body is in motion in a space where there is no magnet, this motion gives rise to a magnetic field, since a magnetic needle in its vicinity would be deflected. The intensity of the magnetic field is proportional to the velocity; and consequently the variation of that intensity is proportional to the acceleration of the body. Now, from what we have seen above, the variation of a magnetic field produces upon an electrized point a mechanical force equal to the electromotive force of induction, consequently proportional to the velocity of the magnetic variation, and therefore to the acceleration of the body, and with the same direction as the acceleration. But a mechanical force directed thus, and proportional to the acceleration, constitutes what is called a *force of inertia*.

The ratio of the force to the acceleration is a constant quantity for the same electric charge, but not simply proportional to the quantity of electricity.—*Comptes Rendus de l'Académie des Sciences*, July 21, 1879, t. lxxxix. pp. 151–153.

ON THE SENSIBILITY OF THE ORGAN OF HEARING.

BY W. KOHLRAUSCH.

With the aid of a toothed wheel working against a disk of metal or pasteboard, Savart* found that two impulses can make upon the ear the impression of a comparable tone; M. E. Exner† finds by means of tuning-forks vibrating before spherical resonators that 17 impulses, M. Pfaunder‡ again, by experiments on holed sirens and reflection-tones, that only two impulses are required; lastly, M. Auerbach§, nearly in accordance with M. Exner, that about 20 vibra-

* *Ann. de Chim. et Phys.* xliv. p. 348 (1830).

† Pflüger's *Archiv*, xiii. p. 228 (1876).

‡ *Wien. Ber.* lxxvi. p. 572 (1877); cf. A. Seebeck, *Pogg. Ann.* liii. p. 417 (1841).

§ *Wied. Ann.* vi. p. 591 (1879).