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1 Despite the ubiquity of the inverse square law of static electrical attraction discovered by Charles Augustin Coulomb (1736-1806), -which he expresses for a fixed quantity of charge in his First Memoir of 1788 (Coulomb 2023, 208) as :

> « The repulsive force of two small globes electrified with the same kind of electricity, is inversely proportional to the square of the distance between the centers of the two globes ».

2 And more completely, by including the amount of charge, in his Second Memoir of 1788 (Coulomb 2023, 257) :

> « The electric action, whether repulsive or attractive, of two electrified spheres, and therefore of two electrified molecules, is in the ratio compounded of the

> densities of the electric fluid of the two electrified molecules and inversely as the square of the distances »

3 - a complete translation of all seven of his *Memoirs* on torsion, electricity, and magnetism has only recently been accomplished, by Ampère and Weber electrodynamics expert André K. T. Assis and the engineering and technology studies professor Louis L. Bucciarelli.

4 Not only do they translate all the *Memoirs* ; but they also include translations of Alfred Potier's introduction to his reprint of Coulomb's works in 1844, Coulomb's researches on the force of torsion (of filaments that included harpsichord strings ! Cf. Goodway and Savage 1992), and Coulomb's "Investigations of the Best Method of Making Magnetized Needles"[1], which won an award from the French Academy of Sciences in 1777 (Coulomb 2023, 55 n. 125 ; Wipf 2011, 75–77).

5 Although Coulomb is best known today for his electrical law, he formulated an analogous formula for magnetic attraction (Wipf 2011, 76) in the conclusion of his Second Memoir (Coulomb 2023, 257) :

> « The attractive and repulsive force of the magnetic fluid, as of the electric fluid, is exactly in the ratio directly of the densities [of the fluid] and inversely of the square of the distances between the magnetic molecules ».

6 Coulomb, in his Seventh Memoir, changed the conception of magnetism away from that of Æpinus. Poisson described Coulomb's innovation in 1824 (Duhem 2015, 314 :14) :

> « Before the works of Coulomb, one assumed the two transported fluids, in the process of magnetization, traveled to both ends of compass needles and accumulated at their poles ; while, following this illustrious physicist, boreal and austral fluid only experience infinitely small displacements and do not escape from the molecule of the magnetized body to which they belong ».

7 Assis has written an excellent « Background to Coulomb's Researches » introduction, and Assis and Bucciarelli have commentated on each of the Memoirs in their own "Remarks" sections. In one interesting « Remarks » section (Coulomb 2023, chap. 13), Assis mentions Heering's conclusion (Coulomb 2023, 222) :

> « that Coulomb did not get the data he published in his memoir by measurement. [...] From our work in replicating Coulomb's experiment it seems quite plausible that Coulomb did not find the inverse square law by the doubtful measurements from his torsion balance experiments but by theoretical considerations ».

8 Ampère stated results before actually performing some of his experiments, too (Ampère 2015, 188). Assis believed Heering's thesis, but changed his mind :

> « I have now totally changed my mind after studying Coulomb's original papers. » (Coulomb 2023, 222).

9 Torsion balances have played an important role in electrical researches all the way up to and including « Weber and Kohlrausch's famous experiment to find the value of the constant *c* appearing in Weber's electrodynamics » (Coulomb 2023, 226), recently translated into English (Kohlrausch and Weber 2021).

10 My first exposure to torsion balances was as an undergraduate physics student, when I took a course on experimental physics. I measured the universal gravitational constant (Aversa 2008) by measuring the oscillation period of a torsion balance and calculating *G* using a formula similar to Assis's equation 16.4 (Coulomb 2023, 268). Our class textbook did not mention torsion balances, so Assis & Bucciarelli's translation would be a good

supplement for experimental physics classes ; Assis mentions low-cost torsion balances to reproduce Coulomb's experiments (Coulomb 2023, 220).

11 Why has there not yet been a complete English translation of Coulomb's *Memoirs*, considering it has been over two centuries since his death ? It might be that Faraday's and Maxwell's field approach -which Ampère, whom Maxwell called the « Newton of electricity » and whose force law Maxwell said « must always remain the cardinal formula of electro-dynamics » (Maxwell 1873, 2:162), would have opposed (Ampère 2015, 234–35)- eclipsed the instantaneous action-at-a-distance approach that Newton pioneered with his universal law of gravitation (Fricke 1979).

12 Assis considers fields as among the « several theoretic concepts of modern physics [that] have the same role as the epicycles in the old ptolemaic theory » (Assis 2014, 310) - viz., the field concept is « scaffolding » that is no longer needed for the development of the physical theory (cf. Duhem 1991, 103).

13 Assis hopes his translation will lead researchers back to the experimental foundations of electricity and magnetism and, as Duhem put it, « restore the continuity of the tradition » « of the doctrines of Poisson, Ampère, Weber » leading « logically from the principles laid down at the beginning of the XIXth century to the most attractive consequences of Maxwell's theories, from Coulomb's laws to the electromagnetic theory of light » (Duhem 2015, 314:173).

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NOTES

1. "La meilleure manière de fabriquer les aiguilles aimantées".

INDEX

Mots-clés: histoire des techniques, histoire des sciences, électricité, magnétisme, physique, expérimentation
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