

The *Weber* as an Electrical Unit of Measure

A. K. T. Assis

Posted in October 2024 at www.ifi.unicamp.br/~assis

Contents

1 The <i>Weber</i> as an Electrical Unit of Measure	5
Bibliography	7

Chapter 1

The *Weber* as an Electrical Unit of Measure

A. K. T. Assis¹

The first International Electrical Congress was held in Paris in 1881. It established international electrical units of measure. It endorsed the 1873 proposal of the British Association for the Advancement of Science for defining the *Ohm* and the *Volt* as practical units and also defined the *Ampère*, *Coulomb* and *Farad* as units for electrical current, quantity of charge and capacitance, respectively. It was a tribute to the works of Georg Simon Ohm (1789-1854), Alessandro Volta (1745-1827), André-Marie Ampère (1775-1826), Charles Augustin de Coulomb (1736-1806) and Michael Faraday (1791-1867). The Chairman of the congress was Adolphe Cochery (1819-1900), Minister of Posts and Telegraphs of the French Government. The foreign vice-presidents were William Thomson (1824-1907), also known as Lord Kelvin, Hermann von Helmholtz (1821-1894) and Gilbert Govi (Italy).

It was a surprise that the names of Carl Friedrich Gauss (1777-1855) and Wilhelm Weber (1804-1891) were not included in this list of electrical units. After all, they were the creators of the absolute system of units. In this system, the electric and magnetic units could be defined solely in relation to absolute units of length, mass, and time. Their original proposal was based on a millimeter-milligram-second system of units. The CGS system of units is based on the same idea, although it utilized a centimeter-gram-second system of units.²

At that time the term *Weber* enjoyed some use, especially in England and Germany, for the unit of electric current.³

Two of Weber's main opponents were Helmholtz and William Thomson,⁴ The decision to replace the term *Weber* by *Ampère* as an unit ele electric current was taken by Helmholtz and Thomsobn in this congress of 1881. This fact has been registered by Éleuthère Mascart (1837-1908), the secretary of the section of the congress dealing with electrical units. He recounted how agreement was finally reached on international electrical units.⁵

¹Homepage: www.ifi.unicamp.br/~assis

²[Ass21b].

³[Con82, pp. 44-45], [Wie60, Chapter 2, Section 7: Die praktischen absoluten elektrischen Einheiten und ihre Namengebung, pp. 102-107], [Wie67, Die internationalen elektrischen Einheiten und ihre Namensgebung, pp. 135-137], [Woo68, footnote 20, p. 305] and [Woo81, p. 205].

⁴See [Ass21a].

⁵See: [Lan09], [Jan09], [Woo68, footnote 20, p. 305], [Fri82, p. 209], [Tun92, p. 35], [Bor08], [Bor09] with

As we still only had two units, the *Ohm* and the *Volt*, and it was necessary to complete the system, I asked the president, M. Cochery, if the commissions could at least meet.

I had to bow to his negative response, and we stayed, with von Helmholtz, near Lord and Lady Kelvin who, having neglected to eat lunch, were having a chocolate in the Chiboust restaurant, located near the Congress hall. It was in this small committee, around a common white marble table, that the following three units were agreed: *Ampère* (instead of *Weber*), *Coulomb*, and *Farad*.

I was responsible for reading the text the following day, September 21, in the general session. Many members of the commission, who only knew about the Saturday session, were a little surprised, but the comments of Lord Kelvin and von Helmholtz no longer allowed any hesitation. The practical system of units was thus born.

It was only in the 1930s that the terms *Gauss* and *Weber* were officially introduced for the practical unit of magnetic flux by the International Electrotechnical Commission (IEC). On the one hand, this was a late tribute to Carl Friedrich Gauss and Wilhelm Weber. On the other hand, it must be pointed out that Gauss and Weber never worked with the magnetic field concept, nor with the magnetic flux concept.

English translation in [Bor12] and [Bor13]:

Comme nous n'avions encore que deux unités, l'ohm et le volt, et qu'il était nécessaire de compléter le système, je demandai au président, M. Cochery, si les commissions au moins pouvaient se réunir.

Je dus m'incliner devant sa réponse négative, et nous restâmes, avec von Helmholtz, auprès de Lord et Lady Kelvin qui, ayant négligé de déjeuner, prenaient un chocolat dans le restaurant Chiboust, installé près de la salle du Congrès. C'est dans ce petit comité, autour d'une vulgaire table en marbre blanc, que furent convenues les trois unités suivantes: Ampère (au lieu de Weber), Coulomb et Farad.

J'étais chargé d'en lire le texte le lendemain 21 septembre en séance générale. Nombre de membres de la commission, qui ne connaissaient que la séance du samedi, en furent bien un peu surpris, mais les commentaires de Lord Kelvin et de von Helmholtz ne permirent plus aucune hésitation. Le système pratique d'unités était fondé.

Bibliography

- [Ass21a] A. K. T. Assis. Editor’s Introduction to Weber’s Sixth Memoir on Electrodynamic Measurements. In A. K. T. Assis, editor, *Wilhelm Weber’s Main Works on Electrodynamics Translated into English*, volume IV: Conservation of Energy, Weber’s Planetary Model of the Atom and the Unification of Electromagnetism and Gravitation, pages 59–65, Montreal, 2021. Apeiron. Available at www.ifi.unicamp.br/~assis.
- [Ass21b] A. K. T. Assis. Gauss and Weber’s absolute system of units and its difference to the modern “Gaussian” system of units. In A. K. T. Assis, editor, *Wilhelm Weber’s Main Works on Electrodynamics Translated into English*, volume I: Gauss and Weber’s Absolute System of Units, pages 207–212, Montreal, 2021. Apeiron. Available at www.ifi.unicamp.br/~assis.
- [Bor08] G. Borvon. Dans les coulisses du congrès international des électriciens de 1881. Available at <http://www.ampere.cnrs.fr/parcourspedagogique>, 2008.
- [Bor09] G. Borvon. Histoire de l’électricité: l’histoire des unités électriques. Available at <http://seaus.free.fr/spip.php?article324>, 2009.
- [Bor12] G. Borvon. History of the electrical units. Available at <http://seaus.free.fr/spip.php?article964>, 2012.
- [Bor13] G. Borvon. Histoire des unités électriques. Le premier congrès international des électriciens à Paris en 1881. Available at <http://histoires-de-sciences.over-blog.fr/2013/11/histoire-des-unit%C3%A9s-%C3%A9lectriques.html>, 2013.
- [Con82] Congrès International des Électriciens, 1882. G. Masson. Paris.
- [Fri82] H. Fricke. *Two rival programmes in 19th. century classical electrodynamics: action-at-a-distance versus field theories*. PhD thesis, The London School of Economics and Political Science, London, 1982. Available at <http://etheses.lse.ac.uk/3430/>.
- [Jan09] P. Janet. La vie et les oeuvres d’Eleuthère Mascart. *Revue Générale des Sciences Pures et Appliquées*, 20:574–593, 1909.
- [Lan09] P. Langevin. L’Oeuvre de E. Mascart. *La Revue du Mois*, pages 385–406, 1909. Available at <https://www.anales.org/archives/x/mascart.html>.
- [Tun92] P. Tunbridge. *Lord Kelvin: His Influence on Electrical Measurements and Units*. Peter Peregrinus Ltd., London, 1992. IEE History of Technology Series 18.

- [Wie60] K. H. Wiederkehr. Wilhelm Webers Stellung in der Entwicklung der Elektrizitätslehre. Dissertation, Universität Hamburg, 1960.
- [Wie67] K. H. Wiederkehr. *Wilhelm Eduard Weber — Erforscher der Wellenbewegung und der Elektrizität (1804-1891)*, volume 32 of *Grosse Naturforscher*, H. Degen (ed.). Wissenschaftliche Verlagsgesellschaft, Stuttgart, 1967.
- [Woo68] A. E. Woodruff. The contributions of Hermann von Helmholtz to electrodynamics. *Isis*, 59:300–311, 1968.
- [Woo81] A. E. Woodruff. Weber, Wilhelm Eduard. In C. C. Gillispie, editor, *Dictionary of Scientific Biography*, Vol. 14, pages 203–209, New York, 1981. Charles Scribner's Sons.