Composition of Galvanic Piles

Friedrich Wöhler and Wilhelm Weber

Abstract

English translation of Friedrich Wöhler and Wilhelm Weber's 1841 paper "Zusammensetzung galvanischer Säulen", [WW41c].

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[By F. Wöhler and W. Weber][1,2,3]

Professors Wöhler[4] and Weber informed the *Königl. Gesellschaft der Wissenschaften* (*Royal Society of Sciences*), together with some remarks, about a discovery made by Professor Poggendorff[5] on the composition of galvanic piles and submitted them to the *Königl. Akademie der Wissenschaften zu Berlin* (*Royal Academy of Sciences of Berlin*) on April 29th of this year.[6]

It is known that in order to produce the greatest galvanic effects, it is no longer necessary to use giant devices that are as uncomfortable as they used to be, but that in recent times one has learned to achieve the same effects with small and convenient devices. The best performance is shown by a pile, described by Mr. Grove,[7] where small clay cells, the walls of which are permeated with liquid, are filled with ordinary nitric acid and externally surrounded with dilute sulphuric acid. In the former liquid platinum plates are immersed, amalgamated zinc plates are immersed in the latter, and the necessary connections are made with strong copper wires (see Poggendorff's *Annalen* 1839, Vol. 48, p. 300; 1840, Vol. 49, p. 511).[8] The cost of the platinum plates has hitherto limited the use of these otherwise powerful and comfortable piles; therefore it will be pleasant for those who, for this reason, could not obtain these plates, that Professor Poggendorff has used iron plates instead of platinum plates with almost the same success.

> "Now I am concerned," writes Professor Poggendorff on May 1 of this year, "the cells with two liquids that seem to deserve the most attention and are still not much examined. I have made about 50 such cells and found that almost all of them have the invaluable advantage of giving a constant current, so you can make accurate measurements... I want to tell you only one thing of practical use, namely that in the Grove-cell you can replace the expensive platinum with iron, steel or cast iron as long as you

[1] [WW41c], see also [WW41a] and [WW41b].

[2] Translated by H. Härtel, haertel@astrophysik.uni-kiel.de and http://www.astrophysik.uni-kiel.de/~hhaertel/index_e.htm. Edited by A. K. T. Assis, www.ifi.unicamp.br/~assis. We thank R. W. Gray and S. Kühn for relevant suggestions.

[3] The Notes by A. K. T. Assis are represented by [Note by AKTA:].

[4] [Note by AKTA:] Friedrich Wöhler (1800-1882).

[5] [Note by AKTA:] Johann Christian Poggendorff (1796-1877) edited the *Annalen der Physik und Chemie* from 1824 to 1876, where many of Weber's papers were published. The modern *Annalen der Physik* is the successor to this Journal.

[6] [Note by AKTA:] See also [Pog40].

[7] [Note by AKTA:] The Grove voltaic cell, element, battery or pile was named after its inventor, William Robert Grove (1811-1896).

[8] [Note by AKTA:] [Gro39] and [Sch40].

take *concentrated fuming acid* (*acidum nitricum fumans*) instead of the usual nitric acid. You can even dilute this fuming acid with $1\frac{1}{4}$ part of ordinary nitric acid, or to the extent that the iron is not yet attacked. The latter is necessary; if you take the acid too weak, the iron will be violently attacked. In the acid of the specified concentration, the iron remains as bright as the platinum. Here are the elements of the aforementioned cells for smoking concentrated nitric acid and sulphuric acid with 4 parts of water. The zinc was amalgamated."

	Electromotive force	Resistance
zinc and platinum	100.00	13.120
zinc and iron	78.62	11.275
zinc and steel	86.99	12.927
zinc and cast iron	89.63	12.913

"From the resistance come here 4.36 (inch nickel silver wire with 1/6 line diameter) on the closing wire."[9]

"So you see, with the *same* plate size you can get 9/10 of the effect of the Grove-cell with iron. The missing tenth can easily be replaced by enlarging the plates. Incidentally, the *current* is just as *constant* as with the Grove-cell."

In response to the above notification, Messrs. Wöhler and Weber immediately made several attempts to confirm the given information, which at the same time yielded the curious result that a very strong current is produced if you immerse only iron in *both* liquids and also interchange the amalgamated zinc plate dipped in dilute sulphuric acid with an iron plate. This latter plate, because it cannot be amalgamated, was attacked by the sulphuric acid under a weak development of hydrogen gas. This, however, did not impair the effect; rather, it turned out that the effect of this cell was just as constant as Grove's cell. This cell, composed *just of iron* and two liquids, that gives such powerful effects, is of interest for the theory of the pile in general and for the study of the galvanic properties of iron in particular. Cells have already many times been put together in which two identical metals are combined with two different liquids, for instance by Becquerel and De la Rive, of which Fechner gives a list in the *Repertorium der Experimentalphysik* (*Repertory of Experimental Physics*), p. 454 and following;[10] but it seems that only the

[9] [Note by AKTA:] Original sentence: Vom Widerstand kommen hier 4,36 (Zoll Neusilberdraht von 1/6 Linie Durchmesser) auf den Schliessungsdraht.

[10] [Note by AKTA:] [Bec29, pp. 14-18], [dlR29, p. 102] and [Fec32, pp. 454-455].

existence and direction of the current attracted interest, but the further use and investigation were prevented by the weakness and inconsistency of the effect. Such a strong and constant effect as the one described [here], is new. It makes these types of cells really useful, capable of close examination, and deserve special attention. Two pairs, where each plate was only about 3 square inches in surface area, caused thin platinum wires to glow and were sufficient to vigorously decompose water. Certainly, this subject deserves to be pursued further, unless Professor Poggendorff has perhaps already extended his much more extensive investigation to this topic.

The weak development of hydrogen gas at the iron plates immersed in the dilute sulphuric acid can be easily avoided by using a *tinned iron sheet*, which in this regard does the same service as amalgamated zinc; it even seems to be preferable to the latter because it is thin and durable, while the zinc becomes brittle due to mercury and easily loses part of its amalgam, which, as a gray powder, covers the surface of the plate or settles in the acid, thus weakening the effect of the pile.

References

[Bec29] Becquerel. Mémoire sur l'électro-chimie et l'emploi de l'électricité pour opérer des combinaisons. *Annales de Chimie et de Physique*, 41:5–45, 1829.

[dlR29] A. de la Rive. Untersuchungen über die Ursachen der sogenannten Contactelektricität. *Annalen der Physik und Chemie*, 15:98–121, 1829.

[Fec32] G. T. Fechner. *Repertorium der Experimentalphysik: enthaltend eine vollständige Zusammenstellung der neuern Fortschritte dieser Wissenschaft; Als Supplement zu neuern Lehr- und Wörterbüchern der Physik*, volume 1. Leopold Voss, Leipzig, 1832.

[Gro39] W. R. Grove. Volta'sche Säule von großser elektro-chemischer Kraft. *Annalen der Physik und Chemie*, 48:300–304, 1839.

[Pog40] J. C. Poggendorff. Ueber die galvanischen Ketten aus zwei Flüssigkeiten und zwei einander nicht berührenden Metallen. *Annalen der Physik und Chemie*, 49:31–72, 1840.

[Sch40] C. F. Schönbein. Notizen über eine Volta'sche Säule von ungewöhnlicher Kraft. *Annalen der Physik und Chemie*, 49:511–514, 1840.

[WW41a] F. Wöhler and W. Weber. Neue galvanische Säule. *Journal für praktische Chemie*, 23:313–316, 1841.

[WW41b] F. Wöhler and W. Weber. Ueber eine neue Construction der Grove'schen Säulen. *Annalen der Chemie und Pharmacie*, 38:307–311, 1841. Reprinted in *Polytechnisches Journal*, Vol. 81, pp. 273-275 (1841).

[WW41c] F. Wöhler and W. Weber. Zusammensetzung galvanischer Säulen. *Göttingische gelehrte Anzeigen*, 1:801–805, 1841. 81. Stuck der *Göttingische gelehrte Anzeigen*, den 24. May 1841. Reprinted in Wilhelm Weber's *Werke*, Vol. 3, H. Weber (ed.), (Springer, Berlin, 1893), pp. 3-5.