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# THE INVENTION OF THE LEYDEN JAR

BY

C. DORSMAN AND C. A. CROMMELIN



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# THE INVENTION OF THE LEYDEN JAR

BY

C. DORSMAN (Eindhoven) and C. A. CROMMELIN (Leiden) \*)

See PLANCHE X

In many books concerning the history of physics one may read a more or less extensive story about the invention of the Leyden jar <sup>1)</sup>. This story runs as follows: the real inventor of the "so called" Leyden jar is Ewald Jürgen von KLEIST, dean of the Cathedral (in German *Domdekan*) at Kamnin in Pomerania (Germany), who made the experiment on the 11th of October 1745. A certain KRÜGER published it in 1746, but the experiment remained practically unknown outside Germany. Moreover the name of von KLEIST is entirely unknown in the history of physics, except for this experiment. The most circumstantial account about the person of von KLEIST and his work is given by FELDHAUS who in 1903 consecrated a booklet of 27 pages to this subject <sup>1)</sup>. The author calls von KLEIST the "Vater der sogenannten Telegraphie ohne Draht" (everybody knows, that the condenser is used in all wireless sets), he gives a genealogy and a biography of von KLEIST, describes his experiments extensively and mentions that, on the 10th of December 1898, on the occasion of the commemoration of the day of von KLEIST's death, 150 years earlier, a commemorative tablet was fixed into the wall of his house in Kamnin, with the following inscription:

"Zum Ehrengedächtnis des Domdekans, nachmaligen Königl. Hofgerichts-Präsidenten Ewald Jürgen von Kleist, geb. 10 Juni 1700, gest. 10 Decbr. 1748,

\*) Communication n° 97 from the National Museum of the History of Science, Leyden.

1) E. HOPPE, *Geschichte der Elektrizität*, Leipzig, 1884, p. 18 and 21.

E. HOPPE, *Geschichte der Physik*, Braunschweig, 1926, p. 353.

E. GERLAND, *Geschichte der Physik*, München and Berlin, 1913, p. 698.

F. M. FELDHAUS, *Die Erfindung der elektrischen Verstärkungsflasche durch Ewald Jürgen von Kleist*, Heidelberg, 1903.

C. A. CROMMELIN, *Descriptive Catalogue of the Physical Instruments in the National Museum of the History of Science at Leyden*, Leyden, 1951 (Comm. N° 81 from the above mentioned Museum), p. 17-20.

J. TORLAIS, *L'abbé Nolet*, Paris, 1954, p. 79-81.

welcher 25 Jahre hindurch in diesem Hause (ehemal. Dekanatskurie) gewohnt und im Oktober 1745 die elektrische Verstärkungsflasche (KLEISTSche Flasche) erfunden hat. Gestiftet Cammin, d. 10 Decbr. 1898 von den dankbaren Bürgern Cammins im Verein mit der Familie von Kleist."

As to the experiments of Petrus VAN MUSSCHENBROEK (1692-1761, professor at Leyden 1740-1761) of 1746, it seems to us best to quote in full what one of us (C.A.C.) has written about them in the catalogue of the physical instruments in the National Museum of the History of Science at Leyden (1951)<sup>1</sup>), because the readers of this paper will very probably not have this catalogue at hand.

"In Januari 1746, PETRUS, quite unaware of VON KLEIST's work, made the same experiment, but he has told us why he did it (which VON KLEIST had not done). A charged conductor surrounded by air loses its charge often very rapidly and PETRUS, attributing this rapid loss to a (supposed) conductivity of the air, had the idea to enclose the conductor in a nonconductive vessel, in order to avoid the escape of the charge. So he took a glass vessel with water, connected the water with one of the poles of an electrical machine by means of a metallic wire and in this way gave a charge to the water, which is a good conductor unless it should be absolutely pure.

The experiment failed, very naturally, and the water lost its charge as rapidly as before, but a couple of days afterwards, PETRUS' co-operator, the amateur ANDREAS CUNAEUS, (quite incidentally) took the glass with the charged water in his hand, giving in this way the glass its outer coating and making of it a real condenser, with a capacity much larger than that of a single conductor. With his other hand he now touched the wire, the condenser could discharge itself through CUNAEUS' body and the latter received a fearful shock.

PETRUS wrote immediately to his friend RÉAUMUR at Paris; ALLAMAND wrote to the abbé NOLLET, which was certainly by far the best way to make the "expérience de Leyde" universally known in the shortest time possible.

Afterwards NOLLET published<sup>2</sup>) parts of the Latin letter from PETRUS to RÉAUMUR, in a French translation: "Je veux vous communiquer une expérience nouvelle mais terrible, que je vois conseille

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2) *Histoire de l'Académie royale des sciences*, Année 1746. Avec les mémoires de Math. et de Phys. Tirées des Registres de cette Académie, Paris, 1751, p. 1 des Mémoires.



PETRUS VAN MUSSCHENBROEK  
1692—1761

*Oilpainting on wood (27 × 31½ cm) by J. M. Quinkhard, 1738. Nat. Museum.  
Hist. Science, Leiden*





de ne point tenter vous-même ... le bras et tout le corps sont affectés d'une manière terrible, que je ne puis exprimer: en un mot, je croyais que c'était fait de moi". ALLAMAND in his letter to NOLLET, speaks of "un coup prodigieux ... c'est un coup de foudre — j'en fus étourdi au point que j'en perdis pour quelques moments la respiration".

NOLLET adds in a note that "le véritable auteur de cette expérience est Mr. CUNAEUS" and speaks of "l'expérience de Leyde ... cette fameuse expérience qu'on admire depuis trois mois, que tout le monde s'empresse de voir et qui a achevé de rendre l'électricité si célèbre, qu'elle se donne enfin en spectacle au peuple". It is also NOLLET, who has given to the apparatus the name of "*bouteille de Leyde*".

PETRUS himself gives the first description of his experiment in his "Institutiones Physicae" of 1748<sup>3)</sup>, where he says about the shock: "excitabitur mox scintilla magna, lucis rubicundae, quae terribili agitatione manum, brachium, pectus, abdomen, crura totumque corpus hominis afficit"; in the "Introductio ad Phil. nat." <sup>4)</sup> of 1762 the author uses the same words and adds: "... et nonnumquam vulnerat, in febrem ardentem, haemorrhagiam, aliamve aegritudinem conjicit" <sup>5)</sup>.

In those years it was not yet possible to explain the experiment satisfactorily, nor to foresee the importance of the condenser in the further development of the science of electricity, but the phenomenon, especially the shock, was so striking, that the "expérience de Leyde" soon became famous all over Europe.

It is clear that, in the whole experiment, the shock was the main point. Before 1746 it was unknown that electricity was able to deal out blows and that with so simple an apparatus. PETRUS and ALLAMAND, having felt the shock themselves, can hardly find words strong enough to describe the horror of it.

It were RÉAUMUR and NOLLET who advertised it, not PETRUS himself who never made a great fuss about it. He describes the experiment

3) § 626, etc.

4) § 932.

5) The following somewhat free French translation of these Latin sentences is borrowed from SIGAUD DE LA FONDS' translation of the *Introductio* under the name of "*Cours de physique expérimentale et mathématique*" 1769. § 932: "cette étincelle qui sera d'une rouge couleur de feu, sera très violente: elle excitera une commotion très forte dans la main, dans le bras, dans la poitrine, en un mot, dans tout le corps de cette personne: elle est quelquefois si terrible, qu'elle peut blesser celui qui la tire; qu'elle peut même lui causer une fièvre ardente, une hémorrhagie ou quelqu'autre maladie"

rather shortly in his books, he does not claim any priority, he never speaks of the "*expérience de Leyde*", nor of the Leyden jar (Dutch: *Leidse fles*). Under this name the instrument is still universally known, not quite justly in respect to VON KLEIST".

About June 1954 one of us (C. DORSMAN) found in the Philosophical Transactions of the Royal Society (London) <sup>6)</sup> a letter "from Mr. TREMBLEY F.R.S. <sup>7)</sup> to MARTIN FOLKES Esq; Pres. R.S. Concerning the Light caused by Quicksilver, shaken in a Glass-Tube, proceeding from Electricity". This letter is dated: Hague, 4 Feb. 1745 N.S. (New Style), but was not read in a meeting of the R.S. before Feb. 13 1746 <sup>8)</sup>.

It begins with a description of the experiments of "Mr. L'ALLAMAND" <sup>9)</sup> concerning the phenomenon mentioned in the title, which has nothing to do with the Leyden jar. But at the end of the letter we read:

"There is an experiment that Mr L'ALLAMAND has tried; he electrify'd a tin Tube, by means of a glass Globe; he then took in his left Hand a Glass full of water, in which was dipped the End of a Wire; the other End of this Wire touched the electrified tin Tube: He then touch'd, with a Finger of his right Hand, the electrified Tube, and drew a Spark from it, when at the same Instant he felt a most violent Shock, all over his Body. The pain was not always equally sharp, but he says, that the first time he lost the Use of his Breath for some Moments; and he then felt so intense a Pain all along his right Arm, that he at first apprehended ill Consequences from it; tho' it soon after went off without Inconvenience.

It it to be remarked, that in this Experiment he stood simply on the Floor, and not upon the Cakes of Resin.

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6) Vol. 44 (1746) p. 58.

7) "Mr. TREMBLEY" is ABRAHAM TREMBLEY (1710-1784), a French Swiss, native of Geneva and in his time a well-known biologist. From 1739 until 1747 he was tutor of the children BENTINCK and lived with the family on Sorgvliet, a country-seat near the Hague, where out of the pond he fished fresh-water hydrae for his biological researches. In these years he made the acquaintance of the Leyden professors 's GRAVESANDE and PETRUS VAN MUSSCHENBROEK and of course of his compatriot ALLAMAND. There exists a biography of TREMBLEY by JOHN R. BAKER: ABRAHAM TREMBLEY of Geneva, Scientist and Philosopher 1710-1784, London, 1952.

8) C. DORSMAN, *Enige grepen uit de geschiedenis van de omroepontvanger*, Tijdschr. v. h. Ned Radiogenootschap Vol. 19 (1954), p. 179.

9) "Mr. L'ALLAMAND" is Jean Nicolas Sebastien ALLAMAND, native of Lausanne (1713-1787), first tutor of 's GRAVESANDE's children, then 1749-1787 professor at Leyden, biologist and physicist.

Mr. MUSSCHENBROEK<sup>10</sup>) the Professor has repeated this experiment, holding in his Hand a hollow Bowl exceeding thin, full of water; and he says he experienced a most terrible Pain. He says, the Glass must not be at all wet on the outside."

The main point in the letter of Mr. TREMBLEY is, that from it appears clearly, that as early as the very beginning of the year 1745 (that is nine months before VON KLEIST's experiment) the Leyden jar was invented at Leyden, by ALLAMAND or by MUSSCHENBROEK or by both of them, exactly a year earlier than the well-known experiments of CUNAEUS and MUSSCHENBROEK.

As to the part, that CUNAEUS played in 1746 and ALLAMAND in 1745 in the experiments described above, we must keep in mind that both of them were, from a physical point of view, rather insignificant men and that they acted as assistants of the eminent PETRUS VAN MUSSCHENBROEK, and doubtlessly in accordance with the latter's ideas. It has therefore to be considered as quite accidental, that in both cases, CUNAEUS and ALLAMAND have enjoyed the privilege of receiving the first shock, and "*der langen Rede kurzer Sinn*"<sup>11</sup>) is therefore that about the first of February 1745 PETRUS VON MUSSCHENBROEK *invented the instrument justly called the "Leyden jar", the first condenser*, and that the name of VON KLEIST may conveniently disappear from all accounts concerning the invention of the Leyden jar.

#### POSTSCRIPT

There is one point, to which we want to draw attention. In the Phil. Trans. one reads, that TREMBLEY's letter is dated 4 Febr. 1745 but that it is read (i.e. in the meeting of the Royal Society) as late as 13 Febr. 1746. Therefore the idea occurred to us, that 4 Febr. 1745 could possibly be a misprint for 4 Febr. 1746. We wrote to the R.S. about this point, asking whether the original of TREMBLEY's letter was still to be found in the Archives of the R.S. The answer dated 17 Nov. 1955 runs as follows:

"We have preserved in our archives the document from which TREMBLEY's letter to MARTIN FOLKES was printed in the Philosophical Transactions to which

10) "Mr. MUSSCHENBROECK" is the in his time celebrated Leyden professor who lived from 1692-1761 and was professor (at Leyden) from 1740 to 1761, as already mentioned above.

11) SCHILLER, *Die Piccolomini* I, 2.

you refer. It is dated "Hague 4 feb. 1745 N.S." The original [i.e. the copy for the printer] is not signed and we do not believe that it is in TREMBLEY's writing", etc.

It is quite clear from this letter that the original of TREMBLEY's letter does not exist any more: what is called "original" in the above letter, is not the original, as it is not in TREMBLEY's writing; it is dated but not signed.

Our reconstruction of what has happened is therefore as follows:

1°. "FOLKES receives a letter from TREMBLEY (dated 4 Febr. 1745), but, not being a scientist at all, he does not grasp the importance of it and thinks it not worth while to be read immediately in the meeting of the R.S. This letter is lost.

2°. The letter must now (Feb. 1746) be read and printed. It is copied (dated 4 Feb. 1745 N.S., but without signature). The date is taken from TREMBLEY's original, then of course still existing".

In our opinion the possibility of a misprint is out of the question. A delay of half a year, one year or even more between the date of a letter and the date of it in a meeting of the Royal Society was in those days quite common as may be seen in vol. 44 *Phil. Trans.*, and other volumes.

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