

## First Electrical Stimulations of the Ear with Voltaic Pile (Letter by Professor Volta to Professor Brugnatelli, "Above the Application of Electricity to Deaf-Mutes from Birth")

### ABSTRACT

In the late 18th century, several European scientists started describing the clinical effects of different types of electrical stimulation and tried to find new treatments for medical conditions, but only in the very early years of the 19th century, first attempts to cure deafness began. The letter written between 2 famous Italian scientists in the second half of 1802, by Professor A. Volta to Professor L.V. Brugnatelli, "Above the application of electricity to deaf-mutes from birth," is one of the most detailed examples of how the experiments were conducted applying the voltaic pile as a cure for deafness. In order to gain a better understanding of the context in which the scientists of the time experimented with "medical electricity" on the ear, some of the experiments conducted by European scientists will be described in this study, including those conducted by J.J.A. Sprenger, F.L. Augustin, C.H. Wolke, C.J.C. Grapengiesser, and E.A. Eschke.

**Keywords:** Alessandro Volta, deafness, ear electrical stimulation, hearing, Luigi Valentino Brugnatelli

### INTRODUCTION

In the second half of the 18th century, several Italian scientists (Luigi Galvani, Giovanni Aldini, Lazzaro Spallanzani, and Giuseppe Veratti) devoted themselves to the study of the biological effects of electric currents; the spread of machines producing electrostatic electricity and the increased interest in medical physiology developed a new field of study called "medical electricity" as the applications of the electric fluid to the human body as a medical remedy. Several European scientists started describing the clinical effects of different types of electrical stimulation against various pathologies, using capacitors and electric generators, such as the Leyden jar, or the voltaic pile.

**Alessandro Volta** (1745-1827), physician and professor of experimental physics at the University of Pavia, began his studies on how to generate electricity from a chemical reaction in 1792, after reading the work of Luigi Galvani on the existence of intrinsic electricity in living organisms. Count Volta invented the first electric battery at the end of 1799 and reported the results of his experiments to the Royal Society of London in 1800.<sup>1</sup>

The first electrical stimulation of the inner ear is to be attributed to the Bolognese physicist Giuseppe Veratti, who conducted some experiments on people with deafness. Veratti used the electric machine, invented together with his wife, Laura Bassi, capable of generating static electricity from some glass cylinders.<sup>2</sup>

The first use of the voltaic pile for stimulation of the inner ear was performed directly by Volta on himself; in the letter dated March 20, 1800, addressed to Sir Joseph Banks, president of the Royal Society of London, where Volta describes the use of a stack of 30-40 pairs of silver and zinc metal plates to stimulate the inside of one's ears with 2 metal probes.

*"I have introduced, long before in both ears, two kinds of probes or metal rods, with rounded tips; and I made them immediately communicate at both ends of the apparatus.*

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*At the moment the circle was thus completed, I received a jolt in the head; and, a few moments later, (communications continuing uninterruptedly), I began to feel a sound, or rather a noise, in my ears, which I can not easily define; it was a kind of shock, or crackling, as if some paste or tenacious matter was boiling. This noise continued unabated, and without increase, all the time that the circle was complete. The unpleasant sensation, which I feared dangerous, of the jolt in the brain, made that I did not repeat this experience several times" (trad.)*

Our attention was focused on the letter written by Professor Volta to Professor Brugnatelli, in the second half of 1802, "Above the application of electricity to deaf-mutes from birth (*Sopra l'applicazione dell'elettricità ai sordomuti dalla nascita*)."<sup>3</sup>

**Luigi Valentino Brugnatelli** (1761-1818) was a personal friend of Volta and professor of chemistry at the University of Pavia; he was among the first to study the chemical action of the current produced by the pile and in 1802, he invented the galvanoplasty. In 1801, Volta asked him to accompany him to Paris to illustrate the invention of the pile, where they stayed from September 26 to December 4 and on that occasion, met not only Napoleon, emperor of France, but also numerous French scientists.

Within the dense correspondence that Volta and Brugnatelli held from 1788 to 1804, some letters are reported by Brugnatelli in the *Annals of Chemistry*, a collection of scientific publications published in 22 volumes from 1790 to 1805.

At the beginning of the letter "Above the application of electricity to deaf-mutes from birth" written by Volta a Brugnatelli in the second half of 1802, Volta begins by quoting a certain Sprenger of Jever.

"I wrote to you already, that the many detailed reports of deaf-mutes, to which hearing was given by the application of my electro-motor apparatus, individually to Jever (City of Westphalia, and Capital of Jeverland, which is a Lordship belonging to the Muscovar Tsar) by work, and by the judiciously imagined method of a certain Sprenger, were more than enough to show even the most incredulous, that the thing is not despicable, and that it deserves at least, that it proves from others." (trad.)

From the reconstruction carried out on the basis of historical information of the time, we can place Jeverland as an area by the sea in Lower Saxony, belonging to the Principality of Anhalt-Zerbst until 1797, when it passed to Catherine the Great, Empress of Russia.

## MAIN POINTS

- The situation in Europe in the second half of the 18th century, with some scientists starting to apply electrical stimulation as a potential cure for different diseases.
- The first application of the Voltaic battery as a cure for deafness, described by Volta himself.
- The different applications and subsequent experiments carried out by other European scientists.

**Johann Justus Anton Sprenger** was an apothecary of the town in Jever who developed a method to electrically stimulate hearing in deaf people. Sprenger describes his experiments for the first time in the *Annalen der Physik* of 1802, in the chapter titled "Anwendungsart der Galvani-Voltaischen Metall-Electricität zur Abhelfung der Taubheit und Harthörigkeit (Application of galvanic-voltaic metallic electricity for the remedy of deafness and ear hardness)."<sup>4</sup>

Reading some experiments that used the voltaic column to cure diseases, Sprenger made his first experiment on a boy from the city of Jever.

*"A local resident, the father of a deaf and stupid young man, who knew he had something to do with a voltaic pile and had done some experiments to study its chemical effects, begged me to try his unfortunate son, if his deafness could not be remedied. I ventured first with my ear and let the current of a voltaic column, composed of 70 double metal plates, pass through both ears until I could bear it, and I concluded that what does not give me unbearable pain." (trad.)<sup>4</sup>*

Sprenger describes how the daily application of electrical stimulation on the young man, from November 1 to November 15, 1801, produced the restoration of hearing. Because of the success with Jever's young man, Sprenger tells how many deaf people came with a request to be treated by his method.

*"Now, on June 26, I counted 45 people who appreciate the sense of hearing they acquired through my application of metallic electricity and who have become able to teach orally. Of these, four received at the same time the sense of smell, which had been lacking for so long. There were also three people with hearing problems, who now also hear others. All the deaf I have treated have been helped almost without exception; on the other hand, some deaf people because they were incurable or too impatient to endure electrification for the necessary time." (trad.)<sup>4</sup>*

Later, in the article, Sprenger describes the material used, consisting of a voltaic column of 70 copper plates and 70 zinc plates interspersed with 70 discs of felt soaked in salt water. At the 2 ends of the column, there are discharge plates, connected on one side to a metallic sphere that the patient must touch with the wet hand and on the other side, to the mediator that is used to stimulate the ear.

*"Then I take the mediator for his glass handles, and pass the button, wet with salt water, into the wet ear-cup (Tragus), where I leave it for a minute. Then I bring it for 2 minutes to the external auditory canal (Meatus auditus externus), then 1 minute on the mastoid process area (Processus mastoidei)." (trad.)<sup>4</sup>*

The machinery designed by Sprenger is connected to a clockwork mechanism, which creates a series of impulses every second. The procedure is subsequently applied to the contralateral ear and repeated 3 times a day after 3 hours, for a variable duration of days for each patient.

Table IV of the *Annalen der Physik* (Figure 1) includes both the machinery built by Sprenger (on the right) and Wolke's "acumeter" (on the left) which will be subsequently treated.

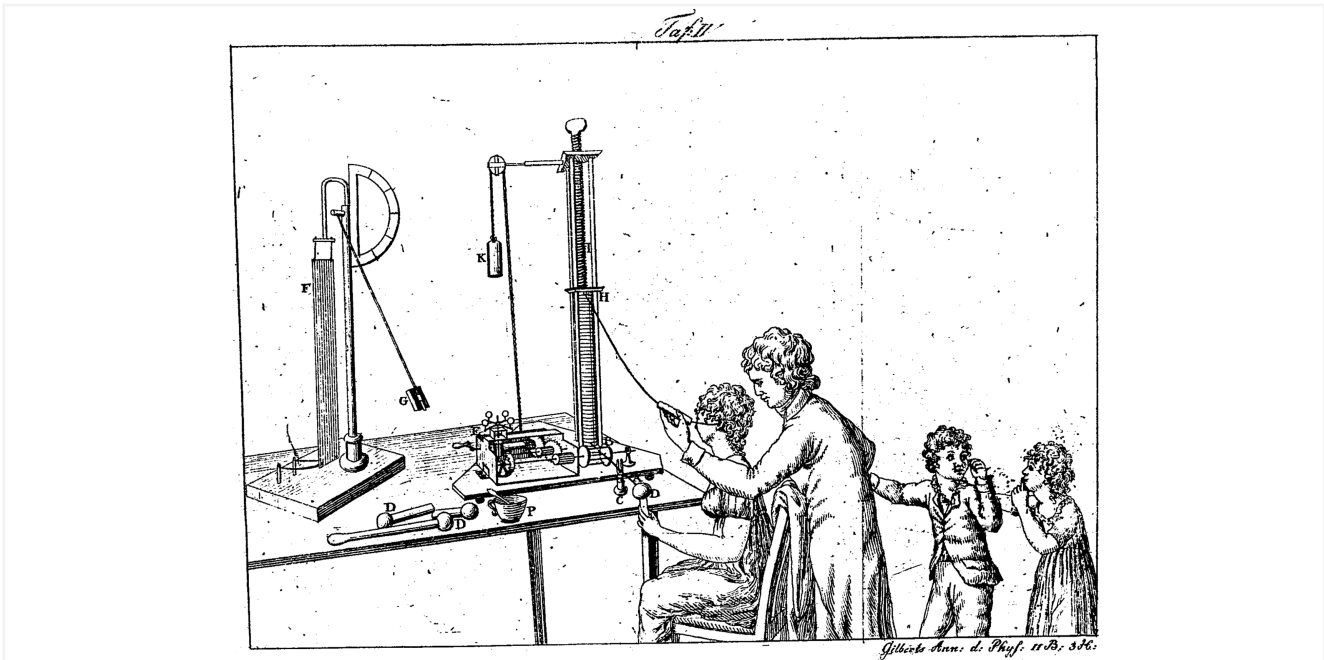


Figure 1. The Sprenger's machinery (on the right) and the Wolke's "acumeter" (on the left). Image from article on the Annalen der Physik of Sprenger.<sup>4</sup>

The description of the figures at the end of the Sprenger article includes the following paragraph:

*"The galvanic scene on Table IV presents, on the right side, my galvanic-electric apparatus, and a lady whose auditory organ is interested. The energiser holds the mediator from the glass handles, and carries the wet salt button inside the Tragus. On the left, there are two children. The boy manages to make the girl with the pantomime understandable that the woman's ear is electrified, galvanized, and soon after a similar one must be undertaken with him."* (trad.)<sup>4</sup>

It is interesting to note how the "Sprenger method" cited by Volta in his letter to Brugnatelli is a direct application of the pile he invented himself and shows amazing results in the treatment of deafness.

*"... and already from days 15, I use a method similar to that of Sprenger over a young deaf girl from birth, aged about 15 years, who is here in Como in a conservatory of poor spinsters. I can not say I have had a great success so far; but it can not be denied, that the patient has acquired the sense of hearing to mark various sounds even not very strong, and in the distance of a few feet"* (trad.)<sup>3</sup>

Volta tells how the girl began to notice that she felt on the third day of stimulation, then after 8/9 applications lasting 10 minutes in each ear, initially hearing simple noises such as the clap, until she heard the music and the human voice, although this confused. In the letter to Brugnatelli, Volta tells how he intends to continue the stimulation on the deaf-mute girl for at least a month, more than the average time used by Sprenger.

*"I doubt, that my patient can come to well distinguish articulated voices. She certainly bought something: she could not hear*

*the loudest sounds from any of the ears, now she feels the discretely strong singularly from the straight ear; but we are far from that subtlety of hearing, which seeks to listen to the poorly raised human voice, and to distinguish the articulation of words, as required to learn to speak."* (trad.)<sup>3</sup>

Volta continues in his letter doubting that he could have lasting results in the treatment of deafness, since he received news from Germany that some deaf patients undergoing electrical treatment had returned deaf as before.

*"As I already said I do not have much hope of succeeding perfectly with the deaf girl, on which I am now experimenting. I hope a lot more from another deaf mute, who still hears some loud sounds, and will soon be subject to experiments"* (trad.)<sup>3</sup>

In the final part of the letter, Volta asks Brugnatelli about the experiences in Paris at the Institute of the Deaf, of which he did not know which method they had used. On the experiments carried out in various places in Germany, Volta claims to be able to find numerous reports on the stimulation of other organs and systems.

Carlo Amoretti, librarian in the Ambrosian Library of Milan, in his *Opuscoli scelti sulle scienze e sulle arti* in 1803, makes a complete summary of the use, until then, of the voltaic pile for the treatment of deafness and other auditory disorders.<sup>5</sup>

**Friedrich Ludwig Augustin** (1776-1854), was a German physicist follower of Brownism, a doctrine of the late 19th century according to which all the vital phenomena are governed by a metaphysical spiritual force. In the treatise *Vom Galvanismus und dessen medicinischer Amwendung* of 1801, Augustin himself described various applications of voltaic pile, recounting "the

many healings made by this means, freeing many from deafness and hardness of ear, from aphonia and bitterness, from the mal de teeth, and also from the dropsy increasing the strength of the absorbent vessels" (trad.).<sup>6</sup>

Augustin decided to adapt the electrode of galvanic stimulation during his ear stimulation experiments, to better apply the electricity to the "acoustic nerve affected by the paralytic state." "A region behind each ear, at the mastoid process, was deprived of the epidermis and then applied a zinc disc on one side and a silver disc on the other, through the use of a bandage with a whale bone" (trad.).

**Christian Heinrich Wolke** (1741-1825), teacher in Philanthropinum in Dessau and author of several scientific publications; in 1802, in "Nachricht von den zu Jever durch die Galvani-Voltaische Gehör-Gebe-Kunst beglückten Taubstummen und von Sprengers Methode sie durch die Voltaische Elektrizität auszuüben" he describes the "Sprenger Methode," its application on deaf and the details of an instrument for measuring auditory acuity, called "akumeter."<sup>7</sup>

**Carl Johann Christian Grapengiesser** (1773-1813), medical advisor to Friedrich Wilhelm III., King of Prussia, and personal physician of the crown prince, made numerous attempts to investigate the healing power of electricity. He has achieved considerable success, particularly in the case of amaurosis, deafness, and paralysis, described in his work entitled "Experiments to apply Galvanism to cure some diseases. With 2 folded copper plates" (Figure 2)<sup>8</sup>

The first patient he treated was Heinrich von Schoning, a 12-year-old student of the Royal Deaf-Mute Asylum in Berlin, with whom he needed to use "Drohungen, Zureden und Versprechungen" (threats, encouragement, and promises) to have cooperation to undergo the galvanic application; according to Grapengiesser's writings, the boy's hearing improved considerably after electrical stimulation, allowing listening and understanding of words pronounced behind him.

**Ernst Adolph Eschke** (1766-1811), Founder and Director of Berlin Royal Deaf-Mute Asylum, in the spring of 1802 ordered 2 voltaic piles and performed the "Sprenger Methode" on 18 deaf boys.<sup>9</sup> The young students grabbed a copper sphere with one hand, while Eschke applied one end of the conductor on the organs of hearing or speech (external ear, mastoid process, larynx, tongue), with the aim of being able to stimulate "das funfte und achte Gehirn-Nervenpaar" (the acoustic and trigeminal nerves).

Electrical stimulation was performed for at least an hour of time, 3 times a day, for each ear of all the boys enrolled in the study; immediately after each stimulation, the pupil was placed in the shower under running water, and sometimes packs of nettles were applied behind the ears. Every 4 days, the boys alternated the use of a cap with a necklace formed by plates of gold and silver, with the conviction of increasing the effect of Galvanism also in the following days. Eschke in his study describes the effects of this experimentation: pain, bleeding, weakness, facial spasms, skin burns, auditory, and visual hallucinations. The small patients were reluctant to undergo electrical stimulation, both of the proven physical pain and the complete absence of positive results.

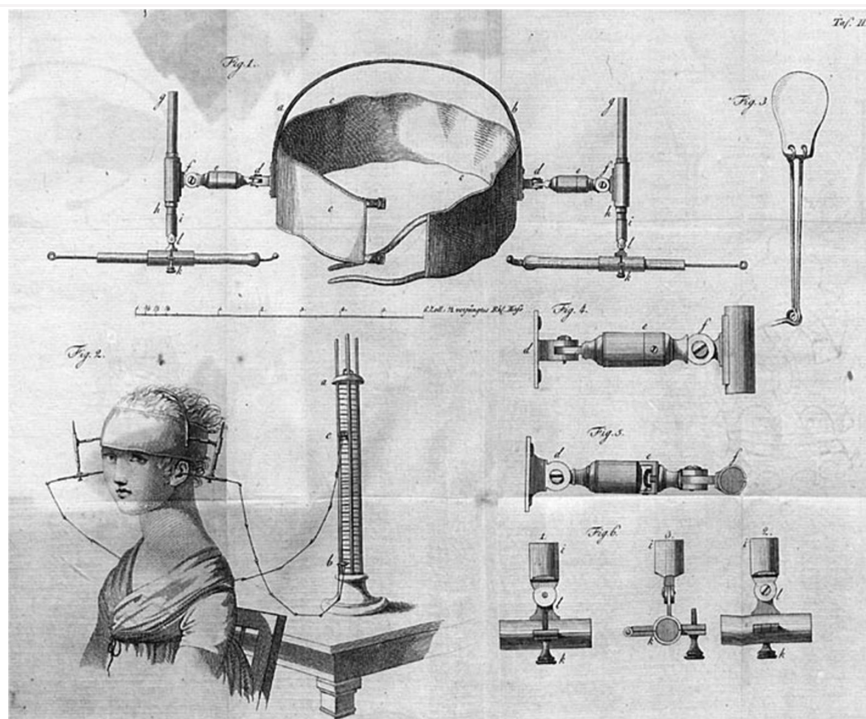


Figure 2. Some tools for galvanic application, including a band used for electrical stimulation of the ear (above) and its connection with the voltaic pile (on the left). Image from book on the Galvanism of Grapengiesser.<sup>8</sup>

The history of the effects of electricity on human health is long and also rich in anecdotes; since the very interesting “De l’électricité du corps humain dans l’état de la santé et de maladie” by l’Abbé Nicole Pierre Bertholon published in 1780,<sup>10</sup> to the recent Arthur Firstenberg’s book,<sup>11</sup> in which the author reports what happened to Johann Doppelmayer, professor of mathematics at Nuremberg, who published in Germany probably the first book devoted to electricity,<sup>12</sup> became gradually paralyzed on one side of his body and then stubbornly persisted in his researches and died of a stroke in 1750 after one of his electrical experiments.<sup>13</sup>

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## REFERENCES

1. Volta A. *On the electricity excited by the mere contact of conducting substances of different kinds. In a letter from Alessandro Volta to the Rt. Hon. Sir Joseph Banks, Bart. K.B. P. R. S.* Philosophical Transactions of the Royal Society of London, 1800 v. XVII:403-431.
2. Marchese-Ragona R, Pendolino AL, Mudry A, Martini A. The father of the electrical stimulation of the ear. *OtolNeurotol.* 2019;40(3):404-406. [\[CrossRef\]](#)
3. Brugnatelli LV. Sopra l'applicazione dell'elettricità ai sordomuti dalla nascita. In a Letter from Alessandro Volta. *Ann Chim.* 1802;XXI:100.
4. Sprenger JJA. Anwendungsart der Galvani-Voltaischen Metall-Electricität zur Abhelfung der Taubheit und Harthörigkeit. *Ann Physik.* 1802;11(7):354-366. [\[CrossRef\]](#)
5. Amoretti C. Altre notizie intorno al Galvanismo, o Voltaismo Medico. In: *Opuscoli Scelti Sulle Scienze e Sulle Arti, tomo XXII.* Milano: Giuseppe Marelli; 1803.
6. Augustin FL. *Vom Galvanismus und dessen medicinischer Anwendung.* Berlin: Öhmigke; 1801.
7. Wolke CH. *Nachricht von den zu Jever durch die Galvani-Voltaische Gehör-Gebe-Kunst beglückten Taubstummen und von Sprengers Methode sie durch die Voltaische Electricitet auszuüben.* Oldenbur: Schulzeschen Buchhandlung; 1802.
8. Grapengiesser CJC. *Versuche den Galvanismus zur Heilung einiger Krankheiten anzuwenden. Mit 2 gefalteten Kupfertafeln.* Berlin: Mylius; 1801.
9. Eschke EA. *Galvanische Versuche.* Berlin: Eigendruck des Taubstummeninstitutes; 1803.
10. Bertholon NP. *De l'électricité du corps humain dans l'état de la santé et de maladie.* Lyon: Chez Bernuset; 1780.
11. Firstenberg A. *The Invisible Rainbow: A History of Electricity and Life.* Chelsea: Chelsea Green Publishing Co; 2020.
12. Doppelmayer J. *Neu-Entdeckte Phænomena von Bewunders-würdigen Würckungen der Natur.* Nuremberg: Johann Joseph Fleischmann; 1744.
13. Galath D. *“Geschichte der Electricität”. Versuche und Abhandlungen der Naturforschenden Gesellschaft.* Danzing: Schreiberische Buchdruckerei; 1756.