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Jean-Martin Charcot´s medical instruments: Electrotherapeutic devices in *La Leçon Clinique à la Salpêtrière*

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ABSTRACT

In the famous painting *La Leçon Clinique à la Salpêtrière* (A Clinical Lesson at the Salpêtrière) by André Brouillet (1857–1914), the neurologist Jean-Martin Charcot (1825–1893) is shown delivering a clinical lecture in front of a large audience. A hysterical patient, Marie Wittman (known as "Blanche"; 1859–1912) is leaning against Charcot's pupil, Joseph Babinski (1857–1932). Lying on the table close to Charcot are some medical instruments, traditionally identified as a Duchenne electrotherapy apparatus and a reflex hammer. A closer look at these objects reveals that they should be identified instead as a Du Bois-Reymond apparatus with a Grenet cell (bichromate cell) battery and its electrodes. These objects reflect the widespread practice of electrotherapeutic faradization at the Salpêtrière. Furthermore, they allow us to understand the moment depicted in the painting: contrary to what is sometimes claimed, Blanche has not been represented during a hysterical attack, but during a moment of hypnotically induced lethargy.

KEYWORDS

André Brouillet; Jean-Martin Charcot; electrotherapy; history of medicine; hysteria; medical instruments

Introduction

Jean-Martin Charcot (1825–1893) is widely considered the father of modern neurology. The lectures he delivered at the Salpêtrière Hospital in Paris attracted a large number of visitors from all over the world (Goetz, Bonduelle, and Gelfand 1995). While working as chief of service at this hospital (1862–1893), Charcot became increasingly interested in hysteria, which he described in its various stages and forms (Bogousslavsky 2014; Bogousslavsky and Moulin 2009; Goetz, Bonduelle, and Gelfand 1995). For him, hysteria was a condition with distinctive neurologic signs but no detectable morphological lesions in the brain identified at autopsy. Charcot had initially considered hysteria as the consequence of a "dynamic lesion" *(lésion fonctionnelle* or *lésion dynamique*) of the nervous system (Goetz, Bonduelle, and Gelfand 1995). Furthermore, he vehemently rejected the equation between hysteria and simulation. Only shortly before his death, he became increasingly convinced of the importance of psychological factors in the genesis of hysteria (Bogousslavsky and Moulin 2009). Because he believed only hysterical subjects could be hypnotized, Charcot advocated the use of hypnotism for studying this phenomenon (Goetz, Bonduelle, and Gelfand 1995).

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La Leçon Clinique à la Salpêtrière (A Clinical Lesson at the Salpêtrière) is a famous oil painting made in 1887 by the French painter André Brouillet (1857–1914), held at the Hôpital de la Salpêtrière in Paris. It represents Charcot delivering a clinical lecture and a demonstration of hypnosis in front of a large audience. Charcot's pupil Joseph Babinski (1857–1932) is holding a patient up. She is Marie Wittman, a famous hysterical patient known as "Blanche" (1859–1912). Contrary to what is sometimes claimed (Geisler 2011; Harris 2005; Justice-Malloy 1995; Morlock 2007), in this painting the woman is not having a hysterical attack. Her posture resembles that of opisthotonus (or *arc de cercle*), which defined the second phase (*période des grands mouvements*) of *grande hystérie*, the prototypical form of hysteria (Richer 1881). However, Blanche's left arm and hand are held in a contorted posture, which indicates a hypnotically induced lethargy. The first phase of the hypnotical state was catalepsy: The patient's eyes remained open but unblinking, the subject was endowed with waxy flexibility, and the body and limbs could maintain any position into which they were molded (Richer and Gilles de la Tourette 1889). The following stage was lethargy, characterized by eye closure, muscle flaccidity resembling that of a corpse before the onset of rigor mortis, complete unconsciousness, and total anesthesia (Richer and Gilles de la Tourette 1889).

Lying on the table close to Charcot are some medical instruments, which are traditionally interpreted as an electrical device and a reflex hammer (Figure 1). According to Harris (2005), for example, "on the table beside Charcot, on his right, are a reflex hammer and what is thought to be a Duchenne electrotherapy apparatus." In an important monograph devoted to Charcot, Goetz, Bonduelle, and Gelfand (1995) wrote, "On the table in front them and close at hand for Charcot is an electrotherapeutic device and a Skoda hammer for testing tendon reflexes."

Figure 1. André Brouillet, *Une Leçon Clinique à la Salpêtrière* (detail). Public domain.

Figure 2. Duchenne medical induction machine, made by Joseph Charrière (1803–1876), Paris, France, 1849. Copyright ©Science Museum, London. Copyrighted work available under creative commons attribution only license CC BY 4.0.

A closer look at these objects reveals they are something different. The French neurologist Guillaume-Benjamin-Amand Duchenne de Boulogne (1806–1875) had developed a noninvasive technique of muscle stimulation (*localized electrization, électrisation localisée*). He stimulated the muscles using a specific machine with cloth-covered electrodes and an induction coil to produce electricity. The machine was reproduced in detail in his work, *On Localized Electrization and its Application to Pathology and Therapy* (*De l'Électrisation localisée et de son application à la physiologie, à la pathologie et à la thérapeutique*; Duchenne de Boulogne 1855; see Figure 2). A closer look at the device in the painting reveals that it is not the apparatus invented by Duchenne. Furthermore, the shape of the second instrument is not that of a Skoda percussion hammer. More generally, it does not represent a reflex hammer at all, as the first medical hammer designed specifically to assess reflexes had not yet been invented (Lanska 1989).

Overall, the objects lying on the table should be identified as a Du Bois-Reymond apparatus with a Grenet cell (bichromate cell) battery and its electrodes (Figure 3). This article does not provide a history of medical electricity (for more on this topic, see Broussolle et al. 2014; Walusinski 2013), but instead aims to correct a misinterpretation of what Brouillet painted.

Figure 3. A portable Du Bois-Reymond medical induction device, complete with a Grenet cell and electrodes, very similar to that depicted in André Brouillet's painting (the one in the photo is covered with cotton tissue) Copyright ©Le Compendium/Albert Balasse—2007/2015.

Grenet cell (bichromate) battery *(pile de Grenet)*

In 1850, Eugène Grenet (?–1909) proposed his battery (Grenet battery, *pile de Grenet*; Balasse 2016) as an evolution of that invented by Johan Christian Poggendorff (1796–1877) in 1842. Poggendorff, a famous physicist at the University of Berlin, replaced the nitric acid in Robert Wilhelm Bunsen's (1811–1899) battery with potassium bichromate dissolved in sulfuric acid. This innovation had the advantage of not spreading corrosive acid fumes. Instead, this safer practice facilitated its more frequent use, although potassium bichromate is also a toxic product. Grenet improved the battery by replacing the initial porous vase with a spherical glass bottle, closed with a hard rubber lid. This single-liquid battery has amalgamated graphite-zinc electrodes (Cadiat and Dubost 1885). These electrodes, previously soaked in mercury, plunge into a bichromate solution with an amber color, which was accurately depicted by André Brouillet within the glass bottle. Grenet batteries vary in size from 13 to 25 cm high (Grenet 1859).

Du Bois-Reymond's device

In front of Grenet's pile, Brouillet painted the medical induction coil of German physiologist Emil du Bois-Reymond (1818–1896), one of the founders of electrophysiology in the nineteenth century (Pearce 2001). This therapeutic device—akin to the induction reel of Heinrich Daniel Ruhmkorff, 1803–1877), but adjustable—created electrical currents that were painful when applied to patients. This device included a primary coil responsible for induction and a secondary, movable induced coil set on slide rails and connected to the stimulating electrodes. The magnitude of induced current could be modified by changing the distance between the two coils, reducing the pain experienced by the patients. The coil powered by the Grenet battery transmitted the electrical current to the patient through contact, using electrodes with the shape of large flat buttons covered with cotton or with thin chamois leather. The object falsely interpreted as a reflex hammer is one of these metal electrodes covered by chamois leather. To ensure good electrical contact with human tissue, these electrodes were moistened with salt water. The glass of water depicted at the corner of the desk – depicted in the painting by Brouillet – was used to moisten the electrodes and not the speaker's throat. In their essay on medical electricity, Ernest Onimus (1840–1915) and Charles Legros (1834–1873) considered these devices "very convenient and capable of giving, under a small volume, very powerful currents of induction" (Onimus and Legros 1872).

The use of electrical therapy as envisaged by Jean-Martin Charcot

Pierre Briquet (1796–1881) advocated for electrical therapy with faradic currents as an effective treatment for hysteria. In his *Clinical and Therapeutic Treatise on Hysteria* (*Traité Clinique et thérapeutique de l'hystérie*), he reported referring several patients to Duchenne for faradization, with reporting a good clinical outcome (Briquet 1859).

On December 26, 1880, Charcot held a conference in Salpêtrière entitled "The Employment of Static Electricity in Medicine" (*De l'emploi de l'électricité statique en médecine*; Charcot 1881). His lesson began with an explanation of "the quantity and voltage" of the electricity implemented. Charcot presented the same device painted by Brouillet: "The induction devices, to which belong our faradic devices, provide quite high voltage in a relatively large quantity" (Charcot 1881). He then provided some examples of its use "in some lesions of the nerves or their trophic centers." Charcot explained, "the galvanic current causes muscle contractions, and even more intense than in the normal state when it is impossible to achieve this contraction with faradic current in humans, at least after stimulation of the external teguments" (Charcot 1881). He finally referred his listeners to a memoir by Pierre Jean Étienne Mauduyt de La Varenne (1733–1792) published in 1780 (see Mauduyt de La Varenne 1780).

In 1875, Charcot encouraged Romain Vigouroux (1831–1911) to set up an electrotherapy department at the Salpêtrière, where the practice of faradization to treat hysteria and neurasthenia began in 1881 (Walusinski 2013). Electrical stimuli could be delivered to the face of hysterical patients during the first phase of the hypnotical state (catalepsy). It could be stopped as soon as the desired facial expression had been obtained. As Charcot (1890) wrote,

> Once produced, the movement imprinted on the features of the face cannot be erased, even after removing the electrodes that had generated it. The facial expression remains immobile during catalepsy, as well as the accompanying attitude and gesture. The subject is thus

Figure 4. Progressive faradization of the frontal muscle in a hysterical patient (Marie Wittman, "Blanche") during catalepsy (*Faradisation progressive du muscle frontal chez une hystérique dans la catalepsie*). From Londe (1893). *La photographie médicale. Application aux sciences* médicales *et physiologiques*. Paris: G. Villars et fils. Public domain.

> transformed into a sort of an expressive statue, an immobile model representing with striking truth the most diverse expressions. Definitely, artists could take advantage of this.

Charcot noted that the immobile state thus obtained could greatly facilitate photographs (Charcot 1890); indeed, in that era, photographers had difficulty capturing fleeting facial expressions due to the limitations of the lenses and film emulsions then available. Blanche herself appeared in some photos that illustrated the effect of "faradisation" on hysterical patients during catalepsy (Figure 4).

Conclusions

The objects depicted by André Brouillet reflect the widespread practice of faradization at the Salpêtrière, which increasingly became an internationally recognized treatment for hysteria in the late-nineteenth and early-twentieth centuries (Broussolle et al. 2014). Furthermore, they allow us to examine and understand what is happening in the painting: Charcot has laid down the electrodes with which he had artificially molded an ecstatic expression over Blanche's face. The hypnotized woman had just transited from catalepsy to lethargy and leans unconsciously on Babinski's arms before the attentive gaze of spectators.

Disclosure statement

No potential conflict of interest was reported by the authors.

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