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The Scientific Illusion of Victor Burq (1822–1884)

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Keywords

Victor Burq · Jean-Martin Charcot · Jules Luys · Victor Dumontpallier · History of neurology · Hysteria · Hemianesthesia · Dynamometer · Metallotherapy · Mettaloscopy

Abstract

Victor Burq (1822–1884) is closely associated with a therapy named "burquism" by Jean-Martin Charcot, which was used in treating hysteria, especially hysteric anesthesia and paralysis, by applying metals, mainly copper, to affected zones. In 1876, Charcot, Luys, and Dumontpallier, commissioned by the Société de Biologie, issued 2 opinions validating the results obtained by Burq during the 25 years he dedicated to his research. From that point forward, the careers of these 3 famous physicians were lastingly reoriented toward the practice of hypnosis. This neo-mesmeric resurgence at the end of the nineteenth century can be considered the cause of an epistemological change that gave rise to "psychological medicine." During the repeated cholera epidemics in the mid-nineteenth century, Burq recommended preventive and corrective ingestion of copper, after observing that smelter workers were unaffected by the disease. The mechanisms of copper's anti-bacterial action have since been elucidated and legitimize Burq's anti-cholera campaign. Burq also advocated the ingestion of copper sulphate to treat diabetes. Current-day findings on intestinal microbiota and how these organisms influence blood sugar regulation support Burq's claims, considered far-fetched for many years.

The work of physician Victor Burq (1822–1884) in the middle of the nineteenth century can be seen as a resurgence of the magnetism theory put forward by Franz-Anton Mesmer (1734–1815), despite the condemnation of this practice in 1784. Indeed, the report submitted on August 11, 1784, by the committee of eminent scientists appointed by King Louis XVI concluded that there was no scientific evidence with regard to the existence of "a fluid" and that "the imagination is the true cause of the effects attributed to Magnetism" [1]. This condemnation of magnetism was a result of the initiative of the Académie des Sciences, which sought to fight charlatanism in general; it was not a direct repudiation by the medical authorities of the Faculté de Médecine. More than the medical doctrine, which the public was most often unaware of, the popular success of magnetism owed to its therapeutic intention and its supernatural aura, the latter due to the complex and ambiguous relations between magnetism, on the one hand, and power and religion, on the other. In fact, the public was fascinated by the marvelous

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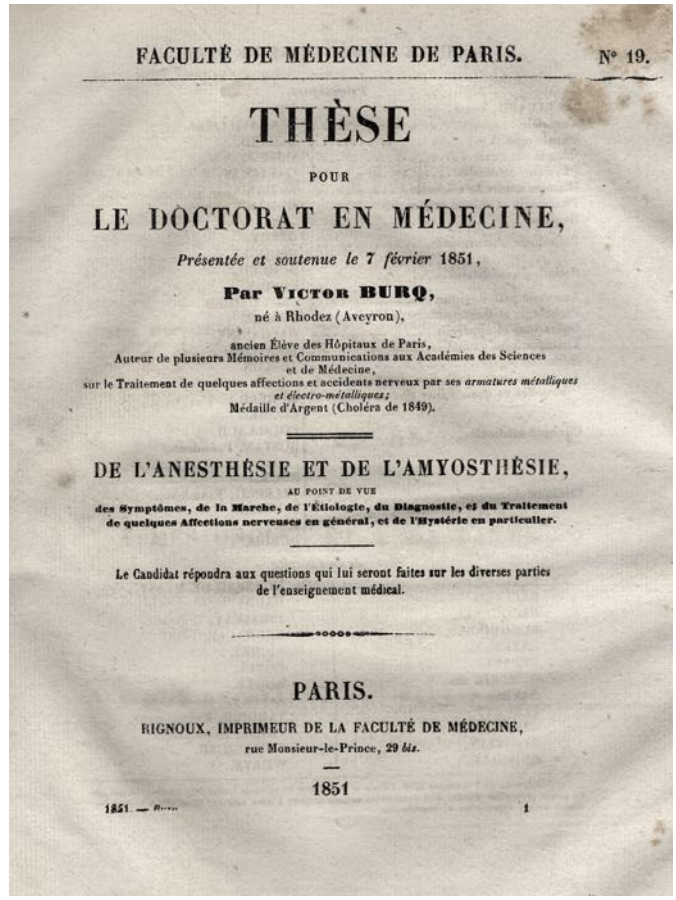
and the imaginary, which indirectly called into question the foundations of social organization. The dispute would grow more clearly political after the French Revolution. Bringing to a close the revolutionary period, the Napoleonic Empire promoted social reconciliation by authorizing "philanthropic circles" where the defenders of "magnetism" had the opportunity to disseminate "their discoveries" to an even broader public, hungry for the new and the sensational [2].

At a time when medical treatments were extremely limited, the successes of magnetic therapies, at least as reported by their partisans, offered the hope of reducing the carnage and upheaval of wars and of recurrent cholera epidemics, among others. Joseph Deleuze (1753–1835), the librarian of the Museum of Natural History in Paris, and the first historian of animal magnetism, went so far as to call Amand-Marie Jacques de Chastenet (1751–1825), the disciple closest to Mesmer, a "friend of humanity" [3]! These 2 famous promoters of "magnetism" were able to get around the hostility of those in favor of official medical views by opening their treatment demonstrations to the public at large, whereas the Académie Royale de Médecine, notably Frédéric Dubois d'Amiens (1797–1873), condemned "magnetic somnambulism" in 1833, this time more for ideological than scientific reasons [4]. Indeed, due to the rejection of mesmerism by royal powers, it was associated with revolutionary thinking in the fight against the monarchy.

Fascinated more by the cures obtained by Mesmer's disciples Charles Deslon (1738–1788) and Chastenet than by the practices of Mesmer himself, Victor Burq (1822–1884) can be considered a physician of the succeeding generation who also wanted to cure nervous diseases. He experimented and developed his own "magnetic theory" for nearly 25 years before seeking recognition and attempting to have his results validated by the most famous scientists of his day – Claude Bernard (1813–1878) and Jean-Martin Charcot (1825–1893), among others. This unusual saga demonstrates the illusion of a scientific discovery and is worth recounting.



FACULTÉ DE MÉDECINE DE PARIS. N° 19.

THÈSE

POUR

LE DOCTORAT EN MÉDECINE,

Présentée et soutenue le 7 février 1851,

Par VICTOR BURQ,

né à Rhodez (Aveyron),

ancien Élève des Hôpitaux de Paris,
Auteur de plusieurs Mémoires et Communications aux Académies des Sciences et de Médecine,
sur le Traitement de quelques affections et accidents nerveux par ses *armatures métalliques et électro-métalliques;*
Médaille d'Argent (Choléra de 1849).

DE L'ANESTHÉSIE ET DE L'AMYOSTHÉSIE,

AU POINT DE VUE

des Symptômes, de la Marche, de l'Étiologie, du Diagnostic, et du Traitement de quelques Affections nerveuses en général, et de l'Hystérie en particulier.

Le Candidat répondra aux questions qui lui seront faites sur les diverses parties de l'enseignement médical.

PARIS.

RIGNOUX, IMPRIMEUR DE LA FACULTÉ DE MÉDECINE,
rue Monsieur-le-Prince, 29 *bis*.

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1851

1851. — Burq. 1

Fig. 1. Cover of Burq's thesis (private collection of the author).

Who Was Victor Burq?

Victor (Jean, Antoine) Burq was born on July 8, 1822, in the city of Rodez in the south of France. His mother was Victoire Viguier and his father Antoine Burq was a pharmacist. After finishing his classical studies at the Rodez secondary school, Burq went to Paris to study medicine. On the front page of his thesis, he indicated only "former student in the Paris hospitals" and there is no archival evidence that he passed the internat exam (for students seeking to live and work in the hospitals). His teachers were Antoine-Joseph Jobert de Lamballe (1799–1867), Alphonse Devergie (1798–1879), and Charlemagne Legroux (1798–1861) at Hôtel-Dieu hospital, and Auguste Nonat (1804–1887) at the La Salpêtrière. He particularly revered Léon Rostan (1790–1866), well known for his book on brain softening: "Recherches sur le ramollissement du cerveau" (1823), who presided over the jury for his thesis, defended on February 7, 1851 [5] (Fig. 1). In 1825, Rostan authored the entry for "magnetism," "this erroneous word," in the first edition of what is referred to as the Adelon-Béclard Dictionnaire de Médecine [6]. The other members of the jury were Ambroise Tardieu (1818–1879) and Eugène-Napoléon Vigla (1813–1872), in whose departments Burq had carried out his research. They were thus favorable to his work, whereas Alfred Velpeau (1795–1867), "by nature very sceptical, expressed his reservations" [7].

Basis for a Theory

In 1786, Jean-Jacques Menuret de Chambaud (1733–1815) published for the first time his Essais sur l'histoire médico-topographique de Paris (Essays on the medical-topographical history of Paris). Attesting to the activities in Paris of Franz Anton Mesmer (1734–1815), he clearly described the underlying concept of Burq's thinking:

> To revive and regulate the flow of the fluid that distributes life with feeling and movement, there seemed to be no means more effective and specific than this same fluid, which is apparently the soul and the principal instrument of nature, but which the marvelous industry of art has nonetheless dominated, directed, led, excited, and strengthened at will.

These philosophical more than physiological notions were inspired by the thesis defended in Vienna in 1766 by Mesmer [8]. "A subtle and universal fluid" bathed the celestial bodies, including the Earth, and circulated in all living bodies. This fluid explained a mutual, reciprocal, and permanent influence between stars and beings. Mesmer called the faculty of circulating this fluid "animal magnetism." Disturbances in this circulation were the cause of "nervous" disorders in human beings. This is where scientific hypocrisy came into play. Christian Kratzenstein (1723–1795) [9] and Jean Jallabert (1712–1768) [10] in 1745 and 1748, respectively, were the first to use the discovery of electricity and its powers for medical treatment. Kratzenstein in Halle in Germany and Jallabert in Geneva treated paralysed patients, drawing on the writings of Benjamin Franklin (1706–1790) [11]. It was not until 1791 that Luigi Galvani (1737–1798) demonstrated electrical conduction in nerves and muscles [12], the phenomenon that supplanted the notion of "animal spirits," in existence since antiquity and reconsidered in 1627 by René Descartes (1596–1650) and in 1633 by William Harvey (1578–1657) [13]. But "magnetism," as Burq understood it, became by a form of grammatical heresy the semantic substitute for the electricity conducted by "the nerves." Burq used the same analogy that William Gilbert (1544–1603) undertook in 1600 comparing magnetic attraction with the attractive property of the electrified bodies [14, 15]. Menuret de Chabaud had said, "This same fluid that appears to be the soul and the principal instrument of nature" [16] is a means of acting "powerfully on the nerves," a sort of infallible panacea, capable of acting on the entire "animal economy." In this way, he aligned this thinking with the treatment of "vapours" recommended by the Englishman George Cheyne (1671–1743) in the 18th century. In his only and incidental allusion to the discoveries contemporary to his own research, Burq wrote that Emil Dubois-Reymond, spelled Raymond (1818–1896), had presented in 1848 a galvanometer to the Académie des Sciences in Paris that could measure "the properties of this nervous fluid" [17].

Confirming the source of his inspiration, Burq chose a citation from the introduction to Règne animal d'après son organisation (animal kingdom based on its organization) by Georges Cuvier (1769–1832) as the first quote in the epigraph to his thesis: "It seems quite apparent that the nerve acts on the fibre by an unweighable fluid, since demonstration has shown that it does not act mechanically" [18, 26]. Even though Jacques-Henri Désiré Petetin (1744–1808) had explained the most recent findings in this area in his book Électricité animale in 1808, Burq seemed unaware of them [19]. What Burq did, in fact, was to refashion an older theory to contemporary tastes, that of William Gilbert, who began developing it in 1600 and published it under the title De magnete [20]. With great abnegation, Burq would devote his entire career as a physician to this theory.

But what were the patients and pathologies that Burq hoped to treat? His choice of a second quote for his thesis, placed below the first and taken from a translation of Thomas Sydenham (1624–1689) [21], gives us some indication:

> It appears to me that what is called the hysteric affection in women and the hypochondriac affection in men, and in general, the vapors, come from the disorder or irregular movement of animal spirits, which act impetuously and in too great a quantity on this or that part and cause spasms there.

Hysteria and Its Diagnosis According to Burq

Hysteria was the only pathology that Burq wished to study in his thesis. He believed it was characterized either by "positive, dynamic, or sthenic" symptoms, that is, those that "amount to a simple augmentation or exaggeration of sensitive, motor, circulatory, caloric, secretory, and other functions or properties"; or, in contrast, by "a decrease in or even complete suppression of functions or properties," which he called "negative, adynamic, or asthenic" symptoms [5]. For diagnosis, 2 symptoms were sufficient.

> The constancy and continuity of anesthesia or amyosthesia, their habitual co-existence, their mobility, and their anomalies, the initial peripheral and partial invasion of analgesia, then of anesthesia, the constant relationship between these 2 symptoms, and all of the phenomena of neurosis

were enough to distinguish it from other diseases [5].

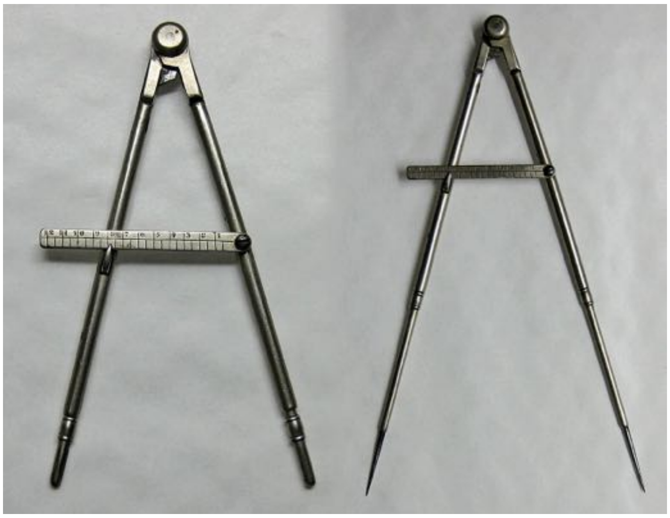


Fig. 2. Burq's "Æsthésiomètre," based on the compass of Ernst-Heinrich Weber (with kind permission of Le Zograscope – A. Piffault).

The physiological notions underlying his thinking were basic. In keeping with the writings of Joseph-Henri Beau (1806–1865), Burq identified only 2 sensitivities: pain and the sense of touch [22]. To precisely measure sensitivity, he began in 1850 to use the compass invented in Germany by Ernst-Heinrich Weber (1795–1878), who was a precursor of experimental psychology [23] (Fig. 2). Burq's compass had a graduated scale to measure sensibility according to the distance separating 2 blunted points. Unbeknownst to the patient, it was possible to turn the end a quarter-turn and make a fine point emerge to prick the patient, thereby testing the perception of pain. He called his compass an "Æsthésiomètre" and considered it an instrument that could also detect trickery.

"Motility undergoes variations that are no less frequent or significant." Burq hoped to measure muscular activity and "measure it with exactitude and rigour." He thus invented a dynamometer (Fig. 3 and 4) and made a dozen improvements to it over the course of his career. They were built by Hermann Wülfing Lüer (1802–1883), a German manufacturer of medical instruments in Paris as well as by the Charrière workshop.

> When motility as measured by this instrument is below the force indicated by the volume of the muscles, their rigidity and their habitual exercise, the moment of their action, and the general state of the individual, amyosthesia is present.

This imprecise term indicates decreased muscular force without differentiating between muscular work and motor control. Although the term today seems ambiguous, Burq was satisfied with "this word we have been the first to employ, (and that) we consider a felicitous find." Incidentally, a catalogue of "gymnastic machines" from 1877 indicates that "the dynamometer was created for medicine around 1850 and soon came into use for gymnastics as well." This advertisement extended the use of the dynamometer to "gymnasts," as well as to patients, for the purposes of "orthopaedic gymnastics," that is, a technique to aid muscle development and rehabilitation [24].

Diagnosis seemed easy to Burq: "Whatever the cause of hysteria and its onset, as soon as positive phenomena start to appear, lesions are found affecting sensitivity or motility" [5]. Burq added a personal argument that he considered irrefutable, in order to ensure the diagnosis:

The possibility of bringing about cessation, most often with applications of metal, in addition to the patient's antecedents and exterior state, are enough in most cases to establish the differential diagnosis for nervous affections of the second class (hysteria) relative to all other diseases that might cause confusion [5].

As to the etiology of hysteria, after simply dispensing with "the womb" as having any role, Burq remained purely mechanistic and never referred to any emotional component; in this he adhered wholly though implicitly to cartesian duality:

> Anesthesia, as well as all other negative phenomena, such as amyosthesia, nervous paralysis, and amenorrhea, are due to a momentary decrease or suspension of the conductibility of the nerves, which means that these organs, be they sensitive or motor, have ceased transmission or only transmit imperfectly the nervous influx to the various parts of the body [5].

Anesthesia and amyosthesia were, for Burq, pathognomonic with regard to hysteria: "We do not hesitate to consider them, metaphorically, as the very pulse of hysteria." Treatment of hysteria consisted in "finding any agent that can bring about complete cessation of anaesthesia and amyosthesia, and thus return sensitivity and motility to normal conditions" [5].

> We have been convinced since 1848 that some sort of nervous circulation existed in animals and that it alone could explain all of the highly complex phenomena of nervous pathology and indicate proper treatment. We thus undertook a series of experiments [5].

He presented the first results "in a sealed envelope" submitted to the office of the Académie des Sciences on April 13, 1849 (listed by the Académie "envelope no. 63"), along with a second envelope on November 19, 1849 (listed by the Académie envelope no. 963), which

Color version available online

Fig. 3. Burq's dynamometer, 1876 (private collection of the author).

preceded the defense of his thesis by more than a year. He baptized his discovery "metallotherapy," "a new branch of the art of healing," hoping to retain the attribution for himself. In his own words, he took advantage of "the conductibility of certain metals in their natural form to treat certain affections and accidents resulting from a problem of innervation." Burq selected for this purpose "a metal that is a good conductor of electricity and that, by certain mysterious and unknown affinities, is sometimes copper, sometimes steel, etc." After a conventional introduction in which he noted that "the conductors and nervous centres are not damaged in any way," he recommended applying a metal plate or a bandage he called an "armature" on the anesthetized and/or paralysed limb (left part of Fig. 5).

In the second part of his thesis, Burq presented 10 highly detailed observations from among the 57 that he had accumulated between 1848 and 1851. In each case, he claimed to be able, by applying metals, to observe the recovery of sensitivity in the anesthetized area, or motility where it had been absent. Most often this cure was temporary and required daily applications for several days. If one metal had no effect, another had to be tested, which led him to conclude that customized treatments were necessary; this involved tests with around 40 different metal or alloy plates:

> Due to certain mysterious affinities between living beings and the principal elements making up the environment in which they breathe, there exists between the various organisms and metals, especially iron, intimate relations of sensitivity, relations that are more frequent for a given metal.

He called the identification of this affinity for each individual patient "idio-métalloscopie," its aim being to determine his or her "idiosyncrasie" (right part of Figure 5). The method for using metallotherapy was as follows:

> The patient must use it at night when going to bed and keep the application in place for 2, 4, 8, or 10 h, according to the intensity of the effects to be obtained.

Burq noted that his teachers – Rostan, Viola, and the legal specialist Tardieu, who had observed his experiments – had attested to their authenticity.

In August 1851, Burq was summoned to London "to treat the Marchioness X..., one of the most famous members of the English aristocracy"; she was suffering from "nervous paraplegia." He cured her in around 10 days by applications of silver. In addition, he met several English physicians, including John Elliotson (1791–1868), who allowed him to carry out a demonstration on the many patients he had brought together, "at his mesmeric infirmary on Bedford Square." In 1852, Elliotson published in his journal, The Zoist: A Journal of Cerebral Physiology and Mesmerism, and their Applications to Human Welfare, a translation [25] of Burq's Métallothérapie, which was published in Paris in 1853 [26].

Origins of Metallotherapy

When Burq was "a student in the Paris hospitals," he became intrigued with somnambulism. Wishing to understand this state, he observed a somnambulist named Clémentine X, hospitalized in 1847 at Hôpital Beaujon in the department of the surgeon Alphonse Robert (1801–1862):

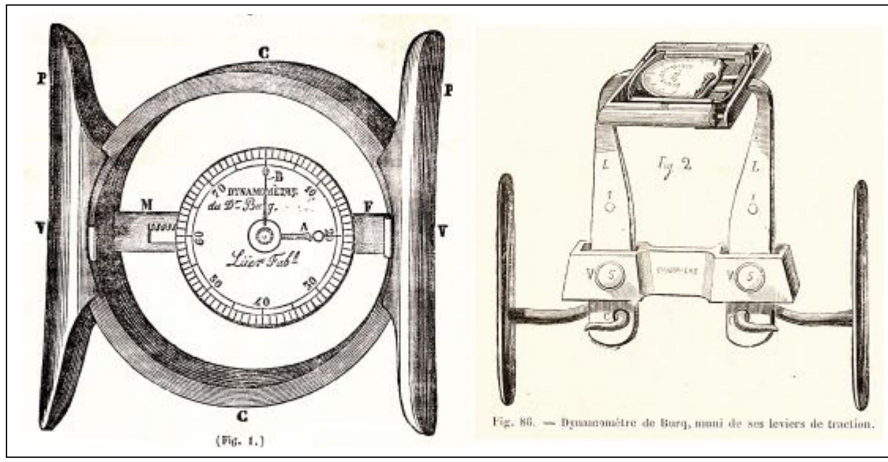


Fig. 4. First models of Burq's dynamometer (private collection of the author).

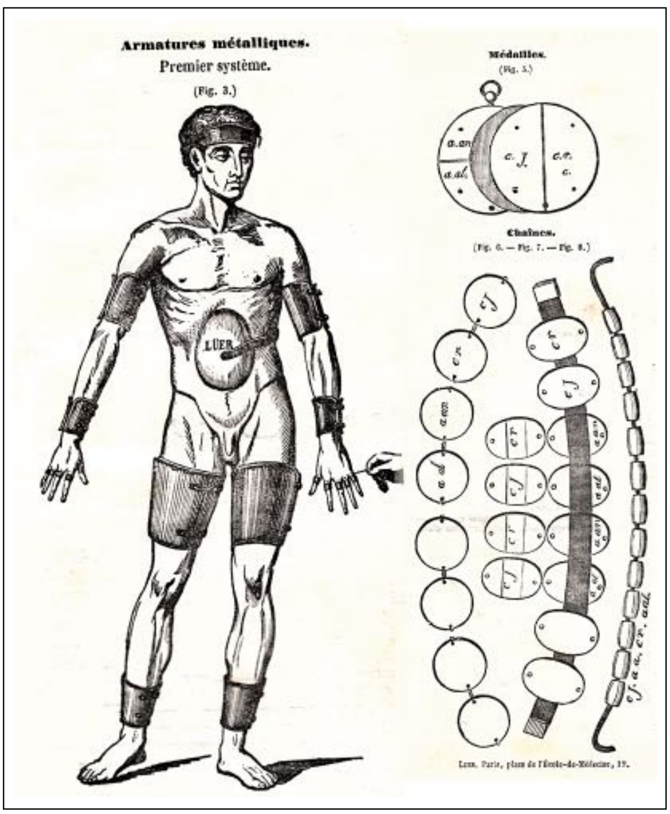


Fig. 5. Metal plates, bracelets, and armatures made by Lüer and used by Burq. In Métallothérapie. Germer-Baillière, 1853 (private collection of the author).

One day, in a somnambulic state, when Clémentine went to open the door to her room, we saw her approach it cautiously, cover her right hand with her skirts, raise it fearfully to the door knob then quickly turn the knob, rubbing her hand afterwards as if she had touched a hot object. It turned out the knob was made of copper [27].

While she was still under hypnosis, Burq questioned her and learned "that this metal burned her as if it were fire," but that she liked contact with gold and silver. He ensured that her sensibility was totally abolished "in a state of lethargy" and then placed a copper coin on her forearm, which she promptly pulled away. Burq was surprised to find that a very keen sensitivity was restored where only moments earlier, there had been complete anesthesia. By contrast, during the application of gold or silver, her forearm remained anesthetized. After repeating this sort of experiment numerous times, Burq concluded that copper put an end to the patient's anesthesia and drew her out of her hypnotic state. It was these descriptions that he prepared and submitted "in sealed envelopes" to the Académie des Sciences. And it was in this way that he conceived of the idea of treating hysterics with copper. Not long after, while working in the department of Jacques-Gilles Maisonneuve (1809–1897), he stopped the agitation and choking fits of Pauline X by applying copper on the epigastrum. He was also successful in the presence of Nonat at La Salpêtrière.

At nearly the same time, in 1849, an epidemic of cholera broke out in Paris:

There was a cholera outbreak at La Salpêtrière. This plague, contained for a few days within the walls of the vast establishment, soon spread to the rest of Paris, until all of the hospitals were overflowing with victims [28].

Copper and Cholera

Sufferers from cholera have very painful cramps in all limbs; the metabolic explanation was unknown in Burq's day. These cramps are only a symptom of the disease, but pain relief is required. One of Burq's patients reported that his cramps had disappeared after brass rings were applied to his rigid muscles.

> Not content to use them with the patients at Hôpital Cochin throughout the epidemic, I (Burq) went day and night to other hospitals, where there were hundreds of cholera patients, in order to demonstrate the use of these rings.

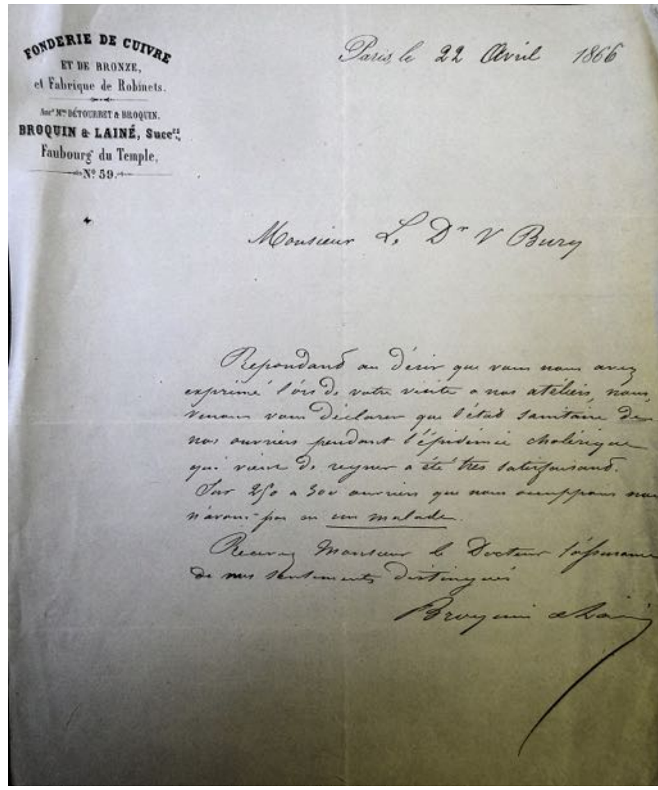
According to Burq, Rostan noted the following in an unspecified clinical lesson in 1849:

> A special technique worthy of mention is that which Mr. Burq borrowed from physics, and which consists in surrounding the limbs and trunk of cholera patients with copper plates. You have seen this technique used in our department, almost always with success, to treat cramps, choking fits, precordial chest pain, and so on [26].

In April 1852, Burq visited a copper smelting facility on 22 rue des Gravilliers in the 3rd arrondissement of Paris. He learned that during the 1832 epidemic as well as the 1849 epidemic, few were ill of mild forms of cholera and none of the 200 workers had died of cholera. He then undertook a vast investigation in other Paris smelting facilities where his findings were the same: This new immunity was very surprising and in no way justified by the salubrity of the district or the state of the lodgings themselves. Their exteriors were in poor condition as were the facilities housing the smelters. Furthermore, the hygiene of the inhabitants and their mortality rates were pitiful. I was thus unable to see this as a simple coincidence [26].

He prepared a questionnaire and sent it to several companies in France and England as well as to the ambassadors of several countries stationed in Paris. The responses he received, "covering a population of around 300,000 individuals," led him to conclude the following: "the curative power appears to belong to copper alone, which seems to act on the choleric miasma as quinine sulfate acts on the miasma of recurring fevers." The numerous letters that were sent to Burq, as well as the tables of his statistical data, are preserved in the library of the Académie de Médecine in Paris (Fig. 6).

Burq began recommending not only external applications, but also the ingestion of "a very fine powder of this metal." The 1854–1855 epidemic strengthened his conviction that the ingestion of copper sulfate was effective both preventively and curatively. Among the deaths by cholera, there had been no jewellers, goldsmiths, burnishers, foundry workers, boilermakers, and so on. Burq went as far as to survey the army and observed that military musicians who played brass instruments were also spared. He considered that the protection, which he called "immunity," was proportional to internal copper levels and


FONDERIE DE CUIVRE
ET DE BRONZE,
et Fabrique de Robinets.
Anc^{ne} M^{on} DÉTOURBET & BROQUIN.
BROQUIN & LAINÉ, Succ^{rs}.
Faubourg du Temple,
N° 59.

Paris le 22 Avril 1866

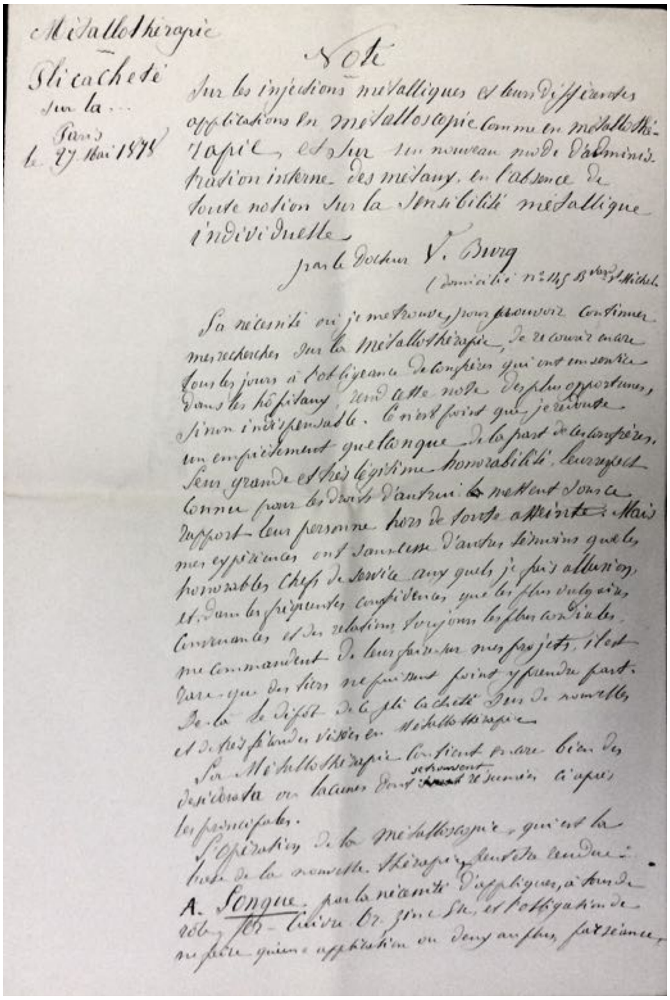
Monsieur le D^r V Burq

Répondant au désir que vous nous avez exprimé lors de votre visite à nos ateliers, nous venons vous déclarer que l'état sanitaire de nos ouvriers pendant l'épidémie cholérique qui vient de régner a été très satisfaisant.
Sur 250 à 300 ouvriers que nous occupons nous n'avons pas eu un malade.
Recevez Monsieur le Docteur l'assurance de nos sentiments distingués
Broquin et Lainé

Color version available online

Fig. 6. Example of the letters Burq received during his inquiry into the preventive effect of copper on cholera (copyright by Académie de Médecine, Paris).

compared this protection to the smallpox inoculation. But Burq ran up against a theory widely held, especially by medical examiners, that copper had a toxicity equal to that of arsenic, which was potentially fatal. Tardieu and Zacharie Roussin (1827–1894) defended this theory in their book on poisoning [29]. Certain that the theory was erroneous, Burq first called upon Alfred Vulpian (1826–1887) to study this toxicity, as Vulpian had done so for curare and certain venoms. Vulpian delegated this task to his interne Albert Malherbe (1845–1915), who seems to have concluded that no acute toxicity was associated with copper. Another publication confirmed Burq's claims. Victor-Louis Galippe (1848–1922), a pharmacist and future pioneer in stomatology, defended a doctoral thesis in medicine in 1875 entitled Etude toxicologique sur le cuivre et ses composés (Toxicological study of copper and its compounds). Galippe, a student of Louis-Charles Malassez (1842–1909), pursued his work on the innocuousness of ingestion, then of subcutaneous injection and, notably, on the external antiseptic effect of cupric sulfate, applying his skills as a well-informed pharmacologist to perform


Métallothérapie

Pli cacheté

Paris le 27 Mai 1878

Note

sur les injections métalliques et leurs différentes applications en métalloscopie comme en métallothérapie, et sur un nouveau mode d'administration interne des métaux, en l'absence de toute notion sur la sensibilité métallique individuelle

par le Docteur V. Burq

Fig. 7. Sealed envelope submitted to President J. Baillarger of the Académie de Médecine on May, 27 1878 (copyright by Académie de Médecine, Paris).

tests on rats and guinea pigs [30]. Following his experiments, he concluded that copper was not toxic when used in the way Burq had recommended since 1852. Burq leveraged these results to carry out research in the facilities of Victor Dumontpallier (1826–1899) at Hôpital de la Pitié, and Charles Lasègue (1816–1883) at Hôpital de la Charité, eventually recommending a subcutaneous injection of cupric sulfate when the oral route was impossible. On May 27, 1878, he submitted "a sealed envelope" to the Académie de Médecine to ensure his own priority for the results he had obtained (Fig. 7) [31]. He extended his concept to the preventive and curative treatment of typhoid fever during the epidemic in Paris in 1876. Referring to the work of Louis Pasteur (1822–1895), Burq qualified his discovery as "an antidote to cholera" and its therapeutic action as "antiseptic." He regretted having not been able to extend his research to a range of other substances, including gold salts, but also arsenic, antimony, zinc, bismuth, and silver!

The archives of the Académie de Médecine contain a very detailed report that Burq submitted on March 15, 1874 to Léon Renault (1839–1933), prefect of the Paris police at the time. According to that report, the administrative bodies in Paris participated in the collection of epidemiological data which Burq used to substantiate his strategy for preventing cholera and typhoid fever epidemics.

Burq left the capital in the summer months to treat those taking the waters at the spa town of Vichy. For these patients, he recommended the combination of oral copper salts, with the most alkaline and ferruginous thermal waters, to improve the effectiveness of treatment at the spa, where diabetics were often sent. He reported having observed reduction or disappearance of glycosuria and reduction of pain and paraesthesia in the limbs, which were probably the result of diabetic neuropathies.

Burq was steadfast not only in his research but also in his hope to gain official recognition. In addition to the "sealed envelopes" that he submitted to the Société de Biologie and the Académie de Médecine, as mentioned above, he submitted an application in 1873, and again in 1880, for the Barbier prize which the Académie de Médecine awarded each year. This body recognized the discovery of new means of preventing and treating cholera and typhus epidemics, among other distinctions. Burq was not awarded the prize [32]. However, the Société de Biologie awarded him the Ernest Godard prize on February 9, 1878 for his discovery of metallotherapy [33]. Ange-Maxime Vernois (1809–1877), a member of the hygiene council for the region around Paris, would officially endorse Burq's statistics and the conclusions he made, as reported in 1873 by Amédée Dechambre (1812–1886) in his encyclopedic dictionary [34].

Copper is both a necessary micronutrient and an antimicrobial agent that was already in use in Egypt before 2000 BC, then in Mesopotamia, and later in Greece at the time of Hippocrates. In addition, copper is found in several proteolytic enzymes. During an infection, the plasmatic concentration of copper is observed to double or triple [35]. It is possible that this metal is directly toxic to microbial, viral, and parasitic pathogens by means of oxidation, and it may also favor the phagocytic activity of granulocytes and stimulate the production of interferon gamma [36]. Whatever the case may be, Burq was clearly an attentive observer and his recommendation to fight

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Fig. 8. Burq's cutaneous thermometer. Gazette médicale de Paris. 1880;S6–5:59.

infections by ingestion of small doses of copper, based on his empirical work, would remain current until the discovery of antibiotics [37]. The famous "bouillie bordelaise," containing cupric sulfate, had been used, since that time, against mildew and other fungi since 1878, notably in the castles around Bordeaux. In light of the exponential development of research on the intestinal microbiota and its role in obesity and diabetes, Burq's observations are perhaps relevant [38, 39].

At La Salpêtrière and Hôtel Dieu Hospitals and Elsewhere

In 1850, Burq wrote: "Now that cholera is gone, we hasten to continue with our experiments on hysterics." His description of Hôpital de la Salpêtrière, when Charcot was an interne, makes quite an impression: "It is pitiful to see ten or twenty of these poor women in heavy chains, which they grow used to putting themselves into early on. All at once they cry out, groan, froth at the mouth, and writhe, fighting against the often impotent measures to confine them. The disorders observed are so upsetting that the hospital administration deemed it necessary to limit access to this pavilion to workers. Although accustomed to this sort of patient, it took us several days to get used to our new environment" [26]. Burq recognized his initial failure and that he was unable to stop epileptic seizures by using "armatures as a replacement for the straightjacket": "The seizures still took place, even with the metal rings, with just as much violence." Aided by Eugène Cazalis (1808–1882) and his interne Jean-Baptiste Briffaut (1826–1901), who was Charcot's predecessor, Burq determined the specific action of different metals to stop attacks of hysteria by the return of sensitivity to affected areas. A conflict developed between Burq and the short-tempered Francisque Lélut (1804–1877), another La Salpêtrière physician in whose department Burq also conducted experiments. As a result, Burq had to leave La Salpêtrière suddenly, as he no longer felt he could "continue with the care of 4 patients whose recovery was almost inhumanely compromised." Burq never spoke of the reasons for this dispute, though it probably involved Lélut's rejection of his practices.

Allowed to work in the departments of Rostan and Tardieu at Hôpital Hôtel Dieu, Burq had to contend with the failure of one of his demonstrations, in which he tried to restore the motor functions of 2 paraplegics. The Académie de Médecine had sent Pierre-Honoré Bérard (1797–1858), Jules Cloquet (1790–1883), and Jules Guérin (1801–1886) to assess his practices.

> These 2 successive failures, which could have been very damaging for our discovery had we not already achieved many successes, were advantageous in that they led us to this conclusion [26],

That is, that the active metal for the upper limbs could differ from that for the lower limbs. Burq called this phenomenon "bimetallic aptitude." Burq continued his research and demonstrations in a number of hospitals, first at Necker, then Beaujon, followed by Les Enfants Malades, Saint-Antoine, and Maison Impériale de Santé. He treated recalcitrant contractions, neuralgias, and migraines.

In 1870, he completed his array of instruments with a thermometer (Fig. 8), which led to his adding hemi-hypothermia as a symptom of hysteria, along with anesthesia and amyosthenia. He also invented "a gymno-inhaler pulmometer" and "a pectirometer," both to be used for spirometry.

Achieving Recognition

After the republication in 1871 of his 1853 book on metallotherapy [37], Burq, sure of the results he had obtained with "metallotherapy" after 25 years of research

Color version available online

Fig. 9. From left to right: Jean-Martin Charcot, Jules Luys and Victor Dumontpallier (private collection of the author).

and itinerancy between hospitals, sought out the endorsement of Claude Bernard (1813–1878), who was, at that time president of the Société de Biologie. François-Victor Foveau de Courmelles (1862–1943) gave this account:

> The year was 1876. A man who thought he was at the end of his life wrote to our great physiologist, Claude Bernard, that he wished to know, before his death, whether he had deceived himself about what he had observed over a quarter-century. Claude Bernard, president of the Société de Biologie, considered the request motivated by an honourable sentiment and deemed it appropriate to seek a response [40].

The appointed members of the expert committee were Charcot, Dumontpallier, and Jules Luys (1828–1897). This version of events differs from that in L'exposé des titres scientifiques de Charcot (presentation of Charcot's scientific works), published in 1878:

> For more than 25 years, Mr. Burq had attempted several times and in several Paris hospitals to demonstrate his discoveries, which he referred to by the terms metalloscopy and metallotherapy. He had only managed to gain support from isolated individuals, however, when in 1876 he asked Mr. Charcot for authorization to attempt a final test in his department at La Salpêtrière. This authorization was granted. Mr. Charcot, who soon came to believe in the reality of several of Mr. Burq's findings, decided to sanction them with a collective attestation. At his initiative, the Société de Biologie appointed a three-member committee including Mr. Luys, Mr. Dumontpallier as rapporteur, and Mr. Charcot as president [41].

In their first report presented on April 14, 1877 [42], the 3 experts only examined the effect of applying metals to zones where the sensitivity of the skin was affected (metalloscopy). They completed their observations in a second report presented on August 10, 1878, in which they confirmed that the external applications were well founded, as was the ingestion of metal salts, primarily for the treatment of hysteria [43] (metallotherapy). They expressed their hope that research would continue on other pathologies.

Expert Assessment by Charcot, Dumontpallier, and Luys (Fig. 9)

Charcot gave his first lesson on hysteria in 1870. Désiré-Magloire Bourneville (1840–1909) regularly published Charcot's lessons in Le Progrès Médical. The first volume of the Iconographie Photographique de La Salpêtrière was published the same year the expert committee was formed, in 1876 [44]. With the photographs taken by Paul Regnard (1850–1927), the new journal provided unprecedented illustrations of hysteria. Charcot was appointed president of the committee because of the relevance and significance of his discoveries and those of his students. He confirmed Burq's assertions, as he recounted in 1878 in his lesson on "hysterical rhythmical chorea" [45]:

> Our patient, to use the terms of Mr. Burq, is a polymetal hysteric. She is sensitive to gold and brass, which means that if a brass plate or a few gold coins were applied, you would observe that after 10–15 min, her sensitivity would return in all of its manifestations, not only under the metal plate itself, but also above and below it, within a certain expanse. According to the observations of Mr. Burq, observations that are today recognized as being perfectly accurate, at least regarding this point, certain hysterics are sensitive exclusively to gold, or to iron, or to copper, zinc, or silver. There

are also, as you see in the example here before you, polymetal hysterics, who are sensitive to all metals.

On principle, Charcot was initially skeptical, but not hostile:

> When Mr. Burq came to speak to me of internal metallotherapy, and to tell me that he cured patients by exposing them to metals that acted internally, I said neither yes nor no. I said simply that this was possible, and that we would see. By conviction I keep myself as far as possible from arbitrary skepticism which too often leads to pedantic ignorance, just as I distance myself from naïve credulity. The observer must know how to make his way between these 2 pitfalls, equally dangerous.

The publication of his 1877 interne, Paul Oulmont (1849–1917), provides an interesting example. Oulmont worked with the ophthalmologist Edmond Landolt (1846–1926) to describe the case of a patient who had been hospitalized for 12 years for hemiplegia "with hemianaesthesia and hemichorea." By wearing a gold bracelet and having iron plates applied to her face, she completely recovered her sensitivity and the choreic movements disappeared [46]. Charcot was thus directly and personally involved in testing this therapy and, as in this example, he went so far as to experiment with it on pathologies other than hysteria.

On Charcot's recommendation, the committee turned to Regnard, at the time assistant to Paul Bert (1833–1886) and later a professor of physiology at the Institut Agronomique. Regnard was given the task of trying to find a scientific explanation for metalloscopy. For him, "transpiration acted on the metal parts and they gave a significant current with the galvanometer of Dubois-Raymond (sic)";

> First we used a very weak battery and placed the patient and the galvanometer in its circuit; using a rheostat, we then brought the intensity of the current to that of the metal plates; this allowed us to reproduce all of the phenomena of metallotherapy: the return of sensitivity, the transfer, and the oscillations [47].

Charcot never gave up on his goal to discover the pathophysiology of hysteria, and in Burq's theory he undoubtedly saw the opportunity to advance toward this goal [48].

After Burq's experiments in his department, Charcot extended his studies of hysteria by using hypnosis. At that point, he realized that numerous methods other than metal applications may cause the hypnotic state. In this way, the idea gradually came to him that imagination and suggestion influenced hysteria, which led his initial search for an anatomical explanation to take another path. This paved the way to the "psychological medicine" of Pierre Janet (1859–1947) and Sigmund Freud (1856–1939), as well as to the "psychotherapy" of Paul Sollier (1861–1933) and Jules Dejerine (1849–1917).

Dumontpallier was a disciple of Claude Bernard, a former interne under Lasègue, and a former chief interne under Armand Trousseau (1801–1867). Since 1866, he had been a hospital physician and department head at Hôpital La Pitié. He was familiar with all areas of medicine and took particular interest in gynecology. For example, he introduced the rubber pessary to prevent ptosis in uterine prolapse, a device that still bears his name. Dumontpallier's appointment to the committee was due to his inquisitiveness as a clinician and his consistent presence at the sessions of the Société de Biologie; he was at that time secretary general. Although he had published only one article on hysterical hiccup, in 1867 [49], he decided after the assessment to focus exclusively on hysteria and hypnotism, with the help of 2 students, Edgar Bérillon (1859–1948) and Paul Magnin (1854–1913). Gradually losing their scientific rigour, they ended up performing pseudo-experiments, especially after 1882, demonstrating "cerebral duality and the functional independence of the 2 cerebral hemispheres" [50]. Apparently without knowing it, they give new life to the theories of the English physician Arthur Ladbroke Wigan (1785–1847), who, in 1844, argued that the corpus callosum was "an organ of no importance, and not necessary to the functions of the brain"; he considered that each hemisphere was "a distinct and perfect whole, as an organ of thought" and that "each cerebrum is capable of a distinct and separate volition, and that these are very often opposing volitions." Bérillon and Magnin used the discovery of man's "duality of mind" to explain various forms of madness, as Wigan himself had done [51].

Dumontpallier would preside over the first "International Congress of experimental and therapeutic hypnotism," held in Paris in August 1889, and would later serve as the Président perpétuel of the Société d'Hypnologie, de Psychothérapie et de Psychologie. Finally, it was Dumontpallier who argued in Burq's favor to Paul Bert in order that Burq be decorated with the Légion d'honneur, which he was on March, 14 1882 [52].

Jules Luys, a student of Charles Robin (1821–1885), promoted the use of the microscope in pathological anatomy, as exemplified by Virchow (1821–1902). Luys published remarkable studies concerning the functional anatomy of the central nervous system, especially the basal ganglia. In 1865, he published Recherches sur le système cérébro-spinal, sa structure, ses fonctions et ses maladies (Research on the cerebrospinal system, its structure, its functions, and its diseases), and in 1883, the first Iconographie photographique des centres nerveux (Photographic Iconography of the Nervous Centres). The subthalmic ganglion was called "Luys" body' for more than a century, in his honour. There is little doubt that the experiments that he observed with Charcot and Dumontpallier played a major role in his interest in hysteria and hypnosis. From 1876 to 1885, Luys devoted himself to their study with the same rigour he applied to his anatomical work, as attested by his monumental Traité clinique et pratique des maladies mentales (clinical and practical treatise on mental illnesses), published in 1881. Appointed chief physician in 1886 at Hôpital de la Charité, Luys focused all of his efforts on the study of hypnotism, his new area of interest. This led to his attempt to imitate the famous lessons of Charcot at La Salpêtrière. Honestly naïve and coming under the influence of his laboratory director Gérard Encausse (1865–1916), who went by the name "le mage Papus," he published numerous articles in La Revue d'hypnologie théorique et pratique. The titles are as iconoclastic as they are ridiculous: Des miroirs rotatifs et leur action thérapeutique (Rotating Mirrors and their Therapeutic Action), Du transfert comme méthode thérapeutique (Transfer as a therapeutic method), De la visibilité des effluves magnétiques et électriques (Visibility of magnetic and electrical effluvia), and De l'emmagasinement de certaines activités cérébrales dans une couronne aimantée (Storage of certain cerebral activities in a magnetic crown), among others [53]. His unscrupulous entourage took advantage of his credulity, fooling him with experiments such as the attempt to show the remote action of medicines, which unfortunately became famous [54].

Unbeknownst to Burq, the committee unexpectedly

> made the chance discovery during their experiments of the singular phenomenon referred to as "transfer." Recovery of general or sensory sensitivity in any part of the body under the influence of various applications is intimately linked to the simultaneous disappearance of either type of sensitivity, within an expanse equal to the symmetrical region on the other side of the median plane.

This is how Paul Richer (1849–1933) came to write an article on "consecutive oscillations," that is, the spontaneous back and forth between anesthesia and sensitivity in areas where the metal was applied [55].

It is clear that in validating the work of Burq, these 3 experts were each profoundly influenced, and this impact had a lasting effect on their medical activities.

Impact of Burq's Research

In Charcot's Oeuvres complètes, there is a lesson devoted entirely to metallotherapy which reveals Charcot's motivations and his surprise at the results obtained, notably the demonstration of "transfer phenomena" from the anesthetized side of the body to the other side, and recovery from hysterical color blindness and amblyopia [56]. Another indication of Charcot's interest in Burq was his 1878 publication in The Lancet of a lesson on metallotherapy [57]. As for his chief interne, Joseph Babiński (1857–1932), he prepared an article in 1886 entitled Recherches servant à établir que certaines manifestations hystériques peuvent être transférées d'un sujet à un autre sujet sous l'influence de l'aimant (Research to establish that certain hysterical manifestations can be transferred from one subject to another under the influence of a magnet) [58]. This uncritical article was aligned with the work of Charcot. Babiński made no mention of it in his personal description of hysteria, nor did he mention it in his Exposé des travaux scientifiques (account of scientific works), published in 1913 [59].

The most interesting on the subject was written by Jules Moricourt (?–1896), who presented a detailed history and clearly linked the lineage of Burq's research to that of Mesmer. He pointed out that Burq practised the hypnosis of James Braid (1795–1860) [60]. In addition, several theses were defended on the theme of metallotherapy. Examples include the 1879 thesis of Douglas Aigre (1851–1912), who endorsed metallotherapy, entitled Étude clinique sur la métalloscopie et la métallothérapie externe dans l'anesthésie (Clinical Study on external Metalloscopy and Metallotherapy in Anaesthesia); and the 1881 thesis of Jean Garrel (1852–1931), entitled Traitement de l'hystérie par les feuilles métalliques administrées à l'intérieur (Treatment of Hysteria by the Ingestion of metal Foil).

Oscar Jennings (1851–1914), on the other hand, who translated the works of Silas Weir Mitchell (1829–1914) into French, was much more critical; he maintained that

> The action of metals involves 2 types of phenomena. The first type is simply a matter of an exalted imagination, whereas the second type consistent and thus appears to depend on the action of physical forces.

He concluded by evoking the long history of hysteria: "All of the phenomena produced by metal plates in hysterics have been observed with other treatment methods, such as exorcism and animal magnetism" [61]. Several English authors – John Hughes Bennett (1812–1875)

[62], Daniel Hack Tuke (1827–1895) [63], and Arthur Gamgee (1841–1909) [64] – remained skeptical as well, referring to "an expectant attention" [65]; that is, autosuggestion. The German physician Eduard Schiff (1849–1913) discussed another explanation for metalloscopy based on molecular vibrations (Molekularbewegungen) naturally produced by aesthesiogenic agents, which stimulated the nervous system through physical means, using this term without the meaning it has come to have in the field of spectroscopy [66].

On January 20, 1880, Pierre Briquet (1796–1881), presented a report to the Académie de Médecine, for the purposes of awarding the Civrieux Prize, in which he severely criticized the thesis of Paul Richer (1849–1933) describing Charcot's "hysteria major." Briquet defended the therapeutic benefits of faradization in the treatment of hysteria:

> This powerful, reliable, and rapid treatment is easy to use and available to everyone at no cost. It is supported by day-to-day experience and yet is hardly mentioned in the voluminous document here before you. Preference is given to metallotherapy, which has had the advantage of familiarity among physicians since the Asiatic cholera epidemics. There can be no reason for this preference other than a desire for novelty [67].

In 1880, Romain Vigouroux (1831–1895), a student of Guillaume Duchenne de Boulogne (1806–1875) and of Charcot, published a critical review of metalloscopy, metallotherapy, and aesthesiogenic agents in the new journal directed by Charcot, Les Archives de Neurologie. This review can be read as a summary of the studies conducted at La Salpêtrière; it also indicates also indicated all of the unknowns that remained to be explained [68]. Continuing with the experiments of Regnard, Vigouroux went on to become a pioneer of electrophysiology, introducing the concept of cutaneous resistance [69], which drew on explorations aimed at understanding the mechanism of metal applications. Vigouroux argued that metallotherapy, as well as electrotherapy, worked by means of changes in electrical voltage in a given part of the body, due in part to changes in blood flow, and possibly also to changes in nervous conduction. [70]. Burq's research can thus be seen as the first step toward future neurophysiological explorations, carried out by Charles Féré (1852–1907), Emil du Bois-Reymond (1818–1896), Ivan Romanovitch Tarchanoff (1846–1908), and many others [71].

As for Ernest Onimus (1840–1915) and Charles Legros (1834–1873), they approached metalloscopy as involving "an electro-capillary activity," that is, capillarity changes due to external electric field [72]. Antoine Rabuteau (1836–1885), like Regnard, was of the opinion that the oxidation of the metals by transpiration created a current [73].

Epilogue

In 1871, Burq wrote: "My health has not withstood the latest insult (Franco-Prussian War). Forced to leave Paris for a time, I had to once again postpone the work I had started." Moricourt had this to add: "In July 1876, recently convalescent after a long and cruel disease, Burq returned to Mr. Charcot's department at La Salpêtrière." We were unable to find a more detailed biographical account. Victor Burq died on August 12, 1884 in Bièvres, a small city fifteen kilometres south of Paris (Essonne).

Vigouroux's assessment of how Burquism was viewed in 1881 is judicious:

> Mr. Burq discovered the action of metals on anesthesia, as well as on the circulation, temperature, and muscular force in anaesthetized limbs. He recognized the existence of idiosyncrasies with regard to metals. His views on neuroses, though hypothetical, were real in the sense that anesthesia and amyosthenia have a connection with neuroses, are significant, and require treatment. The very term and notion of amyosthenia originated with him. And for these phenomena, he invented ingenious measuring instruments [68].

In 1891, Albert Pitres (1848–1928), who as an interne under Charcot at La Salpêtrière in 1876, wrote in his Leçons cliniques sur l'hystérie et l'hypnotisme: "Experience does not confirm the theoretical data, and I must admit that after having made several attempts, I completely abandoned internal metallotherapy" [74]. Fulgence Raymond (1844–1910), Charcot's successor at the helm of the Clinic for Nervous System Disorders, mentioned Burq during his inaugural lesson on Novemberm 1, 1894 in order to illustrate Charcot's open-mindedness:

> This for me is an occasion to highlight the admirable role Charcot played when he undertook to make metallotherapy acceptable. The inventor of this treatment method, Doctor Burq, was a worthy man, but he made the error of exaggerating the prophylactic and curative virtues of the application of metals. He had knocked at a good many doors, but in vain. His hope was that his observations would be validated in hospital departments. He was tireless and tenacious, but he met with prejudice because of his exaggerations. In the hospitals and academies, Burq's approach was seen as merely empirical, and many were happy to dismiss him as they would a bonesetter. I speak of what I myself witnessed. That is why Charcot demonstrated nothing less than civic courage, if I may express myself thus, when he took metallotherapy under his protection and allowed Burq to perform his experiments in his department at La Salpêtrière. This turned out to be in the very best interests of science, as you are well aware.

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The French writers Edmond de Goncourt (1822–1896) and Jules de Goncourt (1830–1870) took a different a view: "Charcot's scientific activity was a curious mixture of genius and charlatanism" [75].

In 1895, Georges Gilles de la Tourette buried the neomesmeric resurgence [76] that metalloscopy and metallotherapy represented:

> Burq's methods are gradually being forgotten; the active substances are uncertain and the application imprecise. They have been replaced to great advantage by the various electrification procedures reviewed here [77].

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