

OCCASIONAL PAPER

Electrotherapeutic disputes: the ‘Frankfurt Council’ of 1891***Holger Steinberg**

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Since the 1980s and 1990s, vagus nerve and deep brain stimulation, transcranial magnetic stimulation and cranial electrotherapy stimulation have found their way into neurology as therapeutic approaches to epilepsy, Morbus Parkinson and other central nervous symptoms. Moreover, these methods have proven useful and provided hope in the therapy of other diseases, most of all in psychiatry. From a historic perspective, this new emphasis on somatic therapies in the case of transcranial magnetic stimulation and cranial electrotherapy stimulation represents the return of therapeutic methods widely used in the 19th century and based on very similar techniques. Against the background of a general rise in the importance of neurobiological concepts in the neurosciences, we are now in a new situation of change. Yet, as in the 1880s and 1990s, many epistemic questions remain unresolved, the methods not yet having been standardized. In particular, the inability to explain which way and precisely how electricity induces healing processes in the body continues to put the neurosciences, which have always regarded themselves as exact and scientific in nature, in a rather uncomfortable position. There was a similar situation in the 1880s and 1990s, when positivist scientific dogmas prevailed. For ideological and professional reasons, neurologists strongly rejected the notion pioneered by Leipzig neuropsychiatrist Paul Julius Möbius that curative effects of electrotherapy were based on suggestion. One should see, however, that Möbius's actual concern was not to raise opposition towards or question electrotherapy as such, but rather to sensitize his colleagues in view of the prevailing solely materialistic–somatic approach in order that they should not neglect the psychological component of all illness, both in clinical practice and in research. A singular and very special event illustrates the heated debate among German-speaking neurologists on the psychological/suggestive effects of electrotherapy in the last decade of the 19th century—namely the ‘Frankfurt Council’ of 1891. The statements made at the Frankfurt convention of 35 leading electrotherapists in opposition to Möbius's criticism very much resemble present-day arguments and attitudes. Yet neuroscientists of earlier generations also found very individual answers to fundamental questions in their field that might help both to understand problems from a long-term perspective and enrich present-day discussion as a beneficial corrective.

Keywords: history of neurology; electrotherapy; suggestion; placebo effect; Paul Julius Möbius

Introduction: the return of electrotherapy

Although the benumbing effect of (what later appeared to be) electric fish had been applied for centuries, it was only in the latter part of the 18th century that electricity from machines was employed for physiological experiments and therapy. In the second half of the 19th century, electricity was used on a much larger scale, not only for therapy, but also for diagnostic purposes (Rowbottom and Susskind, 1984). Following this, it continued to be applied in the diagnosis of illnesses, but to a much lesser extent in neurological therapy and it was not until the 1980s and 1990s that electricity began to re-attract a similarly high degree of interest. Since then, increasing hope has been invested in these new therapies and their use has been extended to an ever larger number of disorders. Thus transcranial magnetic, vagus nerve and deep brain stimulation are now used for the treatment of central nervous symptoms and diseases such as dystonia, tardive dyskinesia, essential tremor, Morbus Parkinson's disease, cluster headache, Tourette syndrome and epilepsy. This surge towards electricity is more evident in psychiatry, which regards itself as a psychosocial discipline. Here studies have reported positive results in otherwise treatment-resistant affective disorders, primarily depressions, obsessive-compulsive disorders and schizophrenias. Although effects are being disputed, cranial electrotherapy stimulation has raised hopes for the treatment of addictive and sleep disorders, chronic pain, fear and affective disorders. This tendency in present-day neurosciences is supported by the renewed appreciation of electroconvulsive therapy, which had remained virtually unused since the 1970s and 1980s due to social pressure.

Against the background of these developments, electricity was able to regain the position it had previously enjoyed (~1900), as a major therapeutic option in conventional Western medicine. It is used for a wide variety of mental diseases as well as central nervous symptoms in neurology. In the case of psychiatry, this new focus on somatic treatments, namely psychopharmacology and electrotherapy, reflects its periodic re-somatization (now referred to as neurobiologization) of mental illness and neglect of its psychogenesis and sociopsychological dimension and hence also of psychotherapeutic approaches (Gilman, 2008).

This review is primarily historical and not epistemological or philosophical in nature. Hence, it will not evaluate the appropriateness or inappropriateness of the individual neuropsychiatric schools described here in an apodictic approach (although these pure, dogmatic forms can indeed be found in both theory and practice). It rather aims at reminding readers of the major importance that electrotherapy and electrotherapeutical apparatuses once had and of the hopes attributed to them before they fell into disrepute, when the era of the 'mental illnesses are illnesses of the brain' dogma ended. These were replaced by couches in the private practices of psychiatrists and neurologists who adhered to the 'suggestionist' school, which was the case with most psychotherapists in the 1880s and 1890s. Although derided and denigrated as heretics and defeatists by scientific materialistic dogmatists, 'suggestionists' were to gain the upper hand for

some time. One event that illustrates this state of transition is the 'Frankfurt Council' of 1891. It condenses the heated debate around electrotherapy in German-speaking neurology and in a few incidents resembles attitudes maintained today. Inevitably, history does not repeat itself. Yet previous generations found their own original answers, often of a 'zeitgeist' nature, to basic neuroscientific questions; answers that might contribute to evaluating and approaching current problems in a more long-term perspective or that could be used as correctives.

Electrotherapy: genesis and methods

Rowbottom and Susskind's (1984) excellent and informatively illustrated work documents the 'History of electricity in medicine' from its emergence as a scientific discipline in the 17th century and its first application treating paralysis, rheumatism and a variety of other complaints in the 18th through to the 20th-century electronic and computer-based therapeutic as well as diagnostic applications. The wide use of electricity in neurology and psychiatry in the 19th century is the primary focus of the book.

In the early 18th century, soon after electricity could be produced artificially with the help of machines, it soon became the widespread convention to use electricity as a therapeutic option. A famous and widely used appliance was the so-called 'Leiden Bottle' invented by Pomeranian scientist Ewald Georg von Kleist and experimental physicist Pieter van Musschenbroek in Leiden (Holland) shortly before 1750. Before 1800, galvanism was discovered (or the fact that muscles could be led to contract by means of electricity) and faradization (the induction of electricity in the body by running electrodes over the skin surface) started to be applied. It was only after this that scientific electrotherapy embarked on its triumphant crusade in medicine, mainly at the expense of humoral pathology. For a long time though, this new therapeutic option was not subject to differential diagnostic indication, just like mersmerism.

Galvanization refers to the application of electricity to the body. Here electricity was produced by combining several elements into one large battery and induced in the human body by means of electrodes in the form of button- or plate-shaped pieces of metal covered by moistened sponges or strips of canvas, which were firmly pressed onto the skin surface. In contrast, in faradization electricity was induced by so-called induction machines or inductors. These consisted of one or two galvanic elements, which served as the power source, and two induction coils, formed by turns of wire, one of which delivered the primary and the other the secondary current, and finally of a bundle of sticks of iron wire, which formed the core of the induction coils (Brockhaus' *Konversations-Lexikon*, 1894). All of these therapies were increasingly applied as primary remedy to illnesses that are nowadays classified as neurological, to functional diseases (neuroses) and illnesses classified today as psychosomatic. At that time, however, the latter two groups overlapped in many ways and were mostly subsumed in the concept of 'neurosis' as it emerged from

observations made by two Scottish doctors, William Cullen and Robert Whytt. Cullen presented his most generalizing concept of neurosis in 1777. According to him, every disturbance in the usual functioning of the nerves was neurosis. In the extreme, this led to the conceptualization of almost every illness, at least all kinds of mental disorders as well as illnesses that, in his understanding, were based on disturbed irritability or tone of individual organs, e.g. of the heart (heart neurosis), the uterus (hysteria) or the digestive organs (hypochondria). Contrary to Cullen, Whytt restricted the use of the term (and concept) of neurosis to illnesses in the nervous system that were the consequence of such alterations of functioning of the nervous system. He subsumed both of these groups of illnesses under the term 'nervous illness' (López Piñero, 1983, p. 11–15). Only towards the end of the 19th century were independent subcategories of this concept established and the generalizing concept ceased to exist. Throughout the 19th century, electrotherapy was increasingly used as the primary remedy to all of these 'neuroses' and gained the same importance and spread as opium, chloroform, bromine, ether, salicylic sodium or baths, compression and vibration applications, massages or operations and hypnosis, which soon made many neurologists of the second half of the 19th century include the title 'electrotherapist' on their doorplates. Moreover, electrical science had a major impact on the development of both neurophysiology and neurology, since electrical concepts were converted into neurological ones, under the assumption that the nervous system worked like a sophisticated circuit. In Germany, through results attained by Hermann von Helmholtz, Johannes Müller and Emil Heinrich Du Bois-Reymond in their electrophysiological laboratories, diseased parts of the body, nerve tracts, muscles or a sick brain were regarded as electrically undersupplied or as disturbed components and thus the nervous system was 'electrified' (Roelcke, 1999, p. 210). Supplying energy to these parts was assumed to cure the diseased parts and thus propagated as a major therapeutic option in clinical neurology. Works by Duchenne (1855), Robert Remak, Rudolf Lewandowski and Wilhelm Erb reflected the application of electrotherapy in neurology and promoted its rise. The 'Handbuch der Elektrotherapie' (Erb, 1882; Bryan, 1966) soon established itself as the most widespread 'manual' for therapists. It supported the notion that electricity could not only be applied as a cure in a wide variety of diagnoses, but could also be used as a diagnostic tool. In particular Erb, who was then Head of the Medical Outpatients Department at Leipzig University, claimed that by using current neuraesthesia, the enigmatic and individual repository of symptoms with a multitude of courses could be securely diagnosed. This, he maintained, was possible by establishing that, contrary to other neurological diseases, in neuraesthesia the reaction of motor nerves and muscles did not differ from standard physiological behaviour (Erb, 1882, p. 201–3). Hence the degeneration reaction, which proved or disproved aberrations from typical physiological behaviour, gained importance in neurology and resulted in a general sense of a new era beginning, where everything seemed possible (Erb, 1882, p. 3–18; Stainbrook, 1948; Roelcke, 1999, p. 101–137; Gilman, 2008).

The critic: Paul Julius Möbius

Following an increase in knowledge and improvements in the techniques applied in the 1880s and 1890s, many electrotherapeutic practices and clinics appeared in Central and Western Europe (for development in Great Britain, see Beveridge and Renvoize, 1988; Morus, 1992; and for development in the USA, see Rosner, 1988). Before long, any spa or seaside resort that strived to maintain high standards boasted such facilities. In addition, during these years, there were a large number of publications on the topic. The leading German review paper *Schmidt's Jahrbücher der in- und ausländischen gesammten Medicin* could only offer its readers an overview of the most important new works by way of survey reviews, instead of the customary reviews of individual works. Between 1882 and 1893, Leipzig neurologist, psychiatrist and committed writer Paul Julius Möbius supplied a total of six extended surveys of new monographs, papers and other works on electrotherapy and diagnostics. Möbius's reviews and surveys played a significant role in the favourable reputation gained by Schmidt's Annuals among German readers. As far as the reviews on neuroscientific publications were concerned, Möbius was one of the most important contributors to the journal. From 1878 onwards, and for 28 years, his reviews made him adored by some and feared by others. Regarded from a historical perspective, he became one of the last and most respected authorities in medical criticism. It may be true that through his contributions to *Schmidt's Jahrbücher* he endeavoured to enter into scientific debates that had become inaccessible to him after being refused an academic career. It is possible that he also wanted to satisfy an inner need to overthrow traditional views and lay new foundations, to promote new ideas and approaches that were disregarded by the majority or by 'orthodox medicine', and not least to oppose current mainstream opinion or overcome habits. What is true from any perspective is that these reviews caused controversy and made Möbius well-known and well-regarded among German-speaking and international medical professionals. Through his inborn pleasure and urge to be critical when his views differed, it was inevitably difficult, if not impossible, for him to be sycophantic with authorities or superiors in the academic hierarchy. Nonetheless, his opposition in many instances expressed the sentiments of many practitioners and young doctors (Waldeck-Semadeni, 1980; Steinberg, 2004, 2005a, b).

In 1878, Möbius opened his private practice in Leipzig. The doorplate as well as his letterhead read 'Arzt für Nervenkrank und Elektrotherapeut' (doctor for the nervously ill and electrotherapist). For more than 10 years, during his concurrent assistantship under Wilhelm Erb and Adolf Strümpell (Steinberg, 2005a) at the Neurological and Electrotherapeutical Department of Leipzig University's medical clinic, Möbius himself applied electrical current as a cure, above all for neuraesthenics and as palliative for patients suffering from neuralgias (Möbius, 1880a, b, 1889, p. 87). He thus shared the hopes of the mainstream and was among the large group of electrotherapists who applied current to the afflictions described. However, he found that electrotherapy did not produce the same results in every patient, which at first led

him to assume that some subjects were 'electrosensitive persons', with an 'unusually nervous state of mind' and a 'nervous lability' (Möbius, 1881, p. 277). As a lecturer at Leipzig's medical faculty he offered courses on electrotherapy and electrodiagnostics between 1883 and the summer semester of 1890 (Steinberg, 2005a, p. 56–57) (Fig. 1).

Yet, with each of his six survey reviews in *Schmidt's Jahrbücher*, he became increasingly critical. This is not to say that he strived to dismiss the approach in general, since in a number of cases there were effects and positive results. He nonetheless rejected the general hype and appraisal of electrotherapy as panacea, which he disregarded as supported by nothing more than a mechanistic positivist commitment (Möbius, 1882, 1884, 1887, 1889, 1891). From his point of view, in four out of five cases, the positive results of electrotherapy were suggestive (suggestion based)

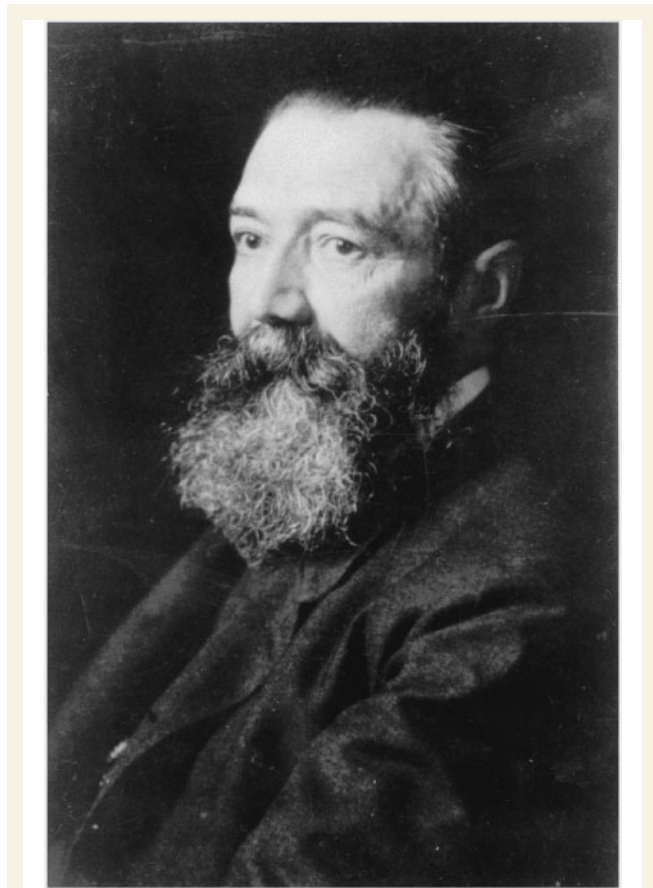


Figure 1 Paul Julius Möbius (1853–1907). His name has survived in many neurological eponyms. In Morbus Basedow, he established increased activity of the thyroid gland as the cause of the disease and weakness of convergence, the so-called Möbius sign, as a diagnostic test. His work was also acknowledged in the eponymous Möbius syndrome, i.e. paralysis of the muscles innervated by the the abducens and the facial nerves as the result of infantile nuclear degeneration (congenital ptosis), and in ophthalmoplegic migraine, also known as Möbius's disease. (Source: Möbius PJ. Ueber die Anlage zur Mathematik. Leipzig: Barth; 1900, frontispiece).

rather than physical in nature (Möbius, 1889, p. 87). However, even before Möbius, as early as the 18th century, there had been several researchers, such as Benjamin Franklin and Jean Nicolas Sébastien Allamand, with a similar opinion (Koehler *et al.*, 2009). Möbius was influenced by his contemporary Hippolyte Bernheim who, like himself, supported the notion that suggestibility could and should be used to the therapeutic benefit of patients. Contrary to their similarity in views here, Möbius totally refused Bernheim's (mis)conception of hysteria as pathological suggestibility and rather shared Pierre Janet's view, namely that hysteria had a pathopsychological genesis and would thus have to be treated by psychological means (Möbius, 1888a, b, 1893a).

Möbius's criticism peaked in 1891, when he postulated the following five theses as to the basically suggestive effects of electrotherapy:

- (i) So far nothing has proved that electricity has a curing effect in paralyses. On the contrary, paralysis following the destruction of central nervous cells cannot heal and paralysis following the destruction of peripheral nerves or muscle fibres heals, if curable, by itself. Until now no evidence has been produced that electricity has the potential to accelerate regeneration processes. Indirect central paralyses and so-called slight peripheral paralyses cure by themselves without intervention from outside.
- (ii) There is no doubt that electricity is effective with certain kinds of pain, paraesthesia, motor irritations or certain organic irregularities (e.g. vasomotor disturbances, underactivity of the bowels, menstruation abnormalities, insomnia).
- (iii) The same disturbances are subject to suggestive influence.
- (iv) Hence the effects of electricity may be suggestive in nature.
- (v) This assumption is supported by a variety of reasons, primarily by the irregularity of the curative effects. The latter could easily be explained if one were to accept that the effects were mediated psychologically but would remain inexplicable on the assumption that there was a physical relation. No explanation could furthermore be found for the proven fact that on the one hand the method itself seems to have no impact on the curative outcome, since different ways of application produced exactly the same result, and that on the other hand, applying one and the same method, one doctor produced outstanding results, whereas the other produced none' (Möbius, 1891).

The conference and the emancipation of German neurology

It was these hypotheses and the increasingly coarse 'most damaging attacks' (Killen, 1999, p. 138) mounted by Möbius that finally resulted in a harsh reaction on the side of the so-called 'positive electrotherapists' (i.e. supporters of the electrotherapeutic approach). Leading in this counter-attack were three Frankfurt-based private neuropsychiatrists: Ludwig Edinger, Leopold Laquer

and Ernst Asch. On 27 September 1891, they gathered 35 electrotherapists in Frankfurt on Main to respond to the inflaming 'subversive ideas' that Möbius had spread in *Schmidt's Jahrbücher*. In order to draw attention to the conference and raise its attendance, the organizers guaranteed in advance that all contributions made at this 'Frankfurt Council' (as Möbius later named it; see Möbius, 1894a p. 113) in addition to any papers and comments submitted by non-attendants would be published (Edinger *et al.*, 1892) (Fig. 2). The motive for this 'gathering' was confirmed by co-organizer Lacquer when he said that the electrotherapists simply 'had to defend their positions and oppose the attacks from...our most respected antagonist Möbius', which once more illustrates the reputation and influence of both Möbius and *Schmidt's Jahrbücher*: Lacquer continued: 'Without him and his almost metaphysical battle against the mechanical nature of the curative effects of electrotherapy, which are most threatening in general and to the scientific foundations of the whole approach, this meeting would not have been called. In fact, his attacks act as ferment' (Lacquer, 1892, p. 7–8, 14). Throughout the convention, attendants referred to Möbius's works, above all his criticism. In their own words, the organizers had sent a 'limited' number of invitations to 'doctors interested in

electrotherapy' prior to the conference, which leaves us to assume that attendance of the meeting was to be restricted to sympathizers and outstanding authorities of the subject. In the first invitation, recipients were asked to name the topics they felt should be raised at the conference. As a result of this 'poll' the most often suggested topics were grouped around 10 subjects that they proposed to be discussed on the occasion of the International Electrotechnical Exhibition (*Internationale Elektrotechnische Ausstellung*) in Frankfurt, 16 May to 19 October 1891 (Fig. 3).

To ensure that the tenor of the conference was positive and attendants were in a pro-electrotherapy mood, 10 introductory reports were invited, one on each of the 10 subjects in the list of topics, and Wilhelm Erb chaired the convention. In his opening speech, Erb emphasized that the conference was about 'reviving the scientific development of electrotherapy, countering the spread of negation and therapeutic scepticism and promoting positive results and development'. Since recent clinical research on electrotherapy had made little or no progress, one of the aims of the convention, Erb continued, was to present 'exact proof', acknowledging however, that this would be 'presumably scarce' (Erb, 1892, p. 6). Erb, who by 1891 had been appointed Head of the medical clinic in Heidelberg, where he had attempted to establish an electrotherapeutic ward as early as 1872 (Bryan, 1996), shared the concerns of many of his co-promoters of electrotherapy, that the distrust in its somatic curative effectiveness could lead to the loss of what effectively constituted the keystone of neurological theory and medicine. He regarded electricity as an important foundation of the entire discipline (or neuropathology as he called it for many years; Erb, 1882, p. 175): 'It is no exaggeration to say that the majority at least of German neuropathologists began in electrotherapy. Full mastery in neuropathology is impossible without a full understanding of the electrodiagnostic and electrotherapeutic methods' (Erb, 1880, p. 11). The 'Frankfurt Council' illustrates what the situation was like and how difficult it was for the neurosciences to abandon electricity as an interpretation model (Roelcke, 1999, p. 110).

Erb used the words 'neuropathology' and 'neuropathologists' at a time when the term 'neurologist' was not generally approved in the German-speaking countries. Even as late as 1890, doctors specializing in illnesses of the nerves, who usually had their background either in internal medicine or psychiatry, called themselves 'Nervenarzt' (i.e. 'nervous doctor' or 'doctor of the nerves'), for which—to the author's knowledge—no special term existed in the English language. The term 'Nervenarzt' involved not only being what is nowadays called a neurologist, but being both a neurologist and a psychiatrist. This is linked to the 2-fold emergence of neurology as a medical discipline in both internal medicine and psychiatry, which is unique to the history of the discipline in the German-speaking countries. Specialist neurological journals and societies were founded long before 1918 and from the 1890s neurology gradually separated itself from the mother disciplines but still remained within the traditional institutional boundaries, i.e. the clinics and hospitals for psychiatry or internal medicine. In 1925, neurology was granted institutional independence for the first time in Hamburg, when the first independent chair of neurology and independent neurological clinic were established for Max Nonne, 'whose biography impressively reflects the strive

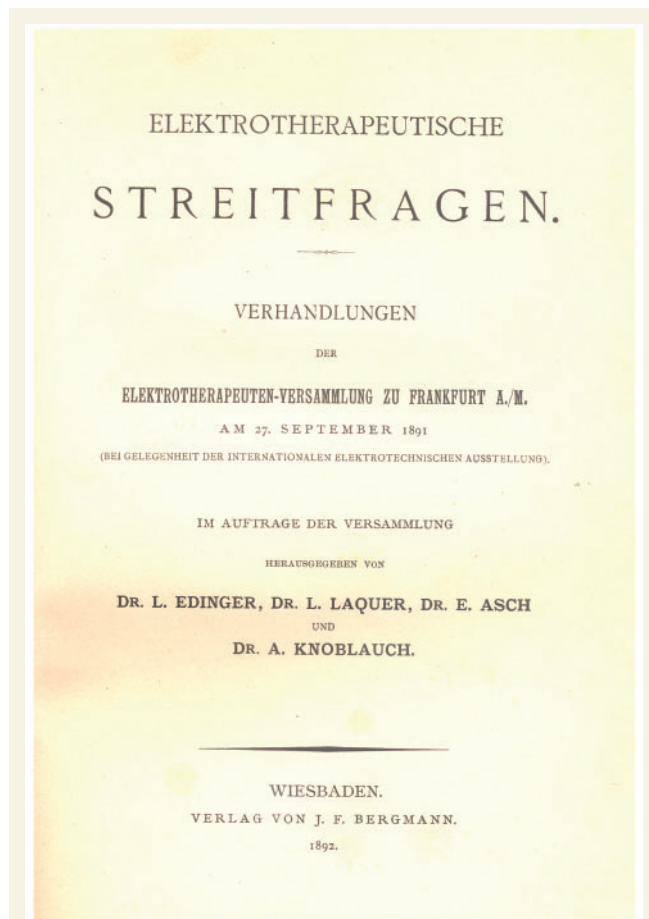


Figure 2 Title page of the 'Frankfurt Council' conference volume on the 'electrotherapeutic dispute' (Edinger *et al.*, 1892).

Im Folgenden sind die Themata, deren Besprechung vorgeschlagen ist, so geordnet, dass die am meisten gewünschten den weniger häufig vorgeschlagenen voranstehen.

1. In wie weit beruht der Erfolg der elektrischen Prozeduren auf Suggestionenwirkung? Lassen sich namentlich durch die Elektrotherapie Wirkungen erzeugen, welche auf suggestivem Wege nicht zu erreichen sind? (Weitاً von der Mehrzahl gestellte Frage.)
2. Ist ein Nutzen von der Elektrotherapie bei organischen Erkrankungen der nervösen Centralorgane überhaupt zu erwarten? (In einer Frage heisst es ausdrücklich: „Sollte man nicht bei organischen Hirnerkrankungen überhaupt ganz von Elektrotherapie absehen?“)
3. Uebt der Strom heilende Kraft auf periphere Erkrankungen?
4. Welcher besondere Vortheil, den nicht andere Stromesarten bieten, ist von der Influenzelektricität zu erwarten?
5. Wie und warum sind elektrische Bäder zu verordnen?
6. Wären nicht experimentelle Studien über die Wirkung elektrischer Ströme anzubahnen? Wie hat man sich die Wirkung des Stromes auf erkrankte Gewebe vorzustellen?
7. Haben der galvanische und der inducirte Strom je besondere Indikationen? Welche sind dies?
8. Ist eine einheitliche Methodik in der Applikation anzustreben?
9. Giebt es Veränderungen des Leitungswiderstandes, welche bei bestimmten Erkrankungen immer auftreten?
10. Inwiefern werden funktionelle Neurosen durch die Elektrisation in ihrer Heilung beschleunigt, resp. überhaupt beeinflusst?

Die Unterzeichneten erlauben sich nun, Sie, geehrter Herr Kollege,

Figure 3 According to a survey among potential attendants, these 10 questions were to be discussed at the 'Frankfurt Council' (Edinger *et al.*, 1892, p. 3), given in order of their relevance: (i) In how far is the effect of electrotherapy based on suggestion? Are there, on the other hand, effects that could not be produced by suggestion? (ii) Can electrotherapy be expected to produce effects in organic illnesses of the central nervous system? (iii) Can electricity produce curative effects in peripheral diseases? (iv) What could be the advantage of influential current in contrast to other kinds of current? (v) In what way and for what purpose should electric baths be applied? (vi) How can the effect of current on diseased tissue be explained? (vii) What are the particular indications for galvanic current on the one hand and induced current on the other? (viii) Is a standardization in the application of current advisable and beneficial? (ix) Are there alterations in resistivity typical of particular diseases? (x) In how far can the cure of functional neuroses be positively affected by electrotherapy, if at all?

of the young discipline for independence' (Karenberg, 2007, p. 26). Yet even this was an exception to the rule. In most places in Germany, advancement in neurology, institutionally speaking, was secured by the university chairs and hospitals for internal medicine and psychiatry until the 1950s and 1960s. As Schein put it, neurology went through its 'first phases' and 'its classical era...under the umbrella' of these mother disciplines. It was only after World War II that this 'unity which could only be justified in historical terms' was discontinued (Scheid, 1983, p. 3–4). Until then, however, it was mainly the university chairs and hospitals for psychiatry that had claimed responsibility for

both the academic teaching of the subject and the medical treatment of neurological patients. This development was pioneered in the German state of Prussia, which had taken over leadership of opinion in the German-speaking countries after the Unification of the German States into the German Empire in 1871. In Prussia, all hospitals newly opened after 1871 were established as clinics for psychiatry and neurology. This was also usually reflected in the official name of the institutions. Apart from economic restrictions and the traditional balance of power within the individual university departments, this affiliation of neurology to psychiatry may have been facilitated by developments in Berlin, the capital of

Prussia. There Wilhelm Griesinger, after becoming Head of the Department of Psychiatry at Berlin's Charité in 1865, claimed responsibility for care of all patients with mental and nervous diseases. Making this claim was the logical consequence of his localizational, brain-anatomical concept, which was one-sidedly subsumed in the slogan of all mental illnesses being illnesses of the brain, and which was to prove most influential in the history of psychiatry in Germany. Interestingly, Griesinger's successors, Carl Westphal, Friedrich Jolly, Theodor Ziehen and, in a neuropsychiatric sense, Karl Bonhoeffer, as Professors of Psychiatry at Berlin's Charité, gave the discipline more of a neurological influence. After 1876, when Ernst Viktor von Leyden of Strasbourg was appointed Professor and Head of the first Medical Clinic of the Charité, some of the nervously ill patients were claimed by the Department for Internal Medicine. Yet within internal medicine, neurology formed only one of many fields, along with cardio-, nephro- and pneumopathy, social hygiene and cancer.

The lack of institutional independency and thus of career opportunities in Germany, in contrast to other European countries at that time, resulted in neurology falling behind other medical disciplines. At Leipzig and many other universities, questionable appointment decisions were made and opportunities to attract or keep top specialists were missed. Alarming often, non-academics or Jews were denied professorships or other influential posts. Hermann Oppenheim, who was generally appraised as '*Praeceptor mundi* in neurology' (Zülch, 1987, p. 7), was not accepted at the Charité in Berlin as successor to Carl Westphal (Mennel *et al.*, 2007). Consequently, it was often private practitioners who contributed significantly to the advancement of neurology in Germany. In particular, they played an active role in promoting the institutionalization of neurology as an independent discipline. Understandably their colleagues at the universities, who were satisfied with their positions within the university clinics, neither understood nor promoted such independence. In some cases they even openly fought such strives with the argument that neurology had always been an integrated part of their discipline (Karenberg, 2009).

Electrotherapy was mainly applied by private practitioners and to a much less extent at university out-clinics, let alone at university clinics and hospitals. In academic medicine the notion that electrotherapy was, if at all, best used as a palliative or placebo was widespread. University professors, who oversaw scientific advancement, did not generally accept or approve electrotherapy and hence often denied their support. This may also be a reason why advancements and application of electrotherapy made little progress throughout most of the 20th century.

The conference papers

With the exception of the lectures on Questions 6 and 7, each of the 10 introductory reports was followed by a lengthy, often diverging discussion among the attendants, which included (among others) Moriz Benedikt, Paul Dubois, Albert Eulenburg, Ewald Hecker, Alfred Erich Hoche, Emil Kraepelin, Leopold Loewenfeld and Franz Nissl. The discussion and output of the

conference was supported by contributions submitted in written form, including one from Romain Vigouroux, who had worked with Charcot in Paris and discovered galvanic resistance; and Russian–Swiss neurologist and neuropathologist Constantin von Monakow, who at the time of the conference was not widely known. He was a lecturer at Zurich University and head of a private nervous institution. From the design of the convention it seems most probable that Möbius was not invited in the first place, although he did correspond with Edinger, as proved by a letter to him in September 1892 and another, rather contemptible one, from late 1894 (Peiffer, 2004, p. 206, 224). Yet Möbius's name is not included in the list of attendants. Moreover, should he have been invited, his refusal to attend or his (un)excused absence would have been commented on hypocritically, especially by his most fervent opponents. The circumstances of the Frankfurt Convention were most felicitously characterized by Möbius's friend Auguste-Henri Forel, as a convention 'behind the "Enemy, ho!" shield for a virtually clandestine discussion' (Forel, 1892/93, p. 80).

The opening report was given by co-organizer Laquer. He pugnaciously approached the question 'Are the positive results produced by electrotherapy based on suggestion?' From the very beginning he (who had a private neuropsychiatric practice and was co-owner of a private clinic for the nervously ill) made it clear that, ontologically speaking, he considered the curative effects of electrotherapy in many neurological illnesses to be an 'empirical fact'. This had been supported and manifested by the observations of numerous researchers and practitioners who over the centuries had dedicated their lives and energy to gaining them. And these efforts should and could not be disregarded! 'Any red-neck can... influence a patient's mind!' Yet, to a degree, Möbius was right in warning about over-enthusiastic reports of curative success in protracted electrotherapeutic cures, since the possibility of natural healing could not be excluded. He also conceded to Möbius that 'no neurologist with clear capacity of thought would... even regard the treatment of incurable, chronic inflammatory processes caused by fibrous degeneration of nervous elements, apoplectic scars, focal scleroses as more than a comforting treatment' [indirectly Laquer here conceded that electrotherapy could have a suggestive component, which in the case of the above syndromes could also be consciously (ab)used]. On the other hand, he continued, 'a great deal of' nervously ill patients would 'not be suggestible at all' and would 'resist any insinuation or even the application of electricity with utmost determination', others even feared the current. Hence Möbius was wrong in assuming that it was merely the 'belief in electricity that brought about a cure'. He then dealt with Möbius's objection that the curative effect in so many cases depended on the doctor applying the treatment, but was independent of the method itself; Laquer saw this phenomenon as proof of the 'diversity in the dynamic effectiveness' of electricity. Moreover, he played this reservation down by stating that 'anyone knows how electricity is applied in public hospitals, in whose hands it is laid: normally nurses, students, medical assistants are the keepers of this therapeutic treasure'. On the other hand, 'in many cases electricity was only available on Sundays! And then M. is amazed as to why so many electrotherapists have so few positive results.' Laquer

makes no reference to his many colleagues in their private practices. If the arguments presented so far could still be regarded as unsound, there were more convincing ones to come. Not knowing how electrical current worked or how it produced its indisputable effects by no means diminishes its effectiveness, which would be the same for massage-, hydro- or balneotherapy, the application of iodine or mercury. Since Möbius conceded that electrical current could have a curative effect in neuralgia, he should allow similar correlations in other cases, too. Furthermore, natural healing as such is no proof for the alleged ineffectiveness of electricity. To follow a 'mechanistic approach', Laquer called for exact and detailed case studies, which comprehensively described at what time(s) of day and for how long current was applied and at what strength, density and measure. In all of these cases, suggestive components were to be excluded as much as possible (Laquer, 1892, p. 7–14).

After Laquer, Associate Professor Ottomar Rosenbach, Chief of Staff at All Saints Hospital in what was then the German city of Breslau (today Wrocław, Poland), gave his report on 'Electrotherapy in organic illnesses of the central nervous system'. He began by saying that, in order to assess the effect of a given therapy, it is necessary to know for sure the natural course of the illness treated, which was not the case with 'many colleagues'. His ample experience, which included electrotherapy, demonstrated that 'so many acute brain diseases are cured entirely or partially by themselves, which is without special treatment, that not even the most brilliant statistics on electrotherapy will provide better results'. Conversely, in chronic brain and acute diseases of the spinal cord (except poliomyelitis), chances of recovery are few, regardless of whether therapy is applied or not. The biological tissue alterations in these diseases and their causes are well known, as are the transformations and power that electricity can produce. For this reason it is 'mysticism' to believe electrical current could promote resorption within the body, such as the deletion of haematoma or the revival of atrophied nerves. Catalytic and vasomotor effects as well as effects on the nerves were classified as 'most doubtful hypotheses', since current could not even abolish skin irritations. Hence why or by which means, asked Rosenbach, a specialist in internal medicine and supporter of psychotherapy, should electricity have the capacity to cause effects within the body? Summarizing his observations, Professor Rosenbach concluded that in organic diseases of the central nervous system, neither electrotherapy nor suggestion had an effect. On the contrary, all cure is produced by natural means (Rosenbach, 1892, p. 14–19).

Surprisingly and, as one can assume, to the annoyance of other attendants, the third report on 'Electrotherapy in diseases of peripheral nerves' shared views very similar to those proposed by Möbius. The talk was given by Ludwig Bruns, who had studied under Eduard Hitzig and then opened a private practice in Hanover. Bruns 'protested' against 'being labelled as an opponent to Möbius'. By no means had he 'come here to fight Möbius, but to lead an objective discussion'. He explicitly wished to restrict his observations to peripheral paralyses and neuralgia and did not want to include convulsions or contractures, as there was some doubt as to whether they were to be classified as peripheral or as neuroses. In his detailed account on peripheral paralyses, Bruns

raised 'serious doubts' as to whether traumatic or neuritic paralyses could be cured or their cure be helped by applying electricity. In order to make a clear statement about this, and in order to differentiate effects from the application of electrical current from natural healing powers, experimental studies would be necessary, including studies on animals. Contrary to traumatic and neuritic paralyses, Bruns expressed his 'deep conviction' that neuralgia can be directly influenced and cured by electricity; the natural, uninfluenced course of the disease was, after all, well-known. Further differentiating the therapeutic options and potential therapeutic results for different kinds of neuralgias, Bruns classified rheumatic, traumatic and peripheral neuralgia of short perseverance as 'extremely suitable objects' for the application of electrical current and even more so for brachial and independent occipital neuralgia. Contrary to these, therapeutic effects in trigeminal neuralgia were rather poor and only average in sciatica. In all of these cases, electrotherapy should be started as early as possible, in particular since chances of recovery were good and pain could be eliminated (for which Bruns assumed suggestive mediation). Last but not least, the speaker concluded that, therapeutically speaking, electricity had no effect in neuralgia as a result of organic diseases such as tumours, suppuration or periostitis (Brunns, 1892, p. 19–29).

Ewald Hecker gave a short overview on the theme 'To what degree neuroses can be therapeutically influenced by applying electricity'. The speaker had become widely known through his fruitful cooperation with Karl Ludwig Kahlbaum in Görlitz, in around 1870, and his conceptual description of hebephrenia. After re-opening the former hydrotherapeutic sanatorium in Johannisberg (Rhine District) as a neuropsychiatric spa in 1881, he translocated to Wiesbaden in 1891. There he continued his studies of hypnosis and suggestion as cures, which finally resulted in a comprehensive monograph on the subject (Hecker, 1893). He made it clear that the doubts that had been raised regarding the therapeutic effects of electricity in organic diseases would be 'justified even more' as far as functional diseases were concerned. This was due to the fact that in functional diseases 'a vast number' of symptoms, which was 'maybe much higher than we previously assumed', were based on auto-suggestion. For this reason, functional neuroses could be cured solely by suggestion and without applying any other therapeutic method, including hypnosis. Hence 'we are to admit that in a certain number' of cases, electricity was merely 'more or less the carrier of suggestion'. But electrotherapy did of course have effects on its own. This was proved by two observations; electricity could cause organic changes that in turn clearly affected functional symptoms. In particular, electrotherapy could produce changes in blood circulation, including the cranial cavity by contraction of the pial vessels, anaemia or hyperaemia. Applying electricity to the pectoral muscles or extremities (and thus contraction of muscles in the venous and lymphatic system) could also lead to changes in blood circulation. And such disturbances in circulation played a significant role in the genesis of neuroses. He also reported some cases in which patients were first submitted to suggestive treatment that had produced no effects at all; only then were they referred to electrotherapy, which led to the patients' recovery. Hecker, therefore, concluded that a possible suggestive effect or mediation could be

excluded, since it had been applied to no avail. One case that Hecker reported was a hypochondriac neuroaesthetic who had suffered from pain in the first occipital nerve and had first been submitted to hypnosis, or suggestion, without any result, but recovered after the faradic brush was applied. Contrary to this, there were cases in which the patient was solely submitted to suggestion and to no other therapy, and was still cured. In a second instance, he reported of a patient suffering from phobia, who was treated with galvanic current and promptly cured (Hecker, 1892, p. 59–62) (Table 1).

Results and Möbius's response

The Frankfurt Convention did not end with binding conclusions or even a programme for the future. Whenever a resolution was suggested, these were disapproved as premature. The reports and additional papers, as well as Erb's summary of the central thread, nonetheless allow the following conclusions to be drawn.

Möbius's notion that the effects of electrotherapy were, to a large degree, based on suggestion was supported in a number of contributions. This was particularly true for the alleged analgesic effect. The second point that he made, which weakened the position of the 'positive electrotherapists', was that peripheral paralyses and diseases of the central nervous system could not be influenced by the application of electricity. With regard to functional diseases, Hecker clearly supported both the aetiopathogenetic and therapeutic impact of suggestion. Only in one case did the convention meet the intended aim of promoting electrotherapy and proving its effects, namely in neuralgias. Here the therapeutic effects of electrotherapy were unambiguously confirmed as solely resulting from the application of electrical current. Against

this background, the repeated reassurance in many contributions that electricity had long-since proven its curative effects and was proving them in day-to-day practice must have seemed subjective and somewhat awkward to some attendants. The latter possibly raised awareness to the fact that such effects must still be proven, and on a scientific empirical basis. In consideration of the substantiated, carefully thought-out and well-balanced statements made at the convention, even Erb seems to have regarded the suggestive component of electrotherapeutic results as more justified. Yet he insisted that this explanation was 'undoubtedly untrue... for the larger part' (Erb, 1892, p. 55–56), relying mainly on the objection that there were too few experts who were specialists in both electrotherapy and suggestion. It can only be assumed that, in view of this, it took Erb by surprise that the Frankfurt Convention did not enable him to gather a phalanx against Möbius as he had hoped when planning the convention and possibly even while listening to Laquer's report. On the other hand, Erb must have held his former colleague and good friend at the Leipzig out-patient department in high regard and cherished appreciative thoughts about him at least until September 1890. Otherwise he would not have approached him to ask for contributions to the *Deutsche Zeitschrift für Nervenheilkunde*, which he planned to launch (Drobner, 1982, Letter 14 in the appendix). Möbius's attacks on his beloved electrotherapy nonetheless caused him 'no small pain' (Strümpell, 1925, p. 125). It may have been Rosenbach's and Bruns's reports, which followed Laquer's, that brought about this change in mood, since they were not at all polemic, but textually and methodically sober, down-to-earth and unprejudiced. The latter is what made them different from Möbius's survey reports. Besides all justified criticism he raised therein, Möbius also wanted to attract attention and attain some kind of result. This inclination to draw public attention

Table 1 Indication recommendations for electrotherapy

Wilhelm Erb (esp. Erb, 1872)	As basic therapy for cerebral hemiplegia and bulbar palsy (certain recovery), focal diseases in the brain in combination with partial paralysis or vertigo. Treatment of symptoms of brain diseases such as headache, tinnitus, insomnia; early phase of tabes dorsalis, meningitis and myelitic processes and paralyses caused by those, spinal poliomyelitis, progressive muscular/myoatrophy, paralysis in the external eye muscles, accommodative paralysis, nervous ear diseases, neuralgia, migraine. Treatment of symptoms in anaesthesia. Causal treatment for paralyses, e.g. cerebral, spinal, neuritis, or traumatic and rheumatic diseases of peripheral nerves.
Albert Eulenburg (Eulenburg, 1883)	Favoured electrical baths as electrotherapeutic cure for general weakness of the nervous system, neuroaesthesia, nervosism, hypochondria, hysteria, general neuroses, neuralgia, chorea, epilepsy, athetosis, tremor, paralysis agitans, Morbus Basedow. Also recommended as general anti-neuralgic, antiparalytic, antispasmodic and antianaesthetic remedy.
Paul Julius Möbius (Möbius, 1891)	Neuroaesthesia, neuralgia, some kinds of pain, certain forms of paraesthesia, motor irritations. Symptomatic treatment for some forms of organic irregularities such as vasomotor disturbance, obstipation, menstruation anomalies, insomnia.
Moriz Benedikt (Benedikt, 1892)	Remedy for chronic, therapy-resistant central paralyses, chorea major, diseases of the peripheral nerves, tabes, Morbus Basedow, functional neuroses, migraine, hysteria, tinnitus, vertigo, pressure in the head, neuroaesthesia, cerebral exhaustion, insomnia, nervous excitement, impotence, stranguria.
Ottomar Rosenbach (Rosenbach, 1892)	Prophylactic treatment against atrophy or contractures of paralysed muscles.
Ludwig Bruns (Bruns, 1892)	Neuralgia
Ewald Hecker (Hecker, 1892)	'Favourable influence' on functional neuroses
Emil Kraepelin (Kraepelin, 1892, 1909)	Neurasthenia, hysteria (esp. twilight states), insomnia, pressure in the head

The table lists recommendations made by the attendants of the Frankfurt Council with regard to afflictions in which applying electrotherapy could produce positive effects. In general, galvanic current was used to excite the brain, spinal cord or individual sense organs, whereas faradic current was used to affect peripheral nerves and muscles.

may have been rooted equally in his narcissistic personality structure and in his fight against the academic medical establishment that had denied him his career (Waldeck-Semadeni, 1980; Steinberg, 2005a). Contrary to him, Rosenbach and Bruns showed a sincere, unprejudiced endeavour to shed light on and investigate central scientific issues.

The last of Möbius's six survey reports on new publications in the field of electrotherapy appeared in *Schmidt's Jahrbücher* in 1893. Therein Möbius commented in detail on the Frankfurt Convention of Electrotherapists. In this report, he also announced that this section, contrary to other neurological and neuroendocrinological subjects that he continued to cover, would henceforth be supervised by Konrad Alt, who had just been appointed Head of the Uchtspringe Asylum near Stendal. Although Alt followed Möbius's sense, one can only assume why the latter gave over this section to Alt. One reason may have been that Möbius had reached his objective, which was to ignite a debate on how electrotherapy produced its effects, and that it was well appreciated that it was he who had brought it about. Although the last of Möbius's survey reports includes the sentence 'I no longer have the nerve to electricise a neurasthenic or private patient suffering from tabes for a period of three or six months', it should not be believed that Möbius had resigned and regarded electrotherapy as an unsuccessful and useless method of treatment. On the contrary, as late as 1891, Möbius had repeatedly maintained that it was an extremely suggestive medium and a method that produced excellent compliance with out-patients (Möbius, 1891). Furthermore, Möbius seems to have remained a committed user and in 1894 he even admitted that electrotherapy indeed had its effects in the treatment of migraines (as suggestively as they may have been mediated) (Möbius, 1894b p. 91–2). Hence, despite all reservations, and the general increase in acceptance that electrotherapy was unsuitable as a sole cure, electrotherapy was a widespread method of treatment for headache, migraine or hemicrania (Koehler and Boes, 2010).

Another main issue and point of criticism at the Frankfurt Convention was the 'completely wrong' conception of suggestion. Möbius considered suggestion to mean that an effect was reached or brought about through 'imagination', i.e. through mental processes, albeit not consciously; it was involuntary and could not be imitated intentionally. These imaginative effects were far-reaching, somatically speaking and could both cause or eliminate pathological states. Hence suggestion was a widespread phenomenon and hypnosis, which was referred to so often in connection with suggestion, was just a seldom and special case of it. Depending on disposition and/or education and training, each human being is suggestible, but not through the same methods and not to the same degree (and hence with varying success). Suggestibility is particularly high in phases of excitement, be it fear, hope or horror. Hence the point in suggestion is not, as Laquer suggested, believing in cure, but believing in the efficacy of electricity. Contrary to what had been suggested in Frankfurt, Möbius maintained that it is simply impossible to exclude suggestion. This does not mean that he neglected the natural course of a given disease. On the contrary, he was in full agreement with Rosenbach and fully aware of the fact that many false impressions or misconceptions arise precisely from this ignorance of the natural facts.

Another point Möbius criticized in his last survey on electrotherapy was that many colleagues did not differentiate between an individual physiological effect, i.e. therapeutic success in one person, and a general and regular, hence reproducible, therapeutic effect. These colleagues presented individual case studies as proof of the effectiveness of a given therapy. Such proof, however, can only be established through larger comparative studies that investigate the effects of electricity in the body or in a certain disease. A good starting point for proving the effects of electrotherapy could be experiments on animals or treating an illness that usually occurs on both sides of the body or only on one side. Studies on brain or constitutional diseases should be postponed until later. The 'main shortcoming' at present, however, would be the lack of psychological insight and understanding among medical professionals who had been one-sidedly (mis)trained in the direction of a purely materialistic–naturalistic approach. This was also one of the reasons, Möbius admitted, why he had attacked electrotherapy, the other one being that this therapy was very well-known and a 'hobbyhorse' of many of his colleagues. The points he made here should be regarded as exemplary in many regards and as addressing general issues (Möbius, 1893b).

Discussion and outlook on 20th century electrotherapy

Present-day readers are genuinely struck by two facts that become obvious when reading the contributions from the conference volume of the Frankfurt Convention of Electrotherapists. On the one hand, this is the uncritical and hence unprofessional approach of many doctors, therapists and researchers towards their own thinking and practical scientific or clinical work. On the other, it is the very limited grasp of what suggestion is about and how it works, namely by means of the authority of the (alleged) therapy of the doctor/therapist. The very notion that there might be a medical practice totally excluding suggestive components may furthermore appear naive to present-day readers. The introductory report by Laquer in particular mirrors both of these aspects clearly, as do the contributions made by Moritz Benedikt, who in 1899 had been appointed first ever Professor of Electrotherapy at Vienna University [interestingly, electrotherapy was awarded its first professorship long before neurology was acknowledged as a scientific subject in its own right (Schiller, 1982, p. 24)]. Some of Laquer's comments on suggestion make for somewhat absurd reading, above all the factual equation of suggestion and hypnosis, hereby referring to the definition of suggestion that Jean-Martin Charcot gave when he criticized its inappropriate application in the treatment of hysteria: 'Suggestion prevents the human being from acting and the human mind and nature from expressing itself independently. In many cases suggestionists (hypnotists) strive to impute and train weak will and lack of character in their patients' (Laquer, 1892, p. 8). Erb showed more greatness and awareness of the problems. Arguing that there was neither a theoretical explanation for the effects of electricity, nor for those of suggestion in the body, he did not acknowledge reports on individual cases as proof, but demanded thorough and

systematic methodological studies (Erb, 1892, p. 6–7, 55). Yet every issue Erb raised indicates that psychological explanations or mental issues were not part of his ideology and that he was convinced of a regular physical effect and that this effect (i.e. cure) was brought about by electricity. Conversely, he regarded mental effects as nothing more than a source of disturbance and their consideration as being equal to charlatanism, incompatible with scientific medicine. Hence psychotherapy, even as applied by doctors for somatic illnesses, was subject to the same scepticism. In fact, it is Erb's scepticism that should have given rise to scepticism among attendants of the conference and contemporaries. There was, after all, not even a clear understanding of the nature and the natural course of the most important neurological diseases. Some protagonists did not understand that they had been simply raised in the belief that electricity was the one cure and that applying it was the only viable method, which at the same time provided the guarantee for working scientifically and meeting scholarly standards. Yet since there was no scientifically valid proof of its effects, they were blind to the fact that they had become faithful followers of what could even be termed a pseudoscientific approach. Many remained ignorant of alternative ideas or approaches, such as those that deviated from the mainstream and the reigning paradigm.

Against this background, Möbius's actual aim was not to attack electrotherapy, much less to condemn it, but rather to ignite a comprehensive discussion on the one-sidedly materialistic and somatic approach and to raise awareness of and understanding for the impact of psychological, mental aspects, i.e. factors that could not be measured, counted or seen in neurological practice. He also wanted to make his readers aware of what lapse or distortion neglect of these factors could lead to. Other works published by Möbius in the second half of the 1880s support the notion that it was at this time that he altered course in order to focus more on considering the human psyche and on an internal, psychological approach to the human being and human illnesses and diseases (Steinberg, 2005a). His articles and books are among the first, and pre-Freudian, publications of this kind in German neuroscientific literature. Waldeck-Semadeni (1980, p. 67) went as far as declaring Möbius the 'pioneer' of this approach. Through attacking electrotherapy, which constituted one, if not the most essential treatment option at that time, and thus the basics of their subject and self-understanding, he caused neurologists to take up the subject, investigate it more closely, take a stand and react to the criticism raised. Later, Möbius like others, such as Krafft-Ebing (Roelcke, 1999, p. 136), abandoned electricity and electrotherapy in favour of degeneration theory. Here too, he was of lasting importance for German-speaking neurosciences (Steinberg, 2006), in particular through linking endogenous mental and nervous diseases to the concept of degeneration (Möbius, 1893c, 1898), but equally by pioneering and thus helping to establish the differentiation between endogenous and exogenous mental and nervous diseases. Many colleagues were to follow his approach and reached a factual examination of both electrotherapy and mental phenomena.

Among others, a direct influence of Möbius's reviews can be substantiated by one colleague, Sigmund Freud, who later came to a similar conviction, but to a less radical or influential degree. In

1887, Freud comprehensively investigated suggestion therapy, since he had become 'baffled' by the 'disappointments' he experienced applying 'W. Erb's "electrotherapy", so rich in both indications and recommendations'. Much to his regret, Freud 'soon experienced that going by the rules never helped and that what was assumed to be the result of exact observation was nothing but fantastic creations... Hence, I hid away the electric appliances even before Möbius spoke the saving words that the effects of electrotherapeutic treatment, if there were any at all, were but a result of suggestion on the part of the doctor'. In the 1920s Freud vindicated himself, admitting that he 'had not got through to the evaluation that was later accepted by Möbius' due to 'the lack of the promised positive results', when he had practised it himself. The disappointing results soon led him to stop applying electrotherapy, hence coming to this conclusion (Freud, 1924, p. 5, 1960–68, p. 40). This did not, however, prevent Freud from acknowledging Möbius's merit. As early as 15 years prior, in 1909, Freud had already raised Möbius, equal to Auguste Ambroise Liébault and Bernheim, to peerage as founding fathers of modern psychotherapy (Freud and Adelbert, 1968, p. 335).

Möbius's view also found its way into German academic medicine. In 1915, Karl Bonhoeffer, Head of the Psychiatric and Neurological Hospital at Berlin's Charité, evaluated that organic effects of electrotherapy were limited 'to a rather small and even there... disputable area'. On the contrary: the 'fundamental effect' of electrotherapy is mediated 'via the psyche... in the vast majority' of cases. Hence electrotherapy was 'psychiatry in its primary sense' (Bonhoeffer, 1915, p. 100). This evaluation was made in his negative response to Erb's call to the medical faculties at German universities and the Ministries for Higher Education in the German Reich in 1914 to acknowledge neurology as a discipline in its own right and to grant institutional independence, separated from psychiatry. Bonhoeffer's refusal to support Erb may have weighed more heavily since he was not only most acknowledged as a scientist, but had also been consulting and advising Prussian ministerial bodies on basic administrative, clinical and university-teaching issues. Hence his opinion may have had an enormous impact. Kraepelin seems never to have placed great hopes or even to have bothered gathering first-hand experience himself in electrotherapy. Even in the eighth, much enlarged and amended edition of his monumental *Textbook of Psychiatry*, he did not include more than two paragraphs on electrotherapy. In these, presumably from a purely psychiatric point of view he ruled that electricity still worked best in hysteria, namely through exciting patients in semiconscious states by means of faradization, in neuroaesthesia and in insomnia by hypnotizing patients through a galvanization of their head. Yet, he added, in all these treatments the 'surely not negligible part that has to be attributed to the mental influence' in this therapy can 'by no means be separated' from a physical effect (Kraepelin, 1909, p. 587–8). In 1892, with reference to the Frankfurt Convention, he stated that in general, electrotherapy was less effective for the treatment of local affectations but, contrary to that, good to amend general affectations, primarily those that could just as easily be influenced by suggestion therapy, such as tension in the head, insomnia, neuroaesthetic fear, etc., in which—as he did not forget to mention—suggestion therapy produced results 'highly superior' to those gained with the

help of electrotherapy (Kraepelin, 1892). Comments of later years prove that, whenever electrotherapy was applied in the 20th century, 'many hospitals' (both psychiatric and neurological) used it to treat psychogenic neurological and mental illnesses, not because they believed in a primarily somatic therapeutic effect, but mainly because of the suggestive impact it had. One such comment was made by Dietfried Müller-Hegemann, then Head of the Leipzig Department of Neurology and Psychiatry. In 1956, he published a case study on a patient suffering from psychogenic aphonia saying that, instead of time-consuming psychotherapy, the patient was submitted to suggestive electrotherapy, which produced most satisfying results. But Müller-Hegemann put restrictions on its use and also apologized for making use of suggestion as an 'emergency substitute therapy' (Müller-Hegemann, 1956, p. 45). Even Ludwig Edinger, one of the co-initiators of the Frankfurt Convention of 1891, seems to have been more conciliatory towards Möbius's psychological evaluation, or at least became so after 1900. This is substantiated by several of his anonymously or unpublished works, in which he fulminated against the positivist scientific 'pseudoexactness' that is so much inclined or overwhelmed by the 'appeal' of numbers and measures (Kreft, 2005, p. 325–6).

Undoubtedly Möbius's views were perverted, when during and after both World Wars front-line soldiers were submitted to electrotherapeutic treatment. Yet the manifold implications, in which electrotherapy was (ab)used, also demonstrate *in extremum* that Möbius's evaluation had become common opinion—i.e. until it was rediscovered and gained new popularity over the last decades. During World War I, Ludwigshafen neurologist Fritz Kaufmann and his Austrian colleague Wilhelm Neutra developed the so-called 'Surprise Method' (*Überrumpelungsmethode*, see Kaufmann, 1916; Neutra, 1920). Within the framework of this therapy, soldiers having returned from war as 'hysterics', i.e. they suffered from post-war traumatic stress disorder in present-day terminology, were consciously submitted to pain and torture (not seldom resulting in death) by means of electricity in order to pass the treatment off as somatic. Basically this treatment was intended and widely used to discipline psychophysical functions, admittedly by means of suggestion (Lerner, 2003; Hofer, 2004; Riedesser and Verderber, 2004; Schaffellner, 2005). In France, it was called the 'Torpillage Method', thought of by Clovis Vincent and Gustave Roussy, which was widely used in military medicine. Electro-suggestive applications were used to restore war neurotics to a fit-for-military-service condition so that they could return to the front as quickly as possible (Tatu *et al.*, 2010). The German concept of war neurotics was based on and the result of decade-long discussions of the concept of traumatic neurosis, as proposed by Hermann Oppenheim (1889), and of the question of malingerers and malingeries, which had become imminent through pension and compensation claims after the introduction of Bismarck's social security system. According to the original 1889 concept, organic alterations in the nervous tissue were the result of physical shock. In the course of discussion, degeneration theory and in particular Charcot's concept of traumatic hysteria (*Névroses Traumatiques*) and the hereditary diathèse, i.e. a combination of a constitutional predilection to nervous degeneration and an environment 'agent provocateur' (Micale, 1995), were more often

considered, but without any specific reference to the latter during the war years. This, however, could be explained by remembering that even though most German neuroscientists standing up for a psychogenic origin of nervous diseases had worked with Charcot, they still shared the general war enthusiasm and thus may have hesitated to appreciate anything originating in France, the enemy. In addition, at that time, Charcot had been dead for over 20 years. One of the participants of the Frankfurt Council, Munich private practitioner Ludwig Loewenfeld, is a good example for the general abhorrence towards anything French having conquered even the sciences. In 1914, he presented his concept of a psychopathia gallica, postulating that the French suffered from a most far-reaching degeneration, which would primarily show in intellectual inferiority, increased effeminacy, emotivity, vanity and suggestibility, the latter interestingly being the issue discussed here, whether electrotherapy produced its effects physically or through suggestion (Loewenfeld, 1914). During World War II, German war neurology and psychiatry at least relied on similar treatments that involved the application of electrical current. In 1942, Karl Otto Wuth, who was Head of the Institute for General Psychiatry and War Psychology at Berlin Medical Academy, pushed the use of Faraday brushes and galvanic currents on neurotic soldiers. He even went as far as postulating that this treatment need not be given by specialist doctors, since the methods were not only low cost, but also demanded little in application. By June 1944, this method was replaced by a therapy relying on higher galvanic current developed by Friedrich Panse and Günter Elsässer near Cologne. Soon this 'therapy', nicknamed 'Pansing' ([das] *Pansen*, from the surname), was dreaded as a method of torture (Schröder, 1993; Hilpert, 1994; Müller, 2001; Kloocke *et al.*, 2005).

Present-day electroconvulsive treatment, vagus nerve and deep brain stimulation are new therapeutic approaches, totally different from the electrotherapeutic methods of the 1880s or 1890s, which were neither convulsant, nor neurosurgical in nature. Yet similar to the situation at that time, their exact mode of action and method of achieving effects are still unclear. For decades, electroconvulsive treatment has proven to be a most effective therapeutic option, yet in a very strict and narrow indication. For vagus nerve and deep brain stimulation more data are required and moreover the long-lasting effects need to be established. As the available data suggest, however, these new methods seem to have produced promising effects in a remarkable number of patients who had proven resistant to standard and other therapies. In the case of transcranial magnetic stimulation and cranial electrotherapy stimulation, both non-invasive in nature, a mode of action similar to electrotherapy of the 1880s and 1890s can be assumed. Not only are both therapies very close to the methods used then, they could not prove any significant permanent clinical effects, but only temporal, in placebo-controlled trials. No valid evidence as to the exact effects has ever been produced. Doubts may be increased by the fact that these methods have not yet been standardized and many studies show a generally bad design. In addition to that, double-blind studies cannot be conducted (Koehler and Boes, 2010). The stimulation or depolarization of nerves and muscles, or the influence on the reticular activating system, the limbic system or the hypothalamus have been taken to signify

their true curing mechanism. However, none of these suggestions satisfactorily explain the way effects are reached, as far as the stimulation of combined cortical areas or networks is concerned. Interestingly Möbius proposed an explanation very similar to the depolarization hypothesis for the curing mechanism of electrotherapy. With particular reference to the analgesic effect in neuralgia, pseudoneuralgia, affectations of joints and muscles, in headache and caries, Möbius suggested that pain that could be abolished by the application of current had to be neuralgic in nature. He also claimed that presumably such neuralgic pain was based on 'most peculiar alterations in the sensitive nerves or the central organs', which could not be equated to established, anatomically detectable changes such as inflammations. To describe their nature, Möbius drew an analogy with iron: 'If one imagines a nerve to be built like a magnet, in its unaffected, healthy constitution all parts of the nerve would be oriented the same way, e.g. all south poles showing to the periphery. Neuralgic alteration, however, would mean that this usual condition has been disturbed and the parts of the nerve are disarranged like in a non-magnetic piece of iron'. To explain the possible effect of electrotherapy, Möbius continued that 'galvanizing a nerve would be equal to rubbing a magnet over a piece of iron'. Each rub will rearrange a certain number of pieces in the iron to their usual orientation and, depending on the degree of disarrangement, a larger or smaller number of rubs will suffice to give all pieces the same orientation. If on the contrary in between the individual rubs the original shock that brought about the disarrangement occurs again, such disarrangement will also repeat. If the shocks' intensity declines, each rub of the magnet will rearrange a larger number of pieces to their previous, usual orientation than the shocks can disarrange again. Hence electrotherapy will produce a curative effect in nerves when the inflammatory process subsides, without however having a direct effect on the inflammation' (Möbius, 1880a p. 502–3).

All functioning mechanisms in human beings, from the single cell, to organs including the brain, and the whole living being, are based on electrical processes. Even though throughout most of the 19th century, this was still a hypothesis, which had not yet been verified and proven, this theory was wide-spread and nurtured the conviction that the application of current to the body should be able to cure any disturbances in the electrical 'circuit' of the nervous system with particular reference to this hypothesis. The increase in neurophysiological experience seemed to support clinical neurology in this approach. The electricity concept overlapped and for a certain period, e.g. the decades between 1850 and 1890, paralleled the reflex paradigm that had already been present in conceptual history. In the latter, neuroanatomic structures in the body were conceptualized as interdependent and connected with each other through a reflex arc. Thus for instance the ovaries, the spinal cord and the brain were considered as one functional unit, in which the affection of e.g. the ovaries would disturb the whole system and result in hysteria. As the connectivity within these units was conceptualized as being realized through the nerves and since, according to the electricity paradigm, the nerves' activity was based on electricity, electrotherapy and its alleged curative effects are nothing but a logical result of these two paradigms. Yet in opposition to those, there were other conceptual paradigms

in both neurology and psychiatry that refused to accept the notion that natural processes within the body could be based on electricity. Those concepts relied on totally different foundations and basic assumptions and hence led to totally different conceptions of functioning, aetiological, diagnostic and therapeutic approaches. Periodically the different paradigms, usually in an updated if not a mixed form, came back and took turns in influencing the development of both neuroscientific disciplines, and presumably they will continue to do so. The psychogenic paradigm that had originated in Paris and Nancy in the 1870s and 1880s and been supported in Germany, among others, by such outstanding figures as Josef Breuer, Sigmund Freud and, before them, by Möbius, concentrated on the psychological aspects of neurological and mental illnesses. According to this paradigm, there are illnesses that are caused by psychotraumata or reactive processes, i.e. pathogenic suggestions, and could/should be cured by psychological or suggestion therapy. The first psychotherapeutic methods—Charcot's hypnosis therapy, Bernheim's suggestion therapy and the psychocatharsis method developed by Josef Breuer—were purely suggestive in nature. For these 'suggestionists', it was impossible to think that a phenomenon as enigmatic as electricity would not affect the psyche when being applied to the body. At the Frankfurt Council of 1891, this overemphasis of suggestion as supported by the followers of the psychogenic paradigm crashed against the hypotheses of the supporters of the electricity and reflex paradigm who conceptualized suggestion in a way that was typical for very early psychogenic theories such as Franz Anton Mesmer's magnetism or James Braid's hypnotism concepts. Against this background, it is little wonder that the mere term suggestion provoked fierce attacks on both sides, since it was conceived to undermine the foundations of a whole school. On the example of the controversy on electrotherapy it becomes evident that each paradigm perceived and propagated its own hypotheses and scientifically evidenced findings and its own working methods, procedures and techniques (which were all based on the paradigmatic foundations) as the ideal approach, sometimes not even allowing, let alone accepting alternatives. Besides factual argument, a common strategy in fighting scientific opposition was and is the marginalization of competing concepts, methods or hypotheses—or declaring them unscientific. However until now none of the paradigms has succeeded in offering the key to absolute truth, for none of them is capable to consistently explain all phenomena that occur in illnesses. Against this background, one thing was established for sure: electrotherapy is capable of producing curative effects through suggestion and these effects should not be played down. Yet suggestion cannot be the only basis for the manifold therapeutic effects electrotherapy has been producing. In certain patients and indications, suggestion can be effective, but to declare it the only way to treat a certain illness would be inappropriate. This is also true for electrotherapy. The different methods that are based on the use of current for therapeutic purposes have established themselves as neurological treatments and been applied until the present day. To carefully choose and apply them and to establish the right dose and mixture requires a skilled doctor, who should submit personal preference for a certain paradigm to the wellbeing and cure of his/her patient. Consequently, neither electrotherapy nor suggestion therapy

should be seen as (nor have they been proved to be) a dead-end of an early, allegedly overcome neurological period. The Frankfurt Council clearly showed that scientists who overestimate or insufficiently question their own approach, e.g. by claiming that electricity could cure each and every illness and denying that electrotherapy may have a strong suggestive component, can easily fall prey to marginalizing themselves. In the same way, one may ask the question if, perhaps, today we have reached a similar point, where it may be regarded inappropriate or even impossible to even mention a suggestive component in modern electricity-based psychiatric and neurological treatments without falling prey to being laughed at, attacked or declared unscientific. One should, however, not forget that until a few decades ago, physical processes such as electricity had not yet been reappreciated as part or the basis of therapies to central nervous illnesses. Historic reflection and consideration of the dispute regarding electrotherapy conducted around 1890 may help a self-critical examination of present-day methods from a different point of view as well as a more balanced evaluation of the half-life period and return of attitudes or arguments over time. It may also help regard criticism not as an attack or as being driven by an urge to destroy, but as a cleansing, supplementing contribution, just like August Forel, leading Swiss psychiatrist and Head of the famous Burghölzli Asylum in Zurich, who commented on the debate on electrotherapy ignited by Möbius: 'Suggestion theory is not to defeat [electro- H.S.] therapy, but to purify, strengthen and enrich it. Anyone unable to understand that has not understood anything about what suggestion theory is about' (Forel, 1892/93, p. 80). From a long-term historical perspective we are witnessing and forming a new change and must not only allow, but also strive to find answers to unanswered questions.

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