Wilhelm Erb's Years in Leipzig (1880–1883) and Their Impact on the History of Neurology

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Abstract

Background: Between 1880 and 1883, the famous German neurologist Wilhelm Erb was appointed Professor of Special Pathology at Leipzig University and Head of the Medical Outpatient Department. **Summary:** Besides the favourable clinical conditions, it was first and foremost the access to large numbers of patients that enabled him to both establish a new, juvenile form of progressive muscular atrophy and to classify various forms of muscular atrophies already discovered into a new clinical entity which he called dystrophia muscularis progressiva. **Key Messages:** His summarising these different forms of muscular atrophies into one group is the most long-lasting outcome of Erb's years in Leipzig. The access to large numbers of different patients at the Medical Outpatient Department, on the one hand, and the dynamics of Leipzig's neurosciences, in particular the so-called 'Leipzig Nervous Circle', on the other, had a lasting impact on Erb and definitely gave him other valuable insights, such as the thought that tabes dorsalis must have been caused by a syphilitic infection.

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Introduction

Internist and neurologist Wilhelm Erb is frequently associated with the town of Heidelberg. As a result, many are unaware of the fact that his long Heidelberg years were interrupted by a short, yet for the history of primary myopathies surprisingly fruitful interval of 3 years spent in the town of Leipzig.

Wilhelm Heinrich Erb was born on November 30, 1840, in the village of Winnweiler (province of Palatinate in Germany) and died on October 29, 1921, in Heidelberg. He was one of the best known specialists in internal medicine of his time and one of the founders of German neurology. He wrote several basic clinical and methodological neurological works and provided major stimuli both for the subject's development and for its institutional 'emancipation'. Together with Adolph von Strümpell (1853–1925), Ludwig Lichtheim (1845–1928) and Friedrich Schultze (1848–1934), he co-founded the *Deutsche Zeitschrift für Nervenheilkunde*, the 'German Journal of Neurology', in 1891 [1], which became a leading publication of the entire discipline soon thereafter. In 1907, he was elected the first President of the Society of German Neurologists, which later became the German Society of Neurology, acting as the professional representation organisation [2–11].

The First Period in Heidelberg

Erb studied at the Universities of Heidelberg, Erlangen and Munich. He completed his studies in Munich, where he received his medical doctorate with a thesis on picric acid [12]. For a short time, he also assisted Ludwig von Buhl (1816–1880) in pathological anatomy in Munich. He subsequently returned to Heidelberg and was taken on as assistant to Nikolaus Friedreich (1825–1882) at the Medical Clinic of Heidelberg University. Here, he qualified as University Lecturer in 1865 with his thesis ‘On the Evolutional History of Erythrocytes’ [13]. Four years later, he was awarded Associate Professorship. At the clinic, he contributed to Friedreich’s neuropathological research, above all on hereditary ataxias, and pursued his own projects investigating the effect electricity could produce on muscles and nerves. In the course of their research, an argument ensued between Friedreich and his younger assistant on the subject of muscular atrophies, in which Erb strongly opposed and rejected Friedreich’s hypothesis that these were caused by an inflammatory process. He instead agreed with views expressed by Jean-Martin Charcot (1825–1893), with whom he would later be in contact for a short period during his Leipzig years [14, 15]. The key principles of Erb’s approach included careful observation, subtle clinical investigation and systematic medical testing and assessment. Like most researchers at the time, he also included pathological-anatomical findings. It was possibly due to this latter fact that Erb also used the term ‘neuropathology’ to refer to ‘neurology’ [16]. Following his approach thoroughly, Erb succeeded in finding clinical phenomena, making terms more precise and establishing illnesses that are named after him to this day [e.g. ‘Erb’s disease’ for progressive muscular dystrophy (PMD), ‘scapulohumeral muscular dystrophy type Erb’ (= juvenile form of PMD); ‘Erb-Charcot paralysis’ for spastic spinal paralysis; ‘Erb’s point’ for a spot for the electric stimulation of the brachial plexus; ‘Erb’s reaction’ for a myotonic reaction; ‘Erb-Duchenne palsy’, also known as ‘Erb’s palsy’, for a brachial plexus palsy or muscular paralysis during childbirth; ‘Erb-Oppenheim-Goldflam syndrome’ for myasthenia gravis pseudoparalytica].

Hence, even before Erb was appointed Fellow Professor in Leipzig in 1880, he had established his reputation as a specialist in neuropathology and as an outstanding doctor – also, but not exclusively, on the basis of several scrupulously researched publications.

Fig. 1. Wilhelm Heinrich Erb (1840–1921) is acknowledged as one of the founders of German neurology (source: [10], p 72).

Erb in Leipzig

With the beginning of the Easter 1880 semester, Erb took over as Fellow of Special Pathology and Therapy and Head of the Medical Outpatient Department at Leipzig University. It is evident, however, that it was not easy for him to leave his native region, the Palatinate and North Baden in West Germany, in order to go to Saxony. He felt closely connected with his native country and loved the city of Heidelberg. His memoirs tell of his misgivings in accepting the honourable appointment as Professor at Leipzig University. Within his professorship, the Leipzig Medical Faculty required him to lay particular emphasis on neuropathology, a sub-discipline of internal medicine little represented by other Leipzig professors and at the same time the specialty in which he had made a name for himself; it was this concentration on his key interest subject that convinced Erb to accept the post [17, 18] (fig. 1).

Erb spent 3 years working solely with outpatients in Leipzig, and these were to prove particularly significant for his work. Due to the enormous amount of patients seeking treatment at the Medical Outpatient Department, Erb was exposed to virtually all aspects and illnesses in internal medicine; at the same time, he benefitted from access to a huge patient database devoted to the clinical and electrodiagnostic assessment of neurological patients, in whom he had a particular interest.

Fig. 2. The Medical Outpatient Department (*Medizinisch-Poliklinisches Institut*) of Leipzig University. Here, Erb worked as Head between 1880 and 1883. The Medical Outpatient Department included a very busy Neurological Section and was located in the so-called *Mittel-Paulinum*, a central building in the yard of St. Paul's central city campus of Leipzig University at Augustusplatz (source: Leipzig City Archives).

The Neurological Section at the Medical Outpatient Department and Erb's Leipzig Colleagues

The institutional basis for this was the Neurological Section at the Medical Outpatient Department of which he was Head. When Erb took over in Leipzig, the entire Medical Outpatient Department was located in the so-called *Mittel-Paulinum*, the central building in the courtyard of the former St. Paul's Monastery, the University's main campus in the centre of town. Starting in December 1892, this complex underwent major reconstruction work [Dresden Saxon State Archives, Coll. Leipzig University 10151/7] (fig. 2). In this context, it would appear feasible that he did indeed set up the Neurological Section, as he wrote in his memoirs of 1911, or at least enhanced the focus laid on those illnesses [19]. The claim that his appointment put new emphasis on neurological research is substantiated by the fact that invoices issued by the Medical Outpatient Department and retrieved from files in the University Archives began carrying the sub-specification 'for nervous diseases' in 1880, which is the year Erb was taken on [Leipzig University Archives, Coll. Medical Faculty, Bursary 861; 1323–28]. Erb's arrival in Leipzig and this institutional emphasis may also have contributed to the increase in neurological patients, substantiated also by Adolf von Strümpell [20]. What may also support Erb's clear intention to focus on neurology is the fact that he brought Alfred Kast (1856–1903) with him from Heidelberg. Kast was a proven expert in

neurology. In 1909, Erb himself pointed out that, during the years of his first fellowship in Leipzig, he had laid particular emphasis on neuropathology, both in medical practice and tuition [17]. Consequently, Erb intensified and widened neurological research at the clinic and secured the subject's institutional basis in Leipzig, for which his predecessors Ernst Leberecht Wagner (1829–1888) and Otto Heubner (1843–1926) had already laid the first foundations and attracted a great number of patients.

It is interesting to note that from 1882 two psychiatrists and neurologists, who would later become famous, worked as unpaid voluntary assistants at the Neurological Section under Erb: Emil Kraepelin (1856–1926) and Paul Julius Möbius (1853–1907). Both had hoped to be awarded a paid post in spring 1883. Yet Kraepelin's hopes were disappointed [21] and Möbius became a regular assistant at the clinic under Strümpell, Erb's successor [22]. Evidently, it remains unknown whether Erb was not convinced by their work or instead believed that he would not be granted permission to hire another paid assistant; for by autumn 1882, Erb already had four regular assistants and a *famulus*, obviously a student or assistant assisting him in his lectures [Dresden Saxon State Archives, Coll. Leipzig University 10151/7, pp. 98–152; contrary to this, the official register (*Personalverzeichnis der Universität*) lists two assistants each for the winter semester 1882/1883 and summer semester 1883]. Among them, Karl Rudolf Biedermann Günther (1855–1926), who

succeeded the above-mentioned Alfred Kast from May 1, 1882, seems to have been hired specifically for the Neurological Section [Dresden Saxon State Archives, Coll. Leipzig University 10151/7, pp. 98, 148]. Even though he could not (or did not wish to) hire Kraepelin officially, Erb supported or even pushed through Kraepelin's *Habilitation* (qualification as University Lecturer) at Leipzig's Medical Faculty in autumn 1883 [23, 24]. Another person working in Leipzig under Erb's directorate merits reference: August Rudolf Brenner (1821–1884). Born in Merseburg, the young doctor went to St. Petersburg (Russia), where he worked as a consultant for electrotherapy and nervous diseases for 20 years at the St. Maximilian Hospital before returning to Leipzig, where he became Associate Professor for Electrotherapy in 1877. It appears that it was Brenner who established this form of therapy in Leipzig, offering a variety of lectures and practical courses until the winter semester 1881/1882, laying particular emphasis on chronic nervous and muscular diseases. Brenner also published a number of studies acknowledging the effects of galvanic electricity and its impact on therapy and diagnostics. Moreover, he discovered the reaction of the acoustic nerve to galvanic electricity and thus laid the basis for electrotherapeutic intervention in diseases of the auditory system. He furthermore contributed to elaborating the patterns of muscular/motor reactions to galvanisation under normal and pathological conditions, a major prerequisite for Erb's discovery and description of the so-called reaction of degeneration in nerves and muscles. Before his arrival in Leipzig, Brenner had published a two-volume practical manual of electrotherapy, which was highly significant for the early conceptual history of this approach [25]. Erb shared a deep interest in electrodiagnostics and electrotherapy since he had attempted to treat muscular atrophies and nervous diseases with faradisation or galvanisation under Friedreich in Heidelberg in 1862. At that early point in time, he asked for a special electrotherapeutic ward to be opened, to no avail [26]. In Leipzig, Brenner and Erb became very close neighbours in the *Mittel-Paulinum* and evidently compared notes not only on neurological patients but also on their research and teaching. A revealing document of this close interaction and their mutual understanding is Erb's very sensitive and touching obituary in the *German Archives of Clinical Medicine*, written after Brenner's death from a brain disease in 1884 [27].

Erb benefitted from the favourable working environment in Leipzig that enabled him to pursue his Heidelberg-born electrotherapeutic and diagnostic ideas and

studies. As acknowledged by Erb himself [14], this led to the publication of his *Handbook of Electrotherapy* [28]. We can only assume that the contact to Brenner as well as to his employees Kast, Günther, Möbius or Kraepelin may have had a particular impact in this regard.

Several other factors could well have played a role: first and foremost his scientific and personal contacts to Leipzig pathologists Julius Cohnheim (1839–1884) and Karl Weigert (1845–1904), allowing him to benefit from their latest findings on the pathology of the nervous system. Moreover, he actively participated in the weekly meetings of the illustrious 'Leipzig Nervous Circle' (*Nervenkränzchen*) at Leipzig's renowned *Baarmann* restaurant, where he joined Cohnheim, brain researcher and psychiatrist Paul Flechsig (1847–1929), neuroanatomist Wilhelm His (1837–1904) and clinician Adolf von Strümpell, who in 1883 was to become Erb's successor as Head of the Medical Outpatient Department [29]. Besides discussing scientific and personal issues in a pleasant and sociable atmosphere, the members of this circle also shared a deep interest in the city's musical life. The above-quoted name 'Nervous Circle' was coined by Strümpell in his memoirs, also confirming that the scientists who met here made Leipzig the 'centre of neurological research' at that time [20]. There is little doubt that the Leipzig community stood in regular and lively contact, and discussed their latest clinical experiences or anatomical pathological findings, the progress made with the help of the new, more powerful microscopes and improved cutting and staining methods (e.g. Weigert's method for staining myelin sheaths, His's discovery of the neuroblasts, Flechsig's findings on the myelogenesis of different fibres in the brain and spinal cord).

Syphilis as the Cause for Tabes Dorsalis

During his Leipzig years, Erb wrote a large number of publications, totalling between 15 and 20. These were case studies or reports on individual clinical phenomena in peripheral nerve lesions and spinal diseases, but they also included his inaugural lecture held on June 16, 1880, in which he expressed his very personal view on 'Recent Developments in Neuropathology and Their Impact on Medical Teaching' [16].

Six of his Leipzig publications describe problems in the treatment of tabes dorsalis or confront the aetiology of the condition. The 1880s saw a hefty discussion on the question of whether syphilis could indeed be the cause for tabes as well as for progressive paralysis, a question of enormous clinical relevance. In this discussion, Erb referred to publications by French authors that suggested such a

link, thus causing these publications to become known. Initially, Erb was rather reluctant to accept this notion, but soon his own clinical and statistical investigations, conducted between 1881 and 1883, produced 'figures that categorically support an aetiological connection between syphilis and *tabes*' [30]. Erb thus became one of the most prominent and eager advocates of this notion, strongly and passionately opposing his 'specialist colleagues in Berlin' [30], above all Ernst Viktor von Leyden (1832–1910) and his followers, who likewise strongly opposed this notion. In point of fact, it was not until two decades later that it became widely accepted that *tabes* and progressive paralysis were caused by syphilis.

Dystrophia Muscularis Progressiva – The 'Discovery' of Primary Myopathias

Another important issue of the time was PMD, which described an entity characterised by the surreptitious beginning and progressing of atrophies in a variety of muscles, which mostly started at the hand or shoulder muscles and proceeded from there. Since a progressive degeneration of the grey anterior horns in the spinal cord had been established as an anatomical basis [31], the illness was also referred to as spinal form or Duchenne-Aran type of progressive muscular atrophy (PMA).

His critical judgement and clinical training led Erb to conclude that there must be another type besides this spinal form, which he subsequently found and referred to as juvenile form of PMA [28]. In his first dedicated study 'On the Juvenile Form of Progressive Muscular Atrophy' of 1884 [31], Erb characterised the illness as a gradually increasing myasthenia and atrophy of the muscles, primarily of the pectoral girdle and the brachium, which took its beginning before the patients reached the age of 20 years (i.e. in their childhood or adolescence); it then proceeded, to a lesser degree, to the pelvic girdle and thigh. He added that this progression could also happen 'in a reverse order' and with different expressivity. Furthermore, he added that, contrary to atrophies, which were characterised by hypotrophies, e.g. slim upper arms, this form could come with temporary, highly expressive 'real' or 'so-called pseudo-' hypertrophies of individual muscles, e.g. of the deltoid muscles and/or the calves. On the other hand, no fibrillar twitches or reactions of degeneration could be established in any of the more than 20 cases to which he had access for his 1884 study. Following this general characterisation of 'his' new form, Erb provided some sample case descriptions, the chronology of

which shows that he first saw these patients while in Leipzig (e.g. case 3: Russian notary, 'first showed up in June 1880 ... for a follow-up in May 1882'). This is also supported by the geographical denominations of cases 1 (Leipzig) and 2 (Paunsdorf, a village outside Leipzig which has since become part of the town) [31]. Hence, the clinical conditions he encountered in Leipzig along with the benefit of access to large numbers of patients enabled him to devise his own approach. Moreover, they proved crucial in his discovery of this new kind of illness. Case description 3 [31] also suggests that following his arrival in Leipzig Erb benefitted from the opportunity to meet and work with August Rudolf Brenner.

Based on the more than 20 cases in his first publication of 1884 [31], Erb established that there had to be a hereditary component, since the illness prevailed within families as well as affecting individuals. Erb thus found 2 sisters (cases 7 and 8) and 3 children from another family (cases 9–11). In the latter 3 children, Erb also found differences in the course and the distribution or in the muscles affected. When he first examined them on December 27, 1880, Erb observed 'severe pareses in arms and legs (without hypertrophies)' in case 9 (Max R., aged 12 years), 'minor atrophies of the arms', but 'severe pareses of the quadriceps femoris and the peroneal region on both sides, the right leg, in particular the right calf with expressive hypertrophies' in case 10 (Richard R., aged 8 years) as well as 'pareses in the peroneal region predominantly (without atrophies or hypertrophies)' in case 11 (Clemens R., aged 7 years). When he examined all 3 children again, their symptoms had 'deteriorated significantly', and in cases 10 and 11, atrophies of the shoulder and brachial region had developed [31].

The analysis of his cases makes Erb suggest that there are hereditary cases of his 'juvenile form' of PMA as well as cases which develop in childhood, beginning in the lower limbs, accompanied by hypertrophies and pseudo-hypertrophies.

In 1876, Ernst Viktor von Leyden (1832–1910) had established a case of 'hereditary muscular atrophy', that was different to the 'typical Aran's Disease' (Duchenne-Aran spinal muscular atrophy), since primarily the lower limbs and the pelvic girdle region were affected. Although Leyden himself saw similarities with the pseudohypertrophic type of muscular atrophy, he still preferred to see the 'hereditary muscular atrophy' described as a separate diagnosis, especially due to the strange, but differentiating attendant symptom of lipomatosis [32]. Contrary to this, Erb included both forms, hereditary and pseudohypertrophic atrophy, in one group with his new juvenile form

of PMA, concluding from his more than 20 cases. These more than 20 cases were always progressive, no matter where they set in, and other body regions were affected in the course of time [31]. As early as 1882, Möbius too had likewise concluded that Leyden's hereditary muscular atrophy and pseudohypertrophy were expressions of one and the same illness [33]. [To honour the research and achievements of those two neurologists at a later point, the kind of hereditary muscular atrophy which takes its beginnings in the lower limbs of the pelvic region was called Leyden-Möbius (muscular) dystrophy.] Yet, he saw a clear distinction between hereditary and acquired forms of muscular atrophies [34]. Again, Erb opposed such differentiation since among his cases he had found atrophies 'which had not begun in the low limbs, but can still be counted as hereditary forms'; in case 12 (examined on May 29, 1883) he had found 'a classic picture of so-called pseudohypertrophy', which on closer inspection also showed 'atrophies in the upper half of the body', but had no hereditary links in the family. He thus concluded that all three forms, hereditary, pseudohypertrophic and juvenile, were different expressions of one and the same PMA and needed to be put into one clinical category for which he suggested the Latinised name *dystrophia muscularis progressiva* in his study of 1884 [31].

Erb 'did not have access' to all desired examination methods, in particular with regard to pathological anatomy; in 1884, this compelled him to leave open whether these forms were a 'local muscular disease' or a 'central nervous disease', like a special kind of muscular trophoneurosis. In an addendum to his study, Erb nonetheless maintained that the three forms categorised as one group were different from spinal PMA and 'most probably myopathic in nature' [31].

Erb's second study on muscular dystrophy of 1891 [34] reviews his conclusions of 1884 on a broader basis; this consisted of more cases he had treated himself and of those presented in the literature – totalling over 100 cases. As a result of his subtle analysis, he saw all his claims made in 1884 on the basis of his studies in Leipzig confirmed, the only addition being the new subgroup of very early cases, which he called *dystrophia muscularis progressiva infantum*. In this more comprehensive study, Erb discussed and included the findings by Duchenne (on a special infantile form of PMA [35]) and Landouzy and Dejerine [36]. The latter two had revisited the findings by Duchenne in 1885 and added 7 of their own cases. For 1 of these, they even had the section results, which clearly established that in cases of infantile PMA the nervous system obviously remained unaffected. This led

them to the conclusion that these infantile forms were myopathic in nature with clear hereditary traits and also effects on the face. For this reason, they called these forms *facioscapulohumeral* [36]. Those cases, however, in which the face was not affected (*scapulohumeral* forms), were identical to what had been defined by Erb as juvenile PMA, the difference being that the former developed earlier. Erb now found that all these forms coincided with regard to their course, which was his main criterion. He also provided evidence to show that the question of the face being affected could change over time, which was proven by the course of his Leipzig case 4. When examined for the first time in 1882, the patient showed the symptoms typical of the juvenile form, i.e. without facial affection. In 1888, Erb had the opportunity of a follow-up examination (then defined as 'case 23'), and the patient showed 'clearly expressive' facial affection as well as expressive atrophies and pareses of the lower limbs (in particular the thighs) as well as hypertrophies in individual muscles in the pelvic girdle (*musculus glutaei*, *musculus iliopsoas*) and the calf, which had not yet manifested 6 years previously [34].

For his 1891 study, he analysed a total of more than 100 cases. All of them lacked reactions of degeneration and fibrillar twitches, which was a determining criterion or symptom declared by him in his first study of 1880. One can therefore say that this later study confirmed the findings of the study carried out in Leipzig on a wider basis. Working out this new clinical entity of PMA as such can nonetheless be regarded as a product of his Leipzig years. As an addition, in 1891, Erb provided pathological anatomical findings for 7 cases in which he found 'changes in the muscles that are identical in all major aspects'.

These reasons led to Erb's view that 'the different forms of muscular atrophy (juvenile, pseudohypertrophic, hereditary and infantile) belong together and form one group of illnesses or one clinical entity, best referred to as progressive muscular dystrophy/*dystrophia muscularis progressiva*'. Any sub-differentiation into infantile, juvenile and adult forms within this entity was regarded by him as an additional differentiation [34].

Even though Erb, and Landouzy and Dejerine, had both found evidence for hereditary spreading of muscular dystrophy, it was not before the 20th century that these dystrophies had been established as genetically heterogeneous diseases. Today, *facioscapulohumeral* muscular dystrophy (Landouzy-Dejerine type) is regarded as an autosomal dominant disease. In contrast, the juvenile form described by Erb (*scapulohumeral* muscular dystrophy or *dystrophia muscularis progressiva juvenum et adultorum*)

rum) and the pelvifemoral Möbius-Leyden type of PMA have been re-classified among 'limb girdle muscular dystrophies', which are regarded as mostly autosomal recessive diseases, although there are singular descriptions of autosomal dominant transmission [37]. During recent years, the clinical heterogeneity of this group of illnesses has been further sophisticated [37, 38].

Today, the classification of PMD is becoming increasingly sophisticated due to an influx of new etiological and pathogenetic findings. Yet, the basis, i.e. the grouping of different clinical descriptions into one group of muscular atrophies, dates back to Wilhelm Erb and his years in Leipzig. His success is due, on the one hand, to his subtle methodological approach, electrodiagnostic expertise, profound specialist knowledge and scrupulous clinical work, but on the other hand, it was undoubtedly promoted by the unique and very exceptional conditions that he found in Leipzig, i.e. the large number of patients treated and the manifold interdisciplinary contacts with colleagues of his subject and of neighbouring disciplines. His separation of juvenile muscular atrophy from the group of spinal PMA and its classification with hereditary, pseudohypertrophic and infantile PMA into one group, which he called PMD, represented fundamental progress for the discipline of neurology. The name he suggested became known worldwide and with it 'primary myopathias' became a subject of neurology.

Besides PMD, Wilhelm Erb also dealt with another muscular disease while in Leipzig – namely myotonia congenita (or hereditary myotonia). The name was coined in 1881 by Adolf Strümpell, a colleague and assistant at the Medical Clinic, i.e. during his Leipzig years. Strümpell came to diagnose and elaborate this clinical picture on the basis of 1 patient who had been referred to him by his boss Privy Council and Professor Ernst Leberecht Wagner (1829–1888). The symptoms he diagnosed in his patient, a member of the influential Thomsen family, had been ascribed to a mental weakness or a weakness of will in the family, but Strümpell resisted this, claiming he had detected an inborn abnormality in the muscular system as their basis [39]. Strümpell and Erb discussed the case and this evidently led Erb to take such a deep interest in the illness that he dedicated a whole monograph on Myotonia congenita (or Thomsen's disease) to the 500th anniversary of Heidelberg University in 1886 [40].

Electrodiagnostics

At a very early stage, Erb was convinced of the crucial impact that the application of electricity and electrodiagnostics had on neurology. Yet, their application re-

quires considerable clinical knowledge, methodological understanding and practical experience. Erb had already stated these requirements by way of a simple rule: 'Always apply the same method and the same test process, always stick to the same procedure. Yes, I even strongly advise you to stick to the same devices, whenever possible ... Every observer must practice carefully and master his instruments; in particular he must acquire great certainty and perfect skills in both applying the apparatus and evaluating the results gained by the tests. Only then can he be sure to make a firm and correct judgment and may his statements claim plausibility. That's no easy thing to do ... it requires much exercise, a lot of technical talent, and experience in making judgements to make an electric examination reliable and to assess slight changes accurately' [28]. Erb himself met the expectations raised in the quote in their entirety. He achieved neurological prominence through excellent methodological skills, clinical knowledge and the ability to combine the two.

When Erb arrived in Leipzig in 1880, he had already gained prominence in electrotherapy and -diagnostics. It was in Leipzig that he compiled his rich experience of the previous 15 years into his 673-page *Handbook of Electrotherapy*, which was published in Leipzig in 1882 [28].

His competence as an experienced, meticulous and critical examiner can well be proven by his approach to differentiating and integrating progressive muscular atrophies. In his study of 1884, Erb stated that he had been convinced at an early stage that the 'lack of fibrillar contractions' in the juvenile form and the occurrence of fibrillar 'muscular sparks' (*Muskelblitze*) in spinal muscular atrophies was of diagnostic significance. He also reported his electrodiagnostic findings, which helped him further separate his juvenile form from spinal forms: in particular, he found a decrease in faradic and galvanic irritability, on the one hand, and 'no sign of reaction of degeneration whatsoever', on the other. He found that 'the electric irritability is of particular interest. Depending on the severity of the illness, it is either simply reduced or has ceased completely. At no point, however, did I find a change in its quality. Try as I might, I never found any clear reactions of degeneration in the muscles affected – which was one of the main reasons for my differentiation in these cases from the spinal forms'. He nonetheless remained unsure about the relevance of this electrodiagnostic difference: 'Yet I am far from saying that the reaction of degeneration is not at all possible in the juvenile form ... still I should think it to be extremely seldom and

exceptional, if it can be shown at all. In the spinal form the reaction occurs constantly' [31]. It took him until 1891 to abandon his misgivings concerning his own previous electrodiagnostic findings. In his comprehensive study on *Dystrophia Muscularis Progressiva*, he summarized that he had since had access to 'far more than 100 closely examined cases, in which no reaction of degeneration could be found. Hence I believe this to be clear proof of the claim I made in 1884' [36].

So, Erb substantiated the importance of electrodiagnostic assessment in order to properly differentiate between juvenile and spinal muscular atrophy and hence of proper diagnosis. With his *Handbook of Electrotherapy*, he provided a standard work in German on the entire subject, which then gained cross-country and worldwide appreciation through its translation into English and French [41]. The book was reedited in Germany in 1886 as the third volume of Ziemssen's influential *Handbook of General Therapy*.

Return to Heidelberg

The 'era' of Wilhelm Erb in Leipzig ended when he accepted his desired appointment as Professor of Internal Medicine to succeed his former mentor Friedreich at Heidelberg University as of April 1, 1883. This appointment also involved becoming head of the newly opened Medical Clinic [Dresden Saxon State Archives, Coll. Leipzig University 10151/7 and 10281/133; Leipzig University Archives, Personnel file 1314]. Whereas Leipzig had been happy to have Erb, Heidelberg seemed to have deeply regretted his change to Saxony. Erb did not hesitate in accepting the new appointment in Heidelberg. First and foremost, it provided him with the opportunity to return to his beloved native region, but the University in Heidelberg also granted him funds to establish not only a Neurological Outpatient Department, like the one

he had in Leipzig, but also neurological wards at his clinic. The latter were to form the basis for an independent Neurological Clinic, which was established at Heidelberg University after Erb's retirement along with a dedicated Chair of Neurology. Despite these favourable circumstances, Erb's departure from Leipzig was not without grief. This becomes clear in the letter he wrote to the Saxon minister for culture and public education. Therein, Erb asks for the minister's understanding for his acceptance of the unique opportunity to take over a complete and already functioning clinic, to which he could also admit neurological patients in separate wards, which had always been his greatest desire. He confirmed that it had nonetheless been a difficult decision and he wished to acknowledge and thank the minister once again for his openness and for agreeing to have a Neurological Clinic built and set up for him. Erb acknowledged this as a great reward to him as a scientist, but also for the discipline. He went on to state that he felt most obliged to the minister for this. However, he had now decided to return to his native region and the university he had come from in order to fulfil his wishes in the short term [Dresden Saxon State Archives, Coll. Leipzig University 10281/133, pp. 43–46]. It becomes clear that Erb might have accepted to remain in Leipzig, had the Saxon administration agreed early on to the establishment of a separate Neurological Clinic and Chair of Neurology. Yet, the minister's proposal came too late.

Up to his retirement in Heidelberg in 1907, Erb would go on to win international acclaim as Professor for Internal Medicine and Head of the Medical Clinic; due to his work in neurology, this continued to be the case until his death in 1921.

Disclosure Statement

The authors have no conflicts of interest.

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