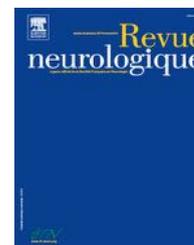




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## History of Neurology

# Jean-Martin Charcot and Parkinson's disease: Teaching and teaching materials



O. Walusinski\*

Cabinet Privé, 20 rue de Chartres, 28160 Brou, France

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### ABSTRACT

James Parkinson's 1817 seminal article was not well known in France until 1861, when Jean-Martin Charcot and his friend, Alfred Vulpian, published a detailed description in French of paralysis agitans. Their article provided clinical information to help French physicians make an accurate diagnosis by considering gait, shaking and rigidity as well as masked facies. As Charcot always had a strong desire to teach, this article describes his lessons on Parkinson's disease from 1868 to 1888, and also examines the teaching approach he used to pass on his latest findings to his students and colleagues. Charcot also used his role as thesis advisor to disseminate Parkinson's work, and seven of the theses he oversaw, which until now have been overlooked, reveal another facet of his teacher–student relationship. These dissertations provided Charcot with an opportunity to highlight what he had already identified concerning what is today referred to as 'Parkinson-plus syndromes'. Finally, this report concludes with an historical survey of the teaching materials that Paul Richer and Albert Londe developed for the Master at La Salpêtrière to provide him with visual documentation.

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In 1817, James Parkinson (1755–1824) wrote the first clear medical description of the disease that now bears his name. In the years that followed, a few cases were reported, with varying degrees of accuracy, in Great Britain and Germany [1]. In France, Germain Sée (1818–1896) in 1850 [2] and Armand Trousseau (1801–1867) in 1859 [3] referred to 'paralysis agitans', the name given by Parkinson to one of the differential diagnoses for chorea. However, the pathology did not become a discrete entity until the work of Charcot and his students in the second half of the 19th century. The hagiographic hyperbole of Victor Cornil (1837–1908) in referring to the

diseases described by Charcot gives a sense of how the latter was viewed by his contemporaries: "You have so profoundly reexamined the study of these diseases that one is tempted to believe you were the first to describe them" [4].

In this report, a brief review of Charcot's rise to the position of professor, and his achievements in this role, is followed by a description of how he taught each of the cardinal signs of the disease—tremor, hypertonia and bradykinesia—that he helped to establish as an individual entity. Charcot provided his students with numerous suggestions for research topics, and the theses in which they developed these topics were an

\* Correspondence to: Cabinet Privé, 20 rue de Chartres, 28160 Brou, France.  
 E-mail address: [walusinski@baillement.com](mailto:walusinski@baillement.com).

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**Box 1. Charcot-inspired theses on Parkinson's disease**

Jean-Martin Charcot was a jury member for the following theses. Léopold Ordenstein (born 23 July 1835 in Offstein, Grand Duchy of Hesse), 'Sur la paralysie agitante et la sclérose en plaques (On paralysis agitans and multiple sclerosis)', 1867; No. 234

Jury: Béhier, president; Gosselin, professor; Charcot, Raynaud, associate professors

Fulgence Raymond (born 29 September 1844 in Saint-Christophe, French administrative department: Indre et Loire), 'Etude anatomique, physiologique et clinique sur l'hémichorée, l'hémianesthésie, et les tremblements symptomatiques (Anatomical, physiological and clinical study of hemichorea, hemianaesthesia and symptomatic shaking)' [but no specific discussion on parkinsonian shaking], 1876; No. 157

Jury: Charcot, president; Chauffard, professor; Bouchard, Anger, associate professors

Albert Boucher [born 9 December 1852 in Metz, trainee military physician (aide-major) at the Val-de-Grâce military hospital], 'De la maladie de Parkinson (paralysie agitante) et en particulier de la forme fruste [Parkinson's disease (paralysis agitans), in particular its mild form]', 1877; No. 75

Jury: Charcot, president; Gavaret, professor; Bouchardat, Damaschino, associate professors

Paul-Désiré Leroux (born 22 June 1880 in Créances, French administrative department: Manche), 'Contribution à l'étude des causes de la paralysie agitante (Contribution to the study of causes of paralysis agitans)', 1880; No. 267

Jury: Charcot, president; Panas, professor; Lancereaux, Fernet, associate professors

Gaston Lhironde (born 22 July 1855 in Saint-Julien le Faucon, French administrative department: Calvados), 'Antécédents et causes de la maladie de Parkinson (Antecedents and causes of Parkinson's disease)', 1883; No. 236

Jury: Charcot, president; Proust, professor; Landouzy, Rendu, associate professors

Paul Blocq (born 4 January 1860 in Toul, French administrative department: Meurthe et Moselle), 'Des contractures (Contractions)', 1888; No. 128

Jury: Charcot, president; Fournier, professor; Brissaud, Chauffard, associate professors

Adolphe Dutil (born 18 February 1862 in Villefranche du Queyran, French administrative department: Lot et Garonne), 'Contribution à l'étude clinique des tremblements hystériques (Contribution to the clinical study of hysterical shaking)', 1891; No. 159

Jury: Charcot, president; Brouardel, professor; Chauffard, Ballet, associate professors

Eugène Béchet (born 30 July 1862 in Avranches, French administrative department: Manche), 'Contribution à

l'étude clinique des formes de la maladie de Parkinson (Contribution to the clinical study of forms of Parkinson's disease)', 1892; No. 351

Jury: Charcot, president; Proust, professor; Ballet, Poirier, associate professors.

In addition, this important thesis for which Charcot was not a jury member:

Paul de Saint-Léger (born 27 March 1855 in Cherveix, French administrative department: Dordogne), 'Paralysie agitante (Maladie de Parkinson), étude clinique [Paralysis agitans (Parkinson's disease), clinical study]', 1879; No. 121

Jury: Lasègue, president; Peter, professor; Debove, Legroux, associate professors.

additional means of dissemination for the Master (Box 1). Several of these have been selected as examples that, while mostly forgotten today, focus on atypical forms of the disease. Finally, the visual aids that complemented Charcot's teachings, for which he owed Paul Richer (1849-1933) and Albert Londe (1858-1917) for their skill and innovations, are also presented here.

## 1. Charcot, his teaching and La Salpêtrière Hospital

Jean-Martin Charcot entered La Salpêtrière for the first time in 1852. The hospital was at that time a rest home for elderly women called the Hospice de la Vieillesse-Femme. Charcot was to complete his fourth year there as an *interne* (medical student living and working in a hospital) under Eugène Cazalis (1808-1882), an obscure physician whom Charcot never referred to during his long career. Responsible for several hundred elderly and infirm women, Charcot brought together the observations of chronic rheumatism and gout that would eventually form the material necessary for writing his inaugural thesis, defended on 13 March 1853. He went on to become *chef de clinique* (senior *interne*) for 2 years at Hôpital La Charité in the department of Pierre-Adolphe Piory (1794-1879). In 1856, Charcot became a physician at the Central Office of the Paris hospital system. After failing the *agrégation* exam (to become an associate professor) in 1857, he succeeded 3 years later in 1860. He was appointed hospital physician at La Salpêtrière in 1862 at the same time as his friend, Alfred Vulpian (1826-1887), was assigned to another, smaller department. Charcot explained the advantages of being a physician at La Salpêtrière this way: "Here we have benefits one does not find in most ordinary hospitals, in that the conditions are right for fruitful study of diseases with slow progression" [5]. In 1866, Charcot transformed an old kitchen at the hospital into a place of study and teaching. This was the first step toward developing the research/teaching center that La Salpêtrière would eventually become.

That same year, Charcot inaugurated '*des cours libres*', classes outside of the university program, which he held in his



**Fig. 1 – Jean-Martin Charcot teaching, drawing by Paul Richer done around 1882. © École des Beaux-Arts de Paris, with kind permission.**

own department (Fig. 1). He gave a dozen of these classes per year, and his teaching soon gained a reputation for excellence and attracted large numbers of students, especially from outside of France. In 1872, he was elected to the medical school's Pathological Anatomy Chair, which he occupied for 10 years as a professor. In 1880, the hospital administration granted Charcot's request for a ward in which women and men could be admitted for short stays. In June 1881, Charcot was also granted an outpatient service, which transformed recruitment for his department. Finally, a Chair of Nervous System Diseases was created for him in 1882 at the medical school [6].

In addition to his teachings as a medical school professor, Charcot set up weekly classes at La Salpêtrière. These 'Tuesday lectures', combining impromptu interviews and examinations, were a major teaching tool in Charcot's pedagogical repertoire. They were clinical show-and-tell exercises, often with contrasting cases shown side by side. This made them pivotal for educating peers and students. These "unpretentious lectures", as Charcot called them, were initiated on 17 November 1882. In the words of Pierre Marie (1853–1940), who recalled the Master at the centennial celebration of his birth in 1925, these lectures were aimed at "introducing students to practical and diagnostic difficulties which one often encounters, particularly with nervous pathologies [...] Charcot's teaching was bipartite: in addition to his official lessons, which took place on Friday, there was the teaching he dispensed daily to the students in his

department [...] This daily teaching was precious for his immediate entourage. Morning sessions with the Master were a key element of his students' training. As for his official teaching, how to describe his admirable Tuesday lessons? For one thing, they took place in the same facilities that housed the outpatient services. Some of the patients who had come for a consultation were examined by Charcot one after another. He questioned them himself [...] Though his questions were precise, he was nonetheless charming and affable, drawing responses out of his patients with a kind of Socratic method. A diagnosis gradually became clear, accompanied by Charcot's remarks based on his long experience [...] As for the Friday lessons, Charcot gave them with a great deal of style, and few lessons compared in terms of the care and time that went into their preparation. For Charcot, the weekly university classes in the lecture hall were the major event in his life, what mattered more than anything. The weekdays led up to them, with special preparation on Friday morning at the hospital. Each lecture continued to be a topic of discussion well into the evening" [7].

Joseph Babiński (1857–1932) recalled the way in which Charcot cultivated research ideas in the minds of his students. During the Tuesday lessons, "the Master often introduced novel ideas, presented new angles and sketched out research areas that he felt were not yet ready to be included in his Friday university classes but that could nonetheless have a positive influence on his audience, particularly those inter-

ested in exploring new realms in the intriguing field of neuropathology". Babiński went on to add: "It was not a matter of finished science, but science in the making" [8]. According to C. Goetz, "These latter presentations were especially important for establishing the evolving nosology or classification system of clinical neurology that has remained largely unaltered into the twenty-first century" [9].

In one 1872 lesson, Charcot gave his own explanation of his teaching philosophy: "You are well aware, sirs, of the value of these symptomatologies presented with great eloquence, far from the bedside of the patient. Rarely can they do more than give rise to flat, two-dimensional images that generally leave the audience with a vague, transient impression. To avoid the shortcoming I have just described, I will proceed before you with the methodical examination of a patient who presents all of the symptoms, perfectly developed, of cerebrospinal multiple sclerosis." He used the same approach for his teachings on Parkinson's disease [10].

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## 2. Dissemination through writing

Most of Charcot's lessons were initially published in the journal *Gazette des Hôpitaux Civils et Militaires*. Désiré-Magloire Bourneville (1840–1909), who had been involved with medical journals since 1861, became Charcot's *interne* in 1868. He was also at that time editor-in-chief of *Le Mouvement Médical*, which led him to publish the Master's lessons in his journal. He then left this position (for unknown reasons) and went on in 1873 to found, with Charcot's support, one of the most influential medical journals of the last 30 years of the 19th century, *Le Progrès Médical*. From that point onwards, all of the La Salpêtrière lessons would be published in this journal. They were also compiled into books published in several editions before their inclusion in Charcot's *Oeuvres complètes* [11].

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## 3. First publication on paralysis agitans

In the 29 November 1861 issue of *La Gazette hebdomadaire de Médecine et de Chirurgie*, Charcot and Vulpian published a collaborative article entitled 'De la paralysie agitante' [12]. This article is an example of a lesson given as part of the "open classes" at La Salpêtrière; Charcot hoped its publication would help it reach a wider readership. Charcot and Vulpian took as their starting point James Parkinson's 'Essay on the Shaking Palsy': a "remarkable treatise on paralysis agitans [...] Paralysis agitans is without contest a disease that is generally not well known; careful, detailed observations are difficult to find." Charcot and Vulpian also put forward the recent publication by Viennese physician Johann Ritter von Oppolzer (1808–1871) [13]. Their purpose was thus "to use the existing material to sketch out a short history of paralysis agitans [...] and to add several cases which [they had] been observing for some time". The pedagogical aims of the work are evident in its organization. The first chapter—"Symptoms, progression, prognosis"—is a detailed discussion of shaking, of "the feeling of muscular rigidity", of "irresistible propulsion" and of slowness of speech despite "very clear and accurate comprehension", although "later on, the psychic faculties tend to

decline significantly". The prognosis "is very sad" due to "weakening and, above all, loss of mobility resulting from paralysis, as well as deterioration of the memory and intelligence [which] demonstrates that damage caused by the disease is increasingly profound [...] Therapeutic treatment is almost powerless to stop the disease's progression".

The second chapter covers etiology, treatment, autopsy, nosography and diagnosis. "Given what can rightly be called the rudimentary state of the etiology and autopsy of paralysis agitans today, it is almost exclusively the symptomatology that must predominate in efforts to characterize this disease." For Charcot and Vulpian, cold weather, humidity and acute states of fear could bring on the symptoms: "It is natural to assume that this phenomenon [shaking] begins in a relatively limited space of the central nervous system, including the medulla oblongata, the pons and possibly part of the upper regions of the spinal cord." To describe the rigidity of the patients, they were clear-sighted in their discussion of abnormal "innervation of stability" and "a stability neurosis" involving "muscle tone", a term coined by Ernst Blasius (1802–1875) in 1851 [14].

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## 4. Teachings on tremor

Charcot began a lesson in 1868, transcribed by Bourneville, as follows: "Those of you who, this morning, visited our wards were perhaps surprised to find a considerable number of women in whom shaking appears to be the predominant symptom, or at least the most obvious symptom of the disease they suffer from. I purposely brought together these patients, who have specific, similar symptoms" [15]. As an experienced teacher, Charcot often presented cases of different pathologies side by side to highlight the semiological elements that distinguished shaking in each case: "Some of [the patients] only shake when they are performing a global movement using their limbs, such as lifting a glass to their lips to drink, or attempting to rise from their chair to walk [...] On the other hand, when they are resting and unaffected by any emotion, these same women, whether sitting or lying down, appear most natural in their posture; none of their body parts are agitated, such that if only observed in these conditions, they do not appear to have the disease they are suffering from. On the contrary, in the second series of cases, their shaking is continuous and permanent, causing ceaseless shaking, and while intentional movements may exaggerate this condition, the resting state does not eliminate it."

The main purpose of the lesson for Charcot was to highlight the importance of the clinical distinction between paralysis agitans and multiple sclerosis, as they "had until now been included in one category, despite their being perfectly independent in all ways". As for the shaking, Charcot noted that "it is almost universally misunderstood in our times". He cited only Adolphe Gubler (1821–1879), who worked at Hôpital Beaujon, for accurately interpreting this phenomenon in 1860: "Shaking consists not in a succession of opposing movements beyond voluntary control, but rather in alternating contractions and relaxations of the muscles involved" [16].

Charcot devoted most of his Friday lesson on 16 November 1876 "to shaking in Parkinson's disease", reviewing the

differential diagnostic information in relation to multiple sclerosis. It goes without saying that most of his audience had not heard the 1868 lesson and, like all good teachers, Charcot had updated his material. Specifically, he noted that the movements of the head were a transmission of the body's shaking and, thus, did not originate in the head. Another point raised during this lesson was the characteristic handwriting, which was not only affected by shaking but "often diminishing in size". During this lesson, he proposed abandoning the term 'paralysie agitante' in favor of the eponymous 'Parkinson's disease' [17]. Charcot's aim was to help physicians abandon the idea of paralysis while clarifying the clinical picture he wished to impart. Thus, from 1880 onwards in France, Parkinson's disease was the name used by all physicians whereas, in Great Britain for example, this eponymous name was not used until the middle of the 20th century. A transcription of a lesson on Parkinson's disease was the first article on this pathology published in *Le Progrès Médical*.

During his lesson on Tuesday, 22 May 1888, Charcot explained his own pedagogical method for teaching the differential diagnosis as regards shaking; in the same lesson, he presented his students with a case of shaking in action and another in a resting state: "Now is the time to use the method of contrasts. To impress upon your minds the characteristics of shaking due to mercury poisoning, I will present a subject who has just now come to the outpatient services and who offers a fine example of paralysis agitans or Parkinson's disease" [18]. Charcot drew some sketches of the different patterns of shaking (Fig. 2).

During a lesson in March 1885, Charcot analyzed, before his students, recordings based on "the graphic method", using "the rotating drum invented by Mr. Marey" (Etienne-Jules Marey, 1830-1904) to distinguish between cases of multiple sclerosis and Parkinson's disease. "You already know that one cannot judge the rapidity of the rhythmic oscillations that constitute a tremor with only the information gleaned from the eye. To surmount this difficulty, the graphical method is not overly technical. We are not ignorant of the fact that the data provided by such measurement techniques are of considerable clinical importance." He then presented the graphs: "Shaking in Parkinson's disease involves rhythmical oscillations, but their scope is limited as is their duration [...]. This shaking is continuous, and it is important to note that it occurs outside of all voluntary movement [...]. Shaking in multiple sclerosis and Parkinson's disease involves slow oscillations, four or five per second on average" (Fig. 2). These graphics allowed him to clearly distinguish the role of movement in the aggravation of shaking in mercury poisoning and in multiple sclerosis. He continued the lesson by mentioning other types of shaking, in hysteria, alcoholism, general paralysis and Graves' disease. Londe subsequently perfected the recording of oscillations and their visual representation (see below) [19].

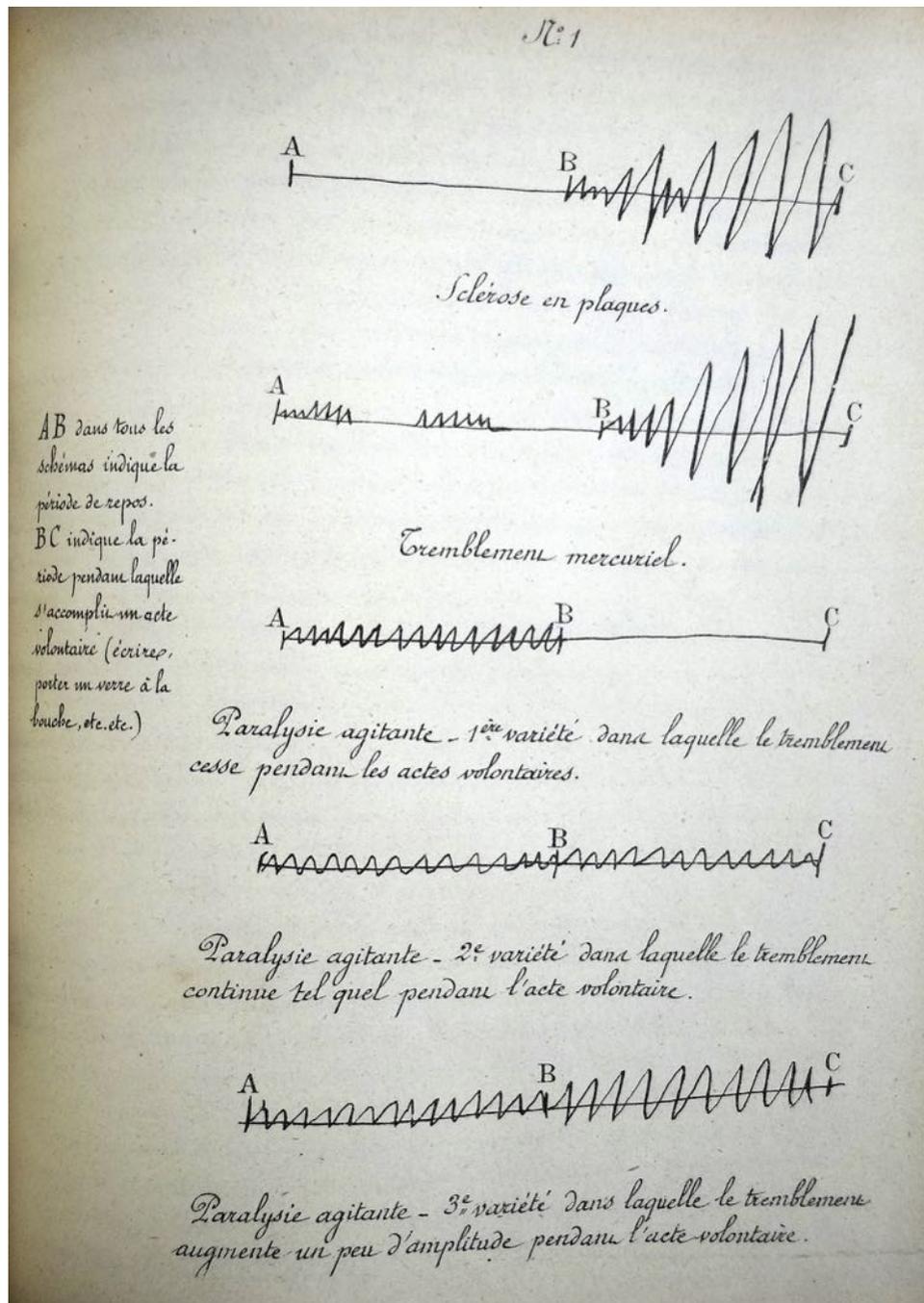
## 5. Rigidity and slowness

In an 1872 lesson, Charcot started by noting that "paralysis agitans strikes subjects already advanced in age, especially those older than 40 or 50 [...]. but to consider it as a disease of

senility would be to go too far". He went on to insist: "We wish to highlight an aspect that appears to have escaped Parkinson's notice as well as that of most of the authors that followed him: rigidity, which at a certain phase of the disease affects the muscles of the limbs, the trunk and, most frequently, the muscles of the neck." He completed the clinical picture with a description of posture during walking: "The patient is bent forward; he appears forced into adopting a rapid step, and it is only with great difficulty that he is able to stop, having no choice but to race along after his forward-bound centre of gravity. A particular posture of the body and the limbs, a frozen gaze, and facial traits that are immobile are the most significant symptoms of the disease" [20]. He never used the term 'bradykinesia', although he did mention "difficulty in movement", and later stated: "Movement is slowed rather than hindered by real motor weakening [...]. It seems that the nervous influx can be initiated only after exceptional efforts."

During the Tuesday lesson on 31 January 1888, Charcot interrogated a 52-year-old mason unable to continue his work due to shaking. Charcot proceeded with his habitual method of comparison: standing next to the mason was another patient from the department "with the opposite form of the disease, rigidity without shaking. Look at them, both of them. They represent the two extremes of the same disease. One of them has what the second lacks, i.e. rigid joints, characteristic physiognomy, fixed gaze, the appearance of a wooden figure, rigid facial muscles which cause raised eyebrows and squinting eyes, giving him an expression both sad and surprised" (Fig. 3) [18]. Charcot then added the following to highlight the gait peculiarities: "I wish to stop using the term 'paralysis', as patients are aware of their state; they don't wish to be paralyzed and, in fact, they are not paralyzed. They almost always have such a singular physiognomy that they are taken for morons, for individuals whose brain is damaged. The truth is that intellectual phenomena are absolutely intact, and their brains are perfectly healthy" [18]. The lesson went on this way, rather like an animated conversation orchestrated by Charcot for his students. He recalled voyages to Rome, Amsterdam and Spain during which he diagnosed this disease with great simplicity: "You can recognize [patients] from a distance; no need to question them" [18].

During the Tuesday lesson on 12 June 1888, Charcot explained how to distinguish contraction in Parkinson's disease from that of hemiplegia, noting the exaggeration of reflexes in the latter; however, "the muscular rigidity in paralysis agitans remains a problem from a physiological perspective" [18]. To illustrate this rigidity, he discussed gait, contradicting his lesson of 1872: "Parkinson spoke of the rigidity and stiffness which makes patients look like automatons, like 'a piece of machinery' he said, speaking of their appearance." In a gesture characteristic of his lessons, Charcot underscored the importance of his research for confirming the diagnosis, although a secondary reason for this may have been to encourage students to seek out causes: "It is precisely our ignorance in this area that I wish to highlight for you, if only to incite you to pursue your own research. I also draw your attention to the absence of reflexes in the rigidity of paralysis agitans patients in contrast to what we see in what is properly spasmodic contraction or, if you prefer, spinal contraction" [18].



**Fig. 2** – Schematic diagrams by Charcot of different shaking frequencies according to their etiology. *Leçons du Mardi à La Salpêtrière, 1887* (page 417). Private collection of the author.

Charcot also used his own drawings as visual aids for his teachings (Fig. 4). This allowed him to show characteristic facial expressions, as in the following lesson: “What strikes us immediately is the immobility of the head and the facial features [...] The wrinkled forehead and the raised eyebrows due to the exaggerated action of the corresponding muscles are among the most common features and the most characteristic facial traits in paralysis agitans.”

Charcot had established all clinical aspects of Parkinson’s disease by 1872, including slowed speech, saliva at the corners of the mouth and limb rigidity (“joints seemingly welded and

the forward-flexed posture”). He also did not fail to point out the initially insidious onset that could sometimes lead to its sudden manifestation and the gradual progression. He gave a detailed description of the chronic period: “Facial muscles are immobile; even the gaze has remarkable fixedness, and the facial features are marked by a permanent sadness, sometimes a daze” [15]. Charcot paid particular attention to deformations of the hands, providing specific information on the differential diagnosis between paralysis agitans and “chronic rheumatoid arthritis of the joints”. Once again, he used his own drawings of deformed hands as visual aids for



Fig. 3 – Drawing by Charcot of gait. *Leçons du Mardi à La Salpêtrière, 1887 (page 440). Private collection of the author.*



Fig. 4 – Drawing by Charcot of the non-expressive facies of the Parkinson's patient Bachère. *Leçons du Mardi à La Salpêtrière, 1887 (page 437). Private collection of the author.*

these lessons (Fig. 5). “Notice that the hands and the fingers shake individually, but what you should impress upon your minds is the very specific appearance of the hand. The phalanges are extended one upon the next, but the fingers are flexed toward the metacarpus. The thumb is adducted and the pad rests on the index finger in a position recalling that of a hand holding a pen, and the movements in these various parts of the hand sometimes bring to mind the act of rolling a ball of paper or bread” [19].

Finally, to avoid any anachronism, it should be noted that the classic sign dubbed ‘cogwheeling’ was proposed later, in 1901, by the Italian neurologist Camillo Negro (1861–1927).

## 6. Theses by Charcot's students: another means of disseminating knowledge

From his earliest days at La Salpêtrière and throughout his career, Charcot delegated some of his work to successive *internes* and his favorite students. Whether or not he was part of the defence jury, their theses always gave an overview of Charcot's research. Some of them are worthy of critical attention because they describe cases that today might be classified among the Parkinson-plus syndromes; in addition and thanks to Bourneville, some of these were published in commercial editions. In the commentaries below, Charcot's students provide some insight into the teacher-student partnership and the aims of these collaborations.

Pierre Marie: “It most often happened that he specifically asked one of his students to carry out a study, to conduct bibliographic research on a subject. He remained interested in how the work was progressing and was unstinting in his advice to the student chosen for the task. This sort of collaboration with the Master was not only a sought-after honour, but also a valuable lesson [...] The many strengths



**Fig. 5 – Drawing by Charcot of the hand of Parkinson’s patient Françoise-Auguste Berlin, former servant, age 59 years. © Bibliothèque Charcot, Bibliothèque Universitaire Pierre et Marie Curie (BUPMC), with kind permission.**

and skills that Charcot brought to these collaborations enabled him to found and maintain a school. Few in his position had the savvy to attract such a host of students” [7].

Paul Peugniez (1859–1943): “From a scientific viewpoint, he allowed his students to enjoy all of the benefits of their work and also let them work in complete liberty, offering his assistance only to help them gather the fruits of a shared effort” [21].

Indeed, the theses written by Charcot’s students, whom the Master guided and encouraged, are of historical interest today and this, in a sense, has fulfilled Charcot’s hope that the research and discoveries at La Salpêtrière would have a wider sphere of influence. What follows are three examples of this.

### 6.1. Thesis of Léopold Ordenstein

The thesis of Léopold Ordenstein (1835–1902), defended on 17 December 1867, was the very first thesis on paralysis agitans prepared in Paris [22]. It was dedicated “to my dear Master, Professor Charcot, to whom I pay the homage of my profound and affectionate gratitude”. Ordenstein’s thesis presents the state of knowledge as Charcot wished it to be presented to all physicians. The thesis reproduces word for word the outline and large sections of the initial article published by Charcot and Vulpian in 1861. He focused in his description on shaking as rhythmic oscillations or “shaking paralysis”—or, for him, “Schüttellähmung”. The initial unilaterality is also noted, as well as the diffuse chronic pain state. Gait was described as having “a jerking and precipitous appearance” marked by an “irresistible forward-leaning propulsion or a tendency to move backward”, with deformation of the trunk. Ordenstein’s

text included the term ‘Parkinson’s disease’, most likely as a suggestion from the Master, who himself did not use the term until 1876. Whereas Charcot focused on clinical aspects in his lessons, Ordenstein noted in his thesis that Charcot prescribed hyoscyamine granules, which significantly alleviated his patients’ shaking [23].

Charcot never failed to refer to his students and especially their theses during his lessons, which can be taken as proof of his involvement in their work. During his 1868 lesson, for example, he made the following remark: “If I am not mistaken, I indicated the delineation between these two conditions for the first time, as noted in the thesis of Mr. Ordenstein.” Even today, this thesis remains a significant event in the history of neurology, as Lucien Denombré (1839–?) pointed out in his own thesis in 1880. It was only after Ordenstein’s thesis in 1867 that “Parkinson’s disease was definitively considered as a distinct morbid entity” [24].

### 6.2. Albert Boucher

Albert Boucher (1852–?) defended his thesis, dedicated to Bourneville, on 28 February 1877 [25]. He began his text by recalling the circumstances that gave rise to his study. After listening to one of Charcot’s lessons, he decided to focus on cases of paralysis agitans that “while having most of the general characteristics of this disease, stand apart due to a total lack of agitation [. . .] While our study is limited to a few observations only, this may not be indicative of their rarity, but rather the ignorance of physicians as to their existence”. It is clear that Charcot wanted to make non-shaking forms more widely known and accomplished this by having one of his

students write the relevant thesis. Boucher compiled six highly detailed observations of cases without shaking. He insisted on including “rigidity [...] Charcot’s intelligent addition of this clinical sign that Parkinson had overlooked”. He also included the results of dynamometric examinations, carried out by Bourneville, indicating a loss of muscle strength, “whereas until now it has been generally thought that there was no weakening”. Boucher also remarked that Charcot emphasized a symptom that he (Boucher) was the first to describe: “There is often a sensation of excessive heat that is felt especially in the epigastric region and in the back.” As noted by Charcot, body temperature was not affected. Would this today be considered a type of autonomic dysfunction? Boucher’s work provides yet another opportunity for highlighting Charcot’s relationship with his students. In 1885, Boucher, who went on to become a military physician, published in *Le Progrès Médical* a clinical case which he attributed to prolonged exposure to cold damp conditions. He made mention several times of his teacher: “Despite the attention Charcot’s work has garnered, there are still few observations of paralysis agitans.”

### 6.3. Paul Oscar Blocq

Paul Oscar Blocq (1860–1896), Charcot’s *interne* in 1887, was one of many brilliant students who died prematurely and so were unable to realize the potential of their initial contributions. On 24 February 1888, with Charcot presiding over the jury, Blocq defended his thesis entitled ‘*Des contractures*’ [26]. Therein he discussed muscle rigidity in Parkinson’s patients and suggested they were suffering from “a pseudo-contraction”. He listed a series of observations in which rigidity preceded the presence of shaking, or grew worse without the presence of any shaking. Having discovered no lesions during the pathological–anatomical examination of the central nervous system, Blocq suggested that “parkinsonian rigidity depended on damage to muscular fibres”, establishing a parallel with Thomsen disease. In other words, he presented Parkinson’s disease as a myopathic condition. The fact that Charcot oversaw this thesis raises the possibility that he used Blocq’s work to advance a hypothesis that he himself never explicitly formulated.

It was Blocq’s 1893 publication, however, that is noteworthy from an historical perspective. Along with the Romanian student Georges Marinesco (1864–1938), who attended Charcot’s lessons and would eventually become famous himself, Blocq published (3 months before Charcot’s death) a case of “hemiplegic parkinsonian shaking” [27] secondary to a tuberculoma that unilaterally destroyed “Sømmerring’s substance”<sup>1</sup>, now known as the ‘substantia nigra’ [28]. Blocq and Marinesco pointed out the probable coincidence of tuberculosis and Parkinson’s disease, basing their conclusion on an unpublished observation of a similar case prepared by Charcot. Edouard Brissaud (1852–1909), referring again to these precise lesional data, had the perspicacity to propose, in 1894, the pathophysiological hypothesis of dysfunction in the ‘black substance’ (his term for the substantia nigra) as the explanation for Parkinson symptoms [29].

<sup>1</sup> Samuel Thomas von Sømmerring (1755–1830) was a German physician and anatomist.

## 7. Charcot’s teaching on atypical forms and their significance today

Eugène Béchét (1862–1939), a former *interne* at the insane asylums in the area around Paris, defended his thesis on 28 July 1892 before a jury that Charcot presided over. He dedicated his thesis to Charcot: “All of the data collected in his department and the related commentaries are based on the training I received there.” After a long discussion of all the signs and symptoms of Parkinson’s disease, Béchét undertook to establish a list of atypical forms based on personal observations or found in the literature, including: atypical forms due to the absence of shaking or rigidity; atypical forms due to the location of symptoms; and atypical forms due to additional disturbances (most notably, his accurate description of depression and hallucinations following dementia; he also included urological and ocular problems). Béchét remained “exclusively in the clinical domain [...] in part because [he] was aware that Paul Blocq was carrying out pathological–anatomical research in this area” [30]. The detailed observations included one that Blocq and Marinesco took up the following year in 1893. Béchét also mentioned that it was Jean-Baptiste Charcot (1867–1936), the Master’s son, who had passed this observation on to him.

In addition to hemiplegic forms, Béchét presented three observations of stiffness in the trunk and extension to the limbs. One involved a 52-year-old man who “had undergone treatment in the vibratory chair at La Salpêtrière for several weeks”; Charcot had tasked Georges Gilles de la Tourette (1857–1904) with testing this treatment [31]. “But what is most marked in this patient is an unusual appearance, a special way of holding himself that is notably different than that usually observed during paralysis agitans. It seemed thus appropriate to place this case with those grouped together by Charcot and referred to as extension cases.” He also included the case of a patient examined by Charcot during his Tuesday lesson on 12 June 1888. The patient was a man referred to as “Bachère, aged 31”, with onset at age 26. Charcot highlighted for his audience the characteristic hypomimia (Figs. 3 and 4): “Look how he stands. I present him in profile so you can see the inclination of the head and trunk, well described by Parkinson. All of this is typical. What is atypical, however, is that Bachère’s forearms and legs are extended, making the extremities like rigid bars whereas, in the ordinary case, the same body parts are partly flexed. One can say then that in the typical case of Parkinson’s disease, flexion is the predominant feature, whereas here, extension predominates and accounts for this unusual presentation. The difference is even more evident when the patients walk.” Charcot also gave an in-depth description of the patient’s forehead wrinkles, while noting that “the fixed gaze is also due to a rigidity which is equally pronounced in all of the muscles of the eye”. Charcot finished his lesson with this pronouncement: “We have arranged for admission at Hôpital Bicêtre, incurable status” [18]. The published lesson included a drawing of Bachère’s face that Charcot himself had sketched (Fig. 4). Charcot enjoyed drawing and sometimes even illustrated his lessons while they were underway.

During his *internat* (internship) under Charcot, Adolphe Dutil (1862–1929) published, in 1889, an observation of a

50-year-old woman, Pauline Dro—, whom Charcot had used in his 19 July 1889 lesson as an example of “hemiplegic Parkinson’s disease”: “The upper limb presents the characteristic flexion and shaking, whereas the head and the trunk are strongly thrown back rather than inclining forward, as is usually the case” [32]. Dutil also added that her eyes did not move.

Thus, once the archetype of Parkinson’s disease was established, Charcot, along with his students B chet and Dutil, could then identify variants with atypical features compared with the classic descriptions, calling them ‘Parkinson’s disease with extended posture or with hemiplegia’. These cases are of historical interest because they are now recognized as ‘Parkinson-plus syndromes’. Bach re (Figs. 3–7) would perhaps today be considered an example of progressive supranuclear palsy (Steele–Richardson–Olszewski syndrome)<sup>2</sup>, whereas the case of the woman with asymmetrical rigidity of the extremities is perhaps more evocative of corticobasal degeneration (Fig. 9) [1].

## 8. Teaching pathological anatomy: in search of an etiology

In his 1868 lesson, Charcot moved rapidly through the disease’s pathophysiology: “A discussion would be premature.” Charcot tasked his *interne* for the year 1869, Alix Joffroy (1844–1903), with the department’s first publication on the pathological–anatomical research conducted there. After three autopsies of patients whom Charcot had diagnosed as suffering from paralysis agitans, Joffroy, who “did not see lesions of the medulla oblongata or pons as having the importance accorded by foreign specialists”, arrived at the following conclusion: “We are inclined to adopt the opinion that the anatomical location of paralysis agitans is exclusively in the spinal cord, and thus absent from the medulla oblongata and the pons” [33]. The use of “we are inclined” is a telling example of the deference of Charcot’s students with regard to the Master. It would have been wrong for Joffroy to say “I am inclined” as Charcot was the mastermind behind such projects and the basic thinking was his.

In his 22 May 1888 lesson, Charcot only touched on the cause of shaking in the disease: “This subject is shrouded in obscurity and new studies are called for.” In fact, the clinical cases presented in these lively lessons do not appear to have benefitted from follow-ups through to the patients’ deaths. Also, Charcot made no mention of autopsies and, as for other cases published in France and in other countries, the results of pathological–anatomical examinations were contradictory and not convincing to him.

Ten years after the very first lesson at the beginning of the 1880s, the clinical signs for diagnosing Parkinson’s disease,

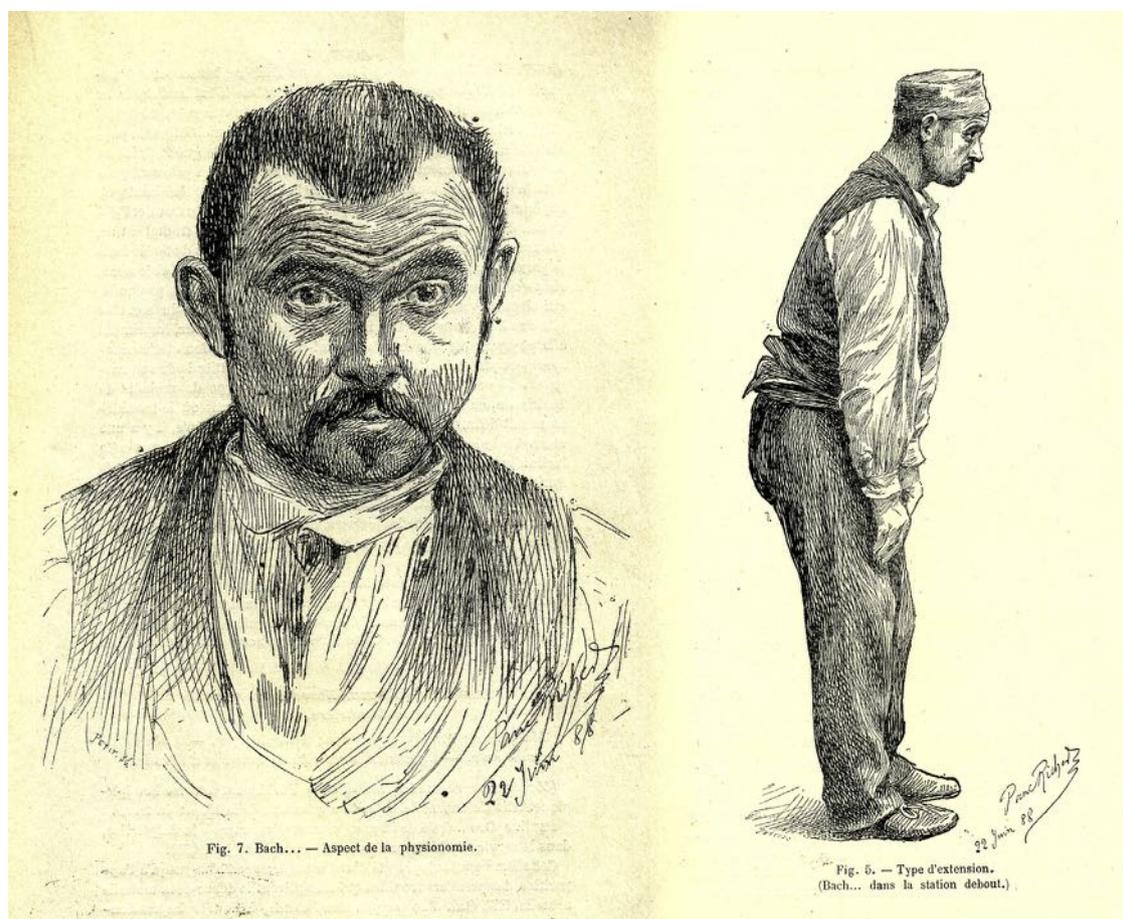
<sup>2</sup> Steele–Richardson–Olszewski syndrome is a progressive neurological disorder characterized by supranuclear ophthalmoplegia, especially paralysis of vertical gaze, retraction of eyelids, pseudobulbar palsy, dysarthria, dystonic rigidity of the neck and trunk, and dementia. Onset is usually in the sixth decade of life. Richardson first recognized the condition in 1955 in his private practice and began looking for other patients, and the eponymous team began working together in 1959.



**Fig. 6 – Etching by Paul Richer: *Un type de paralysie agitante* (A type of paralysis agitans), published for the first time in Paul de Saint-L ger’s thesis in 1879. Private collection of the author.**

their various presentations and their different patterns of progression were considered established. However, the causes of the disease remained unknown. Charcot tasked two of his *externes*, Paul-D sir  Leroux in 1880 and then Gaston Lhironde 3 years later, to compile observations from the Clinic of Nervous Diseases to demonstrate the role of heredity. This period was important for the development of Charcot’s etiological concepts at a time when the Chair of Nervous System Diseases had just recently been created for him. A clinician through and through, Charcot gave priority to rigorous empirical observations and made his skepticism with regard to theory an element of his teaching: “I am not in the habit of proposing things that cannot be demonstrated experimentally. As you know, my principle is to pay no attention to theory and to set aside prejudices. To see clearly, one must take things as they are [...] In this way, I am nothing more than a photographer” [18].

As shaking was an additional behavior rather than a functional deficit, there was no precise anatomical correspondence. Thus, the anatomical–clinical method, which had



**Fig. 7 – Physiognomy of a Parkinson’s patient, drawn by Paul Richer on 22 June 1888. *Nouvelle Iconographie de La Salpêtrière*, 1888; 1: 213–216 (plates XLIII and XLIV). Private collection of the author.**

led Charcot to so many discoveries, revealed its limitations not only for Parkinson’s disease, but also epilepsy and hysteria. The time was ripe for an epistemological reassessment, especially as the Pasteurian revolution had been consecrated at the International Medical Congress in August 1881 in London, an event at which both Pasteur and Charcot were lauded [6]. Later, Charles Féré (1852–1907), *interne* and then personal secretary to Charcot, compiled data to officially establish “the neuropathic family” in his famous 1884 article. Convinced by Féré’s concept, Charcot would defend until his death the predominance of heredity in the origin of neurological diseases, thereby aligning himself with the leading hypothesis at the time [34]. His ideas are evident in the writings of Féré: “Nervous system diseases, whether manifest in psychic, sensory or motor disturbances, have many points of correspondence and contact between themselves. Although in recent years both clinical and pathological-anatomical studies have multiplied the types, they still constitute one family indissolubly linked by the laws of heredity” [35].

Paul-Désiré Leroux (1851–?) defended his thesis, with Charcot presiding over the jury, on 22 June 1880 [36]. He concluded his introduction with an homage “to Professor Charcot for his guidance and the encouragement he gave me”. Based on eight patients he had personally interrogated and examined, Leroux made the following remark: “Exterior

causes, moral emotions, humid cold weather and irritation of peripheral nerves are causes that merely activate the potential for illness, inducing flare-up of the underlying disease. Heredity is a real cause of *paralysis agitans*, perhaps the only real cause.”

Gaston Lhironde (1855–?) defended his thesis, with Charcot presiding over the jury, on 18 May 1883 [37]. He began thus: “The ideas for this study did not originate with us. Two years ago, Professor Charcot gave us the assignment of delving into the hereditary antecedents of several outpatients with Parkinson’s disease [...] We are grateful to our eminent teacher, Professor Charcot, who assisted and guided us on several occasions. It was his lessons that prompted us to take up the study of Parkinson’s disease, and the patients we studied were either his outpatients or patients in his department.” Later in his text, Lhironde’s statements are surprising: “We found nothing of what we were looking for. By contrast, we did find what we were not yet looking for; that is, traces of arthritic diathesis.” The presentation of cases in Lhironde’s thesis strikes the modern reader as extremely confused. The association of chronic, mostly rheumatoid, pathologies, or ‘diatheses’ (as they were called at the time), with Parkinson’s disease as an etiological factor and proof of family transmission stands out, especially as the possibility of coincidence is never raised.

Sigmund Freud (1856–1939), in the posthumous homage he wrote when Charcot died, may have offered the most telling commentary on the epistemological impasse at which the Master found himself: “It will undoubtedly soon be necessary to review and correct the etiological theories defended by Charcot in his doctrine of the neuropathic family and on which he founded his global understanding of nervous diseases. Charcot so overestimated the etiological role of heredity that no place remained for other neuropathic etiologies” [38]. This concept of familial disease in Charcot’s day was more related to a deterministic philosophy (“one cannot choose to become an hysteric or a neurasthenic”) than to our present-day notion of genetics. Indeed, Charcot never presented, in any of his lessons, a family of Parkinson’s sufferers, and any extrapolation of Charcot’s ideas on heredity as precursors of the current knowledge would be anachronistic [34].

### 9. Paul Richer: artistic talent in the service of Charcot’s teaching

For Achilles Souques (1860–1944) and Henry Meige (1866–1940), “Charcot has an excellent mind for the synthesis of ideas as well as a fine sense of schematization. He has a broad view; he aims to be clear and concise. This explains his use of drawings and other visual aids; by engaging the eyes of his audience, he can keep explanation to a minimum” [39]. To develop his use of drawings, Charcot turned to his talented *interne* for the year 1878, Paul Richer (1849–1933). There is no doubt that Richer did the most to help Charcot develop the visual teaching materials that enriched his lessons and publications. Richer went well beyond the masterly illustration of hysterical episodes in his thesis, defended on 9 April 1879. He made striking drawings of parkinsonian physiognomy during his *internat* in 1878 and again as head of the laboratory of the Clinic of Nervous System Diseases (from 1882 to 1895). For the first issue of *La Nouvelle Iconographie de La Salpêtrière*, published in January 1888, Richer drew “a typical case, particularly appropriate for demonstration; she remained for a long time in Charcot’s department at Hôpital La Salpêtrière, and the eminent professor presented her many times to his students during his clinical lessons. Her observation was published *in extenso* in the first volume of Charcot’s complete works” [40]. An etching of the patient was also used to illustrate Paul de Saint-Léger’s thesis in 1879 (Fig. 6).

While Charcot had made his own drawings of Bachère, Richer added further drawings of the patient to illustrate “what could be called the artistic side of Parkinson’s disease”. He emphasized the facial expression, which he wanted to render as accurately as possible: “Between this forehead, expressive or wrinkled transversely and vertically, and the rest of the impassive face, we have the fixed and immobile eyes that are wide open, with a near absence of blinking; these are the fundamental elements of this strange and striking mask” [40]. In comparison, his portrait of Bachère is clearly more accomplished than Charcot’s drawing (Fig. 7).

Charcot also gave Richer the idea to make a sculpture modeled after Gell—, aged 58, a patient admitted on 12 July

1892 to the Rayer ward. Two years after an emotional shock, her right hand began to shake during rest. The shaking spread to the entire upper limb and eventually the lower right limb as well; the entire right side of her body was thus affected. She also suffered from diffuse pain that gradually increased in intensity; the overall result was reduced movement. Richer and his student Meige presented this observation in detail in *La Nouvelle Iconographie de La Salpêtrière* in 1895 [41]. Charcot died on 16 August 1893 and would never see the sculpture, which Richer did not finish until 1895. Instead, it was left to Charcot’s successor, Fulgence Raymond (1844–1910), to use it for his lessons [42]. Richer was able to render “the general emaciation and cutaneous folds” with amazing precision. In fact, the skin is depicted so realistically that the entire subcutaneous venous network is distinctly visible, including even the hypogastric hernia secondary to the patient’s 11 pregnancies. Richer noted the following: “The brachioradialis [long supinator] of the forearm protrudes in a characteristic way. In the normal state, this muscle is never observed to contract for simple elbow flexion. Its rope-like, visual protrusion is almost important enough to be pathognomonic” (Fig. 8) [43]. As an artist in his own right, Charcot was able to take advantage of Richer’s talents to enrich his lessons: “Whereas the learned man addresses the intelligence of his audience, the artist does not hesitate to capture the eye and create a lasting image” [21].

The first photographs taken at La Salpêtrière, after the end of the Franco-Prussian War, were the work of Bourneville and



**Fig. 8 – Sculpture of *La Parkinsonienne*, by Paul Richer, 1895. Private collection of the author.**



**Fig. 9 – Photographs taken by Albert Londe. *Nouvelle Iconographie de La Salpêtrière*, 1889 (plates XXVIII and XXIX). Private collection of the author.**

Paul Regnard (1850–1927). The hospital’s photographic department was officially created in 1878. After these two originators left La Salpêtrière, Charcot temporarily assigned the department to Loreau, who was in charge of anatomical wax models at the hospital. He was eventually replaced by Albert Londe in 1882, a young photographer who pioneered a new technology using gelatin silver bromide, and also invented a rapid mechanical shutter and a sequential photo technique: “In his clinic, Professor Charcot has numerous patients; they suffer from paralysis, hysteria, epilepsy, chorea, etc., and they represent a challenge for the photographer, who must capture shaking and attacks so as to allow examination and analysis” [44]. Londe transformed what began as a simple studio for taking pictures into a research laboratory to develop photographic techniques for the purposes of science. The photographs of Parkinson’s patients that Londe took were used to illustrate Dutil’s article in *La Nouvelle Iconographie de La Salpêtrière* in 1889, and Béchet’s 1892 article as well as his thesis (Fig. 9) [30,32,45].

In fact, Londe’s inventions extended well beyond photographs. To overcome the difficulties of recording the shaking of patients using Marey’s graphic method, Londe developed a method using dots of light: “On the limb for which oscillations

are to be recorded, we firmly attach a small  $\frac{3}{4}$ -volt electric lamp (Edison bulb). This lamp should be as small as possible so that its light is perceptibly punctiform. Then the subject is positioned facing the photographic objective behind which the cylinder of a Foucault regulator is in motion. It is covered with a sheet of sensitive paper or a plate that glides over the rollers with uniform motion in the transversal direction.” The movements of the point of light were recorded as a thin trace on the photographic paper. Dutil explained this technology in his thesis and added that Londe “was generous enough to advise us with the skills and knowledge he is known for”. Unfortunately, no such traces of Parkinson’s disease were reproduced, and there is no record of how or if Charcot ever made pedagogical use of this technology [46].

## 10. The power of Charcot’s teaching

This historical overview of how Charcot helped to isolate Parkinson’s disease not only shows his clinical skills, but also demonstrates the many ways in which he excelled as a teacher, as recalled by Pierre Janet (1859–1947), one of his last students: “Aside from the value of his discoveries, Charcot

was known as one of the most remarkable professors to have taught at the medical school. The clarity of his lessons and their pertinence have remained legendary. Not only were they rigorously constructed; they were as lively as performances. Charcot had a passion for teaching and prepared his classes with meticulous care" [47].

This portrait of Charcot, the teacher, gives us the opportunity to highlight the importance of his lectures in the modernization of the Faculté de Médecine and the creation of new chairs, leading to a range of medical specialties in France at the end of the 19th century.

## Disclosure of interest

The author declares that he has no competing interest..

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