

# Jean-Baptiste Bouillaud and the dogma of the left third frontal gyrus

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## ABSTRACT

**Introduction.** In 1906, Pierre Marie published “Revision de la question de l’aphasie: l’aphasie de 1861 à 1866, essai de critique historique sur la genèse de la doctrine de Broca.” In the article, he postulated that the findings presented by Paul Pierre Broca to the Société d’Anthropologie de Paris in April 1861 had become a dogma due to the mediation of Jean-Baptiste Bouillaud. The purpose of this article is to analyse Marie’s hypothesis through a review of Bouillaud’s works on the localisation of articulate language.

**Development.** In 1825, Bouillaud postulated that the organ of articulate language is located in the anterior lobes of the brain. He again defended this hypothesis in 1839 and 1848. Broca’s 1861 findings motivated him to address the topic on another two occasions (1864 and 1877). In the latter two lectures, Bouillaud praised Broca as the discoverer of the neuroanatomical substrate of the faculty of articulate language.

**Conclusions.** Marie accuses Bouillaud of infecting Broca with localisationist ideas and of promoting the dogma of the left third frontal gyrus. Based on the documents reviewed, we may hypothesise that the influential Parisian physician used Broca’s findings to consolidate his modular view of brain physiology.

## KEYWORDS

Language, aphasia, phrenology, Paul Pierre Broca, Pierre Marie, Jean-Baptiste Bouillaud

## Introduction

In 1906, Pierre Marie (1853-1940) (Figure 1A) published three articles on aphasia in *La Semaine Médicale*. The last of the three is titled “Revision de la question de l’aphasie: l’aphasie de 1861 à 1866, essai de critique historique sur la genèse de la doctrine de Broca” (A review of aphasia: aphasia from 1861 to 1866, a critical historical essay about the origin of Broca’s doctrine).<sup>1</sup>

In the 1860s, Paul Pierre Broca (1824-1880) (Figure 1B) provided the first documented, empirical evidence of the correlation between a cognitive process and a specific area of the cerebral cortex. He postulated that the left third frontal gyrus was the neuroanatomical substrate of articulate language.<sup>2,3</sup> In “Revision de la question de l’aphasie,” Marie posited that this clinicopathological finding had become a dogma thanks to the support of Jean-Baptiste Bouillaud (1796-1881) and a group of

physicians interested in phrenology:

Early in 1861, the influence of Gall's theories was still considerable; although his system had largely been abandoned, his theory of the localisation of articulate language in the frontal lobes had been supported by Bouillaud, who adopted it and made it his own, working tirelessly for the theory to be recognised by all physicians, and even, it must be said, imposing it if necessary.<sup>1(p24)</sup>

The article also mentions that:

Bouillaud had become an ardent supporter of this doctrine, he had huge authority in every sense of the word. [...] Many physicians of previous generations were 'localisationists' as they were supporters of Gall's system. The new generations included even greater numbers of 'localisationists' [...] they felt that this doctrine could bring progress, and also partly supported it because it was in vogue.<sup>1(p34)</sup>

This study aims to deepen our understanding of the theory proposed by Marie. To this end, we reviewed Bouillaud's works on the localisation of articulate language between 1825 and 1877.

## Development

### *Bouillaud: a short biographical note*

Jean-Baptiste Bouillaud (Figure 2) was born on 16 September 1796 in the region of Nouvelle-Aquitaine in south-west France. He studied medicine at the Faculty of Medicine of Paris, under François Magendie (1783-1855), Guillaume Dupuytren (1777-1835), Georges Cuvier (1769-1832), and François J. Victor Broussais (1771-1838), among others. He graduated in 1823 and was appointed as a member of the Académie de Médecine two years later. In 1831, he joined the medical team at Hôpital de la Charité in Paris, where he was appointed chief physician 30 years later. Between 29 February and 30 December 1848, he was dean of the Faculty of Medicine of Paris. He was vice-president of the Académie de Médecine in 1847 and 1861, and president in 1862 (Figure 3). He also became a member of the Académie des Sciences in 1868. He died in Paris on 29 October 1881.<sup>4,5</sup>

Bouillaud's medical interests included a wide range of topics, from the study of the cardiovascular system to rheumatism and diseases of the nervous system.<sup>6</sup> In 1825, he published *Traité clinique et physiologique de l'encéphalite ou inflammation du cerveau et de ses suites* (Clinical and physiological treatise of encephalitis or

brain inflammation and its consequences).<sup>7</sup> With the publication of this treatise, he became one of the leading specialists in cerebral pathology of the time. In the preface, he wrote that:

The location of muscle paralysis varies according to whether the brain alteration affects the anterior, middle, or posterior lobes; in this way, we can determine some of the functions of the different parts that form it. [...] One of the most interesting findings from my clinical observations is that the anterior part of the brain is indeed the organ of articulate language, as Dr Gall had proposed.<sup>7(pxiv)</sup>

### *Bouillaud and phrenology*

Bouillaud was involved in the foundation of the Société Phrénologique de Paris, on 14 January 1831. The society included prominent figures in medicine, such as Guillaume Marie André Ferrus (1784-1861), chief physician at Hôpital Bicêtre; Achille Louis Foville (1799-1878), medical superintendent at the Saint-Yon asylum in Rouen; Gabriel Andral (1797-1876), a prominent figure at the medical school of Paris; François-Joseph-Victor Broussais (1772-1838), chief physician at Hôpital Militaire du Val-de-Grâce; Jean Pierre Falret (1794-1870), physician at Hôpital de la Salpêtrière; and Louis Joseph Sanson (1790-1841), surgeon at Hôtel-Dieu in Paris.<sup>a</sup> The main purposes of the Société Phrénologique de Paris were "propagating and improving the doctrine of Gall," and promoting the study of "human and comparative anatomy, the nervous system in general, and the brain in particular; as also their physiological and pathological phenomena."<sup>8(p299)</sup> The institution was dissolved in 1848.

Franz Joseph Gall (1758-1828) proposed that, just as the body contains organs associated with specific physiological functions, the brain is also made up of mental organs, each of which is dedicated to a specific task.<sup>9</sup> This *Schädellehre* ("skull doctrine"), later known as phrenology, was based on the following postulates:

- The brain is the organ of the mind.
- The brain comprises a set of organs or mental faculties.
- The organs or mental faculties making up the brain are located in different brain areas, each of which has a specific function.

<sup>a</sup>Some members of the Société Phrénologique de Paris were lecturers at the Faculty of Medicine of Paris, as well as physicians; this is the case of Andral, Foville, Broussais, and Bouillaud.

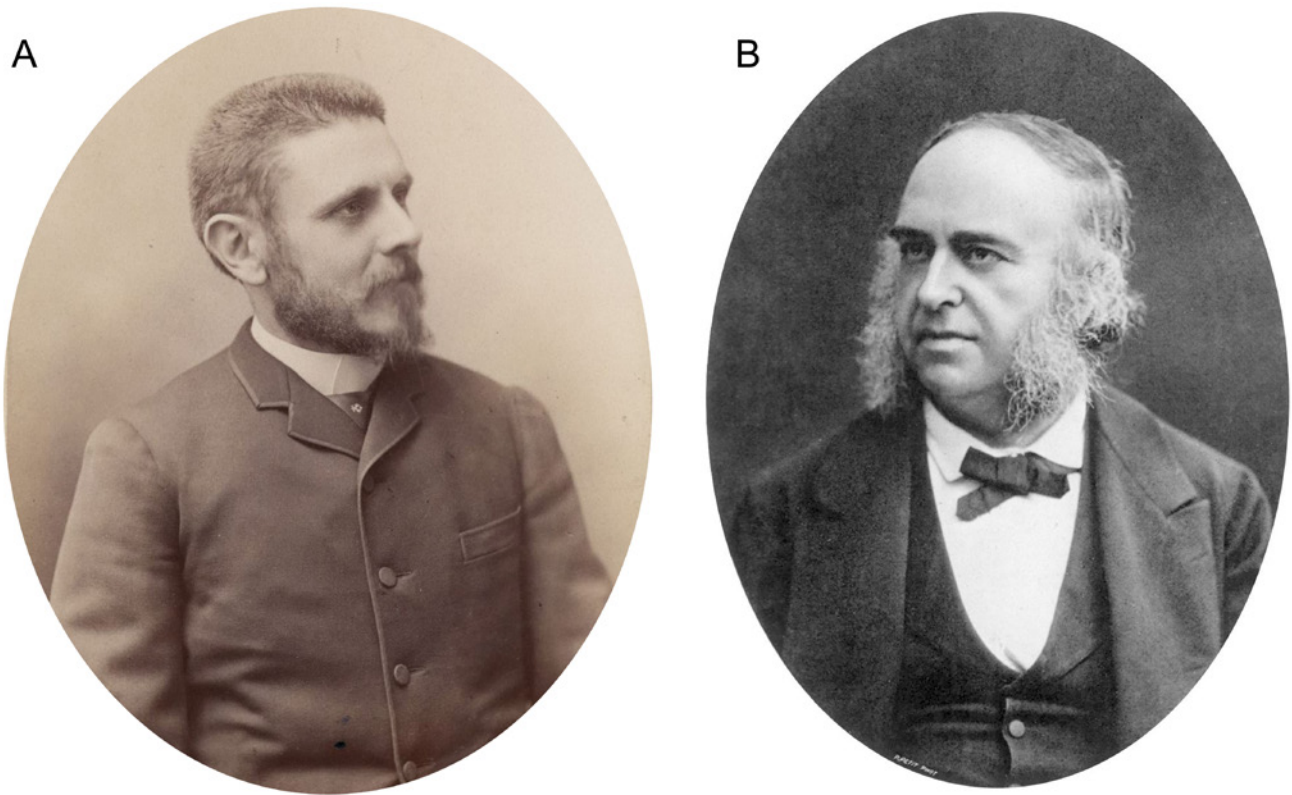


Figure 1. A) Pierre Marie (1853-1940). B) Paul Pierre Broca (1824-1880).

— As the skull ossifies over the brain during its formation, external analysis of the cranium (cranioscopy) is a method for diagnosing the state of the organs or mental faculties.

Although Bouillard shared Gall's postulates, he did not consider cranioscopy to be a suitable method for studying brain function. Rather than inferring the functional role of brain regions through studying the bumps on a person's skull, Bouillaud used the anatomopathological method, establishing correlations between neurological signs and structural brain lesions.

#### *Bouillaud and the localisation of articulate language*

For over five decades, Bouillaud vehemently argued that the organ of articulate language is located in the anterior

lobes. In May 1825, he gave a lecture at the Académie de Médecine whose title was a true statement of intent: "Recherches cliniques propres à démontrer que la perte de la parole correspond à la lésion des lobules antérieurs du cerveau, et à confirmer l'opinion de M. Gall sur le siège de l'organe du langage articulé" (Clinical research aimed at demonstrating that loss of speech corresponds to a lesion to the anterior lobes of the brain, and at corroborating Gall's opinion on the location of the organ of articulate language).<sup>10</sup> Bouillaud begins his lecture by questioning the theory postulated by Marie-Jean-Pierre Flourens (1794-1867),<sup>11</sup> according to which the cerebral cortex is homogeneous and equipotential (all cortical regions participate in mental functions, functioning as a whole). Flourens had also argued that this brain structure does not have an immediate and direct influence on





Figure 2. Jean-Baptiste Bouillaud (1796-1881).

muscle activity. Bouillaud suggests that:

The plurality of brain organs is an infinitely probable, or rather a rigorously proven, fact if we consider that it is not uncommon to find partial lesions to muscle functions, due to the effect of local damage to the brain. Thus, for example, we frequently observe paralysis affecting the upper or lower limb exclusively, as a result of a deep lesion to a portion of the brain.<sup>10(p26)</sup>

He subsequently asserts that it would be a mistake to assume that the limbs are the only parts of the body whose movement is linked to specific brain centres, suggesting that the same is true for the tongue and other muscles involved in speech production: “I cannot fathom why it is not widespread knowledge that the movements of the organs of speech must have a special centre in the brain— so simple and natural this truth seems to

me!”<sup>10(p28)</sup> He continues with a description of the findings from post mortem examinations of several patients who had lost the ability to speak due to lesions located in the anterior lobes of the brain.<sup>b,c</sup> He also describes patients with lesions to the middle and posterior lobes whose ability to speak was preserved. Bouillaud postulates the existence of two distinct language regions in the brain. The intellectual centre of word memory, or the executive organ of speech, is located in the anterior cerebral cortex. The white matter located below the anterior grey matter is responsible for executing the movements needed to produce words. He ends his lecture with the following conclusions:

- The brain plays a pivotal role in a wide range of movements.
- The brain contains several special organs, each of which controls the movement of specific muscles.
- The movements of the organs of speech are controlled by a distinct, independent brain centre, located in the anterior lobes.
- Loss of speech is sometimes due to problems with word memory, and other times due to problems with movement of the muscles of speech.
- Loss of speech does not necessarily involve tongue movement problems.

The members of the Académie de Médecine were not unmoved by Bouillaud’s lecture, which was met with harsh criticism. Bouillaud responded to his critics, though 14 years after his intervention.<sup>12</sup> This time, his lecture revolved around two main axes: presenting further evidence in support of his hypothesis, and refuting the objections made by three members of the Académie: Jean Cruveilhier (1791-1874), Claude-François Lallemand (1790-1854), and Gabriel Andral. Bouillaud argues that the neuroanatomical evidence presented by Cruveilhier

<sup>b</sup>In 1807, François Chaussier (1746-1828) divided the cerebral cortex into three sections: the anterior, middle, and posterior lobes. This division remained in use until well into the 19th century.

<sup>c</sup>Bouillaud describes his own cases as well as observations made by Claude-François Lallemand and Léon Louis Rostan. In 2001, Luzzatti and Whitaker suggested that Bouillaud’s interpretation of Lallemand’s observations were biased. Although this possibility cannot be ruled out, we should bear in mind that presentism (interpretation of historical facts through the lens of present-day ideas) may lead us to interpret past observations as erroneous. Frequently, these alleged mistakes are no other than conceptions and interpretations made within the scientific framework of a particular time (Luzzatti C, Whitaker H. Jean-Baptiste Bouillaud, Claude-François Lallemand, and the role of the frontal lobe. *Arch Neurol*. 2001;58:1157-62).

and Lallemand was not valid due to a lack of appropriate clinical detail and pathological descriptions. The observations made by Andral, however, were solid and difficult to refute, and Bouillaud opted to ignore them, claiming that Andral did not provide an alternative theory:

To summarise the observations made by Prof. Andral, we should admit that they tend to question my doctrine and, unfortunately, do not provide an alternative explanation. We must never forget that, in science, it is not sufficient to do justice to erroneous opinions; rather, we must also build better theories upon the ruins of the ideas we have demolished.<sup>12(p303)</sup>

In the late 1840s, the discussion about the localisation of speech centres was revived at the Académie de Médecine. In 1848, Jacques-Étienne Belhomme (1800-1880) presented his study “De la localisation de la parole ou plutôt de la mémoire des mots dans les lobes antérieurs du cerveau” (On the localisation of speech or rather word memory in the anterior lobes of the brain).<sup>13</sup> This presentation, and the ensuing discussion, prompted Bouillaud to reopen the debate on the localisation of articulate language.<sup>14</sup> That same year, he once more claimed that lesions to the anterior lobes of the brain cause speech alterations and that this brain region therefore constituted the seat of the faculty of articulate speech.

It should be noted that all of Bouillaud’s lectures focus on the anteroposterior dichotomy, overlooking any interhemispheric differences, concluding that both anterior lobes are responsible for the production of articulate language. This idea, also supported by Gall, is probably influenced by the law of symmetry formulated by François-Xavier Bichat (1771-1802).<sup>15</sup> The law of symmetry, a widely accepted dogma during the first half of the 19th century, held that two parts essentially alike in their structure cannot be different in their functioning. This led to the belief, defended by Gall and Bouillaud themselves, that both hemispheres were anatomically and functionally similar.

#### *Bouillaud and the localisationist ideas of Broca*

On 4 April 1861, at the Société Anthropologique de Paris, Simon Alexandre Ernest Auburtin (1825-1895)<sup>d</sup> described the case of a patient who had deliberately shot himself in the head. As a consequence, the bones of the anterior part of the skull were fractured, exposing the brain. He conducted a simple clinical experiment: “During the ex-

amination, the blade of a large spatula was placed in the anterior lobes. When light pressure was applied to them, speech suddenly halted; the patient stopped in the middle of a word. The faculty of speech was restored as soon as compression ceased.”<sup>16(p217-8)</sup> At the same session, Auburtin also presented the case of a patient named Bache, who had lost the ability to speak but could understand everything he was told and was able to answer questions with gestures. From these symptoms, Auburtin deduced that the patient presented anterior lobe involvement, contributing further evidence in support of Bouillaud’s theory. Auburtin’s lecture motivated other members of the Société Anthropologique to examine in greater detail the evidence on the neuroanatomical basis of language. This was the case of Paul Pierre Broca.

At the 18 April 1861 session of the Société Anthropologique, Broca presented the case of Leborgne (*Monsieur Tan-Tan*). The patient was admitted to Hôpital Bicêtre on 4 December 1834. Around 1839, he lost the ability to speak, and a decade later he began to manifest progressive paralysis of the right side of the body. On 17 April 1861, he died due to complications associated with a gangrenous diffuse abscess in the right lower limb.<sup>17</sup> Broca performed an autopsy study, finding a lesion in the left third frontal gyrus.<sup>18</sup> In August of the same year, he presented the case once more, this time before the Société Anatomique de Paris.<sup>19</sup> In his lecture, he argued that the cerebral cortex was not equipotential, and proposed the left third frontal gyrus as the seat of articulate language. Unlike Gall, who located the faculty of speech in the posterior part of the orbit (Figure 4),<sup>20</sup> and aware that anything with even a hint of phrenology about it was branded as pseudoscience, Broca concluded that:

In any case, it is sufficient to compare our observation against those which precede it to rule out the idea that the faculty of articulated language resides in a fixed point, located under any bump of the skull. The lesions of aphemia<sup>e</sup> were more frequently found in the most anterior part of the frontal lobe, not far from the eyebrow, and above the orbital arch; this difference in localisation is incompatible with the system of protuberances.<sup>19(p357)</sup>

<sup>d</sup>Auburtin was chief clinician at Hôpital de la Charité in Paris, and married Marie Elisa Bouillaud, the daughter of Jean-Baptiste Bouillaud.

<sup>e</sup>Broca used the term “aphemia” to refer to the alteration of articulate language in isolation. In 1864, Armand Trousseau (1801-1867) proposed the term “aphasia” (*aphasie*).



**Figure 3.** Board of directors of the Académie de Médecine de Paris (1862). From left to right: D. d'Amiens (permanent secretary), H. Larrey (vice-president), J.B. Bouillaud (president), and J. Béclard (secretary).

Broca maintained that it was possible to localise distinct functions in specific brain regions. However, like Bouillaud, he linked clinical symptoms to anatomopathological findings rather than 'reading' skulls, as phrenologists did. He continued gathering cases and, in April 1863, presented a report to the Société Anthropologique de Paris, claiming once more that the lesion causing loss of speech was located in the left third frontal gyrus.<sup>21</sup>

Taking advantage of the impact of Broca's findings, Gustave Dax (1815-1893) presented the manuscript "Observations tendant à prouver la coïncidence constante des dérangements de la parole avec une lésion de l'hémisphère gauche du cerveau" (Observations aiming to prove the consistent concurrence of language disorders and lesions to the left hemisphere of the brain) to the Académie de Médecine in 1863.<sup>22</sup> Based on Broca's observations and the report written by his father, Marc Dax

(1770-1837),<sup>23</sup> in 1836, Gustave Dax postulated that language disorders are always associated with lesions to the left hemisphere.<sup>f</sup> The Académie charged a group of experts, including Bouillaud, Jules-Auguste Béclard (1817-1887), and Louis Francisque Lélut (1804-1877), with reviewing the manuscript.<sup>24-26</sup> Lélut published his conclusions in December 1864. His report ridiculed the hypothesis proposed by Marc and Gustave Dax, linking it to phrenology: "This idea is nothing but phrenology, and I myself have had enough of this pseudoscience in the past and do not wish to continue dealing with it."<sup>27(p173)</sup>

In his own report, Bouillaud summarises his hypotheses on the localisation of articulate language published

<sup>f</sup>Gustave Dax argues that the brain lesions responsible for language disorders are located in the middle lobe of the left hemisphere, and does not mention the anterior lobe.



in 1825, 1839, and 1848,<sup>g</sup> and acclaims Gall as “one of the finest and boldest geniuses that the physiological and psychological sciences can boast about,”<sup>28(p605)</sup> comparing the contributions of the latter to those made by such other scientific giants as Copernicus, Kepler, Galileo, Newton, Lavoisier, Laplace, Haller, or Bichat. Furthermore, he does not miss the opportunity to reply to Lélut, who was opposed to anything that may be linked to phrenology:

Whatever the case, perhaps M. Lélut should have chosen a more timely occasion to release his new manifesto, especially regarding the localisation of the faculty of speech in particular, since this is no longer about Gall’s work or the findings that I have had the honour to present to the Académie on several occasions, but rather a sort of mass uprising [a new age] to defend this special localisation.<sup>28(p584)</sup>

In his report, Bouillaud also writes that:

This age is divided in two: one is that in which the author of the report [Gustave Dax], like his father before him, has localised the principle of language in the left hemisphere of the brain. The other, much more important, is that in which Broca, not content to accept our localisation, audaciously located the faculty of language in the third gyrus of the left frontal lobe of the brain.<sup>28(p631)</sup>

With regard to Broca, Bouillaud declares himself a convert, calling him “le saint Paul de la nouvelle doctrine” (the Saint Paul of the new doctrine), but notes that his localisationist hypotheses are not sufficiently proven.

In February 1874, Armand de Fleury (1830-1892), a lecturer at the medical school of Bordeaux, submitted the report “Recherches anatomiques, physiologiques et cliniques sur l’inégalité dynamique des deux hémisphères cérébraux” (Anatomical, physiological, and clinical research on the dynamic inequality between the two cerebral hemispheres) to the Académie de Médecine.<sup>29</sup> On this occasion, the review committee included Broca, Jules Baillarger (1809-1890), and Louis Gavarret (1809-1890).<sup>30</sup>

Fleury proposed that the greater prevalence of language alterations following lesions to the left hemisphere may be explained by interhemispheric haemodynamic imbalances. More specifically, he asserted that blood circulation is more active in the left hemisphere than in the right, as a consequence of the asymmetry of the vessels of the aortic arch. After evaluating Fleury’s report, Broca concluded that “the general doctrine of comparative

anatomy and physiology that the author [Fleury] has, after an ingenious exercise of imagination, deduced from the facts observed in men is rather illusory.”<sup>30(p530)</sup> Furthermore, he reiterates that the relationship between articulate language and the left third frontal gyrus is a well-established fact. However, he does admit that loss of speech may be secondary to right hemispheric lesions, although in a minority of cases.

After Broca’s presentation, Bouillaud took the floor, asserting that “the lesion causing loss of speech is generally, if not always, located in the left anterior lobe of the brain (third gyrus) [...], a marvellous observation made by M. Broca.”<sup>30(p534)</sup> He subsequently admitted that:

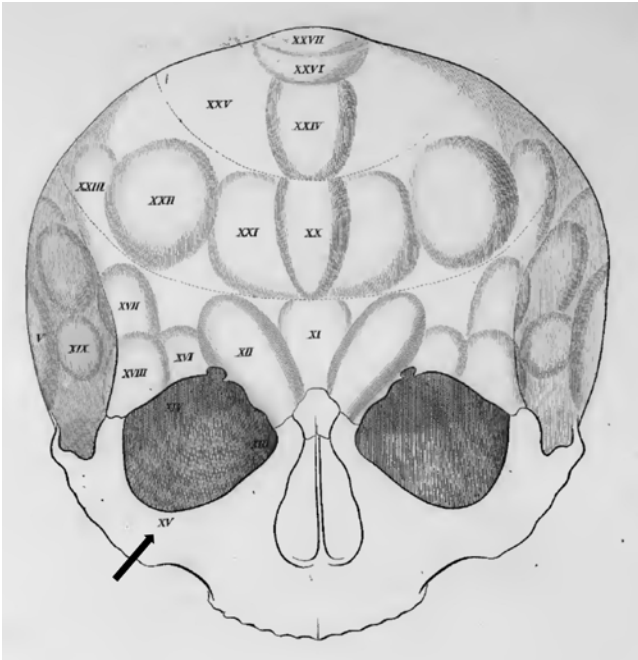
The idea of this particular location never occurred to me [...] if this timely idea, which M. Broca can be proud of, had been my own, I could simply have selected any of the numerous observations made by myself before Broca postulated his hypothesis to confirm this truth.<sup>30(p534)</sup>

He also indicated that, in the 1830s, Marc Dax had observed a special relationship between the faculty of articulate language and the left hemisphere. After Bouillaud’s brief intervention, Broca once more took the floor to reply to the latter point.

He recalled that, in 1865, during a trip to the south of France, he was told about the arguments put forward by Gustave Dax and travelled to Montpellier to find his father’s communication, which had supposedly been presented to the Congrès Méridional, held in that city between 1 and 10 July 1836. He was helped in his search by Dr Gordon, librarian at the Faculty of Medicine of Montpellier. The result could not have been more disheartening: they could find no written record confirming the existence of Marc Dax’s communication. This led Broca to conclude that, in 1861, when he started his research on the seat of articulate language, nobody knew about that lecture.<sup>h</sup> After Broca’s intervention, Bouillaud closed the session with the following words: “I am glad to have lis-

<sup>g</sup>Bouillaud reminds the members of the Académie that, in his 1848 lecture, “I offered the sum of 500 francs to the person who could provide an example of a patient with a deep lesion to the anterior lobes and no language impairment. Seventeen years have passed, and I am still awaiting such an observation.”<sup>28(p623)</sup>

<sup>h</sup>In 1879, Raymond Caizergues published a letter in Montpellier Medical stating that he had found a copy of Marc Dax’s communication among the documents kept by his grandfather, Fulcrand César Caizergues (1777-1850), a renowned physician in Montpellier and dean of the Faculty of Medicine of Montpellier between 1836 and 1846.



**Figure 4.** Mental organ XV, faculty of spoken language (black arrow). Plate C from *Anatomie et physiologie du système nerveux en général et du cerveau en particulier* (Gall, 1819).<sup>20</sup>

tened to M. Broca's explanations, which I consider a priority. It is he whom we must praise for such an important discovery regarding the faculty of language."<sup>30(p539)</sup>

### Conclusions

In his 1906 article, Marie speculates about aphasia and its neuroanatomical substrate, accusing Bouillaud of turning Broca's finding into dogma. Marie does not call Broca a phrenologist, but does accuse him of being a localisationist, as well as a "puppet" in the hands of Bouillaud: "Unfortunately, Broca got carried away, willingly or otherwise, by the localisationists, and this current was so powerful that the renowned surgeon soon lost his balance."<sup>1(p34)</sup> But to what extent are these claims true?

In 1831, Bouillaud was appointed professor of clinical medicine at Hôpital de la Charité, and soon gained recognition as an exceptional clinician.<sup>4</sup> Between 1846 and 1856, Broca worked at the surgery department of the same hospital, under Pierre Nicolas Gerdy (1797-1856).<sup>31</sup>

He subsequently transferred to Hôpital Bicêtre, where he had been an intern in 1844-1845 under François Leuret (1797-1851).<sup>1</sup>

During his years at Hôpital de la Charité, Broca had the opportunity to meet Bouillaud, as demonstrated by the correspondence he exchanged with his parents.<sup>32,33</sup> In April 1847 Broca wrote to his mother: "The day before yesterday I had dinner at M. Bouillaud's. [...] We were a small group and it was rather informal. After the dinner we played pontoon with him and his ladies, that is his wife and daughters."<sup>32(p394)</sup> A few months later, he recalls that:

Given the good relationship I have with him [Bouillaud], I hope to continue rising under him. [...] M. Bouillaud is professor of clinical medicine. Clinical medicine professors do not have interns, but rather chiefs of clinic [...]. If, by the end of the year, I were on sufficiently good terms with Bouillaud as to obtain the position of chief of clinic under him by 1849 [...].<sup>32(p429-30)</sup>

Although his plan to become Bouillaud's chief of clinic did not come to fruition, Broca continued to profess great respect and admiration for his master. In February 1848, he wrote a letter to his family describing, with great enthusiasm, the changes that had taken place at the Faculty of Medicine as a result of the popular revolt of that same month:

Down with the dean of the Faculty of Medicine! Bouillaud will replace him. Down with the Board of Public Instruction! Gerdy is the one in charge of anything related to the *lycées*, and I hope that this will continue to be the case. The Republic! I have dreamt of it for so long, and in twenty-four hours it has become greater, finer, stronger than I would have dared imagine.<sup>33(p6)</sup>

Bouillaud held this position for only a few months, a victim of university intrigue. Broca wrote: "M. Bouillaud,

<sup>1</sup>François Leuret was a major detractor of phrenology, as demonstrated by the following anecdote from his work *Du traitement moral de la folie* (On the moral treatment of madness; 1840, p. 49): "One day, Gall visited Esquirol at the Salpêtrière. Firstly, Esquirol gave Gall the medical histories of the mad women he had shown him, and Gall explained, based on the protuberances of their skulls, the cause of their illness: the shape of their heads and the nature of their madness were always in perfect harmony. To refute this, Esquirol asked the inventor of phrenology first to observe the patients' heads and, based on this observation, to tell the nature of their illness. Gall was speechless; he had confidently established the cause based on the effect, but was unable to determine the effect based on the cause. It seemed as though his science, so fruitful at that time, had abandoned him."



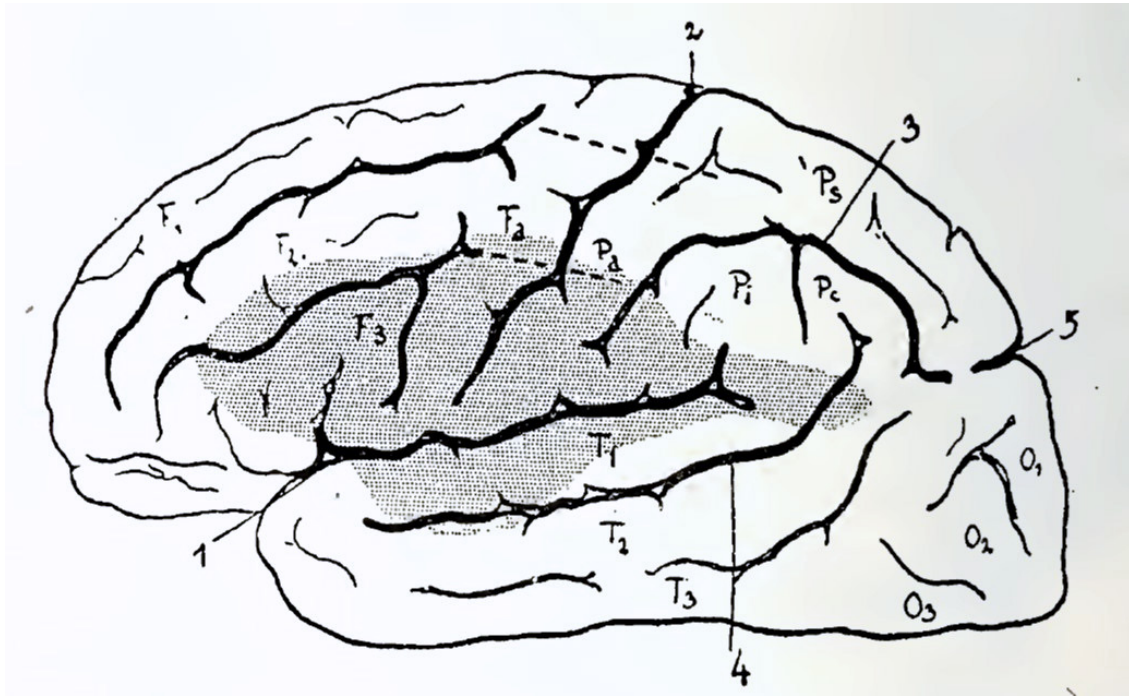


Figure 5. Schematic representation of the lesions observed in Leborgne's brain, by Pierre Marie (1906).<sup>1</sup>

sensing that he was soon to be dismissed from his position as dean, wished to gather some guests one last time at the hall of the School of Medicine, and so I had dinner at his house on Thursday.”<sup>33(p75)</sup>

Marie accused Bouillaud of infecting Broca's brain with localisationist ideas. Based on the documents analysed, we may hypothesise that the successful Parisian doctor transmitted to the young Broca, over whom he had great influence and control, his modular view of the cerebral cortex. Marie's hostility towards Bouillaud is probably explained by the discrepancies between their views of brain physiology. While Bouillaud supports the idea of functional localisation, Marie considers that mental processes are the result of holistic processing and that the identification of brain centres is based on the misinterpretation of anatomopathological data, suggesting that localisationist ideas lack scientific rigour. In the case of Leborgne, for example, Marie maintained that, in addition to the lesion observed in the left third frontal gyrus, the patient displayed lesions involving most of the cor-

tical territory of the Sylvian artery, including Wernicke's area (Figure 5). Marie attacked Bouillaud for perpetuating Gall's ideas and promoting the theory of brain localisation.

In 1922, Marie published the article “Existe-t-il chez l'homme, des centres préformés ou innés du langage?” (Do men have preformed or innate centres for language?).<sup>34</sup> Adamant in his beliefs, Marie asserts that:

Under the influence of Gall's doctrine [...] the only question that interested Broca and Auburtin, Bouillaud's son-in-law, who were present at the autopsy, was the following: Will we find a lesion to the anterior lobe of the brain? And, as indeed there was, among many other lesions, a lesion to the third frontal gyrus, and given that this gyrus is located in the anterior lobe, this was the only lesion that Broca considered significant. The matter was settled: loss of speech was well explained, as Bouillaud concluded, by a lesion to the anterior lobes of the brain. The results of the autopsy were published. Gall had won.

His supporters, who were many, seized Broca's autopsy findings as their central argument. The dogma of the third frontal gyrus had taken root.<sup>34(p545-6)</sup>

### Conflicts of interest

The authors have no conflicts of interest to declare. This study has received no public or private funding.

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