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Considérations sur l'agraphie

à propos d'une observation nouvelle d'agraphie motrice pure.

Par Albert Pitres

Revue de Médecine, 1884, 855-873.

Considerations on agraphia
in light of a new observation of pure motor agraphia
Translation into English by Isabelle Barrière¹ & Marjorie Lorch²

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In the lectures M. Charcot¹ gave last year on different forms of aphasia, he defines agraphia as “the aphasia of the hand”. It would be difficult to find a more complete and concise definition. In fact speech and writing are closely related. These are two common means which enable humans to communicate their thoughts. Both are acquired through study and refined by education; both arise from similar or identical psychological actions. Both are based on the juxtaposition and various combinations of purely conventional signs (sounds or characters). So that intelligence can judge the value of these signs, they must be stored in memory and be appreciated by the senses: for these signs to be elicited by our will, active muscle groups which have been trained and adapted to these functions must be brought into play. Pathological disorders are associated with analogous physiological mechanisms. One could say that aphasia and agraphia² are functional disorders of the same nature with different sites.

Despite the numerous common similarities which these two symptoms have in common, the study of agraphia has not shown parallel development to that of aphasia. For a long time, aphasia has been the exclusive focus of observation. Initially, it was surprising to find that some patients whose muscles were not paralysed and whose verbal intelligence was preserved could no longer express their thoughts through speech. Writing disorders were disregarded or perceived as part and parcel of speech disorders.

The term ‘agraphia’ was introduced by W. Ogle³ in 1867 but we owe the discovery of agraphia to Marcé.

¹ The complete version of these lectures have not yet been published in France. Mr. Féré published some extracts in *Progrès Médical*, 1883, and Mr. Marie published a synthesis in *Revue de Médecine* (1883, p.693). The lectures were published a few months ago, in Italy under the title: *Differenti forme d'afasia. Lezioni fatte nella Salpêtrière, nel semestre d'estate dell'anno 1883, redatte col consenso d'ell autore dal dottore*, G.Rommo, Milano 1881. It is from this translation, approved by Mr. Charcot, that we have borrowed our quotes from the work of the Master.

² The term ‘aphasia’ is used in the paper in the restricted sense which it had when it was created, that is in the sense of loss of speech without hearing impairment or paralysis of the speech organs. Later the definition of the word ‘aphasia’ has encompassed all the disorders of expression and comprehension of signs through which man expresses his thoughts. It would have been more valuable to create another word rather than alter the original meaning which was already in widespread use.

In 1856, with amazing perspicacity, Marcé⁴ formulated the main issues raised by the relation between speech and writing. After he demonstrated that disorders of speech and writing often co-occur in pathological cases, he attempted to demonstrate that the functional impairments of speech and writing did not consistently or systematically do so. Aphasia may be total in patients who are still able to write, and the reverse is also true: some patients who are still able to speak can no longer express their thoughts in writing. There is, says Marcé, a principle which co-ordinates speech, a specific driving force to control and to co-ordinate all the movements required by articulation. Similarly, there is another principle, another agent, which does not depend on the former, the role of which is to co-ordinate the movements required by writing. "At the physiological level the action of this agent precedes writing in the same way as the action of the co-ordinating agent of speech precedes the articulation of words; this is what controls the drawing of letters, their combinations in syllables and in words so that speech has a graphic representation and is made permanent". (Loc. cit, pp110-111)

Marcé's explanation is not explicit regarding the nature of the controlling agent, principle or driving force, the role of which is to co-ordinate the movements required by articulation of speech and by writing. However he does consider this principle in relation with memory: "if it is not memory" says Marcé, "this controlling agent shares many features with memory in that it is responsible for the control and reproduction of movements required by the conventions of letter forms"(p94)

Finally Marcé stresses that the co-ordination of the movements for writing can be lost while the general mobility of the hand is apparently intact. "The integrity of the movements of the hand, in an individual who is intellectually intact is not sufficient for him to write, the part of memory which enables him to recall the sign [symbolic unit] and its representation must also be intact for writing to be expressed in speech or speech translated into writing." (Loc. cit. pp94-95).

To support his claims, Marcé reported twelve pathological observations, which are unfortunately too complex; none of them exhibits writing disorders without the co-occurrence of aphasia. However, he draws conclusions which subsequent studies have borne out. "Undoubtedly" says Marcé, "because in none of the cases reported above, have we found the agent controlling writing either damaged in isolation or spared in isolation other functions have systematically been associated with this agent; nevertheless the faculty of expression through writing distinguishes itself and it emerges as independent in the numerous lesions which involve the loss of speech or the loss of writing one observes. In fact, the faculty of expression through writing does not depend on the faculty of expression itself since in two cases patients could write fluently without being able to speak. It does not depend on the mobility of the hand since the contractility of the arms may be preserved while writing is impossible. Finally it cannot be related to the mobility of the tongue and of the phonatory muscles, although we have observed 2 cases who exhibit this co-occurrence of symptoms. As our much missed master Sandras reported he had often observed

³ J.W. Ogle. Aphasia and Agraphia, St Georges Hospital Reports, 1867, vol. 2, p83.

⁴ Marcé. *Mémoire sur quelques observations de physiologie pathologique tendant à démontrer l'existence d'un principe coordinateur de l'écriture et de ses rapports avec le principe coordinateur de la parole. Mémoires de la Société de biologie de Paris*, 1856, p98.

individuals who were hemiplegic on the left side and whose tongue was paralysed, who used writing to express their thoughts.” (loc. cit., p111)

It is useful to cite these pages to understand the role of Marcé in the history of agraphia. His contribution is significant. By demonstrating that aphasia and agraphia do not depend on a central disorder of the superior psychological faculties but on partial disorders which affect specific mechanisms and which are adapted to specific functions, he has, in great part, paved the way for psycho-physiological analyses which have been perpetuated so successfully by Mr. Kussmaul, Mr. Wernicke, Mr. Magnan, Mr. Charcot, etc... By demonstrating that the coordinated hand movements required for the realisation of graphic characters could become impossible while the common motor functions of the arms are relatively spared. He has identified the most significant form of agraphia, that is motor agraphia. The great limitation of Marcé's work is that it is not founded on the study of simple and precise clinical observations. His observations are of a heterogeneous nature which require a great of interpretive judgement to draw the deductions from the comparison outlined above. The merit of Marcé is however undiminished. Nevertheless this explains why his investigations have not had the influence they deserve. The conclusions of his article have been reproduced by most of the authors who have been concerned with aphasia since 1856. However they have been cited without enthusiasm, almost without conviction and from then onwards they have failed to generate fruitful scientific debates. In the mind of most authors, aphasia was the only disorder of expression which deserved a separate description, agraphia being mentioned/outlined at most in a few sentences in monographs on aphasia.

The way paved by Marcé was quickly abandoned. Instead of continuing to separately analyse each combination of symptoms that clinical observation reveals, glib syntheses were provided. Trousseau, Gairdner and Hughlings Jackson assumed that true aphasics write as badly as they speak and that those who do not speak at all are completely unable to write. Once this supposedly systematic association of speech and writing disorders was adopted as a premise, the theory of verbal amnesia was postulated. It characterises the common form of aphasia as a disorder which primarily involves the psychological faculties and consists of a loss of the memory of the symbolic value of signs (phonetic, graphic, and others) which represent ideas.

For a short while, the theory of verbal amnesia enjoyed great status. It was a simple doctrine, it is true, but it left out all the cases reported by Marcé and analogous cases observed by the most respected authors after his publication, in which patients affected by total aphasia were still able to express their thoughts in writing, or had lost the faculty to write without becoming aphasic.

Recently the theory of verbal amnesia has been completely undermined. The method of analytical observation has been re-adopted. Observations of various disorders in pure cases which often co-occur with aphasia but which can also appear independently have been carried out. Pure cases of various disorders which often co-occur with aphasia but can also appear independently have been observed. A precise formulation of the variety of aphasia and agraphia and the relationship between these two has been conceived.

Modern physiological psychologists accept that the link which joins together the superior psychological faculties to the various types of expression of thought is primarily represented by memory⁵. To be able to read or to write, one has to learn these skills. What is acquired through education must be stored in memory. If we did not retain the memory of things previously learnt, no education would be possible: the child would indefinitely spell the letters of the alphabet and would forever trace the downstrokes of the same letters.

Memory is not an indivisible faculty or, if it is, in any case the elements of its activity relies on various sources and acts upon different entities. With respect to reading and writing, several partial memories are involved. These are:

1. Visual memory which stores the memory of the shape of the letters and their relative status in their innumerable combinations in syllables and in words
2. Auditory memory which gives us the memory of the sounds and of their status in the phonetic language
3. Motor memory which stores the memory of the actions and muscle synergies required to correctly produce written letters.

Each of these partial memories can be lost in isolation while the activity of the others remains intact. The loss of visual memory constitutes word blindness; the loss of auditory memory constitutes word deafness; the loss of graphic memory constitutes motor agraphia.

Patients affected by *pure word blindness* have lost the memory of the meaning and of the conventions associated with graphic signs. The patients clearly sees the characters, but they no longer understand them. Placed in front of a printed text or a page of writing, they find themselves in exactly the same situation as if they had never learnt how to read. A curious fact, and one which would seem highly unlikely had it not been verified several times on the basis of clinical observation, this type of patient can write correctly to dictation. They can fluently express their thoughts in writing but are unable to read what they have written.

Facts of this type were considered inexplicable before current notions on word blindness were developed. Trousseau has reported the story of a patient who had had a slight stroke followed by a mild right hemiplegia and transitory aphasia. After his stroke, this patient could no longer read although he was still able to write. He was not amblyopic, since he could pick up a pin from the floor. In spite of the facts that his vision and intelligence were intact, Trousseau could not get him to decipher the title of a newspaper: "What is most unbelievable" adds Trousseau, "is that this patient cannot read what he correctly writes. I invited him to sit at my desk, and he soon wrote this very sentence: '*I am very happy, Sir, to have come to see you; I hope that when I leave I will be cured*'." He found it impossible to read the sentence he had just written⁶. The patient obviously suffered from word-blindness.

⁵ See the very interesting book by M. Ribot on this topic: *Diseases of Memory*, (1881)

⁶ *Sur l'Aphasie*, from the clinical lectures of Trousseau, recorded by M. Petter (*Archives générales de médecine*, 1865).

There are approximately ten observations which document cases of pure word blindness with no co-occurrence of aphasia or hemiplegia in the scientific literature. In all these observations the patients were able to produce error-free writing but were unable to read what they had written. I have had the opportunity to see a patient of this type with my colleague Dr. Armaignac⁷, who clearly exhibited this phenomenon. The patient wrote business letters with great fluency. But if, for whatever reason, he was interrupted before he finished the letter, he could only carry on after having the last sentences or words he had written read out to him. Patients who suffer from word blindness write without relying on their vision. One of these patients studied by M. Guéneau de Mussy⁸, could see objects distinctly but was unable to read or even recognise letters. "Nevertheless he was able to write," says M. Guéneau de Mussy "when I had him write successively with open and closed eyes I noticed that there was very little difference in the result. The same irregularities in the spacing between letters and the size of the letters were found in the same places. I concluded that he wrote automatically and was relying upon his overlearned memory. His vision was used, if at all, solely for assistance with the direction of his handwriting". In fact it is motor memory which guides the act of writing while it is visual memory which enables the act of reading.

By a curious deceit, some patients who suffer from word blindness manage to read a few words or a few sentences by relying on their intact motor memory to make up for the visual memory which they have lost. That is how one of M. Charcot's⁹ patients who suffered from pure word blindness managed to read, provided that he could trace in the air with his right hand the characters that were placed in front of him. When a word was written in front of him, he would look at it attentively, not recognising any of the letters. Then he would stare successively at the letters which composed the word and would enact the movements required for the reproduction of these letters with his right hand. The movements of his hand would then remind him of the signification of the letters and of the words that he had just reproduced in space. In other words, he could only read through writing: he compensated the defect of his visual memory by producing the movements required for making the letters with his fingers, that is by motor memory.

It is unclear whether visual memory is an indivisible functional unit. It is very likely that this is not the case and that each group of memories successively acquired by the education of the eye can be lost in isolation. In other words, it is probable that the loss of the memory of signs may only affect printed characters, or only cursive characters, or only numerals, or only musical notation. It is true that partial psychic blindness is not commonly observed independently from the concomitant disorders of language, intelligence, or movement. However, in some complex pathological cases, one finds clusters of symptoms which can only be explained by hypothesising a partial loss of visual memory. For example an aphasic studied by Mr. Grasset was able to silently read printed writing while he was unable to comprehend handwritten

⁷ This observation has been published by Mr. Armaignac in the *Revue clinique d'oculistique du Sud-Ouest*, Year 3, No. 4, April 1882, p. 73.

⁸ Noël Guéneau de Mussy, *Contribution à l'étude pathologique et physiologique de l'amblyopie aphasique* (*Revue d'ophtalmologie*, 1879).

⁹ *Loc. Cit.* p. 12.

messages¹⁰. Lasègue described a musician who had become completely aphasic. He could neither read nor write, but he could easily transcribe a tune in musical notation when he heard the notes being sung¹¹. It would be easy to find in the old literature a great number of observations which would confirm the hypothesis presented above.

A patient who suffers from *pure word deafness* has lost only the memory of the significations and conventional status of articulated sounds which form the basis of the phonetic language. If one speaks in front of this type of patient, they hear the noise but do not understand speech. It is as if a foreign language unknown to them was being spoken. They can express their thoughts in writing; they can copy written texts placed in front of them but are unable to write to dictation because the sounds that they hear no longer have signification and as a consequence cannot be translated into writing. Thus a patient of Mr. Magnan, whose observation is reported in details in the thesis of Miss Nadine Skwortzoff could answer none of the questions that he was asked verbally¹². He could read and copy writing, write his name and address, but he could not write to dictation. An interesting patient described by Mr. Giraudeau¹³ could not understand the questions he was asked verbally, but could easily read questions she was asked in writing and answer them either orally or in writing. Writing was also intact in the patients reported by Mr. Veiss¹⁴ and Mr. Burckhardt¹⁵.

In summary, the fundamental phenomenon of pure word deafness is the loss of the memory of sounds, the association of which compose words, while visual and motor memory are intact. Although observations of pure word deafness are not yet numerous, some¹⁶ do exist and they provide useful insights. The same richness of literature does not exist for motor agraphia.

Pure motor agraphia consists of the isolated loss of the memory of the very complex muscle synergies which control the movements of the hand and the forearm in the act of writing. This type of agraphia does not involve any serious disorder of intelligence; the patient understands what is said to him. He can read silently and aloud; he has no paralysis of the arms but is unable to produce graphic characters because he has lost the memory of the co-ordinated movements which writing requires. In effect, he can no longer write.

In the great majority of cases where motor agraphia has been observed, it was found in aphasic patients who also presented with complex disorders of movements and intelligence. Until last year no single detailed study of pure motor agraphia had been reported in the scientific literature. In the paper by Ogle, published in 1867, case of

¹⁰ Grasset, *Contribution clinique à l'étude des aphasies* (Montpellier médical, Jamès, 1884, Obs V., p14, l'édition spécial).

¹¹ Case cited by Trousseau in his *Cliniques sur l'aphasie*.

¹² Miss Nadine Skwortzoff, *De la cécité et de la surdité des mots dans l'aphasie*, Th. Doct. Paris 1881, p71.

¹³ Giraudeau, *Note sur un cas de surdité cérébrale (surdité psychique) par lésion des deux premières circonvolutions temporo-sphénoïdales gauches* (Revue de médecine, 1882, p446).

¹⁴ Weiss, *Wiener medicinische Wochenschrift*, p.12, 1882.

¹⁵ Burckhardt, *Correspondenz Blatt für Schweizer Aerzte*, 1882.

¹⁶ These observations can be found in a collection of lectures by M. Charcot, in the thesis of Miss Skwortzoff and in a study of M. Seppilli published in *Rivista sperimentale di freniatria e di medicina legale*, 1884, p94.

agraphia with paraphasia and with some intellectual impairment was reported. Here is a summary of this case to which references are often made.

Observation 1 Mild Hemiplegia. Paraphasia. Ataxic agraphia¹⁷
(Observation III of the article by Ogle)

A man who had been hit seven years before on the left side of his head had exhibited since then some form of language impairment. After an apoplectic stroke, he had an incomplete right hemiplegia and aphasia.

Current state: incomplete hemiplegia which does not prevent him from walking. The muscles of his face are slightly affected. Speech is hesitant and imperfect. The patient often stops to search for a word or uses an inappropriate word. For instance he would say "barber" for "doctor"; "two shilling piece" for "spectacles"; "winkles" for "watercress". He can however repeat correctly when he is told what to say. He says that he usually realises that he is using the wrong word, but not always. Before his illness he wrote well; he was well educated. Now he can no longer write a single letter. Even with a model to copy from in front of him, he only produces shapeless downstrokes. I gave him some individual printed letters and told him to compose his name. After searching for a long time, he came up with the combination "J I C M N O S" (his name is James Simmonds), in which some remnants of his name can be recognised. Before his illness his spelling was good and he was particular about the spelling of his name which can be spelled in different ways. If he had a model in front of him, he could copy his name quickly and correctly. He can read, but reading soon gives him a headache. His intelligence is intact.

It should be pointed out that Ogle's patient presented with a rather serious language disorder, independent from his motor agraphia. The difficulty he experienced in assembling the letters of his own name demonstrates that the patient had multiple deficits in that there was, co-occurring with agraphia and paraphasia, some degree of word blindness, and perhaps a more profound disorder of intelligence.

Charcot reported in detail in his lesson on agraphia a simpler and therefore more convincing case. As this observation has not been published in France yet, the main features of the case are summarised below.

Observation II - Motor agraphia (summary based on the details provided by Charcot in his lessons on different forms of aphasia)

Mr. X... fifty-two years old, appointed on a high grade in the Russian army, has been between twenty and forty years subjected to attacks of ophthalmic migraines. In August 1882, he suddenly felt that his fingers were getting weaker and his quill fell out of his hand. He found himself unable to write. At that time, the patient had not lost the idea of the movements associated with the production of letters, rather he did not write due to a paresis of some of the muscles of his hand which he no longer had

¹⁷ W. Ogle distinguished two forms of agraphia: *amnesic agraphia* and *ataxic agraphia*. In *amnesic agraphia*, the patient is able to write letters and words quite clearly but sometimes substitutes one word for another, sometimes writes a series of letters in incorrect orders which bears no relation with the intended word. In *ataxic agraphia* the patient has entirely lost the faculty of writing even isolated letters.

volitional control of. This paresis quickly resolved, and the patient began to write again.

Six months later, Mr. X who usually spoke equally fluently in Russian, French and German was at a social gathering. Someone spoke to him in French. He clearly understood the question and wanted to answer it in French but, to his great surprise, he realised that he could no longer reply in French or in German. He still understood these two languages, but could no longer speak them. He spoke Russian as fluently as before his illness. Gradually, his state improved. Mr X. started to speak in French again quite well but he remained completely unable to speak German.

At that time, when he attempted to write, he realised that it was impossible for him to produce a single written word, although he was not paralysed. It is at this time that he was examined by Charcot, on 10th April 1883.

His intellect was intact. M. X spoke French, answered question accurately and related in detail the various phases of his illness.

He still experienced some discomfort when moving the fingers of his right hand and he had slight cutaneous sensory loss and incomplete loss of position sense of his fingers.

Mr. X could read aloud from Russian, French and German books. But he could write in none of these languages, not even in his mother tongue, Russian. "I am not surprised", he said, "not to be able to write in French; what amazes me is that I cannot write in Russian and I am very upset about not being able to write in Russian although understand it, I speak it, and I possess enough strength to direct a quill. When I was affected by the paralysis of the fingers of my right hand, I could write correct sentences, although with very poor penmanship. Today I am no longer paralysed but I find impossible to write a single word."

Charcot asked him to say and to write his Paris address. He immediately replied: "*Je demeure hôtel de Bade, Boulevard des Italiens*" but when he was asked to write what he has just said, the patient could only produce "Je dem...".

However, to dictation, he succeeded with some difficulty to write the end of the sentence. When a model was placed in front of him, he could copy it quite easily. When he was asked to write the name of M. Charcot in Russian, French and German [orthography/scripts] he could write it with ease in Russian; he found it more difficult to write it in French and impossible to do so in German.

A few days after this examination, Mr X. suddenly died. No autopsy was carried out.

I have had the opportunity this year to study a patient who presents clear symptoms of motor agraphia. This patient was very intelligent and insightful about his state and was willing to submit to rather long examinations. His detailed clinical observation is reported below.

Observation III. Severe cerebral syphilis. Rapid resolution of most of the symptoms. Persisting motor agraphia (unpublished).

Mr. Leopold L., wine merchant, aged 31, had been living an irregular life for the last few years. At the age of 21, he had a syphilitic chancre, followed by roseola and by mucous plaque. Since that time he had been living a very debauched life and spent most nights in cafes and boudoirs.

On 30 July 1882, Mr. L. was in a café when he suddenly felt sick. However he did not lose consciousness: he sent for a carriage and was driven home. He managed to get out of the carriage unaided but was dragging his right leg. Dr. Garant who saw him shortly after diagnosed total and incomplete right hemiplegia with signs of aphasia. The paralytic symptoms increased in severity over the next few weeks and by the beginning of September, Mr. L. was confined to his bed, in a semi-conscious state, with incontinence and complete paralysis of both the right limbs. In light of his critical condition, a strong antisyphilitic treatment was administered consisting of 2 applications per day with 10 grams of Neapolitan ointment. Eight days after the onset of treatment, the patient regained consciousness. He recovered the use of speech. His intelligence and his memory returned. Finally the control of his right limbs was gradually regained, in a slow but regularly progressive fashion.

By December 1882, the patient could walk unaided. His improvement continued throughout the next year and what remains today [1884] are a few relatively mild but very interesting functional disorders, on which I have managed to record the observations below, thanks to the kind friendship of Dr. Garat who brought the patient to my clinic on 5 February, 18 months after the initial onset of illness.

Current state: 5 February 1884. Mr L. appears to be in a poor state of health. The muscles of the limbs are nevertheless well developed. The basic vital systems are normal. His intellectual faculties seem intact. Speech is fluent, there is no effortfulness in articulation.

The patient can read aloud and he reads cursive or printed writing with the same ease: he understands perfectly the meaning of what he reads.

When asked about the symptoms which concern him, Mr. L. replied that he didn't have any complaint except for a slight stiffness in the right leg and a complete inability to write with the right hand, although he could move that hand easily and used it to get dressed, eat, and used it generally for all functions which it is normally used easily.

Upon examination of the patient, we noticed that his face did not exhibit any asymmetry. The tongue could be pulled out of the mouth easily and stretched in all directions: mild fibrillations could be seen on the tongue. Taste, smell and hearing were all intact. His pupils were equal and reactive to light. Visual acuity was normal. The ophthalmic examination revealed a severe hemianopsia of the right visual field.

His left limbs were unaffected. A more detailed examination confirms that there was no observable functional disorder.

His right leg exhibited mild chronic rigidity. This rigidity was not however marked enough to impede the performance of voluntary or passive movements of the leg or

the thigh. Mr. L. was ambulatory, although his right leg dragged bit, which however he does not complain of fatigue in his right leg.

He could stand on his right leg and could even hop on his right leg almost as well as on his left. By flexing the tip of the right foot triggered a very intense clonus which persisted when the foot was held in dorsiflexion. This was not seen on the left.

The knee jerk reflex on the right side was very brisk. Every time the tendon was hit a very sudden and exaggerated movement of the leg occurred. It was followed by a series of often quite prolonged tremors of the foot. The knee jerk reflexes on the left side were also brisk, but much less than on the right side.

The pressure strength, as measured by a dynamometer at the angle of the flexion of the legs at the thigh was: 19 kg on the right side, and 27kg on the left. The sensitivity to touch and to pinprick was normal along the whole surface of the leg. The right arm did not exhibit any noticeable spasm. The fingers, wrist and forearm could be flexed without any resistance. There was no eliptoid tremor of the hand. The reflexes which result from percussion of the bones of the forearm are larger and more brisk on the right side than on the left side.

The right hand is usually redder and colder than the left hand. It is currently affected by chilblains not found on the other side.

Sensitivity to touch and to pinprick appeared perfectly intact in both arms. When the patient has his eyes closed, he correctly identified the shape of an object placed in his right hand. He correctly identified a quill, a pen, a coin, a letter opener. In general, his sensory discrimination was somewhat disturbed. When a 5 franc silver coin was placed in each hand, he felt that the coin placed in the right hand was lighter than that placed in the left hand.

When his eyes were shut, M. L. was not fully aware of the position that his right hand occupied in space. He systematically perceived it as higher than it actually was. When he was asked to raise his hands up to the level of his forehead, the right hand was always placed 4 or 5 centimetres higher than the left hand. However this error could be corrected: when the patient was asked to bring his right forefinger to the tip of his nose or to his earlobe, he carried out these actions with precision.

Further evidence that the patient's sensory-motor disorder was mild comes from the fact that when one traces with his right hand the movements required to write in the space the word 'Paris' while his eyes are closed, Mr. L. can accurately recognise the word that he has been made to write in this fashion.

The voluntary movements of his right arm were intact and were carried out with ease, except for the movements which writing requires which are discussed below. Mr. L. could put his right hand behind his back or on his head. He could comb his hair and get dressed unaided. He could fasten a pin to a piece of fabric without exhibiting any clumsiness. He could make his hands rotate around one another rather quickly. He could also bring a glass or a spoon to his lips. However the performance of the latter was a bit hesitant, proof hat he was less confident than before his illness. Since his

illness, Mr. L. had been eating soup with his left hand, but cutting his food by holding the knife in his right hand and the fork in his left hand.

On the whole, the movements of the right hand were performed with precision but slightly more slowly than those of the left hand. If, for instance, the patient was asked to slap his thighs as quickly as possible with his hands, he made 14 hits with the left hand and only eight with the right hand over a five second period. The grip strength was relatively equal for his two hands: as measured by a dynamometer it was 30 kg for the right hand and 34 kg for the left hand.

To summarise, the examination of the patient revealed: a chronic right hemiplegia with mild contraction of the right leg; almost complete recovery of the strength and mobility of the right arm; absence of facial paralysis and absence of aphasia; with right hemianopsia.

What remains to be described are the phenomena concerning the patient's agraphia. Before providing all the details of the analysis to which these phenomena have been subjected, it is useful to recall that at the time of the examination M. L. had intact intellect and did not exhibit any speech disorders or effortfulness in verbal articulation; that he could read aloud unhesitatingly and that he could read both cursive and printed writing with the same ease. In addition, during the past year, Mr. L. had practiced writing with the left hand and managed to produce very legible characters with that hand.

While seated comfortably at a table, Mr. L. was given some paper and a pen and was asked to write with the right hand the word: *Bordeaux*. He picked up the pen and positioned it correctly between his fingers and held it with no apparently stiffness or discomfort, but found writing a single letter impossible. He knew which letters compose the word. He spelled aloud the letters which compose it *B, o, r* etc... He picked out these letters from a newspaper but was unable to write them. "I know very well, said the patient, how the word *Bordeaux* is written but when I want to write with my right hand I no longer know how to do anything." With his left hand, Mr. L. was able to write very legibly and without error the word *Bordeaux*. Subsequently, he took the pen in his right hand, and with great effort managed to slavishly copy with his right hand the characters he has just produced with his left hand. He could copy what he could not write.

On a more simple task Mr. L. was asked whether he knew the shape of isolated letters, the letter *L*, for instance. He replied "yes" and to prove it, he looked for it and pointed it out to us in several printed and handwritten words. We then asked him to write this letter with his right hand on a piece of paper. He picked up the pen but only managed to produce some indeterminate marks which did not exhibit any of the characteristics of the general shape of the letter *L*. In contrast, he could produce this letter with his left hand very well. He could make an approximate copy from a model with his right hand. The results were the same with other letters that were tested: *p, c, x*, etc.

The same phenomenon was demonstrated with numbers. Mr. L. could read figures unhesitatingly. He could carry out mental calculations with no difficulty. If one placed several numbers in a column, he could add them up without making any errors,

but he could not write the total sum with his right hand. He was asked to write the number 125 but he only managed to do this after he had written it first with his left hand although he knew that this number was composed of the numerals 1, 2 and 5.

We were interested to determine whether when Mr. L. produced the writing with his left hand, prior to producing the writing with his right hand, he was aiming to make a visual model for copying or to recall the memory of the movements of the left hand for producing the letters he was asked to write with his right hand. To resolve this issue, Mr. L. was asked to write the word "*souvenir*" [memory]. As in the previous experiments, he could correctly recall the letters which make up this word; he spelled them aloud without hesitation but, when he took up the quill in his right hand, he no longer knew "how one proceeds in order to produce the characters." He hesitated, scribbled a few irregular strokes, and, in the end, he resorted to his usual strategy: he transferred the quill into his left hand and wrote with that hand the word "*souvenir*" [memory]. When he was going to copy it with his right hand, the model was removed. He found himself in the same difficulty as at the beginning of the experiment: he was unable to write even the first letter of the word he had been asked to write. This letter was then written on a piece of paper and placed in front of the patient. He immediately recognised the word and copied it without difficulty.

In addition when Mr. L. was asked to write a word that he was shown on a printed page on a piece of paper: the word "*hôpital*" [hospital] for instance, he could copy it with the right hand but reproduced the same printed shape. He could not copy in cursive writing what he saw in print.

If, instead of being asked to write a word, a letter or a number, he was asked to produce a geometrical figure, a circle, a triangle, an octagon, he successfully did it with no hesitation with his right hand. In addition, he could draw a quite well proportioned profile of a human face with his right hand.

Finally Mr. L. was placed in front of a wooden blackboard and the experiments carried out with a pen were re-administered with chalk. The results were identical. Mr. L. could draw geometrical shapes and initials of his signature with chalk but he was absolutely unable to write a letter or a number with his right hand, unless he had in front of him the written model to be produced, so that he could *copy* it.

I saw Mr. L. again on 13 September 1884. His state was unchanged. The writing disorders were as marked as the day of the 1st examination (5 February 1884) although he had endeavoured to re-learn to write with his right hand.

Unless I am mistaken, the observation that we have just read can be compared to that of Mr. Charcot. It provides a precise example of pure motor agraphia. In fact it is clear that our patient did not suffer from word blindness or word deafness since he understood what was said to him and could read with no difficulty. Nor did he have any verbal amnesia or any intellectual disorders which would explain the agraphia since he could write with his left hand. The inability to write with the right hand did not come from a common paralysis of the muscles of the forearm since he could draw geometrical figures and draw the profile of a human face on a piece of paper. What our patient was lacking was the memory of the movements which had to be transmitted to the hand in order to write. And the proof is that, if one compensated

this loss of graphic memory by placing in front of him a model he found it possible to copy it quite legibly.

The observation reported by Mr. Charcot, and that which I have described in details above, enable us to establish on the basis of positive evidence an outline of the functional disorders which characterise motor agraphia.

The patient who suffers from pure motor agraphia can read silently or aloud. He hears and understands phonetic language. He can freely express his thoughts in speech, but he is unable to write because he has lost the memory of the muscular efforts which he had trained to combine to produce written letters. It is as if he had learnt to read but never practiced writing. Motor agraphia is to writing what motor aphasia is to speech. In both cases the intellectual faculties are intact; the patient understands what is said to him and what he reads; he also knows what he should say or write to express his thought. But he has become unable to perform the movements required to articulate sounds or to trace letters, although the movements of his tongue or of his hand are intact. What prevents him from speaking or writing is a selective disability of the muscles, the synergic activity of which is required for the production of articulated sounds or of graphic characters. For many years, pathologists have distinguished for a long time 'logoplegia' and 'glossoplegia', there is also a point in distinguishing 'graphoplegia' and 'brachoplegia': the terms 'glossoplegia' and 'brachoplegia' will be applied to the common 'monoplegia' of the tongue and of the arm, respectively while 'logoplegia' and 'graphoplegia' will be used to refer to the isolated loss of learned muscular synergies involved in the acts of speaking or writing.

The knowledge of word blindness, word deafness and motor agraphia enable us to classify most observations of agraphia triggered by cerebral disorders. From this viewpoint, clinical facts can be grouped into three distinct categories. In the first type, the patient can no longer write following a model; but he can still write what is dictated to him or what he thinks: agraphia by word blindness. In the second type, the patient can no longer write to dictation but he is still able to write by following a model and from their thoughts: agraphia by word deafness. In the third type, patients are unable to write fluently either by following a model or to dictation or from their thoughts: motor agraphia. What comes out of the complexity of the phenomena relating to the disorders of writing is that in order to carry out a complete clinical examination, it is not sufficient to place a quill in the hand of the patient and to ask him to write, one has to ask him successively to copy from a model, dictate a few words, make him write a sentence he has thought of. Each of these means of investigations is required if one wants to reach a precise analysis of the case observed.

In the interpretation of results, the functional compensations which may be established between different types of sensory memories will have to be considered. We recalled earlier how a patient of Mr. Charcot affected by word blindness managed to read by carrying out with his hand the movements required to produce the characters placed in front of him. In this case, graphic memory was compensating for the visual memory which was lost. Similarly, a subject affected by word deafness can, on the basis of the movements of the lips of his interlocutor, his gestures, his regard, guess his thoughts although he does not understand his speech. Finally in motor agraphia, the patient manages to reproduce the word written in front of him. He does so, it is true, stroke by stroke, as if he copied hieroglyphs or, even more

precisely, as if he had never learnt to write, but he still manages to produce legible characters although he is actually agraphia.

The lesions which give rise to the various types of agraphia seem to have distinct sites in the brain. According to all the cases collected so far, Mr. Charcot admits that the organ of auditory memory is situated in the region of the left angular gyrus, that of auditory [sic] memory in the first left temporo-sphenoid convolution, that of graphic memory in the foot of the second frontal convolution.

These localisations enable us to understand how various types of agraphia can be produced in isolation and also how they frequently co-occur with phenomena of motor paralysis or aphasia. The greater or lesser complexity of the symptomatology depends on the topography and the extent of the responsible lesions. A very limited lesion of the angular gyrus or of the first temporo-sphenoid convolution will result in word blindness or pure word deafness. If the extent of the lesion is greater, it will reach the motor zone and will result in hemiplegia. If it is even more extensive, it will destroy the centres of graphic memory (foot of the second frontal convolution), and phonetic memory (foot of the third frontal convolution) and will in addition to the symptoms outlined above give rise to aphasia and motor agraphia.

It is due to the immediate proximity of the two last centres that speech and writing disorders frequently co-occur in the same patients, although, fundamentally, their association is incidental. In other words the symptoms of aphasia and agraphia often coexist but are not subordinated to each other by a relation of causality or by a common aetiology. This association is coincidental and only depends on the extent of the brain lesions. This is a detail which Mr. Ogle had clearly determined solely on the basis of clinical observation. The possible dissociation of aphasia and agraphia, Ogle insisted, demonstrates the existence of distinct brain centres for the faculties of speech and writing, but, the frequent co-occurrence of this two morbid symptoms prove that these distinct centres must be in close proximity.

CONCLUSIONS

1. Very close analogies between the physiological mechanisms which control the production of speech and writing exist OR the physiological mechanisms which control speech and writing share common characteristics. Great similarities between the pathological disorders which can alter their functioning also exist.
2. Three forms of agraphias, which correspond to the three classic forms of aphasia are to be distinguished. These are:
 - a. *Agraphia* by word blindness in which the patient can no longer copy a model although he can write spontaneously and to dictation.
 - b. *Agraphia by word deafness* in which the patient cannot write to dictation, although he can still write spontaneously or copy a model.
 - c. *Motor agraphia or 'graphoplegia'* in which the patient can no longer write at all.
3. Each of these forms of agraphia can be observed in isolation in patients whose intellect and mobility are intact. Several very precise observations of agraphia by word blindness and word deafness have already been reported in the literature.

Observations of pure motor agraphia are rarer, but today we can cite two case reports which provide convincing evidence.

4. In most pathological cases agraphia is associated with that of hemiplegia and aphasia. In complex cases, the various symptoms which co-occur in the same patient must be considered independent of each other and unrelated. The complexity of the semiology in each particular case solely depends on the variable topography and the greater or lesser extent of the brain lesions.