The early history of aphasiology: From the Egyptian surgeons (c. 1700 BC) to Broca (1861)

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Published in:
Aphasiology

DOI:
10.1080/02687030500399293

APHASIOLOGY, 2006, 20 (8), 762–791 Psychology Press Taylor & Francis Group

History of Aphasia

The early history of aphasiology: From the Egyptian surgeons (c. 1700 BC) to Broca (1861)

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Background: According to many aphasiologists the scientific study of aphasia dates back to the second half of the 19th century when Broca and Wernicke described the two classical forms of aphasia that now bear their names. About 100 years later, Benton and Joynt presented a historical overview of the literature on aphasia from the Hippocratic writings (c. 400 BC) to 1800. Since this seminal review (Benton & Joynt, 1960) there has been a growing interest in the history of aphasiology, resulting in many papers (cf. the *Journal of the History of the Neurosciences*) and even books (e.g., Eling, 1994; Finger, 2000; Jacyna, 2000) about hitherto unknown writings about aphasia.

Aims: The aim of this paper is to present a new, updated, and extensive review of the early history of aphasiology, starting with the earliest observation of "speechlessness" in an Egyptian papyrus (c. 1700 BC) and ending with Broca's discovery of the "speech centre" in 1861.

Main Contribution: By presenting and discussing passages taken from major contributions to aphasiology in the past 3500 years, this literature survey offers a review of the clinical observations and theoretical analyses of aphasic phenomena preceding the pioneering article by Broca in 1861.

Conclusions: Although many forms and symptoms of aphasia were described and a few theoretical explanations of its nature had been advanced before 1800, significant hypotheses about the localisation of aphasia were not formulated until the period 1800–1860. Based on his (otherwise misguided) "phrenological" theory, Gall (in Gall & Stuart, 1806) was the first to localise language in the frontal cortex. This hypothesis was then tested and supported by neuropathological data collected by Bouillaud (1825) who not only localised language in the frontal lobes, but also made the fundamental distinction between "a general faculty of language" and "the faculty of articulated speech", thus preparing the ground for Broca's famous discovery in 1861.

Our current knowledge about aphasia is, of course, the result of a long history, but it is difficult to judge when the study of aphasia first began. It can be assumed, however, that from the time that man possessed language, possibly some 125,000 years ago (Lieberman, 1998), there must have been people who became aphasic as a

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The authors would like to thank Anne Baker, Suzanne Ludérus, Ceske Niewold, and Eline Veldkamp for their comments on an earlier version of this paper.

http://www.psypress.com/aphasiology DOI: 10.1080/02687030500399293

result of traumatic head injuries caused by accidents like falling off a cliff or being hit by a stone in the course of a fight. In the history of medicine relatively little attention has been paid to aphasic phenomena, and up to the 19th century the true nature of aphasia and the relation between language and the brain were largely unknown. According to many aphasiologists (e.g., Caplan, 1987; Geschwind, 1972) the scientific study of aphasia dates back to 1861 when the Parisian surgeon Paul Broca discovered that a specific form of "motor" aphasia was associated with a lesion in a specific part of the brain (i.e., the posterior part of the third frontal gyrus). Shortly after Broca's discovery, in 1874, the German assistant-neurologist Carl Wernicke described another, "sensory", form of aphasia caused by a lesion in a different part of the brain (i.e., the posterior part of the first temporal gyrus). In addition Wernicke constructed a lexical model explaining the different forms of aphasia then known on anatomical grounds.[1]

Although the interest in and understanding of aphasia has increased strongly as a result of the publications of these two classical authors, it has been pointed out in some earlier reviews (e.g., Benton, 1964; Benton & Joynt, 1960; Whitaker, 1998) that it would be wrong to discard all descriptions and theories of aphasia before Broca and Wernicke as unimportant, bizarre, or "prehistoric". In fact, it can be argued that the "discoveries" of Broca, Wernicke, and their contemporaries such as Lichtheim and Jackson, would not have been possible without the observations and hypotheses about the nature and localisation of aphasia made in the preceding centuries.

In the following review of the early history of aphasiology the development of the ideas about aphasia is divided into five periods:

(1) The first descriptions of possible aphasic phenomena found in the so-called Edwin Smith surgical papyrus (c.1700 BC) and in a Hittite text about King Mursilis II (c.1300 BC).
(2) Greek and Roman references (c. 400 BC to c. AD 400) in which "speechlessness" was first linked to the brain.
(3) Renaissance descriptions (15th and 16th century) containing the first clear (albeit brief) references to aphasic disorders.
(4) Reports from the 17th and 18th centuries in which the various characteristics and forms of aphasia were described in more detail.
(5) The period between 1800 and 1860 in which aphasia was explicitly linked to specific parts of the brain and the concept of cerebral dominance for language was first formulated.

THE FIRST DESCRIPTIONS OF APHASIA

The Egyptian physicians (c. 1700 BC): Speechlessness, an ailment not to be treated

The first reference to aphasic phenomena that we know of comes from the so-called "Surgical papyrus of Edwin Smith", which was discovered in 1862 in the Egyptian city of Luxor. This was written about 1700 BC (although the original text is thought to have been written several centuries earlier). The text is written in

[1] Because of his psychological-anatomical theory of aphasia, Wernicke is considered by some (e.g., Geschwind, 1974) as the true founder of aphasiology.

hieratic script (see Figure 1), which was sometimes used by priests because it could be produced more quickly than the well-known ideographic hieroglyphs (Finger, 2000).

The Edwin Smith surgical papyrus contains descriptions of 48 individuals with physical injuries, including 27 cases of head trauma caused by fractures of the skull. In several of these cases an association seems to be made between head injuries and "loss of speech", as can be seen in the following example (case 20; cf. figure 1):

> *If thou examinest a man having a wound in his temple penetrating to the bone [and] perforating his temple bone, while his two eyes are blood shot, he discharges blood from both his nostrils, and a little drops; if thou puttest thy fingers on the mouth of that wound [and] he shudder exceedingly; if thou ask him concerning his malady and he speak not to thee; while copious tears fall from both his eyes […] [this is] an ailment not to be treated […] Now when thou findest that man speechless, his [relief] shall be sitting; soften his head with grease, [and] pour [milk] into both his ears.* [Breasted, 1930, p. 284; underlining by the present authors]

From this example it might appear that the Egyptian physicians were aware of the fact that there was a causal connection between "speechlessness" and brain damage, but other parts of the text suggest that this is not the case, because it is mentioned

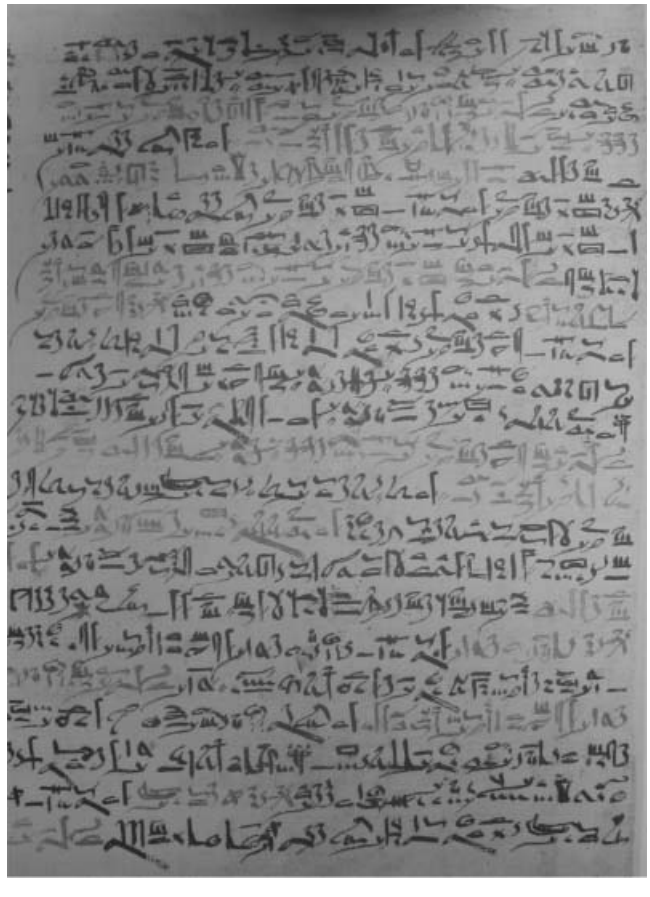

Figure 1. A section of the Edwin Smith surgical papyrus (c. 1700 BC). [Breasted (1930), vol. 2, plate VII]

that "speechlessness" was caused by "something that came from the outside to the inside" like "the breath of an outside God or death".

Another indication that the Egyptians did not associate language with the brain is that they looked upon the heart as the central organ of the soul—that is, they believed that the heart (and not the brain) was the organ responsible for feeling, thinking, and other cognitive functions. In fact, the heart was so important to the Egyptians that they left it in the body when it was prepared for mummification, whereas the brain was scooped out with an iron hook inserted through the nostrils and then simply thrown away (Finger, 2000).

King Mursilis: TIA with aphasia?

The next reference to possible aphasic phenomena is a section from a Hittite text written in cuneiform script on a clay tablet in the last quarter of the 14th century BC. The text is a ritual regarding Mursilis II, one of the most important kings in the Hittite empire which dominated Mesopotamia from 1600 to 1200 BC. King Mursilis reigned from 1344 to 1320 BC. The following section of the text refers to an event experienced by King Mursilis during one of his travels:

> *Thus spoke "His Majesty" Mursilis, the Great King: "I rode to Til-Kunnu […] and suddenly a thunderstorm broke out, whereupon the Stormgod caused terrible thunder and I became afraid and the speech faded away in my mouth and the words rose up with some difficulty. These happenings I forgot completely. But as the years came by and passed by, it happened that this matter repeatedly occurred in my dreams and the hand of God struck me during a dream and my mouth went askew*. [Houwink ten Cate, 1966, p. 34; underlining by the present authors]

Although the nature and cause of the speech difficulties of King Mursilis are not entirely clear, from the literal translation "and my mouth went askew" in the last line, it can be argued that the King had a nocturnal stroke resulting in a paralysis of the mouth and possible aphasic symptoms. From the text following upon the section quoted above, however, it can be deduced that the "speech paralysis" of King Mursilis was only temporary. It might therefore be hypothesised that the aphasic symptoms and facial paralysis of the king were the result of a so-called "transient ischaemic attack" (or TIA, a short-lasting disorder of the blood supply in some part of the brain).[2]

GREEK AND ROMAN REFERENCES

Hippocrates (c. 400 BC): The brain as the organ of mind

The first references to aphasia in classical antiquity can be found in the so-called "Hippocratic Corpus", which was written about 400 BC. As can be illustrated by the following quotation, Hippocrates and his followers were convinced that the brain

[2] This assumption seems more obvious than the interpretation of Houwink ten Cate (1966) who concluded in his inaugural address that King Mursilis must have had a nocturnal stroke, or the rather far-fetched suggestion of some other historians that the king suffered from "hysterical aphasia" (Oppenheim, 1956). Although the speech disorder of Mursilis is briefly mentioned by Whitaker (1998), as far as we know the quotation given in the text has hitherto not been given and commented upon in the context of the history of aphasiology.

was the organ of mind, and not the heart, as the Egyptians and earlier Greek writers had believed:

> *Man ought to know that from nothing else but the brain come joys, delights, laughter and sports, and sorrows, griefs, despondency, and lamentations. And by this, in an especial manner, we acquire wisdom and knowledge, and see and hear and know what are foul and what are fair […] And by the same organ we become mad and delirious, and fears and terrors assail us […] All these things we endure from the brain […] In these ways I am of the opinion that the brain exercises the greatest power in the man*. [Finger, 2000, p. 29]

There is no doubt that the physicians of the Hippocratic School did observe speech disorders in patients with cerebral disease, such as stroke and epilepsy. In the original Greek texts these speech disorders were variously designated with terms such as *aphonos* and *anaudos*. Because these Greek words have been given different meanings in later English translations, it is unclear whether the observed speech disorders refer to a disorder of language (aphasia), speech (dysarthria), or voice (dysphonia).

The Hippocratic doctors were aware of the fact that "loss of speech" could be a result of damage to the brain, and that wounds on one side of the head could be associated with convulsions on the opposite side of the body, as is shown in the next citation:

> *And, for the most part, convulsions seize the other side of the body; for, if the wound be situated on the left side, the convulsions will seize the right side of the body; or if the wound be on the right side of the head, the convulsion attacks the left side of the body*. [Finger, 2000, p. 30]

It should be pointed out, however, that there is no clear evidence that the Greek physicians were also aware of the fact that speech disorders are almost always caused by damage to the *left* hemisphere, and on the basis of the few isolated lines just cited, we certainly cannot conclude that Hippocrates and his followers were aware of the concept of "cerebral dominance for language" as we know it today.

The view that the brain, and not the heart, is the central organ of mind was not generally accepted though. For instance, the great philosopher Aristotle, who was a contemporary of Hippocrates, still believed that the heart was the centre of body and mind. Aristotle believed that the heart was responsible for movement, sensation, and feeling, and that the only function of the brain was to cool the heat and passions of the heart (Finger, 2000).

It may be noted in passing that the debate over the functions of the heart versus the brain continued for more than a thousand years. William Shakespeare, for instance, at the end of the 16th century, considered the brain as the organ for reason, but was unsure as to which organ was responsible for feelings and emotions (or "fancy" as he called it), as can be seen in the following quotation:

> *Tell me where is fancy bred,*
> *Or in the heart, or in the head?*
> [William Shakespeare, Merchant of Venice, 1596][3]

Galen (2nd century AD): A theory of brain function

In the first centuries AD some references can be found regarding possible aphasic phenomena. Valerius Maximus (c. AD 30), for example, described the case of a "very learned man from Athens", who after being hit in the head by a stone, lost his "memory for letters", but could remember everything else (Benton & Joynt, 1960, p. 206). This same case is mentioned by Plinius (AD 23–79) who also reports the case of Messala Corvinus, "the great Orator", who following an otherwise unspecified sickness "forgot his own proper name" (Benton & Joynt, 1960, p. 207). Soranus of Ephesos (AD 98–135), in a treatise "On acute and chronic diseases", pointed out that a paralysis of the tongue leads to faulty articulation of speech, and that such paralysis "may be distinguished from cases of loss of speech resulting from some other disease" in which the tongue remains mobile (Benton & Joynt, 1960, p. 207). He also observed that not only paralysis could occur after a stroke, but also "trembling and indistinct speech and unmotivated pauses" (Creutz, 1934, p. 99).

Without doubt the most important medical figure in this period is the Greek physician Galen (Claudius Galenus, AD 131–201), who was born in Pergamon (a Greek colony along the Ionian coast). He later moved to Rome, where he would become the personal physician of Emperor Marcus Aurelius. Galen deserves his prominent place in the history of aphasiology because he developed a theory of human brain function that, as dissection of human bodies was forbidden by Roman law, was based on vivisection and experimentation with living animals.

In one experiment he found that a struggling pig he was operating on stopped squealing, but kept breathing, immediately after he severed one pair of nerves in the throat, thus demonstrating that the voice does not come from the heart, as was asserted by Aristotle, but must be considered as a function of the brain. In later experiments (which were sometimes attended by the emperor himself) Galen confirmed his discovery of the "nerves of voice"[4] originating from the brain "with bleating goats, barking dogs and even roaring lions in Rome's Colosseum" (Finger, 2000, p. 43). Galen's finding that nerves from the brain control the voice was corroborated in another set of experiments in which he demonstrated that if the heart of an animal was exposed, then the animal was still able to breathe and cry, but if the brain was exposed and pressure applied to one of the cerebral ventricles, then the animal could no longer cry, breathe, or move.

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[3] The idea of the heart as the centre for feelings and emotions is, of course, still held by many laymen today, and it is also reflected in the English language in expressions such as "I love you with all my heart", "a broken heart", "a heart of stone", and "to learn by heart". Interestingly enough, this last expression suggests that the heart is not only important for emotions and feelings, but that it also plays an important role in verbal memory, at least in English, for in some other languages learning something by rote—e.g., Dutch: "uit het hoofd leren" (to learn from the head)—is considered to be a function of the brain (proving, of course, that the Dutch have a much better understanding of the functions of the brain than English-speaking people).

[4] These nerves, the "recurrent laryngeal nerves" as they are called nowadays, are sometimes also called "Galen's nerves" in his honour (Finger, 2000, p. 43).

Following Hippocrates and earlier Greek philosophers, Galen located the "soul" (i.e., cognition, perception, and memory) in the brain. He considered the brain, together with the spinal cord, as the centre of the nerves giving both life and movement to the whole body:

> *The brain is placed in the skull as a grand king in his castle, with as messengers and vassals all the senses gathered around him; this leads to the conclusion that this part must be the seat of the soul*. [Meunier, 1924, p. 126]

According to Galen's theory, all sensory impressions were carried in the form of "psychic pneuma" or "animal spirits" (*spiriti animales*) through hollow nerves to the anterior ventricles of the brain, whereas these same spirits were also transported from the ventricles to the muscles for movement. Galen described the symptoms of stroke as a simultaneous loss of mobility, sensation, and respiration, which according to his theory was caused by an accumulation of phlegm, particularly black bile, obstructing the flow of the psychic pneuma or animal spirits (Karenberg & Hort, 1998; Rocca, 1997).

Galen's theory about the ventricular system as a place where the animal spirits were stored and distributed to the nervous system was later elaborated by Bishop Nemesius (c. AD 400). He assigned a specific function to each of the three cerebral ventricles: the first ventricle was the seat of perception, the second of cognition, and the third of memory.

Galen's ideas about medical science and the doctrine of the cerebral ventricles as the seat of higher psychological functions lasted more than 1200 years, as is apparent from the illustration in Figure 2 showing the form and function of the three ventricles in a book published in 1517.[5]

RENAISSANCE DESCRIPTIONS

In the medical literature of the Renaissance, in the 15th and 16th century, only a few references to aphasic phenomena and their localisation can be found. Here we will present three of the most interesting case reports.[6]

Antonio Guainerio (1481): Localisation of language in a specific part of the brain

One of the earliest Renaissance references to aphasia was made by Antonio Guainerio (?–1440), a famous professor at the University of Padua. In his *Opera Medica* ("Medical Works"), published in 1481, he gave the following short description of two aphasic cases:

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[5] There are four cerebral ventricles, of course, but Nemesius looked upon the two symmetrical anterior (i.e., lateral) ventricles as being one and the same.

[6] For some other case descriptions in this period, see Benton & Joynt (1960), O'Neill (1980), and Whitaker (1998).

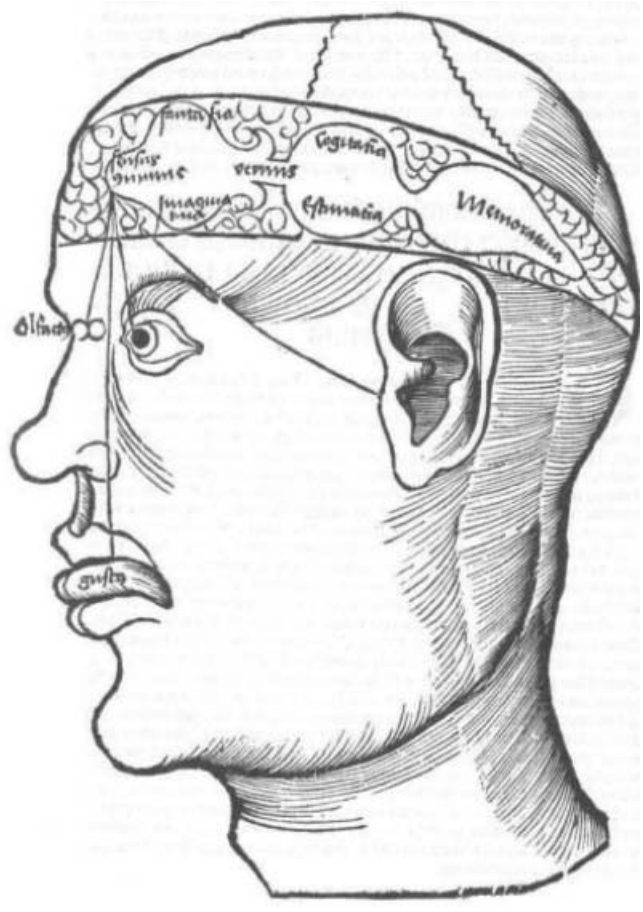

Figure 2. Form and function of the three cerebral ventricles as depicted in the *Margarita Philosophica* by Gregor Reisch, first published in 1504. The frontal cavity, connected by nerves to the sense organs, is the seat of perception (*sensus communis*), phantasy (*fantasia*), and imagination (*imaginativa*), the middle cavity is the seat of thought (*cogitatia*) and judgement (*estimatia*) and the posterior cavity is the seat of memory (*memorativa*). [Reisch (1517/1973)]

> *I had under my care two old men, one of whom did not know more than three words […] The other […] rarely or never recalled the right name of anyone. When he summoned someone, he did not call him by name*. [Benton & Joynt, 1960, p. 208]

From this brief description we can guess that the first patient suffered from motor or Broca's aphasia, and the second from anomia (or possibly "proper name aphasia"). According to Guainerio both of these speech disorders were the result of the accumulation of too much "phlegm" in the posterior ventricle, and in this case "the organ of memory can retain little or nothing". On the basis of this assumption, although totally false from a modern point of view, it can be argued that Guainerio was the first physician who explicitly localised aphasic disorders in a specific part of the brain.

Nicolas Massa (1558): Miraculous recovery of speech through surgical intervention

Another interesting case was presented by the famous anatomist Nicholas Massa (†1569) in his *Epistolae Medicinales* (''Medical Letters''), published in 1558. He described the case of a handsome young man who was wounded in the head by the sharp point of a spear and as a consequence was not able to speak for 8 days:

> *Since the doctors declared that they had seen no bone* [in the wound] *I concluded that the reason of the loss of voice was that part of the bone was lodged in the brain. I took an instrument from a certain surgeon who was in attendance and extracted the bone from the wound, whereupon the patient began to speak at once, saying: ''Praise God, I am cured.'' This drew much applause from the doctors, nobles, and attendants who were present.* [Benton & Joynt, 1960, p. 208]

On the basis of the text cited above it cannot be decided if the loss of voice of the handsome young man was a case of (traumatic) aphasia or anarthria, although the latter possibility seems to be most likely given the sudden recovery of speech.

Johann Schenck von Grafenberg (1585): Aphasia not due to paralysis of the tongue

In 1585 the German physician Johann Schenk von Grafenberg (1530–1598) published a book entitled *Observationes medicae de capite humano* (''Medical observations on the human head'') in which he assembled a collection of clinical observations ranging from ancient descriptions to those of his contemporaries. More than a dozen of these observations reported the consequences of brain damage, for example:

> *I have observed in many cases of apoplexy […] and similar major diseases of the brain that, although the tongue was not paralyzed, the patient could not speak because, the faculty of memory being abolished, the words were not produced.* [Luzzatti & Whitaker, 1996, p. 159]

Although this observation was quoted as a personal communication made by a contemporary colleague, Schenck von Grafenberg (Figure 3) may still be credited as being the first author who implicitly made a distinction between a disorder of language (aphasia) and a disorder of speech (dysarthria), thus appreciating the essential nature of aphasia.

The idea that aphasia is not caused by a paralysis of the tongue did not become generally known, however, and this fact would be ''rediscovered'' time and again during the following centuries. The belief that aphasia was due to a defect of the tongue was quite persistent and until the middle of the 19th century it was common practice to try to cure aphasia by putting plasters on the tongue, bloodletting, or polypharmacy (treatment with a combination of different medicines at the same time; see below).

Figure 3. Portrait of Schenck von Grafenberg at the age of 45, credited as being the first author to appreciate the essential nature of aphasia [from his book *Paratereseon, sive observationum medicarum, rararum, novarum, admirabilium, & monstruosaru, volumen tomis septem de toto homine institutum*, published in 1609 in Frankfurt am Main).

SEVENTEENTH- AND EIGHTEENTH-CENTURY REPORTS

From the 17th century onward we find an increasing number of clinical descriptions of aphasia which are generally more extensive and precise than in the preceding centuries. Yet, as noted above, there is also evidence of the fact that most physicians up to the beginning of the 19th century did not have a clear idea about the causes and treatment of aphasia, as can be illustrated by the following remedy prescribed for the effects of a stroke written in the last quarter of the 17th century.

Theophile Bonet (1684): A prescription for a stroke

In his *Guide to the practical physician* (published in London in 1684) Théophile Bonet (1620–1689), an important French physician who assembled one of the first collections of autopsy reports and advocated a scientific approach in medicine, advised the following remarkable remedy for ''apoplexy'':

> *A most secret and certain remedy against the apoplexy is to take a lion's dung, powdered, two parts, pour spirit of wine till it be covered three fingers breath, let them stand in a vial stopped three days. Strain it and keep it for use. Then take a crow, not quite pinfeathered, and a young turtle, burn them apart in an oven, powder them, pour on the above said spirit of wine, let them stand in infusion for three days. Then take berries of a linden tree, an ounce and a half. Let them be steeped in the aforesaid spirit, then add as much of the best wine and six ounces of sugar candy, boil them in a pot till the sugar be melted. Put it up. Let the patient take a spoonful of it in wine, often in a day, for a whole month. In the paroxysm give a spoonful with Aqua Tiliae, and with the same water, rub the forehead, neck, temples and nostrils. The Archduchess of Austria had frequent experience of the virtue of this medicine*. [Licht, 1975, pp. 21–22]

Needless to say this wonderful remedy for a stroke would only be prescribed to the rich and royal people, like the Archduchess of Austria.

As is apparent from Bonet's prescription for a stroke, treatment in medicine was often based on imagination leading to polypharmacy originating from the works of Galen. Although there was little knowledge about the treatment and pathogenesis of aphasia, there exist a vast number of detailed descriptions of different aphasic disorders in this period. We will focus on the five most interesting contributions.

Johann Schmidt (1676): Alexia without agraphia

In 1676, Johann Schmidt (1642–1690), ''Stadtphysicus'' in Dantzig, described a case of alexia without agraphia, entitled: *De oblivione lectionis ex apoplexia salva scriptione* (''On the forgetting of reading following apoplexy with the preservation of writing''). After a severe stroke the patient, a 65-year-old man, had a right-sided paralysis and produced verbal paraphasias in speaking:

> *He muttered a good deal but was incapable of expressing the feelings of his mind; he substituted one word for another so that his attendants had difficulty in determining what he wanted*. [Benton & Joynt, 1960, p. 209]

After some time both the difficulties in speaking and the paralysis disappeared, but the patient retained a severe alexia:

> *He could not read written characters, much less combine them in any way. He did not know a single letter nor could he distinguish one from another. But it is remarkable that, if some name were given to him to be written, he could write it readily, spelling it correctly. However, he could not read what he had written even though it was in his own hand […] No teaching or guidance was successful in inculcating recognition of letters in him*. [Benton & Joynt, 1960, p. 209]

In his final paragraph, however, Schmidt noted that the course of acquired alexia could vary individually:

It was otherwise with a certain stone cutter in our country. Wilhelm Richter came to see me after his apoplexy because he was not able to read at all or recognize letters. However, he learned the alphabetic elements of the language in a short time. He then combined them and attained perfection in his reading. [Benton & Joynt, 1960, p. 209]

Johannes Wepfer (c. 1690): Syntactic disorder with paraphasias in a bilingual patient

Johannes Jakob Wepfer (1620–1695), a former German army surgeon and personal physician to Duke Leopold of Württemberg, described at least a dozen cases of language disorders caused by stroke or head trauma in his *Observationes medico-practicae de affectibus capitis internis & externis* (''Medical-practical observations of afflictions inside and outside the head''), written about 1690 and posthumously published in 1727. In the following fragments he presents the interesting case of a 53-year-old bilingual man with anomic aphasia, which largely disappeared 2–3 days after onset, although additional aphasic symptoms were noted in the following month:

R.N.N. is a 53-year-old man […] in July, 1683 he complained he had suddenly forgotten all names, and in fact he could not even express his own name. He could not designate any object with his name, neither in Latin nor in German. He gave the impression he could recognize things and people, but names did not occur; he tried and tried with all his will to explain what he was thinking on various topics, but he was destitute of his words; those he could utter were alien and incoherent […]
[August 14] *Sometimes, however, he could not find proper names for people and places as quickly as customary, and from time to time he could not find some of the little words.*
[August 17] *When he was talking, I could observe him from time to time to violate syntactic rules and, against the structure of German sentences, he would pre-pose one word to another and sometimes he could not complete a word*. [Luzzatti & Whitaker, 1996, pp.161–162; underlining by the present authors]

It may be noted that the type of aphasia is difficult to determine on the basis of the description given above (in an apparently rather free translation from the original Latin text). Whitaker (1998) considered Wepfer's case report as an early study of agrammatism, based on the fact that the patient had difficulty finding some of the ''little words'' (function words?) and on his occasional inability to ''complete a word'' (loss of morphological suffixes?). On the basis of the ''alien and incoherent'' words (paraphasias) in the beginning and the later-occurring violation of ''syntactic rules'' and word-order mistakes, whereby the patient ''pre-posed one word to another'', it might as well be argued that Wepfer's patient was suffering from a fluent type of aphasia with paragrammatism.

Peter Rommel (1683): A rare case of ''aphonia''

Peter Rommel (1643–1708), ''city physician'' in Ulm (Germany), reported a case of severe motor aphasia and a right-sided paralysis in a study entitled *De aphonia rara* (''On a rare aphonia''). According to Rommel, the rarity of this case was based on the fact that the speech of this patient (''a highly respected lady 52 years of age'') was limited to a few speech automatisms, whereas she was still able to fluently recite biblical verses and prayers. She could also understand everything that was said to her. The following is a translation of the most relevant parts of his report:

> *At the same time* [as the stroke and the paralysis], *she lost all speech with the exception of the words, ''yes'' and ''and''. She could say no other word, not even a syllable, with these exceptions: the Lord's prayer, the Apostles' Creed, some Biblical verses and other prayers, which she could recite verbatim and without hesitation but somewhat precipitously.*
> *But it is to be noted that they were said in the order in which she was accustomed to saying them for many years and, if this regular sequence were interrupted and she were asked to recite a prayer or Biblical verse not in its accustomed place, she either could not do it at all or only after a long interval and with great difficulty.*
> *I tried this test myself and was astonished to hear her reciting some prayers. However, when I requested her to repeat a prayer she had already recited she could not do it even after great effort, until her maid, who had long been familiar with the order of the prayers, would recite it. Then she would recite the requested prayer, although with some difficulty. Similarly, I asked her to repeat some words in the order in which I said them, e.g., ''God will help''. Stimulated to effort, she tried several times, but was unsuccessful. Overcome with misery, she burst into tears*. [Benton & Joynt, 1960, p. 210]

Olaf Dalin (1745): On a mute who can sing

In the 18th century we find not only many detailed descriptions of aphasic symptoms, but also a first attempt at constructing a theory of the underlying psychopathological mechanisms. At the same time it should be stressed that aphasia was still considered a rare and remarkable disorder and that many of its symptoms (such as paraphasias and the relative preservation of automatised speech) were rediscovered time and again.[7]

A typical example is the following case description of the Swedish historian and literary figure, Olaf Dalin, who in 1745 (some 60 years after Rommel's report) described another example of the now well-known dichotomy between automatic and propositional language. In a treatise for the Royal Swedish Academy of Science, entitled *Berätsele om en dumbe, som kan siunga* (''Story of a mute who can sing'') he gave the following revealing description of a patient virtually without speech who nevertheless could still sing certain hymns:

> *Jon Persson, a farmer's son from Ofvankih […] born in 1703, brought up in the usual simple way to know his Christianity and to read; in 1736, after he had been married for three years, he had an attack of a violent illness which resulted in a paralysis of the entire right side of the body and complete loss of speech. After almost half a year in bed, he began to move to some degree but he limped and carried his right arm in a sling.*
> *For two years he went to a mineral spring at Joliette parsonage which many people had found to be helpful. However, he did not note any improvement except that he was able to walk more steadily and to pronounce correctly the small but often important word ''yes''. However, he gained one advantage, which was later observed and which is the occasion for his present notoriety. He can sing certain hymns, which he had learned before he became*

[7] For some other interesting 18th-century reports on aphasia—e.g., the case description of a patient losing ''the memory for nouns'' by the Swedish biologist Carl Linnaeus (1745), several case descriptions of speechless patients with right hemiplegia who ''showed by nods and signs that (they) understood what was said'' by Giovanni Morgagni (1762), the often-quoted description of motor aphasia by Johann Wolfgang von Goethe in his novel *Wilhelm Meisters Lehrjahre* (1795), and, finally, the interesting case of Alexander Crichton (1798) who described the case of an almost 70-year-old paraphasic attorney who apparently became aphasic because, although ''married to an amiable lady much younger than himself, he kept a mistress whom he was in the habit of visiting every evening''—see Benton and Joynt (1960).

ill, as clearly and distinctly as any healthy person. However, it should be noted that at the beginning of the hymn he has to be helped a little by some other person singing with him […] Yet this man is dumb, cannot say a single word except "yes" and has to communicate signs with his hands.

The vicar of Joliette parish […] whose personal and signed statement is the source of my information, has kept him in the vicarage for eight years and has made every effort to determine whether this is deception or illusion on the part of the man for the purpose of providing himself with food more easily. However, the vicar has found the case to be completely genuine. Parishers of higher and lower rank offer the same testimony. I have also personally seen this man and have heard him sing. [Benton & Joynt, 1960, pp. 211–212]

Johann Gesner (1770): The language amnesia

In 1770, the German physician Johann A. P. Gesner (1738–1801) published in Part 2 of his *Sammlung von Beobachtungen aus der Arzneygelahrtheit* ("Collection of observations from the medical scholarship") a chapter of no less than 75 pages on *Die Sprachamnesie* ("The language amnesia"). This can be considered as a landmark in the early history of aphasiology. In this study Gesner not only gave a number of excellent descriptions of various forms and signs of aphasia not earlier reported (e.g., jargon aphasia, stereotyped utterance, jargon agraphia, and a differential deficit in reading Latin as opposed to German) but he also paid ample attention to the psychological mechanisms underlying the symptoms of aphasia.

Gesner's study contains six case descriptions of aphasic patients, based on his own personal observations as well as on those of some of his colleagues. As an illustration of the quality of his work we will quote some characteristic parts from the extensive report of his first patient ("Herr K.D.") who presented with jargon aphasia and recurring utterance. Following a seizure Mr K.D., a 73-year-old man, experienced a cramp in the muscles of his mouth and at the same time "an itch like the crawling of ants which he tried to eliminate by rubbing". After two weeks he suddenly became mentally confused and showed the following "very peculiar impairment of speech":

The words which Mr. K.D. pronounces are for the most part meaningless sounds. However, their total number is not very great, in that a meaningless word is often repeated successively and only occasionally replaced by others which are equally incomprehensible. […] Doubtlessly these sounds are not always associated with the same ideas for him. […] Thus his currently favorite word "Zettejuset" can mean more than 1000 things. It is also used by him indiscriminately and mixed up with other words in such a manner that his speech is incomprehensible.

At the same time there also occur occasional meaningful words […] Examples are such expressions as "obedient servant", "most humble servant", "good morning", "I do not wish to", […] as well as swear words such as, "Oh God; oh God" and "Damn foolishness", whereby he indicates his futile efforts.

For the most part he uses these words in their proper meaning. However, I have also observed that if I drink to his health and he wants to thank me, the word, "Adieu", is brought forth instead of the usual formula. He is likely to say "Good evening" in the morning and "Good morning" in the evening involuntarily [Benton, 1965, p. 56-57].

Following his case descriptions, Gesner gave an extensive contemplation on the anatomical and psychological correlates of "language amnesia", which, although at times hard to follow, can be summarised as follows (see Benton, 1964):

Aphasia is not a consequence of a general decline of intellect or memory, but a specific disorder of *verbal* memory consisting of an inability to associate images or abstract ideas with their corresponding verbal symbols. Under ordinary circumstances this deficit in the relation between concepts and conventional linguistic signs normally results in the patient being silent. However, when the idea that the patient has in his mind is very lively and he wants to express it very badly, this may lead to a wrong association between this concept and the corresponding verbal symbol, resulting in paraphasias or neologistic speech. Paraphasia and jargon aphasia thus reflect a forgetting of speech rather than a disorder in thinking or understanding language. The anatomical basis of this selective impairment of verbal memory is a disease of the brain causing a weakness or inertia between those parts of the brain in which the mental representations of words and their underlying concepts are stored. According to Gesner's theory the language impairment in jargon aphasia is therefore not caused by focal damage to a specific anatomical and functional unit, but should be considered as the manifestation of a general sluggishness of associative mental processes.

Although this explanation of the psychopathology of aphasia is somewhat obscure and certainly incorrect from a modern point of view, it can be argued (cf. Luzzatti, 2002) that Gesner's assumption that words and their underlying concepts have specific, but separate, representations in the brain laid the ground for the phrenological and associationist theories of Franz-Joseph Gall and others in the following century (see below).

1800–1860: ADVANCES IN UNDERSTANDING APHASIA

The first half of the 19th century saw some major advances in theoretical formulations of the nature of aphasia and the relation between language and the brain. On a clinical level, auditory comprehension disorders were described for the first time, a clear distinction was made between disorders of speech and those of language, and it was argued that aphasia could occur without significant intellectual impairment. Concerning the anatomical basis of language it was argued that the seat of (expressive) language could be localised in the anterior part of the brain, and that language use was controlled by the left hemisphere.

In the same period many papers were published describing the clinical symptoms of aphasia in much greater detail than before, and a number of heretofore unknown aphasic phenomena were described, such as jargon aphasia without comprehension disorders (Osborne, 1833), a selective loss of language in a bilingual patient (Lordat, 1843), and agraphia with and without severe disorders of spoken language (Marcé, 1856).

Franz-Joseph Gall (1806): The speech centre is located behind the eyes

Around the year 1800 an important renewal took place in ideas about the localisation of the higher cortical functions. The most salient figure in this development was a neuroanatomist from Vienna, named Franz-Joseph Gall (1758–1828) (Figure 4).

Gall developed a new theory about the function of the brain that radically broke with the medieval ideas about the relation between body and mind. Although Gall

made important contributions to neuroanatomy, such as the distinction between the grey matter of the brain containing cell bodies (neurons) and the white matter containing fibres (axons) and the decussation of the pyramids (Gall & Spurzheim, 1810), his view of the localisation of mental functions was not based on neuropathological research, but on the pseudo-science of cranioscopy (or ''phrenology'' as it was later called). According to Gall the cortex of the brain should no longer be seen as an indivisible whole, as his contemporaries did, but as consisting of multiple, distinct organs, each with its own form and function. Gall further assumed that it was possible to localise the various psychological functions by examining and feeling the shape of the skull (as can be seen in Figure 4). The underlying idea was that strongly developed mental functions (or ''talents'') would be associated with large cerebral organs, which could be felt on the skull as protuberances or ''bumps''.

By systematic investigation of the skulls of all kinds of talented people, like scientists, musicians, and poets on the one hand, and ''bad'' people, like criminals, prostitutes, and lunatics on the other hand, Gall was able to produce a map containing 27 different brain organs, each associated with its own specific mental

Figure 4. Portrait of Franz-Joseph Gall (1758–1828). [Collection de la Bibliothétique de l'Académie Nationale de Médicine, cliché Assistance Publique, Paris, vol. 5, p. 30.172.]

faculty, like "sexual drive", "parental love", and most interestingly, "verbal memory" (Figure 5).[8]

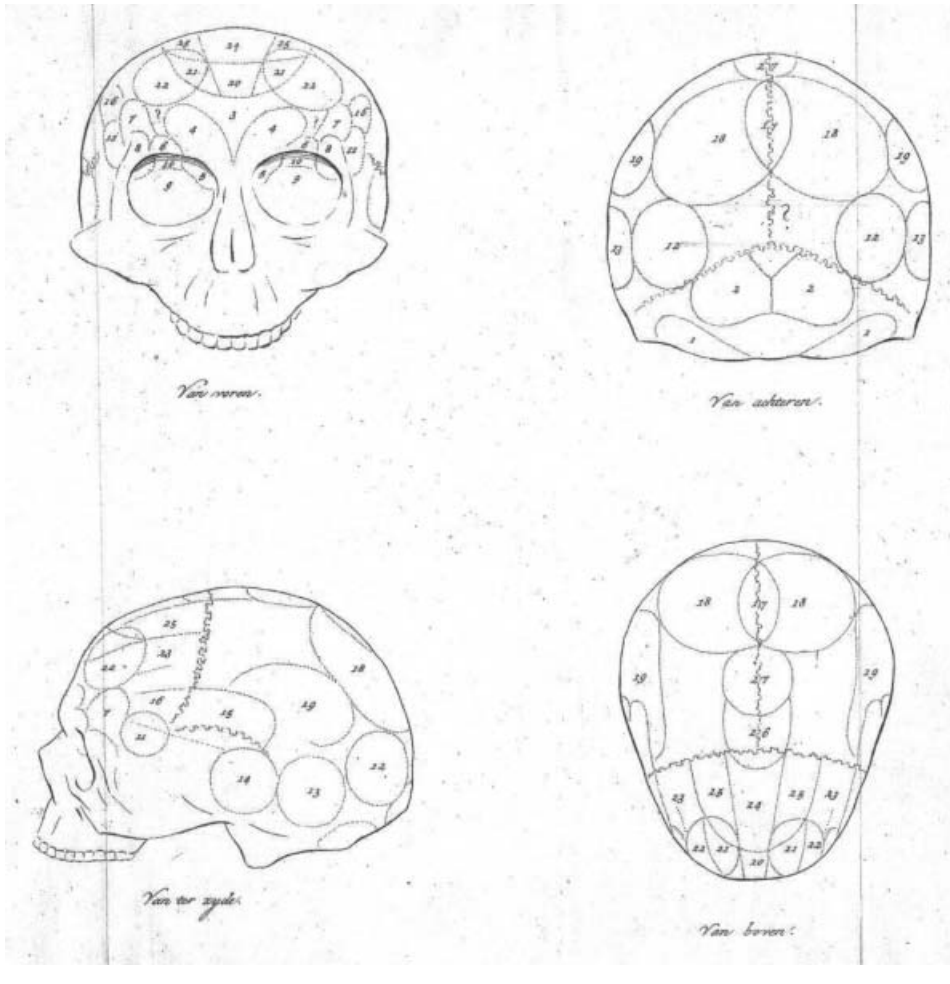

Figure 5. Location and function of the cerebral organs according to Gall, as depicted in a Dutch booklet [Gall & Stuart, 1806]. 1. Impulse to propagation, 2. Parental love, 3. Aptness to receive an education, 4. Sense of locality, 5. Recollection of persons, 6. Disposition of colouring, 7. Musical talent, 8. Arithmetic, 9. Memory, 10. Verbal memory, 11. Artistic skill, 12. Friendship, 13. Valour, 14. Impulse to murder, 15. Sense of cunning, 16. Impulse to larceny, 17. Pride, 18. Ambition and vanity, 19. Circumspection or indecisiveness, 20. Comparative perspicuity, 21. Metaphysical perspicuity, 22. Wit, 23. Decisiveness, 24. Kind heartedness, 25. Mimic, 26. Theosophy, 27. Perseverance.

[8] The map shown in Figure 5 is from a Dutch booklet published in 1806 in Amsterdam. This booklet (Gall & Stuart, 1806) is rather special, because it is probably Gall's very first illustrated publication of his "phrenological" theory. Originally Gall presented his ideas in a series of public lectures around the turn of the century in Vienna. These lectures, however, were forbidden in 1801 by a decree of the Austrian Emperor Franz II, because they were considered "materialistic" by the church and thus politically dangerous. In 1805 Gall left Vienna and made a tour through several European countries, including Holland. In April 1806 he gave a series of lectures in Amsterdam which were written down and published by a Dutch disciple, the Rev. Martinus Stuart.

According to Gall the seat of "sexual drive" (or "impulse to propagation", as he called it) was located in the cerebellum (number 1 in figure 5), because he had noticed that "hysterical" women usually had two very large "bumps" behind their ears:

> *Called to attend a hysterical woman who had the most violent convulsions and whose overheated constitution was no secret for him, he noticed, while holding his hand under her head in order to support the same during such a very violent attack, what seemed like a veritable furnace above the back of her neck as well as a remarkable width of the same and a very strong protuberance of both sides behind her ears*. [Gall & Stuart, 1806, p. 52]

Gall found out that these large bumps at the back of the skull were also present in most prostitutes, as opposed to a French priest "who had never shown any sign of this passion, although he liked to be in women's circles" (Gall & Stuart, 1806, p. 53).

The seat of "parental love" (number 2 in figure 5) was placed in the back of the brain because Gall had noticed that women who loved children had a rather large back of the head (Figure 6, top), while the back of the head of women who were indifferent to children was very small, as was the case for desperate women who had murdered their offspring out of pity (Figure 6, bottom):

> *Child murderesses confirm this idea as well, since they usually are found not to possess this protuberance, and thus can offer lesser resistance to this side of the urge to another which, under desperate circumstances, drives her to that horror, when the morality lets her supreme authority unexercised with that. Sometimes, however, despair can force the mothers to child-murder just out of love for the children, in order to save them from equal misery; but in that case the protuberance shows itself most truly, and only wrong and wicked decision of reason has taken place*. [Gall & Stuart, 1806, pp. 62–63]

Last but not least, Gall localised the faculty of spoken language (or "verbal memory" as he originally called it) in the part of the brain directly behind the eyes (Figure 5, number 10), because he had noticed that people who were talented at learning and reciting long epic poems by heart had protruding, bulging eyes. Gall reasoned that this was the case because the organ for verbal memory was so strongly developed that it had pushed the eyes forward:

> *The competence to skillfully learn words and names by heart and to save them in memory is seated in the posterior part of the eye socket. In people in whom this organ is very developed, the eyes are situated very much forward so that they seem to posses large eyes*. [Gall, Selpert, & Van Doornik, 1805, p. 91]

Later in his career Gall (together with his pupil Spurzheim who was largely responsible for popularising phrenology in Britain and the United States) made a distinction between "verbal memory" and a more "general faculty of language" (Spurzheim, 1815). An exceptional verbal memory reflected itself in prominent, protruding eyes (Figure 7, top), while a highly developed general faculty of language (as could be found in great literary and philosophical figures like Bacon or Voltaire) manifested itself in largely swollen lower eyelids or "bags" (Figure 7, bottom).

In his later work, Gall (1822–1825) described several cases of aphasic patients with (sometimes presumed) frontal brain damage in support of this thesis, but as has been rightly pointed out by Whitaker (1998, p. 33), "Gall himself evinced little direct interest in clinical neurolinguistic cases" and he considered this clinical material at

Figure 6. Seat of *parental love* according to Gall. A woman who loved children (top) and one who was indifferent to children (bottom). The woman in the bottom picture was found guilty of infanticide without remorse. The faculty of *parental love* (II) is placed in the back of the cerebrum, above the *impulse to propagation* (I) in the cerebellum. [Spurzheim (1815), plate VII]

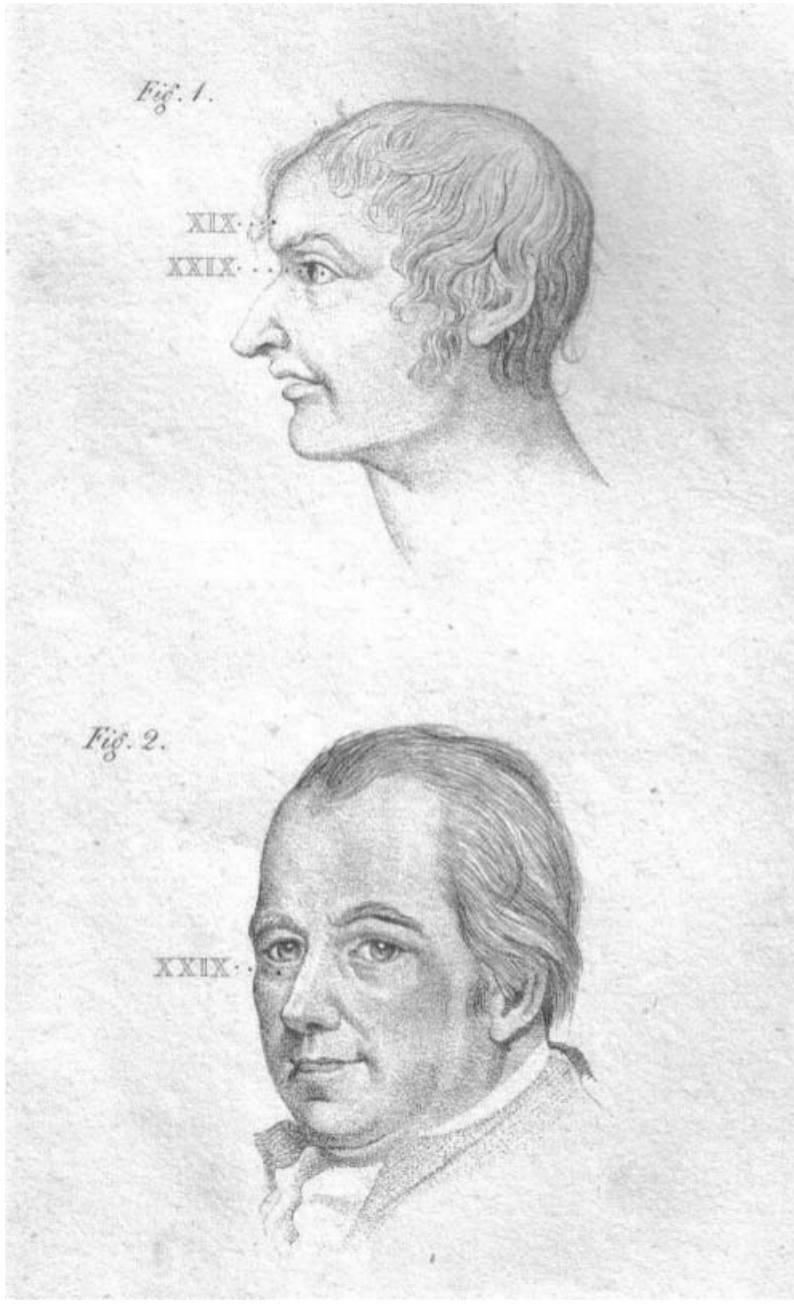

Figure 7. The seats of *verbal memory* and the *general faculty of language* according to Gall as depicted in Spurzheim (1815). The man in the top figure has an exceptional verbal memory and associated protruding eyes, while the man in the bottom figure has a highly developed general faculty of language and corresponding swollen lower eyelids. Gall located both faculties on a continuous region of the supra-orbital plate (area XXIX), the first one being slightly posterior to the latter. (Note that Spurzheim distinguished 33 different "brain organs" and used a slightly differing numbering compared to Gall & Stuart, 1806; XIX is the "organ of eventuality".) [Spurzheim (1815), plate XVI]

most as secondary evidence for his phrenological theory about the localisation of language in the frontal lobes.

The pseudo-scientific doctrine of phrenology was very popular for about 30 years but, especially after the critique by Flourens (1842), it was soon discredited as a serious scientific medical discipline (Ackerknecht & Vallois, 1956). Nevertheless, many eminent political and literary figures in the second half of the 19th century (e.g., Karl Marx, Walt Whitman, and Queen Victoria) still believed in it and the British Phrenological Society was still in existence as late as 1967.[9]

However, Gall's assumption that language could be localised in the anterior part of the brain (and particularly in the cortex) was adopted by other scholars, like Bouillaud, whose view about the localisation of language led to fierce discussion up to 1861, and thus it seems fair to say that the phrenological theory of Gall has ultimately laid the foundation for Broca's discovery of the so-called "speech centre" in the same year (Brown & Chobor, 1992).

Jean-Baptiste Bouillaud (1825): Language is localised in the frontal lobes

One of the most prominent supporters of Gall's theory that the seat of language is situated the frontal lobes was Jean-Baptiste Bouillaud (1796–1881), professor of clinical medicine in Paris. In 1825, at the age of 29, Bouillaud read a paper to the French Royal Academy of Medicine in which he presented his observations in favour of Gall's theory. Bouillaud tested the theory by reviewing the data from a large number of autopsies of brain-damaged patients published by some of his colleagues, in particular Lallemand (1820–1823) and Rostan (1820). In his 1825 paper Bouillaud described 14 of such cases in some detail: eight patients who had suffered a loss of speech (*perte de la parole*) had a lesion in the anterior part of the brain, whereas this part of the brain appeared to be intact in the other six patients without a speech disorder. On the basis of this analysis of positive and negative cases Bouillaud concluded that:

> *The movements of the speech organs are controlled by a special, distinct, independent center [and that] this cerebral center is seated in the anterior lobes*. [Hécaen & Dubois, 1969, p. 30][10]

[9] For more detailed information about phrenology and its ultimate fate in the 19th century, see Greenblatt (1995) and Van Wyhe (2002); for an interesting paper published in 1824 by "an obscure phrenologist and medical practitioner from Schotland" who tried to combine phrenological views with aphasic data to support the theory of the modularity and localisation of language in the frontal lobes, see Whitaker (1998).

[10] In a reanalysis of 147 clinical cases described by Lallemand (who was one of the most important sources of Bouillaud), Luzzatti and Whitaker (2001) showed that the actual data refuted Bouillaud's conclusion that the frontal lobes are crucial for speech, because some of Lallemand's cases had speech disorders with lesions outside the frontal lobes, and some others had frontal lesions but no speech disorders. Not surprisingly, Luzzatti and Whitaker also found that almost all patients with speech disorders had a lesion of the left hemisphere. This was overlooked by Bouillaud, because the principle of cerebral dominance for language had yet to be discovered (see below).

Furthermore, Bouillaud made a fundamental distinction between a disorder of articulated speech and that of language, both disorders being quite separate from an impairment to the mobility of the tongue:

> *[…] it is quite necessary to distinguish in the act of speaking two different phenomena, namely, the faculty of creating words as signs of our ideas, to preserve their memory, and to articulate these same words. There is, so to speak, an internal speech and an external speech: the latter being only the expression of the former.*
> *[…] The loss of speech depends sometimes on that of the memory of the words, and at other times on that of the muscular movements which constitute the words, or which is perhaps the same thing, sometimes on the lesion of the grey matter, and at other times on that of the white matter of the anterior lobes.*
> *[…] The loss of speech does not imply that of the movements of the tongue, considered as organ for the grasping, mastication and swallowing of food […] which supposes that the tongue has three different action sources in the nervous center*. [Hécaen & Dubois, 1969, p. 29-31]

Bouillaud thus made a fundamental distinction between what is now called ''apraxia of speech'' (Broca's ''aphemia'') on the one hand and ''anomia'' on the other hand, or in anatomical terms, between the ''organ of articulated language'' and that of ''the memory for words'', both being located in the anterior lobes.

Bouillaud's claim of the existence of a ''special, distinct and independent cerebral centre'' for speech and language was severely criticised, both on theoretical and empirical grounds. One of his most important opponents, Pierre Flourens (1794–1867), stated that the cerebral hemispheres were responsible for perception and intellectual functions, but that all motor functions (including speech) were completely controlled by the cerebellum. According to Flourens there was no question of a further functional division within the cerebrum and the cerebellum, and the effect of a brain lesion solely depended on its size and not on its location (Flourens, 1842).

Bouillaud's views on the cerebral localisation of speech were also refuted by the observations of Andral (1834). He found that 16 of 37 patients with a lesion of the frontal lobes did not have a speech disorder, whereas a speech disorder was found in 14 patients whose anterior lobes appeared to be intact after postmortem examination of the brain (Benton, 1964).

In spite of all these criticisms, Bouillaud remained convinced that he was right. In 1848 he presented a large number of new cases to support his theory on the localisation of speech (Bouillaud, 1848) and in the discussion following this paper he even offered a reward of 500 francs if a profound lesion in the anterior lobes of the brain could be shown in a patient without a disorder of speech (Stookey, 1963).

Marc Dax (1836): First description of cerebral dominance?

Four years after his famous discovery of the ''seat of articulated speech'' in the posterior part of the third frontal gyrus, Broca made another important contribution to the study of language and the brain in a paper published in the June issue of the *Bulletin de la Société d'Anthropologie*. On the basis of eight personally observed cases he noted that aphasia in right-handers is always caused by lesions to the left half of the brain and not the right:

> *Just like we direct the movements of writing, drawing, embroidery, etc., in the same way we speak with the left hemisphere*. [Broca (1865) in Hécaen & Dubois (1969), p. 114]

It is a moot point whether Broca can indeed be credited with being the first to conclude that the left hemisphere is dominant for language, because 6 weeks earlier, on 28 April 1865, a little-noticed article entitled: *Lésions de la moitié gauche de l'encéphale coïncidant avec l'oubli des signes de la pensée* (''Lesions of the left half of the brain coinciding with the forgetting of the signs of thought'') had appeared in the *Gazette Hebdomadaire de Médecine et de Chirurgie*. The manuscript of this paper was originally written by Marc Dax (1770–1837) in 1836 for presentation at a regional medical congress in Montpellier in the South of France, but it was not published until three decades later by his physician-son Gustav Dax (1815–1893). Interestingly enough, Gustav Dax had first submitted his father's paper in 1863 to the Académie de Médecine in Paris, but it was refused by the referees (one of them being Bouillaud). It is not known whether Broca was familiar with the paper Gustav Dax had sent to Paris in 1863.[11]

Leaving aside the question of priority of discovering the lateralisation of language, the paper posthumously published by Marc Dax is interesting enough to merit a short discussion. At the start of his memoir Dax described the case of a former cavalry captain who, following a sabre wound in the left side of the head, showed a major change in his ''memory for words'' while his ''memory for objects'' remained fully intact. In trying to find the solution to this enigma Dax vainly turned to the teachings of Dr Gall, who assigned word memory to the frontal lobes directly behind the eye sockets (see above), while the wound of the patient appeared to be in the centre of the left parietal bone. In the following years Dax met two other patients with aphasia after a left-sided lesion. Although he was struck by the similarity of the side of the lesion in these three cases, he

> *found them too small in number to convince [himself] that there was a general law, without taking into account the improbability that the functions of one half of the brain could differ on this point from the functions of the other half*. [Dax (1865) in Hécaen & Dubois (1969), p. 98]

Nevertheless, in 1814, after observing three more cases, ''his hope of turning his observations into a general rule was confirmed'' and from that year on Dax systematically collected more than 40 similar cases without encountering one single exception, such as ''an alteration of the memory for words, dependent on a disease that exclusively occupies the right hemisphere''. On the basis of almost equal numbers of cases from the medical literature and those of his own, Dax finally wrote that:

[11] Although Gustav Dax insisted that his father had presented his paper at the congress in 1836, there is no solid evidence that he had actually done so. In the controversy following the publication of Dax's paper in 1865 over whether he or Broca should be accorded priority for being the first to describe the principle of left cerebral dominance for language, the latter even had the librarian of the faculty in Montpellier question 20 physicians who had been present at the congress 30 years before; however, none of them could remember Dax presenting his paper, although it is now known that he gave a copy to the former dean at the University of Montpellier (Finger & Roe, 1996; Joynt & Benton, 1964).

> *[…] I believe to be able to conclude, not that all diseases of the left hemisphere must alter the verbal memory, but that, if this memory is altered by a disease of the brain, one must look for the cause of the disorder in the left hemisphere, and still look for it there when the two hemispheres are diseased together*. [Dax (1865) in Hécaen & Dubois, 1969, p. 99]

Dax further observed, citing Schenck von Grafenberg with approval, that the alteration of verbal memory cannot be attributed to a paralysis of the tongue, and that many patients continue to speak, saying one word for another. Following the explanation of Lordat (see below), he attributed the loss of speech to a "defect in the synergies of the muscles which cooperate in the execution of speech" (Dax, 1865, in Hécaen & Dubois, 1969, p. 100).

Near the end of his paper, Dax expressed the hope that his work would be of some use for the diagnosis and therapy of this type of disease. As an example he described the case of a lady who could not speak for a short while after she had fainted and fallen off her chair. Two days later Dax was called in great haste to see the same lady who just had a similar attack, but this time much more severe:

> *I found her to be completely mute, [and] I did not have to think to know the nature, site, nor the treatment of this disease. I immediately applied a large number of leeches to the left temple, and, within a few minutes, as the blood flowed, the speech gradually recovered.* [Dax (1865) in Hécaen & Dubois, 1969, p. 101]

Dax noted that his new point of view might not only be useful for the therapy of this type of disorders, but also for clarifying legal medical issues, stating that:

> *A patient of this kind can testify, can arrange his affairs, because his intelligence is usually very well preserved, and it would be inaccurate and cruel to deny him this and to regard him as suffering from a mental disorder*. [Dax (1865) in Hécaen & Dubois, 1969, p. 101]

Jacques Lordat (1843): Auto-observation of aphasia

In addition to the neuroanatomical observations and views on aphasia of Gall, Bouillaud, Flourens, and Dax, a growing number of case descriptions of aphasic patients were published between 1800 and 1860. One of the most important clinical contributions was made by Jacques Lordat (1773–1870), professor of physiology at the University of Montpellier. In 1843 Lordat published a paper, entitled: *Analyse de la parole pour servir à la théorie de divers cas d'Alalie et de Paralalie (de mutisme et d'imperfection du parler) que les Nosologistes ont mal connus* ["Analysis of speech to be used for the theory of different cases of Alalia and Paralalia (mutism and imperfection of speaking) that the nosologists have ill recognised"]. In this paper Lordat gave a detailed description and theoretical analysis of an aphasic episode that he himself had experienced at the age of 52 and which had lasted for several weeks. This autobiographical report contains several new and noteworthy elements.[12] First,

[12] Lordat's paper was not the first autobiographical description of aphasia, because three earlier self-observations of (transient) aphasia were written by the German theologian Johann Joachim Spalding (1783), the famous English writer Samuel Johnson (1783), and the French astronomer Jean-Paul de Fouchy (1784).

Lordat pointed out that he experienced difficulties not only in speaking, but also in language comprehension:

> *[…] I noticed that when I wanted to speak I could not find the expressions that I needed […] The thought was all ready, but the sounds that had to express it as intermediary were no longer at my disposition.*
> *[…] The difficulty increased rapidly, and, in twenty-four hours time, I found myself deprived of the use of almost all words. If some of them remained at my grasp, they were almost useless for me, because I could no longer recall the ways to coordinate them in order to express a thought.*
> *I found myself therefore affected by an incomplete alalia. I was no longer able to receive the ideas of others, because the very amnesia that prevented me from speaking, made me incapable to comprehend quickly enough the sounds that I heard so that I could grasp their meaning. There was not enough time to make an effort to remember each sound, and the conversation was too fleeting to comprehend a sufficient number of words*. [Lordat (1843) in Hécaen & Dubois (1969), pp. 140–141]

Second, Lordat associated his difficulties with spoken language (or ''verbal amnesia'' as he called it) with problems in understanding written language (an association that even today many neurologists might be unaware of):

> *If you have not given much thought to the extent of this amnesia, you might think that I could have taken comfort in reading, but in the beginning this came to nothing. In losing the memory of the meaning of heard words, I had lost that of their visible signs. The syntax had disappeared along with the words: the alphabet alone had remained, but the junction of letters for the formation of words was quite a study.*
> *When I wanted to take a look at the book that I was reading when my illness had visited me, I found it impossible to read the title. – I will not tell you about my desperation, you can guess it. I had to spell out the majority of words; and I must tell you, by the way, that I had the opportunity to experience the very absurdity of the spelling in our language*. [Lordat (1843) in Hécaen & Dubois (1969), p. 143]

Apart from his observations on deficits in understanding spoken and written language, Lordat noted two other symptoms of aphasia that had not been distinguished before (at least not as explicitly), i.e., verbal and phonemic paraphasias and a differential loss of spoken language in a bilingual patient.

With regard to his own illness he observed that aphasia (or ''alalia'' as he called it)[13] did not only consist of a ''forgetting of words and of the meaning of words still present'', but also in the use of paraphasias (or ''paramnesia'' to use his own term), which he defined as ''the faulty use of known and remembered sounds''. Thus, when he wanted to ask for a book (*livre*), he said *mouchoir* (''handkerchief''), but was immediately aware (contrary to some other patients he had seen) that he had produced the wrong word. Another manifestation of paraphasia consisted in ''inverting the letters of the syllables of a complex word'', for example, wanting a grape (*raisin*) he said *sairin*, and instead of *Musulman* (''Muslim'') he tended to say *Sumulman*.

Further on in his paper Lordat gave a detailed case report of a priest with a severe expressive aphasia after a stroke who could only utter

[13] As is well known, the term ''aphasia'' was first used by Trousseau (1864).

two very vigorous words, one of which was "I" and the other the most energetic swearword in our language that starts with an "F", and that our dictionaries have never dared to write down. [Lordat (1843) in Hécaen & Dubois (1969), p. 151]

The patient steadily improved and when Lordat met him again he was in good health, except for the fact that

he had almost lost the use of the french language, but he said everything he wanted in Languedoc [a provincial dialect of France]; however, his speech was so hesitant that one could think that he had a paralysis of the tongue to some degree […] and he could only talk with his servants and with the farmers. [Lordat (1843) in Hécaen & Dubois (1969), p. 151][14]

Finally, at the end of his paper Lordat discusses in detail the relation between aphasia and intelligence. On the basis of his own experiences with and observations of other aphasic patients he concluded that (1) aphasia is by no means a symptom of mental deficiency or madness (as many of his contemporaries still thought), (2) language and thought are in principle independent of each other, and (3) the intellectual abilities of aphasic patients can therefore be completely unaffected.

DISCUSSION AND CONCLUSIONS

This review of the literature on the early history of aphasiology, starting with the observations of "speechlessness" by Egyptian surgeons about 1700 BC, and extending up to Broca's discovery of the "speech centre" in 1861, has made it clear that through the ages there has been an ever-increasing accumulation of knowledge about the signs, forms, nature, and localisation of aphasia. Although the division of the history of a scientific discipline into separate periods is always somewhat arbitrary, it can nevertheless be argued that the year 1800 marks a turning point in the understanding of aphasia.

As has been already pointed out in Benton and Joynt's (1960) excellent survey of the early literature on aphasia up to 1800, many common symptoms (e.g., paraphasia, recurring utterance, and the retention of automatised speech) and types of aphasia (e.g., motor aphasia, jargon aphasia, anomia, and alexia) had been observed before the beginning of the 19th century. However, other symptoms and forms of aphasia (notably language comprehension disorders) remained unnoticed, or were possibly interpreted as a sign of dementia or insanity. Also, before 1800 aphasia was still considered as a rare phenomenon and many of its symptoms (e.g., paraphasia and the preservation of serial speech) were "rediscovered" time and again.

Furthermore, before 1800 no important ideas about the localisation of aphasia were advanced beyond the fact that aphasia could occur as a result of various brain diseases such as epilepsy and stroke ("apoplexia"). Up to the 16th century views on the localisation of language were influenced by Galen's ventricular theory of "animal spirits" being transported through hollow nerves from the periphery to the cerebral

[14] Although Gesner in 1770 mentioned the case of a German patient who was more successful in reading Latin as compared to German, Lordat's case report of the French priest is probably the first explicit description of a differential, selective loss of spoken language in a bilingual patient (Benton, 1964).

ventricles and vice versa. As a consequence language, being considered as a part of memory, had been localised in the posterior ventricle of the brain for more than a thousand years.

From a neuropsychological point of view, insights into the nature of aphasic disorders were quite limited in the period under discussion. Although Schenck von Grafenberg had already pointed out in 1585 that aphasia could not be explained by a paralysis of the tongue, this fact was generally overlooked in the following two centuries, and up into the 19th century it was common practice to try to cure "speechlessness" by applying leeches to the tongue, or by polypharmacy. A notable exception in this regard is Johann Gesner's psychological explanation of aphasia as a disconnection between the image or concept (i.e., word meaning) on the one hand and the corresponding linguistic sign (i.e., word form) on the other.

Between 1800 and 1860 the interest in and knowledge of aphasia increased rapidly, both from a clinical and theoretical point of view. A large number of case descriptions were published and in much greater detail than before. They included some previously unknown aphasic phenomena such as severe jargon aphasia with relatively intact comprehension, difficulties in auditory comprehension, and selective aphasia in a bilingual.

More importantly, at the beginning of the 19th century there was a radical change in the ideas concerning the anatomical basis of aphasic disorders. The starting point of this development was the "phrenological" theory of Gall, who assumed that various psychological functions could be localised in different parts of the brain by inspecting the outer shape of the skull (Gall & Stuart, 1806). Although the misguided doctrine of phrenology was soon discredited, Gall's view that the faculty of language could be localised in the frontal lobes was adopted by Bouillaud (1825) who presented neuropathological evidence for his claim that "the movements of the speech organs" are controlled by a special centre in the anterior lobes. The ideas of Gall and Bouillaud that different brain regions had different functions and that "articulated speech" could be localised in the frontal lobes led to heated debates in the following decades and thus laid the foundation for Broca's discovery of the "speech centre" in 1861. It is not clear whether Marc Dax or Broca should be credited with discovering the principle of cerebral dominance, although it is common in science for there to be a discrepancy between making a great discovery and publishing the results.

The period between 1800 and 1860 also brought forth some new insights concerning the psychological mechanisms underlying aphasic disorders. Bouillaud (1825) made the fundamental distinction between a disorder of "articulated speech" (apraxia of speech) and that of the "memory of words" (anomia), while Lordat (1843) noted that word-finding problems could manifest themselves not only as anomia, but also as verbal and phonological paraphasias.[15]

In his famous article in 1861 Broca followed Bouillaud in describing the speech problems of his first patient Mr "Tan" as a loss of the "ability to coordinate the movements associated with articulated speech". Based on the localisation and extent of his lesion (cf. Signoret, Castaigne, Lhermitte, Abelanet, & Lavorel, 1984) it is now known that Mr "Tan" must have had a severe (global) aphasia instead of just an

[15] For a detailed review of the theoretical analyses of aphasia and the development of scientific thinking about the relations between language and the brain in the period between 1825 and 1860, see Jacyna (2000).

apraxia of speech (Broca's "aphemia"). This goes to show that Broca's famous article in 1861, which is considered by some to be the "first truly scientific paper on language–brain relationships" (Caplan, 1987, p. 46) was heavily influenced by, and could not have been written without, the work of his predecessors in the previous decades and possibly centuries.

Manuscript received 30 March 2005
Manuscript accepted 4 October 2005

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