

APHASIA  
AND KINDRED DISORDERS OF SPEECH

PART I  
CHAPTER I

FROM THE SCHOOLMEN TO GALL

THE evolution of our knowledge of cerebral localisation is one of the most astonishing stories in the history of medicine. Throughout the middle ages the brain was supposed to contain three ventricles, each of which was the dwelling-place of one or more aspects of the soul. The anterior chamber received the nerves of taste, smell, sight and hearing, and was the situation of the “Sensus Communis”; in the middle ventricle dwelt the faculty of cogitation and reasoning, whilst the posterior one was the seat of memory<sup>1</sup>.

This doctrine appears to have started from Herophilus and, although Galen placed the site of the activities of the mind in the substance of the brain, it persisted until it was rendered untenable by the dissections of Vesalius, in the early part of the sixteenth century. But theories continue to exert a subtle influence on medicine long after they have ceased to be reasonable; in 1798, Soemmering thought the seat of the soul was in the fluid which filled the ventricles, and even as late as 1844, the author of the article on psychology in Wagner’s *Handwörterbuch der Physiologie* states that there are facts “which make it very probable that the cerebral ventricles are the organ which stands in the closest relation to consciousness<sup>2</sup>.”

With the revival of learning the discussion of the relations between mind and body underwent a fundamental change. A return to the teaching of Aristotle that human reason depends on the senses and imagery made the existence of the mind dependent on bodily activities. This led to the conception that the soul in all its aspects, both higher and lower, was inseparable from the body and incapable of surviving its dissolution.

Accurate anatomical knowledge acquired by dissection destroyed the fantastic dogmas of the Schoolmen about the ventricles, and attempts were made to bring the vital activities of the brain into harmony with the

<sup>1</sup> [124], pp. 179–180, 204.                      <sup>2</sup> [128], p. 705.

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new theories on the functions of other organs. The soul, as the principle of life, was distributed to various parts of the body, and in conjunction with the crude substances it found there was distributed in three forms of “spirits.” The liver concocted from the food the “natural spirits,” whilst the heart was the centre of the “vital spirits,” which rushed through the vessels of the body. In the same way the brain manufactured the “animal spirits,” according to Vesalius, out of the blood together with the air which entered through the ethmoid plate and other orifices of the skull. These animal spirits were distributed from the brain through all parts of the nervous system to form the basis of consciousness and voluntary action. He said:

Nerves<sup>1</sup> serve the same purpose to the brain that the great artery does to the heart, and the vena cava to the liver, in as much as they convey to the instruments to which it ought to be sent the spirit prepared by the brain, and hence may be regarded as the busy attendants and messengers of the brain.

He adds:

Meanwhile we will not too anxiously discuss whether the spirit is carried along certain hollow channels of the nerves, as the vital spirit is carried by the arteries, or whether it passes through the solid material of the nerves, as light passes through the air. But in any case it is through the nerves that the influence of the brain is brought to bear on any part, so far as I can certainly follow out the functions of the brain by means of vivisections, with great probability and indeed truth.

But how the brain performs its functions in imagination, in reasoning, in thinking and in memory (or in whatever way, following the dogmas of this or that man, you prefer to classify or name the several actions of the chief soul) I can form no opinion whatever. Nor do I think that anything more will be found out by anatomy or by the methods of those theologians who deny to brute animals all power of reasoning and indeed all the faculties belonging to what we call the chief soul. For as regards the structure of the brain, the monkey, dog, horse, cat, and all other quadrupeds which I have hitherto examined, and indeed all birds, and many kinds of fish, resemble man in almost every particular. Nor do we by dissection come upon any difference which would indicate that the functions of those animals should be treated otherwise than those of man; unless perchance anyone says, and that rightly, that the mass of the brain attains its highest dimensions in man, which we know to be the most perfect animal, and that his brain is found to be bigger than that of three oxen; and then in proportion to the size of the body, first the ape, and next the dog exhibit a large brain, suggesting that animals excel in the size of their brains in proportion as they seem the

<sup>1</sup> Translated by Michael Foster [49], p. 255 et seq.

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more openly and clearly to be endowed with the faculties of the chief soul. Indeed the more I examine the nature of the heart, the liver, the testes, and the organs secondary to these, the functions performed by which are, there can be no doubt, the same in us as in other animals, and the more I persuade myself that we ought not to draw conclusions concerning the operations of the chief soul, other than those taught by our most holy and true religion, the more I wonder at what I read in the scholastic theologians and the lay philosophers concerning the three ventricles with which they say the brain is supplied.

The revolution in anatomical knowledge produced by the work of Vesalius did not preserve him from enunciating such purely metaphysical doctrines with regard to the functions of the body. These would have been of little historical importance had they not influenced all the theories put forward up to the end of the eighteenth century to account for the relation between the structure and functions of the nervous system. The brain was supposed to secrete thought as the liver forms the bile.

Harvey's discovery that the circulation of the blood obeyed mechanical laws applicable outside the body helped to destroy the idea of a vegetative soul and belief in the existence of vital spirits. Descartes cited it to support his view that all the activities of the body are the mechanical consequence of their structure. Animal life is inanimate and automatic; man alone is endowed with the power of thought and possesses an immaterial soul. The seat of this action of soul upon body is the brain, which from the time of Descartes onwards was universally recognised as the sole organ of mind. For him even the animal spirits which flow along the motor nerves are the result of filtration from the blood; the soul no longer animates the whole body in different forms, but exerts its influence through the pineal gland, chosen for this purpose because of its proximity to the ventricles of the brain<sup>1</sup>.

Throughout the eighteenth century the doctrine of the relation between mind and matter became increasingly metaphysical; soul and body were thought to be coexistent but independent factors in the life of man. Knowledge of the structure of the nervous system grew steadily, but up to the end of the eighteenth century the brain was looked upon as a single organ from which flowed vital energy under the influence of the will into all parts of the body. The nerves formed the channels for this distribution, and all of them consequently took their origin in the brain.

Gall was the first to suggest that the apparently uniform mass was made up of organs which subserved the vital, intellectual and moral

<sup>1</sup> Even in 1851, Lotze postulated a central seat of the soul in the brain.

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faculties of man. We habitually think of him with derision, as a quack who deduced character from the external conformation of the skull, and was directly responsible for phrenology. But it is to this man that we are really indebted for the ideas we now hold of the relation of the constituent parts of the nervous system to one another.

Franz Joseph Gall was born on March 9th, 1758, at Tiefenbronn in Baden. He studied medicine in Strasbourg, and in 1781 settled in Vienna. From 1796 to the end of 1801 he lectured on a new theory of the functions of the brain; but his views were considered so subversive of religion and morals that, on December 24th, 1801, his lectures were interdicted by an autograph letter of the Kaiser. Charles Villers writes to Cuvier: "L'Autriche comme tous les états soumis à un régime militaire et absolu, repousse avec une farouche obstination tout ce qui porte l'impreinte d'une certaine libéralité de pensée." Gall seems to have remained in Vienna for the next three years and then journeyed through Europe with his pupil Spurzheim, lecturing as he went<sup>1</sup>. In 1807 he reached Paris and the following year presented a Memoir to the Institute of France entitled *Introduction au Cours de Physiologie du Cerveau*. This was the first serious attempt made by Gall to put forward the new doctrine in print. In 1798, when his lectures were exciting universal interest in Vienna, he wrote a short account of his views in Wieland's *Der neue Teutsche Mercur*, a monthly popular journal; this consists of a series of dogmatic assertions concerning the localisation of the various human faculties and proclivities in different "organs," or, as we should say, "centres," of the brain. It contains nothing of any permanent value, but is of interest as showing how early the fantastic doctrines of "Craniology" formed an essential part of teaching, which contained so much that was new with regard to the structure and functions of the nervous system.

A fuller account of Gall's views is contained in an open letter of Charles Villers to Cuvier, published at Metz in 1802<sup>2</sup>. This lively description of the new doctrines by one who was greatly impressed by their scientific importance, touches on all the principles subsequently enunciated by Gall in his various publications. The apparently uniform mass of the brain is made up of organs which subserve the manifestations of our vital and moral faculties; these consist of three groups: (1) those which concern purely the exercise of vital force; (2) the inclinations and affections of the soul; and (3) the intellectual qualities of the mind. Each of these groups

<sup>1</sup> According to his own account (Preface to vol. I, p. xvi) he left Vienna because his father wrote to him: "Es ist Abend und könnte bald Nacht werden; werde ich dich noch sehen?"

<sup>2</sup> [127].

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is localised in a different portion of the brain. The organ of the vital force resides in the brain-stem<sup>1</sup> (“moelle allongée”), which forms the intermediary between the brain and the spine; for butchers kill oxen by thrusting a stylet between the first vertebra and the occiput. The inclinations and affections of the soul belong to the basal ganglia, whilst the intellectual qualities of the mind are situated in various parts of the cerebral hemispheres. Hence the moral and intellectual characteristics can be deduced from measurements of the skull, which is modified in shape by the underlying brain.

Now it is obvious that this doctrine, though logically conceived and developed, consists of two parts of very unequal value to-day. It introduced an entirely new method of approaching the structure and functions of the nervous system, but at the same time formed the basis of what was called “Craniology,” or the estimation of character and mental faculties from the shape of the skull. Unfortunately it was this latter aspect of Gall’s teaching which excited at the time such widespread interest and subsequently led to its disrepute; but by an odd chance it is this part of the theory that has the more intimate bearing on the history of aphasia.

In the memoir presented in conjunction with Spurzheim to the Institute of France, he devoted his attention solely to general conceptions of the structure and functions of the brain and spinal cord. These have been absorbed so completely into the pool of general knowledge that their importance can only be recognised by studying the current teaching of the time. This has been fairly summarised by Gall himself in the Preface and in the Introduction to vol. I of his complete publication<sup>2</sup>.

He insists that when dissecting the brain it should be approached from the spinal cord upwards; the customary method of cutting it into slices from above downwards must be abandoned. For the brain is not the seat of a “sensorium commune,” but is the expansion of lower nervous mechanisms which are thus enabled, though independent, to interact upon one another. The spinal cord and brain-stem (“moelle allongée”) are not simply downward projections from the brain, but are made up of independent ganglia, from which arise the nerves of the body and head. Amongst other facts in support of this contention, he cites the condition

<sup>1</sup> It must be remembered that the “moelle allongée” is not the medulla oblongata, but the whole of that portion of the central nervous system between the upper end of the spinal cord and the basal ganglia. When the older authorities said that all nerves arose from the brain, they meant the hemispheres and basal ganglia. Thus the “couches optiques” or optic thalamus was so called, because it was supposed to give origin to the optic nerves.

<sup>2</sup> [53].



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found in certain anencephalic foetuses where a spinal cord exists in spite of the absence of a “brain.”

The brain and spinal cord are composed throughout of two substances; one of these, the white matter, consists of nerve fibres and is solely concerned with conduction of the nervous influence; whilst the other, the “pulpy or gelatinous” matter, of a more or less grey colour, forms the cortex of the brain and the ganglia<sup>1</sup>.

The nervous system of invertebrates is composed of ganglia united by filaments, and the same organisation is present in the spinal cord of fishes, birds and mammals. Here, however, the ganglia are represented by swellings of grey matter opposite each pair of nerves. These masses, and consequently the size of the spinal cord, are proportional to the nerves which leave it and the brachial and lumbar enlargements correspond to the large outflow for the supply of the upper and lower extremities.

Gall and Spurzheim demonstrated by dissection the crossing of the pyramids, which, though previously suggested, was generally denied by contemporary anatomists. But they went further, pointing out that some such arrangement was necessary to explain the occurrence of paralysis on the opposite half of the body to that of the cerebral lesion. They considered that the cortex of the brain was formed by expansion of the peduncles, and consisted of fibres covered by grey matter; its convolutions were produced by folding and could be unrolled by internal pressure as in hydrocephalus to form a continuous membrane.

Each mechanical system of the “vie animale” is double and is restored to unity by commissures, which subserve the same function, whether they are found in the spinal cord or in the brain; the biggest of these uniting bands is the corpus callosum. Since the central nervous system is composed of many “organs” united from side to side and capable of influencing one another, there can be no common centre for all sensations, thoughts and voluntary actions. Such a conception shows how the brain and spinal cord can have developed out of simpler systems and amongst the conclusions at the end of this memoir occur the following passages:

Nous pouvons dès-à-présent considérer sous un point de vue beaucoup plus relevé, l'ensemble des systèmes nerveux, cette partie de l'organisation animale dont nulle autre n'égale l'importance. Les lois sur leur origine, leur renforcement successif, leur épanouissement, et sur le complément des appareils des fonctions

<sup>1</sup> Gall and Spurzheim suggested in this memoir that the grey substance could also be found in the labyrinth of the ear, in part of the mucous membrane of the nose and in the rete malpighi of the skin. But this does not take away from the value of their generalisation concerning the grey and white matter in the central nervous system.

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les plus variées, sont en partie découvertes et ramenées à un principe général. Le nerf qui préside au mouvement, au sentiment et aux fonctions des sens, naît et se développe d'après les mêmes lois que l'organe au moyen duquel l'esprit sent, veut et pense.

De quel intérêt et de quelle importance va devenir l'étude du cerveau, maintenant qu'il n'est plus condamné, comme autrefois, à être simplement taillé et en quelque sorte ciselé comme une masse brute et sans but! Ce viscère ne présentera désormais plus de simples débris; l'on y verra partout une disposition pour un but quelconque; partout des moyens d'influence réciproque, malgré la diversité la plus étonnante des fonctions. Toutes ces anciennes formes et ces connexions mécaniques se transforment aujourd'hui en une collection merveilleuse d'appareils matériels pour les facultés de l'âme. De même que l'action des différens viscères, et la sensation des différens sens se trouvent subordonnées à un appareil nerveux particulier, de même aussi chaque instinct, chaque faculté intellectuelle, se trouvent subordonnés dans l'homme et dans tous les animaux, à une partie quelconque de la substance nerveuse du cerveau.

This remarkable memoir was handed over to a committee consisting of Tenon, Sabatier, Portal and Pinel with Cuvier as "rapporteur"; the result was the sort of half-hearted judgment that might have been expected from men of such established reputation and public eminence. They allowed that the description of the grey and white matter was novel, and agreed that Gall and Spurzheim had overthrown the theory that all nerves descended from the "brain" (i.e. the hemispheres and basal ganglia). But they failed to appreciate the revolutionary significance of this new conception of the nervous system and damned it with faint praise, suggesting that what truth it contained was already familiar, whilst the rest was of doubtful value.

Gall and Spurzheim responded by publishing in full their original memoir with comments on the report of the committee<sup>1</sup>. A year later (1810) appeared the first volume of the *Anatomie et Physiologie du Système Nerveux en général et du Cerveau en particulier*. Here they insist<sup>2</sup> that man and the animals, whatever their respective faculties, are links in a chain of living beings. The human nervous system does not differ fundamentally in structure from that of the beasts; its functions are identical in quality but more highly developed. How is it possible, they ask, to look on the brain as the seat of the faculties of the soul, if it is nothing but a secretory or excretory organ or is solely destined to secrete the principle of voluntary movement? It is impossible to explain the successive development, isolated activity and fractional diminution of the different

<sup>1</sup> [52].<sup>2</sup> [53], Preface p. x.

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intellectual faculties by postulating a central point, where all the nerves unite, the unique and exclusive organ of the soul.

The brain, cerebellum and spinal cord, together with the sympathetic nervous system, are composed of grey and white matter. The white substance wherever it occurs consists of fibres; it must not be compared with the medullary substance or grey matter from which all nerves take their origin<sup>1</sup>.

All special systems of the brain and other parts of the nervous apparatus are reinforced and made perfect gradually. For this purpose the fibres of the brain are brought together and enclosed in ganglionic masses just as other neural systems unite to form sometimes plexuses and sometimes ganglia.

Each particular system of the brain terminates by an expansion of fibres disposed in layers ("en couches") in the same way as other neural endings expand in fibres at their peripheral extremity; these are brought into connection with their neighbours by communicating branches.

Every such special cerebral apparatus is double, like those of the spinal cord and of the senses. All these double portions, whether they belong to the cerebrum, cerebellum, the same organs or vertebral column, are reunited by commissural mechanisms.

Those parts of the brain which are the prolongation or reinforcement of the pyramidal bundles are in connection by crossing with the nervous system of the spinal column, and it is for this reason that a cerebral lesion causes paralysis on the opposite side of the body.

Sometimes one and sometimes another of the integral portions ("parties intégrantes") of the same system, whether in the brain or elsewhere, are developed to a different degree in individuals of the same species. Any one of these mechanisms or even a part of it may be attacked alone by disease, just as any single organ of the body can suffer without the others being affected.

The second volume, issued in 1812, has little direct bearing on the history of cerebral localisation as we understand it to-day. Gall insists that the instincts, aptitudes, sentiments and faculties are not situated in the viscera, nervous plexuses and ganglia of the chest and abdomen (sympathetic nervous system) and that they are not determined by the temperament or general constitution of the body. They are associated solely with the active life of the nervous system. The "vie animale" can be divided into two classes; firstly, the faculty of sensation, voluntary movement and the sensory functions; secondly, the moral and intellectual

<sup>1</sup> [53], vol. I, p. 317, et seq.



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faculties, inclinations and feelings. The brain is the exclusive seat of the second group; moreover, these moral and intellectual dispositions are innate, contrary to the teaching of Locke.

Volume III did not appear till 1818. By this time Gall had parted from Spurzheim, who meanwhile had written a book on what he called *Phrenology* greatly to Gall's annoyance. In the fourth volume<sup>1</sup> Gall reveals the course of reasoning which led him to pitch on the anterior portion of the brain as the situation of the faculty of speech. He again tells the story of how he was sent in his ninth year to an uncle who was a *curé* in the Black Forest. Here he was educated with another boy of his own age who excelled him in learning his lessons. The two youths passed on to school at Baden, and Gall discovered that, when it was a question of learning by heart, he was beaten by those who were greatly inferior to him in written composition. Two of his new schoolfellows surpassed even his first companion in the ease with which they learnt by heart, and because they had large and prominent eyes ("yeux à fleur de tête") they received the nickname of "Ox eyes." Three years later at Bruchsal and again at the University of Strasbourg he continued to notice that those who learnt easily by heart had the same sort of eyes. He began to associate this conformation with a good verbal memory, and so arrived at the conclusion that this faculty was situated in that part of the brain which lay behind the orbits. From such fantastic beginnings sprang the idea that the memory for words was situated in the frontal lobes.

This was confirmed in his mind by subsequent cases of injury to these parts of the brain. Gall mentions an officer who received a sword thrust just above the eye, and another young man injured in the same situation by the point of a fencing foil; both had lost the "memory for words" and could not recall the names of relatives or friends. But the following remarkable case<sup>2</sup>, which forms the first complete description of aphasia due to a wound of the brain, seems to have escaped the notice of medical historians.

M. Edouard de Rampan was sent to Gall by Baron Larrey, Napoleon's famous surgeon. He was 26 years of age and had received a wound from a foil, the point of which broke on the padded front of his fencing jacket. It entered the cheek in the middle of the left "canine region" close to the ala nasi and passed obliquely from below upwards and a little from without inwards. The instrument penetrated for a depth of about three inches and a half across the left nasal fossa and traversed the perforated plate of the ethmoid close to the insertion of the falx cerebri. It appears

<sup>1</sup> [53], vol. IV, p. 68.

<sup>2</sup> [53], vol. IV, p. 76, et seq.

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to have penetrated in a vertical direction and a little obliquely from before backwards to a depth of five to six lines (half an inch) into the inner and posterior portion of the left “anterior lobe” of the brain. The patient suffered from considerable haemorrhage at the moment of the wound and a large number of sequestra came from the nose and mouth. At the same time all the sense organs were paralysed but recovered their functions little by little. The following changes alone remained, when the patient was seen by Gall.

The sight of the left eye, which was lost for a month, had recovered, but the patient saw double. Smell and taste were also abolished at first; the former returned completely, whilst taste remained defective on the left half of the tongue. The tongue was “dragged over to the right in opposition to the hemiplegia, which occupied the right side, the mouth being drawn to the left.” Hearing, at first lost in the ear on the side of the wound, gradually returned and nothing abnormal remained but a humming sensation. The voice, which was also lost, was restored except for a slight stammer. At first the injury produced hemiplegia of the whole of the right side of the body; but Gall found paralysis for walking only, sensibility remaining intact.

Memory for names was completely destroyed and they could be recalled with great difficulty only, whilst the memory of images and all that was susceptible of demonstration remained intact. The mental aberration which existed in the organs of the intellect during the earlier days had passed away entirely; but all that bore on his “amour propre,” his military success, etc., threw him into a state of alienation and profound melancholy, whilst conversation bearing on his family, relatives and friends restored his faculties. The patient recalled perfectly the person, face and characteristics of M. le Baron Larrey; he recognised him without difficulty. In the words of the patient he “sees him before his eyes”; and yet he could not remember the Baron’s name and called him “M. Chose.”

Gall describes another patient<sup>1</sup> where the loss of speech was due to a vascular lesion. In consequence of an attack of apoplexy a soldier found it impossible to express in spoken language his feelings and ideas. His face bore no signs of a deranged intellect. His mind (“esprit”) found the answer to questions addressed to him and he carried out all he was told to do; shown an arm-chair and asked if he knew what it was he answered by seating himself in it. He could not articulate on the spot a word pronounced for him to repeat; but a few moments later the word escaped from his lips as if involuntarily. In his embarrassment he pointed to the

<sup>1</sup> [53], vol. iv, p. 83.