



ON

APHASIA,

OR

LOSS OF SPEECH IN CEREBRAL
DISEASE.

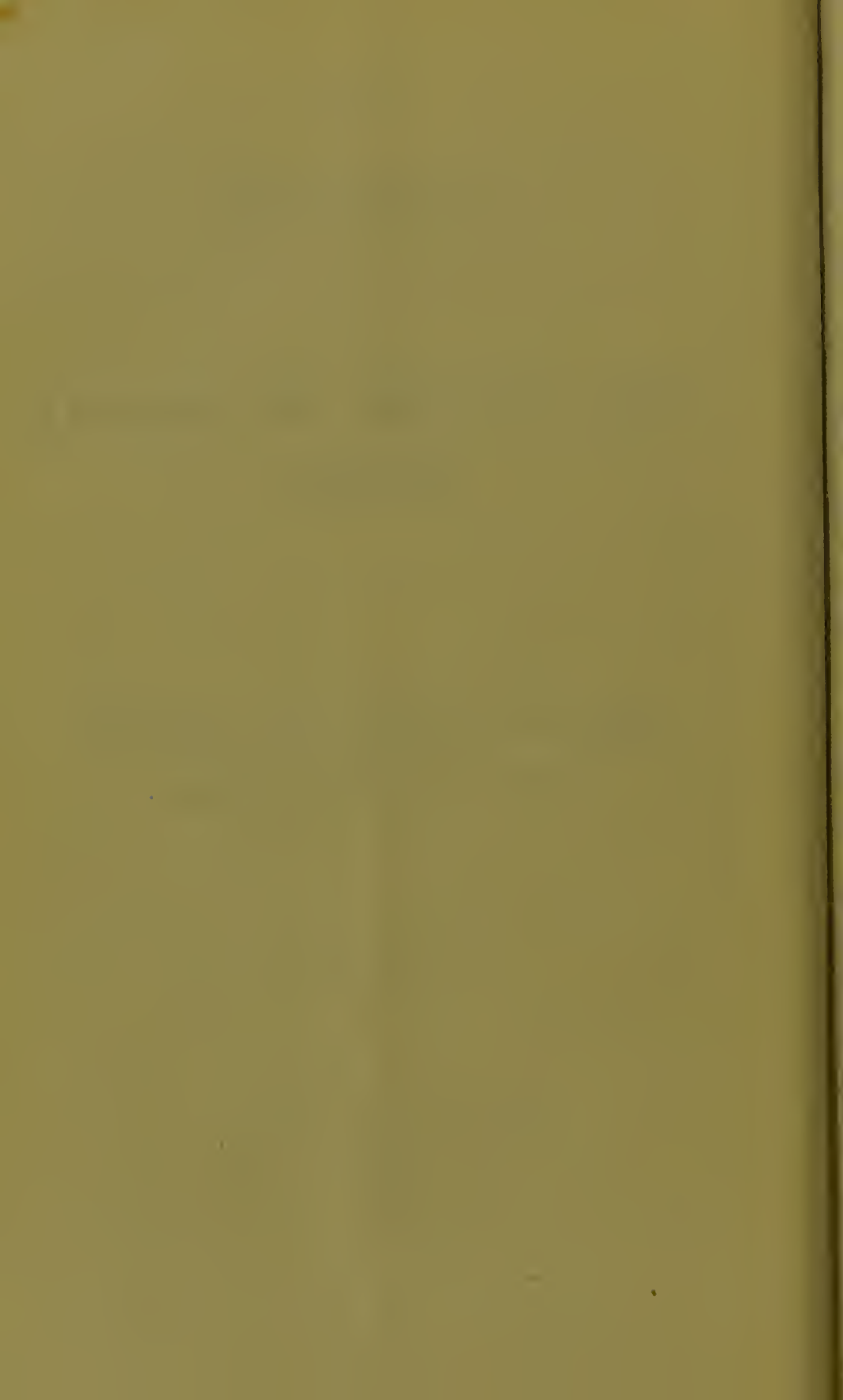
BY

FREDERIC BATEMAN, M.D., M.R.C.P.,

PHYSICIAN TO THE NORFOLK AND NORWICH HOSPITAL.

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PART VI.

IN the first two parts of this essay I entered into the subject of the bibliography of aphasia, as illustrated by the French, German, Dutch, British, and American writers; the third part contains a detailed account of the clinical history of cases that have fallen under my own immediate observation; the fourth treats of the different forms and varieties in which loss or lesion of articulate language is met with in practice; whilst in the fifth part, I have considered the subject in reference to the question of Cause, Diagnosis, Prognosis, and Treatment.

We are now, therefore, in a position to criticise the value of the different opinions which have been propounded as to the precise point of the cerebro-spinal centre which is affected in aphasia, or in other words, to consider whether there be a cerebral seat of speech at all, and if so, where it is located; and I propose in this concluding part to summarise, and carefully to weigh the evidence furnished by the numerous cases recorded in the previous pages. Leaving for the present the question of the existence or non-existence of a speech centre, and assuming *pro hac vice* that there is one, I shall proceed at once to consider the different theories which have been from time to time promulgated as to the seat of articulate language.

The ancients seemed to have possessed the most crude notions of the functions of the brain, as evidenced by Hippocrates assigning the seat of the mind to the left ventricle, and by Aristotle also placing the sensorium commune in the heart; Michael Servetus, who flourished in the sixteenth

century, believed the choroid plexus was the organ destined to secrete the animal spirits, that the fourth ventricle was the seat of memory, and that the habitation of the soul was in the aqueduct of Sylvius; a century later René Descartes assigned to the soul a more secure position in the pineal gland. In later times, the brain has been universally considered to be the organ of thought and intelligence, but opinions have been and are still divided, as to whether it is to be regarded as a single organ, or as consisting of a series of distinct organs, each endowed with a special and independent function—whether, in fact, the phenomena of intelligence are due to an action of the brain as a whole, or whether the different psychological elements which constitute them are connected with isolated and circumscribed parts of the encephalon.*

Out of the last theory has arisen the principle of the localisation of the cerebral faculties, which was first announced in a definite form by Gall, who divided the encephalon into organs endowed with primordial faculties, distinct the one from the others. The germ of this idea of the polysection of the encephalon is to be found in the writings of physiologists long before the time of Gall; indeed, one writer, Charles Bonnet, assigned a special function to each fibre, stating that every faculty, sensitive, moral, or intellectual, was in the brain connected to a bundle of fibres, that every faculty had its own laws which subordinated it to other faculties, and determined its mode of action, and that not only had every faculty its fasciculus of fibres, but that every word had its own fibre!

The circumstance which directed Gall's attention to the possibility of connecting the brain with certain faculties of our mental nature is so well known that I scarcely need allude to it. In his early days, he often found himself surpassed by certain of his fellow students whom he felt were intellectually inferior to himself, but in whom a remarkable memory coincided with a striking prominence of the ocular globes. This external prominence led him to the inference that there was an internal cerebral prominence which produced it, and it was the application of this reasoning to other cranial protuberances that gave rise to his craniological doctrine.

* Those who may desire more detailed information as to the various theories of the seat of speech which were in vogue before the time of Gall, I would refer to an extremely interesting series of papers now being published by Dr. Hunt in the *Anthropological Review*.

According to Gall, the brain is composed of various parts, to each of which a special function belongs, and his system embraces the topographical determination of each of these organs. The organs of the memory of words, of the memory of persons, and of the faculty of language, he located in the convolutions which rest on the floor of the orbit, and which form the inferior surface of the anterior lobe; the organ of the memory of persons he placed immediately above the inner angle of the orbit, that of the memory words in the convolution which rests on the posterior half of the roof of the orbit, whilst the organ of language or speech he placed in the convolution which rests on the anterior half of the orbital roof, in front of the preceding faculty.

The minute anatomy of the convolutions was unknown in the time of Gall, and he based his phrenological theories rather on the external prominences of the skull—on cranioscopy—than upon a careful study of the convolutions to which the prominences corresponded, and although his conclusions must be considered in many instances arbitrary and hypothetical, still I would say “Let not the spark be lost in the flame it has served to kindle,” for in spite of all that has been said against Gall, and all that has been written in depreciation of his labours, beyond all doubt, his researches gave an impulse to the cerebral localisation of our faculties, the effect of which is especially visible in our own days; and I look upon his work as a vast storehouse of knowledge, and as an imperishable monument to the genius and industry of one of the greatest philosophers of the present age.*

* Gall's labours would undoubtedly have met with a more hearty recognition from his contemporaries, had not the Austrian priesthood raised the cry of “materialism” as applied to his doctrines. The great German psychologist had no such heterodox notions as his adversaries maliciously attributed to him, for as Hufeland philosophically observes, “he was employed in analysing the dust of the earth of which man is formed, not the breath of life which was breathed into his nostrils.”

As in Gall's days so in ours, this very indefinite and unmeaning word “materialism” is used as a kind of psychological scare-crow to frighten all those who are endeavouring to trace the connexion between matter and mind. Surely there is nothing contrary to sound theology in assigning certain attributes or functions of an intellectual order to certain parts of our nervous centre; the cerebral localisation of our divers faculties, and the plurality of our cerebral organs, strike no blow at the great principle of the moral unity of man. The same power that caused the earth “like a spark from the incandescent mass of unformed matter, hammered from the anvil of omnipotence, to be smitten off into space” this same power, surely, could just as well ordain that a multiplicity of organs should be necessary to the full development of man's mental faculties, as that the manifestation of them should depend upon the integrity of one single organ.

Gall's conclusions were based purely on the study of anatomy, but subsequent observers—Bouillaud, Schroeder Van Der Kolk, and Broca—have brought the light of pathological observation to shine upon this obscure subject, and, with the view of testing the soundness of the respective theories advanced by these physiologists, I propose briefly to weigh the evidence which has been furnished for or against the four different theories which have, in modern times, been promulgated as to the seat of speech; and here I would observe, that this question will never be settled by mere theoretical speculation, without the aid of that inexorable scrutiniser of facts—necroscopic examination.

I will first discuss the theory which has perhaps found the fewest advocates—that of Schroeder Van Der Kolk—who placed the seat of speech in the corpora olivaria, a theory which has lately found a warm supporter in M. Jaccoud, who thus expresses himself in reference to it:—"The functional centre of the articulation of sounds and of deglutition is situated in the medulla oblongata. It is constituted respectively by the union of the hypoglossal, the facial, the glosso-pharyngeal, the spinal accessory, and the trifacial nerves. For the isolated movements of the tongue, of the lips, of the cheeks, of the velum palati, and of the pharynx, each of these nerves acts independently in its sphere of distribution; but for the complex and simultaneous movements which are necessary for the production of articulate sounds and of deglutition, all the original nuclei of these nerves are connected together, also the one side with the other, by the olivary system, which thus becomes the co-ordinating organ of the final functional act."* A more recent writer, M. Vulpian, criticises most severely Van Der Kolk's conclusions, and quotes a case observed by himself, where, although the olivary bodies were both manifestly diseased, yet speech remained perfectly unimpaired to the last.†

Of the sixty-five cases to which I have called attention in the preceding pages, I find that in five only the olivary bodies were stated as having been found diseased after death. The first three cases are quoted by Van Der Kolk. In one of these, in addition to atrophy of the olivary bodies, there was an extremely imperfect development of the frontal convolu-

* *Gazette Hebdomadaire de Médecine et de Chirurgie*, July 22, 1864.

† *Leçons sur la Physiologie générale et comparée du Système Nerveux*, p. 495.

tions, and also a positively diseased condition of the anterior lobes; in another case, although there was found grey degeneration of the right olivary body, there was also disease of other parts, namely, in the crura cerebri, the corpus callosum, one of the thalami, the fornix, and the corpora pyramidalia; in the third case I have quoted from Van Der Kolk, as well as in one from Abercrombie, in addition to the disease in the corpora olivaria, there was also disease in one of the crura cerebelli and in the tubercula mamillaria; and, lastly, in a case observed by Romberg, the affection of the corpus olivare coincided with disease in the right half of the pons Varolii. It must, therefore, be conceded, that as in all these cases, in addition to a diseased state of the olivary bodies, there was extensive disease in other parts, they cannot be looked upon as substantial evidence in favour of the localisation of speech in the corpora olivaria; in fact, Cruveilhier, who was the author of all the cases which I have quoted from Van Der Kolk's work, was quite innocent himself of drawing from them any inference as to the connexion of the olivary bodies with the articulation of words.*

The next theory for consideration is that of M. Bouillaud, who places the seat of speech in the anterior lobes, and who, twenty years ago, offered a prize of 500 francs for any well authenticated case negating his views. Although this theory has met with less opposition than the others, several cases have been recorded which, to say the least, throw considerable doubt upon its truth. Let us see what evidence the previous pages of this essay furnish for or against the views of M. Bouillaud, who, it must be remembered, admits that speech may exist with one frontal lobe destroyed, but who maintains that when both are destroyed or seriously damaged, articulate language becomes impossible. 102

I have quoted three cases† in which both anterior lobes were destroyed or very extensively injured. What does a

* Since the above was penned, my attention has been called to the latest publication on the anatomy of the medulla oblongata in this country, in which the author, Dr. Loekhart Clarke, mentions two cases of aphasia, in each of which one of the olivary bodies was diseased, being in the one case atrophied, and in the other the seat of a former clot. In both these instances there were numerous and extensive lesions in other parts of the brain, therefore—as Dr. Clarke also admits—they by no means prove that the loss of speech was due to the diseased condition of the olivary bodies.—“Researches on the Intimate Structure of the Brain.” Philosophical Transactions 1868, Pt. I., p. 312.

† *Vide* Journal of Mental Science, Jan., 1868, pp. 528, 530.

conscientious analysis of them teach us? In M. Peter's case we have seen that speech was preserved, although both frontal lobes were reduced to a pulp (*réduits en bouillie*); in one of M. Trousseau's cases, a ball had traversed the two frontal lobes at their centre, entering at one temple and making its exit by the other, articulation remaining unimpaired during the six months the patient survived this fearful injury; in M. Velpeau's celebrated case a scirrhus tumour had replaced the two anterior lobes; but instead of being speechless the man was remarkably loquacious.*

These three cases, to which I could add others, seem to upset M. Bouillaud's doctrine by showing that a profound lesion may exist in both anterior lobes, without impairment of articulate language; but on the other hand, it is only fair to observe that in none of them was there positive evidence of the complete destruction of the anterior lobes, for in M. Peter's case, although the lesion must have been extensive, still as the words "*cornes frontales*" are used to describe the part injured, the posterior part of the same lobes may possibly have remained unaffected; again, in M. Trousseau's case it is possible to conceive that the transit of a ball through both anterior lobes may have left a portion of the cerebral substance uninjured; in reference to M. Velpeau's barber, in reading carefully the details of the autopsy as noted in the *Bulletins de l'Académie de Médecine*, I find it stated that a portion of the right anterior lobe was not involved in the tumour, also that at the posterior, external, and inferior part of the left lobe, there was a certain thickness of cerebral substance unimpaired.

The adversaries of the localisation of speech in the anterior lobes have attached an immense importance to a case mentioned by Cruveilhier of a congenital idiot, who could pronounce words distinctly articulated, although after death it was found that there was congenital absence of the two anterior lobes. This observation has such an important bearing upon

* It is well known that tumours of the brain, by their slow and gradual development, frequently compress, deform, and displace the cerebral tissue, without sensibly altering the function of that organ; and it has been suggested, that in these cases there may be a sort of unfolding of the brain tissue by the pressure of the tumour which has developed itself in its place, but not at the expense of the tissue itself, which, in its new relations, and under the form and volume to which it has been reduced, may still retain the integrity of its structure, and its habitual functional aptitude. I need scarcely add, that this explanation cannot apply to the cases I have quoted, in which integrity of speech coincided with tumours involving nearly the entire anterior lobe.

our present inquiry, that an abridgement of it must find a place here.

Alexandrine Vaillosge, a congenital idiot, came under observation at the age of twelve—the idioey being carried to the highest degree. She could neither dress nor feed herself; although she could move her limbs in all directions she was unable to co-ordinate her movements for the act of walking, and it was necessary to carry her from place to place. The sense of smell seemed not to exist, or rather the young idiot was insensible to bad odours; the other senses presented nothing remarkable. If one threatened to strike her she would make the most frightful noises. The desire for food was readily felt, and when hungry she would express her wants by means of words *very distinctly articulated*. This girl having died at the age of fifteen of chronic diarrhœa, the following post-mortem appearances were observed:—The skull was very well formed exteriorly, but its cavity was not completely filled by the brain. The anterior lobes were entirely absent, and a limpid serum contained in the cavity of the arachnoid occupied the space which separated the anterior extremity of the brain from the frontal portion of the dura mater. Strange to say, the orbital plates, although not in contact with the brain, but with serum, presented the mammillary eminences and digital impressions exactly similar to those of a healthy individual of the same age. With the exception of the absence of the anterior lobe, the left hemisphere completely filled the corresponding part of the skull; the right hemisphere, the size of which was only about half that of the left, was separated from the parietes of the skull by a space filled with serum.*

Cruveilhier himself seems to have considered this case as fatal to the doctrine of the localisation of speech in the anterior lobes; on examining, however, carefully the beautiful plate annexed to the description of this case, it is evident that when the author stated that the two anterior lobes were wanting, he did not limit these lobes in the same way that we do now. For Cruveilhier, the anterior lobes were limited inferiorly to that part of the hemisphere which lies on the root of the orbit,† for a glance at the plate will show that only the anterior half of the left frontal lobe was destroyed, the transverse frontal convolution was preserved, as well as the posterior half of the 1st, 2nd, and 3rd frontal convolu-

* Cruveilhier, Anatomie Pathologique, 8^e Livraison, pl. 6.

† This limitation of the anterior lobe is correct only as far as the orbital convolutions are concerned, for a glance at the plate, at the end of this essay, will show that above the orbital portion the anterior lobe extends very much further backwards.

tions; although the disease in the right hemisphere was more extensive, still the plate shows that a considerable portion of it still remained. According, therefore, to our present mode of dividing the brain, this case cannot be cited as impugning M. Bouillaud's theory.

I now pass to the consideration of the theory of M. Dax. The brain as a whole has hitherto been considered as a symmetrical organ, even by those who regarded it as an assemblage of lesser organs arranged in pairs with corresponding functions; M. Dax, however, assigns a function to the left hemisphere, which, according to him, is not shared by the right, for he places the lesion in aphasia solely in the left hemisphere, without however limiting it to any part of that hemisphere.*

This is a question that can only be settled by a careful statistical research. M. Broca estimates the proportion of aphasics with lesion in the right hemisphere as 1 in 20. In 1864, M. Vulpian tabulated all the cases bearing upon this question which came under his observation at the La Salpêtrière. They were twelve in number, and divided as follows:—Lesions of the left anterior lobe with aphasia, 5; lesions of the left anterior lobe without aphasia, 4; lesions of the right anterior lobe without aphasia, 1; cases of aphasia without lesion of either anterior lobe, 2. Amongst the 63 cases I have recorded in the first three parts of this essay, in 32 only there was hemiplegia, the paralysis occurring 21 times on the right side and 7 times on the left, whilst in 4 instances the side was not stated. It will be remembered that M. Dax's paper contained 140 observations confirmatory of his view. Notwithstanding numerous and well authenticated exceptions, it must be conceded that in a vast majority of instances, loss of speech occurs in conjunction with right hemiplegia, a coincidence which may perhaps be explained on physiological grounds, as we shall see presently.

Dr. Dax's theory receives valuable support from such cases as that I have quoted as occurring in the Middlesex Hospital

* Dr. Dax's conclusions were embodied in a communication to the medical congress held at Montpellier, in the year 1836, the title of his paper being—*Lésions de la moitié gauche de l'encéphale coïncidant avec l'oubli des signes de la pensée.* In 1863 his son, Dr. G. Dax, presented a memoir to the Academy of Medicine of Paris, in which, whilst supporting the views of his father as to the seat of speech in the left hemisphere, he confined it to more narrow limits, namely, the anterior and external part of the middle lobe.

under Dr. Stewart, where the patient retained the power of speech after an attack of left hemiplegia, but became aphasic a few days later, on the occurrence of dextral paralysis. An analogous case has recently been published by M. Auguste Voisin, the leading features of which deserve a passing allusion, not only from its clinical importance, but from the scrupulous care with which the autopsy is described.

A female aged 55, was under the care of M. Voisin, at La Sal-dêtrière, for left hemiplegia of four years' duration; speech, as well as the intellectual powers, being unimpaired. One day she was suddenly seized with giddiness, followed by complete aphasia; at the expiration of four days the report states that there was no recovery of speech, but that the patient made herself understood by gesture. On the fifth day death ensued. Autopsy—The membranes are normal in appearance, and are easily removed without injury to the grey substance beneath. A large number of vessels contain calcareous plates. In the right hemisphere, the 1st, 2nd, and 3rd frontal convolutions are perfectly healthy, as also the island of Reil; on opening the lateral ventricle from above, a pulpy softening is noticed of a pale yellow colour occupying the corpus striatum, without, however, involving its extraventricular nucleus, or extending to the grey and white substance adjoining the insula. In the left hemisphere, the 1st, 2nd, and 3rd frontal convolutions present no alteration, but not so the island of Reil in which there is a very superficial and circumscribed softening (de 8 ou 10 millimètres de diamètre), limited to the grey matter, the subjacent white matter, as well as the extra-ventricular nucleus of the left corpus striatum, being perfectly free from disease of any kind. The neighbouring vessels are more or less infiltrated with calcareous salts, and an artery of medium calibre, destined for the nutrition of the island of Reil, is entirely obstructed by a calcareous deposit. Several portions having been submitted to microscopic examination, the following appearances were observed: 1° A large number of corpuscles of Gluge of a reddish yellow colour; 2° some crystals of hematoidine disseminated here and there, also of a decidedly reddish yellow colour; 3° a considerable number of oil globules; 4° very irregular nerve-tubes; 5° blood vessels completely discoloured, and presenting some isolated colourless corpuscles.*

M. Voisin calls attention to the fact that the interest of the above case consists in the limitation of the lesion to the grey matter of the left island of Reil, also to the complete aphasia occurring in a woman who, for four years, had been hemiplegic on the left side from softening of the right corpus striatum; he also observes that if his attention had not been called to

* Gazette des Hôpitaux, Jan. 25, 1868.

the loss of speech, such a circumscribed lesion might well have escaped his notice, in which case this necropsy would have swelled the number of those where no anatomical lesion could be found to explain the aphasia.

Thus the arguments in favour of M. Dax may be said to be of a positive and of a negative kind, and could we stop here, M. Dax's position might be said to be impregnable; but—*audi alteram partem*—there is another side to the picture, and the partisans of M. Dax must explain away certain exceptional cases, which it seems difficult to reconcile with the truth of his views.

Several cases have been recorded in which serious disorganisation of the left anterior lobe coincided with perfect integrity of speech. I have already quoted such cases, and I can make but a cursory allusion to some others that have been brought under my notice. M. Maximin Legrand has related the history of a man who was shot in the head during the Revolution of 1848, and whose speech was not in the least affected, although after death it was found that the left anterior lobe had been shattered by the discharge from the gun.* M. Béclard has published the case of a syphilitic patient whose speech remained unaffected to the last, although it was found that all the left hemisphere was reduced to a pulp.† One of the most uncompromising opponents of M. Dax's views is M. Lelut, whose report on M. Dax's paper gave rise to the prolonged discussion on this subject at the Academy of Medicine of Paris. After inveighing in general terms against all cerebral localisation, M. Lelut reminds the academy of a case he had published thirty years ago, of an epileptic who retained his speech in its integrity to the last moment, although his entire left hemisphere was completely disorganised.‡

* Dictionnaire Encyclopédique des Sciences Médicales, Article "Aphasic," par Jules Falret, p. 628.

† *Ibid.*, p. 628.

‡ I give the leading features of this case in M. Lelut's own words. It affords another illustration of the manner in which cases are distorted to suit particular theories, for on referring to the original description as it appeared in the *Journal Hebdomadaire de Médecine*, it seems that instead of complete disorganisation of the left hemisphere, the lesion was limited to the posterior and middle lobes, and the report goes on to say that "the anterior lobes were very well developed and their convolutions had the usual proportions." In reference to the question we are now considering this is, doubtless, not the only instance in which a clinical observation has been misinterpreted according to the fancy of individual critics. M. Lelut has chosen to cite it as militating against Dax's theory; surely Bouillaud and Broca have a better right to claim it as pre-eminently tending to support their views.

There is also another class of observations which seem to me to be irreconcilable with the exclusiveness of M. Dax's unilateral theory, for there exists a certain number of carefully recorded cases, in which aphasia was one of the symptoms, although the lesion was limited to the right hemisphere. I have already cited cases of this kind in our first part, and quite recently Dr. Spender, of Bath, has published an interesting case of idiopathic abscess in the *right* hemisphere, in which during life the symptoms were epileptic convulsions in the left arm and leg, and subsequently loss of speech and left hemiplegia.

I could multiply observations of a similar character to those I have mentioned, the study of which would tend to discredit the idea of locating the faculty of speech in one side of the brain to the exclusion of the other, but enough has been said to prove two things:—

1°. That aphasia certainly is not invariably connected with lesion of the left anterior lobe of the brain.

2°. That the converse of this is not true also—namely, that when a positive lesion of the left anterior lobe exists, aphasia is necessarily one of the symptoms.

I now arrive at the consideration of the views of M. Broca, whose researches lead him to confine the seat of speech to a very narrow limit—the posterior part of the third frontal convolution of the left hemisphere! } 40

However startling this assertion may be, a considerable number of observations have been recorded, which, at first sight, would seem to substantiate it, and in the previous pages I have quoted several cases published by such careful observers as Dr. Sanders, Dr. Scoresby Jackson, and Dr. Bastian, which give a general support to this exclusive doctrine.* To my mind, however—and I say it with the greatest possible respect for the distinguished surgeon of La Pitié—of all the different theories that have been advanced, this least of all will stand the test of an impartial scrutiny.

Since the publication of M. Broca's pamphlets, the attention of the profession in all parts of the world has been directed to the question of the cerebral localisation of speech, and evidence is daily accumulating of such a nature as to

* Since the above was written, M. Charcot has informed me that he has met with two cases of aphasia without hemiplegia, in which the only lesion found after death was obstruction from atheromatous degeneration of the branch of the middle cerebral artery which supplies the third left frontal convolution.

undermine M. Broca's position at every point. I have already quoted cases observed by MM. Charcot, Vulpian, and Trouseau, in which aphasia existed with complete integrity of the third left frontal convolution, and it would be tedious to dwell further on this kind of evidence. It has been stated by M. Broca, and repeated by M. Jules Falret and Dr. Wm. Ogle, that there is no example of the opposite condition—namely, positive lesion of the third left frontal convolution without aphasia; it will, however, be remembered that I have quoted such a case in our second part, as reported by Dr. Simpson of the Gloucester Asylum.* Therefore, we can have aphasia without disease of the third left frontal convolution, and *vice versa*. Furthermore, M. Moreau (de Tours) has observed at La Salpêtrière a case of *congenital absence of the third left frontal convolution*, as well as of the inferior parietal and the superior temporo-sphenoidal convolutions on the same side—or, in other words, all that part of the left hemisphere which bounds the fissure of Sylvius, and which is known in M. Foville's nomenclature as *la circonvolution d'enceinte de la fissure de Sylvius*, had never become developed. Now, if the third left frontal convolution, or even its immediate neighbourhood, were the exclusive seat of speech, this patient ought to have been aphasic, which, it is stated, was not the case.†

Let us now weigh in the balance of impartial criticism the case which has served as the foundation stone upon which M. Broca has erected his theory. I allude, of course, to the case of Tan, the details of which I have already given. This observation has been quoted by writers in all parts of the world as a case of aphasia from lesion of the third left frontal convolution; indeed, it was the very case which resulted in the conversion of its author to the unilateral theory. Now, on referring to the description I have given of Tan's autopsy, it will be seen that in addition to the disease in the second and third left frontal convolutions, upon which M. Broca lays such stress, the following morbid conditions were

* Dr. Long Fox, of Bristol, has observed a case of syphilitic disease of the left frontal convolutions involving Broca's region, the power of speech being unimpaired. Lond Hosp. Reports, vol. iv., p. 350.

† M. Broca, in commenting on this case, the importance and significance of which he fully admits, says, that when the third left frontal convolution—the ordinary seat of articulate language—is congenitally deficient, the individual learns to speak with the third right frontal convolution, just in the same way as a child born without the right hand becomes as skilful with the left, as others are with the right hand.

also observed :—Thickening of the cranium and of the dura mater, universal infiltration of the pia mater with yellowish plastic matter of the colour of pus. The greater part of the left frontal lobe was softened, and a cavity of the size of a hen's egg was caused by the destruction of the inferior marginal convolution of the temporo-sphenoidal lobe, the convolutions of the island of Reil, and the subjacent part or extra-ventricular nucleus of the corpus striatum. It will also be observed that the weight of the encephalon was less by 14 ounces than the average weight of the brain in men of fifty years of age. As the softening, instead of being limited to Broca's region, involved the greater part of the left frontal lobe, surely it implies a breach of the laws of probability, to assume that the disease commenced in the third frontal convolution *21 years before his death*, simply because the softening was most apparent at that spot which M. Broca considers was the primary seat of mischief at the period of the clinical history during which the faculty of speech alone was abolished.

I have also formed an opinion of the value of M. Broca's theory from a consideration of cases observed by myself. Of the cases that have fallen under my own observation, a careful autopsy was made in five instances, when the frontal convolutions, being examined with great care, were invariably found healthy. The clinical history of these cases is given in the third part of this essay,* but the post mortem appearances are added in four instances only, as the subject of one of them, William Sainty, was still living at the time I wrote. I will here add that he soon afterwards died from exhaustion after another epileptiform seizure, when the following appearances were noticed after death :—Cranium somewhat thickened; dura mater much more so. Intense congestion of the convex surface of hemispheres, decidedly more marked on the left side; considerable opacity of the arachnoid, also more marked on the left side. A little flattening of convex surface of left anterior lobe. In the middle of the left posterior lobe was a softening of about the size of an apricot; a similar condition existed at the same spot in the right hemisphere, but the softening was not so far advanced. The frontal convolutions were especially examined, but no trace of softening or other disease was discovered; the central gang-

* *Vide* Journal of Mental Science, Oct., 1868, p. 345.

lia, pons, and cerebellum were also healthy. There was a want of firmness in the brain generally, but no appearance of hemispheric disease elsewhere than as above stated, although various portions were submitted to a careful microscopic examination. All the arteries of the base of the brain were atheromatous; the left middle cerebral was completely filled by a fibrinous plug, and the left vertebral contained a small thin red filiform fibrinous cast, occupying only about a quarter of the diameter of the vessel. The heart weighed $11\frac{1}{2}$ ounces; the left ventricle was hypertrophied. Narrowing of mitral orifice with considerable atheroma at the base of the valve, as also at the base of one of the aortic valves. Considerable dilatation of tricuspid orifice with slight thickening of the valve itself. The weight of the encephalon, stripped of dura mater, was 47 ounces.

The advocates of M. Broca's views will charitably say that there may have been some slight disease of the frontal convolutions not patent to my means of investigation. This is an objection that may be raised against all negative cases; but granted that there may have been some slight change in the texture of the third left frontal convolution not appreciable to my senses, the whole history of this case points to the certain conclusion, that the *fons et origo mali* was in the posterior lobes, and here must have been the commencement of disease, when, four years before his death, the first and only morbid symptom showed itself in the total suspension of the faculty of articulate language.

It will be observed that I have hitherto considered this question solely from a pathological stand-point; but it seems to me that the anatomist, the physiologist, the comparative anatomist, and the anthropologist, can do us good service, and that it is to their researches, perhaps even more than to those of the clinical physician, that we are to look for the removal of the cloud which now envelops the obscure subject of the localisation of the faculty of speech.

ANATOMY—Let us first consider whether the study of the minute anatomy of the brain, and especially of the cerebral convolutions, can help the question of localisation. We may fairly assume that difference of structure implies difference in function, it is important, therefore, to ascertain whether the

generally assumed symmetry of the two hemispheres is correct. There cannot be a doubt that in general form the two opposite sides of the brain are alike, or at all events, resemble each other so closely, that no essential difference can be appreciated by the naked eye. Dr. Todd, however, says that although the convolutions of opposite hemispheres in the human subject cannot be said to be absolutely unsymmetrical, yet a careful examination will shew that if the same convolutions exist on each side, they are of apparently different sizes, and not closely corresponding as regards situation; on the other hand, he says, that in the imperfectly developed brains of the idiot or young child, as well as of the inferior animals, the convolutions are quite symmetrical.*† M. Broca, who never takes anything for granted, and whose indefatigable zeal led him to examine forty brains, came to the conclusion that the convolutions are notably more numerous in the left frontal lobe than in the right, and that the converse condition exists in the occipital lobes, where the right is richer in convolutions than the left.

The comparative weight of the two hemispheres is an interesting point to note. The researches of M. Broca, made at Bicêtre and at La Salpêtrière, have shewn that although the difference of weight between the right and left hemispheres is scarcely appreciable,‡ yet the left frontal lobe is perceptibly heavier than the right; there would seem, therefore, to be a sort of compensation between the weights of the two frontal and the two occipital lobes, as we have already seen that the right occipital lobe is richer in convolutions and therefore presumably heavier than the left.

The question of the identity of minute structure in the different cerebral convolutions must now engage our attention. M. Baillarger distinguishes six different layers of nervous substance in the convolutions, and Dr. Lockhart Clarke says that in most of them at least seven distinct and concentric

* *Cyclopedia of Anatomy and Physiology*, vol. iii., p. 696.

† Dr. Moxon considers that education is unilateral, that the brain becomes unsymmetrical in higher and more intelligent animals, and reaches its greatest want of symmetry in man, whose early life is spent in the acquirement of what he affirms to be one-sided educational developments.—*British and Foreign Medico-Chirurgical Review*, vol. 37, p. 489.

‡ According to Dr. Boyd's statistics, which are based on nearly 800 cases observed at the Marylebone Infirmary, the weight of the left hemisphere almost invariably exceeded that of the right by at least the eighth of an ounce.—*Philosophical Transactions*, 1861, vol. 151, p. 241.

layers may be distinguished. Dr. Clarke says that the other convolutions differ from those at the extremities of the posterior lobes, not only by the comparative faintness of their several layers, but also by the appearance of some of their cells; he also adds that at the extremity of these posterior lobes the cells of all the layers are small, but on proceeding forward from this point, the convolutions are found to contain a number of cells of a much larger kind; again, in the insula which overlies the extra-ventricular portion of the corpus striatum, he finds a great number of the cells are somewhat larger, and the general aspect of the tissue is rather different. M. Broca has also studied the minute structure of the cerebral convolutions, and has ascertained that the relative thickness and general disposition of the six layers recognised by M. Baillarger differ notably in the divers regions, and although his researches are not definitely terminated, he ventures to assert that the structure of the convolutions of the insula differs from that of the frontal convolutions and of the hippocampus major. I can nowhere find that any difference has been noticed in the convolutions of the two hemispheres.*

PHYSIOLOGY.—What does physiology say to Dax's theory, which has in its favour the undoubted frequency of aphasia with right hemiplegia, as compared with loss of speech as an accompaniment of sinistral paralysis? This may possibly be explained by the anatomical difference between the origin of the right and left carotids, making the supply of blood to the left side of the brain more direct than that to the opposite hemisphere, and by increasing its functional activity, thus rendering the left hemisphere more adapted for the exercise of speech.

* Since the above was written, Dr. Broadbent has kindly favoured me with a private communication in reference to his recent researches as to the course of the fibres of the brain, so far as his observations bear upon our subject. Dr. Broadbent's dissections shew that the structure of the third frontal convolution is peculiar, inasmuch as it receives fibres from a greater variety of sources than any other convolution; and he adds that although this anatomical fact does not throw any particular light on the function of the third frontal convolution, it seems to indicate that it is an important part of the hemisphere. In comparing the two sides of the brain, Dr. Broadbent has usually found the third frontal convolution larger on the left side than on the right, and in the brain of a deaf and dumb woman, he noted that this gyrus was small on both sides, and especially on the left.

It would be interesting to know what effect would be produced upon speech by cutting off the direct supply of blood from the left hemisphere, Dr. Win. Ogle quotes a case where the left common carotid artery was tied by Mr. Lee; the patient died in two days, and in the interval between the operation and his death he was speechless.* In the *Medico-Chirurgical Transactions* for 1859 and 1865, are recorded four cases in which the left common carotid was tied by Mr. Nunneley of Leeds; speech was unaffected in three instances, but in the fourth, great difficulty in speaking was noticed on the sixth day. Since the publication of these cases Mr. Nunneley has tied the common carotid in two other instances, and he writes to say "in neither of these was there any difficulty in speech, either as regards the idea or the power of utterance."†

An important question for inquiry is, the frequency of the coincidence of left hemiplegia with aphasia in left-handed people. I can only find two instances of this combination; one recorded by Dr. John Ogle,‡ and the other by Dr. Hughlings Jackson.§

As a cognate question, I would ask, why are we right-handed? Is the human race right-handed by mere accident? Although there are a few left-handed people in the world, the immense majority of persons use the right hand for every mechanical act. Is this a question of education or of mere imitation? If we concede this, we must admit that our ancestors in remote ages must have been influenced by some cause connected with the organization itself; if it were a mere chance that had determined the choice of the right hand, we should find some left-handed races in certain parts of the world, which, I believe I am right in stating, is not the case. Besides, this question may be set at rest, says M. Broca, by the consideration "that notwithstanding all their efforts to counteract it, there are left-handed people, who remain left-handed, and one must, in their case, admit the existence of an inverse

* St. George's Hospital Reports, 1867, p. 111.

† On looking over the published cases of ligature of the common carotid artery, I find that one of the earliest instances is one where the left common carotid was tied in 1815, by Mr. Dalrymple, the well known Surgeon of the Norfolk and Norwich Hospital, for aneurism by anastomosis of the left orbit. In this case speech seems not have been affected, for it is stated that "a few minutes after the patient was placed in bed, she declared that her head no longer felt like her old head, as the noise by which she had been so long tormented had now ceased."—*Medico-Chirurgical Transactions*, 1815, v. 6.

‡ *Lancet*, March 21, 1868.

§ *Medical Times*, Jan. 27, 1866.

organic predisposition, against which imitation, and even education, cannot prevail.”*

The study of Embryology may assist us here. An eminent foreign physiologist, Gratiolet, says that in the development of the brain, the frontal convolutions of the left hemisphere are in advance of those of the right, and that the left are already properly figured, whilst the right are not yet even visible. Thus according to Gratiolet the left hemisphere, which holds in its dependence the movements of the right limbs, is more precocious in its development than the opposite hemisphere, and thus the young child uses by preference the limbs of which the innervation is the most complete, or in other words he becomes right-handed. From the cause which thus makes us use the left hemisphere for mechanical acts, may arise the circumstance of our using it in preference for speech, and we thus become left-brained—*gauchers du cerveau*—to use M. Broca’s expression. But is this theory of the early development of the left frontal convolutions true? Gratiolet says it is; Carl Vogt, an equal authority, denies it. This is an extremely interesting and important question about which very few are in a position to give a valid opinion, and I regret I can quote no British authority in reference to it.

COMPARATIVE ANATOMY.—Does the study of Comparative Anatomy throw any light upon our subject? Here we must inquire whether language be the exclusive prerogative of man? Some would answer this question in the negative, and M. Lemoine, in the work to which I have already alluded, devotes a chapter to *Le Langage des Bêtes*.† Max Müller, speaking of this subject, says, “Speech is a specific faculty of man. It distinguishes him from all other creatures; and if we wish to acquire more definite ideas as to the real nature of human speech, all we can do is to compare man with those animals that seem to come nearest to him, and thus try to

* At the discussion on aphasia which took place at the Norwich meeting of the British Association, Professor Broca alluded to the circumstance that all birds perched on the right leg: Dr. Crisp, on the other hand, said that this peculiarity was confined to Grallæ, and he believed it was a question of equilibrium, and that the bird was compelled to take this position from the greater weight of the liver.

† A distinguished French anthropologist, M. Coudereau, says that articulate language in man is neither an innate nor an exclusive faculty; that man acquires the faculty of speech by his memory, labour, and imitation—the parrot does no more; that from a linguistic stand-point, this faculty is in its nature identical in man and animal.

discover what he shares in common with these animals, and what is peculiar to him, and to him alone." Further on he says, "Language is something more palpable than a fold of the brain or an angle of the skull; it is the one great barrier between the brute and man; it admits of no cavilling, and no process of natural selection will ever distil significant words out of the notes of birds or the cries of beasts. Language is our Rubicon and no brute will dare to pass it." Without entering into the question of whether the means of communicating with each other undoubtedly possessed by brutes be entitled to the appellation of a language or not, it cannot be denied that one of the great distinctions between man and animals is the possession of articulate language. One of the differences between man and the more intelligent animals is in the degree of development of the cerebral convolutions, which, moreover, exist only in the class Mammalia; and according to Flourens, the Rodentia, the least intelligent of the Mammalia, have no convolutions; the Ruminantia, more intelligent than the Rodentia, have convolutions; the Pachydermata, who are still more intelligent than the Ruminantia, possess still more convolutions, and so on the number continues to increase as we ascend to the Carnivora, then to the Apes, the Orangs, and lastly to Man, who is the richest of all animals in cerebral convolutions. If this gradation in the number of the convolutions has a relation to the intelligence of the animals, it would seem to give an *a priori* reason for concluding that the highest product of intelligence—speech—may well have some connection with the development of the convolutional grey matter.

Let us consider for one moment the comparison which Carl Vogt makes between our quadrumanous cousins and ourselves. According to this distinguished naturalist, the Apes have an extremely imperfect development of the third frontal convolution, and the same condition exists in the Microcephali; therefore, he says, as neither Apes nor Microcephali can speak, Comparative Anatomy gives a subsidiary support to the theory which places speech in this convolution. Professor Vogt's views seem to me of such great importance, and so extremely pertinent to our subject, that I shall give them in his own words.

The brain of Man and that of Apes, especially of the anthropoid apes (Orang, Chimpanzee, Gorilla), are constructed absolutely upon the same type—a type by itself—and which is characterised, amongst

other things, by the fissure of Sylvius and by the manner in which the island of Reil is formed and covered; but there are secondary differences in the arrangement of the folds, in the comparative development of the lobes and of the convolutions. One of the principal characters is, that in the brain of all the human races, without exception, the frontal lobe, by its posterior and inferior part (that is in Broca's region) touches the temporo-sphenoidal lobe, so as to give the fissure of Sylvius with its two branches, the appearance of a double-pronged fork; whilst in the Apes, Broca's convolution is separated from the temporo-sphenoidal lobe by the lower end of the transverse frontal and transverse parietal convolutions; in other words, in Man, the third frontal convolution is extraordinarily developed and covers partly the insula, whilst the transverse central convolutions are of much less importance; in the Ape, on the other hand, the third frontal convolution is but slightly developed, whilst the central transverse convolutions are very large, descending quite to the edge of the hemisphere, and giving to the fissure of Sylvius the form of a V. The cause of this difference dates from the period of embryonic development:—the brain of the fœtus of any of the Mammalia at a certain age (two months in Man), has the form of a bean with a large infero-lateral sinus corresponding to the insula and the surrounding parts. From the third to the fifth month, this large space becomes covered in Man by the *very rapid* growth of the third frontal convolution, and by the *slow* growth of the transverse central convolutions; whilst in the Ape, it is just the reverse, the space is filled by the *rapid* growth of the transverse central convolutions, and by the *slow* growth of the third frontal convolution. To shew the bearing all this has upon the seat of speech, I would refer to the Microcephali who do not speak—they learn to repeat certain words like parrots, but they have no articulate language. Now, the Microcephali have the same conformation of the third frontal convolution and of the central folds as Apes—they are Apes as far as the anterior portion of their brain is concerned, and especially as far as regards the environs of the fissure of Sylvius. Thus, Man speaks; Apes and Microcephali do not speak; certain observations have been recorded which seem to place language in the part which is developed in man and contracted in the Microcephali and the Ape; comparative anatomy, therefore, comes in aid of M. Broca's doctrine.*

I have reason to believe that these views of Professor Vogt are not very generally known in this country, and I

* The above is an extract from an autograph letter with which Professor Vogt has favoured me. In this communication he expresses a doubt whether we shall ever be able satisfactorily to assign "the divers functions" which compose language, to special parts of the brain, until we have a physiological analysis of articulate language, similar to that which Helmholtz has given of sight and hearing.

need hardly allude to the extremely important bearing they have upon the question at issue. With the view of obtaining some confirmation of the statement of the arrest of development in the third frontal convolution of the microcephali, I have consulted Mr. Marshall's extremely interesting paper in the Philosophical Transactions for the year 1864, in which he gives a detailed description of the frontal convolutions of a microcephalic woman and boy, neither of whom possessed the power of articulation. In both these brains the frontal convolutions are described as being singularly short and defective as compared with their wonderfully tortuous and complex character in the perfect brain; in fact, Mr. Marshall adds that they were far more simple than in the orang's or the chimpanzee's brain. In only one of these microcephalic brains, however, was the want of development most apparent in the third frontal convolution. Further investigations would, therefore, seem necessary before admitting with Carl Vogt that the conformation of the microcephalic brain gives a direct support to the localisation of speech in the third left frontal convolution.

As far back as 1827, M. Bouillaud instituted a series of experiments upon animals, with the view of determining the functions of the brain, and on several occasions he removed different portions of the cerebral lobes, without impairing sight or hearing; he also removed the entire hemispheres from a chicken, in whom the power of expressing pain by its peculiar cry was retained.* On one occasion he pierced with a gimlet the anterior part of the brain of a dog, from side to side, at a spot corresponding to the union of the anterior with the middle lobes—that is in the immediate neighbourhood of Broca's region. The dog survived the mutilation, but was much less intelligent than before the operation, and although he could utter cries of pain, he had entirely lost the power of barking.† As far as the present inquiry is concerned, I am aware that but little importance can be attached to these experiments, for there is little or no analogy between the cry of a chicken or the bark of a dog, and the articulate speech of man; still, experiments of this kind may have an indirect bearing upon our subject, and it would be extremely

* Recherches expérimentales sur les fonctions du cerveau. Journal de Physiologie, tom. x., p. 49.

† *Ibid*, p. 85.

interesting to know what would be the effect of traumatic injury to certain regions of the anterior lobes upon the quasi-articulatory powers of the parrot.

I think that much valuable information in reference to the seat of speech may be elicited from a more careful study of the affinities and differences between the brain of man and that of animals; but this study, surely, should not be confined to the convex surface, or even to the anterior half of the hemisphere. Professor Rolleston, in a most interesting paper, has called attention to other points of difference between the brain of man and that of apes, and he attaches a great physiological value to the presence or absence of the "*bridging convolutions*," which more or less fill up the space known as the external perpendicular fissure, which separates the occipital from the parietal lobe.*

Professor Owen mentions the superior development of the hippocampus minor, as a point of distinction between man and the lower animals. According to him, in the inferior mammalia the posterior cornu of the lateral ventricle is capacious and simple, whereas in the chimpanzee and gorilla the growing walls begin to be reduced by the encroachment of a protuberance, which in the archencephala is developed into the hippocampus minor.† It will be remembered that it was in this lesser hippocampus that Dr. Barlow formerly located the faculty of speech.

ANTHROPOLOGY. The comparative facility of speech in different races of mankind is an interesting point to notice, and it is much to be regretted that we possess so little authentic information upon the subject.

Gratiolet has established three principal divisions of our species under the names of Frontal or Caucasian, Parietal, and Occipital or Ethiopic. He has shown that in the Caucasian the anterior fontanelle is the last to ossify, in order to permit of the greatest possible development to the frontal lobes; and that in the Ethiopic race the converse condition exists, the posterior fontanelle being the last to ossify. According to this arrangement, in the superior races the frontal lobes of the hemispheres continue to develop them-

* *Medical Times*, Feb. 22nd and March 15th, 1862. There are many other points in Dr. Rolleston's paper which, although having no direct bearing upon speech, afford a collateral aid to that subject, and it is impossible to overrate the value of the talented Oxford Professor's researches in this direction.

† *Comparative Anatomy and Physiology of the Vertebrates*, vol. iii., p. 138.

selves for a long time after the occlusion of the posterior sutures has put an end to the growth of the rest of the brain; in the inferior races, on the contrary, the ossification of the sutures proceeds from before backwards, and thus the anterior parts of the brain are first arrested in their growth.

Of course, the above arrangement only tends to prove that the development of the higher faculties of the intellect is in relation with the development of the anterior region of the skull; * it has, however, an indirect connection with the power of speech—the greatest of all man's mental attributes.

Having now considered the subject of speech, its loss, and its localisation, in all its various phases and aspects, I would observe that I am aware that my remarks may be said to be of an iconoclastic character. I may be told that I have set up the authors of the four popular theories for the mere pleasure of knocking them down again, without substituting any theory of my own in their place.

In reference to these doctrines, the truth and value of which I have called in question, it is no fault of mine if the pedestals upon which they stand are rotten. In lieu of offering any hypothesis myself as to where the cerebral centre for speech may be, I would ask, is it certain that there is a cerebral centre for speech at all? When we talk of the "*faculty of speech*," have we any very clear and definite notions as to what we mean? † May not speech be one of those attributes, the comprehension of which is beyond the limits of our finite minds? Does the loss of it necessarily imply organic lesion of structure? If it were so, how can we account for the instances I have quoted, in which the restoration of the power of speech was due to the effect of a severe mental shock? ‡ The brilliant experiments of Dr. Richardson, of freezing the cerebrum of animals—which it has been my privilege to witness—conclusively show that various cerebral functions may be temporarily but completely suspended, without leaving

* With the view of verifying the accuracy of this statement, M. Broca examined the heads of thirty-two house-surgeons who had successively resided at Bicêtre during the years 1861—1862, and compared their dimensions with those of the heads of twenty-four porters attached to the various wards of the same hospital. This comparison resulted in the confirmation of the generally received opinion, that the anterior lobes are the seat of the highest order of intellectual faculties.

† Dr. Maudsley denies the existence of a speech faculty, and says, "There is no more a special faculty of speech in the mind than there is a special faculty of dancing, or of writing, or of gesticulating."

‡ *Vide* Journal of Mental Science, for April, 1869, p. 117.

any trace of organic mischief; and I confidently predict that the question of the localisation of our different faculties is destined to receive considerable elucidation from Dr. Richardson's valuable researches.

It has occurred to me to inquire whether during the anæsthesia produced by the inhalation of chloroform, there is any altered structural state of the cerebral tissue, which would be patent to our senses, supposing we were in a condition to make the necessary examination. From experiments lately made in Paris by Dr. Ferraud, it would seem that the action of chloroform on the cerebral nerve tissue is direct by means of the olfactory nerves, and that the production of the anæsthetic condition does not necessitate the passage of the drug into the arterial system by means of the pulmonary mucous membrane.*

May not loss or lesion of speech depend on some altered state of the cerebral tissue not appreciable to the sense of vision—to the eye—for microscopic examination is only the aided eye? Without doubt, there may be changes going on in nerve tissue which escape our means of investigation, and I am supported in this view by one of the greatest continental histologists, who, in conversing with me about softening of the brain, said that he believed there were changes of structure not revealed by the microscope, but which were patent to the sense of touch. I find that Dr. Sankey is of the same opinion, for he thinks the altered specific gravity of the brain in old people indicates that the nerve tissue has undergone some change of structure which the microscope has not yet made palpable to our vision.†

The fact of the occasional benefit obtained from the use of electricity in impaired speech, as observed by Dr. Marcet and others, would lead to the inference that the defect may depend in some instances upon an altered electrical condition.

* I am aware that the above conclusions are disputed by other physiologists (MM. Dieulafoy and Krishaber). M. Ferraud's experiments, however, seem to me to be conclusive; having opened the trachea in rabbits, he introduced a tube, and then divided the trachea above; a small cupping glass, containing a sponge imbibed with chloroform, was then placed over the nose of the rabbit; in three minutes the anæsthetic condition was produced, and maintained as long as the olfactory apparatus was submitted to the action of chloroform. When the same animal was chloroformed by means of the tracheal tube and the respiratory apparatus, anæsthesia was produced a little sooner (*i.e.*, by 15 seconds) than when the anæsthetic was administered by the olfactory apparatus. *Gazette des Hôpitaux*, May 29, 1869.

† On the state of the Small Arteries and Capillaries in Mental Disease. *Journ. Ment. Science*, Jan., 1869.

“It may be,” says Dr. Beale, “that each little brain cell, with its connected fibres, in some way resembles a minute voltaic battery with its wires; the matter of which the cell is composed undergoing chemical change, in the course of which slight electrical currents are developed; these being transmitted by the fibres ramifying to different parts, exert an influence upon tissues and organs amongst which they ramify.”*

May not some thermal change, the result of chemical action, interfere with the exercise of speech? Here I would observe that although we are living in an age when organic chemistry is vastly increasing our knowledge of the essential nature of disease, writers on disorders of the nervous system have paid but little attention to the chemical pathology of the brain, although Dr. Adam Addison has paved the way for more extensive researches on this subject by his extremely interesting and highly original paper in the *Journal of Mental Science* for July, 1866, in which he very justly says he is treading on a field which is a *terra incognita* of unknown extent. The result of Dr. Addison’s observations—which are all the more valuable because they are controlled by comparison with those of Bibra, L’Héritier, Schlossberger and others—are as follows:—

1°. That the different anatomical parts of one and the same brain present great differences in their quantities of water and fat.

2°. That the grey substance is far poorer in fat than the white.

3°. That the quantity of matters soluble in ether, stands in an inverse relation to the quantity of water.

4°. That the quantities of phosphorus do not have a parallel connexion with the degree of intelligence.

5°. That in three cases of hemiplegia the average quantity of fat in the corpus striatum, optic thalamus, and grey substance of the hemisphere opposite the paralysis, was less than the average quantity in the same parts of the other side.

I trust that Dr. Addison may be induced to supplement his most useful essay by a special chemical analysis of those particular portions of the brain in which the seat of speech has been severally placed by the various authors who have written upon the subject.

* Lectures on the Germinal or Living Matter of Living Beings. *Medical Times*, July 10, 1869.

Practitioners of the healing art are no longer divided, as in the good old days of yore, into solidists and humorists, and I am inclined to think that in our over anxiety to connect every disorder, in some way or other, with structural lesion, we are apt to overlook the condition of the fluids of the body, and in corroboration of this view I would refer to the recorded cases of loss of speech from the effect of certain drugs such as Stramonium, Belladonna, also from the introduction into the lymphatic system of a poison from the bite of a snake. Possibly the discovery of the perivascular canals of His, and of the existence of miliary aneurisms in the minute arteries of the brain, may serve as an element for a better understanding of certain functional disturbances of that organ.*

In bringing this long dissertation to a close, I wish to add that I am painfully sensible of the great disproportion which exists between the demands of this important subject, and the capacity of the person who has undertaken to deal with it, and my own sense of inadequacy is enhanced by the consideration, that although one of the most learned scientific bodies in the world devoted the long period of two months to its elucidation, the discussion in the Academy of Medicine of Paris terminated without a solution of the difficulties which its members had attempted to grapple with.

No subject of late years has so occupied the attention of physiologists in all parts of the world, as the attempt to localise the grand attribute of humanity, the faculty of speech; but, I am bound to say that in spite of all that has been written in reference to it, the question must still be considered as *sub judice*, and an impartial sifting of the mass of evidence I have accumulated has led me to the following conclusions:—

1°—That although something may be said in favour of each of the popular theories of the localisation of speech; still, so many exceptions to each of them have been recorded, that they will none of them bear the test of a disinterested and impartial scrutiny.

* In the elaborate paper by Dr. Sankey, to which I have already referred, is the following passage corroborative of these views:—"Each act of cerebration (which results from an action of the blood and the cerebral tissue) requires that the blood be unimpaired in quality, and of a just quantity; blood impaired as to quality produces imperfect cerebration as proved by the injection of poisons into the blood, by the action of certain drugs which are known to enter the circulation."

2°—That I by no means consider it proved that there is a cerebral centre for speech at all, and I would venture to suggest that speech, like the soul, may be something, the comprehension of which is beyond the limits of our finite minds.

I have heard it said in reference to this inquiry, *cui bono?* What good purpose is served by the numerous and extensive researches which have been, and are still being, made to decide whether we have, or have not, a portion of our cerebral substance, to which belongs the exclusive prerogative of presiding over articulate language? Now to this objection I would apply the trite remark that all knowledge is power; besides, surely no subject is more worthy of the careful investigation of all labourers in the field of science than the origin of speech; it is one of the questions in which the physiologist and the student of language meet, and now that the sluice-gates of public opinion are opened upon it, error will be swept away, and a fresh impulse be given to the study of the mind. Moreover, the scientific result of the recent researches about the seat of speech, need not necessarily be limited to the acquisition of a better knowledge of the conditions under which that faculty is developed or lost, for since the attention of the profession has been directed to the investigation of the causes which interfere with the exercise of speech, a new flood of light has been thrown upon the minute anatomy and physiology of the nervous centres, which may eventually lead to the localisation of our other faculties.

The definite solution of the question I have been discussing has been retarded by the fact that authors, in many instances, have written with pre-conceived notions, and their works bear the impress of a desire to prove one theory as against another, rather than to place on record facts which may, as it were, speak for themselves. Some not wishing to leave the scientific rut in which they have so long moved, content themselves with boldly asserting that this or that theory cannot be—that it is contrary to common sense, and is the annihilation of all traditional scientific data. Others decline to discuss the unilateral theory, on the ground that it is impossible that a perfectly symmetrical organ like the brain should possess a property in one hemisphere not appertaining to the other. Now the question is not so much how it is, but if it is. In an inquiry of this kind we must dismiss all pre-conceived opinions and notions, and if physiological experiments

well made, if rigorous pathological observations confirmed by necroscopic verification, should happen to furnish a number of facts sufficiently significant to establish an evident relation between certain functional alterations of speech, and the lesion of certain definite parts of the encephalon; in that case, all conjectural propositions, and all bold assertions, must vanish before the light of scientific truth.

It is in the spirit of the above remarks that I have endeavoured to approach this inquiry, and if in my attempt to unravel the difficulties with which this subject is surrounded, I have only succeeded in making "confusion worse confounded," I would say with Heberden—"Fateor equidem ea esse rudia, inchoata, et manca; cujus rei culpa, ut maximam partem in me recidat, partim tamen in ipsius artis conditionem erit rejicienda."

ENGRAVING OF THE CONVEX SURFACE OF THE LEFT HEMISPHERE,
 SHEWING THE DISPOSITION AND ARRANGEMENT OF THE CEREBRAL
 CONVOLUTIONS,

From a cast kindly sent to the author by Prof. Broca, of Paris.



RR, Fissure of Rolando.

SS, Fissure of Sylvius.

1, 2, 3, First, second, and third frontal convolutions.

FF, Transverse frontal convolution.

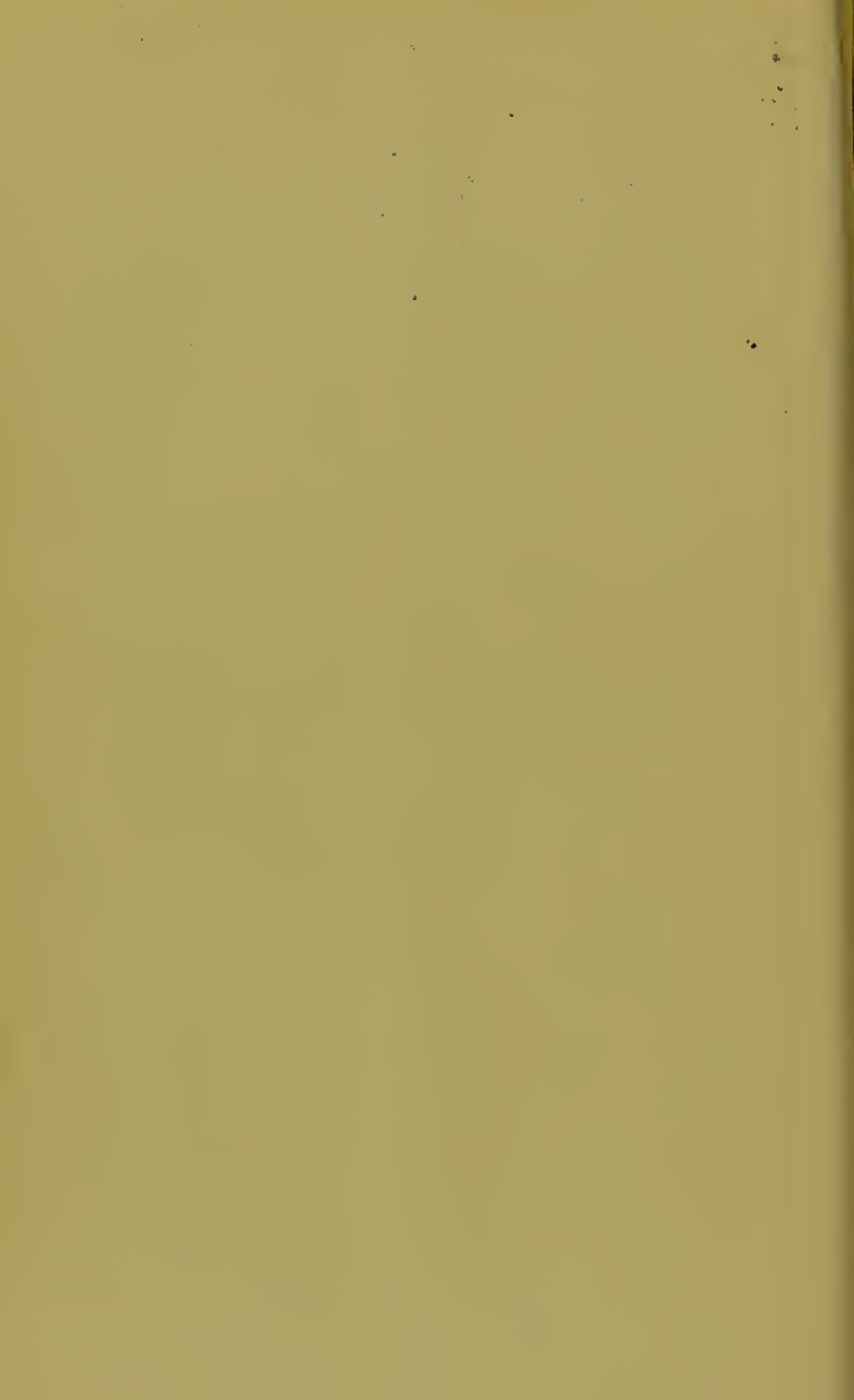
PP, Transverse parietal convolution.

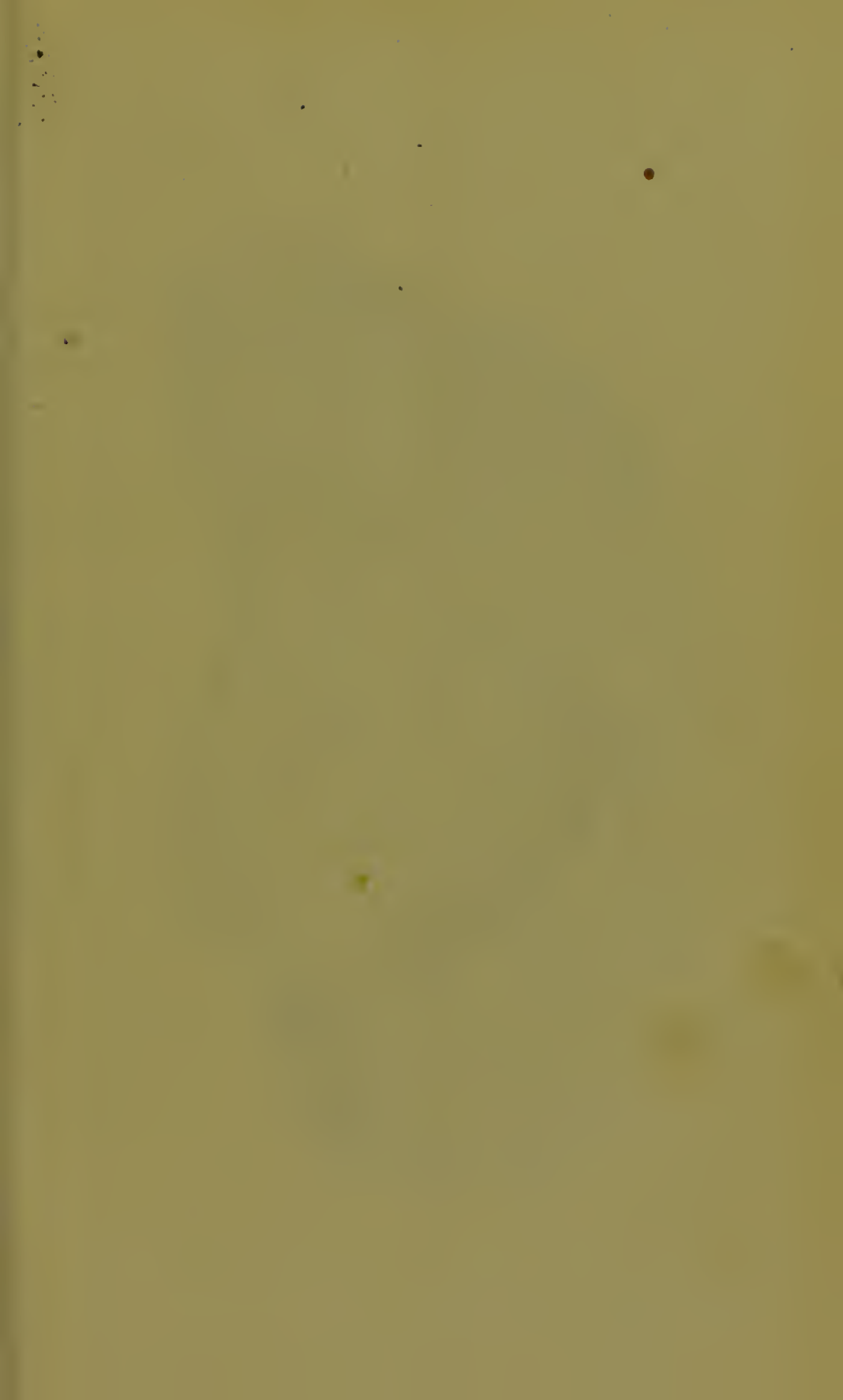
OO, Orbital convolutions.

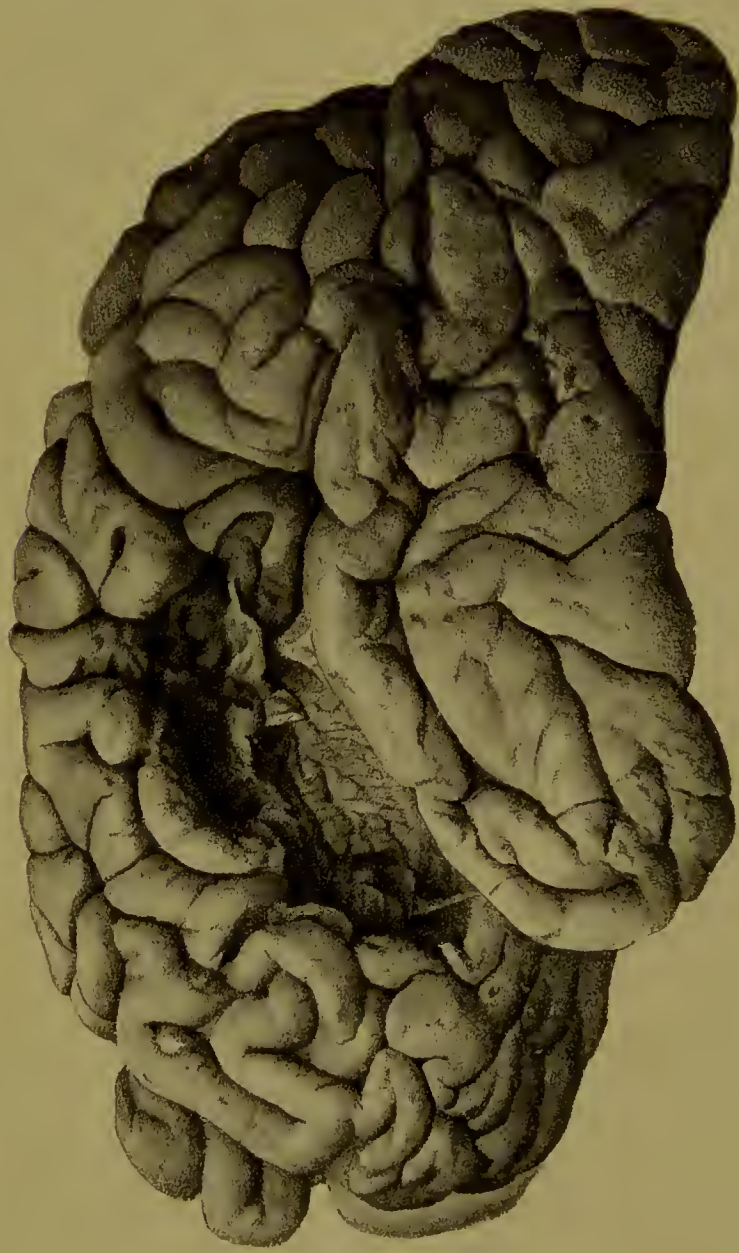
T1, T2, First and second temporo-sphenoidal convolutions.

I, Island of Reil (the superior and inferior marginal convolutions are represented as being drawn asunder so as to expose it).

For further description, see Part I. of this series of papers, page 4.







From Photo by F. W. Dallas, Edin^g

McCarrison & Erskine Lith^{rs} Edin^g

Brain Lesion involving Broca's Convolution.

No Aphasia.

Reported by Dr. J. BATTY TUBE, & J. FRAZER.

