Observations on the structure of the brain, comprising an estimate of the claims of Drs. Gall and Spurzheim to discovery in the anatomy of that organ / By John Gordon.

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Gordon, John, 1786-1818.
Gall, F. J. 1758-1828.
Spurzheim, J. G. 1776-1832.

Publication/Creation

Edinburgh : Printed for William Blackwood ... : And T. & G. Underwood ... London, 1817.

Persistent URL

https://wellcomecollection.org/works/rw56t2bm

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OBSERVATIONS

ON THE

STRUCTURE OF THE BRAIN,

COMPRISING AN ESTIMATE OF THE CLAIMS

OF

DRS. GALL AND SPURZHEIM

TO DISCOVERY IN THE ANATOMY OF THAT ORGAN.

BY

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EDINBURGH:

PRINTED FOR WILLIAM BLACKWOOD, 17, PRINCE'S STREET:
AND T. & G. UNDERWOOD, 32, FLEET-STREET,
LONDON.

1817.

Printed by James Clarke,
Edinburgh.

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OBSERVATIONS

ON THE

STRUCTURE OF THE BRAIN.

THE interest I necessarily feel in the advancement of anatomical science, made it impossible for me to hear with indifference, that certain discoveries had been made, some years ago, in the anatomy of the brain, by two German Physicians, DRS. GALL and SPURZHEIM. But though the matter did not escape my notice, I had no opportunity of considering it with the attention its importance required, till I was occupied in preparing a description of the nervous system, for the first volume of my *System of Anatomy*. It then became necessary for me to examine, with all care, the writings of these gentlemen on the same sub-

ject, to repeat their dissections frequently, and to compare their descriptions and engravings strictly with nature. I will not pretend that this inquiry left me very doubtful concerning the accuracy of their observations. To a certain degree, however, I did suspend my judgment; as it was just possible that the appearances and structure which they claim the merit of having first displayed, had been invisible to me in consequence of some mistake in the method of dissection, or a want of expertness in the manipulations peculiar to these anatomists. It was with considerable satisfaction, therefore, that I learned Dr. Spurzheim's intention, after his arrival in this place, to give a demonstration of the brain. I have twice seen his dissections of this organ; but I am sorry to say, that, by these opportunities, the unfavourable estimate I had formed of his, and Dr. Gall's labours, has been not removed, but confirmed. I cannot but believe that their pretensions, while they carry with them a charge of neglect and ignorance against every preceding inquirer, in contempt of much well-earned reputation, are yet as unfounded as they have been confidently advanced; and are, both in their re-

sults and in their principles, calculated to retard the progress of real knowledge.

This opinion has been adopted after long and painful research; and I own it neither surprises me, nor (if I may be pardoned for so speaking) diminishes my confidence, that others, whose names are not unknown to the medical world, have expressed different sentiments. An intimate acquaintance with the structure of the brain is exceedingly difficult of acquisition; the organ is peculiarly delicate, and its parts are intricate and numerous. Fully proportioned, however, as the importance of this knowledge may be to the obstacles in the way of attaining it, in a physiological point of view, it is fortunately not of essential consequence in the practice of medicine. Diseases may be distinguished from each other, and the proper remedies applied to them, without it; and hence it happens, that a study at once arduous, and in a great measure unnecessary, is easily relinquished; and that skilful and eminent practitioners are satisfied, and justly so, with a general view of the structure of this organ. The information, too, demanded by the profession, cannot fail to influence the learning and the lessons

of its instructors; who have little inducement to possess, as they have none to impart, more knowledge than they are required or expected to convey. It is neither unaccountable nor unreasonable, therefore, that the anatomy of the brain should be imperfectly known to many, who are distinguished in teaching and practising the various branches of the medical art.

These circumstances are undoubtedly favourable to the progress of any hypothesis respecting the structure of this part of the human frame. Provided its author have the prudence to found it on some established truths, and the dexterity to represent it as the means of explaining certain phenomena hitherto inexplicable, he may often venture, with great prospect of success, to bring to its support facts not observable in nature, and not the parents, but the offspring of his theory. The persons he addresses, whose early studies (never, perhaps, in this department complete) have much faded from their recollection, and whom the duties of an active and toilsome profession prevent from yielding the attention requisite for mature judgment on such a subject, are apt to acquiesce in any statements having an air

of plausibility, and asserted with confidence. Without time or opportunity for experiment or observation, they are willing to compromise; and to receive that as correct, which looks as if it might be so.

In some such way as this alone, can I account for the support, with which the alleged discoveries of Drs. Gall and Spurzheim are said, in several places, to have been honoured. For I am quite persuaded that no one can consult the history of the science, and afterwards appeal to nature, without being convinced, that such of their statements as are peculiar to them, owe all their plausibility to inaccuracy, to the neglect of some appearances, and to the imagining of others; and that the descriptions which they have derived from the writings of other anatomists, and which they have sometimes modified but never improved in the transference, make up the whole portion of truth which this new system comprehends.

Entertaining this opinion,—satisfied that it must be sanctioned by all attentive inquirers,—and anxious to check, as far as I may, errors of such magnitude in anatomy, I have been encouraged to lay the following pages before the profession and the public. Little, perhaps, can be

said that would not readily occur to those, who attempt to verify, by dissection, the descriptions of Drs. Gall and Spurzheim. But as this test is not always convenient, and as the works of other anatomists, whose labours must not be forgotten in estimating the merits of their successors of this day, are not always accessible or easy of reference, it was represented to me, that the result of my inquiries would not be unacceptable to those who, with smaller opportunity or occasion of study, wished to have some materials for forming their opinion on a scientific question of such interest.

On a subject of this kind it is not easy, without demonstration, to be always quite intelligible. The force of mere authorities is likely to be sometimes overlooked by the reader; and it is natural to expect, that in the end a good deal may still appear as disputed assertion. But notwithstanding these difficulties, the late claims to discovery will still, I trust, be sufficiently refuted. They will always be found more groundless the more narrowly they are inspected; and my pains cannot be altogether without reward, if they prove effectual in promoting investigation. I have only

to add, that nothing could have engaged me to publish the present remarks, but a strong anxiety for the progress of medical knowledge, and a deep concern for the reputation of a Medical School which was indebted to anatomy for its first celebrity throughout Europe.

THE most complete summary of the doctrines which it is my object to examine, is to be found in the article *Cerveau*, in the 4th volume of the *Dictionaire des Sciences Medicales*, published at Paris in the year 1813. It is written by DRS. GALL and SPURZHEIM themselves, and bears their signature; and as it is the latest dissertation which they have composed on the subject, it may be presumed to contain the expression of their most matured opinions. This essay I have inserted *verbatim* in the APPENDIX; and it is my intention to refer to it constantly, in the following pages. Two advantages will result from this. In the first place, it will enable my readers to perceive whether or not I have, on all occasions, correctly interpreted the meaning of the descriptions which are the object of my criticism; and secondly, it will afford those who have no other means of knowledge, an opportunity of acquiring

a perfect idea of the claims which Drs. Gall and Spurzheim have brought forward. In this last respect I cannot refrain from remarking that I believe the Appendix to be particularly necessary; for I am firmly persuaded, that the number of persons is exceedingly small, in this country at least, who have any conception either of the nature or the extent of the discoveries alleged to have been made by the authors of this new system. Their work in quarto*, of which the first volume was published at Paris in 1810, is too expensive for extensive circulation, and much too tedious for general perusal, even were it more accessible; while the abstract of their anatomy of the brain prefixed by Dr. Spurzheim to his English book on Physiognomy†, is in several essential points imperfect.

In the year 1808, the Institute of France appointed a Committee of its members‡, to examine and report on a Memoir which had been pre-

* Anatomie et Physiologie du Systeme Nerveux en General, et du Cerveau en particulier, &c. Prem. Vol. 4to. Paris; avec 17 planches folio.

† The Physiognomical System of Drs. Gall and Spurzheim, &c. by J. G. Spurzheim, M. D. 8vo. 2d edit. Lond. 1815.

‡ The Committee consisted of Tenon, Portal, Sabatier, Pinel, and Cuvier.

sented to it by Drs. Gall and Spurzheim, containing an account of their anatomical researches and alleged discoveries. So little satisfied, however, were these anatomists with the Report * which was returned, and with the small measure of praise granted to them by the Commissioners, that in the following year they published a quarto volume consisting of 274 pages †, wholly occupied with a criticism on the decision of the Committee; and in which, with the exception of a single article, the sentiments of the Commissioners implying partial approbation, as well as those expressing direct dissent, are alike impugned and protested against. To this work, also, I shall sometimes have occasion to refer, in the course of the following pages ‡.

In the three first paragraphs of the Appendix, it will be seen, that Drs. Gall and Spurzheim,

* There is a translation of this Report in Edin. Med. and Surg. Journ. for January, 1809.

† This volume is entitled "Recherches sur le Systeme Nerveux en General et sur celui du Cerveau en particulier." Paris, 1809.

‡ It is amusing, notwithstanding the existence of this work, to hear the Committee of the French Institute occasionally named as supporters of the whole anatomical doctrines of Drs. Gall and Spurzheim.

after stating various objections to the methods of investigating and describing the brain which have hitherto prevailed, claim to themselves the merit of having discovered a new mode of dissecting this organ, viz. of commencing the examination of each part from its first origin, and of following the course and direction of its fibres *by scraping* (en raclant). I propose, however, to reserve the particular examination of these criticisms, and of the claim which follows them, till the conclusion of the present pamphlet.

I have, therefore, in the first place, to direct the attention of my reader to the opinions of Drs. Gall and Spurzheim, respecting the structure of the *White* and *Grey Substance* of the brain in general. I shall then consider the two *Systems of Fibres* which they profess to have discovered in this organ. And lastly, I propose to offer a few remarks on the *Engravings* of the brain which accompany their large work.

I. OF THE WHITE AND GREY SUBSTANCE OF THE BRAIN IN GENERAL.

The White Substance.—In paragraphs 6, 7, 8, and 9 of the APPENDIX, DRS. GALL and SPURZHEIM explicitly maintain, that the *white substance* of the brain is *fibrous* in its structure; they describe the circumstances in which its fibres may be distinctly seen; and affirm that this fact was known to few anatomists. In the passages, however, which I have subjoined in a note, they acknowledge, that since the time of VIEUSSENS, it has been known to many that this *substance* is fibrous *in general;* but no one, according to them, has ventured to pronounce that it is fibrous *everywhere*; and this, therefore, is an important discovery, for which anatomy is indebted to them alone

On this first article in their claims, the following remarks will suffice.

Every anatomist, who has enjoyed frequent opportunities of examining the recent brain, must have observed, that there are particular portions of the *white substance* which tear much more readily in one particular direction than in any other;

and that the surfaces of the lacerated parts in the former case, but never in the latter, put on an appearance similar to that exhibited by a piece of muscle or any other fibrous texture, when torn in the direction of its fibres. When the surfaces, however, are closely examined with the naked eye or with a microscope, there are perceived on them only very fine striae and ridges, placed parallel to each other; no intervening substance, like cellular substance, can be discovered, separating fibre from fibre, or embracing fasciculi of fibres, as in the case of a muscle. In the *white matter* of some parts of the brain, numerous capillary bloodvessels uniformly appear, on the torn surfaces, running exactly in the direction of the laceration; in other parts, the vessels seem rather to pursue an opposite course; and in others, scarcely any vessels appear at all. If we attempt to raise any of the ridges on such surfaces, in the form of a single filament, we uniformly fail; the substance is so tender, that it immediately gives way.

The fibrous appearance just now described, is much more distinct, if the *white substance* previously to being lacerated, be plunged for a few

minutes into boiling oil, or steeped for a few days in alcohol, dilute muriatic or nitric acids, mixtures of alcohol and acids, or a solution of corrosive sublimate. These agents increase its consistence greatly; the laceration, consequently, can be pursued to a greater extent; and it is possible, with the point of a pin, to raise fibrils finer than a bristle, from the surfaces of the torn portions. Such filaments, however, can seldom be separated from the rest of the mass, for a greater length than an inch.

From these facts, I confess, I am rather inclined to think, that such portions of the *white substance* are actually composed of very slender fibres of nervous matter, surrounded and separated from each other by some delicate texture, similar to the neurilema of nerves, or the cellular substance of muscle; but too tender to bear dissection, and too fine to be perceptible to the naked eye. This, however, is merely matter of opinion, and may or may not be correct; I do not mean to affirm that it is a point of structure susceptible of demonstration *.

* See System of Human Anatomy, Vol. I. p. 123.

This inference is, I believe, applicable to the greater part of the *white substance* of the brain; but whether or not it ought to be extended to the whole, I cannot venture, from my own observations at least, to pronounce. There are several portions of it, in which, hitherto, I have failed to produce the fibrous laceration, either in the recent or the indurated state. Other anatomists, however, such as PROFESSOR REIL, appear to have been more successful.

Now although no method has yet been discovered by which the actual length of these *fibres*, (supposing them to be such) can be ascertained, yet it is obviously practicable to trace their general direction in different parts of the cerebral mass; and an accurate series of observations on this subject, would unquestionably constitute a very interesting accession to our anatomical knowledge. RAYMOND VIEUSSENS, whom MORGAGNI has justly styled, "*Monspeliensis Academiæ decus et lumen*," and whose admirable work entitled, *Neurographia Universalis*, was published as early as the year 1684, seems to have been the first who occupied himself particularly with this investigation. He appears sometimes to have employed

the indurated brain in his dissections *; but it is obvious, that his favourite method of tracing the fibres of the *white substance*, was by *scraping* its surface in the recent state. No one seems to have prosecuted this inquiry after VIEUSSENS, until it was resumed by PROFESSOR REIL about twenty years ago. The first results obtained by this ingenious and indefatigable anatomist, in whose recent death the science has sustained a serious loss, were published in GREN's Journal * for 1795. His subsequent discoveries form the subject of no fewer than ten separate dissertations, which will be found in the volumes from 1807 to 1812 inclusive, of the periodical work entitled *Archives of Physiology* †, edited by himself and AUTHENRIETH at HALLE. The brains which he subjected to his operations, were previously hardened and rendered more elastic, by immersion in alcohol, alkalis, acids, &c. Without this previous preparation, REIL was fully aware, from experience,

* See Lib. I. Cap. XI. p. 73.

* Neues Journal der Physik, Erst. Band. 8vo. Leipsig. 1795.

‡ Archiv für die Physiologie.

that it was in vain to attempt tracing the fibrous arrangement at all in some parts, or with perfect accuracy in any. I have repeated most of his dissections; and obtained results which induce me to put great confidence in the correctness of the whole. From the language in which they are written, and the scarcity of the work in which they are inserted, REIL's essays are less familiar to British anatomists than their merits entitle them to be. I shall endeavour, therefore, as soon as other avocations permit, to make them more extensively known in this country, through the medium of an English translation or abridgement. For the present, I have only to assure my readers, that the descriptions which they contain, are such as to put entirely to shame the inaccurate and imaginary anatomy, to which DRS. GALL and SPURZHEIM, have, in the meanwhile, succeeded, in securing so much more of the public attention.

The apparent fibrousness of the *white substance*, both in the recent state, and after coagulation with boiling oil, alcohol, acids, &c., has been long known; and no opinion has been more prevalent, than that this substance is really fibrous.

The following passage, which seems to me in several respects a curious one, is extracted from the celebrated MALPIGHI's Exercitatio Epistolica de Cerebro, dated 1664 *.

" The medulla of the Brain, or the Corpus Callosum, has been said to be more solid than the cortex, and to be surrounded with veins and arteries which fill up the intervening spaces; this, however, is incorrect, as I have been able to observe distinctly in the brains of fishes, and less so with the microscope in the more perfect animals. For it is quite evident, that the whole of this white part of the brain is divided into fibrils of a flattish round shape, not unlike those white bodies or *intestinuli* which compose the substance of the testes. These are so evident in the brains of fishes, that if they are examined between the eye and the light, they look like an ivory comb, or the common pipe-organ of a church; and they are the more plainly distinct from each other, that the blood-vessels springing from the margins of the cortex in

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* The passage in the original is this.

" De Cerebri medulla, seu calloso corpore illud exaratum extat, cortice solidius esse, venis, & arteriis circumaffundi, ad replenda scilicet intercepta spatia, quod tamen, prout evidenter in piscium Cerebro, & subobscurè in aliis perfectioribus microscopio observare potui, falsum deprehenditur: nam constat evidenter totam hanc Cerebri albam portionem divisam esse in fibrulas depressè rotundas, non absimiles albis illis corporibus, seu intestinulis, quibus testiculorum moles conflatur. Hæ in piscium cerebri ventriculis ità evidentes sunt, ut si adverso lumine observentur, eburneum pectinem, vel vulgatum in Eclesiis organum cannulis conflatum, repræsentent; & ut major emergat horum corpo-

the ventricles traverse the spaces between the fibres. I have remarked the same fibrous structure, in the brain, both recent and boiled, of sheep, oxen, and other such animals; but it is particularly evident in the posterior part of that portion of the spinal marrow which is contained within the cranium: Moreover, as I have above observed, one may see these white fibres of the brain, at the sides of this commencement of the spinal marrow, prolonged through the middle of the mass of adjoining cortex. This structure too may be remarked in the extreme appendages of the corpus callosum; for the fibrous bodies which form the roof of the ventricles, at last terminate in laminated fimbriae, or convoluted productions, which are immersed like the numerous roots of a plant, in the cortex, which seems as a soil or earth to them. What progress those fibrous bodies have, of which the medullary mass of the brain is composed, it is not so easy to assign; for it is difficult to bring them under the cognizance of the senses, on account of

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rum distinctio, in ventriculis circa extrema affusi corticis sanguinea vasa enata inter fibras spatia subintrant. Eandem fibros nam naturam, in pecudis bovis, & similium, tum crudo, tum elixato Cerebro observavi: sed evidentior præ cæteris emergit in parte postica spinalis medullæ intra cranium contentæ, quin &, ut superiùs innui, ad latera ejusdem principii spinalis medullæ albas hasce fibras Cerebri protractas per medium affusi copiosi corticis videbis: eandem etiam structuram in extremis appendicibus callosi corporis observabis; nam fibrosa corpora, quibus ventriculorum testudo contexitur, tandem desinunt veluti lancinatis fimbriis, seu productionibus in gyrum ductis, quæ immerguntur, & implantantur, non secus ac copiosæ plantarum radices, in cortice, qui soli, seu terræ vicem gerere videtur. Quem progressum habeant hæc fibrosa corpora, quibus medullaris Cerebri moles conflatur, non est ità facile assignare, quia ob ventriculorum tortuosas cavitates, & corticis implicitam substan-

the tortuous cavities of the ventricles, the complicated stratum of the cortex in the more perfect animals, and their own delicacy, multiplicity, and brittleness. In fishes, indeed, it is in some respects more evident, but in others, on account of their minuteness, more obscure. From a comparison of both, however, the following may perhaps be conceived to be their course.

"From the trunk of the spinal marrow contained within the cranium *(medulla oblongata)*, as from a remarkable collection of fibres, the whole fibres dispersed through the brain and the cerebellum seem to take their origin; for they ramify from four reflected *crura* of this medulla in all directions, until they end by their branched extremities in the cortex. Their progress in the cerebellum is more evident; it consists of fibres extended in the form of a tree, on the extreme branches or leaves, as it were, of which, the cortex is elegantly laid, but so unconnected with the adjacent parts, that the leaves appear free. In the brain, however, the arch or roof of the ventricles consists of fibres which are inclined towards the sides, and formed into a vault; as may be seen in the engraving of the

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tiam in sanguineis perfectioribus, accedente propria exilitate, multiplicitate, & friabilitate, non ità facilè sub sensum cadunt; & in piscibus quidem aliqua evidentiora sunt, alia ob exiguitatem obscuriora: ex utrisque tamen facta collatione talis censeri potest probabilis, progressus: A spinalis medullæ trunco intra calvariam contento, veluti insigni fibrarum collectione egressum videntur habere omnes fibræ per Cerebrum & Cerebellum dispersæ; à quatuor enim medullæ reflexis cruribus hinc inde ramificantur, donec ramosis terminationibus in corticem desinant: Hujus progressus in Cerebello evidentior est; fit enim ex fibris in arboris formam ductis, cujus extremis ramis, & quasi foliis, affunditur eleganter cortex, solutus tamen ab adjacentibus, ità ut referat liberum folium. In Cerebro autem concameratio, seu ventriculorum testudo constat fibris

Fish, in which likewise a parcel of fibres is observed running in an opposite direction towards the cortex, so as to form with the fibres below, already described, a sort of *riding* or *decussation*. All these are probably continuous with the anterior beginning of the spinal marrow. In the more perfect animals, the progress is the same towards the sides in the superior ventricles; and of these and other fibres derived from the posterior part of the brain, the structure of the corpus callosum * is composed; in which, as one may somewhat indistinctly see, the extremities of the fibres issuing from it, constitute certain varicose bodies not unlike intestines; which are overlaid with cortex. Of those, also, which issue from the forepart of the brain, the septum lucidum is composed."

No language can be more precise than that in which VIEUSSENS delivers his opinions respecting the structure of the *white substance*.

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versùs latera inclinatis, & in fornicem exstructis, ut in Piscium icone apparet, in quibus etiam observatur fibrarum portio, quæ supra ventriculos versùs corticem excurrit inversa via, ità ut fiat superequitatio, & incruciatio cum inferioribus superiùs descriptis. Hæ omnes continuitatem cum principio anteriori spinalis medullæ probabiliter habere censentur. In sanguineis ipsis perfectioribus idem est progressus ad latera in ventriculis superioribus, & ex his, & aliis à posteriori Cerebri parte deductis, fit callosi corporis structura, in quo, prout sensus subobscurè ostendit, ex erumpentibus fibrarum finibus fiunt varicosa corpora non dissimilia intestinis, quibus coaffunditur cortex: ex iisdem etiam ab anteriori Cerebri parte erumpentibus fit septum lucidum."

* MALPIGHI uses the terms *corpus callosum* and *medulla cerebri* synonimously.

"The *white substance* of the brain," says he, "which I shall in general denominate the medullary substance, and sometimes simply medulla, is composed of innumerable fibrils connected together and arranged into various fasciculi. This becomes very obvious when it is boiled in oil; for then the innumerable fibrils, of which I have said it is composed, are easily separable from each other. These fibrils, however, in their natural situation, and where no cineritious matter is interposed between them, are so closely compacted together, that they leave not the smallest intervening space, but constitute one continuous mass: Just like the internal fibrils of a rod of wood which, although they are in fact separable from each other, compose a continuous body *."

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* "Alba cerebri substantia, quam passim substantiam medullarem, imò & aliquando medullam nominabimus, innumeris è fibrillis simul connexis, ac veluti plures in fasciculos distinctis conflatur, quod apertè patet dum hæc in oleo excoquitur; illa nàmque tunc temporis innumeras in fibrillas, è quibus simul connexis ipsam conflatam esse modò diximus, facilè dividi potest. Hujusmodi autem fibrillarum aliæ aliis, dum situm naturalem servant, adeo proximè juxtà ponuntur, ubi scilicet glandulosæ nullæ particulæ ipsis interseruntur, ut sensile nullum inter ipsas relinquatur spatiolum, & continuum constituant corpus: quemadmodum interiores baculi fibrillæ, licèt ipsarum aliæ ab aliis separabiles sint, continuum alterum corpus, baculum nempe componunt." Lib. I. cap. X.

LEEUWENHOECK examined with the microscope thin slices of the brain of a hog and of mice, which had been previously hardened; and found that they appeared to consist of exceedingly minute fibrils, which he conjectured were surrounded, each of them, with a delicate membrane too fine to be perceptible. But the parts of the brain from which the slices were taken are not mentioned. Epist. Physiol. xxxiv. March 1718, and xxxvi. May 1717.

HALLER expresses himself with his usual brevity and good sense on this subject.

"This, however," says he, "we find *everywhere*, that the medulla is disposed to be compacted and arranged into straight lines and fasciculi, known under various names, such as are very obvious in the crura of the brain, the pons Varolii, and the corpus callosum. Hence there is produced in the medulla a sort of resemblance to fibres *."

MAYER, the author of a valuable System of Anatomy, published in German, at Berlin, in 1794, describes the medulla in the following terms.

"The medulla exhibits a fibrous structure; and this is particularly distinct in those parts which serve to connect the opposite halves of the brain, or in those which lie near the origins of the nerves. The fibrous structure may be rendered still more obvious, by immersing the medullary parts of the brain in strong spirit of wine, or concentrated vinegar, or by boiling them in oil. Freezing shews the layers of the fibres less distinctly. In a brain which is much loaded with water, or in one which is very dry or hard, the fibrous layers of the medulla are likewise visible †."

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* "Id tamen *ubique* reperimus, amare medullam in lineas rectas lacertulosque comprimi et figurari, quos variis cum nominibus repetemus, in cruribus cerebri et ponte Varolii et corpore calloso adprime conspicuos, unde in medulla rudior aliqua fibrarum similitudo nascitur" Elem. Physiol. iv. p. 31.

† "Das Mark zeigt einen faserigten Bau, und besonders deutlich sieht man diesen Bau in denjenigen Theilen, welche zur verbindung beyder Hälften des Hirns dienen; oder in denen, welche dem Ursprunge der

The author then goes on to describe the differences of direction, which are perceptible in the medullary fibres, in different parts of the brain.

Professor Reil, in a paper on the structure of the Brain and Nerves, already referred to, in Gren's Journal for 1795, enters much more minutely into the subject than had been done by any preceding anatomists. He details the whole fibrous structure of the cerebellum; traces with great minuteness the bands of fibres from the corpora pyramidalia through the annular protuberance to the peduncles of the brain proper, and thence through the corpora striata to the convolutions; follows carefully and precisely the fibres of the corpus callosum, and of the anterior commissure, to their destination in the hemispheres; describes the structure of the convolutions with singular accuracy; and alludes briefly to other parts. In conclusion, he observes, that if one were to fix upon a point in the nervous system, such as the *medulla*

Nerven näher liegen. Diesen fasrigen Bau kann man durchs einlegen markiger Hirntheile in starken Weingeist, oder in concentrirten Essig, und durchs Kochen in oel, noch deutlicher machen. Das gefrieren zeigt die Lagen der Fasern des Markes weniger bestimmt. In einem Hirn, welches mit vielem Wasser überladen ist, oder in einem sehr ausgedörreten oder erhärtaten, sieht man ebenfalls die faserlagen des markes. Beschreib. des ganzen Menschlichen Körpers. B. vi. p. 91.

oblongata, this system might be regarded as radiating from this point, to the extremities of the nerves on the one hand, and to the extremities of the fibres in the cerebrum and cerebellum on the other; or reversing the matter, all these nerves and fibres might be considered as converging from their extremities towards the *medulla oblongata*.

CUVIER, in describing the structure of the brain in general, in red-blooded and vertebral animals, remarks,

"The medullary substance is white, opaque, and firmer than the cortical; and it appears to the eye to be composed of very fine fibres, of which the directions vary *."

And PORTAL, in his description of the human brain, expresses himself thus;

"The medullary or white substance, is much more dense than the vertical; it appears *everywhere* to be formed of fibres laid closely along each other. We distinguish them easily in the corpus callosum, the corpora striata, and the pons Varolii."—"It is in brains especially, which have been macerated and preserved in spirit of wine, that this structure is seen †."

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* "La substance medullaire est blanche, plus firme que la corticale; elle paroît à l'œil composée de fibres très-fines, dont les directions varient." Leçons d'Anatomie Comparée, tom. ii. p. 100. Paris, 1800.

† "La substance medullaire ou blanche est beaucoup plus dense que la corticale; elle paroît *par-tout* formée de divers filets adossés les uns à

These remarks, will, I trust, sufficiently enable my readers to judge of the extent and importance of the discoveries made by Drs. Gall and Spurzheim in this department of the anatomy of the brain.

In the first place it is obvious, that the fibrous structure of the *white substance* is not a fact first demonstrated by them; but is merely an opinion which they entertain in common with many other anatomists for nearly 150 years back; and when they affirm, that merely by *scraping* the recent brain, they can display the fibres of the *white matter* distinctly to the naked eye, it is plain that they substitute an hypothesis for a fact. The operation of *scraping*, which is merely a mode of laceration, discloses only a fibrous appearance, from which the actual fibrous structure is inferred; and whether the inference be correct or not, it is for future investigation to determine.

Secondly, this very operation of *scraping* was not invented by them; but was the method prac-

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côté des autres. On les distingue facilement dans le corps calleux, dans les corps cannelés, et dans le pont de Varole." Anat. Medic. iv. p. 85. Paris, 1804.

tised by VIEUSSENS, the first anatomist who directed his attention in particular to this subject, as is expressly stated in many pages of his treatise. By DRS. GALL and SPURZHEIM the *scraping* is performed, in general, with the handle or the blade of a scalpel; but sometimes rudely enough with the points of the fingers; as all those who have seen their dissections must have remarked. And for my own part, I must confess, that if any doubts had remained on my mind as to the total inadequacy of the method they employ, to the accurate unfolding of the minute structure of the brain, they would have been wholly removed by the public demonstrations which I have lately had an opportunity of witnessing in this place. They have little experience, indeed, in the actual dissection of the brain, who imagine, that the arrangement of its apparent fibres can be satisfactorily developed, merely by scraping its *white substance* in the recent state. There are many portions of this substance which are arranged into such narrow bands, and such thin laminae, and in which the disposition of the fibres is so complicated, that it is not without the greatest difficulty that their structure can be un-

folded even after coagulation. On such parts the operation of *scraping* is entirely impracticable, even in the freshest state of the organ. The method so steadily pursued by REIL is the only one which is applicable to every part, and ensures certain results; and they alone can form a just estimate of the merit of his investigations, who have devoted some considerable portion of their time to the faithful repetition of them.

Thirdly, the statement made by DRS. GALL and SPURZHEIM, that no one had extended the hypothesis of a fibrous structure, or ascribed a fibrous appearance, to the *white substance* of the brain *everywhere*, until this important discovery was made by them, is wholly incorrect. In proof of this, I refer the reader to the extracts which I have already given, from the works of the most distinguished anatomists, from the time of MALPIGHI downwards.

In conclusion, I have now to mention a circumstance, which, I presume, after the preceding detail, will be read with some surprize. When DR. SPURZHEIM, in the course of his second demonstration of the brain in this place, was called upon

to display, by means of *scraping*, the fibrous structure of those bands of *white substance* which pass through the corpus striatum, and the edges of which he had just exposed, he denied that he had ever affirmed that the *white substance* of itself, unmixed with the *grey*, possessed any such structure. This placed me under the necessity of reading to his audience two paragraphs from p. 20 and 21 of his Physiognomical book, (the only work of his, unluckily, then accessible) which are almost a literal translation of paragraphs 6, 7, 8, and 9 of the essay in the APPENDIX. Singular, however, as this circumstance may seem, it is only one of a series of similar denials made by DR. SPURZHEIM in the course of the same demonstration; each of which will be taken notice of, in its proper place.

The Grey Substance.—The term *grey*, or *cineritious*, which is generally applied to this substance, is calculated to convey an inaccurate idea of its colour to those who have not seen it. *Brown* is every where its predominating hue; and in most parts it is of that species of *Brown*, which

is called by WERNER in his Nomenclature of Colours, *Wood-Brown* *.

This substance is described by DRS. GALL and SPURZHEIM in the 5th paragraph of the Appendix; and the reader will not fail to remark the following peculiarities in their opinions with respect to it.

In the first place, it is pronounced to be without any apparent organization. I am correct, however, I believe, in stating, that, at the present day, the term *organized* is universally applied by physiologists to any part which is simply ascertained to possess vascularity; how little soever may be known with regard to its structure in other respects; in which case, it is obvious, that *organization* cannot be denied to the *grey substance*. But if DRS. GALL and SPURZHEIM mean by this term, any arrangement of the particles of a texture into laminae or fibres, then there is the same proof that the *grey substance* is *organized* as the *white*. For if any one of the convolutions of the brain proper, or of the laminae of the cerebel-

* See WERNER's Nomenclature of Colours, with additions, &c. by Patrick Syme, Edin. 1814.

lum, be torn vertically, after coagulation, or even in the recent state, the fibrous appearance will be exhibited as distinctly by the one kind of matter as by the other. REIL * has described and represented this effect of laceration on the grey coating of the convolutions; and SOEMMERRING takes notice of the fibrousness of the *grey substance* in general, after immersion in a coagulating liquor †.

Secondly, DRS. GALL and SPURZHEIM are of opinion, that the use or function of the *grey substance*, everywhere, is to form the *white*;—an hypothesis, for which it seems to me, in the present state of our physiological knowledge, there is no proper epithet but absurd. If any thing be certain in science, it is, that every vascular part is formed by its own vessels; and there is just as little reason or philosophy in imagining, that the *white fibres* of the brain, or of the nervous system in general, are produced by the *grey matter*, as there would be in supposing that the skin forms the cellular substance which it covers, or the cellular substance the muscles, or the muscles the bones. Why not conceive that the *grey substance*

* Archiv. B. 8. and GREN's Journal, p. 105.

† De Corp. Hum. Fab. IV. p. 50.

is intended to absorb the *white*? The one hypothesis is in every respect as physiological as the other.

Drs. Gall and Spurzheim affirm that there is not a single filament of *white substance* anywhere, which does not take its origin from a proportional mass of *grey matter*. But this is a mere averment, without the shadow of a proof. For aught that has yet been demonstrated to the contrary, there may be millions of fibres in every part of the cerebral mass which have no connection of any kind with this substance. It is to be remembered, that when we tear a piece of *white substance*, we see merely a fibrous appearance;—that the actual existence of *fibres* in the mass is only an hypothesis founded on that appearance; and that of the length or breadth of the ultimate fibrils we know nothing whatever. The *white matter*, therefore, over the whole brain, may either consist of continuous fibrils, such as are represented in *fig.* 8, connected by one or both extremities to *grey substance*, or it may be composed of a series of comparatively short and insulated filaments, as in *fig.* 9, placed close together and parallel to each other, and of which only a very inconsiderable number, such

as those touching the lines *a b*, and *c d*, are in union with the *grey matter*. We may conjecture, but we cannot demonstrate, which of these is the structure which really obtains; in the meanwhile, therefore, we must content ourselves, like Professor REIL, with endeavouring to trace the general direction of the supposed fibres.

The hypothesis I have now considered would have been unworthy of much notice, had it not been so essentially connected by DRS. GALL and SPURZHEIM with the actual description of the brain.

II. OF THE FIBRES OF THE BRAIN.

AFTER delivering their opinions on the structure of the *white* and *grey substance* in general, DRS. GALL and SPURZHEIM proceed to unfold their new views respecting the brain in particular.

In this organ they profess to have discovered two distinct orders or systems of fibres. The one system is called *diverging*, or the *apparatus of formation*, the other, *converging*, or the *appara-*

lus of union; and in this last are included the parts which have been long known under the name of *commissures*. (See APPENDIX, § 12. and 35.)

These two systems pervade the whole organ; and there are *diverging* and *converging fibres* in the cerebellum as well as in the brain-proper. The systems of these two parts may be considered separately.

I. OF THE FIBRES OF THE CEREBELLUM.

THE two orders of fibres, *diverging* and *converging*, which according to DRS. GALL and SPURZHEIM constitute this part of the cerebral mass, are described in the paragraphs from 17 to 22, and from 38 to 40 of the essay in the APPENDIX.

The following are my sentiments with respect to that description.

In the *first place*, the *diverging fibres* of the cerebellum are said to take their origin from the *grey matter* lodged in the interior of the medulla oblongata (§. 17.); and to form on each side, a bundle or fasciculus usually known under the

name of corpus restiforme; which running upwards, and increasing as it ascends, penetrates into the corresponding hemisphere of the cerebellum, and enters the substance of the mass situated there, called corpus dentatum. Accordingly, in the engravings accompanying their large work, particularly in their representation of a section of the cerebellum, which I have copied in *fig.* 1. Drs. Gall and Spurzheim have distinctly delineated this fasciculus of fibres, as extending themselves into the cerebellum, until the anterior extremity of the corpus dentatum intercepts them.

To this I reply, that the origin of all, or even any of the fibres here described, from the *grey substance* of the medulla oblongata, is a mere assumption; it has not been proved, and was not even attempted to be shewn by Dr. Spurzheim in his demonstrations. The actual dimensions, too, of the bundles which they are said to form, has been left wholly undefined; and Dr. Sprurzheim seemed little disposed in his public dissections to fix their limits more precisely. Yet until this is done, it is unreasonable to expect, that we should listen to any account of alleged discoveries with respect to their future destination.

To call them *corpora restiformia*, is to apply to them a vague appellation, which, hitherto, has been employed only by some anatomists, as the name of a superficial eminence; and which is not calculated to convey any idea of the extent of the medulla oblongata which the fasciculi occupy. These bundles, moreover, are said to increase as they ascend; and in conformity with Drs. Gall and Spurzheim's views with respect to the functions of the *grey substance*, we ought to find some portions of this matter attached to the fasciculi or intermixed with them, from which the reinforcing filaments can be shewn to take their origin; yet no such matrix has been pointed out. Lastly, I maintain that it is impossible to trace any fibres, either from the corpus restiforme, or from any other part of the medulla oblongata, into the corpus dentatum, in the manner described by Drs. Gall and Spurzheim; or to exhibit, in any human brain, such an appearance of fibrous connexion between these parts, as they have represented in their engravings. A cautious examination, according to the method of Reil, of those filaments which seem to extend from the region of the corpus restiforme, into the corresponding

hemisphere of the cerebellum, will shew, that they pass, not into the corpus dentatum, but external to it, and afterwards over it. Dr. Spurzheim did not, in his public demonstrations, trace these fibres to the termination he has assigned them; he merely scraped off *(en se servant du manche du scalpel)* the root of the auditory nerve, and its ganglion, as he calls it, from the upper part of the corpus restiforme; produced a fibrous appearance on the surface underneath; and then, without following the fibres into the corpus dentatum, proceeded to speak of the situation and structure of that body.

In the *second place,* the corpus dentatum itself, is described by Drs. Gall and Spurzheim, as being an accumulation of *grey matter (un amas de substance grise,* § 17.*)* Accordingly, this matter is represented in their engravings as pervading its whole substance; and as existing in it, in such quantity, that when the body is divided, (see *fig.* 1.) it exhibits as dark a colour throughout, as the coating of *brown substance* on the outer surface of the convolutions of the brain-proper, or the laminae of the cerebellum. They acknowledge (§ 17.) that they cannot follow the fibres of the corpus resti-

forme through this grey mass; yet they affirm (§ 18.) that these fibres not only penetrate it, but receive a reinforcement of filaments from the *grey matter* in their progress; and that at last, the whole emerging at different points, form a variety of strata, which are distributed to all parts of the cerebellum. The corpus dentatum, therefore, according to their views, is a true ganglion for each hemisphere, *(son veritable ganglion, § 18.)* and is a preparatory apparatus, or point of origin and reinforcement for a great part of the nervous mass of the cerebellum. Accordingly, wherever a principal branch or stratum of nervous fibres leaves the ganglion, there is at that part a greater quantity of *grey substance*, forming an eminence or projection; and hence it is, they affirm, that the ganglion is irregular on its surface, and that the number of its teeth or eminences, corresponds to the number of the principal nervous bundles which leave it. (§ 18.)

This description is inaccurate to a degree that it is not easy to account for, and of which no one can have any idea who has not compared it with nature.

The corpus dentatum is not a mass of *grey substance*, but consists of a small quantity of *white nervous matter*, surrounded at all points, except towards the anterior and inferior part, with a thin capsule of *brown*. Its *white matter* has no connexion whatever with the corpus restiforme; but is continuous, where the capsule is deficient, with the corresponding pillar of the Vieussenian valve*; many fibres of which can be distinctly traced into it, accompanied with pretty large blood-vessels. It is impossible to demonstrate a single filament either entering or leaving it, at any other point†. Its surface is very irregular, so that in whatever direction it is divided, its section appears deeply serrated; but the projections do not consist of *grey matter*, as Drs. Gall and Spurzheim have affirmed; they are composed of *white substance*, with a coating of *brown*, like the rest of the mass;

* The Pillars of the Vieussenian Valve are the Processus ad Testes of the older anatomists, and the Anterior Crura of the Cerebellum of Reil, and others.

† This is precisely the opinion, also, of the Commissioners of the French Institute. "The corpus fimbriatum," say they, "is enveloped, and, as it were, immersed in the medullary matter, instead of giving a passage to it; and we do not observe that it supplies it with any filament." *Report*, &c.

nor is there the slightest foundation for the assertion which they have also made, that there is a correspondence, in point of size, between these projections, and the strata or laminae of the cerebellum.

In *fig.* 2. and 3. two views are exhibited of the corpus dentatum, taken from the cerebellum of an adult male, only 24 hours after death *. The original drawings were executed with the most scrupulous exactness by my friend Mr. Syme, whose talents for depicting such objects are well known. I have to request that my readers will contrast this representation with that which has been given by Drs. Gall and Spurzheim in *fig.* 1.

That the fibres of the corpus restiforme, then, enter the corpus dentatum, as these anatomists have affirmed;—that they pass through it and receive a great reinforcement from the *grey matter*

* In a cerebellum which has been steeped in spirits, the natural appearance of the corpus dentatum is destroyed. The blood seems diffused from the blood-vessels with which it abounds through the *white matter*, and gives it a brownish tinge; while at same time the *brown capsule* becomes paler. The anatomist, therefore, ought to be on his guard against this deception.

with which it is filled ;—and that the strata which they form on emerging from it, correspond in magnitude to the projections on its surface ; are things which Drs. Gall and Spurzheim may have imagined, but which they cannot have seen : And it is for them to explain how these appearances were produced, which the artist has delineated as natural to these parts, in the engravings accompanying their large work ; particularly in the XII. Plate, of which I have copied the part representing the cerebellum, in *fig.* 1.

Knowing how inaccurate all this description was, and having no reason to doubt that Dr. Spurzheim was acquainted with that which I had myself given of the corpus dentatum, in the First Volume of my System of Anatomy, I naturally felt considerable curiosity to see, in what manner that anatomist would endeavour to reconcile his dissections of this body, with the account and delineations of it in his book. In his first demonstration, however, the subject was passed over altogether. But in the second, the reader may judge of my surprise, when Dr. Spurzheim, just before exhibiting a section of the substance in question, affirmed, that it had been denied that

it contained any *grey* or *brown matter* at all; and in proof of this, immediately proceeded to read the following sentence from the description I have given of it in the work already mentioned: "I have invariably found the nucleus of this body composed of pure orange-white matter, not differing in colour in the slightest degree from that of the central mass in general *." It was in vain

* System of Human Anatomy, Vol. I. p. 144. The whole description is as follows:—"It consists of a nucleus of Orange-White Matter, contained in a capsule of Wood-Brown Matter, not more than a fiftieth part of an inch in thickness. It varies in its dimensions a little; but in general it measures, from before backwards, from three quarters of an inch to an inch; from side to side, about half an inch or three quarters; and in heighth or thickness, from an eighth to a sixth of an inch in the middle, gradually tapering towards the edges. Its outline is sometimes quadrangular, sometimes elliptical; and it sends off a number of processes from its surface, so that in whatever direction it is divided, the outline of the section appears jagged or serrated, and hence has arisen the name of Corpus Dentatum. It is lodged in the substance of the Lateral Part of the Central Mass; its margin upon the inside, coming within a sixth of an inch of the inner boundary of this Part. On the forepart, where it rests, as it were, on the roof of the Central Fissure of the Cerebellum, the lower part of its capsule seems wanting altogether; so that at this point, the White Matter forming its nucleus, is connected directly, with the White Matter belonging to the Pillar of the Vieussenian Valve on the same side. *I have invariably found the nucleus*

that I repeatedly called on Dr. Spurzheim to read the whole of the paragraph of which this sentence forms a part; he persisted in confining himself to this extract. It was easy to foresee what the effect of this partial quotation would be on his audience. Being kept in ignorance of the distinction I had made between the *nucleus* of the corpus dentatum, which I affirm to be pure *white*, and its *capsule*, which I have expressly described as consisting of *brown matter*, they would naturally imagine, when a section of the body came to be exhibited, and they saw a quantity of *brown substance* of which no mention had been made in the sentence read to them, that an inaccuracy had been detected in my description. Accordingly, I have been assured by several persons who were

of this body composed of pure Orange-White Matter, not differing in colour in the slightest degree from that of the Central Mass in general. Its Venous Vessels, however, are considerably larger than they are in this matter in other parts; and I have no doubt, that it has been the accidental tinge communicated to it by the division of these Vessels, or by the transudation of Blood from them, which has led some Anatomists to describe the nucleus as being intermixed with Brown Matter. The capsule appears to differ, in no respect, from the Wood-Brown Matter found in other parts of the Brain, except that it is rather firmer in its consistence.

present, and who did not profess to be familiar with these parts, that this was actually the impression which was produced on them at the time. The particular section, too, which DR. SPURZHEIM chose on the occasion, was calculated to aid this effect. It was a vertical division of the corpus dentatum, so close to its inner margin, that scarcely a particle of its white nucleus was exposed; and its serræ, or teeth, being shorn off at their roots, portions of their brown coating appeared at various points of the divided surface. I objected immediately and repeatedly to this section, as one not adapted for unfolding the true structure of the body, because not carried through its nucleus; but my remonstrances were not listened to; and DR. SPURZHEIM went through among his spectators (most of whom had never seen the corpus dentatum before, and not one of whom had rendered himself familiar with its appearance by dissection) exhibiting this preparation as a fair specimen of the structure of this *veritable* ganglion of the cerebellum.

From the whole of this proceeding, which I am given to understand has not been confined to this demonstration, but has been repeated by DR.

SPURZHEIM elsewhere, I leave my readers to draw their own conclusions. I trust only, that if it shall hereafter be practised before any of those into whose hands these pages may fall, it will fail to produce its former effect.

Thus, however, did DR. SPURZHEIM occupy the attention of his audience, instead of attempting to demonstrate to them that the corpus dentatum was a mass of *grey substance (un amas de substance grise)* an inch long and half an inch thick, such as he and DR. GALL have represented it to be (see *fig.* 1.); with fibres of the corpus restiforme entering into it, passing through it, receiving reinforcement in it, and then radiating or ramifying from it, in all directions. These statements were left without proof or corroboration; and it requires only to examine the hemispheres of the cerebellum once, to be assured that they must ever remain so.

In the *third place*, DRS. GALL and SPURZHEIM describe those fibres which they affirm, (and we have seen with what accuracy) can be traced through the corpus dentatum, as arranging themselves, on their egress, into various strata or branches, which subdivide into smaller laminæ

(§ 18.). One of the principal of these is said to proceed towards the median line, and to contribute, with the corresponding branch of the opposite hemisphere, to form the processus vermiformis, which commonly subdivides into seven branches. The other strata incline backwards, upwards, downwards, and outwards, and expand into very thin layers horizontally laid; those in the middle being the longest, and the rest always the shorter, the nearer they are to the point where the original fasciculus or corpus restiforme enters the ganglion (§ 20.). The fibres of the whole divisions and subdivisions are at last covered at their terminations or peripheral extremities with *grey substance*. (§ 21.)

To this my reply is very short. It is impossible to demonstrate a single such stratum, or branch, or lamina of fibres as have here been described. Bundles of fibres so distinct as these are alleged to be, and which the description would lead us to conclude, constitute at least one half of every stratum or lamina of the cerebellum, we should expect to find as easy of being displayed, *by scraping* (en raclant), as many others which they have represented in the brain-proper. Why, therefore,

have they not been delineated by Drs. Gall and Spurzheim, in any one of the seven engravings of the cerebellum which accompany their large work? Dr. Spurzheim, in his public dissections, did not attempt to demonstrate any part of this structure.

The sum of all these remarks is, that there is no such system of *diverging fibres* in the cerebellum, as Drs. Gall and Spurzheim have described.

This leads me, *in the fourth place*, to consider the system of *converging fibres* which these anatomists profess to have discovered in this organ.

These they describe as taking their origin in each hemisphere, just where the *diverging fibres* terminate; that is, from the *grey substance* on the surface of the cerebellum (§ 38). From this they proceed in different directions, *between the diverging filaments*, towards the outer and anterior border of the cerebellum, where they form a broad and thick stratum *(the lateral crus or peduncle of the cerebellum)*. They then enter the annular protuberance or pons Varolii; the posterior and middle filaments passing transversely over the *diverging fibres* of the brain-proper, which run through this protuberance; and the anterior filaments

forming on the fore part of all these, a fibrous layer. In the middle of the protuberance they unite with the corresponding fibres from the opposite hemisphere; and, therefore, Drs. Gall and Spurzheim prefer applying the term *commissure of the cerebellum* to this body, instead of pons Varolii. It would appear, however, that the *primitive part* (as they call it) of the cerebellum, which is the portion comprehending the vermiform processes, has a commissure also; and this, they say, is constituted by "those soft and tender laminæ of filaments which have improperly been denominated *valvules*." (§ 40.) Such are the *converging fibres* of the cerebellum.

Now, on this subject, I would observe, that the fibrous appearance of the peduncles of the cerebellum has been long known; that it is long since the opinion was entertained that they consisted of a collection of fibrils intended for the hemispheres of the cerebellum, or derived from them; and that the continuation of some of their fibres across the pons Varolii, in the form of strata alternating with, and intersecting, the fasciculi proceeding from the medulla oblongata, has been long observed, and even endeavoured to be deli-

neated *. Professor Reil, however, was the first anatomist who had the merit of ascertaining the precise connexions of these crura. He has described their anatomy very minutely in his essay in Gren's Journal, as early as 1795; but his subsequent investigations enabled him to give a more accurate account and delineation of them in his *Archives of Physiology* for 1807, 1808, and 1809 †.

I have repeated his dissections, and have found them perfectly correct. By far the greater number of the strata and laminæ of the cerebellum, are entirely formed of fibres which are connected

* See Vieussens Neur. Univ. Lib. I. Cap. xii. & xiii. Tab. xiv. xv. and xvi.

Haller, Elem. Phys. tom. iv. p. 73. "Cum ea crura medullaria anterius se cruribus cerebri subjiciant, fit inde quasi arcus, duobus fluviis coelescentibus impositus, quem ideo *pontem* dicunt et Varolio tribuunt, alii *protuberantiam annularem* vocant. Alia tamen a ponte fabrica est. Neque enim tota cerebelli medulla totis cruribus cerebri imponitur: sed intricatio fit, difficilis solutu, hactenus tamen manifesta, quod medulla cerebelli maxime interior inferior sit, transversis fibris conspicua, huic succedent cerebri fibræ longitudinem capitis sequentes: his aliæ a cerebello fibræ transversæ, multa cum natura corticea mistae; iisque novum et posteriori superiori loco positum stratum fibrarum, a cerebro descendentium, et medullæ longitudinem sequentium."

† Vols. 8th and 9th.

with these peduncles. It is a matter of perfect indifference, whether we say that the fibres proceed from these bodies to supply the strata, or are collected from the various strata to constitute these bodies; the fact is equally well expressed by either phraseology. The fibres are not confined to the lateral parts of the hemispheres, but extend into the vermiform processes, and form, perhaps, the greater part of their laminæ. Some of the laminæ on the upper and posterior surface of each hemisphere are formed of fibres derived from the corpora restiformia, or posterior crura of the cerebellum, and from the pillars of the Vieussenian valve or the anterior crura; the expansions of the former being situated above those of the latter. In some of the strata, particularly towards the upper vermiform process, there seems a slight intermixture of filaments derived from these sources, with others from the peduncles; and it is into the same process that the longitudinal fibres run, of which the Vieussenian valve, or *anterior medullary velum* * of REIL, is entirely composed. The thin stratum of white substance which covers

* Das vördere Marksegel.

the superior surface of the head of the inferior vermiform process, and which REIL has denominated the *middle part* of the *posterior medullary velum* *, seems to be composed of longitudinal fibres also, which meet at the posterior angle of the fourth ventricle with those of the anterior velum. Whether those singularly delicate prolongations called by REIL the *lateral parts* of the *posterior medullary velum*, and which had been imperfectly described before by TARIN, under the name of *valvulæ semicirculares* †, consist of fibres or not, I have not been able to ascertain. They are so tender that it is difficult to prepare them for examination. REIL is silent with respect to their internal structure.

The arrangement which the fibres appear to assume after coagulation, in the various strata of the cerebellum at their points of ramification, and their mode of distribution in the ultimate laminae, where they are covered with *grey substance*, have

* Das hintere Marksegel.

† I have described these, minutely, in my *System of Anatomy*, Vol. I. p. 115, under the denomination of the Alæ of the Inferior Vermiform Process. REIL's description of them is very good, and his engravings of them excellent. A section of the left one is represented in *fig.* 2. *e*, of this pamphlet.

been treated of in the most interesting manner by Reil in his second essay *; and to the same indefatigable anatomist we are indebted, for the first precise description of those bands of fibres, which pass from the peduncles or lateral crura of the cerebellum, across the substance of the pons Varolii and over its surface †.

The distribution of fibres in the cerebellum, which has just been described, is one which cannot be unfolded, even after induration, without much pains and delicate management. Drs. Gall and Spurzheim, however, we have seen, profess to be able to trace, by scraping (en raclant), even in the recent state, fibres coming from the *grey matter* of all parts of the cerebellum, except the vermiform processes, and terminating in the peduncles; and this, notwithstanding the fibres decussate (as they must do at every point)

* Archiv. &c. 1807-8, p. 91.

† He has described them in Gren's Journal for 1795, and also in the Archiv. &c. for 1809, p. 500. His account, however, of these and of the longitudinal fibres in the annular protuberance, although greatly superior to any that has since appeared, seems to me still imperfect. It is a piece of structure, which engravings, on the plan of those I have given in *fig. 5 and 6*, alone can illustrate. For further details relative to this point, see *System of Human Anatomy*, I. p. 140.

the system of *diverging filaments*, which they have described as proceeding from the corpora restiformia, to terminate in the very same *grey matter* in all parts of the organ. To this I reply, that there is no such system of fibres in the cerebellum; and that if there were, it would be wholly impracticable to demonstrate them in the recent state, either by *scraping*, or any similar process. The only fibres in this organ, are those which I have already stated as having been first clearly traced by REIL; and in repeating his dissections it will be found, that the strata and laminae of the vermiform processes, are chiefly composed of filaments, which are connected with the peduncles of the cerebellum on each side.

According to DRS. GALL and SPURZHEIM, however, the primitive part of the cerebellum, or in other words, the vermiform processes, are provided with a *commissure* as well as the other parts. Now it will of itself, I imagine, strike most persons as somewhat extraordinary, that a portion of the cerebellum, situated as this primitive portion is, on the median plane, and which is of course single, should have any *commissure* ascribed to it at all; for it is understood to be the office of a

commissure, to unite, on the median plane, two portions of the brain exactly similar, which are situated on the opposite sides of that plane. But the parts which are regarded as constituting this anomalous commissure, are no less remarkable. In paragraph 40 of the APPENDIX, DRS. GALL and SPURZHEIM say, that "it is formed of those soft and thin laminae of fibres belonging to the upper and lower portions of the primitive part, which have improperly been denominated *valvules*;" and from the passage of their large work which I have subjoined in the note, it would appear, that by the *valvules* they mean those parts, to which REIL has applied the less exceptionable appellations of *anterior* and *posterior medullary vela*. Now the anterior of these *vela*, or the Vieussenian valve, we have already seen, is entirely composed of longitudinal fibres placed parallel to the median line, and running from the superior vermiform process towards the corpora quadrigemina; while the *posterior velum* has a *middle part* (see p. 50.) also consisting of longitudinal fibres, and two delicate *lateral parts*, of which the minute structure has not been ascertained; but which stretch outward, until they unite with

the subpeduncular lobules*, and are attached for nearly an inch, by their posterior margins, to the central white mass of each hemisphere. How far these parts can, with consistency, be regarded as a commissure for the middle portion of the cerebellum, I leave my readers to judge. It seems to me, however, abundantly evident from the note to § 40, already referred to, that Drs. Gall and Spurzheim, in fixing on the *medullary vela* for this commissure, had not the slightest conception of the parts which Reil has so well described under that name. How else is it possible to account for the gross error they have committed, in representing that anatomist as meaning by these appellations, the *processus cerebelli ad testes*, and the *processus cerebelli ad medullam oblongatam*? The former are the *anterior crura* of the cerebellum of Reil and various other authors, and the *anterior medullary velum* lies between them; the latter are the *posterior crura* of the *cerebellum*, or the *corpora restiformia*. With respect to the *posterior medullary velum*, in particular, there is satisfactory proof from the engra-

* The *Flocken* of Reil.

vings accompanying their large work, that they are ignorant even of the very place where it exists; for although these contain six representations of the cerebellum, in which either the middle or the lateral parts of this velum ought to have been distinctly exhibited, there is not in any of them a fragment of it to be seen. In Plate XVII, a part is represented at β, under the name of this velum, which does not in the least degree resemble it, either in place or structure; and which, in truth, has no existence at all in the cerebellum.

Lastly, the description which Drs. Gall and Spurzheim have given of the fibrous strata, which extend from the peduncles, across and over the annular protuberance, is vague and superficial; less precise and minute even than Haller's; and very far inferior to that given by Reil, in the essays already referred to.

The conclusion from all these observations is, that a system of *converging fibres*, such as has been described by Drs. Gall and Spurzheim, is not to be found in the cerebellum.

It is a circumstance of too much importance in this examination not to be mentioned, that when Dr. Spurzheim, in the course of his second de-

monstration in this place, was called upon to shew the continuation of the *diverging fibres* into the *grey substance* of the cerebellum, and the origin of the *converging fibres* from the same *substance*, he denied that he had ever affirmed this to be practicable. But when those passages of his English book (p. 35 and 40.) were read to his audience, in which the origin and termination of both these systems are distinctly specified, and he was again called upon to confirm that statement by an actual display of the parts, he excused himself from the task, on the ground, that the cerebellum had already been too much destroyed, by the previous stages of the dissection; and promised on another occasion, and on another cerebellum, to demonstrate all that his description contained.

Professions so contradictory as these, require no comment. But I must take the liberty of remarking, that as I am confident, after some inquiry, that Dr. Spurzheim has not attempted to demonstrate the fibres in question to any anatomist in this country, so it is quite certain that neither he nor Dr. Gall endeavoured to display them to the Committee of the French Institute. "It is a great deal more difficult," say the Commissioners

in their Report, " to demonstrate these orders of fibres in the cerebellum, than in the brain; and it is by analogy rather than by actual knowledge, that Drs. Gall and Spurzheim admit their existence there:" To which these gentlemen reply, that they did not demonstrate the cerebellum to the Committee, because they had only time sufficient for the demonstration of the brain *. It is natural, however, here to ask, (I leave it to others to answer the question) Why did Drs. Gall and Spurzheim limit themselves as to time in establishing a point of so much importance? Why, supposing such limitation unavoidable, always demonstrate the brain in preference to the cerebellum? Why when it is certain that the time was not limited, uniformly shew so little solicitude about the preservation of the cerebellum, that in the course of the dissection, it became totally unfit for the display of those curiously interwoven systems of fibres, which every anatomist must feel so anxious to see?

* " Nous reppellerons que dans les conferences que nous avons eues avec M. M. les Commissaires, nous n' avons pu faire la demonstration de cervelet, n' ayant eu que le temps suffisant pour celle du cerveau." Recherches, &c. p. 161.

It is not enough to scrape the surface of the corpora restiformia (*en se servant du manche du scalpel*) and produce the fibrous appearance there, nor to perform the same operation on the peduncles of the cerebellum; this is only shewing what every anatomist knows, viz. that the corpora restiformia and the peduncles, are parts distinct from each other, and have their apparent fibres running in different directions. Drs. Gall and Spurzheim must demonstrate the whole course of the corpora restiformia through the cerebellum, such as they have affirmed it to be, tracing each fibre or stratum of fibres to the precise destination which they have fixed for it; and they must display, no less distinctly, the origin of each fibre or laminæ of fibres constituting the *converging* system, following each to the termination ascribed to it in the peduncles, or the parts "*improperly called Valvules;*" otherwise the conclusion is unavoidable, that their description of the two orders of fibres in the cerebellum, is taken not from nature, but from their own imaginations. I know, however, that any such demonstration is impracticable; that their professed discovery, therefore, is entirely conjecture; and that this conjecture is

wholly at variance with the real structure of the parts, as unfolded to us by means more certain, and by investigations conducted on principles much more philosophical.

The investigations to which I here allude are those of REIL; to which DRS. GALL and SPURZHEIM, I observe, have referred in their large work (p. 264.) in such a manner, as cannot fail to impress those who are not familiar with the whole of REIL's inquiries, with the idea, that they serve to corroborate, rather than to contradict their statements. They quote a passage from REIL's description of the appearances which present themselves, when the indurated cerebellum is torn from before backwards, into two halves, in which REIL, speaking of certain decussating cords which are necessarily exposed in such a preparation towards the annular protuberance, says, that

"They correspond more or less to the organization of the *crura* of the cerebellum, which unite together at this part from before, from behind, and from the sides*."

* "Die Entwickelung dieser Stränge und ihre Kreutzung in der Tiefe gegen die Brücke zu, entspricht mehr oder weniger der Organi-

And this individual sentence, in which the *crura* of the cerebellum are only casually mentioned, is adduced by Drs. Gall and Spurzheim as a confirmation on the part of Reil, of the existence of the two orders of fibres which they have described; while not one single allusion is made, in the whole of the rest of their work, to those other essays by the same ingenious author, in the same volume of his "Archives," and in the volume immediately succeeding for 1809, in which he traces with so much minuteness the course of the fibres composing these very crura, and shews that their arrangement is wholly different from that assigned to them in the speculations of Drs. Gall and Spurzheim. It deserves to be remarked too, that these authors make no mention in the essay which I have added in the Appendix, and which was published in Paris in 1813, either of the papers by Reil just referred to, or to his additional ob-

zation der Schenkel des kleinen Gehirns, die an diesem Ort von vorn und hinten, und von beiden Seiten zusammenstossen." Archiv. &c. 1807-8, p. 82.

Drs. Gall and Spurzheim, in their translation of this passage, have left out the words "*in der Tiefe gegen die Brücke zu.*"

servations on the same subject, which are to be found in his "Archives" for 1812.

So much for the inquiries of Drs. Gall and Spurzheim into the structure of the cerebellum; of which it is enough to observe in conclusion, that instead of disclosing new facts, they consist entirely of vague, inaccurate, and conjectural descriptions.

Let us now see how far the science has been benefited by their investigations into the anatomy of the brain-proper.

II. OF THE FIBRES OF THE BRAIN-PROPER.

1. *Of the Diverging Fibres.*

By consulting § 23. of the Appendix, it will be seen that Drs. Gall and Spurzheim derive the whole of the *diverging fibres* of the Brain-Proper, like those of the Cerebellum, from the *grey matter* in the medulla oblongata. Here they form certain *original* or *primitive* bundles or fasciculi, which comprehend the anterior and posterior corpora pyramidalia, the corpora olivaria, and

some other fibres situated at the sides of these last bodies. These fasciculi, however, after their developement, contribute to form parts of the brain-proper, quite distinct from each other; and with reference, therefore, to their future destination, they may be divided into two *sets* or *orders*.

The *first set*, it would appear, are destined, after their complete developement, to form the lower, anterior, and external convolutions of the anterior and middle lobes; and their whole course and distribution are described in the paragraphs from 24 to 29 of the APPENDIX. The *second set* are finally distributed on the convolutions of the posterior lobe, and on those which are situated along the whole upper margin of each hemisphere towards the median plane; and their description occupies the paragraphs of the APPENDIX from 30 to 33.

Each of these *sets* will require a separate examination.

THE original or primitive fasciculi of the *first set*, according to DRS. GALL and SPURZHEIM, are the anterior corpora pyramidalia.

Now by the terms corpora pyramidalia anteriora, or simply corpora pyramidalia, anatomists usually understand, two superficial eminences, which are situated, one on each side of the median fissure, on the anterior surface of the medulla oblongata. *(fig. 4. a)*. But it is obvious, that, in this new system, they are meant to include a good deal more; and yet the authors of it, have nowhere in their writings or engravings, endeavoured to convey to us the least idea of the depth or breadth of the medulla oblongata, which, according to their views, these pyramidal bodies occupy.

Desirous of having this deficiency supplied, without which it were in vain to attempt tracing these fasciculi precisely to their destination, I requested of Dr. Spurzheim, in his second demonstration, to define exactly the boundaries of the corpora pyramidalia, so that they might be readily distinguished from the other primary bundles in their vicinity, intended both for the cerebellum and the brain-proper. After a degree of hesitation and evasion, from which only one conclusion could be drawn, he was prevailed on to attempt this demarcation, on a preparation of the medulla oblongata with which I supplied him,

and which I still preserve. On the surface of the section which had separated this preparation from the annular protuberance, he drew the line *a b*, *fig.* 7, extending quite through from the fore-part of the medulla to the fourth ventricle, and marking off the space *c* for the pyramidal body of that side. How far this division, by which the corpora pyramidalia are made to occupy a section of the medulla oblongata extending from its anterior to its posterior surface, is capable of being reconciled with the descriptions in the sequel, we shall afterwards see.

The pyramidal bodies, however, are described by Drs. Gall and Spurzheim as crossing each other immediately after their origin, (§ 24.); so that the whole fibres of the right corpus pyramidale are originally derived from the *grey matter* in the left side of the medulla oblongata, and the whole fibres of the left one from the right side: And they claim it as a discovery made by them, that this crossing is confined entirely to the pyramidal bodies, and does not extend to any of the other fasciculi in the medulla oblongata.

Upon examination, however, it appears, that this complete crossing of the corpora pyramidalia,

is merely an opinion which they have been led to adopt from an examination of the decussating ridges in the anterior fissure of the medulla oblongata, discovered by MISTICHELLI in 1709 *, and by PETIT in 1710 †. DRS. GALL and SPURZHEIM have neither demonstrated nor delineated any other decussation than this. If these superficial ridges alone make up the corpora pyramidalia, then their total decussation is a discovery to which these gentlemen have no claim. If the corpora pyramidalia comprehend more than these ridges, DRS. GALL and SPURZHEIM have yet to demonstrate their total decussation. If each pyramidal body possess the dimensions ascribed to it by DR. SPURZHEIM, (see *fig.* 7.) it is certain that scarcely one half of their fibres decussate each other.

DRS. GALL and SPURZHEIM affirm, that although the decussation in question was described by MISTICHELLI, and PETIT, and also by SANTORINI, yet there is no precision in their description; they not having restricted the crossing to the pyramidal bodies alone, nor excluded the other fasci-

* Trattato dell Apoplessia, Roma, 1709. 4to.

† Lett. d'un Med. des Hosp. du Roi, Namur. 4to. 1710.

culi of the medulla oblongata, in which it does not take place (§ 24. *note.*) This statement, however, is incorrect, and highly unjust towards these anatomists. I regret that I have, at present, no access to MISTICHELLI's Treatise, so as to be able to quote his own words; but the reader will find, that the Committee of the French Institute state, that the decussation is *very well described* by this author. PETIT's description is in these terms:

"Each pyramidal body divides itself at the lower part into two thick *bundles* of fibres, often into three, and sometimes into four. Those of the right side pass to the left, and those of the left to the right, interweaving with one another *."

There is surely no want of precision here. SANTORINI, after describing an appearance of decussation in the upper and lower margins of the annular protuberance, and under the fourth ventricle, proceeds thus:

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* Lettre d'un Medicin des Hospitaux du Roi, Namur, 4to, 1710. "Chaque corps pyramidal se divise a sa partie inferieure en deux grosses manipules de fibres, le plus souvent en trois, et quelquefois en quatre. Celles du côté droit, passent au côté gauche, et celles du côté gauche passent au côté droit, en s'engageant les unes entre les autres." p. 12.

"But if the decussation be obvious anywhere, it is most evidently visible about two lines below the corpora pyramidalia, and of course below the corpora olivaria. For if the corpora pyramidalia be gently drawn asunder at that longitudinal line or fissure which separates them from each other, (the thin membrane being previously removed, which adheres to them very firmly at this part,) they disclose in the plainest possible manner, not slender fibrillæ merely, decussating each other, but strong bundles of such fibrils running towards the opposite sides. Favourable subjects are not only necessary for perceiving these distinctly, but we must employ a proper and long maceration; for in this way the fibres being very much washed, and the intervening cortical or cineritious matter in great part dissolved, and the filaments of the membranes becoming loose, they are each of them more clearly seen *."

The same excellent author also, in his "*Septendecim Tabulæ*," edited after his death by GIRARDI,

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* "Si ea tamen evidenter uspiam conspicitur, profectò quàm evidentissimè duas vix lineas infrà pyramidalia, atque adeo olivaria corpora conspici potest. Qua enim in longitudinem producta linea, seu rimula pyramidalia corpora discernuntur, si leniter deducantur, probe priùs eo potissimùm loco arctissimè hærente tenui meninge nudata, non tenues decussari fibrillas, sed validos earumdem fasciculos in adversa contendere, quàm apertissimè demonstrabunt. Pro hisce tamen luculentius deprehendendis, non modò idoneis uti cadaveribus opus est; verùm aptam diuturnamque macerationem ad hujusce rei opem adhiberi oportet, eà etenim elotæ plurimum fibræ, dissolutaque magna exparte interjecta corticali, seu cinerea substantia, laxatisque obducentibus membranarum fibris, singulæ se apertiùs in conspectum dabunt."---*Observationes Anatomicæ*, 4to, Lug. Bat. 1739. p. 61.

describes a very good method of displaying the decussation of the pyramidal bodies, by opening up the medulla oblongata from behind *; a mode which has since been recommended by REIL, and which I have often practised: And it is in the Second Table of this work, that SANTORINI has delineated the decussation, as it appears when the membranes have been removed from the medulla oblongata, and it is viewed from before. It was this representation (less accurate indeed than his description of the appearance) that led me, notwithstanding VICQ D'AZYR's opinion, nine years ago, when I first began to teach Anatomy, to examine the decussation closely; and I own it has ever since appeared to me surprising, that any doubts should have been entertained of the existence of a piece of structure so distinct, and so easy of being displayed. The maceration recommended by SANTORINI for this purpose, is unnecessary; because after the Pia Mater has been carefully removed, a very slight pressure with the handle of a scalpel, is sufficient to separate the cords from each other, and to unfold them more clearly.

* Septemdecim Tabulæ, p. 29. 4to. Parmæ, 1775.

In general, this separation is accompanied with the laceration of a small quantity of *white substance* which attaches the fasciculi to each other. Until the parts, however, are drawn asunder, the decussation appears quite superficial; and SANTORINI'S description of it is the more faithful, in so far as it states the necessity of this operation. DR. SPURZHEIM, in both his demonstrations, shewed the decussation only after this artificial separation had been produced by the handle of the scalpel; and it is in this state that it is represented by him and DR. GALL in their Vth Plate.

The French Commissioners observe, that it appears to them, that DRS. GALL and SPURZHEIM

> "have the merit, not of having discovered, but of having recalled to the attention of physiologists, the decussation of the filaments of the pyramidal eminences described by MISTICHELLI, by FRANCIS PETIT, and by SANTORINI, but with regard to which some doubt had been entertained."

Even this praise, however, it seems to me, is by no means justly due them. The structure in question has been taken notice of, ever since its discovery, in elementary works of the highest repu-

tation, and such as anatomists still daily consult; and it has been particularly mentioned in the best and most generally known treatises on the brain: So that there is as little room for maintaining that it has been overlooked by modern anatomists, as that the description of the corpora pyramidalia themselves has been forgotten. Several authors, indeed, have doubted, and some have even denied altogether, the accuracy of MISTICHELLI's and PETIT's description; but this of itself is a proof that they were familiar with the alleged discovery; and their doubts have served to perpetuate the knowledge of it, as much almost as direct acquiescence in it would have done. The "*Observationes Anatomicæ*" of SANTORINI are well known; and there are few works with which anatomists are more familiar, or which they more frequently consult with advantage, than the "*Septemdecim Tabulæ*" of the same author, in which the decussation has been distinctly delineated. WINSLOW's admirable "Exposition of the Structure of the Human Body" is in the possession of every one; and he must needs be a careless reader whom the following paragraph in that work has escaped.

"When we separate these ridges (corpora pyramidalia) with the fingers, we observe a crucial intertexture of several small medullary cords, which go obliquely from the substance of one lateral portion into the substance of the other. M. Petit, Member of the Royal Academy of Sciences, and Doctor of Physic, is the author of this discovery, by which we are enabled to explain several phenomena, both in Physiology and Pathology, of which in another place *."

Lieutaud, in his *Essais Anatomiques*, (a work of which Portal has remarked, that perhaps of all others, it contains, in little volume, the greatest number of discoveries and good descriptions) confirms the decussation†. Haller, in his *Elementa Physiologiæ* ‡, refers particularly to the observations of Petit and the other authors I have just mentioned, although he says he has never seen the appearance they describe. Sabatier, too, in his *Traité Complet d'Anatomie*, one of the best elementary books which France has produced, takes notice of Petit's discovery, and describes the appearance of crossing filaments,

* Anatomical Exposition, &c. translated by G. Douglas, M. D. 8vo. 6th edit. Edin. 1772. Vol. II. p. 110.

† Essais Anat. 8vo. Paris, 1742. p. 399.

‡ Tom. IV. p. 80.

without, however, seeming disposed to admit a real decussation*. GIRARDI, the editor of SANTORINI's *Anatomical Tables*, describes the appearance of the crossing cords very well; yet after a very extensive examination, doubts the reality of the decussation†. Last of all, it is sufficient to observe, that VICQ d'AZYR, in his celebrated work on the Brain, after alluding to the observations of MIS-

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* Tom. II. p. 43. "En écartant ces sillons, on y trouve des filets qui paroissent s'entre-croiser et passer obliquement d'un côté à l'autre. François Petit, ancien Médicin des Hôpitaux du Roi à Namur, et depuis Membre de l'Académie Royale des Sciences, a cru que ces filets donnoient naissance aux nerfs, et il a conclu de cette observation que ceux de ces organes qui vont se distribuer à la partie droite du corps, naissent de la partie gauche du cerveau, et *vice versâ*. La pathologie fournit un grand nombre de faits qui montrent que les choses se passent ainsi, mais le prétendu entre-croisement des fibres de la moëlle alongée n'est rien moins que certain, et ne peut être apperçu d'une manière bien distincte sur le plus grand nombre de sujets."

† "Pia igitur matre, quæ arctissime corporibus pyramidalibus haeret, secundum rimae, quæ inter ea corpora est, longitudinem abscissa, pyramidalia corpora diduxi. Fibræ, de quibus serm oest, diductionis initio observabantur nullæ: et paulo infra apparebant sensim: ac quo magis diducebantur, etsi eo luculentius in conspectum venirent, tamen quomodo in rimæ centrum incederent seque haberent, dijudicare admodum

TICHELLI, PETIT, WINSLOW, LIEUTAUD, HALLER, and GIRARDI, on this subject, expresses himself thus:

"S'il m'est permis de parler de mes travaux, après avoir rendu compte de ceux des anatomistes les plus distingués, je me contenterai de dire qu'en écartant les corps pyramidaux, j'ai vu entre eux non des fibres qui se croisent, mais de petits cordons qui se portant d'un côté à l' autre, les uns transversalement, les autres obliquement, font dans la moëlle alongée l'office de commissures*."

This is a piece of history to which DR. SPRURZHEIM does not always (if he does ever) allude, in

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difficile videbatur. Licet enim ex quatuor et triginta cerebris in uno cum triginti (in reliquis enim nisi subobscure conspiciebantur) fibræ, quæ e dextra corporum pyramidalium parte profisiscebantur, oblique sensim descendere in sinistram, sinistræ vero in dexteram, mediis potissimum interjectis, dirimentibusque porulis sese immittere viderentur, idque ipsum singulis annis auditoribus meis publice ostenderim: nihilo tamen minus harum fibrarum in oppositum latus per medullæ truncum incessum non modo inter corpora pyramidalia, sed, in opposita, quam memoravimus, medullæ parte, ubi luculentius apparent, licet etiam per macerationem inquisierim videre tamen datum est nunquam. Quamobrem hanc fibrarum decussationem licet haud negem, tamen eam proponere haudquaquam audeo." p. 29.

* Traité d'Anatomie, fol. p. 111.

his public demonstrations; and all those who attend on such occasions, without any previous knowledge on the subject, and without having looked into his writings, naturally receive the impression, that the decussation of the pyramidal bodies is one of the discoveries made by him or his colleague. He maintained the most perfect silence with respect to the descriptions of Mistichelli, &c. in his first demonstration in this place; and having done so also in his second, I thought it my duty, in justice to these anatomists, to make their claims known to his audience.

The decussating ridges, I may now observe, discovered by Mistichelli and Petit, and so well described by Santorini, are found by the method of Reil*, to be a part of a considerable set of fibres, which actually cross from one side of the medulla oblongata to the other; and the whole of which may be distinctly unfolded in the coagulated brain, but in no other way.

It is far from being the object of these pages to examine the physiological opinions of Drs. Gall and Spurzheim; I shall, therefore, content my-

* Archiv. &c. B. IX. p. 148. 488.

self with only one remark on the hypothesis which they have connected with this decussation of the corpora pyramidalia (§ 25). It is an observation which has been made since the earliest times, that when insensibility or paralysis has been produced on one side of the body, in consequence of disease of the brain, the apparent injury has, in a great majority of cases, been found after death, to be greatest in the opposite side of that organ. The decussation of the pyramidal bodies was supposed by some to afford an explanation of this singular fact; but it was obviously a very loose process of reasoning, and a careless view of the phenomena, which led to this theory *. The modification of the hypothesis thrown out by Drs. Gall and Spurzheim is not only liable to the same objections, but is at variance with their own speculations respecting the structure of the brain, and assumes certain points as facts which are merely conjectures.

* The only philosophical view of this subject I have anywhere seen, is by Dr. Yelloly, in a very interesting paper on a case of Tumour in the Brain, in the 1st Vol. of the Medico-Chir. Transactions, p. 181.

After this decussation, Drs. Gall and Spurzheim describe the corpora pyramidalia as receiving reinforcements during their ascent on the forepart of the medulla oblongata (§ 24.), so that they are larger above than below. Admitting, however, this increase of size to be a constant occurrence, which I apprehend the examination of a very few subjects will shew it not to be, these gentlemen are called upon, according to their own hypothesis, to point out the *grey matter* which affords the reinforcing fibres; but this they have failed to do, both in their writings and their demonstrations. The column of *greyish-brown matter* which occupies the centre of the Spinal Cord, as soon as it reaches the medulla oblongata, or Top of the Cord, inclines backwards; and reaching the lower point of the fourth ventricle, it splits into two parts, which run up, one on each side of the median fissure, for between a quarter and half an inch, and then terminates *. The upper half, therefore, of the medulla oblon-

* I do not remember that this distribution of the upper extremity of the central grey column of the spinal cord has hitherto been taken notice of. See *System of Human Anatomy*, I. p. 183.

gata contains no central column of grey matter at all.

The corpora pyramidalia are now said to penetrate the annular protuberance, or pons Varolii (§ 26.); and no sooner have they entered it, than they separate into many bundles, which are surrounded with a *great quantity* of *grey substance*, whence many new fasciculi arise and join themselves to the first. Thus receiving continual reinforcements in their progress, they extend upwards, decussating the transverse fibres from the cerebellum; and come out from this *true ganglion*, so increased and enlarged, as to form the two outer and anterior thirds at least, of the peduncles of the brain-proper, or crura cerebri.

In this short description it is difficult to say whether inaccuracy or assumption prevails most.

In the first place, the annular protuberance, instead of containing a large quantity of *grey matter*, seems scarcely to contain any of this *matter* at all. Every particle of the substance which appears *grey* when the protuberance is divided vertically, may be shewn to consist of transverse or horizontal fibres coming from the peduncles of the cerebellum; which uniformly present this

dark appearance when they are divided directly across, although they are as white as the whitest nervous substance, when cut in a direction parallel to their length. It is only when divided in a direction exactly parallel to their course, that the fasciculi continuous with the pyramidal bodies themselves, appear of a white colour; if they are cut across or horizontally, they exhibit a grey hue. So that the colour of the different sets of fibres in the annular protuberance depends entirely on the section which is made of them. In a vertical section of this body, the fibres continuous with the corpora pyramidalia are white, and those connected with the peduncles of the cerebellum grey; in a horizontal section it is exactly the reverse; the former are grey and the latter white *. This fact is very well illustrated by the representations of sections of the annular protuberance in *fig.* 5 and 6, which were drawn with the utmost accuracy by my friend Mr. Syme, from preparations in my possession. To these and to the explanations accompanying them I refer the reader.

* See *System of Human Anatomy*, I. p. 140. I am not aware that this circumstance has been remarked by any other anatomist.

The appearance is fully as distinct in an annular protuberance which has been hardened in alcohol before its division, as in one in its most recent state; and there is this additional advantage in examining it in an indurated preparation, that the fibrous appearance of the whole may at same time be rendered obvious, and the exact correspondence of the colour with the direction of the fibres clearly demonstrated.

Nothing, therefore, can be more incorrect than the statement of Drs. Gall and Spurzheim, that the annular protuberance is a great ganglion of *grey substance*; and although the latter gentleman could not but have been aware of the real circumstances respecting its structure, such as I have described them in my System of Anatomy, no allusion was made to that description in his public demonstrations.

Secondly, there is no proof that the fasciculi from the pyramidal bodies receive continual reinforcement in their progress through the annular protuberance; this is wholly arbitrary assertion. The fact, I apprehend, will be found to be quite otherwise; the united mass of all these fasciculi being considerably less at the upper part of the

protuberance, than in its middle, as a comparison of successive horizontal sections of it will very satisfactorily shew. But granting the regular increase actually to take place, the circumstance would be directly at variance with Drs. Gall and Spurzheim's principles; since the protuberance contains no *grey matter* to afford origin to the reinforcing fibres.

Thirdly, Drs. Gall and Spurzheim do not appear ever to have traced these fasciculi through the annular protuberance, with the least degree of accuracy. There are but two delineations of them given in their folio engravings (Pl. V. and XII.), both of which are as unlike nature as it is possible for any such representations to be. One of these will be found in *fig.* 1; and of this, as well as of the other in their Vth Plate, which I have not copied, it may be safely affirmed, that they represent appearances which never were seen in any human brain *. The drawing by Mr. Syme, in *fig.* 5, of some of these fasciculi, during part of

* How are the boundaries ascribed to the corpora pyramidalia in *fig.* 7, to be reconciled with the representation of their course in *fig.* 1?

their course, will, I trust, be found truer to nature.

In Dr. Spurzheim's demonstrations only a few of these fasciculi were exposed. An incision was prolonged upwards from the corpora pyramidalia, penetrating through the outer stratum of the protuberance, and then this stratum was scraped back so as to disclose some of the longitudinal bundles underneath. The whole dissection was superficial, and to persons accustomed to the more careful investigation of such parts, must have appeared exceedingly rude. The fibrous structure of none of the individual fasciculi was attempted to be shewn; but the fasciculi themselves being slender, and appearing whiter than the surrounding parts, in consequence of the method of disclosing them, it was only necessary to call them *fibres*, and those not conversant in the matter, very readily accepted the name for the demonstration.

But lastly, the historical fact is not to be overlooked, that the connexion subsisting between the crura, or peduncles of the cerebrum, and the corpora pyramidalia, by means of longitudinal fibres of *white substance* passing through the an-

nular protuberance, has been known since the time of VIEUSSENS. Speaking of the crura cerebri, this able Anatomist observes,

* "When they have emerged from the grey substance with which they are intermingled, they proceed in a somewhat flexuous course to the anterior part of the spinal marrow; so that they terminate partly in the medulla spinalis, and partly in the anterior roots of the spinal nerves.

"These medullary bands, which are seen in the crura cerebri, in their prolongation towards the spinal marrow, before going out of the cranium, pass over some medullary fibrils of the annular protuberance, and under others. The medullary bands, therefore, of the crura cerebri, and the medullary fibrils of the annular protuberance, mutually decussate each other and communicate *."

And in illustration of these paragraphs, VIEUSSENS refers to three engravings, which certainly

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* Lib. I. cap. xiii. "Ubi è cinerea, cui interseruntur, substantiâ emerserunt, nonnihil flexuoso ductu, ad anticam spinalis medullae regionem tendunt: adeò ut partim in medullam spinalem, et partim in antica spinalium nervorum principia abeant.

"Ubi praedicti tractus medullares, qui in striatis corporibus mediis conspiciuntur, spinalem ad medullam porriguntur, priusquam è calvaria emergant, alias processus annularis fibrillas medullares superscandunt: et aliis sese subjiciunt. Ita est medullares tractus striatis è corporibus mediis emergentes, et medullares annularis processus fibrillae cruciatim sese invicem interserant, imò et simul communicent."

do very little credit to the artist, but which can leave no doubt as to the parts which the author intended should be represented.

On this description of VIEUSSENS, DRS. GALL and SPURZHEIM make the following remark:

"VIEUSSENS had, it is true, discovered the two orders of laminæ in the annular protuberance by scraping; but his sketch embraces nothing beyond the mechanical part; he derives the whole medullary substance from his *centrum ovale*; he never imagined that the formation of the fibres took place from below upwards, and had no notion of the laws of reinforcement of the nervous fasciculi by the addition of new fibres produced by the *grey substance* *."

It is scarcely necessary, however, I imagine, to point out the weakness and futility of this attempt to deprive VIEUSSENS of his just merit. What is meant by calling his description mecha-

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* Anat. et Phys. du Syst. Nerv. I. 277.

" Vieussens avoit, il est vrai, trouvé en raclant les deux ordres de couches de la protuberance annulaire; mais son coup-d'œil n'embrasse rein au-dela de la partie mecanique; il dériva toute la substance medullaire de son *centrum ovale*; il n'imagina pas que la formation des fibres avoit lieu de bas en haut, ne soupçonna rien des lois du renforcement des faisceaux nerveux par l'addition de nouvelles fibres nerveuses produites par la substance grise.

nical, it is not easy to conceive; but it is certain that it would not in any respect have been more correct, if he had said, that the medullary fibres extended from the corpora pyramidalia to the crura cerebri. It is a matter altogether of choice at what extremity the anatomist commences his description of such a piece of structure as this; nothing whatever has been ascertained respecting the physiology of the parts which determines this to be *origin*, or that to be *termination*; these are words which here, as well as on most other occasions, in anatomical description, are altogether of arbitrary application. Supposing it to be true (which is far from being proved), that the longitudinal fasciculi in the annular protuberance are largest towards the upper part, where they are connected with the crura cerebri, it is in no degree more accurate to describe them as extending from the pyramidal bodies, and receiving an increase of fibres as they proceed, than it would be to say that they descend from the crura cerebri, and that part of them are prolonged to the corpora pyramidalia, while part are lost in the protuberance. As to the formation of new fibres by the *grey substance*, it is creditable to Vieussens that he left

the invention of such an hypothesis to his successors; in so far as it is absurd on every occasion, and wholly inapplicable to a part where no *grey substance* exists.

PETIT, an author already referred to, also describes the fibres of the peduncles of the brain, as extending into the pons Varolii, and after traversing the protuberance, uniting to form the corpora pyramidalia *.

MORGAGNI in his *Adversaria Anatomica* †, has the following remark:

Nothing indeed is easier in most subjects, than by scraping gently and gradually the uppermost part of the corpora pyramidalia, and the lowest part of the annular protuberance, or even without abrasion, by carefully pulling the latter from the former, all other connexions being previously dissolved, to

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* HALLER Elem. Phys. iv. p. 80. CHAUSSIER Exposit. Somm. p. 141.

† Adver. Anat. Sext. Anim. xii. Lug. Bat. 1723.---" Certè enim nihil mihi in plerisque cadaveribus facilius est, quam corporum pyramidalium summam partem, imam autem Annularis Protuberantiæ, aut lentè, paulatimque abradendo, nonnunquam sine ulla etiam abrasione suspensa manu hanc ab illa distrahendo, cæteris nexibus dissolutis, duos intus medullares insignes fasces secundum oblongatæ medullæ longitudinem porrectos, adhuc perstantes ostendere: quos sursum, deorsumque persequendo, ex eorum crassitie, loco, positu saepe comperi, non differre ab iis qui in ea VIEUSSENII Tabula medii inter litteras H H. et G G. secundùm longitudinem feruntur.

shew two remarkable medullary bundles still remaining within, extending in a line with the medulla oblongata: Which, by tracing them upwards and downwards, I have often found, do not differ either in size or situation from those which are represented as running longitudinally in the middle, between the letters H H and G G in VIEUSSENS' Table (xvi.)."

In a passage already quoted, (p. 48.) HALLER describes very precisely the longitudinal fibres of the annular protuberance; and afterwards, when treating of the corpora pyramidalia, he says,

"Into these, the straight fibres we have already spoken of from the crura cerebri, descend *."

VICQ D'AZYR was not only perfectly aware of the connection subsisting between the corpora pyramidalia, and the peduncles, and other parts of the cerebrum, but has endeavoured to delineate them in his XXII. and XXIII. Plates.

The general explanation of Plate XXII. is in these terms †:

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* "In ea, fibræ, quas diximus, a cruribus cerebri rectæ, descendunt." iv. p. 80.

† Traité d'Anatomie, p. 73. "Le cerveau étant renversè de maniere que l'on voie la base en-dessus, si l'on fait une coupe horizontale qui commençant au niveau des corps pyramidaux, se prolonge dans l'epaisseur

"The brain being reversed, so that the base looks upwards, if we make a horizontal incision, which beginning on a level with the pyramidal bodies, is prolonged into the substance of the annular protuberance, into the crura of the brain, into the corpora striata, laterally, before and behind, into the corresponding parts of both hemispheres, we obtain a preparation such as this. It is not without a great deal of trouble that I have been able to execute this section with such precision, as to be properly seized by the artist. *The study of the plate appears to me interesting, in so far as it shews better than all possible descriptions the connections of the medulla oblongata and pyramidal bodies with the annular protuberance, and with their crura and whole medullary substance, in the middle of the brain.*"

And in the particular explanation, the longitudinal bands in the annular protuberance are described in this manner *.

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de la protuberance annulaire, dans celle des jambes du cerveau, dans les corps striés, latéralement, en devant et en arrière, dans les parties correspondantes des deux hémispheres, on obtient une preparation telle que celle-ci. Ce n'est qu'avec beaucoup de peine que je sais venu à bout de la faire avec assez de netteté pour être bien saisie par le dessinateur. L'etude de cette planche me paroît intéressante, en ce qu'elle montre mieux que toutes les descriptions possibles les rapports de la moëlle alongée et des corps pyramidaux avec la protubérance annulaire, avec les jambes et toute la substance médullaire moyenne du cerveau.

* P. 74. Des filets ou *tractus* longitudinaux, qui coupent les premiers à angle droit, dans lesquels la substance blanche domine, et qui s'étendent des corps pyramidaux vers les jambes du cerveau. Ces filets

"Fibres or *traetus longitudinaux*, cutting the former at right angles, in which the white substance predominates, and which extend from the corpora pyramidalia towards the crura cerebri. These whitish filaments, intersected at many points with cineritious substance, traverse the whole thickness of the annular protuberance, and expand and separate from each other before: Some go to the middle of the *locus niger crurum cerebri*; others are seen at 18 (parts external and anterior to the *locus niger*;) others may be perceived even at 51 (parts internal to the locus niger); the greater number are blended with the fibres of the corpora striata. *Whence it results that the medulla oblongata, of which the corpora pyramidalia make a part, communicate directly through these* tractus, *not only with the annular protuberance, but with the crura of the brain and the corpora striata; and we may even add, with the optic thalami.*"

In GREN's *Journal* for 1795, REIL has distinctly stated that the fibres of the corpora pyramidalia extend through the annular protuberance, to the crura cerebri; and his description of their

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blanchâtres, entrecoupés dans plusieurs points de substance cendrée, traversent toute l'épaisseur de la protuberance annulaire, s'épanouissent et s'écartent en devant: les uns passent au milieu de la tache noire, *locus niger crurum cerebri*; les autres se voient en 18, et quelques uns s'apperçoivent même en 51, la plupart se confondent avec les filets des corps stries. D'où il resulte que la moëlle alongée, dont les corps pyramidaux font partie, communique immediatement par les *tractus*, soit avec la protuberance annulaire, soit avec les jambes du cerveau et avec les corps stri s; ou peut même ajouter avec les couches optiques.

progress, and of their intersections with the horizontal fibres in that body, is very minute *.

To none of these descriptions, however, have Drs. Gall and Spurzheim made any allusion, except to that of Vicq d'Azyr, and on this they are pleased to remark, that

"Vicq d'Azyr wished to imitate the anatomical preparation of Vieussens. But as he was equally devoid of physiological principles; as he derived all the medullary mass from above; as he did not scrape the fibres, and hoped to make discoveries in the brain by multiplying sections of it, he cut all the fibres, and his preparations, such as we see them in Plate XXII. and XXIII. offer only irregular fragments of the *ensemble* of the organization *."

Drs. Gall and Spurzheim, however, have yet to point out what those physiological principles are in which Vicq d'Azyr was deficient, and by

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* P. 101.

* Anat. et Phys. &c. p. 278. Vicq d'Azyr voulut imiter la préparation anatomique de Vieussens. Mais comme il étoit pareillement dépourvu, de principes physiologiques; qu'il derivoit de haut en bas toute la masse medullaire; qu'il ne racloit pas les fibres, et qu'il esperoit faire des decouvertes dans le cerveau en multipliant les coupes, il coupa toutes les fibres, et ses preparations, telles qu'on les voit Pl. XXII. et XXIII. n'offrent que des fragmens informe de l'ensemble de l'organisation.

which they themselves regulate their inquiries; and notwithstanding the confident manner in which they express themselves on this point, the reader has only to look back to the extracts which I have given in the preceding pages from Vicq d'Azyr's work, to see that this elegant and philosophical writer has described the prolongation of the pyramidal bodies through the annular protuberance in language the most precise. His delineation, too, of these longitudinal bands in Plate XXII. will be found to be an accurate representation of the appearance they must have assumed in the particular section he employed; whereas the representation of these fasciculi given by Drs. Gall and Spurzheim in Plates V. and XII., are unlike any view of them which it is possible to exhibit.

Drs. Gall and Spurzheim, therefore, have added nothing that is not either inaccurate or wholly conjectural, to the descriptions which have been long given of the longitudinal fasciculi connecting the corpora pyramidalia and the crura cerebri.

The anterior and external parts of the peduncles or crura cerebri, thus regarded by these ana-

tomists as the continuation of the pyramidal bodies, are next described by them (§ 27.) as containing throughout their whole length a great quantity of *grey substance*, by which they are continually reinforced with new fibres. It is at their upper extremities, however, just where they are embraced by the optic nerve, in the outer part of the corpora striata, that they receive the greatest increase. From this point they separate and prolong themselves in the form of filaments of various lengths (§ 28.); which expanding into laminæ, covered at their extremities with *grey substance*, form the lower, anterior, and external convolutions of the anterior and middle lobes (§ 29).

This description is objectionable in all its points; it is full of error and hypothesis; and when we take into consideration that it relates to a part of the brain which has long been an object of particular attention among anatomists, and which of late years especially, has been most carefully and accurately delineated, the apparent want of knowledge which it betrays is altogether extraordinary.

When the peduncles of the brain-proper are examined in the recent state, they are found to be

composed of orange-white matter, with a very slight intermixture of greyish-brown; the white matter being arranged into very fine laminæ and threads, which run upwards and a little outwards, gently curved towards the median plane. They are continuous in each hemisphere, with a stratum of orange-white matter, from a fourth to a fifth of an inch in thickness, which runs upwards and outwards external to the thalamus opticus, forming a gentle curve towards the median line; and then expands into an arch or vault, which penetrates through the middle of the corpus striatum from one end of it to the other, and at last joins the central white mass of the convolutions, along the whole border of the corpus callosum. The concavity of this vault looks downwards and outwards, and as it follows the inclination of the corpus striatum, it is also arched from before backwards. Its two anterior thirds nearly, are formed into large cords, by the interposition of strata of greyish-brown matter, and all the cords extend outwards in the general direction of the vault. A number of fine threads, too, of white matter, may be seen, shooting from a variety of points on the superior surface of these cords, into

the greyish-brown substance of the corpus striatum, and there gradually disappearing without reaching its surface. The posterior third of this vault, is composed entirely of white nervous matter; but from the upper surface of this portion of it also, short and slender filaments are found extending, into the brown matter forming the posterior extremity of the corpus striatum *.

The cords or bands of *white matter* which run through the corpora striata, were known to WILLIS; and it was this anatomist who first bestowed upon these bodies the appellation of *striated*, from these white cords.

"These bodies," says he, "if they should be dissected along through the middle, appear marked with medullary streaks, or as it were rays or beams: Which sort of chamferings or streaks have a double aspect or tendency, to wit, some descend from the top of this body, as if they were tracts from the brain into the Oblong Marrow; and others ascend from the lower part, and meet the aforesaid, as if they were paths of the spirits from the Oblong Marrow into the Brain. And it is worth observation, that in the whole head besides there is no part found chamfered or streaked after the like manner †."

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* See Syst. of Hum. Anatomy, I. p. 132.

† The Anatomy of the Brain, Chap. XIII. Lond. fol. 1681. Under the name of *Oblong Marrow*, WILLIS comprehends "all that substance which reaches from the inmost cavity of the Callous Body and conjunc-

The descriptions and delineations of VIEUSSENS sufficiently shew how minutely acquainted he was with the anatomy of these white bands. Speaking of the anterior processes of the medulla oblongata (by which he means the corpora striata *) he says,

"These consist internally of white bands, which are separated from each other by intervening cineritious substance; so that they appear whitish grey. Their surface being *scraped*, the more external and lesser medullary bands of which they consist are brought into view; but when they are *scraped* deeper, the more internal and thicker ones are exposed, which are so arranged, that along with the intervening grey substance by which they are separated from each other, they resemble, somewhat, bodies marked with striæ. Hence without doubt it was, that the celebrated WILLIS called them *corpora striata*.

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ture in the basis of the head, to the hole of the hinder part of the head; where the same substance, being yet farther continued, ends in the spinal marrow."

* Lib. I. Cap. XI. Hæc intrinsecùs tractibus albis constant, quorum alii ab aliis, substantiæ cinereæ interjectu distinguuntur; proindéque albo-cinereæ apparent.

Derasâ primâ anteriorum medullæ oblongatæ processuum superficie, exteriores ac minores, quibus constant, tractus medullares in conspectum veniunt.

Ubi verò ipsi profundiùs deraduntur, interiores ac crassiores eorum tractus sese produnt, qui ita dispositi sunt, ut unà cum cinerea substantia, quâ intermediâ, ab invicem distinguuntur, corporum striis distinctorum figuram aliquatenùs æmulentur. Ex quo procul dubio factum fuit, ut Clarissimus Willisius prædictos medullæ oblongatæ processus, striata

From their situation, and to distinguish them from the other striated bodies of the medulla oblongata, we shall denominate them the upper and anterior corpora striata.

" All the medullary cords of which they consist are derived from the upper region of the centrum ovale, and go into the white or medullary substance which lies between the corpora striata and the optic thalami ; so that this medullary substance, which like a semicircle, surrounds the outer border of each thalamus, may be regarded as a double centre for all the white bands coming from the upper region of the centrum ovale."

In his IX. X. XII. and XIII. Tables, views are given of these bands as seen from above and within ; and in Tab. XIV. XV. and XVI. as seen from below. These last exhibit their connections with the peduncles of the brain, the annular protuberance and the pyramidal bodies. The peduncles, or crura, he calls the *middle corpora striata;*

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corpora nominaverit, quæ nos habitâ situs ratione striata corpora superna anteriora, nominamus : ut hæc à reliquis medullæ oblongatæ striatis corporibus distinguamus.

Medullares omnes tractus, quibus anteriores medullæ oblongatæ processus constant, è superni ovalis centri regione educuntur, et in albam, seu medullarem substantiam abeunt, quæ anterioribus, prædictis processibus, et nervorum opticorum thalamis interjicitur, adeò ut medullaris hujusmodi substantia, quæ exteriorum utriusque thalami nervorum opticorum ambitam, hemicycli adinstar comprehendit, sit veluti geminum centrum alborum omnium tractuum, qui è superna ovalis centri regione educuntur,

and he divides the bands exposed in this view into two parts, an anterior and a posterior, and denominates the one the *anterior* and *lower*, and the other the *posterior* and *lower*, *corpus striatum*. All the views were obtained, as VIEUSSENS states, by *scraping*; but the representations are so coarse, that they can only be regarded as diagrams intended to illustrate the author's verbal description *."

VICQ D'AZYR has represented the progress and appearance of the white bands of the corpora striata in a series of sections, which are among the most correctly executed in his work. To the engravings of the 'Traité d'Anatomie,' in general, there are many objections, but it is impossible for any anatomist who is familiar with the structure of the brain not to admit, that VICQ D'AZYR, in his representations of the corpora striata in Plates IX. to XIV. has copied nature very closely. No one

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* VICQ D'AZYR, in reference to this part of VIEUSSENS' work, observes very correctly;

"Il est cependant juste de dire que VIEUSSENS a connu mieux que tout autre avant lui les rapports des jambes du cerveau avec les couches optiques, les prolongements de la commissure anterieure et ceux des stries inferieures et moyennes qui s'etendent jusqu'aux corps pyramidaux." Traité, &c. p. 35.

can acquire a perfect knowledge of the anatomy of the white bands in these bodies, who does not practise the sections there represented, in addition to the procedure of REIL. VICQ D'AZYR's explanations, independent of the engravings themselves, sufficiently shew, how minutely he had studied this part of the brain; and we have already seen (p. 86.), that he was not ignorant of the connection subsisting between the corpora striata and the peduncles, the annular protuberance, and the pyramidal bodies*.

The additions, however, which REIL was enabled to make to our knowledge of the connections of the crura cerebri, by a careful application of his peculiar method, were very important. As early as 1795, he describes the crura as spreading out, just after they have been surrounded by the optic nerves, almost horizontally, like an unfolded fan, under the lateral ventricles, towards the lower, and lateral parts, and extremities of the

* DRS. GALL and SPURZHEIM do not scruple to affirm, with unparalleled injustice to VICQ D'AZYR, that these very Plates represent "neither the position, nor the internal structure, nor the connexions of the corpora striata." Anat. & Physiol. &c. I. p. 283.

brain-proper *. But the final results of his investigations into this singular structure are to be found in two essays, the first of which is inserted in the *Archives of Physiology* for 1809, and the second in the same work for 1812; each being illustrated with engravings, particularly the last, which are remarkable for their clearness and accuracy. I have compared both these papers with nature, and am satisfied that REIL has left little for his successors, either to correct or to discover, in this department of the anatomy of the brain.

To these valuable dissertations, however, not the least allusion is made either by DR. GALL or his partner, in any of their writings. And yet the essay in GREN's Journal was published thirteen years before these gentlemen presented their Memoir (which is their first composition) to the French Institute; and five years at least, I presume, before they were even heard of as anatomists in Europe †. Again, REIL's essay in the

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* " Und jeder Schenkel breitet sich alsdenn, nachdem ihn der Sehnerve umfasst hat, wie ein entfalteter Faecher fast waagerecht unter der grossen Hirnhöhle gegen die unteren Flächen, Seitentheile und gegen die Extremitäten des grossen Gehirns aus.---GREN's *Journal*, I. p. 102.

† SOEMMERRING, in the IVth Volume of his System of Anatomy, published at Frankfort in 1800, refers expressly to this essay; but without any mention of the name of GALL.

Archives for 1809, (to say nothing of the paper in 1812) which contains the most complete description of the brain-proper, was published a year before the appearance of Drs. Gall and Spurzheim's quarto work in Paris; four years before the composition of their essay for the *Dictionaire des Sciences Medicales,* which I have given in the Appendix; and six years prior to the publication of Dr. Spurzheim's separate book on Physiognomy. I will not do Reil the injustice to insinuate, that Drs. Gall and Spurzheim have borrowed their views without acknowledgement from him; had they adopted the descriptions of this accurate inquirer, the present pamphlet would have been unnecessary. But it is surely not unreasonable to have expected, that some reference should have been made to the writings of an anatomist, who has the sole merit of having revived the investigation of the fibrous structure of the brain in modern times; and who, by pursuing steadily the only method by which that inquiry can be satisfactorily conducted, has obtained results at variance in every particular, with those conjectural statements, which by writing and by travel, these gentlemen have been labouring for years to establish.

The following is a mere outline of REIL's description :

The crura cerebri, or peduncles of the brain-proper, in their course from the annular protuberance to the substance of the hemispheres, consist of numerous very fine laminæ of fibres, the edges of which are turned outwards and inwards, and of which the filaments run in the direction of the crura. Immediately after being embraced by the optic nerves, they penetrate into each hemisphere, and extend upwards on the outside of the optic thalami, diverging and spreading out as they ascend. Certain laminæ of fibres join them from the thalami in their progress ; and at last having arrived at the outer circular margin of these bodies within the lateral ventricles, they spread out from the whole of this margin in the form of radiating fasciculi, or bands of fibres, which run forwards, upwards, backwards, and downwards, and all of them at same time more or less outwards, into the substance of each hemisphere *.

* The circular border from which this radiation takes place, has been denominated by REIL, *Stabkranz*. Rather, however, than adopt the literal translation of this term, I should feel inclined to call it the *Circle of* REIL.

The fasciculi which extend forwards are long, slender, numerous, and lie close together. They run through the corpus striatum; covered, internally, by the inner bulbous part of this body in the anterior horn of the lateral ventricle, and externally, by that portion of the same body which is inclosed in the *capsule**; and the grey matter penetrates between some of the fasciculi. In their progress forwards and outwards, they form an arch or vault, concave downwards. The anterior commissure of the brain passes through between the roots of the first or lowest fasciculi. At last, within the substance of the anterior lobe, they unite at a small angle, with the fibres of the anterior part of the corpus callosum, internally and above, and with the anterior radiations of the outer wall of the *capsule*, externally and below.

The fasciculi which extend upwards are the shortest and thickest. Like the former, they pass through the corpus striatum; but as the portion of this body which projects into the lateral ventricle is of a tapering shape, they are covered, on this surface, only by its narrow posterior part. After a course outwards and upwards of from a

* See the description of this *capsule* in the sequel, p. 107.

quarter to an eighth of an inch, they meet at an angle with the fibres of the corpus callosum above, and the upper radiations of the outer wall of the *capsule* below; and so contribute to form the upper and outer portion of the substance of each hemisphere.

The fasciculi which proceed backwards are the longest and finest of any. The most internal of these, or those which lie nearest the cavity of the ventricle, may be traced to the very extremity of its posterior horn. At their origin they are covered merely by the tænia semicircularis and a little grey matter, continued from the tapering part of the corpus striatum. A little farther back they are distinctly intersected at right angles by fibres extending from the lower surface of the corpus callosum; and all beyond this they are covered by an uninterrupted layer of these fibres, which must be carefully removed in order to bring them into view. The fasciculi, on the other hand, which are more externally situated, after a shorter course, unite above with the fibres of the posterior part and upper surface, of the corpus callosum, and before, with the posterior radiations of the outer wall of the *capsule*; and

thus they contribute to form the outer portion of the substance of the posterior lobe.

Lastly, the fasciculi which radiate downwards extend into the middle lobe; the more posterior ones inclining a little backwards, the middle ones running directly downwards, and the anterior turning a little forwards. Towards the cavity of the inferior horn of the ventricle, they are covered only by a stratum of fibres continued from the tænia semicircularis, and from the lower surface of the corpus callosum behind. Externally, they unite with the inferior fibres of the outer wall of the *capsule*, and with the radiation of the anterior commissure; and thus contribute to form the outer portion of the substance of the middle lobe.

How much this description differs from the statements of Drs. Gall and Spurzheim, my readers will easily perceive. The crura cerebri, according to these gentlemen, contain, throughout their whole length, a great quantity of *grey substance*, by which they are continually reinforced with new fibres; whereas the quantity of this substance mingled with them, is just perceptible, and no more; and the reinforcement of fibres from it, is a mere averment, for which there

is no foundation. Nor are there better grounds for the statement that they receive a still greater increase just where they are embraced by the optic nerve; neither this greatest increase of all (*le plus grand accroissement*, § 27.), nor the means by which, according to their own principles, it must be accomplished, are susceptible of demonstration.

The last part of this description is as imaginary and erroneous as the rest. The crura cerebri are said to be spread out, and prolonged into filaments, which terminate in the *grey matter* of the lower, anterior, and external convolution of the anterior and middle lobes, and form these convolutions (§ 28, 29.);—a statement not one article of which can be made good by demonstration. In the *first place*, it is not practicable to trace a single fibre of the crura distinctly into the *grey substance* of any one of the convolutions here named; far less can it be shewn that these convolutions are wholly formed of such fibres. Indeed this last part of the speculation is quite inconsistent with the origin they have ascribed to their system of *converging fibres*; which, as we shall see in the sequel, they have affirmed to enter as largely in-

to the composition of all the convolutions as the *diverging fibres* do.

Secondly, their description excludes the posterior lobe of the brain-proper, altogether, from any connection with the crura, which is an error of unaccountable magnitude; in so far as the mass of fibres which radiate from the crura into this lobe, is fully as great as that extending into the other parts of the hemispheres, if not greater.

In the *third place*, those fibres of the crura which they describe as supplying the middle lobe, have a destination so entirely different, that the utmost conceivable carelessness will not explain the inaccuracy of their statements with respect to this part of the brain. We are not left to collect from the vagueness of verbal description alone, what these fibres are; they are distinctly represented in the Vth. and Xth. Plates of their large work. In Plate V. a set of filaments are delineated on the left side, as diverging from the peduncle, immediately above the outer border of the optic nerve (*q*, *t*, *u*), and terminating in the lower convolutions of the middle lobe (*w*, *w*, *w*); and in the same Plate, on the right side (*h*, *h*, *h*), as well as in Plate X. (*h*, *h*, *h*), the fibres supplying

the other convolutions of this lobe, are represented, cut off near to their origin from the peduncle. Now with respect to the first of these sets of fibres, I have to observe, that none such exist in the brain; and that there is no such connection between the crura and the inferior convolutions of the middle lobe as here represented. With regard to the second, it will be found, that the whole of them terminate in the external part of the corpus striatum;—that they do not even reach the outer wall of the *capsule* in which this part of the corpus striatum is contained;—and that so far from extending to the middle lobe, they are separated from it, not only by this wall and the convolutions which rest upon it, but also by the fossa Sylvii. Drs. Gall and Spurzheim have taken no notice, in their writings, of this portion of the corpus striatum; and their engravings could not have been more defective with respect to it, even if it had been their avowed intention to avoid any section of the brain by which it might be brought into view. This is an omission for which it is not easy to assign any satisfactory reason. No doubt this part does present an unequivocal instance of fibres running from the crura

into *grey matter*, and there vanishing, instead of originating in the *grey matter*, and going to reinforce the crura; but it would be unreasonable to entertain the supposition that their partiality for an hypothesis had led them to pass over this appearance; because, however extraordinary the mistake may be, it is certain that they really believe these fibres to terminate in the middle lobe, with which they have not the most remote connection. Nor would it be just to these anatomists, professing, as they do, such superior knowledge of the structure of the brain, to suppose, that this portion alone, of all others, had entirely escaped their notice. It is one of the most singular in the whole organ. Every one who has inspected Vicq d'Azyr's IX. X. XI. XIV. XXII. XXIII. and XXVI. Plates, must be familiar with its situation, and know a good deal of its structure; notwithstanding the imperfections in the colouring, and even in the drawing of these representations. Reil has described it at great length, and with his usual accuracy. According to him, this outer portion of the corpus striatum is inclosed in a three-sided *capsule*. The inner side or wall, is formed by the peduncles in their progress up-

wards, and by their anterior and middle radiations. The lower wall consists of the lamina cribrosa, the foundation of the convolutions supporting the root of the obfactory nerve, and that plate of white substance which extends outwards from the peduncle, above the optic nerve, to the outer wall of the inferior horn of the lateral ventricle. The outer wall is the most remarkable of the three, and REIL is entitled to the sole merit of having discovered its very singular structure. It consists of a thin stratum of *white substance*, placed almost parallel to the median plane, and uniting with the lower wall below, and with the inner wall, (that is, with the radiations of the crura) before, above, and behind. At its lower and anterior margin it has a deep semilunar notch, corresponding to the fossa Sylvii. It consists of fibres which radiate from a point behind and a little above the semilunar notch, in all directions, until they meet with the fibres of the crura as already described. More immediately behind the notch, too, it is perforated by the anterior commissure, which immediately after it gets upon its outer surface, radiates along with its fibres backwards and downwards. The small convolutions at the bottom of

the fossa Sylvii rest upon the outer surface of this wall; but the fibres of the convolutions, and of the wall, instead of lying in the same direction, are placed at right angles to each other. Here are a set of fibres of which Drs. Gall and Spurzheim have taken no notice; and which they would find it a hard task to reconcile with any part of their system *.

Lastly, these gentlemen have passed over in silence, the numerous delicate filaments of *white substance*, which shoot out from the anterior radiations of the crura, into the inner bulbous part of the corpora striata, and are there entirely lost; an omission which is the more remarkable, as these fibres present another instance of a distribution quite irreconcileable with their system of continual reinforcement.

It now only remains for me to take notice of Dr. Spurzheim's mode of procedure, when in the

* The peculiarities of colour in the portion of the corpus striatum, contained in the *capsule*, have not yet been well represented; and Reil does not seem to have attended sufficiently to the *grey matter* which is placed in the middle of the outer wall, although Vicq d'Azyr has not failed to delineate this substance. See relative to both these points, *Syst. of Hum. Anatomy*, I. p. 138-9.

course of his public dissections, he is led to the display of those continuations of the crura cerebri, which we have just been considering.

In his first demonstration in this city, he rubbed off, partly with the points of his fingers, partly by scraping with the handle and edge of a scalpel, the whole of the outer part of the corpus striatum, together with the outer wall of the *capsule* containing it, and the convolutions resting on that wall; and thus exposed the outer and lower edges and surfaces of the bands and cords, which traverse the corpus striatum, continuous with the crus cerebri. He then removed, in a similar manner, the whole inner portion of the corpus striatum, which projects into the anterior and middle part of the lateral ventricle, and thus brought into view, the upper and inner edges and surfaces of the same bands. But here ended the demonstration. No attempt was made to shew *en raclant* that these bands consisted of fibres running in the direction of the bands themselves, and not transverse to them, or obliquely; far less was it endeavoured to trace any one of these fibres to its termination in the *grey substance* of any one of the convolutions, into which he and his col-

league profess to have discovered that they extend. He scraped away, in short, two parts of which the structure is at variance with his descriptions, and wholly irreconcileable with his hypothesis, and exhibited lateral views of bands of white substance, with which there is no anatomist who would not be ashamed to confess that he is ignorant, and which, in fact, originally procured to the corpora striata, the appellation by which they have been known for nearly 140 years.

In his second demonstration, the same procedure was repeated; with this only difference, that before removing the outer part of the corpus striatum, he made a horizontal section, or rather laceration of it, and exhibited it hastily to his spectators, as a substance sending fibres to the middle lobe; although if a moment's time had been allowed them for its close examination, they would have seen, that its filaments do not even reach the small convolutions in the bottom of the fossa Sylvii. Being now, however, called upon to shew, by *scraping*, that the white bands of the corpus striatum were actually composed of longitudinal fibres, he appeared surprised at the request; and

seemed to conceive that no other demonstration of their fibrous structure was necessary, than the appearance which they had already been made to exhibit, by removing the grey substance covering them. When after some difficulty, however, he was made to comprehend, that to display slender cords, or the sharp edges of laminæ of *white substance* passing through *grey*, was not to demonstrate that these white cords or laminæ themselves were fibrous, far less that their fibres run longitudinally, he denied that he had ever affirmed that the *white substance*, considered apart from the *grey*, exhibited a fibrous structure. This extraordinary assertion was easily refuted by a reference to two paragraphs of his own work, as I have already had occasion to state (page 28); and the fibrous structure of the white bands of the corpus striatum, (than which nothing is more easy of being displayed in a brain prepared and dissected according to the method of REIL,) proved unsusceptible of demonstration in the recent organ, even in the hands of DR. SPURZHEIM, notwithstanding the ease, with which he and his colleague profess to be able to *scrape* the fibres into view, in any part of the brain. DR. SPURZHEIM,

it is proper to remark, seems disposed, in his public dissections, to dwell very particularly on this part of the brain; a circumstance for which it is not easy to assign any satisfactory reason. I may mention, however, that I have had occasion to observe, that persons whose acquaintance with the structure of the brain did not much extend beyond its division into hemispheres and lobes, but who had heard that Drs. Gall and Spurzheim had professed to have discovered fibres in this organ, have sometimes left the demonstrations of the latter gentleman with the impression, that these *white bands* in the corpora striata were the fibres which he had discovered.

Dr. Spurzheim was next requested to trace any of the fibres of these bands, into the *grey substance* of those precise convolutions to which he and Dr. Gall profess to be able to follow them; and to distinguish them from the fibres of the *converging system*, which, as we shall immediately see, they have affirmed to take their origin from the *grey matter* of the same parts. But here, as upon every other occasion where he was called upon to make good those affirmations which constitute the leading features of his system, he

endeavoured to excuse himself from the task, by denying that he had ever maintained any such structure to be demonstrable. He asserted, very positively, that he had nowhere professed in his writings, that he could trace the fibres, either of the *diverging* or *converging system*, farther than the bottom of the convolutions. How much Dr. Spurzheim's memory had failed him in this instance, I endeavoured to enable his audience to judge, by reading to them the only paragraph relative to the point which he has thought proper to introduce into his Physiognomical Work. It is this:

"Finally, at the external margin of the optic nerve, the nervous bundles of the crura cerebri assume a diverging direction, and *form variously unfolded expansions, which are called the convolutions of the brain.* In this way the pyramidal eminences, being successively increased, and at last completely developed, *form* the inferior, anterior, and exterior convolutions of the anterior and middle lobes. (p. 37.)

Such of my readers, however, as have consulted the paragraphs of the Appendix to which I have referred in the preceding pages, cannot fail to be particularly struck with the nature of the ex-

cuse ventured upon by Dr. Spurzheim on this occasion. In § 27, 28, and 55, it is not only stated expressly that the *diverging fibres* expand to form certain convolutions, and have their extremities covered with the *grey matter* of these convolutions; but in § 56, there is the following observation:

"When we cut one of these prolongations perpendicularly or across, we see that the white substance is broadest at the base of the convolutions, and becomes always narrower towards the top: which arises from the nervous fibres on each side, *losing themselves successively in the grey substance; while those in the middle only, are prolonged to the extremity.*"

And in § 52, there is this unequivocal statement:

"It results then from all we have said, that the *diverging* nervous filaments penetrate into the convolutions, and that the *converging* fibres come out of them. It remains only to be ascertained, whether the *diverging* fibres are merely increased by the *grey matter* situated on the external surface of the convolutions, and then turned round to form the *converging* fibres; or whether they do not terminate in the *grey matter* altogether, while the *converging* filaments constitute a distinct system, *originating in that matter.* Anatomy has not yet determined this point."

I leave my readers to view in what light they may, this denial on the part of Dr. Spurzheim, of those professions which he had so confidently made in his writings. It is sufficient for me to state, that he made no endeavour to shew the progress of any of the *diverging fibres* into the grey matter of the convolutions.

On the *second set* of *diverging fibres*, a very few remarks will suffice.

These, at their origin on each side of the medulla oblongata, are said to be in part formed by a fasciculus of fibres derived from the corpus olivare; which body is pronounced to be a *ganglion* like the corpus dentatum of the cerebellum (§ 31. *and note*). If we cut it through, we are told that we shall find the *grey* and the *white substance* distributed in it exactly as they are in that ganglion; and accordingly, in the XIIth Plate of their large work, Drs. Gall and Spurzheim profess to have given an accurate representation, of the appearance which it exhibits when divided into two parts longitudinally. It is a part of this Plate which I have copied in *fig.* 1, to which I beg the

particular attention of my reader. The corpus olivare is marked *i*.

The description and representation are both equally inaccurate. There is no such mass of *grey matter* in the medulla oblongata, as they have stated. The substance lying immediately within the corpus olivare, is indeed precisely similar to the *corpus dentatum* lodged in the hemispheres of the cerebellum; but not to such an imaginary corpus dentatum as Drs. Gall and Spurzheim have figured. It consists of a finely indented capsule of *brown-matter*, containing a nucleus of pure *white substance;* the capsule being in general deficient towards the inner part. In *fig.* 4. *c*, I have represented its exact appearance, when divided into two parts by a section passing through it from above downwards, and from before a little backwards; in other words, by such a section, as removes the whole prominence of the corpus olivare from the surface of the medulla oblongata, and leaves a flat surface in its stead. The drawing was executed by Mr. Syme with his usual accuracy. It was taken from the medulla oblongata of a full grown subject, only twenty-four hours after death; and it will readily be perceived that it is

a view of the inner half of the right corpus olivare. I have to request of my readers that they will contrast this representation with that given by Drs. Gall and Spurzheim in *fig.* 1. *i*; which on examination, it will be found, exhibits an appearance such as no human brain ever could have presented, and such as no artist ever could have seen in that organ. The same general structure may be observed in the views of the corpus olivare accidentally exhibited in *fig.* 2. *f*, and in *fig.* 5. *c*; although in these, the body is only slightly sketched; my chief object in these figures being to represent other parts.

I subjoin in a note the minute description which I have given of this substance in my *System of Anatomy* *; and have only to remark, that as Dr.

* The top of the cord contains, on each side, between the median plane, and the oblong and oval eminences (*Corpora Olivaria*), a substance exactly similar to the corpus dentatum in the cerebellum, and to which the same name may be applied *. It is oval-shaped and flattened. Its long diameter lies upwards and downwards; and its flattened surfaces are turned, one forwards and inwards, the other backwards and outwards. It is about five eighths of an inch long, a quarter of

* Vicq d'Azyr calls it "Le Corps Festonne, Dentelé, ou Rhomboïdal des Eminences Olivaires." Traité d'Anatomie, p. 98.

SPURZHEIM shewed himself quite familiar with my account of the corpus dentatum in the cerebellum, and endeavoured by a procedure, of which I doubt not that my readers have formed a proper opinion, to fix the character of inaccuracy on that account, it is somewhat surprising that he should have passed over in the most perfect silence my description of the *corpus olivare*, and omitted, or forborn to exhibit, a single view of that body throughout the whole of his demonstration.

From this *ganglion*, as they chuse to call it, DRS. GALL and SPURZHEIM affirm that a strong

an inch broad, and a sixth of an inch in thickness. Its outer half occupies the whole length of the oval eminence; and its capsule is separated from the surface of this eminence only by a stratum of orange-white matter about a twentieth of an inch thick. Its inner border reaches to within a fifteenth part of an inch of the median plane. Its capsule consists of the same brown matter as that of the corpus dentatum in the cerebellum; but its indentations are finer. This capsule is generally quite complete along the outer half of the body; but towards the inner border I have always found several small deficiencies in it. The nucleus consists of pure orange-white matter; through which numerous blood-vessels, chiefly venous, and larger than commonly occur in the white matter, are distributed. This greater vascularity will account for its having been often mistaken for brown matter, as well as the nucleus of the corpus dentatum of the cerebellum.

fasciculus of fibres comes out; but at what part these fibres emerge, or where we are to look for them, these gentlemen have not chosen to mention. Dr. Spurzheim did not touch on this ground in his public demonstrations. If it is meant that the few fibres in *fig.* 1. just below the letter *n*, should represent this fasciculus, I beg leave to observe, that no such fibres exist in the human brain.

This imaginary fasciculus is next said to unite with certain other fasciculi of the medulla oblongata, which they call *posterior*, and which are represented in *fig.* 1. *k*. Nothing, however, is communicated by Drs. Gall and Spurzheim in their writings with respect to the origin of these; and the latter gentleman does not think it necessary to shew them in his dissections. We are left, therefore, to trace them to their source by means of the engravings; and the result is, that they all arise from the corpora pyramidalia! (see *fig.* 1. *k*, *d*.) It is needless to say that no such fibres are to be found in the medulla oblongata.

These united fasciculi are now affirmed to ascend in the direction *k*, *l*, *m*, *fig.* 1; behind the posterior boundary *n*, *o*, of the annular protuber-

ance *f*, but yet between the transverse fibres coming from the cerebellum; and to receive reinforcements in their progress. To this I reply, that no such fasciculi exist. At same time, admitting their existence, it is not easy to understand how they could pass both behind the annular protuberance, and between those transverse fibres of which that protuberance is in great measure composed. Why does not the engraving *(fig.* 1.*)* represent them as intermingling with these transverse fibres?

Next we are told that these united fasciculi, after getting above the annular protuberance, form the posterior and inner part of the crura cerebri; by which Drs. Gall and Spurzheim mean, as will be seen by consulting their engravings, not any portion of those eminences usually called by anatomists the crura cerebri, but a part of the substance situated behind the stratum of black matter, or locus niger of Vicq d'Azyr; though how much of it, they have not chosen to specify. This, however, like the preceding parts of the description, is mere assertion, without any proof, and indeed without any foundation.

The bundles of fasciculi on each side are now said to enter the *optic thalami*, which, it seems, are not bodies sending fibres or giving origin to the optic nerves, as anatomists have generally understood, but are *true ganglia*, intended to reinforce, largely, these fasciculi in their progress. They consist, it is affirmed, of a large mass of *grey substance*, which generates many nervous filaments (§ 31. 32. 33); and when examined internally, it is said that all their fine white fibres are seen proceeding upwards towards the superior border of the ganglion, where they are collected into fasciculi, and from which they immediately diverge. The *anterior* of these bundles are then described as passing through the corpus striatum, and receiving a further reinforcement in their progress, so that they are sufficient to form after their egress, the convolutions of the posterior lobe, and all those which are situated along the upper border of each hemisphere towards the median plane.

This statement, in point of inaccuracy and inconsistency, and pure hypothesis, exceeds, if possible, any that I have yet had occasion to examine.

Fasciculi of fibres passing in the manner they describe, first through the optic thalamus, and then through the corpus striatum, receiving reinforcements during their progress, and finally terminating in the convolutions mentioned, are wholly indemonstrable. Not only do they not exist, but there are no fibres like them existing in this region of the brain. Were it not indeed for the distinct engraving of them with which Drs. Gall and Spurzheim have favoured us, the description would almost incline one to suspect, that these gentlemen had turned, to the best account, the bands of white substance already mentioned as extending from the crura cerebri through the corpora striata; and had described the inner edges of these bands as forming one system of fibres, while the outer edges formed another. But in Plate XII, a view of the fibres in question is exhibited from their origin to their very termination. They are there represented extending upwards through what they are pleased to call the "*pretended optic thalamus*," with a slight divergence from each other; and then radiating in every direction, until they are distinctly seen to terminate in the grey substance of the convolutions of the posterior lobe, and of the upper and inner surfaces of

the hemisphere. This drawing, however, I do not hesitate to affirm, has no prototype in nature. No such appearance ever presented itself naturally in any human brain, and no artifice could have produced it. Drs. Gall and Spurzheim can best explain from what original the copy was made. The structure, let me add, is one, which if it really exists, is too important to be passed over entirely in any demonstration of this organ; and yet Dr. Spurzheim did not attempt to exhibit a single filament belonging to it, in his dissections in this place *.

Independently, however, of these diverging fasciculi, the description which Drs. Gall and Spurzheim have given of the optic thalami, is not only superficial, but consists of assertions as incorrect as they are arbitrary. There is nothing they have affirmed with more confidence than that

* It is worthy of remark that Drs. Gall and Spurzheim, in their Memoir to the French Institute, make no distinction between the first and second set of *diverging fibres*, and take no notice of the distinct convolutions which each are destined to form. This seems to have been a later *discovery*. All the *diverging fibres*, the peduncles or crura cerebri included, are described as passing through the optic thalami! See *Recherches*, &c. p. 134-5.

these bodies have no connexion by means of fibres with the optic nerves, but that these nerves are merely attached to their posterior and lateral surface (§ 32.); and that the thalami are in fact only *ganglia* for the reinforcement of the *diverging fibres*. And yet it will be found, on a careful examination of the coagulated brain, that the whole of that layer of white substance which covers the upper surface of the optic thalami, is composed of apparent fibres, which lie in a direction from before backwards, and which towards the posterior part may be traced with the utmost ease into the optic nerves. This structure was first described by VIEUSSENS *; and it has been abundantly confirmed by the observations of REIL †. DRS. GALL and SPURZHEIM, besides, have passed over

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* Lib. I. cap. xi. "Ubi verò hæc membrana pelliculæ non absimilis ad posticam medullæ oblongatæ crurum regionem sese producit, fibrillæ illius in se invicem sensim inclinantur, adeò ut utrinque simul coalescant, et unà cum tractibus quibusdam albis, è postica suprà memoratorum medullæ oblongatæ crurum parte emergentibus, in nervos opticos abeant: unde fit ut medullæ oblongatæ crura, non immeritò nervorum opticorum thalami nominentur."

† "Die Sehnerven entspringen theils von der dünnen Markplatte, die Oberfläche der Sehhügel bedeckt, theils mit einer Wurzel, die unter dem unteren Rand der Sehhügel vorkömmt, theils endlich von Markfäden, die von dem corpore geniculato entstehen."---*Archiv.* &c. 1809. p. 517. & 153.

in total silence, the fibrous connexion subsisting between the optic thalami and the inner corpora geniculata, the corpora quadrigemina, and the curious fasciculi, called by REIL the *Schleife*; all which have been most carefully described, and in part figured, by that accurate anatomist *. Indeed of the very existence of these latter bundles, DRS. GALL and SPURZHEIM seem to be entirely ignorant.

2. *Of the Converging Fibres.*

The *converging fibres* of the brain-proper are described by DRS. GALL and SPURZHEIM in the paragraphs from 34 to 37, and from 41 to 52 of the APPENDIX. The merits of this part of their anatomy may be appreciated in a very few pages.

At the bottom of all the convolutions, they affirm, a set of fibres may be demonstrated, which are soft and delicate, but distinct and obvious, and which advance between the fibres of the *diverging system* and interlace with them (§ 36.) All these they regard as arising from the *grey substance* of the convolutions (§ 50, 51.); but whether they

* Archiv. &c. 1809. p. 157, and 485.

are merely the *diverging fibres* reflected back, or a new system generated by that substance, they do not yet pretend to have determined (§ 52.) They may be *remarked*, it is said, within all the convolutions; but it is only in the posterior convolutions of the middle lobe, that they can be followed as *distinct* and *visible* fibres (§ 36. *note*). In their progress, however, from the convolutions, they form fasciculi and laminæ, which extend towards the inner part of each hemisphere, and uniting on the median line with the corresponding layers and bundles of the opposite hemisphere, form various reunions, junctions, or commissures (§ 37.) These commissures, it is admitted, have been long known to anatomists, but they have never dreamt, it is said, of inquiring with what particular parts of the brain each commissure is connected.

"Our researches, however," say Drs. Gall and Spurzheim, "have procured us the most precise elucidations of this subject." (§ 41.)

First, The fibres from all the *upper* convolutions of each hemisphere, form the body of the corpus callosum (§ 45.); those from the *lower* con-

volutions of each anterior lobe from the anterior doubling of the corpus callosum (§ 44.); and those from the lower and internal convolutions of the posterior lobes form the posterior doubling or extremity of this body (§ 42.) Secondly, the fibres coming from the posterior convolutions of the middle lobes, bending behind the crura cerebri, and the optic thalami, form what is usually called the fornix (§ 42.) Thirdly, the fibres coming from the anterior convolutions of the middle lobe, and from *some* convolutions situated in the bottom of the fissure of Sylvius, form the cord known to anatomists by the name of the anterior commissure (§ 43.) Such is the system of *converging fibres* in the brain-proper, according to Drs. Gall and Spurzheim.

Now, as these gentlemen have, with unusual forbearance, failed to claim the entire discovery of the corpus callosum, and fornix, and anterior commissure, the novelties in the preceding statement resolve themselves into these two: first, the affirmation that every convolution in the brain-proper contains fibres which originate in the *grey substance* covering that convolution, and terminate in one or other of the commissures mention-

ed; and secondly, the assertion that it is possible to trace the fibres of each individual convolution, to one particular commissure or part of a commissure. Both these novelties are either purely fanciful, or demonstrably untrue.

We have already seen that Drs. Gall and Spurzheim pretend to have discovered, that there is not a convolution in the brain, into which *diverging fibres* do not enter, to terminate in its grey substance. It follows, therefore, that each convolution contains both *diverging* and *converging fibres*, and is made up of these. Drs. Gall and Spurzheim, indeed, express themselves quite decidedly on this point when treating of the convolutions in particular. At p. 299 of their large work, they remark,

"That the two fibrous layers formed by the *diverging fasciculi*, are accompanied also with fibres which *arise from the grey substance*; so that each convolution is composed, first, of very fine *converging* nervous filaments; secondly, of fibres from the *diverging asciculi*; and thirdly, of an external covering of grey substance."

The existence, however, of two sets of fibres, such as these in each convolution, is, I maintain, a mere chimæra. It is just as impossible to de-

monstrate them in the posterior convolutions of the middle lobe, in which alone it is said that they can be followed as *distinct* and *visible fibres* (§ 36.), as it is in any of the other convolutions, where Drs. Gall and Spurzheim inform us, with their accustomed consistency, that they can be seen, *soft* and *fine*, although *invisible* (§ 36.) Accordingly, when Dr. Spurzheim was called upon to shew a single fasciculus of the *diverging fibres* going into any one of the convolutions, and to distinguish these from the *converging filaments* in the same part, he was under the necessity, as was formerly stated (see p. 113.), of denying that he had ever affirmed this to be practicable.

With respect, on the other hand, to the connections which are ascribed to the *converging fibres* of each convolution, I have to observe, in the first place, that unless Drs. Gall and Spurzheim can shew, in the most satisfactory manner, that the corpus callosum is composed of *converging fibres*, derived from the whole upper convolutions of each hemisphere, from the lower convolutions of each anterior lobe, and from the lower and internal convolutions of each posterior lobe,—and that these *fibres* in each convolution arise from the

grey substance covering it,—and that each of these convolutions is made up, not of these fibres alone, but in part also of certain *diverging fibres* formerly expressly mentioned, and which are capable of being distinguished from the *converging* set,—they claim to themselves the merit of having discovered a structure which does not exist in the brain. In the meanwhile I have no hesitation in affirming, that any such demonstration is impracticable. Were it otherwise, it is to be presumed that Dr. Spurzheim would, in his public dissections, have made good, instead of denying, discoveries which he had so confidently claimed. Those who would acquire a knowledge of the true structure of these convolutions, and of the connections of the corpus callosum, must consult the essays of Reil.

Secondly, the statement made by Drs. Gall and Spurzheim that the fornix is composed of *converging fibres* coming from the posterior convolutions of the middle lobes, has not the slightest foundation in nature. It is not possible to trace any connection betwixt them. On the contrary, nothing is more easy than to shew, as Reil first had the merit of doing, that the fornix consists of fibres which begin at the extremity of the pes

hippocampi, in each lateral ventricle, and run up along the inner border of this prominence, forming its tænia. They then extend forwards under the corpus callosum, and constitute, successively, the posterior pillars, the body, and the anterior pillars of the fornix; until they reach the corpora albicantia, where they are turned round into the optic thalamus, and there terminate. This description would be equally correct, were one to say, that the fibres begin in the optic thalamus, and end at the extremity of the pes hippocampi. Throughout the whole of this course, the fibres of the opposite halves of the fornix remain quite distinct from each other; there is no crossing of them from one side to the other, over the median line. So that admitting Drs. Gall and Spurzheim's affirmations with respect to their origin to be correct, the fornix cannot possibly be regarded as a commissure. These gentlemen, however, have stated, that "l'ensemble de filets de jonction de la voûte est la partie que les anatomistes appellent le lyre, la harpe ou *psalterium*" (§ 42.), an expression by which, if it is meant to be asserted that the fibres from the opposite sides of the fornix intermingle at this part, one inaccuracy more

is added to their description of this body. The pes hippocampi, (a prominence the structure of which has been exceedingly well described by REIL,) is passed over in total silence by DRS. GALL and SPURZHEIM ;—it is a part which could not easily be reconciled with their system. It deserves to be remarked, too, that no representation is to be found in any of their engravings, either of the structure of the pes hippocampi, or of the alleged origin of the fornix in the convolutions of the middle lobe. I need hardly add, that DR. SPURZHEIM made no attempt to demonstrate either of these parts in his public dissections.

In the third place, the origin which DRS. GALL and SPURZHEIM ascribe to the fibres of the anterior commissure, is as arbitrary and incorrect as the rest. Instead of arising from the grey matter of the convolutions which they have named (§ 43.), REIL has ascertained in the most satisfactory manner, that the extremity of the commissure on each side penetrates the outer wall of the *capsule* at its lower and fore-part, and immediately radiates backwards along with the corresponding fibres of that wall. So far, however, are even the small convolutions which rest on that wall from receiving

fibres from it, or giving fibres to it, that they stand almost at right angles with respect to each other. Dr. Spurzheim, in his public demonstrations, merely scrapes away with the handle or blade of a scalpel the parts surrounding the commissure, during its progress from, or towards, the median line, and exhibits an appearance known and familiar to every anatomist; but they who expect to see him display the origin of its fibres in the grey substance of the convolutions he has mentioned, will be disappointed. Such fibres as are represented running towards the extremity of the commissure, in his XIIIth Plate, never did exist in any human brain.

By the preceding remarks, I trust I have made it plain to my readers, that under the denomination of *diverging* and *converging fibres*, Drs. Gall and Spurzheim have described, and described imperfectly or inaccurately, parts of the brain-proper long known to anatomists;—that they have represented as demonstrable, and even gone so far as to delineate in their engravings, parts which have no existence in this organ;—and lastly, that they have maintained connexions to subsist betwixt all these parts, for which there is no foun-

dation in nature, and which they are under the necessity themselves of denying, when called upon to display them in their public dissections.

3. *Of the Convolutions of the Brain-Proper.*

The general appearance, externally, of those prominences called convolutions on the surface of the brain, and the arrangement, within, of the *white* and *grey* substance of which they are composed, are, I presume, familiar to every one.

Reil was the first who investigated their fibrous structure. In his paper in Gren's Journal for 1795, already so often referred to, when speaking of the white and grey substance of these prominences, he makes the following remarks:

"The structure of the medulla (or *white substance*) is laminated, the laminæ are fibrous, and the fibres all radiate towards the surface. By a particular manipulation, the medulla may be separated into laminæ, yet not so easily, nor with so much regularity, as in the cerebellum; for in this last, the laminæ are even and plain, while in the brain-proper, they are all curved and bent.

"The cortex (or *grey substance*) is also fibrous; its fibres, however, do not everywhere join the medulla in straight lines,

but rest perpendicularly, on the different surfaces, convexities, and fossæ of this substance, and surround it under various acute and obtuse angles, *'fast wie eine Glorie den Kopf einer Heiligen.'* The fibres of the cortex also lie in laminæ, which unite under very various, acute, and obtuse angles *."

Afterwards, in his *Archives of Physiology* for 1807, he introduced (along with a variety of figures illustrating the fibrous structure of the cerebellum,) an engraving of one of the convolutions of the brain-proper, after it had been hardened in alcohol, and torn perpendicularly; and in the explanation accompanying that engraving, there are the following observations †:

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* " Der Bau des Marks ist blättrig, die Blätter sind faserig, die Fasern strahlen sämmtlich gegen die Oberfläche. Durcl einen besondern Handgriff lässt sich das Mark in Blätter zerlegen, doch nicht so leicht und regelm ssig, wie beym kleinen Gehirn, weil diese eben und plan, die Blätter im grossen Gehirn aber sämmtlich krumm und gebogen sind.

" Auch die Rinde is fibrös; allein die Fasern der Rinde stossen nicht allenthalben in gerader Linie mit dem Mark zusammen, sondern senken sich auf die verschiedenen Flächen, Biegungen, und Gruben des Marks senkrecht, so dass sie dasselbe unter verschiedenen spitzen und stumpfen Winkeln, fast wie eine Glorie den kopf einer Heiligen umgeben. Auch die Fasern der Rinde liegen in Blättern, die unter sehr verschiedenen, spitzen, und stumpfen Winkeln zusammenstossen." p. 105.

† " Diese darmförmigen Windungen sind den Blättchen des kleinen Gehirns gleich, bestehn aus Markplatten, die Platten aus Fasern, und sind am Ende mit Rinde bedeckt. Nur sind die Windungen weit stärker, nicht zerästelt, und in eine Ebene ausgedehnt, sondern überall

"These intestine-shaped convolutions are, like the laminæ of the cerebellum, composed of medullary plates, and the plates of fibres; and they are covered with cortex at their extremities. They are much stronger, however, and not ramified nor extended in the same plane, but everywhere crowded together. Hence their intestine-like shape on the surface, their muscular-looking and bushy laceration, and the difficulty of separating, whole and in connection, as may be done in the cerebellum, the various laminæ lying upon one another. The medullary laminæ in the middle of the convolutions cohere the most weakly; yet, on account of their curvature, the convolutions do not admit of being so easily split into two halves, as the layers of the cerebellum. The laminæ have a radiating and fibrous structure; and the radiations of the fibres proceed from the *nucleus* towards the circumference in a bushy or pencil-like manner."

Again, in his '*Archives*' for 1809, he describes a stratum of white fibres lying between the bottoms of the convolutions and the central parts of

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gegen sich zusammengedrängt. Daher ihre darmförmige Gestalt an der Oberfläche, der muschlichte und büschelförmige Bruch, und die Schwierigkeit, die auf einander liegendem Markplatten ganz und im Zusammenhang abzuziehen, wie beym kleinen Gehirn. Die Markplatten in der Mitte der Windungen hängen am schwächsten zusammen, doch lassen sie wegen ihrer Krümmung sich nicht so leicht, wie die Blättchen des kleinen Gehirns, in zwey Hälften zerlegen. Die Platten haben eine strahligte, fibröse Structur; die Strahlung der Fasern geht büschel- und pinselförmig vom Kern gegen die Peripherie.

the brain, and connecting the convolutions to each other*; and in the same work for 1812, he gives a very distinct representation of a part of these intermediate fibres, as they appear above the outer wall of the *capsule*.

Nothing can be more correct than the description here given by REIL of the laminated structure and fibrous appearance of the convolutions. With regard to the intermediate substance, the dissections which I have hitherto made do not enable me to speak with confidence; though I have no doubt, from REIL's general accuracy, both as to its existence and the correctness of the representation he has given of it.

DRS. GALL and SPURZHEIM, however, not content with having found out two sets of fibres in each convolution which no one else has seen or can see, claim the merit of having discovered that the fibres of the convolutions do not unite into one fasciculus, like the optic or auditory nerves, but form two distinct layers, which are in contact with each other along the median line of each convolution, and are slightly agglutinated to each other

* Page 183, and 302.

by means of a *mucous neurilema*, or a *very fine cellular tissue*. In paragraph 57 of the APPENDIX they state this as a fact; but in the paragraphs which follow, it is pretty plain that it becomes merely an hypothesis; for these passages are wholly occupied with a statement of the experiments from which the hypothesis is deduced. Let us briefly examine the merits of this *hypothetical fact*.

In the first place, the two layers are said to be demonstrated by this, that if any of the convolutions, in their recent state, be subjected to gentle pressure with the finger, they may be split up along their middle, and fairly unfolded or spread out (§ 58, 59, 60.). To which it is quite sufficient to reply, that this operation would be equally practicable, if each convolution consisted of twenty laminæ, or twenty thousand; or if it were composed neither of laminæ nor fibres, but of a uniform, undivided, soft mass;—and that the experiment, at all events, does not prove the existence of that *mucous neurilema*, or very *fine cellular substance* in the middle of the convolutions, of which DRS. GALL and SPURZHEIM have spoken with as

much confidence as if it were matter of easy demonstration.

Secondly, it is said, that if sections of the convolutions be hardened in alcohol, or in nitric acid, diluted with alcohol, or if they be boiled in oil, their two layers separate very easily along the median line, *but only along that line*; and that on the internal surfaces of the layers, no vestige of torn fibres can be perceived, although the fibrous expansion can be distinctly seen (§ 61.) Hence it follows that each convolution is composed of two layers, agglutinated together by means of a *mucous neurilema*, or *very fine cellular tissue*. But this statement is very far from being correct. When a convolution has been hardened by any of the means enumerated, it may be split up either along the median line, or at any distance on either side of this line, and the separation is as easily effected laterally as in the middle. It may be separated into a great many laminæ; and when the surfaces of each are examined carefully with the naked eye, or with the microscope, they will all be found to exhibit precisely the same fibrous appearance; those in the middle not being in the slightest degree smoother than those at the sides. It was

from convolutions indurated in this manner, that Reil's description of their structure already quoted, was drawn up. Nothing is more easy than to perform this experiment; and the result is uniformly as I have stated. Granting it, however, to be otherwise, and the fact to be, as it has been represented by Drs. Gall and Spurzheim, it does not prove that there is either a *mucous neurilema* or a very fine *cellular tissue*, in the middle of the convolutions.

Thirdly, it is held to be incontestably proved that each convolution is formed of two layers, by three experiments, which are detailed in paragraphs 63, 64, and 65 of the Appendix.

The first experiment consists in blowing with a tube * on a transverse section of a convolution. If we blow, it is said, on the median line of the convolution, it splits from the base to the top; but at any other part, we may indeed destroy the *white* and *grey* substance by blowing, but we shall not succeed in effecting the separation of the fibres, or of the two substances from each other (§ 63.). On this experiment, however, I would ob-

* Dr. Spurzheim employed the common blow-pipe used by anatomists.

serve, in the first place, that by using a blow-pipe with a small orifice, and blowing with the utmost strength, we may indeed sometimes, though very rarely, succeed in splitting a convolution along the median line; but in every such instance, it will be found equally practicable to produce the same effect at various distances betwixt the middle line and the sides of the convolution. The result of the experiment, therefore, as stated by Drs. Gall and Spurzheim, is quite incorrect; and I have further to observe, that in both the demonstrations by Dr. Spurzheim which I witnessed in this place, his attempts to produce the exclusive separation he has described, entirely failed. After he had blown on a transverse section of a *narrow* convolution for nearly a minute, the stream of air caused merely a general depression of the surface of the white matter, below the level of the grey substance embracing it; and when he desisted from the experiment, there was not the slightest perceptible separation at any part of the median line. But, in the next place, granting the result of this experiment to be always as Drs. Gall and Spurzheim have affirmed it to be, it is not easy to perceive how this operation of the blow-pipe

proves the existence of a *mucous neurilema* or *very fine cellular tissue*, in the middle of each convolution.

The second experiment consists in projecting a stream of water from a syringe against a transverse section of a convolution. This, it is affirmed, has the effect of separating the convolution in the middle, exactly as in the former case, the surfaces of the two layers remaining perfectly smooth; whereas, no separation at all takes place at the sides, without obviously destroying the structure of the fibres (§ 64.). To which I have to reply, that I have repeated this experiment many times, and have seen it often repeated by others, and that the result has uniformly been directly the reverse of that stated by Drs. Gall and Spurzheim. The stream of water separates the convolution into laminæ with the utmost facility at the sides, as well as in the middle. It may thus be divided into layers, more or less numerous, and more or less thick, according to the pleasure of the experimenter; and the surfaces of all the laminæ will be found equally smooth, and equally without the appearance of lacerated fibres. This operation was practised in Dr. Spurzheim's pre-

sence, during his second demonstration, not only on those very convolutions of the recent brain, in which he endeavoured to shew by injection that there were but two layers, but also on convolutions which had been previously indurated in alcohol. I have never experienced more difficulty in separating the laminæ at the sides from each other by this means, than those situated in the middle. But supposing the contrary to have been the case, this would only have tended to shew, that the laminæ in the middle adhered to each other less firmly than those at the sides, which is the opinion actually entertained by Reil, as we have already seen (p. 137.); but would by no means have proved that no lateral laminæ existed at all. The smoothness of the layers unfolded by this experiment (a smoothness not to be perceived when they are simply torn from each other), is entirely owing to the action of the stream of water on their surfaces. In order to split up a single convolution, Dr. Spurzheim forced in between its middle laminæ, at least 2lbs of water in a continual stream; after which ablution, it would be somewhat remarkable, if the sides of the layers were not sufficiently polished. Indeed, if I

mistake not, those who are attentive to this procedure may easily perceive, while it is going on, small fragments of broken-down medulla flowing out with the current of the returning fluid. Finally, it may be asked, in what manner the injection of a stream of water into the middle of a convolution, demonstrates the existence in that convolution of a *mucous neurilema*, or a *very fine cellular tissue?*

The third experiment differs from the former only in this, that the stream of water, instead of being directed against the convolution in a plane corresponding to the median plane of the convolution, is made to strike on that plane perpendicularly, by previously breaking down a portion of one side of the convolution. The stream, it is then said, insinuates itself to right and left along the median plane, but in no other direction, and separates the convolution into two parts as in the second experiment. On this manipulation I have to remark, that if the stream, instead of being carried at once to the middle of the convolution, be made to play on any intervening point between the middle and the side, a similar separation will be produced by the extension of the water laterally.

The experiment, however, is by no means so uniformly successful as one would be led to imagine from Drs. Gall and Spurzheim's description. It often fails, even when performed on the middle line of the convolutions, to which these gentlemen confine themselves entirely; and accordingly, Dr. Spurzheim's attempt to repeat it, in his second demonstration in this place, was attended with very unsatisfactory results. When, however, it succeeds to the utmost, it does not prove the existence of a *mucous neurilema*, or *very fine cellular tissue*, either in the middle of the convolution, or in any other part of it.

The hypothesis, therefore, of Drs. Gall and Spurzheim, that the convolutions of the brain-proper are composed each of two layers of fibres and no more, joined together in the middle by a *mucous neurilema*, is not only illogically deduced from experiments and observations imperfectly or inaccurately made, but is directly at variance with facts which are easy of demonstration.

Untenable, however, as this conjecture is, Drs. Gall and Spurzheim have brought it to the support of another which is no less so;—an hypothesis which there might, perhaps, have been some

excuse for a physiologist's entertaining a century ago, but which we should not readily have expected to have found supported in our own times by two persons, professing to excel all others in their knowledge of the structure of the brain.

The disease denominated Hydrocephalus consists, as most of my readers know, in an effusion of a serous liquor into those cavities of the brain called ventricles, which in natural circumstances seem to contain little or no fluid of any kind. The quantity of serum effused varies from a few ounces to several pounds. As the ventricles, however, even in a full grown subject, cannot in their healthy state be made to contain more than two or three ounces of any liquor without laceration, it is obvious, that when the effusion in Hydrocephalus exceeds this quantity, these cavities must be morbidly enlarged to receive it.

Now there are two forms of this affection; one in which the enlargement of the ventricles is not accompanied with any enlargement of the external dimensions of the brain, and another in which it is, and in which, of course, the cavity of the cranium is proportionally increased.

The first of these species generally occurs after the age of three or four years, and soon comes to a fatal termination. On dissection after death, the ventricles are found enlarged, but without the slightest appearance of laceration on any part of their surface, or rupture of the smallest vessel. The pia mater which shuts them up along the inner border of their inferior cornua, and the tela choroidea closing them behind, under the extremity of the corpus callosum, remain as closely attached as in health. The substance of the brain lying between the ventricles and the bottom of all the upper and inner convolutions of each hemisphere, and of the whole convolutions of the middle and posterior lobes, is diminished in thickness. Whether or not the patient ever survives so long as that the convolutions themselves become less high or deep, I have not been able to ascertain; but although the cases of this affection are not few which have come under my own observation, I have not yet met with any instance in which this change had taken place. The fluid contained in the ventricles is of the consistence of water, and is always perfectly clear and colourless.

The second species usually occurs before the age of three or four years. In its first stages it resembles the former species; the ventricles being enlarged merely, without the slightest perceptible laceration either of the substance of the brain or its membranes. Gradually, however, the brain begins to increase in its external dimensions, and this increase is accompanied with a proportional enlargement of the cavity of the cranium; the bones forming the roof and sides of the cavity, being separated from each other at the place of the sutures by a thin membrane, such as forms the natural fontanelles. As soon, in general, as this external enlargement commences, the upper and inner convolutions of each hemisphere, and the whole convolutions of the middle and posterior lobes, are observed to become wider or broader, but shallower or less high; though, when cut across, they are found to be as solid as before *; and the fossæ between them are as narrow as in natu-

* "Farther," say the Committee of the Institute in their Report, "we have also examined hydrocephalous patients; and the parietes of "the ventricles, though extended, had the same appearance as usual, "and the circonvolutions, although thinned and partly effaced, never-"theless preserved their internal solidity."

ral circumstances, without the least stretching or rupture of any of the delicate vessels of the pia mater which dips down into these fossæ, and binds the contiguous convolutions to each other. The upper and inner convolutions of each hemisphere, undergo this change soonest and to the greatest extent. This process goes on, until at last the convolutions disappear altogether; and there remains only as a wall to the enlarged lateral ventricles, a stratum of *white substance* not thicker perhaps than the eighth part of an inch, with a layer of *brown substance* superposed, similar to that which covered the convolutions. The external surface of the hemispheres, consequently, becomes quite plain, and is covered with pia mater and the arachnoid membrane in the usual manner; while the surface of the enlarged ventricles retains its usual smooth appearance. In some instances, the progress of the disease is arrested at this point; the further effusion of serum, and the enlargement of the ventricles, of the external surface of the brain, and of the cavity of the cranium ceases; the membranous spaces between the edges of the bones no longer increase, but the bones themselves, extending their ossifications, fill up these open-

ings, and at last convert the whole into a solid shell; and in this condition the individual may live for fifty or sixty years. In other instances, if the patient does not sink before such extensive changes are accomplished, even the thin remaining layer of *white* and *brown substance* forming the vault and sides of the ventricles gradually disappears, and with this, at last, portions more or less extensive of the parts of the brain situated towards the basis. Sometimes, it would appear, from a case which occurred to REIL, that the brain may be very greatly enlarged in consequence of effusion into the ventricles, and yet the convolutions not be at all affected. In this instance, which REIL himself calls a most remarkable one, he mentions expressly that the extension was confined entirely to the ventricles; and that all the convolutions were solid, not split up *. Such cases, however, I believe are rare.

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* "In einem von Wasser in den Hirnhöhlen ungeheuer ausgedehntnen äusserst merkwürdigen Gehirne einer erwachsenen Person, begegneten sich am ausseren Rande des kolbigten und vörderen Theils der gestreiften körper, eben da, wo die bogenförmigen Productionem liegen, die Bundel des Balkens und der Hirnschenkel in gerader Linie, und gingen unmittelbar, durch Anastomose, in einander über. *Die Ausdehnung war ganz allein im Kern des Gehirns, nemlich in der Höhle zwischen Balken und Hirnschenkel-System; hingegen waren alle Windungen dicht, nicht gespalten, als durch die innere dehnende Ursache nicht afficirt.*" Archiv. 1812. p. 35.

The agents by which these singular changes are accomplished on the cranium and its contents in this disease, are imperceptible to our senses; but there is but one theory with respect to them which will explain the phenomena. They can be no other than the secreting and absorbing vessels of the parts which are affected;—those very powers, the balanced and reciprocal actions of which, in the growth and modelling of the healthy machine, have been so well demonstrated by Mr. Hunter, and of which the modified operations are more or less disclosed in almost every instance of local disease;—those agents, for example, which preserve to the thigh bone its peculiar form and structure throughout the whole period of its growth, while they are the very powers by which its growth is accomplished,—which occasion the disappearance of the alveolar arch in old persons, and make way for the rising teeth in young ones,—which throw off a slough from a sore or an exfoliation from a bone,—which cause a lung to waste without hæmorrhage,—which enlarge an ovary until it forms a bag as large as the abdomen,—or thin the substance of a kidney until it is reduced to a mere membrane.

The opinion, however, has been very prevalent, ever since the state of the brain in hydrocephalus has been an object of attention among anatomists, that the substance of this organ is reduced to the state of a membrane in this disease, merely by the distention to which it is subjected, by the effusion into the ventricles and consequent enlargement of these cavities.

The celebrated VESALIUS seems to have been of this opinion; as may be seen by consulting his account of a dissection of the brain of a boy of three years, who had died of hydrocephalus *.

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* "Quanquam ea non inter calvariam, et exterius ipsam succingentem membranam, aut cutem (ubi aliàs aquam reponi, medicorum libri docent) huic puellæ fuerit collectæ: verùm in ipsius cerebri cavitate, adeoque in dextro sinistroque illius ventriculis: quorum cavitas amplitudoque ita increverat, ipsumque cerebrum ita extensum fuerat, ut novem ferè aquæ libros, aut tres Augustanas vini mensuras, (ita me ament superi) continuerint. Ad hæc, ut cerebrum in capitis vertice, membranæ quasi modo erat tenue, & quodammodo continuum cum tenui sua membrana corpus: ita quoque calvaria fuit prorsus membranea, tantaque duntaxat sede ossea, quanta calvariæ puellæ erat amplitudo, priusquam caput extra modum incresceret; ea ferè ratione, qua in nuper natis pueris, frontis os et verticis ossa constare cernimus, ubi illa alioquin mutuo sunt contermina, et in admodum pueris, insigni intervallo, amplitudineque visuntur membranea. Cerebellum interim, cerebrique universa basis secundum naturam habebant, uti et nervorum productiones. Dein nullis prorsus sedibus, quam in cerebri ventriculis adeò atque dixi adauctis, aquam reperi, et puella ad mortem usque sensibus omnibus integrè est usa." Opera Omnia, I. p. 16.

TULPIUS, who dissected the head of a boy of five years who had been affected with this disease, seems to have entertained the same idea *. PETIT, in a short essay on hydrocephalus, in the Memoirs of the Royal Academy of Sciences for 1718, after describing with great precision the symptoms of the affection, states the appearances which he has discovered on dissection after death, and appears to embrace the hypothesis that the substance of the brain is merely distended †. The same opi-

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* "Qua defunctus, ostendit, in capite suo detineri, quinque aquæ libros: quibus effusis, fuêre omnia adeò vacua, ac inania: ut plerique medicorum presentium, sed præproperè, judicaverint hic conspici, caput sine cerebro. At oculi acie, illis penitus directa, vidimus satis perspicuè, cerebum non defuisse: sed amissa figura globosâ, induisse formam convexi fornicis: et ab exuberante aqua sequacem ipsius medullam adeò fuisse distentum: ut instar alicujus crassioris membranæ, adhæresceret undique, arcuatæ, dissolutorum ossium, circumferentiæ." Observat. Med. 8vo. 1716. p. 45.

† "A l'ouverture de leurs cadavres j'ai remarqué la Dure Mere plus adherantes aux parties du crâne, que dans les autres sujets: la base du crâne est applatie, et comme écrasée, la voute de l'orbite est jettée en dehors ainsi que leurs yeux, l'intervalle d'un os à l'autre est occupé par l'expansion de la membrane qui les joint, le cerveau est ferme, les ventricules sont si considerablement étendus, que la substance cendrée et blanche, n'ont pas l'epaisseur de deux lignes. En plusieurs droits où elles sont séparées, il ne se trouve que la Pie-mere qui retient les eaux. De plus les vaisseaux sont alongés et grossis, et dans la plûpart de ces pauvres malheureux, la glande pituitaire se trouve schirreuse, ce qui pourroit n'être pas une des moindres causes de cette maladie. Je n'éntre point dans l'explication de tous ces phénomenes, car quelques observations que j'aye sur ce sujet, elles ne me paroissent pas suffisantes pour hazarder un systême."

nion is very unequivocally expressed by HUNAULD in the Memoirs of the Academy for 1740; where, after detailing the progress of a case of hydrocephalus in a child of 7 or 8 years, which had fallen under his own observation, and in which the ventricles were found to contain more than a chopin of fluid; he adds the very clear description of the state of the brain which I have subjoined in the note *. Lastly, MORGAGNI adopts and defends the same theory, against the opinion of those who had conceived that the substance of the brain was sometimes dissolved in the fluid of the ventricles.

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* "L'effet que l'eau contenue dans les ventricules avoit produit sur la substance du cerveau, ne merite pas moins d'attention. Les parois des ventricules sont, dans l'etat naturel, appliquées les unes sur les autres, et ne laissent presque pas de cavité sensible. Dans cet hydrocéphale les parois s'etoient ecartées pour contenir plus d'une chopine d'eau. Il falloit donc que la substance du cerveau qui compose ces parois, fut considerablement allongée; de plus il falloit que la substance corticale qui etoit placée sur ces ventricules distendus, et qui etoit placée contre le crâne, eut beaucoup plus d'étendue qu'elle n'en devoit avoir; aussi pour acquerir cette étendue, elle n'etoit point disposée en forme de circonvolutions. Au lieu de se replier en dedans pour former ces circonvolutions, elle ne faisoit qu'un plan uni, qui avoit apparemment l'étendue que devoient avoir les circonvolutions développées. La substance medullaire formoit un second plan mince appliquée sous le premier: on sent le raison de cette disposition. La pie-mere n'ayant point, comme à l'ordinaire, des circonvolutions du cerveau à suivre, formoit aussi elle-même un plan sur la substance corticale."

"I would have you, therefore," says he, "join to the observation of Vesalius, those of Hildanus also, and Tulpius, which are mentioned by me in that place, where I shewed, that by the force of the water, distending the ventricles, their upper parietes in particular, and their lateral parietes, are sometimes so far extenuated, and affixed with the meninges, to the bones of the cranium, or pericranium, that it ought not to seem wonderful, if any one, while he supposes, that he cuts only into the cranium itself, should at the same time pierce through the dura and pia mater, and even the substance of the cerebrum itself, which adheres to the meninges, and to the bones and pericranium, in the form of a membrane *."

To this very mechanical hypothesis, I content myself with stating the following (as they appear to me) insuperable objections.

In the first place, the substance of the brain is not susceptible of the degree of distension, which this theory would oblige us to suppose, without extensive laceration. An elasticity almost approaching to that of elastic-gum would scarcely enable it to accommodate itself, without tearing, to the accumulating fluid in the advanced stages of this disorder. And yet no laceration is percepti-

* On the Seats and Causes of Diseases, translated by Alexander. Lett. XII. art. 13.

ble on the surface of the ventricles or elsewhere; nor could it indeed occur without being accompanied with laceration of blood-vessels, and consequently with immediate hæmorrhagy, and in all probability with immediate death. The expansion, too, of the convolutions would necessarily imply a separation of their contiguous external surfaces from each other, which could not possibly take place without a rupture of innumerable delicate vessels of the pia mater, which dips down into the fossæ between these surfaces, and binds them together.

Secondly, the ventricles cannot be distended mechanically either with or without laceration of their parietes, unless the external surface of the brain be enlarged at the same time. And yet the first species of hydrocephalus which I have mentioned, and which is of very frequent occurrence, is unaccompanied with any such external enlargement of this organ, however much the ventricles may be increased in capacity; and the same remark is applicable to the earlier stages of the second species. Further, the external dimensions of the brain cannot be increased, by any distending force operating from the ventricles, without

the convolutions being unfolded; and yet in the case mentioned by REIL, we have seen that these prominences remained unaffected, although the ventricles and whole brain were much enlarged.

Thirdly, neither the vessels of the head nor the heart, with which they are connected, can by any conceivable calculation, be imagined capable of exciting a power equal to one hundredth part of that which would be necessary to distend the parietes of the cranium in the slightest degree, far less to the enormous magnitude which it is sometimes known to assume in the advanced stages of this disease. Nor, supposing it otherwise, can it for a moment be imagined by any one familiar with the pathology of the brain, that an individual could survive the operation of such a pressure on this organ beyond a few minutes.

DRS. GALL and SPURZHEIM, nevertheless, adopt this hypothesis, in so far as it ascribes the change produced on the brain in hydrocephalus, to the pressure of the fluid in the ventricles;—they maintain still more explicitly, even than MORGAGNI, that there is no loss, or destruction of any part of the substance of this organ in any stage of the affection; but they claim to themselves the

sole merit of the *discovery* (as they are pleased to call it,) that the enlargement of the ventricles and of the whole brain is the consequence merely of the unfolding of the convolutions, or the gradual separation from each other of the two laminæ, of which they have found these convolutions to be composed.

Their sentiments on this point are thus shortly stated by Dr. Spurzheim:

"At the bottom of the convolutions, the radiating, or diverging, and the converging filaments, cross each other and form a tissue, from which, however, they are soon afterwards disengaged. Beyond this tissue, therefore, each duplicature may be easily separated into two layers; and as this may be done in all the convolutions, it follows, that if the tissue be destroyed by a rude kind of manipulation, or, as in hydrocephalus, extended by the gentle action of a gentle, but constant, and regular force, all the duplicatures will be transformed into a kind of membranous expansion, externally covered by grey substance. Our knowledge of a person of fifty-four years of age, affected with hydrocephalus, first excited us to examine the structure of the brain in general, and of the convolutions in particular. It is a common opinion, that in hydrocephalic persons the brain is disorganized, or even annihilated. But this hydrocephalic patient still manifested, in a pretty high degree, those faculties which are dependent on the brain; and

several similar examples are recorded. The conclusion that the brain is by no means destroyed in such hydrocephalic persons is therefore unavoidable. Now, in a large hydrocephalus, the upper convolutions do not appear; there is discovered only a membrane, of which the fibres are horizontal, while those of the convolutions possess, in the natural state, a position which is vertical from the basis to the top. It unavoidably follows, that by hydrocephalus, the convolutions are separated into two parts *."

To the argument contained in this passage, (which I take the liberty of observing is a tolerably fair specimen of the kind of reasoning which pervades their whole writings) a very short reply will suffice.

In the first place, the convolutions are not composed of two laminæ;—that conjecture has already been shewn to be without foundation. Secondly, granting that they were, and that in hydrocephalus these layers were merely separated from each other, there is no force operating from the ventricles which could effect that separation, without extensive laceration of the substance

* Physiognomical System, p. 43. *See also* Anat. et Phys., &c. I. p. 300, &c.

everywhere interposed between the surfaces of these cavities and the bottom of the convolutions. This intervening substance, Drs. Gall and Spurzheim have passed over in silence; yet unless that substance be torn, the convolutions cannot be reached, and such laceration is never remarked in hydrocephalus. It could not occur without rupture of vessels and fatal hæmorrhage. Thirdly, if the convolutions be merely split up along the middle, we ought to find them in all states of separation in the different stages of the disease; whereas, long after they have begun to become shallower, they are found as solid as in perfect health. Fourthly, the hypothesis is liable to the second and third objections already urged to the opinion of Vesalius, &c. Fifthly, that there is no loss of substance in a hydrocephalic brain, in any stage or degree of the disorder, is a position not only without proof, but demonstrably incorrect. In the first species of hydrocephalus, and in the earlier stages of the second, the ventricles are enlarged without enlargement of the brain externally; the parietes of the ventricles, therefore, are necessarily rendered thinner, and they are obviously thinner to the eye. Now this thinning has not

been accomplished by any ulcerative absorption on the surface of the ventricles, for they exhibit no marks of that process; but can be ascribed to no other cause than that species of absorption which has been denominated by Mr. Hunter *interstitial*. That this absorption goes on after the cranium begins to enlarge, no one, I apprehend, can doubt, who has examined with attention a single case of hydrocephalus in this advanced state. It is not enough to affirm that the thin parietes of the ventricles in this stage, exactly equal in weight or bulk the mass of the hemispheres in their healthy state; that point must be demonstrated by actual experiment; which, it is to be presumed, Drs. Gall and Spurzheim have never done, else they would not have failed to have mentioned the circumstance. I have little hesitation in predicting, that when the experiment is tried, the result will be wholly unfavourable to their conjecture. As to the argument derived from the circumstance, that persons affected with hydrocephalus have often preserved their intellect for many years, the reply which has been made to that, by the Committee of the French Institute, is unanswerable.

"The phenomena," they observe, "of hydrocephalic patients who have preserved their intellectual faculties for a long time, proves nothing further; for, as we do not know with what part of the brain, nor with what circumstance of its organization these faculties are connected, we can draw no conclusion from it relative to the essential structure of the brain."

From these remarks, I imagine it must appear to my readers, that the observations of Drs. Gall and Spurzheim respecting the state of the brain in hydrocephalus, are not less inaccurate and conjectural, than their speculations regarding the healthy structure of the convolutions.

III. OF Drs. GALL AND SPURZHEIM'S ENGRAVINGS OF THE BRAIN.

In a note to p. 129 of the First Volume of my System of Human Anatomy, I have introduced the following remark:

"A work was published a few years ago by Gall and Spurzheim, entitled *Anatomie et Physiologie du Systeme Nerveux en General et du Cerveau en Particulier*, in which they endeavoured, in a series of plain engravings, to represent the

surfaces and internal arrangement of the substance of the brain. They have omitted, however, several important parts altogether; others are represented very indistinctly; and there is scarcely a plate in the series, in which there are not considerable inaccuracies.

This opinion was not expressed until after repeated comparison of the engravings in question with nature. Every examination to which I have since had occasion to subject these representations, has led me to the discovery of new errors in them; and nothing has contributed more to confirm me in my original judgment, than the dissections of the brain performed by Dr. Spurzheim himself in this city. It was the pretension with which these engravings were offered to the public, and the importunity with which Drs. Gall and Spurzheim have solicited a comparison of them with those of their predecessors, as well as a strong conviction of the inaccuracy of the whole system they are intended to illustrate, which originally induced me to express a general opinion respecting their errors and imperfections. For the same reasons, I shall now endeavour to point out their faults a little more particularly.

Plate IV. is intended as a view of the basis of the brain in a female.

The medulla oblongata points directly backwards, instead of downwards; and the anterior surface of the annular protuberance downwards, instead of forwards. The fossa between the corpora olivaria and restiformia is too superficial. The crura cerebri incline greatly too much back; have a convexity before which they never exhibit, are too broad, and are more exposed than they ever are in natural circumstances. The tractus optici are by far too convex outwards, too round, too large, and too much exposed. The mammillary eminences, or corpora albicantia, are too round; not flat enough towards the median line; too convex towards the outside, where in nature they are quite on a level with the infundibulum. The space between these eminences and the crura is too large, and not cribriform as it ought to be; the furrow, too, in the middle of it, does not exist. The pyramidal prominence from which the olfactory nerves spring is not well represented, nor the space between it and the tractus optici, which ought to be cribriform. The laminæ, or convolutions of the cerebellum, are twice as

large as they ought to be. The anterior lobes of the brain-proper are too broad; the ridge on them towards the median line not sufficiently marked; and the surface external to this neither concave nor sloping enough. The middle lobes are too wide and flat; not sufficiently pointed before; and the form of their convolutions is not natural.

In Plate V. the whole representation of the annular protuberance is inaccurate. There are no fibres in that body distributed in the manner of c, *f*. The appearance between 35 and 37 is not natural. There are no fibres in the brain having the situation and connections ascribed to those between *u*, *t*, *q*, and *w*, *w*, *w*. There never was a human cerebellum, which by any possible section of it, could be made to assume the appearance represented on the right side of this plate. The corpus dentatum S has not the slightest resemblance to nature; nor is there much accuracy in the representation of the arborescent strata.

In Plate VI. the corpus callosum is divided vertically along the median plane, and the superior vermiform process and velum Vieussenii of the ce-

rebellum, in the same direction ; the parts are then laid out, and so distorted, that the cerebellum, instead of lying under the posterior lobes of the brain-proper, is seen resting upon them. The arborescent strata of the cerebellum, particularly on the right side, are represented exceedingly incorrectly, and the corpus dentatum equally so. The lateral part of the posterior medullary velum is omitted, which ought to have been seen on the right side. The longitudinal furrow between the corpora quadrigemina is too wide ; the upper corpora quadrigemina are greatly too large, and the lower have a double ridge extending from them laterally, which they do not possess. The optic thalami are represented of a shape and size, and in a situation, which they were never known to have in nature ; and the same may be said of the corpora striata. A section of the anterior part of the corpus striatum never exhibits such an appearance as is delineated on the right side at *S* and at *L l*. The connection of the pineal gland with the optic thalami is not the least natural.

The VIIIth, IXth, Xth, XIth, and XIIth Plates are said to be intended, principally, to convey an idea of the natural position of the different parts

of the brain within the head, and of the nervous fasciculi. The explanations of them are prefaced with a statement of their importance, and a minute criticism of Vicq d'Azyr's engravings, intended to represent the same circumstances. And yet I am well convinced, that there is no anatomist who, if he were to examine these five plates, without being informed of the individuals under whose superintendence they were executed, would not at once pronounce, that the representations of the skull which they exhibit, independently of all their other errors, are wholly fictitious or imaginary, and never could have been drawn from nature.

Plate VIII. is said to represent the cranium sawn vertically through the middle of the forehead, crown, and occiput, in order to shew the outer surface of the right side of the brain-proper, cerebellum, annular protuberance, and medulla oblongata, in their natural position. As to the skull, however, in this plate, I would observe, that none such ever existed. Who ever saw a cranium having such an outline towards the forepart of the basis of its cavity, where the anterior lobes rest, as is here represented; or the posterior surface of the body of the sphenoid bone, on which the annu-

lar protuberance rests, with such a shape and such perpendicularity; or an occipital bone of such a form, and of such dimensions; or a foramen magnum measuring only half an inch in its long diameter? And with regard to the brain which this singular skull contains, there is no one who is in the least degree familiar with this organ, who will not immediately discover, that the relative position of its lobes has not been preserved. The posterior lobe is represented as projecting as far downwards as the middle one, and the middle and anterior lobes seem to slope into each other. The appearance of the annular protuberance is far from being natural; and a cerebellum of such a form, and with such an arrangement of lobes and lobules was, I am persuaded, never seen in any instance. The size of the convolutions of the brain-proper, also, and of the laminæ of the cerebellum, rendered the information very necessary which Drs. Gall and Spurzheim have given us with respect to them, viz. that they were very much developed *(très developées)* in the male subject from which this drawing was taken. This may have been the case; but as such an instance of *developement* has never in all probability, been

observed but by Drs. Gall and Spurzheim, other anatomists will be disposed to look upon it as a case of monstrosity not likely to occur soon again

Plate IX. is intented to represent a cranium sawn horizontally above the eyebrows, and through the middle of the temples, and upper part of the occipital bone; so that the membranes being removed, the hemispheres of the brain may be shewn from above. No skull, however, was ever seen, which, when divided in this manner, would exhibit an appearance such as is here delineated, whether we regard its general form and dimensions, or the structure and thickness of individual parts. There are equal objections to the representation of the brain. The hemispheres, so exposed, never could have displayed such a shape in any human head. The drawing too, independently of this, is ill executed; the highest part of each hemisphere appears as if it were no higher than the section of the skull, and is flat, or almost concave, instead of being convex.

Plate X. exhibits another vertical and longitudinal section of the cranium, but it is to the left side; and passes through the middle of the left

hemisphere of the brain-proper and cerebellum. The skull here, however, is as remarkable as in the two former plates. The outline given to those parts of the frontal and sphenoid bones on which the anterior lobe rests, has not the slightest resemblance to nature; both in point of dimensions and form it is grossly inaccurate. The view of the occipital bone is equally incorrect; and the foramen magnum is only half the size it should be, even in this lateral section of it. How comes it, too, I may ask, that the artist who has not failed to represent the minute diploe even of the divided bones, should not have delineated, either in this or any of the other plates, a single suture? With respect to the parts of the brain intended to be unfolded by this plate, I would observe, in the first place, that there are no such fibres in this organ as those represented at *e*, running from the corpus restiforme towards the corpus dentatum;—that the corpus dentatum has neither the form nor colour here given to it;—that a section of the lateral part of the posterior medullary velum has been altogether left out;—that the peduncles or crura of the cerebellum cannot by any artifice be made to exhibit such an

appearance as is marked 14;—and that the trigiminal nerve never had such an origin as is represented at 12. Secondly, none of the appearances between 34 and 38 are true to nature; and it is impossible to exhibit in a recent brain those fibres which are delineated with such precision beyond 38; especially those in the posterior lobe towards II, III, which have here an extent and direction given them purely fictitious.

Plate XI. professes to be a representation of the cranium, brain-proper, and cerebellum, divided vertically into two halves along the median plane, the view being one of the inner surface of the left half. But here again the outline of the bones upon which the anterior lobe rests is exceedingly inaccurate. It seems to have been forgotten that there is an ethmoid bone in this region altogether; and instead of a sella turcica on the upper surface of the sphenoid bone, it is actually represented as forming a large eminence, higher a good deal than the posterior clinoid processes. The shape given to the parts of the sphenoid and occipital bones, on which the annular protuberance and the medulla oblongata rest, is altogether unnatural. The foramen magnum is scarce-

ly one half the size it ought to be; and the view of the part of the occipital bone behind and above this hole, has no resemblance either in point of form or dimensions to the bone itself. No coronal and no lambdoid suture appears in this section; and what is still more remarkable, although the section is supposed to pass through the very middle of the sagittal or parietal suture, there is represented in the site of that suture, instead of the appearance of divided serræ, (with which every one is familiar, who has made a single vertical section of the cranium on the median plane) merely a layer of diploe inclosed between two tables, such as would have been disclosed in either parietal bone by dividing it a little to the side of the median line. Is it possible that the artist drew this representation from a skull actually before him? The view of the brain is no less inaccurate. The distance between the anterior commissure 61 and the commissure of the tractus optici is greatly too large; and the margin between 68 and 63 ought to be perpendicular instead of curved. There is a little triangular cavity immediately above the commissure of the tractus optici, and communicating with the third ventricle, which has been

altogether neglected. The commissure of the tractus optici instead of resting, as every one knows it does, on the forepart of the sella turcica, is represented as being close to the posterior clinoid processes, nothing intervening but the infundibulum, which is also entirely out of place. In such a section, too, a view of the pituitary gland should have been exhibited, cut exactly through the middle, and occupying the sella turcica; but neither sella turcica nor pituitary gland are to be seen. The aqueduct of Sylvius, or passage from the third to the fourth ventricle, is ill represented; it is too large throughout, and its commencement, in particular, is too wide. The pineal gland is represented as having a medullary plate, 45, connected with it below, distinct from that marked 44, which is generally called the posterior commissure of the brain; whereas there is but one such plate, and it is that one which, by being doubled back, forms this commissure. There is no such substance in this region as is represented between φ and n. Such a depth of matter as is seen between y and o, never was observed in any brain. The velum Vieussenii is represented greatly too thick. The arbor vitæ

does not correspond with nature, either in the number, or form, or situation of its branches; the part marked 62 in particular, never was seen so so large in any case. The middle part of the posterior medullary velum is altogether omitted. The laminæ of the cerebellum are represented, externally, enormously too large. With all these inaccuracies in their own engravings, does it become Drs. Gall and Spurzheim to dwell on the faults of Vicq d'Azyr's?

Of the representation of the structure of the brain proposed to be given in Plate XII, I have already had occasion to speak, both when following the pretended *diverging* and *converging fibres* in the cerebellum and those in the brain proper (see p. 39, 80, 116, 123.); and it is part of this Plate which I have copied in *fig.* 1. It is altogether an inaccurate or imaginary representation. The corpus olivare is made a solid mass of grey matter twice the size it ought to be; and the corpus dentatum in the cerebellum another mass of grey substance, without the least resemblance in shape to the natural one, and three or four times its real dimensions. Fibres are represented running up to it from the medulla oblon-

gata, which do not exist. The arborescent strata of the cerebellum are very incorrectly delineated. The lateral part of the posterior medullary velum is entirely omitted. The longitudinal bands passing through the annular protuberance cannot have been drawn from nature. The fibres marked 70, 70, p, p, p, have no existence in the brain; and those which are represented as diverging from the line 37, 37, 37, and extending in the direction S S S, until they actually terminate in the grey coating of the convolutions, are equally fictitious. The skull inclosing these parts is of the same character as those in the preceding plates. It has no ethmoid bone, and no sella turcica in the sphenoid; the surface on which the annular protuberance rests is almost perpendicular, and exhibits such depressions for this protuberance, and for the medulla oblongata, as never have been observed in any other instance before. The sections of the frontal and parietal bones are obviously imaginary, and the occipital bone has no resemblance to nature. The foramen magnum measures only five eighths of an inch from before backwards. Neither coronal, parietal, nor lambdoid sutures, are to be seen.

In Plate XIII. the annular protuberance is of most unusual dimensions; the white plane 65 on the left side of the cerebellum could not be exhibited by such a section as is there represented; and the corpus dentatum is extravagantly misplaced, and of a form and appearance altogether different from what it really possesses. The origin and connections of the anterior commissure are very different in nature from those ascribed to them in this representation. There is no white substance or white band such as S in the whole corpus striatum. The section of the skull in this plate seems imaginary.

Plate XIV. represents the brain in a state of enormous distortion. The long diameter of the cerebellum is very nearly $\frac{3}{4}$ths of an inch longer than, I believe, it was ever known to be. The optic thalami and tractus optici, are ill represented; the inner corpus geniculatum is too large, and the outer one too small. The corpora quadrigemina, too, are not natural; and the whole brain is too wide.

In Plate XVII. the arbor vitæ on the left side of the cerebellum is a very inaccurate representation; all the strata are either misplaced, or unlike

in dimensions and form; the second branch below, in particular, having a thickness which it certainly never possessed in any instance. The part marked β, which, with singular inaccuracy, is called the inferior medullary velum of REIL, has no existence in the brain. The fibrous structure of the fornix on the left side where it is left entire, has not been delineated, for what reasons DRS. GALL and SPURZHEIM best can inform us. Nothing can be more unlike than the representation of the septum lucidum. The radiations of the crus cerebri on the right side S S S, are too short before, and too long behind. The representation is much less perfect and less accurate than that which had been given by REIL in 1809, and greatly inferior to that which this anatomist afterwards introduced into his *Archives* for 1812. How DRS. GALL and SPURZHEIM reconcile their representation in this plate, with that which they have given in Plate XII., it is not easy to conceive. Yet it will be observed, that Plate XVII. is one which they are very solicitous, in their demonstrations, should be compared with the results of their manipulations then practised, while very little anxiety is shewn to institute such a comparison with Plate XII.

THESE details, which have stretched much beyond what I expected, and the general remarks they have involved, render unnecessary those observations I once intended to offer upon the introductory paragraphs to the essay in the APPENDIX. I cannot, however, conclude without expressing my conviction, that if a similar inquiry had been instituted into DRS. GALL and SPURZHEIM'S anatomy of the other parts of the Nervous System, the result would not have been different. In that department, undoubtedly, as well as in the brain, there are great pretensions to discovery; but their statements, so far as they have not been anticipated, are in both instances equally unfounded; and have escaped the scrutiny of preceding, as they will remain unknown to future inquirers, exactly because they have no existence in nature. With respect to that mode of investigation which they have challenged as exclusively their own, any attention, however superficial, to the quotations which have been given (perhaps too profusely) from the writings of earlier authors, will discover it to have been known, ever since that organ occupied its proper place among the objects of the science.

And in the same manner it must appear, that those of their observations which are undoubtedly correct, and which form the basis of truth necessary for the establishment of every theory, were made, many of them, at a remote period, and were all received as indisputable, long before they were employed by Dr. Gall or his colleague, in support of hypotheses on the structure of the nervous system.

This estimate of their merits would, probably, have been earlier arrived at and more generally adopted, had it not been that the whole subject has been exceedingly perplexed, by confounding the different modes of investigation which anatomists have at different times made use of, according to the objects proposed in their researches. There seem to be two points which it is most interesting to ascertain in the structure of the brain; the first is the distribution and arrangement of the differently-coloured substances of which it is composed; and the second (which it is evident cannot be successfully prosecuted till considerable advances have been made in the former) is to develope, if possible, the course of its apparent fibres. Sections of the organ in its most recent state, judiciously varied, give the only means of successfully prosecuting

the first; the latter is to be accomplished by delicate separation or laceration of its parts, which may be done to a certain inconsiderable extent on the recent brain, but much more satisfactorily on indurated preparations. VIEUSSENS applied himself to both objects, though with unequal success; because he used the brain generally in that state which alone was proper for the one inquiry, and but rarely in that which is best adapted for the other. VICQ D'AZYR subsequently devoted himself exclusively to the first object; and advanced very far towards its attainment, by the great variety and excellent judgment of his sections; which, though often suffering in representation from the unskilfulness of the artist, will not fail to be fully appreciated by those who peruse the body of his work with candour and competent information. The second object, which, for some time, perhaps, had been too much neglected, was afterwards resumed by REIL; who, soon perceiving with how little hope of success it could be prosecuted on the recent brain, and by coarse lacerations, used the organ prepared by new and very ingenious chemical processes, and investigated it with a delicacy and care formerly unknown. His success was

proportional to his industry and skill. From this statement, especially if combined with the authorities quoted in the preceding remarks, it must be apparent, that there has been nothing objectionable in the modes which these anatomists adopted in investigating the brain;—that Drs. Gall and Spurzheim have no claim to invention in their boasted plan of tracing the course of the fibres, and the connection subsisting by means of these, between the different parts of the organ;—and that their pretensions never would have been listened to, had it not been contrived to represent Vicq d'Azyr's method of investigating one great object in the anatomy of this part of the nervous system, as that exclusively employed in examining the other.

Here it is impossible to omit the mention of one circumstance, neither uninteresting nor unimportant. Reil, after successfully prosecuting his investigations for several years, sensible of the great extent and difficulty of the subject, and, willing by a division of labour to accelerate its advance, confined his attention to the cerebellum, in the hope that Dr. Gall, of whose merits he had formed no correct estimate, but of whose

anatomical pursuits he seems to have been aware, would conduct, upon a similar plan, an inquiry into the structure of the brain-proper*. Reil's part was successfully accomplished; but his expectations of assistance from Dr. Gall were altogether disappointed. So much so, that he seems not to have considered that person's investigations as worthy of attention; but pronouncing his method inadequate†, extended his own inquiries to the department thus fruitlessly assigned to another.

The actual progress which has been made in this branch of the science, is easily overlooked by those, who have no opportunity or leisure to extend their observation beyond the schools in which it is institutionally taught; and where, even were the teachers willing to give a complete view of what has been accomplished, the task would in fact be impossible; since the length and difficulty of this subject, would scarce be rewarded by the importance of the knowledge conveyed to a student, whose object it is to study anatomy, less with a view to refined physiological research,

* See "Archiv." &c. for 1807-8, p. 5.

† Ibid. for 1809, p. 138.

than to the practice of physic and surgery. The advance, however, though unobserved, has not been the less real, and will in time be universally acknowledged, though the successful inquirer may for a season be defrauded of the reputation he has justly deserved. Such, for the present, has been the hard, though not perhaps singular, fate of REIL; whose labours, as unobtrusive as they have been meritorious, have passed unobserved by many, amidst the importunity and confidence, with which the pretensions of others have been pressed upon the public attention.

I have now finished what I have thought it necessary to state respecting the claims which it has been my intention to examine. I am resolved not to resume this subject; which, as I knew it would be a work in some degree of censure, I originally undertook with unfeigned reluctance. All my wish now is, that the accuracy of these statements and opinions should be tried, by an appeal, on the one hand, to former anatomists, whose learned labours have met with most undue disregard, and on the other, to the decisive test of experiment and observation.

APPENDIX;

BEING THE ARTICLE

ANATOMIE DU CERVEAU,

WRITTEN BY

DRS. GALL AND SPURZHEIM,

FOR THE DICTIONAIRE DES SCIENCES MEDICALES,
VOL. IV. PARIS, 1813.

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§ 1. LA connaissance anatomique du cerveau a marché le plus lentement, quoique depuis longtemps on soit convaincu de sa haute importance. D'un côté, ces parties sont les plus délicates, et par conséquent les plus difficiles à examiner ; d'un autre côté, on a mis en usage une methode de dissection très-défectueuse ; on ne faisait que des coupes horizontales, verticales ou obliques, par en haut ou par en bas, et on enlevait successivement des tranches de cet organe. De cette manière, on commençait par détruire les connexions des différens appareils, et on procédait sans égard pour l'ordre dans lequel les parties se suivent naturellement. On manquait entièrement de principes physiologiques propres à conduire par degrés les anatomistes à la connaissance des lois de l'organisation du système nerveux en général, et du cerveau en particulier. On ignorait que les fibres nerveuses dussent leur origine et leur renforcement à la substance grise, et l'on ne savait, par conséquent, d'où procédait le commencement du cerveau*

Enfin, on avait négligé le mode du perfectionnement graduel des animaux, et l'on ne pouvait d'après cela se faire aucune idée de l'ordre dans lequel les conditions matérielles de leurs qualités avaient été progressivement surajoutées dans leurs cerveaux, ce qui empêchait d'en faire la recherche anatomique dans un ordre conforme au procédé de la nature.

§ 2. Toujours guidés par des vues physiologiques, nous avons créé une nouvelle méthode de disséquer le cerveau. Nous commençons l'examen de chaque partie par sa première origine, et en raclant nous suivons le cours et la direction des fibres. De cette manière nous connaissons facilement les renforcemens successifs, les additions des nouvelles parties, et leurs connexions naturelles. Même pour les anatomistes qui n'ont qu'un but méchanique, cette methode a le grand avantage de donner plus de facilité pour suivre la direction des fibres cérébrales, de connaître leurs formes, leur couleur, le degré de leur consistance et leurs connexions.

§ 3. Tous les anatomistes et physiologistes modernes considèrent le cerveau comme l'origine des nerfs et la source de la moelle épinière ; mais les nerfs et la moelle épinière sont aussi peu des prolongemens du cerveau qui celui-ci est une continuation de la moelle épinière. Toutes ces parties naissent et existent indépendamment les unes des autres. Les preuves suivantes ne laissent aucun doute de cette vérité.

1°. Le cerveau, les nerfs des cinq sens et ceux de la colonne vertébrale ne sont nullement en raison directe entre eux, ce qui devrait être, s'ils étaient des prolongemens l'un de l'autre. Le cheval, le bœuf, le cerf ont le cerveau beaucoup plus petit que l'homme, tandis que leurs moelles épinières et leurs nerfs surpassent de beaucoup les mêmes parties de l'homme.

2°. La direction des fibres de ces parties prouve évidemment notre assertion. *Voyez* NERFS.

3°. Ces parties existent séparément l'une de l'autre ; dans les animaux de l'ordre le plus inférieur, il y a des nerfs sans

cerveau. Dans les monstres, des animaux parfaits manquent tantôt telle, tantôt telle autre de ces parties ; il y a des monstres sans tête (*Voyez* ACEPHALE.), et l'on connaît un exemple d'une tête sans tronc. *Transactions*, tome LXXX, page 296.

4°. Les nerfs augmentant en volume dans leur trajet, pourquoi le seul cerveau irait-il toujours en diminuant jusqu'à ne plus présenter dans son prolongement que la moelle épinière ?

Il résulte donc que le cerveau, les prétendus nerfs cérébraux et les systèmes nerveux de la colonne vertébrale ont leur existence pour eux-mêmes, et qu'ils sont seulement mis en communication entre eux.

§ 4. Le cerveau, de même que les autres systèmes nerveux, consiste essentiellement en deux substances différentes : la substance grise et la substance blanche.

§ 5. La substance grise est pulpeuse, gélatineuse, tantôt plus molle, tantôt plus ferme, plus ou moins blanchâtre, rougeâtre, noirâtre, jaunâtre, sans organisation apparente. Elle contient une très-grande quantité de vaisseaux sanguins. Plusieurs anatomistes la regardent même comme un tissue de vaisseaux sanguins très-fins ; mais Albinus, et, depuis, Sœmmering, ont prouvé, par l'injection, qu'outre less vaisseaux, il y existe encore une substance propre, qui probablement est sécrétée par ces vaisseaux. Plusieurs anatomistes pensent qu'elle est destinée à sécréter un fluide nerveux. Nous la considérons comme la matière nourricière de la substance blanche. Elle n'est nullement isolée ; elle est toujours inséparable de la substance blanche. Déjà dans les vèrs, les insectes, les crustacées, les mollusques, elle forme des ganglions d'où naissent les filamens nerveux, et il n'existe jamais un filament nerveux qui ne tire son origine d'un amas proportionnel de cette substance ; dans les animaux plus parfaits, elle est tantôt rassemblée en amas, tantôt elle accompagne les fibres nerveuses dans leur trajet.

§ 6. Les opinions sur la structure de la substance blanche sont aussi très-nombreuses. Les uns ont enseigné qu'elle est solide; d'autres ont prétendu qu'elle est tubuleuse ; quelques-uns ont dit qu'elle était absolument dépourvue de vaisseaux, d'autres ont avancé qu'elle en était entièrement composée ; beaucoup d'autres l'ont crue médullaire, peu ont dit qu'elle est fibreuse ; néanmoins, c'est là véritablement sa structure *.

§ 7. La preuve que l'on oppose à la structure fibreuse du cerveau c'est que, lorsque l'on coupe sa masse, on n'y aperçoit aucune fibre ; elle n'a, dit-on, paru fibreuse à quelques anatomistes qui l'ont déchirée, que par une conséquence de la traction et du tiraillement opérés sur une masse un peu coriace ; et quand même les filamens se seraient réellement montrés d'une autre manière, ce n'aurait été que par suite d'une préparation chimique ou d'une altération survenue après la mort.

§ 8. Nous répondons à ces assertions arbitraires, qu'il est impossible, par des coupes nettes et lisses, de découvrir la veritable structure d'une masse extrêmement fine et molle. On n'y réussit même pas de cette manière dans les parties où elle est manifestement fibreuse ; par exemple, dans les pyramides, dans la protubérance annulaire, dans la grande commissure, et

* " La premiere et la plus importante des découvertes, même sous un rapport purement mecanique, celle sans laquelle toutes les autres seroient imparfaites, c'est celle de la structure constamment fibreuse de la substance blanche du cerveau partout où elle se trouve. Depuis Vieussens et Lœwenhœck, plusieurs anatomistes ont, il est vrai, bien reconnu que cette substance est en géneral fibreuse ; cependant, nous n'en trouvons pas un seul qui soit convaincu qu'elle est fibreuse sous toutes ses formes et dans toutes ses regions ; nous en trouvons, au contraire, beaucoup même parmi les modernes, qui nient, de la maniere la plus positive, que cette substance soit fibreuse en aucun endroit." Recherches, &c. p. 113.

" Les auteurs qui, avec Sœmmerring, Cuvier, reconnoissent la structure fibreuse du cerveau dans plusieurs de ses parties, n'ont cependant pas osé dire qu'elle est partout fibreuse." Anat. et Physiol. I. p. 235.

dans les régions antérieures et postérieures des cavités des hémisphères.

§ 9. Dans l'hydropisie du cerveau, les fibres s'aperçoivent très-distinctement. Si en soufflant de l'air, ou en injectant de l'eau, on sépare les unes des autres les couches formées par ces fibres, on aperçoit ces fibres dans tout leur épanouissement*. On obtient le même résultat, lorsqu'on fait bouillir dans l'huile le cerveau entier, ou quelques-unes de ses parties, ou qu'on les fait macérer dans le l'acide nitrique ou muriatique étendus d'eau ou d'esprit de vin. Si l'on racle la substance blanche dans la direction des fibres, on peut les suivre avec l'œil nu, jusque dans la substance grise des circonvolutions du cerveau ; mais si l'on racle en travers ou obliquement, les fibres se dérangent de leur direction naturelle et se rompent visiblement. Si les fibres sont le produit d'une coagulation qui aurait lieu après la mort, comment arrive-t-il que des agens aussi opposés que le sont l'eau dans l'hydropisie du cerveau, l'alcool, le vinaigre, la liqueur de Monro, les acides minéraux, l'huile chaude et même la gelée, agissent tous d'une manière uniforme ? Pourquoi la substance blanche se coagule-t-elle dans les circonvolutions en fibres qui s'y tiennent dans une position droite et perpendiculaire du fond au sommet ? Pourquoi dans d'autres parties se coagule-t-elle en fibres horizontales circulaires, disposées en éventail, ou entrecroisées ? Pourquoi les fibres se forment-elles toujours de la même manière dans la même partie ?

§ 10. La substance grise et la substance blanche varient par leur forme et par leur arrangement dans le cerveau ; tantôt elles sont, pour ainsi dire, mêlées l'une avec l'autre ; tantôt

* " If in the healthy brain, without any preparation, by means of a syringe we direct a stream of water on a convolution, and thereby separate its two layers one from another, we may see their fibres throughout their whole expansion." _ *Physiognomical System*, p. 21.

elles sont séparées ; ici elles forment des masses épaisses, là des couches, ou bien elles affectent des conformations particulières.

§ 11. On divise la masse du cerveau en deux parties principales : l'une supérieure et antérieure, composée elle-même de deux hémisphères ; l'autre inférieure et postérieure, contigue au grand renflement de la masse nerveuse d'où il faut dériver la plupart des nerfs cérébraux. Cette partie, dans les animaux plus parfaits, étant en général plus petite que les deux hémispheres supérieurs, on lui a donné le nom de *cervelet*, et les deux hémisphéres supérieurs, pris ensemble, a été appelée *cervelet*.

Nous nous en tiendrons ici à un coup-d'œil général, sans nous engager dans une description minutieuse de chaque partie. Nous renvoyons à notre grand ouvrage, tome I, ceux qui voudraient lire l'anatomie du cerveau avec plus de détail.

§ 12. Nous distinguons, dans le cervelet et dans le cerveau, deux ordres de fibres : les fibres divergentes et les fibres rentrantes, ou les appareils de formation et les appareils de reunion.

§ 13. *Cervelet.* Le cervelet suivant immédiatement les systèmes nerveux de l'épine du dos et des sens, et étant la première des parties intégrantes de la masse cérébrale, c'est par lui que nous commençons.

§ 14. Dans les animaux d'un ordre inférieure et même dans les oiseaux, le cervelet est simple, mais toujours composé de deux moitiés. Chez les poissons et les reptiles, on ne voit aucune des divisions qui, dans la coupe perpendiculair, présente l'arbre de vie. Mais chez les oiseaux, les anneaux et les sillons semi-circulaires sont très-visibles, et par le moyen de la coupe perpendiculaire de leur cervelet, on aperçoit une espèce d'arbre de vie.

§ 15. Chez les mammifères, la nature a encore ajouté de nouvelles parties latérales, de sorte que la première partie devient

médiane, dénomination qui nous parait cependant moins bonne que celle de partie *fondamentale*, parce que dans les cervelets des poissons, des reptiles et des oiseaux, il n'existe point de parties latérales.

§ 16. Dans la formation du cervelet, la nature suit toujours le même type. C'est pourquoi, dans le cervelet de l'homme, si compliqué et si parfait, on retrouve toujours l'idée première et la forme élémentaire de sa composition.

§ 17. C'est de la substance grise placée dans l'intérieur du grand renflement au dessus des nerfs cervicaux, que naissent les premières racines visibles du cervelet. Ces racines forment en dehors des deux côtés du renflement, un faisceau fibreux plus ou moins fort, mais très-gros chez l'homme. Ce faisceau grossit continuellement en montant. Près du cervelet, le nerf auditif et la substance grise, ce qu'on appelle le ruban gris, ou selon nous, son ganglion, sont couchés sur ce faisceau. Si l'on enlève le nerf auditif et son ganglion, en raclant avec précaution ou en se servant du manche du scalpel, et si l'on suit la direction des fibres, on voit distinctement le faisceau entier de chaque côté entrer dans l'intérieur de chaque hémisphère du cervelet. A peine y a-t-il pénétré de quelques lignes, qu'il rencontre un amas de substance grise, avec laquelle il forme un tissu assez ferme, de sorte qu'il est impossible d'y poursuivre la direction des filamens nerveaux. Ce tissu offrant un corps dentelé et irrégulier, les anatomistes l'ont appelé le corps dentelé, le corps ciliaire, le corps frangé, le zigzag, corps rhomboïde. D'autres anatomistes ayant regardé cette partie comme la réunion de toute la substance blanche du cervelet, lui ont donné le nom de noyau du cervelet.

§ 18. Cependant la substance grise qu'il contient est, de même que toutes celles des autres systèmes nerveux, un appareil préparatoire destiné à renforcer les filamens nerveux qui y entrent par de nouveaux filets qui s'y engendrent. C'est par conséquent un point de naissance et de renforcement d'une

grande partie de la masse nerveuse du cervelet et son véritable ganglion. En effet, plusieurs nouveaux faisceaux nerveux y prennent naissance, et, continuant leur cours, se ramifient en branches, en couches et en sous-divisions multipliées. Dans chaque point d'où sort une de ces branches principales, on voit une masse plus abondante de substance grise former une éminence. Il résulte ainsi un nombre de franges, de dents ou de proéminences de cette substance, égal à celui des branches principales nerveuses.

§ 19. Le faisceau originaire, le ganglion, les divisions et sous-divisions en branches, en rameaux et en feuilles, sont pour leurs dimensions en raison directe entre elles. La plupart des mammifères ayant le cervelet beaucoup plus petit que l'homme, ont aussi ce ganglion plus petit et moins visible ; c'est pourquoi les anatomistes ont cru que les animaux en étaient totalement dépourvus.

§ 20. Dans l'homme une des branches principales qui sortent du ganglion, se porte vers la ligne médiane et contribue avec sa branche congénère du côté opposé, à former la partie fondamentale du cervelet *(processus vermiformis)*, laquelle se sous-divise ordinairement en sept rameaux principaux. Les autres branches qui sortent du ganglion se dirigent en arrière, en haut, en bas et en dehors, et s'épanouissent en couches très-minces disposées horizontalement ; celles du milieu sont les plus longues, et les autres d'autant plus courtes qu'elles se rapprochent plus de l'endroit où le faisceau originaire entre dans le ganglion.

§ 21. Les filets nerveux de toutes les divisions et sous-divisions sont recouverts de substance grise à leur extrémité périphérique.

§ 22. Si l'on fait passer une coupe verticale par le milieu du ganglion, on trouve ordinairement onze branches principales du cervelet, mais le nombre des divisions varie selon que la coupe se rapproche de l'intérieur du cervelet, ou qu'elle s'en

éloigne. Les couches filamenteuses, étant d'abord réunies en branches assez grosses, et s'épanouissant ensuite en couches larges et en feuilles, présentent dans les coupes verticales une figure qui a beaucoup de resemblance avec le feuillage du thuya ou arbre de vie, de là ce nom. Mais une coupe horizontale ou transversale de ces branches, de ces rameaux et feuillets n'offre qu'une surface blanche.

§ 23. *Appareils de formation du cerveau.* Le cerveau consistant en plusieurs divisions dont les fonctions sont totalement différentes, il existe plusieurs faisceaux primitifs qui, par leur dévelopement, contribuent à le produire. Tous les faisceaux originaires sont composés graduellement de fibres produites dans la substance grise du grand renflement occipital (moelle alongée). Nous rangeons parmi ces faisceaux, les pyramides antérieures et postérieures, les corps olivaires, et quelques autres situés à côté des corps olivaires *.

§ 24. Tous ces faisceaux originaires du cerveau sont mis en communication et en action réciproques avec les systèmes nerveux situés au dessous d'eux. Cette communication, par rapport aux pyramides antérieures, présente une particularité. Les autres faisceaux naissent, comme le faisceau du cervelet, du même côté où ils doivent donner des parties du cerveau. Il en est tout autrement des fibres nerveuses des pyramides antérieures. Celles qui naissent du côté droit dès le commencement du grand renflement, à peu près à quinze lignes audessous de la protubérance annulaire, se réunissent d'abord en deux à cinq petits cordons, puis se rendent au côté gauche en suivant une direction oblique. De même les petits cordons

* " D'apres nos connoissances actuelles, nous rangeons parmi ces faisceaux les pyramides antérieures, et postérieures, les faisceaux qui sortent immédiatement des corps olivaires, les faisceaux nerveux longitudinaux qui aident a former en partie la quatrieme cavité, et encore quelques autres qui sont cachés dans l'interieure du grand renflement." Anat. et Physiol. &c. I. p. 271.

du côté gauche se rendent au côté droit. Un faisceau passe ordinairement par dessus un autre, et par dessous un troisième, de sorte qu'il en résulte un entrelacement semblable à une natte de paille. Cet entrecroisement occupe un espace de trois à quatre lignes *. Ensuite les faisceaux montent sur la

* " L'inspection anatomique, et les phénomènes pathologiques, ne permettent pas qu'on accorde cet entre-croisement à d'autres faisceaux qu'à ceux qui composent les pyramides. Il n'a par consequent, lieu dans aucune autre partie de la moëlle allongée, ni dans aucun endroit de sa face posterieure." Recherches, &c. p. 130.

" Suivant nos recherches anatomiques, les faisceaux des pyramides sont les seuls qui s'entre-croisent." Anat. et Phys. I. p. 275.

" Enfin ce veritable entrecroisement fut décrit d'une maniere si précise par MISTICHELLI en 1709, par PETIT en 1710, et plus tard par LIEUTAUD, SANTORINI, et WINSLOW, que l'on ne peut pas reprocher à ces anatomistes de l'avoir confondu avec les simples couches de fibres nerveuses transverses. Ils disoient cependant, mais probablement par pure supposition, qu'il existoit en plusieurs endroits de pareils entrecroisemens." Anat. et Phys. I. p. 273.

" A la vérité, Mistichelli, Petit, et Santorini ont decrit l'entre-croisement, mais sans aucune précision, ne l'ayant point restreint aux seules pyramides ou il a lieu, et n'en ayant point exclu les autres faisceaux de la moëlle alongée dans lesquels il n'a pas lieu." Recherches, p. 212.

" Pour faire voir distinctement le veritable entrecroisement, il n'est pas besoin de maceration ou de toute autre preparation, ainsi que le croyoit Santorini. Il suffit d'enlever avec precaution la membrane vasculaire au commencement du grand renflement, ou immédiatement en bas de l'extrémité inferieure des pyramides. Pour cela ou fait a cette membrane une incision si légère que les cordons nerveux qui se trouvent au-dessous ne soient pas offensés. Puis on écarte tout doucement les deux bords de la ligne médiane, sans les tirailler ni les dechirer. A peine les deux bords sont ils un peu eloignés l'un de l'autre, que l'entre-croisement frappe les yeux." Anat. et Physiol. I. p. 273.

face antérieure du grand renflement, en se renforçant graduellement dans leur trajet ; conséquemment ils sont plus larges à leur partie supérieure, vers la protubérance annulaire, qu'à leur extrémité inférieure, ce qui leur a fait donner le nom de pyramides. Quelquefois les fibres primitives, au lieu de former un entrelacement semblable à une natte de paille, présentent des bandes qui se rendent dans une direction oblique d'un côté à l'autre.

§ 25. Cet arrangement organique explique pourquoi des lésions à la tête se transportent souvent sur le côté opposé du corps ; et parce qu'il n'y a qu'une partie du cerveau, c'est-à-dire, la continuation des pyramides antérieures, qui communique avec la masse nerveuse du corps par un entrecroisement, on conçoit pourquoi la paralysie du corps produite par les lésions du cerveau, se manifeste ordinairement du côté opposé, et pourquoi il arrive aussi que les dérangemens du cerveau affectent le même côté du corps.

§ 26. Immédiatement avant que les faisceaux pyramidaux entrent dans la protubérance annulaire, ils sont un peu étranglés ; mais à peine y ont-ils pénétré qu'ils se partagent en plusieurs faisceaux qui sont placés dans une grande quantité de substance grise, d'où il sort beaucoup de nouveaux faisceaux qui se joignent aux premiers, et les renforcent durant leur trajet dans ce véritable ganglion. Quelques-uns sont disposés en couches, d'autres s'entrecoupent à angle droit avec des faisceaux transversaux qui viennent du cervelet, et dont nous parlerons plus tard. Ils se prolongent en montant, et sortent de ce ganglion si renforcés et si élargis qu'ils forment en avant et en dehors au moins les deux tiers des grands faisceaux fibreux (des cuisses) du cerveau.

§ 27. Ces faisceaux antérieurs et extérieurs des pédoncules du cerveau sont une continuation et un perfectionnement successif des faisceaux primitifs pyramidaux ; ils contiennent inté-

rieurement dans toute leur longueur une grande quantité de substance grise ; ils acquièrent par là un renforcement continuel, parce qu'il se joint toujours à eux de nouvelles fibres. C'est à leur extrémité supérieure qu'ils reçoivent le plus grand accroissement, dans l'endroit où le nerf optique se contourne autour de leur surface extérieure : c'est dans la partie extérieure des corps cannelés ou striés.

§ 28. Les filets nerveux et les faisceaux qui en sont formés s'écartent du grand faisceau au bord antérieur du nerf optique, au point où ce nerf est attaché par une couche molle au grand faisceau ; ils se prolongent en filets de longueur inégale qui s'épanouissent en couches dont les extrémités sont converties de substance grise, et forment de cette manière plusieurs parties séparées, connues jusqu'à présent sous le nom de circonvolutions.

§ 29. De cette manière, les faisceaux pyramidaux étant continuellement renforcés, et ayant atteint leur perfectionnement complet, s'épanouissent dans les circonvolutions inférieures, antérieures et extérieures des lobes antérieurs et moyens.

§ 30. Il nous reste à parler de la formation du lobe postérieur et des circonvolutions situées au bord supérieur de chaque hémisphère, vers la ligne médiane du cerveau.

§ 31. Le faisceau qui sort des corps olivaires et quelques autres faisceaux postérieurs montent, comme les faisceaux des pyramides, entre les fibres transversales de la commissure du cervelet *. Dans ce trajet, ils acquièrent un renforcement qui est bien moins considérable que celui des pyramides, et ils for-

* " Les corps olivaires ne sont qu'un ganglion, de meme que le corps frange du cervelet. Si on le coupe, ou y voit la substance grise et la substance blanche distribuées de la même manière. Il sont de ce ganglion un fort faisceau qui monte avec les faisceaux posterieures du grand renflement derrière le ganglion du gros faisceau fibreux." Anat. et Phys. I. p. 280.

ment la partie postérieure et intérieure des grands faisceaux fibreux (des cuisses) du cerveau. Ici ils acquièrent leur plus grand accroissement par la masse épaisse de substance grise qui s'y trouve, et qui, avec des filets nerveux qu'elle produit, forme un ganglion assez dur, aplati au milieu et inégal en haut et postérieurement.

§ 32. Ce ganglion a, jusqu'à présent, été connu sous le nom de couches optiques ; mais une couche nerveuse du nerf viseul est seulement attachée à la surface postérieure externe de ce ganglion. D'abord ce ganglion n'est nullement en raison directe avec le nerf optique, mais ils l'est avec les circonvolutions qui sortent de ce ganglion. Ensuite, en examinant l'intérieur de ce ganglion, on trouve une grande quantité de filets nerveux très-fins qui tous vont en montant, et dans une toute autre direction que le nerf optique. Ils se réunissent à leur sortie, au bord supérieur du ganglion, en faisceaux divergens. Les antérieurs de ces faisceaux traversent un grand amas de substance grise, et prennent un nouvel accroissement de cet amas, de sorte qu'ils suffisent pour former les circonvolutions postérieures, et toutes celles qui sont situées au bord supérieur de chaque hémisphère, vers la ligne médiane du cerveau *.

§ 33. Les prétendues couches optiques et les corps striés sont donc de vrais appareils de renforcement, et les circonvolutions ne sont que l'épanouissement des faisceaux nerveux et le perfectionnement de tous les appareils précédens.

§ 34. Avant de parler de la structure particulière des circonvolutions, nous allons traiter de la seconde classe d'appareils, c'est-à-dire, des appareils de réunion ou des commissures.

§ 35. Toutes les parties cérébrales sont doubles ou paires, mais les systèmes nerveux congénères des deux côtés sont

* " Les faisceaux radies, à leur sortie de leur ganglion (couches optiques) traversent un gros amas de substance grise, dont une moitié est placée dans les cavités du cerveau, et l'autre à l'exterieur." Anat. et Phys. I. p. 281.

joints ensemble et mis en action réciproque par des fibres nerveuses transversales, ce qui forme les commissures.

§ 36. Nous avons suivi les fibres divergentes depuis leur origine jusqu'à fond des circonvolutions. Ici, au fond des circonvolutions, on peut démontrer une autre sorte de fibres molles et fines, mais distinctes et visibles, qui s'avancent entre les fibres du système sortant et s'entrelacent avec elles *.

§ 37. Ces filamens du système rentrant se réunissent en filets plus gros, et à mesure qu'ils se portent vers l'intérieur, ils forment des faisceaux et des couches qui se rapprochent de la ligne médiane entre les deux hémisphères, sortent par le bord interne de l'hémisphère en couches nerveuses blanches, se joignent aux faisceaux et aux couches des systèmes congénères de l'hémisphère opposé, et forment ainsi les différentes réunions, jonctions, commissures : ces commissures sont toujours en raison directe avec les parties dont elles forment la réunion.

§ 38. *Commissure du cervelet.* Il y a un ordre de fibres nerveuses qui n'ont pas de connexion immédiate avec le faisceau primitif, ni avec l'appareil de renforcement du cervelet. Les filets sortent de la substance grise de la surface, se portent dans diverses directions entre les filets divergens vers le bord externe antérieur, et forment une couche fibreuse, large et épaisse. Considérés dans la station droite de l'homme, les postérieurs et les médians de ces filamens convergens passent transversalement par les faisceaux longitudinaux et divergens du cerveau, et les filamens antérieurs convergens du cervelet se placent en avant de ces faisceaux longitudinaux, comme une

* " En effet, on remarque dans les circonvolutions formées de deux couches nerveuses du système sortant, des filets plus mous et plus fins ; mais on ne peut les suivre comme fibres distinctes et visibles que dans les circonvolutions posterieures du lobe moyen. On voit ces fibres au fond de toutes les circonvolutions, s'avancer entre les fibres du système sortant, et s'entrelacer avec elles." Anat. et Physiol. I. p. 286.

couche fibreuse, et tous se réunissent dans la ligne médiane avec les faisceaux congénères qui sortent de la même manière de l'autre hémisphère du cervelet. Cet arrangement unit donc les deux hémisphères du cervelet : c'est pourquoi nous lui donnons le nom de réunion ou de commissure du cervelet, au lieu du nom impropre et mécanique de pont.

§ 39. La grandeur de cette commissure étant en raison directe de celle des deux hémisphères du cervelet, il résulte que, dans les mammifères qui ont le cervelet plus petit que l'homme, la commissure est également plus petit ; on voit encore par là pourquoi les anatomistes n'ont pas trouvé le pont chez les poissons, les reptiles et les oiseaux, car ces animaux n'ayant point les parties latérales du cervelet, les fibres qui en forment la commissure manquent nécessairement chez eux.

§ 40. La partie primitive ou fondamentale du cervelet a sa commissure dans les couches fibreuses, molles et minces de la partie supérieure et inférieure de cette partie fondamentale improprement nommées *valvules* *.

§ 41. *Commissures du cerveau.* Les anatomistes donnent depuis longtemps le nom de commissures à plusieurs parties du cerveau. Ils parlent des commissures antérieure, postérieure et médiane, et de la grande commissure ; mais ils ne songèrent pas à chercher quel était, avec les parties du cerveau, le

* " Les faisceaux fibreux qui réunissent la partie superieure des pyramides posterieures avec la partie inferieure de la partie fondamentale, et la partie supérieure de cette dernière avec la masse nerveuse voisine des tubercules quadri-jumeaux, n'ayant pas été considérés jusqu'à present comme entièrement distincts et séparés des fibres de réunion ; et toutes ces fibres passant au-dessus de la partie supérieure et inferieure de la quatrième cavité, ou a très improprement donné à ces epanouissemens fibreux le nom de valvules supérieure et inferieure, ou bien de *processus cerebelli ad medullam oblongatam, et de processus cerebelli ad testes*.. Reil les appelle voiles medullaires, et il se demande a quoi ils peuvent servi. Anat. et Physiol. I. p. 269.

rapport de chacune de ces commissures, ni d'où l'on devait faire dériver celles-ci ; ils n'examinèrent pas si toutes les parties cérébrales étaient unies les unes aux autres de la même manière, ni pourquoi les jonctions des mêmes parties différaient tant entr'elles chez les divers animaux. Enfin ils n'avaient pas établi que ces jonctions sont soumises à une loi générale. Nos recherches nous ont procuré sur cet objet les éclaircissemens les plus précis. Nous abandonnons les expressions de commissure antérieure, postérieure, etc. ; nous nous en tenons à la notion générale que toutes les parties ont leurs réunions, et nous cherchons à découvrir à quelle partie chaque réunion appartient.

§ 42. *Commissures des circonvolutions situées à la base du cerveau.* Les filets de réunion des circonvolutions inférieures du lobe postérieur et des circonvolutions postérieures du lobe moyen se replient derrière les gros faisceaux fibreux (cuisses) du cerveau, et derrière le grand appareil de renforcement inférieur (couche optique), en allant de chaque côté vers l'intérieur, et se recontrent en direction oblique. Les circonvolutions internes du lobe postérieur donnent principalement les filets de réunion que l'on appelle replis du corps calleux ; les circonvolutions postérieures du lobe moyen ont leurs filets de jonction dans ce que l'on appelle la voûte (*farnix*). L'ensemble de filets de jonction de la voûte est la partie que les anatomistes appellant la lyre, la harpe ou *psalterium*.

§ 43. Les filets de réunion des circonvolutions antérieures du lobe moyen et de quelques circonvolutious situées au fond de la scissure de Sylvius se dirigent de dehors en dedans, et se réunissent vers la partie la plus antérieure des circonvolutions les plus internes du lobe moyen ; ils forment un cordon nerveux qui, chez les adultes, est presque de la grosseur d'un tuyau de plume, traverse en avant et inférieurement la moitié extérieure du ganglion supérieur (corps strié) sans cependant, y être adhérent, et se joint dans la ligne médiane avec le cor-

don congénère du côté opposé. C'est à cette jonction que les anatomistes donnent le nom de commissure antérieure.

§ 44. Les circonvolutions inférieures du lobe antérieur ont leur réunion en avant du grand ganglion supérieur (corps strié), au point que l'on appelle jusqu'à présent le repli antérieur du corps calleux.

§ 45. *Commissures des circonvolutions supérieures du cerveau.* Toutes les circonvolutions supérieures des deux hemisphères ont leurs filets de jonction dans ce que l'on appelle corps calleux ou grande commissure.

§ 46. Comme les deux hémisphères sont séparés en arrière et en avant, les filets de réunion des circonvolutions placées le plus en arrière et le plus en avant, ne peuvent pas, pour se joindre, suivre une ligne droite ; mais les circonvolutions inférieures du lobe postérieur se dirigent en avant et intérieurement, et les circonvolutions inférieures (antérieures du lobe antérieur) se dirigent en arrière et intérieurement, afin de se réunir dans le repli de la grande commissure.

§ 47. C'est par la même raison que les filets de réunion des circonvolutions supérieures des hémisphères se dirigent par derrière, en avant et intérieurement ; et par devant, en arrière et intérieurement ; ce n'est que dans la région médiane que les fibres suivent une direction transversale.

§ 48. De cette manière, le nombre des faisceaux qui se réunissent est plus considérable dans l'extrémité antérieure et postérieure, que dans le milieu de la grande commissure ; c'est pourquoi elle est plus épaisse dans ses parties antérieure et postérieure, et l'est encore davantage dans la partie postérieure que dans la partie antérieure, parce que les lobes postérieurs sont plus considérables.

§ 49. Les réunions des parties cérébrales étant toujours en proportion directe avec les parties auxquelles elles appartiennent, et certaines parties du cerveau étant très-petites chez les oiseaux, leurs réunions doivent l'être également : cette peti-

tesse est la cause que, dans l'anatomie comparée, on n'a pas vu jusqu'à présent chez les oiseaux diverses commissures, ni même le corps calleux, la route et leurs dépendances, et qu'on regardait ces parties comme les lignes caractéristiques du cerveau des mammifères. Mais le type primitif est le même chez tous les animaux ; dès qu'il existe une partie du cerveau, elle est double, et chacune est mise en action réciproque avec la partie analogue par des filets ou faisceaux de réunion. Les différences de forme, de grosseur et de direction des filets de réunion, ne sont que de simples modifications du même appareil.

§ 50. On pourrait encore demander si nous sommes fondés à dériver des circonvolutions ces appareils de jonction, et à les considérer comme rentrans *.

§ 51. Les filets nerveux sont partout produits par la substance grise ; la couleur blanche de tous les faisceaux de jonction nous apprend qu'ils ne contiennent pas de substance grise, ou du moins qu'ils n'en contiennent que très-peu ; les réunions sont même situées hors des hémisphères où elles parcourent, pendant un certain intervalle, un espace pour ainsi dire vide : par conséquent, on ne peut pas dériver l'origine de cet ordre de fibres du point de leur réunion, mais de la matière grise des circonvolutions.

§ 52. Il résulte donc de tout ce que nous venons de dire, que les filets nerveux divergens s'enfoncent dans les circonvolutions, et que les filets de jonction en sortent †. A présent, c'est à savoir si les filets divergens sont seulement augmentés par la matière grise située à la surface extérieure des circonvolutions, et se recourbent pour former les filets de jonction, ou si les premiers finissent dans la substance corticale, et qu'une

* " Mais sommes nous fondés a deriver de la substance grise du contour exterieur ces appareils de jonction, et à les considérer comme rentrans ?" Anat. et Physiol. I. p. 286.

† " Nous avons précédemment suivi les appareils de formation ou les filets nerveuse sortans ou divergens, jusques dans la substance grise

autre sorte de fibre y commence. C'est ce que l'anatomie n'a pas encore pu démontrer.

§ 53. *Cavités du cerveau.* Les deux ordres de fibres du cervelet et du cerveau sont séparés en divers endroits par des intervalles connus sous le nom de ventricules ou cavités du cerveau : on en fait ordinairement grand cas ; les anatomistes en ont donné des descriptions détaillés ; nous les regardons comme un résultat du mécanisme organique, et nous nous rattachons plus à la structure des parties qu'au vide qu'elles laissent entr'elles.

§ 54. *Structure des circonvolutions.* Jusqu'à présent, on s'était figuré que la membrane vasculaire s'enfonçait en différens points dans la substance médullaire du cerveau, pour y faire pénétrer le sang à une plus grande profondeur, et que de là provenaient les inégalités, les enfoncemens, ou les anfractuosités et les circonvolutions.

§ 55. Mais la structure du cerveau n'est pas aussi mécanique et aussi accidentelle. Les filets divergens, des qu'ils se sont entrecroisés au bord externe des grandes cavités avec les filets de réunion, s'écartent davantage, se prolongent et forment comme tous les autres systèmes nerveux, une expansion fibreuse. Les fibres de chaque faisceau n'ont pas toutes la même longueur : un grand nombre, et surtout celles qui sont situées

à la surface exterieure des circonvolutions. On reconnoit tres distinctement que toutes les extrémités des filets nerveux penetrent dans la substance grise, qui par cette raison est plus blanche en dedans qu'en dehors. Mais nous n'avons pu encore determiner ce qui se passe ultérieurement avec ses fibres ; nous ignorons si elles se terminent dans cet endroit, ou si elles retournent et prennent leur cours vers l'interieur. Cependant il est tres vrai-semblable, d'après les lois générales, qu'il s'engendre de nouveaux filets nerveux dans cette couche grise, de même que cela a lieu partout ou se trouve de la substance grise ; et qu'il en resulte la production d'un système nerveux qui renforce le précédent avec lequel il est en connexion intime." Anat. et Phys. I. p. 285.

des deux côtés, se terminent immédiatement au-delà des parois extérieures des cavités ; les autres continuent à se prolonger, mais à des distances inégales les unes à côté des autres ; celles qui sont situées en dedans, s'étendent le plus loin. C'est ainsi que se forment à l'extérieur les prolongemens de chaque faisceau, et de deux en trois faisceaux, des intervalles, des enfoncemens ou sinuosités : toutes ces fibres sont recouvertes, à leur extrémité périphérique, de substance grise qui doit affecter la forme de l'expansion nerveuse : la plupart de ces prolongemens ont une position un peu courbe ou inclinée, et sont rarement placés verticalement sur le fond des ventricules ; très-souvent leur bord supérieur est déprimé, ce qui leur donne une figure semblable à celle que prend un pli d'étoffe ou de papier, quand on presse un peu en dedans sa sommitté extérieure.

§ 56. Lorsque l'on coupe perpendiculairement et en travers un de ces prolongemens, on voit que la substance blanche est plus large à la base des circonvolutions, et devient toujours plus étroite en allant vers la partie supérieure ; cela vient de ce que les fibres nerveuses de chaque côté se perdent successivement dans la substance grise, tandis que celles du milieu se prolongent seules jusqu'à l'extrémité : cette coupe ne fait voir à la vérité la substance fibreuse que comme une simple masse médullaire homogène, nulle part l'œil n'y découvre de ligne de démarcation ; même après une légère traction, on ne peut apercevoir des deux côtes aucune séparation des fibres.

§ 57. Cependant les fibres de chaque prolongement ne se réunissent pas en un seul faisceau, comme les fibres des nerfs optiques et acoustiques ; mais elles forment deux couches particulières qui se touchent dans la ligne médiane de chaque prolongement ou circonvolution, et sont légèrement agglutinées l'une contre l'autre, par le moyen d'un névrilème muqueux ou d'un tissu cellulaire très-fin.

§ 58. C'est sur cet arrangement qu'est fondée la possibilité de séparer l'une de l'autre les deux couches de fibres sans les en-

dommager, et d'étendre en une surface, ou de déplisser chaque circonvolution. L'entrecroisement des filets divergens et rentrans à la base des circonvolutions, produit une légère résistance qui est cependant assez forte pour empêcher qu'on ne puisse pas détacher les unes des autres sans en déchirer le tissu. Mais les duplicatures des circonvolutions se séparent facilement et sans destruction des fibres : toute la face intérieure de cette expansion consiste uniquement en fibres nerveuses ; elle est entièrement blanche, lisse et intacte ; la surface externe est recouverte de substance grise.

§ 59. Quand on coupe verticalement et en travers une circonvolution jusqu'à la base, on peut, par une pression continue, mais douce, séparer avec les doigts les deux couches fibreuses des circonvolutions, et les parois intérieures restent lisses.

§ 60. Si l'on met dans la main une portion des hémisphères avec la partie convexe, et que l'on détruise le tissu dans la base des duplicatures, on peut, par un léger effort, détacher les deux couches des circonvolutions, parce qu'elles sont légèrement collées l'une à l'autre. Pendant qu'on les détache en passant légèrement le doigt par dessus, on aperçoit toujours, au point où la séparation s'effectue, un petit sillon, et en même temps la direction perpendiculaire des fibres nerveuses et des vaisseaux sanguins. Toutes ces choses ne pourraient pas se présenter de cette manière, si les circonvolutions ne consistaient pas réellement en deux couches fibreuses qui ne sont pas adhérentes ni réunies par des fibres transversales, mais simplement attachées par un tissu cellulaire fin et lâche.

§ 61. Si on fait durcir dans l'alcool ou dans l'acide nitrique étendu d'alcool, des tranches de circonvolutions, ou si on les fait bouillir dans de l'huile, les deux couches se séparent très-aisément et uniquement dans la ligne médiane *.

* " On n'aperçoit sur les deux faces interieures aucun vestige de fibres nerveuses dechirées, quoique l'on voie très distinctement l'expansion fibreux." Anat. et Phys. I. p. 303.

§ 62. Les expériences suivantes prouvent incontestablement que chaque circonvolution est une duplicature de deux couches fibreuses, et que ces deux couches ne sont pas adhérentes, mais simplement attachées l'une à l'autre.

§ 63. Si avec un tube on souffle sur une coupe transversale d'une circonvolution, on peut bien finir par détruire la substance grise et la substance blanche, mais on n'opère pas la séparation des fibres ni des deux substances. Mais lorsqu'on souffle sur la ligne médiane, la circonvolution ou la duplicature se fend de la base au sommet. Si l'on essai la même expérience sur une circonvolution un peu déprimée par le sommet, elle s'entr'ouvre à la base par une fente simple, et dans la partie supérieure déprimée, la fente se prolonge vers les deux coins : on produit le même effet avec le pli d'une étoffe, lorsqu'on en déprime un peu la partie supérieure.

§ 64. Quand, au lieu de souffler, on jette avec une seringue de l'eau sur une coupe transversale d'une circonvolution, la séparation se fait dans le milieu, de la même manière et avec tant de facilité, que l'injection de quelques filets d'eau la propage à trois ou quatre pouces dans l'intérieur des circonvolutions ; lors même qu'elles ont des sinuosités ou des subdivisions latérales, l'eau passe par toutes les courbures, et toujours dans la ligne médiane*.

§ 65. Mais bien plus, si l'on jette de l'eau sur le côté extérieur d'une circonvolution, jusqu'à ce que la substance grise et la moitié de la substance blanche soient détruites ; ou bien si l'on ouvre latéralement une circonvolution jusqu'à la ligne

* " When through a tube we blow on such a slice, or when, with a syringe, we direct against it a small stream of water, the separation may be made in the middle very easily ; but at the sides, not at all, without obviously destroying the structure of the fibres. In the two latter cases especially, the two surfaces which are separated remain smooth ; nor is there any division of vessels, or any traces of fibres passing from one side to the other." Physiognomical System, p. 45.

médiane, et si l'on injecte l'eau avec la même force dans l'ouverture, l'eau arrivée à la ligne médiane se porte à droite et à gauche, et sépare la duplicature dans une étendue d'un à deux pouces, de même que dans les expériences précédentes.

§ 66. Il résulte de tout ce que nous avons dit jusqu'ici, que le cervelet et le cerveau sont composés de substance grise plus ou moins foncée, et de substance blanche ; que la substance grise est la matière nourricière de la blanche ; que la blanche est entièrement fibreuse ; que les parties cérebrales sont surajoutées l'une à l'autre, et que les faisceaux nerveux s'épanouissent à leur extrémité périphérique, et sont disposés en deux couches ou en duplicatures.

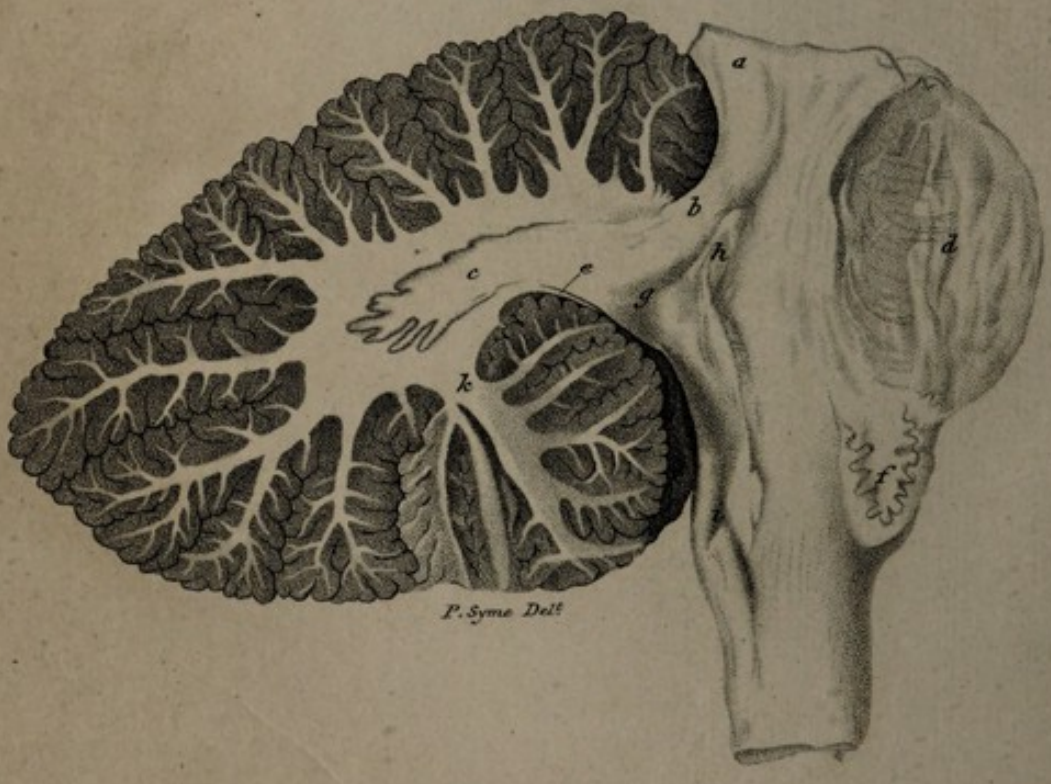
§ 67. Il suit encore que le cervelet et le cerveau sont mis en communication avec les systèmes nerveux inférieurs, et qu'en particulier les parties cérébrales qui sont un prolongement et renforcement des faisceaux pyramidaux, sont en communication, *par entrecroisement*, avec les systèmes nerveux de la colonne vertébrale.

§ 68. De même, il est évident que toutes les parties cérébrales sont doubles, et que les parties congénères des deux côtés sont réunies entr'elles par des appareils de réunion, ou les commissures.

§ 69. Enfin il est certain qu'il n'y a pas de point central des systèmes nerveux.

Fig. 1.

Fig. 2.



EXPLANATION

OF

THE ENGRAVINGS.

FIG. I.

THIS is an accurate copy of a part of the XIIth Plate accompanying DRS. GALL and SPURZHEIM'S large work. It i said to represent the appearances which present themselves when the cerebellum is divided a little to the left of the median plane, on the surface which looks towards that plane.

a b, Fibres of the corpus restiforme, which running upwards, enter the corpus dentatum *c*. No such fibres, however, exist.

c, The corpus dentatum of the left hemisphere of the cerebellum, divided longitudinally; and here represented as a mass of *grey substance*, an inch long, and half an inch thick; an appearance which it was never known to have, and which no section of it can make it assume. Its true structure is such as is delineated in fig. 2. *c*, and fig. 3. *a*.

d, The commencement of the corpus pyramidale.

e, The entrance of the corpus pyramidale under the pons Varolii, or annular protuberance.

f, The progress of the bands from the corpus pyramidale through the annular protuberance. This representation has no resemblance to nature.

g, The crus cerebri.

h, A section of the stratum of dark-coloured matter called by Vicq d'Azyr *locus niger*.

i, The corpus olivare; here represented as a mass of grey substance; its real appearance being such as is represented in fig. 4. *c*.

k, *l*, *m*. The second or posterior set of diverging fibres of the brain-proper; which (however inconsistently with Drs. Gall and Spurzheim's description of them) seem here to arise from the corpus pyramidale *d*. No such fibres exist in the brain.

n, *o*, The line of separation between this posterior set of diverging fibres, and the anterior set *f*, or those proceeding from the corpus pyramidale.

p, A section of the optic nerve.

The shape of the cerebellum in this figure, and the size, and shape, and position, of its strata, which are cut vertically, and exhibit an arborescent appearance, are very inaccurately represented.

FIG. II.

This is a representation of a vertical section of the cerebellum, made entirely with a view to shew the real appearance of the corpus dentatum when divided longitudinally. The delineation was executed with the utmost care by Mr. Syme, from the cerebellum of a full grown male, only 24 hours after death. The section begins at the posterior margin of the left hemisphere of the cerebellum, about half an inch to the left of the median plane; passes perpendicularly forwards and inwards;

crosses the median plane about the anterior surface of the fourth ventricle, and divides the right half of the annular protuberance and medulla oblongata obliquely. No other section of the cerebellum will divide the corpus dentatum from before backwards in the course of its longest diameter. It will be readily perceived that it is the left half of the section which is here represented (see p. 39).

a, b, Is the left pillar of the Vieussenian valve (or anterior crus cerebelli) divided in the middle; many of the fibres of which pass into the corpus dentatum *c.* (see p. 38).

c, Is a longitudinal section of the corpus dentatum. The dark, waving or serpentine line, is the section of its brown capsule; which is wanting at the fore part where the fibres of the anterior crus cerebelli enter it, to form its white nucleus. The reader is requested to compare this representation with that given of the same body, by Drs. Gall and Spurzheim in the former figure.

d, Is the right half of the annular protuberance cut obliquely; but rather sketched than minutely represented.

e, Is a section of the left lateral part of the posterior medullary velum; a part altogether omitted by Drs. Gall and Spurzheim in their engravings (see p. 54).

f, A sketch of the corpus dentatum in the right corpus olivare, cut obliquely.

g, h, i, The left side of the fourth ventricle; *i,* part of the calamus scriptorius.

k, Strata of white substance supplying the spinal lobule cut obliquely, so that they appear broader than the strata supplying the other parts of the cerebellum.

FIG. III.

THIS is a view of the left corpus dentatum of the cerebellum cut directly across. The left hemisphere of the cerebellum is divided into two halves by a vertical incision almost at right angles to the median plane; and this represents the surface of the anterior half. The drawing was taken by MR. SYME from the cerebellum of a full grown male only 24 hours after death.

a, The corpus dentatum. In its *white nucleus* the transverse sections of pretty large blood-vessels are generally seen. Its *brown capsule* always presents a very indented outline in this section.

FIG. IV.

THIS figure exhibits a view of the corpus dentatum in the left corpus olivare, divided longitudinally. The view is obtained merely by cutting off the whole projecting part of the corpus olivare from above downwards. The drawing is by MR. SYME, from the medulla oblongata of a full grown subject only 24 hours after death (see p. 117).

a, The left corpus pyramidale.

b, The left corpus restiforme.

c, The corpus dentatum in the left corpus olivare; consisting of a white nucleus, and an indented *brown capsule*, instead of a uniform mass of grey substance, such as it has been represented in fig. 1. *i*.

d, The outline of the annular protuberance.

Fig. 3.

Fig. 4.

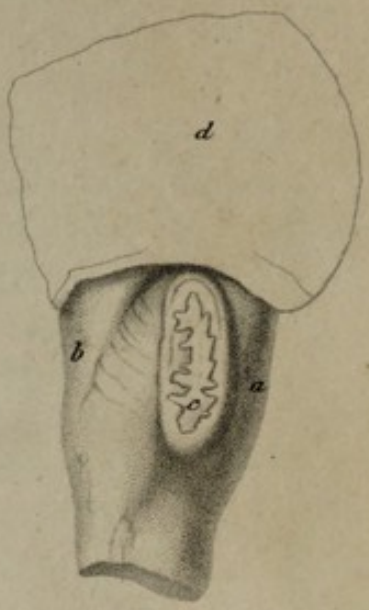


Fig. 5.

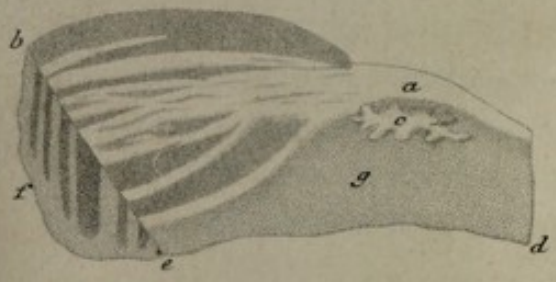


Fig. 6.

Fig. 7.

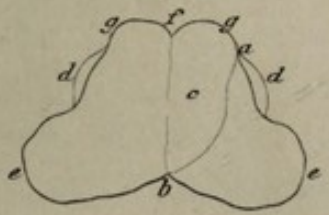


Fig. 8.

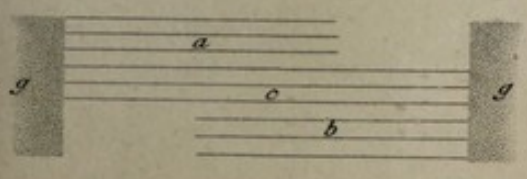


Fig. 9.

FIG. V.

THIS is a view taken by MR. SYME of a portion of the left half of the annular protuberance and medulla oblongata, after preparation in alcohol; and is intended to represent the variety in the colour of the longitudinal and cross bands of white substance in the protuberance, according to the direction in which they are divided. The darkest parts of the figure are in the recent state, of a greyish-brown hue, paler than the brown matter covering the convolutions; and the less dark parts at *g*, are of a reddish brown. The surface *b*, *c*, *d* is parallel to the median plane, and *b*, *e*, *f* perpendicular to it (see p. 78).

a, Is a longitudinal section of the left corpus pyramidale; the edges of the white strata continuous with which, are seen running on towards the line *b*, *e*; but having arrived at the surface *b*, *c*, *f*, they are there cut across, and instead of appearing orange-white, are greyish-brown. The dark strata interposed between them on the surface *a*, *b*, *c*, consist of the horizontal fibres of white substance in the protuberance, which appear dark merely because they are cut across; but which, if examined on the surface *b*, *c*, *f*, will be seen of an orange-white.

c, Is a section of a small part of the left corpus dentatum.

FIG. VI.

Is a representation of a horizontal section of the annular protuberance a little above its middle, after induration in alcohol. The drawing was taken, like the former, by MR. SYME from a preparation in my possession.

The dark bands within the space *a, b, c,* are cross sections of the longitudinal bands of white substance continuous with the corpus pyramidale. In the recent subject, they are of a greyish-brown hue when so divided. The whiter parts, on the other hand, which are interposed between, and surround, these strata, consist entirely of the horizontal fibres of the protuberance, which are intimately blended along the median line *a, d.*

e, e, Are sections of the reddish-brown substance behind the protuberance, and anterior to the fourth ventricle. The little triangular hole is a section of the top of the fourth ventricle.

f, A section of the Vieussenian valve.

g, g, The fibres of the anterior crura cerebelli divided a little obliquely; in consequence of which in the indurated preparation, they always assume a paler hue than the surrounding parts, and have a similunar outline.

h, h, Cross sections of the bands of fibres denominated by Reil, the Schleife.

This, as well as the former figure, represent form, position, and dimensions, with perfect accuracy. Only a general idea, however, of the differences in colour is attempted to be given, as it would be impossible to represent the minute varieties of hue without a coloured engraving.

FIG. VII.

Is an outline of the upper surface of the medulla oblongata when separated by a horizontal section from the annular protuberance. It is taken from a preparation still in my possession, on which Dr. Spurzheim, after much intreaty, was prevailed on to mark off the boundaries of the corpus pyramidale on the right side (See p. 64.)

a, *b*, Is the line he drew; extending from between the corpus pyramidale *g*, and the corpus olivare *d*, before, to the median fissure in the fourth ventricle *b*, behind; thus alloting to the corpus pyramidale the whole space *c*; separated from the corpus restiforme *e*, and all other parts by the line *a b*.

FIG. VIII. & IX.

Are diagrams illustrating remarks at p. 31.

FINIS.

Printed by James Clarke,
Edinburgh.