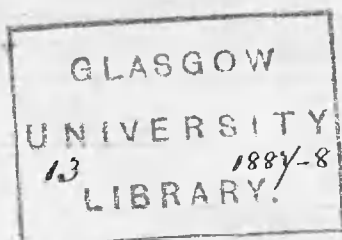


A good thesis, with original observations well  
put, + an intelligent survey of the whole subject.  
MS.

At Dr. Caird's request, I have also read this ~~above~~ thesis and I agree with Dr.  
Caird's opinion. I think the thesis is worthy of commendation.

J.G. Mack.



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Three cases of Cortical Epilepsy  
considered in relation to the  
localization of the discharging lesion.

---

Composed by myself; This testifies

Johnstone

Gartnavel

20th October 1887.

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The phenomena of Epilepsy are, so striking and appalling that they have been observed and noted since the remotest times and find a place in the earliest medical records of antiquity. Up to very recent date the disease was regarded as one quite well defined, a clinical entity, a disease *Sui generis*, such as Typhus or Rheumatism, but the progress of experimental and pathological investigation shows that it cannot properly be regarded as a distinct and definite disease, but must rather be regarded as holding the same nosological position as vomiting or dropsy, in other words that it is rather a symptom and may be associated with a variety of anatomico-pathological conditions of a variable and inconstant character, in short that although clinically it may be convenient to look upon the disease as one *pro se*, the pathologist must regard it rather as representing a mere assemblage of symptoms, - a "Clinico-symptomatological conception", - recurring paroxysms of impairment or loss of consciousness and

and more or less general convulsive seizures, phenomena which occur under various conditions such as (A) Organic diseases of the brain or its membranes (B) injuries to the Cranium such as cause irritation or pressure on the brain, (C) The circulation of certain morbid products in the blood, as in uraemia, and lead poisoning as well as (D) in the condition of functional disturbance known as Idiopathic Epilepsy.

Now although the identity of the intimate pathological processes occurring in all convulsive seizures may be fairly assumed, the sudden excessive discharges of certain groups of cells of the grey matter of the Encephalon whose instability has been by some means raised far above the normal, the questions still remain for answer to what particular region of the cerebral mass are the phenomena to be referred; where are the nerve cells which represent the movements or impressions so suddenly and excessively developed; what is the geographical or anatomical situation of those unstable cells which constitute the "discharging lesion" whatever its nature.

Post mortem the most various anatomical changes have been found in the bodies of Epileptics, changes neither constant in character or uniform in site, still all observers are agreed that Epilepsy is due to some change in the central nervous system.

system, since its most constant and marked phenomena; loss of consciousness and convulsions; are referable to the functions of the encephalic mass, and in the Idiopathic disease, as the most patient search has failed to reveal any constant anatomical change, and indeed, as the appearances have mostly been that of healthy nervous tissues, it has been inferred that the lesion is a molecular one, but there is no agreement as to whether the change is a general one affecting the whole nervous system, or a focal one affecting a definite region.

At various times the seat of the disease has been placed in the Pituitary body, the Hippocampi (1) and Cornu Ammonis (2) while Siemeyer and Rothnagel hold that the excitation of the motor nerves, of which the convulsion is the exponent, proceeds from the Medulla Oblongata; that in the Medulla there exist structures which by their action are capable of giving rise to general convulsions, the "convulsive centre", and that this is the seat of the disease. Schroeder van der Kolk also holds that the disease is due to a morbid increase

- 1 Meynert. Vierteljahrsschrift für Psychiatrie. 1867 p125.
- 2 Sommer. Archiv. für Psychiatrie. 1880 p631.
- 3 Schroeder van der Kolk. "On the minute structure and functions of the spinal cord & medulla oblongata." New York. Soc. 1859.

increase in the irritability of the medulla oblong.  
due to an increased affluence of blood. The  
recent tendency however has been rather to regard  
the disease as owing a cortical origin; certain  
regions of the cerebral cortex have by some means  
become morbidly excitable and apt to discharge  
themselves in irregular muscular actions or  
impressions. "The cortex of the brain is affected  
either directly or indirectly in the large majority of  
cases of Epilepsy. The primary morbid change  
may be in the skull, dura mater, the cortex  
itself, or in the white substance beneath it, but it  
is probable that implication of the cortex by the  
lesion is the essential condition in all of them".  
According to Hughlings-Jackson, a certain dyn-  
amic change has occurred, a "discharging lesion"  
has been established.

Experimentally it is found that Epilepsy can  
originate both from the cerebral cortex and from  
bulbo-spinal centres and Ferrier holds that  
convulsive movements may be evoked by  
stimulation of the Corpus Striatum as well as  
the cerebral cortex - Wilkes writes, "The teaching  
of experiment is, that both the cortex and  
medulla may originate convulsions, the  
teaching of pathology that Epileptiform convulsions  
have

(1) Prop. Diseases of the Nervous System Vol II. p 910.

"have their origin at the surface of the brain".  
Horsley<sup>(1)</sup> holds that the hypothesis of Gottinger,  
and those who share the opinion with him, as to  
the existence of a special convulsive centre in  
the Medulla, receives no support from the ex-  
perimental investigation of Epilepsy and that  
it is as un-needed, to explain the phenomena  
of Epilepsy as it is unproved. "All the convulsive  
phenomena may originate from the ordinary bulbo-  
spinal centres, such as exist for carrying out  
the normal mechanisms."

Although it would thus appear that the disturbance  
may begin in any part of the grey matter of the  
Cerebrum, the hemispheres seem to hold the first  
place in the causation and while pathological  
observation and experiment both point in no  
uncertain way to the cortex as being most frequently  
the seat of the disturbance, clinical observation  
points equally indubitably to the same conclusion; I  
refer to the observations of the modes of onset of the  
seizures especially when associated with an aura  
or warning, for it must be admitted, that when  
the convulsion is ushered in by some special  
sense impression or by some elaborate mental  
state, the seat of the discharge, the cells discharging,  
must be higher than the Medulla oblongata, indeed  
they!

(1) Horsley-Brown lectures, delivered at the University of London 1886.



they can only result from the activity of groups of cells constituting the central representation of the special senses or of those which hold the highest situation of all, those which constitute the anatomical substratum of consciousness as they have been called. As to the pathology, that is the local abnormal condition by which the "discharge" is rendered possible, there is much obscurity. Ringer writes—

"a loss of resistance occurs in certain parts of the central nervous system whereby impressions conducted to these parts spread beyond the normal area"<sup>(1)</sup> while Hughlings-Jackson says that in cases of Epilepsy and Epileptiform convulsions "there is a morbidly increased irritability of the nerve cells due to local increase of nutrition" for as he says "increased expenditure of energy necessarily implies increased absorption of energy."<sup>(2)</sup> The excessive liberation of energy in the convulsion of necessity implies increased taking in of nutrient substances by the nerve cells, having potential energy, but how this increase of nutrition is brought about he does not explain, although he says it is sometimes determined by tumour—which must I suppose be held to do so  
by

<sup>(1)</sup> Ringer—On the condition of the nervous centres in chloraemia, Epilepsy & other explosive neuroses. *Lancet*, Vol. I. 1877. <sup>p225</sup>

<sup>(2)</sup> Hughlings-Jackson—Case of suspected discharging lesion. *Lancet* Vol. I. 1877 p877.



by causing sub-inflammatory changes around and consequent undue excitability of nerve cells. For, of course, the tumour mass is itself a foreign body and quite inert and only able to induce changes in the nervous centres by modifying their state of circulation and nutrition.

Without attempting to follow the numerous theories that have been advanced in explanation of the intimate or ultimate cause of this local instability of grey matter and presuming that in all Epileptic and Epileptiform convulsions, that certain groups of nerve cells have become by some pathological process highly unstable and apt to discharge themselves in excessive irregular muscular movements, what I wish to show is, that the convulsion is the external manifestation answering to the cerebral condition of excessive discharge, and that its distribution corresponds with and represents the region of the brain cortex discharging and that by attentive observation of the character and march of the convulsion, we may be able, in some cases, to localize or fix upon the anatomical or geographical situation of these unstable nerve cells, this discharging lesion. Hughlings-Jackson has long been in the habit of insisting on the value of studying cases of Epilepsy with the view to determining the course of origin of the spasms, of making an anatomical diagnosis!

diagnosis, and from a minute study of the phenomena of unilateral convulsions, he had come to the conclusion that they were due to discharging lesions of some part of the cerebral hemispheres.

Cases of partial epilepsy, or as it is now called Jacksonian Epilepsy, had been observed, and described by Bravais<sup>(1)</sup> as early as 1827 who gave an exact description of their varieties but he failed to recognise their anatomico-pathological significance; similar observations were made by Bright and Wills<sup>(3)</sup>, who surmised that these unilateral convulsions were due to focal disease, but it was not until Hughlings-Jackson turned his attention to the investigation of these partial epilepsies that it was recognised clearly that they owed a causal relation to limited disease of the cerebral cortex, and the explanation of these convulsions first suggested to him the idea of the existence of motor centres in the cortex. "Cases of paralysis and convulsions may

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<sup>(1)</sup> Bravais - Recherches sur les symptômes et le traitement de l'épilepsie hémiplegique. Paris 1827.

<sup>(2)</sup> Bright - On Epilepsy from local disease. - Guy's Hospital Reports Vol. I.

<sup>(3)</sup> Wills - Some cases of General Paralysis - Guy's Hospital Reports 1866.

may be looked upon as the results of the experiments  
of disease on particular parts of the nervous system  
of man, and the study of palsies and convulsions  
from this point of view is the study of the effects  
of "destroying lesions" and of "discharging lesions",  
and, for an exact knowledge of the particular  
movements most represented in particular  
centres, we must observe and compare the  
effects of each kind of lesion. It is just what  
the physiologist does in experimenting on animals  
to ascertain the exact distribution of a nerve,  
he destroys it and also stimulates it. Indeed  
this double method is essential in the  
investigation of nervous disease for physiological  
purposes; for limited destroying lesions of some  
parts of the cerebral hemispheres produces no  
obvious symptoms, while discharging lesions  
of these parts produces very striking symptoms.  
By this double method we shall, I think, not  
only discover the particular parts of the nervous  
system where certain groups of movements  
are most represented, but what is of equal  
importance, we shall learn the order of  
action in which these movements are therein  
represented. (1) In all cases of Epilepsy then  
the

(1) Hughlings-Jackson - The anatomical and physiological  
localisation of movements in the brain.  
Lancet - Vol. I. 1873 / 1884.

the attempt ought to be made to ascertain the localization of the discharging lesion, wherever it may be, and the answer to the question, where is the lesion permitting the occasional, excessive nervous discharge, has even assumed an additional interest and importance, from some recent experiences in brain surgery, and there is now at least a hope, that if we can fix upon the seat of the "discharging lesion" that in some cases, we will be able to extirpate the focus of disease, and that the hope is not quite vain I would direct attention to the cases reported by Mr Victor Horsley to the British Medical Association at Brighton in August 1886, in which the brain was cut down upon at the seat of the supposed lesion and that part cut out when it was found that the fits ceased, but that the parts, the movements of which were here represented, had become parietic, and Dr. Hughlings-Jackson in speaking of these cases says "I had advised operations, bearing well in mind the possibility of there being no tumour", and he goes on to say, that, in the future, he was prepared to advise operations, even where the evidence was against finding a tumour. "Believing that the starting point of the fits was a sign to us of the seat of the discharging lesion, he would advise cutting out that lesion whether it

"it was produced by tumour or not."

Epilepsies then are to be considered, in the hypothesis of a sudden excessive discharge of some highly unstable region of the cortex, and, in their study, we should bear in mind, that as the brain is made up of histological, nervous arrangements which represent both impressions and movements, that the phenomena of Epilepsy may be manifested either in the domain of consciousness or of muscular movement, and that in some cases, although the phenomena of the attack are, chiefly motor, that it may be heralded by some manifestation referred to consciousness, for example a crude sensation; such as a vague sense of taste or smell; while in others, it may be ushered in by some elaborate idea or mental state. That we should carefully study the initial phenomena of a fit, is, I think, evident as it must be assumed, in the light of modern experimental research, that a fit which commences with, let us say, spasm in a finger, must owe a different origin from one which commences with a visual hallucination or a sensation of taste in the mouth, and just as it is by a study of cases where the spasm begins deliberately and proceeds slowly that we may hope to determine the seat of the motor cells discharging, when the lesion is situated in the motor region, so it is by a study of the warnings or subjective sensations that we may hope to determine the seat of the lesion.

lesion when this chance to be situated, without the motor region. "There is no other way of ascertaining the localization of movements in the cerebral hemispheres of man than by a study of his convulsive seizures." (1)

In the study of Epilepsies with a view to determining the region of the brain discharging, the researches of Hitzig and Ferrier have the most important bearing. They show that by faradic or galvanic excitation of the cerebral cortex in dogs and monkeys, convulsive seizures can be produced, which are as closely like epileptiform seizures in man, from disease in the same cerebral regions, as the wide differences between the various movements in man and these animals can allow us to expect. Hitzig is also said to have induced artificial epilepsy, by an injury to the cortical centre of the anterior extremity in the monkey and Dr Bartholow, in the case of a woman whose brain was exposed in part in consequence of ulceration of the skull, by the application of the induced current directly to the brain in the region of the postero-parietal lobule, was able to induce convulsions in the opposite extremities.

Our modern views of localization are of very recent date: to within very recent years nothing was

(1) West Riding Asylum Reports. Vol III. p 181.



was certainly ascertained, in this direction, and indeed, much of the experience of clinical medicine was rather opposed to the doctrine of localization, such as the destruction of considerable tracts of the brain, or the presence of tumours, without the appearance of any defect, either motor or mental; but on the other hand, there were, undoubtedly, cases of monoplegias and limited paralyses, from localized softening and destruction of the cortical substance, on record, and still later when the association of aphasia with destruction of the third left frontal convolution was pointed out by Broca, such occurrences came to be regarded as only explicable on the hypothesis of the differentiation of function in various regions of the brain cortex. But although such occurrences seemed to suggest the idea of localization, the phenomena observed were too inexact and variable to determine the question, and amidst so much uncertainty and contradictory observation, it was hoped that the experimental methods would give more definite results; it was however found that the cortex of the brain could not be made to respond to the usual modes of stimulation which had been found so successfully in the investigation of the functions of the peripheral nerves, and the cortex was thus concluded to be non-excitabile and it was not till about 1870 that



that Fritsch and Hitzig<sup>(1)</sup> discovered, that the hitherto non-excitabile cortex, did respond to electrical stimulation. Their observations showed that although electricity might be applied to some portions of the cortex without producing movements, there were other portions, excitation of which produced movements on the opposite side of the body, and that certain movements could be uniformly caused by excitation of certain definite regions.

Since then there has been much patient investigation, directed towards determining the question of the localisation of functions in the cerebral cortex and in this country the names of Ferrier, Schäfer and Horsley stand out with great prominence, in the roll of investigators: The general result of these investigations has been the mapping out of two areas on the surface of the hemispheres (a) motor and (b) non-motor, according as electrical stimulation does, or does not, cause muscular movements, or destruction causes, or does not cause permanent paralysis on the opposite side of the body.

(a) The motor zone is situated around the fissure of Rolando and also partly on the mesial surface of the hemispheres, and ~~it~~ may be said roughly to correspond to the distribution of the middle cerebral artery and includes the ascending frontal

(1) Fritsch and Hitzig - Du Bois-Reynolds Arch. 1870.

frontal and parietal convolutions and the para-  
: central lobe on the convexity, and the marginal  
convolution on the mesial aspect; stimulation  
of this area gives rise to definite movements, and  
its destruction, to permanent paralysis of these same  
movements, so that it may be concluded, with  
much probability that here, we have, the most  
special representation of movements in the cortex.

(B) The In-motor zone includes most of the pre-  
: frontal region - the orbital lobe and the first,  
second, and third frontal convolutions - the temporo-  
: sphenoidal lobe and the occipito-angular region.

That the brain is the organ of mind, no one doubts  
and that it is necessary to sensory perception is also  
received, as an axiom, but there is much uncertainty  
and want of agreement as to the representation of the  
special senses in the hemispheres. Flourens  
found that when the cerebrum is removed slice by  
slice in an animal that there is a gradual loss  
of intelligence and volition and he concluded that  
the brain acted as a whole without any special  
functions being assigned to special parts. Since  
then, much evidence has been accumulated,  
which renders the notion of functional equivalence  
untenable, and although the "centres" have been, at  
various times, placed in almost every part of  
the cortex and it can hardly be supposed that  
finality has been attained, yet there is much  
probability

probability in thinking that they are represented in the occipito-angular and temporo-sphenoidal regions.

Exner, who like Hughlings-Jackson is opposed to abrupt localization, regards the right hemisphere as specially concerned in sensation and he places the centre for vision in the first occipital convolution, and like the motor areas, he holds that it gradually shades off into the surrounding convolutions, while he regards the temporal convolutions as no less important to speech than the frontal, or the insula: each sensory centre according to Exner is related to both sides of the body. Ferrier and Prof. Gerald Sgo at the British Medical Association meeting at Cambridge, in August 1880 gave an account of their observations on the Visual Centre in Monkeys and after alluding to previous views on the subject gave it as the result of their research (1) that neither as the result of destruction nor removal of one or both occipital lobes was there any discernible disturbance of vision or other bodily or mental functions;

- (2) that after complete destruction of one angular gyrus there is temporary loss of vision in the opposite eye but no ptosis or other paralysis;
- (3) that the destruction of both angular gyri and both occipital lobes causes total and permanent blindness of both eyes; while the same observers reporting

reporting to the Royal Society on the "Effects of lesions of the cerebral hemispheres", as observed, in monkeys, arrives at the following among the more important results:—(1)

- (a) Lesions of the occipito-angular region cause, affection of vision without affections of the other sensory faculties or motor powers but that the only lesion which causes complete and permanent loss of vision in both eyes is total destruction of the occipital lobes and angular gyri of both sides, and that vision is possible with both eyes if only a portion of the visual centres remain intact on both sides;
- (b) Destruction of the Superior temporo-sphenoidal convolution on both sides causes complete and permanent loss of hearing without other sensory or motor defect;
- (c) Lesions of the pre-frontal regions do not produce any discoverable physiological defect and in his recent work Ferrier, as the result of further observations and experiment on the monkey, says that the Cortical centres for movements of the head and eyes may, with much probability, be placed in the frontal region but that this region may be irritated or destroyed without causing any other paralysis of motion or sensation. (2) Numerous cases are on record.

(1) Brain - Vol XXV. 1884. (2) Functions of the Brain 1886 p 242.

records in which this region, both in the monkey and in man, has been extensively destroyed, both by disease and accident without results as to motion or sensation, but on the other hand, it has been observed, that lesions here are frequently accompanied by some mental change, (both in the lower animals and in man) they are fitful, irritable and at times impatient of control, at others dull and stupid, in a state of hebetude or dementia. Ferrier says when speaking of lesions of the frontal lobes experimentally produced "I have observed and recorded certain symptoms indicative of mental deterioration.... I noted after removal of the prefrontal region a decided alteration in the animal's character and behaviour but difficult to describe precisely.... Instead of, as before, being actively interested in their surroundings, they remained apathetic and dull, or dozed off to sleep, responding only to sensations or impressions of the moment or varying their listlessness with restless and purposeless wanderings to and fro. While not absolutely demented, they had lost to all appearance the faculty of attentive and intelligent observation" (1). Horsley and Schäfer have also noted signs of stupidity in monkeys

(1) Ferrier. loc. cit. p 401.

monkeys in which they had removed the pre-  
: frontal region and Hitzig is said to have  
observed decidedly mental deterioration in dogs  
after destruction of this region, while Goetz also  
observed in the dog, great irritability and restles-  
: ness after removal of this same region.

When speaking of lesions in this region in man  
Ferrier says "the symptoms of lesions and diseases  
"of the frontal lobes in man, though not sufficient  
"to establish any positive physiological functional  
"relationships, are however, in accordance with the  
"negative character of experimental lesions, uni-  
: lateral or bilateral, so far as relates to the sensory  
"and motor faculties in general. But several  
"cases have been recorded, in which there has been  
"marked intellectual deficiency and instability of  
"character, not unlike that observed in monkeys  
"and dogs."<sup>(1)</sup> A case which I have been able to observe  
for some years is quite in accord with this observation.  
The man, a soldier, while serving in Crimea was  
shot through the head, the bullet evidently passing  
through the frontal region of the brain and probably  
damaging both optic nerves, as since then he has  
been completely blind in both eyes, ~~but~~ there is no  
paralysis of motion or sensation but he is facile  
and silly and at times irritable. Hughlings-Jackson  
and

(1) Ferrier. loc. cit. p 465.



and Bastian, on the other hand, are of opinion that disease of the posterior lobes is more frequently associated with mental derangement than disease of the anterior lobes or other parts of the brain. (")

The doctrine of localization however, has not yet met with general acceptance, and in this country Dr Hughlings-Jackson has to date as August 1886, when speaking at the British Medical Association, still declared himself, as in opposition to absolute localization; rather unreasonably it seems to me, since at the same time he admits that Dr Horsley "had evidently removed the Thumb centre" and it was clearly demonstrated that the man had lost the more delicate and special movements of the thumb of the opposite side. Even while admitting that lesions of the "two central convolutions" paralyze or impair volitional movements on the opposite side, says the greater portions of the convex surface of the hemisphere must also be reckoned in the motor zone, although of less significance; in short that in the motor zone, there are areas corresponding to certain muscular actions which may be termed absolute, lesions of which invariably, cause affections of these movements, while there are others which are only relative, or related to these movements in a less special sense.

(") Ferrier - Localization of Cerebral Disease 1878 p 131.



The centres according to Esener - are not sharply demarcated but cease gradually which is hardly in accord with the observations of Denier and Horsley who have shown that areas in close proximity to one another reach to electric stimulation in a totally different way and in a way always definite and predictable; thus movements of the limbs can only be excited from certain definite points, all others being ineffective, and currents applied to the pre-frontal or occipital region will not cause movements in the limbs unless they are of enormous intensity and sufficient to cause conduction to neighbouring parts.

Brown-Séquard, in his lectures before the Royal College of Physicians, London, in 1876, declares himself as opposed to the doctrine of localizing. He says - "When we witness a loss of function occurring in connection with a lesion of a part of the brain we are very naturally led to suppose that the lost function has its seat in the part we find altered. Naturally also, but in a less degree, we are disposed to admit, that if some muscles in a limb contract involuntarily when a part of the brain is irritated, it is the part thus irritated contains either the centre or the conductors usually employed by the will to move these muscles" and he proceeds to say, "that all our supposed knowledge of the physiology and physiological ~~pathology~~ pathology

" - pathology of the nervous centres are conclusions  
" drawn from this class of facts, are essentially wrong,  
" and must be given up", and he adds that there  
" is no constant relation between the locality of the  
" lesions and the symptoms manifested. "The same  
" lesions causing the most diverse symptoms and  
" the same symptoms occurring in connection  
" with the most diverse lesions. When we conclude  
" that certain movements are represented in a  
" certain area of the brain, when irritation of that  
" area excites those movements or that function,  
" as well concludes that the centre for laughter  
" is located in the soles of the feet because  
" tickling them excites laughter; similarly when  
" a worm in the intestines causes insanity must  
" we then conclude that the bowel is the seat of  
" the intelligence?"

" We commit the same kind of mistake when  
" we conclude that the third left frontal convolut-  
" ion is the seat of the faculty of expressing ideas  
" by speech because, when it is diseased, that faculty  
" is often disordered or lost, or that the upper parts of  
" of the two convolutions bordering on the fissure of  
" Rolando, on the one side, are the centres for the  
" voluntary movements of the two limbs on the opposite  
" side because, sometimes, these limbs will be  
" convulsed or paralyzed when there is disease  
" in /

"in these parts."<sup>(1)</sup> In short he contends for a disseminating and not a localizing of function in the cortex; that there is no localization whatever but like Flourens he holds that "each part is as microcephalon" capable of itself performing all the functions of the whole.

Recent research, both experimental and clinical, seems more and more to point to the independence of the motor centres in the human brain. M. M. Charcot and Pitres write "there is no well authenticated instance of a destructive lesion outside the cortical motor centres causing permanent paralysis; and on the other hand there is no rigorous observation of a destructive lesion of this motor zone which has failed to produce paralysis on the opposite side of the body."<sup>(2)</sup>

The phenomena of Epilepsy are so complex, so difficult to unravel by merely clinical observation, that the experimental methods of excitation of the brain surface has been lately employed in the investigation, with the general result, that it may be concluded that any part of the grey matter of the

(1) Brown-Sequard - Physiological Pathology of the Nervous System - Lancet. Vol I. 1876 p 1094 seq.

(2) M. M. Charcot et Pitres - Etude critique et clinique de la doctrine des localisations motrices dans l'écorce des hémisphères cérébraux de l'homme - Paris 1883.

The encephalon which subserves sensori-motor processes may originate Epileptic or Epileptiform convulsions; for it has been found, that electrical stimulation of those areas, destruction of which, causes paralysis of certain groups of muscles, excites precisely similar convulsive movements in those muscles to that witnessed in cases of the idiopathic disease, while Ferrier has excited convulsions by stimulation of the Temporo-sphenoidal lobule. M. M. Charcot and Pitres in the paper already quoted say "Irritative lesions of the cortex give rise to Epileptiform convulsions: in general, the lesions are located in, or near, those centres, which, if destroyed, would cause paralysis in the muscles affected by the convulsion. But these lesions may be in the non-motor zones and their relation to the functionally affected centres is not so close as is the case with paralysis and destructive lesions." The whole science of neurology is based on the assumption that the extent and manner of muscular contracting corresponds with, and represents, the extent and manner of nervous discharge taking place in the central nervous mass, and as in all Epilepsies, be they of the kind known as Idiopathic or of the Epileptiform class, the great clinical fact is the sudden irregular occurrence of muscular spasms.

or convulsions, hence it becomes of the greatest importance and value to study the distribution and character of the convulsions if we would determine the localization of those unstable cells forming the discharging lesion: Of course it is mostly in cases of epileptiform convulsions depending on gross organic disease of the brain that this mode of study is available, but when from the suddenness of the onset and the very universal and early distribution of the spasms, this mode of study is not available, there are at times other phenomena connected with the seizure which have lately assumed the greatest importance in the study of Epilepsy, from the point of view of localizing - phenomena which occur before the fit is fully developed and which may be regarded as the initial expressions of the commencing discharge in the brain - I mean the warning or aura. Now as we cannot see the processes actually occurring in the nervous centres, we must study them through their motor or sensory manifestations, and I think we may assume that the Kind of the warning indicates the kind of nerve cells discharging. Dr Hughlings-Jackson was the first to call attention to this mode of study and he indicates the belief that by a study of the warnings we may be able to differentiate the various regions where the discharge originates or to localize it.



In those cases in which the warning is a special sense aura, or a psychological aura, we are obliged to conclude that the process of the fit begins in these centres, wherever situated, and the teaching both of experiment and pathology, as we have seen, is, that they are situated in the cortex of the hemispheres.

Some years ago my attention was called to the study of the modes of onset and the march of the spasm in cases of Epilepsy, in a communication by Dr Hughlings-Jackson in the West Riding Asylum Reports: since then I have tried to make some observations on these points, but I confess, not usually with much success. It is notorious that Epileptics before they find their way into Asylums are far sunk into mindlessness and usually very obtuse and stupid, so that it is not easy to gather from their confused accounts anything very guiding as to their subjective sensations, and the objective motor phenomena in most cases of so called Idiopathic Epilepsy are so complex that the most patient observations of the chaotic motorial disturbances often fails to yield any clear data for an anatomical, or geographical, diagnosis of the region discharging, the three cases which I propose to record, are the only ones which I have examined post mortem in which any obvious focal disease was found associated with

with Epilepsy, and the clinical phenomena seem to be in essential agreement with the results observed in irritative lesions experimentally induced in the same region in the lower animals, and in evidence of the value of the careful study of the distribution and march of the spasms, and of the accompanying sensory disturbances, in cases of Epilepsy, with a view to the determination of the seat of the discharging lesion. As will be seen from the records which follow, at the post-mortem, tumour of considerable size, was found, in each case: now a tumour, of course, cannot be held to constitute a discharging lesion, but, like a foreign body anywhere, it may be supposed to cause irritation, and induce disturbances in the circulation around, which results in modifications of the molecular state and potential, of the neighbouring groups of nerve-cells, and, when the tumour is of considerable size, there can be no doubt, that in addition to these immediate effects, it will also, in a closed cavity like the Cranium, cause far reaching circulatory disturbance, and since the due performance of the functions of the cerebral centres depends so intimately on the state of their circulation, and nutrition, we can readily admit that cases of tumour cause far too wide reaching disturbance to be of great value for precise localization for physiological purposes, but when we find

a7



a tumour in a certain region associated with clinical phenomena having a close resemblance to those observed on electrical stimulation of the corresponding region of the cerebral cortex, in the dog or the monkey, we may, I think, conclude with a fair show of probability that this is the region which has in some way become unstable and apt to explode, the discharge being lesions. The anatomical representation in the brain of those movements or sensations which constitute the phenomena of the fit.

### Case I.

W. S. aet 55.

This man had been epileptic for many years, the duration not being ascertained: he was said to have sustained a fall when a youth and to this the epilepsy was ascribed. He was very dull and stupid, his memory blank and he was without evident interests or employment, in fact deeply sunk into mindlessness and quite unable to give any account of himself and when any attempt was made to ascertain from him his subjective sensations at the onset of a fit he would become irritable and cross and very sulky. The fits had this peculiarity, that suddenly, with a cry, he would leap straight up into the air, to the height of an average man.

man's shoulder, and then plunging down, alighting always on the right frontal eminence, "towering" like a bird when shot dead, as an attendant described it. Beyond this there was nothing peculiar in the character of the fits except their brief duration, they consisted of this single act, this sudden explosion of motor energy, he then got up looked angrily around and promptly attacked anyone who chanced to be near, and when remonstrated with and restrained he fought savagely, declaring vehemently that he had been struck and knocked down, and when he was told that he was mistaken he became furious declaring he "saw him do it". There was usually a succeeding period of stupor and dozing. The interest of this case lies in the extremely short duration of the convulsive seizure, the absolute identity in the character of the motor phenomena and the succeeding post-epileptic actions: The "march of the spasm" or the muscles first invaded, could not be observed, the whole being of such extremely brief duration, but the mode of invasion and the subsequent course seemed to be always identical, since this one act constituted the whole of the motor phenomena, and the uniformly aggressive character of the post-epileptic acts seemed to suggest that they were determined by some event also happening uniformly before or during the fit. In/

In post epileptic actions, external suggestion evidently plays a part, so that the acts vary after the various attacks even in the same person, but here they were so uniform as to suggest a uniform cause and the patient's declaration, that he had been struck, and that he "saw him do it", suggested something like a visual aura or sense impression received immediately anterior, or, at the beginning of the fit, and the finding of a tumour post mortem, in the position indicated in the diagram, would suggest that its presence served to excite the cortical visual centres and that a visual spectre was the result.

In epileptic attacks consciousness departs in various ways, sometimes complete and sudden, when the discharge originates in the highest of all the centres, those concerned in consciousness or in the intellectual processes, at other times it is less sudden, and is preceded by a series of subjective sensations, such as flashes of light or tingling or prickling in the arms for example, and when such are developed, slowly and are remembered, they are spoken of as the aura, now such an aura although purely subjective, seems to me quite as likely to determine actions as sense impressions received through the usual channels, in the condition of defective control following an epileptic explosion, and this would seem to be

ing

in harmony with the views of Hughlings-Jackson who says that "after an Epileptic seizure there is a temporary loss of function, of more or fewer, of the highest nervous centres: there is a removal of the inhibition of the highest centres over the lower, the lower centres become more easily dischargeable or more excitable"; that is the lower centres being uncontrolled, will act in response to impressions reaching them in an automatic or almost reflex manner, and without the intervention of consciousness, so that should an ocular phantom give the impression of being struck at the defensive actions of the arm are at once excited, just as the headless frog will endeavour to remove the offending acid drop, so that a purposive act cannot be said to indicate the intervention of consciousness. Indeed post epileptic actions have been said to be determined by intentions cerebrally formulated just before the loss of consciousness, so that should a man believe himself to be struck, although the belief is false and the result of a visual hallucination, he will probably <sup>have the</sup> intention to defend himself, or to be revenged, and the superintention of unconsciousness interferes with the carrying out of his design, but immediately on the passing of the seizure the remains of the intention set in motion the unuseful acts useful for this end. Hughlings-Jackson says "the Epilepsy is accountable for the convulsions and the unconsciousness."

unconsciousness but that the uncontrolled action of the lower centres is responsible for the post-Epileptic phenomena.

The post mortem examination discovered a bony tumour in the right Occipital region. The note then made says "The chief feature of the examination was the discovery of a large hard tumour in the right side of the brain deep in the Occipital mass. The tumour was of stony hardness, rough and tuberculated, and spicular, resembling generally, and being about the size of the kernel of a walnut and covered with a glistening fibrous investment: it occupied a situation deep in the white substance between the optic thalamus and the cortex and had no connection with the pia mater or the lining membrane of the ventricles: it did not reach the grey matter or give any sign of its presence externally but its presence was only revealed on slicing the brain".

The tumour occupied the situation known as the optic radiation and described by Gratiolet as containing all the fibres going to the Occipital lobe: in fact the Occipital lobe seems to be composed of an expansion of this band: and Gratiolet is said to have traced its direct connection with the optic tract, and in this S Hamilton agrees with him. In passing it



it may be remarked, that on microscopic examination the tumour was found to be a true osteoma, Haversian canals and lacunae being abundant. The tumour itself was noteworthy since true bony tumours of the brain are so rare; "true formations of bone are the rarest of all intracranial growths."<sup>(1)</sup> That the tumour was in some way the cause of the epilepsy, I think, we can readily admit, since it is shown that electrical stimulation of the cortex wherever applied may give rise to convulsive seizures and the presence of this tumour in the optic radiation served by its presence to irritate the subjacent visual centres in the cortex and give rise to its discharges.

Horizontal sections of the Right hemisphere.



fr. Frontal region. occ. occipital region.  
c.a. optic thalamus.

(1) *Principles of Diseases of the Nervous System* Vol II p 426.

Case II

E. F.

A man of about 38 and he was said to have been subject to Epileptic fits for about a year and since then he has been changed in manner, began to entertain suspicions that his wife was unfaithful and that she had made attempts to poison him; that there was a plot against his life and he had been known to carry a pistol for self protection and there is reason to believe that at least for a short time, he had hallucinations of hearing, as there is information to the effect that he declared he heard the details of the plot against his life being discussed, but this was never manifested again while he was under observation. He was under observation for two months and there was abundant evidence of great mental deterioration; he was mostly dull and apathetic, showing little interest in his surroundings and little spontaneity, sitting idly and very apt to doze off to sleep by day, while by night he was often restless, apt to get out of bed and wander aimlessly about, seemingly unable to recollect what had taken him out of bed, and he never indicated any preferences in the matter of food, although formerly he had been used to dainty fare; at times he complained of pain in the head. There was distinct evidence of constitutional syphilis



insofar that there was Syphilitic disease of the frontal bone over the right frontal eminence, seemingly confined to the outer table and a history of a sore some 14 years before was ascertained.

He came under observation on the 21<sup>st</sup> January 1887 and he remained much in the same state as on admission till about the latter half of February when he began to have convulsive seizures, reported as mostly involving the left side, but at times passing into general convulsions.

The first attack witnessed by the writer was of the major kind: he was deeply unconscious and the seizure merely presented the usual chaos of motorial phenomena seen in most cases of ordinary functional epilepsy, although, it was remarked, that the head was strongly turned to the left and downwards to the left shoulder and was violently jerked while the eyes ~~were~~ also deviated to the left. He had now frequent attacks so that there was abundant opportunity of watching them and one could not fail to be struck with the circumstance that each of the seizures commenced in the same way and that in its early period it was peculiarly limited in character.

In the early stage the convulsions were obviously limited to the left side, and attentive watching showed that they always commenced in the left

hand

X "devrate" does not seem  
to be used as a transitive verb  
according to the best English  
dictionaries JMB

hands and wrists then spread to the arms; the fingers were gathered together as in the obstetric position, the wrist semi-flexed and the hands strongly pronated and the elbow flexed, the flexion being performed in a jerky manner (clonic spasm), the convulsion then spread to the face and neck; the muscles which elevate the angle of the mouth on the left side were constantly twitched, retracting the upper lip and exposing the canine teeth at each spasmodic movement; the head was simultaneously drawn downwards and to the left shoulder and the eyes were deviated conjugately to the left - the convulsion would now become rapidly general but the left side was always the most convulsed.

Consciousness was deeply affected. In addition to these major attacks he had also slighter attacks, composed of clonic spasm, limited to the left arm and left side of the face and without loss of consciousness although speech was almost unintelligible: these seizures are distinctly of the character to which the name Jacksonian Epilepsy has been given. No <sup>form</sup> dynamic observations were made but there was evidently a degree of paresis of the left side remaining after these seizures as the grasp was obviously feeble. During the last three weeks of his life he had many seizures of the graver type and each

ended

seemed to leave him more and more stupid, but to the end they presented the same characters. On post-mortem examination a large fungiform tumour about the size of a small Sanguine orange was found occupying the right frontal region of the brain. More particularly it occupied a large portion of the region designated by Ferrier the pre-frontal region<sup>(1)</sup> but it neither reached the extreme frontal end nor the orbital surface of the brain. It mostly occupied the middle and inferior frontal convolutions - but invaded the superior - around the inferior frontal sulcus and adjacent to the ascending frontal convolution. On the left side there was an area of softening of somewhat limited extent invading the first and second Temporo-Sphenoidal convolutions.

The tumour was hard, of cheesy appearance in parts, in others grey; it had extended well into the medullary substance and had destroyed it, while for some distance around, the brain was softened and pulpy but the basal ganglia were not involved. It had arisen, it was thought, from the soft membranes, and the dura mater was thickened and adherent to the surface and indeed could not be separated from the tumour.

But

<sup>(1)</sup> Ferrier. Functions of the Brain p 243.



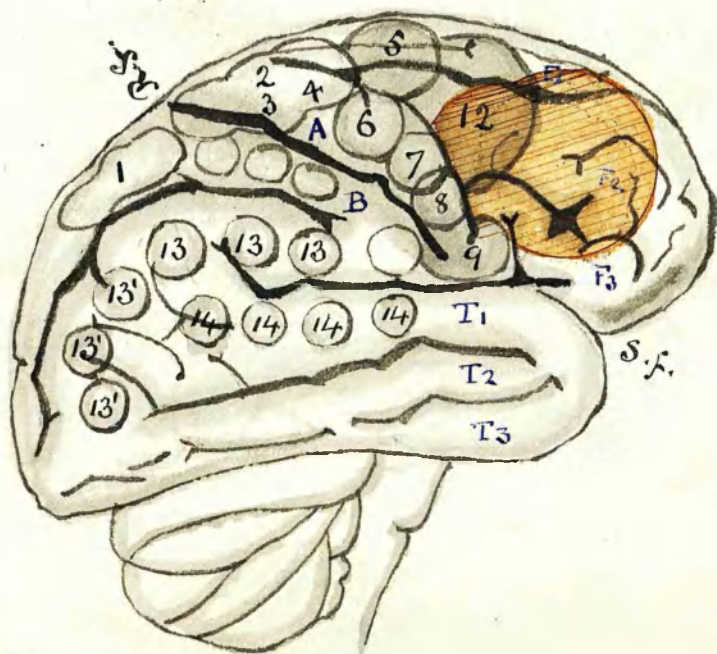


fig 130. Ferrier

Lateral view of the Human Brain — Right side.

The following are the phenomena most constantly observed on electrical stimulation of the various regions of the brain of the monkey.

- 6 . Flexion and Supination of the fore arm.
- 7 . Retraction and elevation of the angle of the mouth.
- 8 . Elevation of the upper lip and ala of the nose.
- 9 . Opening of the mouth and protrusion of the tongue.
- 12 . The eyes open widely, the pupils dilate and head and eyes turn to the opposite side.

but there was no special adhesion to the cranium nor was the inner table of the bone eroded, so that its effects had been mostly to destroy brain tissue. The characters of the tumour were closely in accord with those assigned to *gliomata* of the soft membranes by St Coats. <sup>(1)</sup> The tumour is thus seen to be situated without the "motor region" but it is contiguous to the ascending frontal convolution at the part marked by Ferrier in his diagram of the motor centres in the cortex <sup>(2)</sup> 6, 7, 8, and perhaps 9, and occupies the region marked 12 in the same figures and destroyed it as well as much of the pre-frontal region. As has been seen, according to experiment on the monkey, electrical stimulation of the frontal lobes in front of the region marked 12 was without obvious effect and destruction of these lobes causes neither paralysis of motion or sensation and these negative results of experiment are confirmed by the records of numerous cases of extensive disease of one or both sides in man without results as to either motion or sensation alike; it is certain, mental change has been frequently noted in the subjects of these lesions, as it well exemplified in the American Crowder case, and also in the one   
under

<sup>(1)</sup> Coats. Manual of Pathology. p 469.

<sup>(2)</sup> Ferrier. Functions of the Brain fig 130. p 478.



under consideration. In monkeys Ferrier finds that after destruction of the pre-frontal lobes motion and sensation are intact but that a marked change in their character is observed, they are apathetic, dull and apt to doze off to sleep and their listlessness is only varied by aimless and purposeless wanderings. (1)

Of course the discovery of a tumour is not identical with the discovery of the "discharging lesion". The tumour is itself a quite inert body but it must be supposed to have in some way induced changes in the neighbouring motor centres, modifying their dynamic condition through interference with their circulation and nutrition and inducing a condition of heightened irritability in these centres, thus placing them in a state in which any of them may explode or discharge themselves violently and irregularly, thus disturbing the balance of tension in the molecules of the others and leading in turn to explosive activity in them, and so on, and so on, in those unstable and contiguous centres, until a point is reached in the cell territory where the cohesion of the molecules is such as to be able to oppose a sufficient resistance to the advancing explosion to cause its arrest. We can readily see how a convulsion then, once induced, is apt to spread and/

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(1) Ferrier. Localization of Cerebral Disease.

and in this case the proximity of the tumour to the centres for the forearm and face in the ascending frontal convolution would explain why these regions were first and chiefly invaded in the march of the spasm. This irradiation, this march, is well seen in the case of the spinal centres: the reflex action dependent on irritation of any particular spot is at first more or less definite and limited, in reference to the spot irritated, but, if the reflex irritability be heightened by any means, there is a tendency to irradiation and the discharge of other centres; the same thing happens when the irritation is either stronger or more prolonged, there is the same tendency to spread, by the exhaustion of the forces normally opposed to this irradiation. In the experimental stimulation of the cerebral cortex, a similar tendency to irradiation is seen if the stimulus be either unduly prolonged or unduly intense, and this tendency to the discharge of neighbouring centres, under prolonged severe stimulation, is just what might be expected to happen, as the centres must be supposed to touch one another and if the resistance of a contiguous centre to discharge be overcome, it too, will be involved in the discharge and the result will be the conjoint effect of both centres, and, if the stimulus be sufficiently intense, it may result in the

Discharges!

discharge of the whole motor mechanism.  
In this case the more severe convulsions must, I think, be viewed as resulting from the discharge of the motor areas of both hemispheres while in the minor attacks the discharge must be assumed as not having spread beyond the side originating the convulsion. Of course this raises the question why a unilateral lesion should give rise to bilateral convulsions. Hughlings-Jackson holds that each hemisphere represents both sides of the body, the representation of the opposite side being most marked but still there being a degree of representation of the same side of the body in the same cerebral hemisphere, so that according to this view it would be possible to induce convulsions of the whole body by stimulating any motor centre; but Dr Horsley, who has investigated the subject says that "Clinical and experimental investigation simply showed that one half of the body was represented in the opposite hemisphere, with but few exceptions, and he adds "if the convulsions be bilateral, when the cause is unilateral, and if the bilateral convulsions have the cortical character, it is clear, in the light of experimental evidence, that the two hemispheres have been discharging." Each hemisphere then convulses its

(1) Victor Horsley - Brown lectures 1886.

its own, that is the opposite, side of the body, and it is well recognised, that in unilateral fits there is no necessary spread of the convulsions to the opposite side.

As bearing on the question of the bilateral representation of movement in the hemispheres a case recorded by Oebeke and quoted by Powers<sup>(1)</sup> may be mentioned: A patient who had been epileptic since birth became hemiplegic, from a haemorrhage into the central ganglia of the right side, and although the epilepsy continued the convulsions now only affected the right side of the body, the paralysed side escaping, and further, it is known that if in the condition of Status Epilepticus, in the monkey, the motor region of the cortex of one side is ablated, the convulsions cease on the opposite side of the body. These facts would seem to indicate that the convulsions are the seat of the discharge, and that in generalised convulsions both hemispheres are discharging.

Mr Horsley says - The conclusions are very emphatic "to the effect" that convulsions due to cortical discharge "are evoked in various groups of muscles by "nervous energy proceeding from that centre in each "hemisphere, which is in relation to each group

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<sup>(1)</sup> Powers. Epilepsy and other convulsive diseases.

"of muscles"<sup>(1)</sup> Further there is evidence that at one time the patient had hallucinations of hearing, which *phantasie* may be viewed in the same light as the auditory or visual *auræ*, that is, as evidence of the discharge of sensory centres in the cortex. It is well here to recall the fact of the post-mortem having revealed a limited softening of the first and second temporo-sphenoidal convolutions of the left side and although there is no evidence of the persistence of the auditory phenomena still the question of their association with this lesion may be fairly discussed. That the superior temporo-sphenoidal convolution is the cortical centre for auditory perceptions seems to be extremely probable. In the monkey destruction of this region on both sides, causes complete and permanent loss of hearing<sup>(2)</sup> while electrical stimulation of this region on one side causes pricking of the opposite ear, associated with wide opening of the eyes, dilatation of the pupil and turning of the head and eyes to the opposite side<sup>(3)</sup> as Ferrier says, just such phenomena as occur when a loud sound is made in proximity to the ear, and he adds "from the mere character-

(1) Horsley - Brown Lectures 1886.

(2) Ferrier - Functions of the Brain p 309.

(3) Ferrier - loc. cit.

"Character of the reactions, therefore, it might be  
"fairly concluded, that irritation of the Superior  
"temporo-sphenoidal convolution arouses sub-  
"jective auditory sensations, of which pricklings  
"of the ears and the attitude of surprise, or excited  
"attention, are merely the outward, physical,  
"manifestations". These results are strictly confirmed  
by Horsley and Schäfer as the result of their independent  
observations. The lesion, as we have seen, was not  
such as to completely destroy either of the temporo-  
sphenoidal convolutions but was such as to  
irritate them and cause their discharge and  
may, I think, have given rise to the auditory hallucina-  
tions.

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Case III.

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L. J.

The patient was a Collier, aged 18 and  
he had been subject to occasional Epileptic fits  
for the last six years. At the age of 4 he had had  
a fall, described as serious, but the Epilepsy did  
not declare itself till he was 12 years of age.  
He was of the markedly Strumous type with numerous  
glandular swellings about the neck, and there was  
evidence of some chest mischief, but while he was  
under observation its progress was not rapid.  
It was stated that his fits had been mostly infrequent  
and he had been able to work in the pit till about



a month or six weeks before admission when they had become much more frequent, two, three, and four a day and his temper had undergone a manifest change; he had become impulsive and irritable and very much distressed by pain in the head and he had been dismissed from his work.

On coming under the observation of the writer, he was drowsy, sullen, and when questioned, irritable and his memory was defective: when asked, he said he did suffer from pain in the head, but he was never seen to vomit. He was under observation for four months before death and his general behaviour may be briefly described by saying that he was mostly cross, excitable and very impulsive, but at times dull and lethargic; he replied to questions slowly and sullenly, and some slight defect in articulation was observed as well as some difficulty in expression by words. The fits were infrequent for the few weeks following admission, two or three a week, at the outside, when they suddenly rose to three or four a day and becoming more and more frequent, before death reached twenty or thirty in the course of the day usually, and sometimes even more, and he died in Status Epilepticus, being almost continuously convulsed and deeply unconscious on the day of death.

After being under observation for a short time it was noticed that he was cross and irritable and

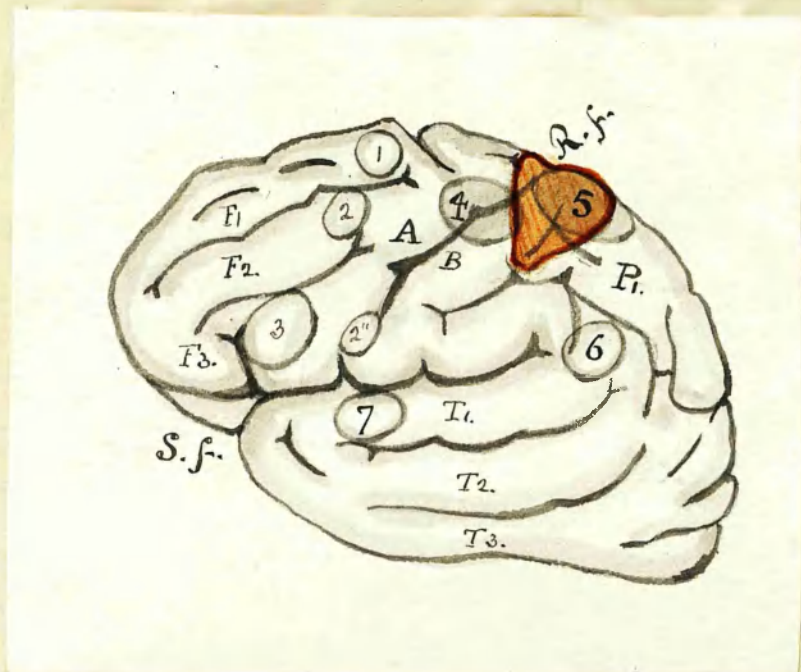
very

very complaining before fits, frequently complain-  
:ing of "deadness" of the right great toe but latter-  
:ly he became too stupid to make any such  
complaint. The evolution of the phenomena  
of the fit was very rapid and the convulsions soon  
so general, that it was not till they had become  
so frequent as, on some days, to be almost continu-  
:ous, that the mode of onset and the march of the  
spasm could be certainly observed, although, it  
had been thought, that the right side was the more  
early involved in the convulsions.

During the fits he was deeply unconscious, passed  
urine, bit his tongue and foamed at the mouth,  
but he did not utter a cry. It was now possible  
even amidst the disorder of the convulsions to note  
that the spasm commenced in the right foot,  
and leg: the ankle and knee were extended  
in a condition of tonic spasm, then the knee  
became rapidly jerked up by a series of clonic  
twitches, the convulsions then spread to the right  
arm and the body and other limbs generally, all  
very rapidly.

Post Mortem: On opening the head, the dura mater  
was found adherent over the left parietal region at  
its upper part, in the region of the upper limit of the  
Rolandic fissure. Growing from the under surface  
of the dura mater in this situation and also from  
the left side of the false cerebri was a tumour of a  
somewhat

N<sup>o</sup> I.



External Convex surface of the Human Brain.  
after Prof. fig 272. Vol. II

F1. F2. F3. First, second and third frontal convolutions.

P 1. Superior parietal lobule.

T1. T2. T3. First, second and third temporo-sphenoid convols.

A. ascending frontal convolution.

B. ascending parietal convolution.

5. Movements of the inferior extremity.

4. Movements of the superior extremity.





Medial aspect of the left hemisphere of the monkey  
 showing the motor areas adapted from Horsley and Schäfer.

- c.c. Corpus Callosum. g.f. Gyrus foveatus.  
 f.i. Fissure frontalis. R.f. Rolandic fissure.  
 C. Muscles of lower limb called into action on stimulation  
 of this region  
 B. Muscles of the upper limb and at times head & neck.  
 A. Muscles of the trunk.

Somewhat pyriform shape and of about the size of a small pear. The tumour occupied the situation of the Postero-parietal, or Superior parietal lobule, and the contiguous portions of the ascending parietal and ascending frontal convolutions (areas marked 3 and 4 in the annexed diagram) and also the portion of the marginal convolution towards its hinder part and corresponding to the area marked C in Horsley and Schäfer's communications to the Royal Society on the functions of the claustrical convolutions.<sup>1)</sup> The parts of the brain corresponding to this were scooped out and pushed aside by the convexity of the tumour but the tumour mass was not incorporated with the brain tissue and could be lifted out, leaving a depression in the situation which it had occupied. The whole of the hemisphere was pushed outwards and forwards so as to cause some flattening of the convolutions in the lateral and frontal regions of the brain. The tumour was tubercular in type. The convulsive seizures it will be remembered, commenced in the right foot and leg and spread rapidly to the other parts of the body. This local mode of commencement is common in Epilepsy due to organic brain disease, and it is usual to find the disease on the surface of the brain

<sup>1)</sup> On the functions of the claustrical convolutions. Proceedings of the Royal Society 40031.

in the region, stimulation of which, causes movements in the part first affected, so that from a study of the clinical phenomena here, we might, with some probability, expect that a lesion, would be found somewhere about the centre which is the cortical representation of movements of the leg and foot and which, as has been seen, was found to be the case; a large tumour being found, occupying the region which experiment has shown, to represent the movements of the leg and foot, for, not only does electrical stimulation excite such movements but the destruction of this region causes the loss of these same movements, and, in man, destruction of this region has been found, associated with cerebral monoplegia: such a case is recorded by S. Haddon of Manchester - in which the paralysis remained limited to the left leg for five months but after a time the left arm also became paralysed: after death a tumour was found, destroying the adjacent portions of the ascending frontal and ascending parietal convolutions as well as the postero-parietal lobe. Of course here we had not destruction of the subjacent brain substance but it had merely been pushed aside by the pressure of the growth and all in accordance with Horsley's experiments of causing artificial tumours by the injection of Plaster of Paris into the brain it seems

Doubtful!

Haddon - Case of cerebral tumour Brain Vol I 1879 p250



Doubtful if a tumour by its mere mechanical pressure can put the nerve cells in a condition to discharge energy convulsively, still there can be little doubt that the tumour had acted in some way as an irritant causing the centres in its vicinity to discharge in an irregular convulsive manner. Turning now to the aura, the feeling of "deadness", here we have an instance of a warning referred to the most general of all the senses, the general tactile sensibility. As we have seen, and as shown in the diagram, the tumour occupied part of the mesial surface of the hemisphere, deeply indenting the Marginal Convolution and exerting considerable pressure upon it; now the experiments of Ferrier and Professors Horsley and Schäfer demonstrate that the various forms of common or tactile sensibility have their cerebral representations in the region of the hippocampus and the gyrus fornicatus<sup>(1)</sup> and that destruction of these regions is associated with various forms of sensory disturbance, more or less complete and lasting, analgesia or tactile anaesthesia, according to the degree of completeness of the destruction and Horsley has lately shown that the removal of the gyrus fornicatus alone, produces effects like those caused by removal of the hippocampal region, namely,

more

(1) Ferrier - Functions of the brain. 1876 p 342.

move or leg lasting analgesia and anaesthesia of the opposite side; now the *Pyramis fornicatus* is situated immediately under the Marginal Convolution and would, thus be exposed to the pressure effects of the tumour, so that its circulation and nutrition may have been interfered with and the subjective sensation of "deadness" result, but why it should have been projected outwards to the great toe remains unexplained unless we assume the differentiation of centres in this region for the various parts of the body and that this hypothetical sensory thumb centre is in anatomical or functional relation with the centre in the motor region of the cortex originating the convulsion.

The conclusions which I would draw from the cases are (a) that the convulsions had their origin in an irritative lesion in the cortex cerebri, (b) that neo-growths can give rise to convulsions of the true Cortical type and indistinguishable from the convulsions of idiopathic Epilepsy, and (c) that the clinical phenomena and the post-mortem appearances are in essential accord with the doctrine of Cerebral localization.

Mr Horsley has shown<sup>(1)</sup> that experimentally, Epilepsy can originate from discharges in the cortex of the brain and from discharges in the bulbo-spinal centres, but, while admitting that the discharge may originate in any part of the Cephalon, he holds that it is only in Epilepsy excited from the cortical grey matter that we see the succession of tonic-clonic spasm which is characteristic of Epilepsy: when the discharge is excited from bulbo-spinal centres the spasm is usually tonic, but may be clonic, and has never the succession of clonic or tonic spasm which is regarded as typical of Epilepsy of cortical origin. Tonic or clonic spasm may be produced by any motor centre but the combination and sequence of tonic-clonic could originate only from the cerebral motor cortex<sup>(2)</sup>

Unverricht<sup>(3)</sup> too has found experimentally that electrical stimulation when applied to the grey matter of the hemispheres causes epileptic convulsions, whether the electrodes are applied to the motor regions or to those behind, and he found that when currents are used of such strength and duration as to excite generalised spasms

(1) Horsley - Brown Lectures 1886.

(2) Horsley - loc. cit.

(3) Unverricht - Experimental and clinical researches in Epilepsy. Archiv für Psych. Bd XIV.

spasms, that the course or succession of the convulsions corresponded with the arrangement of the motor centres in the brain, so that only those groups of muscles come successively into action whose centres lie near one another in the motor areas, a phenomenon which is observed in the disease in man, when the spasm is of cortical origin and the march sufficiently deliberate to permit of its being observed, and which is sufficiently well illustrated in two of the cases recorded, the groups of muscles whose cortical centres are found to lie in juxtaposition being, in succession, involved in the spread of the discharge. Unverricht further has found, that the extirpation of the motor zone in Status epilepticus on one side causes the convulsions to cease on the side opposite and if the motor zones of both sides were removed, the convulsions ceased entirely; facts which seem pretty clearly to indicate that the convulsions in Epilepsy owe a cortical origin, while the sensory discharges present in some cases, such as visual or auditory spectra, are only explicable on the hypothesis of the discharge of these centres in the cerebral cortex.

Gowers concludes as the result of his observations "there are no facts to warrant us in seeking the seat of the disease elsewhere than in the grey matter."

"matter and that this is in most cases in the  
"cerebral hemispheres, probably often in the  
"cerebral cortex."<sup>(1)</sup>

The association of irritative lesions in the  
Occipito-Cingular region with colored visions,  
and other ocular spectra seems to be occasionally  
observed, and Gowers has been able to examine  
one case of Epilepsy, post mortem, with visual  
auras and delusions that people were in the house,  
in which a tumour was found in the Occipital  
lobe<sup>(2)</sup> and although in the case of the man W. S. it  
is not certainly known that he had a visual  
hallucination, still the character of his actions and  
the statements often repeated - "I saw him do it" -  
strongly point to an ocular spectrum or phantom  
resulting from the discharge of the visual centre,  
and the anatomical situation of the tumour was  
such as by its presence to cause irritation and  
discharge of that centre. It is true that the tumour  
was not situated in the cortical visual centre  
but rather in the underlying medullary substance  
of the optic radiating. Of course it is known in  
the case of the motor region that, after removal  
of the grey cortex, the application of electrical  
stimulation to the cut ends of the medullary fibres

(1) Gowers - Epilepsy and other Convulsive Diseases.

(2) Gowers - Cases of Cerebral tumour. Lancet Vol I 1879 p 362

of the Corona-radiata produces the same movements as the overlying cortex; at least for a time, although they ultimately become non-excitable and degenerate; so here we must assume that the tumour did not cut off the whole of the fibres of the Optic radiation from the superimposed grey matter but rather that it served by its presence to irritate it and cause its discharge, or that in some way it supplied the stimulating to the medullary fibres normally supplied by the overlying cortex and thus gave rise to the visual phantom.

Gowers has not met with a published case of a post mortem examination of Epilepsy, associated with subjective auditory spectra but Hughlings-Jackson has, he says, examined a case of cerebral tumour in which bell sounds were heard and at the autopsy a tumour was found in the Optic Nerve. Ferrier has shown that in the monkey electrical stimulation of the superior temporo-sphenoidal convolution causes pricking of the opposite ear and turning of the head and eyes to the opposite side and other evidences of auditory sensation while destruction of this region on both sides, as has been already seen, causes complete and lasting deafness, and although in man, the evidence of deafness in association with cortical disease is dubious

Hughlings-J.



Hughlings-Jackson is said to have met with  
deafness as the result of disease of the hemispheres;  
now in the case of the man E. J. although the  
presence of a large tumour in the frontal region  
introduces an additional element of uncertainty  
into any conclusions that might be drawn from  
the appearances found, post-mortem, still, the  
case is notable in the association of auditory  
hallucinations with disease in the tempo-  
-sphenoidal convolutions.

I think it must be admitted, that these sensory  
discharges in connection with Epilepsy, of cortical  
origin, whether they be referred to sight, hearing,  
or common sensibility, are to be regarded as  
evidence of the discharge of the related centres,  
and although the results of purely clinical, and  
pathological observations in many have not  
hitherto been sufficiently precise to enable us to  
connect any particular form of sensory discharge  
with a specially localizable lesion, still cases  
like these are suggestive of the value of a careful  
study of the clinical phenomena of a case with  
a view to ascertaining the localization of the centres  
originating the discharge.

The symptoms of tumour of the anterior part of the  
frontal lobe seem to have varied much in different  
cases: Motor paralysis has been mostly absent  
when the growth has been quite in front of the  
(motor)

motor region although convulsions have been frequently observed.

Mental symptoms have been sometimes absent, at others, there has been marked defect of memory and general mental deterioration. All of the three cases were marked by a large degree of mental perversion and degradation, a fact so commonly observed in most confirmed epileptics, and which points to this as the natural outcome of prolonged severe epilepsy irrespective of the nature or situation of the lesion.