

ON THE SYMPTOMATOLOGY OF GROSS LESIONS (TUMOURS AND ABSCESES) INVOLVING THE PRÆ-FRONTAL REGION OF THE BRAIN.

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THE symptoms produced by tumours and abscesses involving the præ-frontal region of the brain are often somewhat ill-defined, and probably mistakes in localisation occur more frequently in lesions of this region than in lesions of any other part of the brain. In many cases, however, a careful study of all the symptoms will indicate the seat of the disease.

During the last ten years five cases of tumour or abscess involving the præ-frontal region have been admitted into the medical wards of the Manchester Royal Infirmary, and an analysis of the symptoms in these cases, and in forty-five other cases, reported in medical literature during recent years, presents several points of interest.

Experiments on animals have shown that lesions of the præ-frontal region are not followed by such well-defined symptoms as lesions of other parts of the brain. Nevertheless, the results of these experiments are of great interest. They have been ably discussed by Professor L. Bianchi in the last volume of *BRAIN* (winter part, 1895, p. 497), and hence in this paper need only be briefly referred to. The views which have been advanced as to the functions of the præ-frontal lobe may be summarised as follows (Professor Bianchi):—

“(1) The præ-frontal lobe is the motor centre of the eyes and head on the opposite side, and in consequence of the

close relationship between the movements of these parts and attention, it is also the centre for attention (Ferrier).

"(2) It is the centre for the highest psychical functions. Destruction of it involves a real decadence of psychical activity (Wundt, Hitzig, Bianchi).

"(3) It is part of the so-called 'Fühlsphäre,' and as such is the motor centre of the dorsal muscles. Its highest development is not correlated with that of intellect, but with that of the dorsal musculature (Munk, Luciani)."

Professor Bianchi criticises the first and third views and records a number of experiments made on animals. From the psychical disturbance which he has observed after removal of the præ-frontal lobes he concludes, "that the frontal lobes are the seat of co-ordination and fusion of the in-coming and out-going products of the several sensory and motor areas of the cortex." "The frontal lobes would thus sum up into series the products of the sensori-motor regions, as well as the emotive states which accompany all perceptions, the fusion of which constitutes what has been called the *psychical* tone of the individual."

The following are abstracts of the notes of four cases of tumour and one of abscess, involving the præ-frontal lobes. To the kindness of Dr. Leech, Dr. Dreschfeld, Dr. Graham Steell, and Mr. Wright, I am indebted for the opportunity of reporting these cases.

Case 1.—Sarcoma of both præ-frontal lobes ; absent knee jerks ; unilateral optic neuritis ; spinal cord normal.—Mary O., aged 23 ; under the care of Mr. Wright and Dr. Dreschfeld. A sarcomatous tumour had been removed from the middle of the anterior part of the left thigh, but on November 20, 1893, the patient was re-admitted to the Manchester Royal Infirmary, owing to the appearance of a swelling about the size of an egg at the lower part of the cicatrix.

The patient, on admission, complained of a feeling of sickness. On November 23 she still complained of sickness, but had no pain anywhere. On the evening of the 26th she felt very sick and complained of headache on several occasions. On November 27, whilst having a bath, she had what appeared to be an attack of syncope. The pulse became very feeble, and the patient lost consciousness. Ether and brandy were given, but she remained

unconscious. The temperature was 97·6°. On November 28, she still remained unconscious, and the temperature rose to 100·8° in the morning, and 101·6° in the evening. I saw the patient for the first time on November 29. She then appeared to be unconscious. When the arms were raised into the vertical posture and allowed to fall, the right one fell down more suddenly than the left. When the right arm, leg, and right side of the face were pricked with a pin, no movement could be obtained, but slight movements were obtained on the left side. The pin prick appeared to cause pain on both sides. *The knee-jerk was absent on both sides*; plantar reflexes present; no ankle clonus. The abdominal and epigastric reflexes were present on the left side but not on the right. There was slight blurring of the margins of the right optic disc. Heart and lungs normal. November 30 there was slight optic neuritis in the right eye. The left disc was normal. The patient was in a semi-conscious condition, but could be roused by pinching or pricking with a pin. A few days later she would put out the tongue when asked to do so, but the knee-jerks remained absent on both sides. The optic neuritis in the right eye became more marked, but the left optic disc remained normal. On December 12 the difference between the limbs on the right and left sides was very slight. The patient could be made to perform slight movements of the right limbs, though she still remained in a drowsy state. No facial paresis could be detected. The tongue was protruded straight. She could not be made to answer any questions, but would occasionally speak to the nurse. *The knee-jerks were still both absent*. She could swallow food quite well. On December 27 she became quite comatose, and death occurred on the 28th.

The knee-jerks were carefully examined three or four days before death, but *they were both still absent*, and there was no ankle clonus. During the four weeks the patient was in the hospital the knee-jerks were always absent.

At the *post-mortem examination*, on the surface of the left cerebral hemisphere, in the præ-frontal region, was an oval tumour growth about 2 in. by 1½ in., the long diameter corresponding to the position of the second left frontal convolution. On making vertical transverse sections of the brain, the growth was found to extend deeply (for about 2 inches at one spot) into the white matter of the left præ-frontal lobe. The tumour was very vascular, and at the centre was softened and broken down, giving rise to a cavity which contained yellow fluid and *débris*. In the white matter of the right præ-frontal lobe were two smaller

tumour growths, one just beneath the first frontal convolution, and one beneath the second convolution. The former was softened at the centre; both were vascular. Another section through the posterior part of the third frontal convolution showed the presence of a fourth tumour, situated in the middle of the white matter of the right præ-frontal lobe, and a very small growth invading just the anterior end of the right lateral ventricle.

The ascending frontal convolution, the motor region of the cortex, the motor fibres in the white matter and the basal ganglia were *not* invaded by tumour growth. In the white matter of the occipital lobe on the left side there was a small nodule of new growth about the size of a pea, and one in that of the right occipital lobe almost at the apex of the lobe.

The *cerebellum* medulla and pons were quite normal. The spinal cord was normal to the naked eye; after hardening in Müller's fluid it appeared normal on section. Pieces were taken from the lumbar, dorsal and cervical regions, and embedded in celloid, and sections made. Microscopically the cord appeared normal.

At the inner part of the left thigh, about the apex of Scarpa's triangle, was a tumour growth about the size of an egg. Microscopically, the cerebral tumour was found to be a very vascular sarcoma. There were no changes of importance in the other organs.

Case 2.—Abscess of right frontal lobe. Optic neuritis on right side only. Frontal and occipital headache. Absent knee-jerks.—William B.,¹ aged 19, admitted as an in-patient under the care of Dr. Steell, March 22, 1890. On February 18, 1890, the patient was attacked with influenza. The nasal discharge was profuse, and after recovering from the attack he continued to suffer from pain in the head, especially in the frontal and occipital regions (Previous to the attack of influenza he was not troubled with headache.) His mental condition became very dull and he was unable to return to his work. The pain in the frontal region became so severe that he was obliged to remain in bed. The mental condition became gradually more dull and stupid.

Condition on admission to the Hospital.—Patient is pale and badly nourished. His face has a dull, stupid expression. He takes very little notice of his surroundings, but always recognises his mother. He lies on his back in a drowsy condition, with his

¹ The complete history of this case has been published by the writer in the *Medical Chronicle*, 1890-91, vol. xiii., p. 423.

eyes half closed and his mouth half open. He seldom moves his head. He never speaks unless spoken to, but answers questions quite intelligently and distinctly, though slowly and in a low voice. The patient is constantly buttoning and unbuttoning his shirt, or re-arranging the bedclothes, pulling them a little higher, or turning them down for a few inches. His legs and trunk, however, remain quite still. There is no paralysis of facial muscle, of the tongue, or of the limbs. The movements of the eyeballs upwards and downwards and to the right, are performed quite well, but the patient cannot be made to look to the left. Repeated trials fail to induce him to look in that direction; he always states that he is unable to do so, and the eyeballs remain directed straightforwards. (When examined next day this symptom had disappeared and all the movements of the eyeballs could be performed quite well.) Knee-jerks absent, no ankle clonus, plantar reflexes present. No anæsthesia.

Ophthalmoscopic examination revealed distinct optic neuritis in the right eye, but no optic neuritis in the left eye. The condition remained much the same until March 28, when the evening temperature was 101·2° F. On April 2, the morning temperature was 101°, evening 102·8°; April 3, 103·8° in the morning, 104° in the evening. On April 4, the morning temperature was 105·8°, evening 106·4°. The patient became comatose and death occurred on the evening of April 4.

Post-mortem examination revealed a large abscess in the anterior part of the right frontal lobe. It extended to within $\frac{1}{8}$ of an inch of the surface of the anterior extremity of the frontal lobe, and posteriorly to a point a quarter of an inch in front of the right caudate nucleus; laterally it extended to about a quarter of an inch from the convex surface of the cortex, and almost reached the median surface of the frontal lobe. The abscess cavity contained about three ounces of thick creamypus. The tympanic cavities and petrous portions of each temporal bone were normal. There was no suppuration in either orbit, but a small quantity of pus was found in the upper ethmoidal sinuses of the nose, on the right side. The left sinuses contained no pus. No changes of importance were detected in other parts of the body.

Case 3.—Tumour compressing left frontal lobe; convulsions; mania; coma.—Charles W., age 36, came under my observation when house physician at the Manchester Royal Infirmary in 1884. The patient was brought to the accident room late one evening in December of that year in a comatose state. There

were no unilateral nervous symptoms (such as paresis), no signs of injury to the skull, no peculiar smell of the breath, no indications of disease of the heart or lungs. As no definite history could be obtained, in view of the possibility of some narcotic poisoning, I decided to wash out the stomach. This was done without any improvement following, and the man was afterwards admitted as an in-patient under the care of Dr. Leech. He recovered consciousness gradually next day and was discharged a few days later.

The patient returned to his work and continued fairly well, with the exception of mental dulness, drowsiness and constipation, until June 1, when he had a severe convulsion. He recovered rapidly and after the convulsions ceased, he walked to the Infirmary and was admitted as an in-patient June 1, 1885. From the notes of my friend, Dr. Wild, who was then house physician, I learned that for the first two days after admission he presented no mental symptoms, but on the evening of June 3, symptoms of acute mania developed. He became violent and had delusions of suspicion; later he became more quiet, but remained irritable. On June 4, being allowed to go into the lavatory, he locked the door and jumped through the window. He fell on the grass beneath and immediately got up and commenced to run away. He was seen and captured and brought back to the Infirmary. Beyond a slight bruising of the back, he appeared to have been uninjured. Epileptiform convulsions then commenced and were frequently repeated. In twenty-four hours (from June 5 to 6), he had forty-seven epileptiform convulsions. Between the convulsions he remained comatose. The urine and fæces were passed in the bed involuntarily.

The fits continued for a few days and then gradually ceased, and the patient regained consciousness. He appeared to be in great pain, and frequently made a peculiar wailing noise. Retention of urine came on and a catheter had to be used. In two days after the commencement of the use of the catheter the urine became ammoniacal and contained pus. The patient then improved, the fits ceased, he became conscious and was able to take his food and to pass the catheter himself. The bladder was washed out with a solution of boracic acid daily and the urine became clear and acid. The patient, however, began to emaciate rapidly, and the temperature became raised above normal and irregular. He became much weaker and the retention of urine was succeeded by complete incontinence. He refused food, appeared to suffer from great pain in the head, and often gave a

peculiar wailing cry. The tongue became brown and the teeth covered with sordes. Picking at the bed clothes was noticed, and the patient became completely comatose. Death occurred on July 1.

Autopsy.—Growing from the inner aspect of the dura mater near the anterior portion of the left frontal lobe, was a tumour the size of a large walnut. This tumour had grown into the apex of the left frontal lobe, pushing before it the pia mater which lined the cavity in which the tumour was situated. The brain substance around was not at all infiltrated by the growth, which was circumscribed and could be shelled out easily from the depression in the frontal lobe. On section the tumour was firm and of a reddish grey colour, and contained numerous small spaces (the size of small peas), filled with blood. There was considerable œdema over the surface of the hemisphere, beneath the pia mater. Elsewhere the brain and medulla presented no abnormalities. There was slight tubercular disease at the apex of each lung. Both kidneys were studded with numerous dark red patches, the size of penny pieces. In the liver was a very vascular, dark red, new growth, the size of a large marble. No other changes of importance were found.

The two following cases did not come under my own observation, but are recorded in the clinical reports of the Manchester Royal Infirmary and have never been published.

Case 4.—*Tumour of left frontal lobe, deviation of eye and head to the left; long attacks of profound "sleep."* Ed. B., admitted as an in-patient at the Manchester Royal Infirmary, August 1, 1887, under the care of Dr. Steell.

Previous history.—Five and a-half years previous to admission a boy threw a piece of coal at the patient's head. This struck the occipital region, a scalp wound was produced, but the patient did not lose consciousness. Just when the wound was beginning to heal (five or six weeks after the blow) the patient had a fit. Six months later a second fit occurred and the patient has had five or six fits since. Three months ago he began to be troubled with headache, loss of appetite, sickness and diarrhoea, and his medical attendant ordered him to bed. He slept for two or three days, and it was scarcely possible to rouse him. Similar attacks have occurred once or twice a week since. For several weeks before admission patient is said to have dragged his legs. On July 25 his mental condition became worse, and he was unable to stand. The speech was affected for

about a week before admission. The patient stammered and "made mistakes," "said things the wrong way about." He has complained of pain in the neck for two months.

Present state.—Patient lies with his head and eyes turned to the left. He is very irritable, does not answer questions, appears to be semi-conscious, moans when touched or disturbed. Double optic neuritis is present.

August 4.—Head turned to the left; neck rigid; appears to have much pain in the neck when an attempt is made to turn the head to the right. No paralysis of limbs. Appears to have much pain when the legs are moved; knee-jerks increased.

August 5.—Patient lies with his head still turned to the left. The eyes are half open. When asked "How are you?" he usually answers indistinctly, "I'm all right." There is still much pain when one attempts to rotate the head to the right. He is able to show the teeth and to protrude the tongue quite well. The temperature rose to 104.4° on the evening of August 6; pulse 128, respiration 50. On the morning of August 7 it was 101.2°, in the evening 103.8°. Death occurred on August 8.

Autopsy (head only).—Dura mater normal; pia mater congested, but no signs of lymph or pus at any part thereof. The left frontal lobe was occupied by a new growth which extended to the outer and inner surfaces of the lobe. It projected markedly on the median surface and compressed the median surface of the right frontal lobe. Posteriorly it extended to the anterior part of the left caudate nucleus, but the greater part of that nucleus, together with the lenticular nucleus and internal capsule, was not affected. The growth was very soft and vascular, and the greater part had undergone mucoid degeneration. Other parts of the brain were normal to the naked eye.

Case 5.—*Tumour of right frontal lobe; absence of knee-jerks; occipital headache.* Thos. B.¹ aged 17, admitted June 26, 1888, under the care of Dr. Dreschfeld.

Previous history.—Six years before admission patient began to suffer from epileptic fits. For the first two years he suffered from attacks of *petit mal*. These occurred once or twice a week. Four years ago he began to suffer from attacks of *haut mal*. These attacks occurred sometimes two or three times a week; sometimes he would have four or five attacks daily, and then the attacks would cease for a while. Before each attack patient had an aura, consisting of a "twiching sensation,"

¹ Abstract from notes by Mr. Gore.

running up the left arm from the tips of the finger; this sensation would last five minutes before each attack. Three months before admission the fits ceased. Since that time he has been troubled with pain in the occipital region, which sometimes has passed over to the frontal region. The pain, of a throbbing character, has been constantly present. The vision has become affected considerably; for three months he has suffered from intolerance of light, and on looking at any white object there has been frontal headache. Recently he has been troubled with sleeplessness and loss of memory.

Condition after admission.—The patient lies in a drowsy condition, but is easily roused. The face has a languid expression. The pupils are somewhat dilated, and there is an internal squint of the left eye. He is fairly well nourished. He is intelligent; he answers questions somewhat slowly, but correctly. He suffers from giddiness and constant headache in the inferior occipital region. When he looks at anything white he suffers from frontal headache. The pain in the occipital region is of a throbbing character. There is slight paralysis of the lower facial muscles of the left side, and the left orbicularis palpebrarum is feebler than the right. The movements of the left arm and leg are somewhat weaker than those of the right. The tongue is protruded straight. The epigastric, abdominal cremasteric reflexes present on both sides, better marked on the right side than on the left. Plantar reflexes increased. Knee-jerks *absent*. There is no *anæsthesia*. The gait is staggering; the patient tends to fall towards the right side, and has a sensation of vertigo. He cannot stand upright with his eyes closed. Nothing of importance detected on physical examination of the heart and abdomen. Urine: no albumen, no sugar. Slight dulness at apex of left lung.

June 29.—Marked double optic neuritis.

July 4.—Patient was seized with an attack of rigidity of the muscles of the body, the head was thrown back, the arms, legs, and back were rigid. The attack lasted for about one minute; the patient never lost consciousness completely.

July 13.—Patient has complained of severe headache during the last two days; he complains of pain shooting from the occipital to the frontal region. He is in a drowsy condition most of the day.

July 30.—Patient is very drowsy, almost comatose. He answers questions slowly. Complains of much pain on pressure over the back of the neck. Muscles of the neck rigid; head retracted. Death on August 6.

Autopsy.—Cicatrix of healed phthisis at apex of right lung. A small tubercular cavity at apex of left lung, and several small patches of consolidation around.

Brain.—In the right frontal lobe was a roughly spherical tumour two and a half inches in diameter, which came to the surface in the region of the first and second frontal convolutions; other parts of the brain not affected. Cerebellum normal. No growth at the base of the brain. The growth was *firm*, but was not hard except at the centre. The periphery was of a pale greyish red colour and vascular; the centre was pale and somewhat caseous in appearance; at various parts were masses of calcareous material. The growth could be easily shelled out from the surrounding softened brain substance.

The vertebræ, spinal dura mater, and spinal cord were all carefully examined with negative results. No changes of importance in the other organs.

REMARKS.—In two of the cases reported it is interesting to note that optic neuritis was unilateral; in one case on the side of the lesion, in the other it was unilateral though *both* frontal lobes were invaded by tumour growth. Another point of interest is the absence of knee-jerks in three of the five cases above reported. In one of these cases the spinal cord was examined microscopically, and was found to be normal, and it is probable, from the clinical history, that in the other cases the cord would have been found normal had a microscopical examination been made.

The severe pain in the occipital region in Case 5 was somewhat peculiar. In Case 4 the deviation of the head and eyes towards the side of the lesion was a symptom of interest, since Ferrier and others localise the centre for this movement to the præ-frontal region. The very long attacks of "deep sleep" are also of interest in this case.

All these points will be referred to subsequently, since the symptoms of the five cases above recorded are included in the following analysis.

ANALYSIS OF THE SYMPTOMS, &C., IN 50 CASES OF TUMOUR OR ABSCESS INVOLVING THE PRÆ-FRONTAL LOBES.

The cases comprise the 5 reported above, and 45 recorded in medical literature in recent years.¹

Nature.—Of these 50 cases 4 were cases of abscess, and the rest tumours of various kinds—10 of the latter were gliomatous,

¹ For references see list at the end of the paper.

7 sarcomatous, 5 gliosarcomatous, 4 syphilitic, 3 endotheliomatous, 2 tubercular.

Region.—17 involved the right lobe, 22 the left, and 11 both lobes. The convex cortex was the seat of the growth in 18 cases, the median cortex in 1, the inferior cortex in 2, the white matter in 8, the convexity and the white matter in 5. In 3 the growth was at the tip of the anterior part of the frontal lobe; in 3 it was between the lobes; and in 10 it was situated at the base and compressed the frontal lobe.

Symptoms.

Headache was a prominent symptom in most cases. The pain was generally most intense in the frontal region, in some cases in the occipital region. In the records of 50 cases headache is not mentioned, or the locality not stated, in 23; in 1 there was no headache; in 1 the region of the pain varied. In the remaining 25 cases the distribution of the headache was as follows:—

	Cases.
Frontal region only, in	11
* { Frontal chiefly, occipital also	4
{ Occipital chiefly, frontal also	2
{ Occipital at first, frontal later	1
{ Occipital	2
Frontal and vertical	2
Vertical and temporal (near the growth)	1
Temporal (growth on opposite side)	1
Headache "on the side of the tumour"	1

* In 9 of the 25 cases pain was in the occipital region, with or without frontal headache = 36 per cent. of cases in which headache was *localised*.

Frontal headache is therefore most frequent, but it is remarkable that the occipital headache also should often occur. It is well known that in cerebellar tumour the headache is often occipital, and not infrequently it is frontal or frontal and occipital. Dr. Purves Stewart (*Edinburgh Medical Journal*, January, 1896, p. 659), has called attention to unilateral frontal headache in cerebellar tumour situated in one lateral lobe, the headache in the frontal region being on the side opposite to the cerebellar lesion.

Tenderness on Percussion of the Skull.—In 30 out of the 50 cases there is no note with regard to this symptom. In the other 20 cases it is stated, that there was tenderness on percussion of the skull in the *frontal* region in 15 cases. In one of the cases the occiput was tender also, but the tenderness was most marked in the frontal region. In 5 cases it is stated that there

was no tenderness of the skull on percussion. Of those 15 cases in which there was tenderness on percussion of the skull, the tumour growth was situated at or near the region of the tender area in 12. In 1 there was tenderness on one side, and both frontal lobes were the seat of tumour growth.

Hence it appears that if tenderness be present on percussion, it is of value as an indication of the region of the skull in which the growth is situated. Also when tenderness is present in the frontal region, if it be unilateral, the growth is generally on that side.

Tenderness on percussion is not a sure indication that the growth is cortical, though this is generally the case. Thus in the 15 cases in which there was tenderness on percussion the growth was superficial (cortical or in the meninges) in 12, but in 3 it was in the white matter. Again, in the 5 cases in which there was no tenderness the growth was cortical in 3, seated in the white matter in 2.

Ophthalmoscopic Examination.—In the 50 cases analysed, the records of ophthalmoscopic examination were as follows:—

	Cases.
Double optic neuritis, in	25
One eye previously lost; optic neuritis in the remaining eye, in ..	1
Vision impaired in both eyes, in	1
Vision lost in both eyes, in	1
Condition of optic discs and vision not mentioned, in	11
Optic discs normal, in	4
Optic neuritis on one side only (the side of the lesion), in ..	1
Optic neuritis unilateral, lesion in <i>both</i> frontal lobes, in ..	1
Optic neuritis very much greater on side of the lesion, in ..	2
* Blindness on the side of the lesion; the other eye only affected at a later date, in	1
Well marked primary optic atrophy on the side of the lesion; slight optic neuritis on the other side, in	2

* Hence in 7 out of the 35 cases in which ocular changes were noted, the failure of sight or the ophthalmoscopic changes were on one side only, or were very much more marked on one side. In 6 of these 7 cases, the marked ocular changes were on the *side* of the lesion; in one case there was unilateral optic neuritis and a bilateral lesion.

This marked unilateral tendency, or marked difference on the two sides, in 7 out of 35 cases is of some interest, since such a difference does not occur, or does not occur in this proportion of cases, in lesions of other parts of the brain substance.

Sense of Smell.—In 33 out of the 50 cases no note with respect to the sense of smell is given. In 10 cases it is stated that smell was not affected. In 7 there was unilateral or bilateral loss of smell, and in these cases the growth involved the basal region, *i.e.*, region of the olfactory nerves.

Loss of smell, if present, is therefore an important symptom, but if the sense of smell be normal no conclusion can be drawn from this fact alone.

Exophthalmos.—This symptom was bilateral in 1 case, unilateral (on the sides of the growth) in 2 other cases. In all these cases the growth had invaded the dura mater and anterior fossa of the skull.

Localised Swelling in the frontal region of the skull was recorded in one case; in another case there was an external swelling in the temporal region, at the lower angle of the frontal lobe.

Motor Symptoms.—Paresis, or paralysis of the face or arm or leg, or of all three parts, on the side opposite to the lesion, was met with in many cases at some period; but in the majority it was very slight, and was often noticed *only* at the end of the illness. The paresis was due to the extension of the growth backwards from the præ-frontal towards the motor area of the cortex, or to softening around the tumour growth implicating the motor area or the motor fibres coming from that region.

	Cases.
Slight paresis on side opposite to the lesion, noted at some period, in	27
Marked paralysis, in	4
Motor symptoms absent, in	5
Motor symptoms not mentioned, in	14

Convulsions were met with in many cases; their nature is shown in the following table. The frequency of the attacks varied greatly.

	Cases.
General convulsions occurred at some time in the course of the patient's illness, in	14
Unilateral convulsions from involvement of the motor area of the cortex, in	10
* Convulsive attacks (clonic spasms) in both arms, in	3
Fits resembling those of hystero-epilepsy, in	1
Fits beginning by the legs being drawn up into the lithotomy position, in	1
Attacks of tonic spasms in the neck	2
Convulsions absent, in	4
Convulsions not mentioned, in	15
	<hr/> 50 <hr/>

*In two of these cases the growth was median and involved the median surface of both frontal lobes. In one case there was a lesion in the præ-frontal area, near the arm centre, in *each* hemisphere.

Anæsthesia was never recorded; in many cases it is definitely stated that sensation was not affected, in others no note is made.

Ataxia.—Bruns (²⁰) has drawn attention to the fact that ataxia resembling that of cerebellar disease is sometimes met with in lesions of the præ-frontal area.

In the 50 cases analysed, ataxia, unsteadiness in walking, or a reeling gait was present in 14; these symptoms were not mentioned in 33, and in 3 cases it was stated that no ataxia was present.

Knee-jerks.—It has been long known that the knee-jerks are sometimes absent in cerebellar lesions, whilst in other cases they are increased; why this difference should occur is not known. It is interesting to note that the knee-jerks are sometimes absent in frontal tumour also; in the 50 cases the condition was as follows:—

	Cases.
Knee-jerks absent on both sides, in	6
Knee-jerks very feeble on both sides, in	2
Knee-jerk very feeble on side opposite to tumour, in	4
Knee-jerk very feeble on side of tumour, in	2
Knee-jerks normal or increased, in	16
Knee-jerks not mentioned, in	20

In 30 cases only was the condition of the knee-jerks referred to, and the proportion of cases in which they were absent, amongst these 30 cases was 20 per cent. (6 in 30).

In all the cases in which the knee-jerks were absent, there was no indication of the lesion of the spinal cord or peripheral nerves, but in only one of the cases, the first reported in this paper, was the absence of microscopical changes verified by pathological examination. The absence of knee-jerks is a symptom of interest. In tumour growths involving the motor region of the brain, the knee-jerk on the opposite side is generally increased, and on the side of the lesion, present, if not increased. In 30 of such cases taken for comparison with the 30 lesions of the præ-frontal area analysed above, I found the knee-jerks both present in all except one, and in this case the growth was very extensive and invaded the basal ganglia. The connection of each lateral cerebellar lobe with the præ-frontal region of the opposite side,

is of interest with respect to the loss of long knee-jerks that sometimes occurs in lesion of both these regions.

Mental Symptoms.—The psychical symptoms which have been observed after removal of the frontal lobes in animals are referred to at the commencement of this paper, and it is interesting to note, that clinically mental symptoms have been noted in most cases of lesions of the frontal lobes, though the exact nature of these symptoms has varied somewhat. A dull mental condition, mental decadence, loss of attention, a drowsy, and semi-comatose state have often been recorded.

Some writers have attached considerable importance to a childish behaviour of the patient, with an abnormal tendency to fall asleep.

Jastrowitz²³ has described a peculiar mental condition which he has met with in cases of lesion of the præ-frontal lobes, a condition of mental impairment or dementia along with a peculiar cheerfulness or hilarity, and tendency to jest and make puns (*Verhandlungen des Vereins f. innere Medicin*, Berlin, 1888). He acknowledges that this mental condition is not met with in all cases, and that it occurs also in other diseases, such as general paralysis of the insane and in chronic alcoholism; but he thinks that in a case presenting general symptoms of intra-cranial growth, the tumour may be localised in the frontal lobe, if this peculiar mental condition should be present.

Oppenheim²³ also draws attention to this peculiar humorous mental condition in cases of frontal tumour, and points out that the cheerful mental state stands out in sharp contrast to the miserable physical condition of the patient. There is a tendency to joke, to make sarcastic or trivial answers; Oppenheim compares the mental condition to that of a patient awaking imperfectly from a pleasant narcosis. He adds that it must be allowed that this mental condition occurs principally in tumours of the frontal lobes.

Bruns²⁰ also describes a similar mental state.

Welt (*Deutsches Archiv. f. Klin. Med.*, Bd. 42, 1888, p. 339) attaches importance to an irritable mental condition, with violent and mischievous behaviour, especially in lesions of the convolutions on the orbital surface.

Lloyd (*Journal of Nervous and Mental Diseases*, p. 81) draws attention to a peculiar "inhibition of thought; an increase of the time reaction of cerebration;" a peculiar slowness in answering questions, though the answers are quite intelligent.

In the fifty cases which I have analysed, mental symptoms were generally well marked; in many cases they were the earliest and most prominent symptoms. The following table shows the varieties of mental condition met with:—

	Cases.
* A condition of mental decadence; a dull mental state; loss of power of attention; loss of memory; loss of spontaneity; the patient taking no notice of his surroundings; sleeping during the greater portion of the day, or being semi-comatose	32
Loss memory, mental failure, but patient cheerful	6
Patient suspicious; suffered from delusion, and was occasionally violent	1
Patient irritable and violent	1
Patient generally asleep; irritable when awake	2
Patient ambitious, excitable, memory lost	1
Slowness of mental processes; patient simple and childish ..	1
Mental anxiety; childishness; hallucinations; suicidal tendencies	1
Mental condition not stated	5
	<hr/> 50 <hr/>

* In two of these it is noted that the patients were in a perplexed mental condition, and constantly appeared to be searching for something.

In some cases in which the mental symptoms were well marked, the lesion was chiefly in the white matter, in some cases, chiefly in the cortex, whilst in others both cortex and white matter were involved; so that one does not feel justified in drawing any conclusion as to whether the mental symptoms are the result of lesion of the cortex or of the white matter. In 3 cases in which the lesion was chiefly cortical, the mental symptoms were comparatively slight.

Loss of power in the *muscles of the back* is not mentioned in any of the records.

Sudden onset of Symptoms.—Sudden coma, when only slight and trivial symptoms had been complained of previously, was recorded in 3 cases.

Attacks of Coma.—As a rule the patient finally became

comatose, and in many cases was comatose or semi-comatose for a long period before death. But apart from this terminal comatose state, in some cases the patient suffered from one or more previous attacks of coma, without any preceding convulsions. Sometimes these attacks were followed by hemi-paresis; in other cases no paresis followed. Attacks of unconsciousness previous to the final coma were noted in 10 out of the 50 cases analysed.

Remarks on Diagnosis.—In a case in which there are general symptoms of intra-cranial growth or abscess; the localisation to the præ-frontal region often presents considerable difficulty. The diagnosis is sometimes especially difficult between cerebellar and frontal tumours. In tumours of the præ-frontal region, whilst the headache is chiefly frontal, very often there is occipital headache also. In cerebellar tumours whilst the headache is chiefly occipital, still not infrequently there is frontal headache. In tumours of the cerebellum the knee-jerks are sometimes absent, but as shown by the cases recorded in this paper, the knee-jerks are sometimes absent in lesions of the præ-frontal region. Also ataxia, simulating the ataxia of cerebellar disease, may occur in lesions of the præ-frontal region. Each præ-frontal lobe of the cerebrum is connected with the lateral lobe of the cerebellum of the opposite side, by fibres passing downwards in the anterior part of the internal capsule, on the inner side of the crus cerebri, and in the superior cerebellar peduncle; and this connection may, in some way, account for the above-mentioned symptoms being often common to lesion of both the præ-frontal region and the cerebellum.

In many cases, however, a careful study of the symptoms will lead to a correct localisation. Mental symptoms (especially mental dulness and degeneration) are prominent, and often early symptoms in lesions of the præ-frontal regions, whilst they are generally slight and occur late in lesions of the cerebellum. Paresis on one side—hemi-paresis, or paresis of leg, arm or face only—occurs in a large number of cases of præ-frontal lesions at a late period, owing to the extension backward of the growth, or of the surrounding

softening; whilst paresis of the arms or legs is very rare in cerebellar lesion. Convulsions, general or localised, often occur at some period in præ-frontal lesion; very rarely in cerebellar lesion.

Tenderness on percussion or pressure over the frontal region appears to be a sign of value in localising the lesion to the præ-frontal region.

Whilst optic neuritis is often bilateral in præ-frontal tumour and abscesses, still the facts above recorded show that in some cases it is unilateral, or it is *very much* more advanced on one side, or vision is *very much* more impaired on one side, or there is primary optic atrophy on one side, and only slight optic neuritis on the other. I have never met with any case of cerebellar tumour in which there was this tendency to very marked affection of one optic disc, whilst the other was normal, or only very slightly affected.

[It is interesting to note that the lesion has been on the side on which the optic disc was markedly affected in 6 out of 7 of these cases; in the seventh the lesion was bilateral]. When present, this marked difference of the two optic discs appears to be of some diagnostic importance.

Localised swelling in the frontal region, unilateral exophthalmus and loss of smell are rare symptoms, but, if present, form important evidence in favour of a lesion of the præ-frontal region.

It is to be noted, however, that loss of smell has been reported in cerebellar tumour, but of course is exceedingly rare, whilst it is reported in 7 out of 17 cases of præ-frontal tumours.

With regard to the diagnosis between lesions of the præ-frontal region and the so-called motor area, evidence in favour of localisation in the former would be the prominence and early onset of mental symptoms; the absence or slight nature of motor symptoms, and the development of these symptoms, when present, at a late period, after the general and mental symptoms have become well-marked. Whereas in lesions of the motor area, mental symptoms are often absent or slight until a late period; paresis is an early symptom and develops into well-marked paralysis. Also the

tenderness or percussion over the frontal region, and (in a few cases) the absence of knee-jerks, the loss of smell, the unilateral nature of the ophthalmoscopic changes, or very marked difference of these changes on the two sides, would be points in favour of a lesion of the præ-frontal region.

Suitability for Operative Treatment.—In the 50 cases analysed, the 4 cases of abscess were all suitable cases for surgical interference. One case,³³ McEwen's, was operated on with success. Seven cases of tumour of the præ-frontal lobes were so suitable and of such a moderate size, *even at the time of the autopsy*, that they could have been easily removed by surgical operation. In 2 other cases, a tumour was removed; in one case successfully (Durante), in the other unsuccessfully.

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