A Successful Case of Removal of a Large Brain-tumor from the Left Frontal Region—Opening and Packing of the Lateral Ventricle with Iodoform-gauze.

BY

H. M. THOMAS, M.D.,

CLINICAL PROFESSOR OF NERVOUS DISEASES IN JOHNS HOPKINS UNIVERSITY, NEUROLOGIST TO THE JOHNS HOPKINS HOSPITAL, BALTIMORE;

AND

W. W. KEEN, M.D.,

PROFESSOR OF THE PRINCIPLES OF SURGERY AND OF CLINICAL SURGERY IN THE JEFFERSON MEDICAL COLLEGE, PHILADELPHIA.

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A SUCCESSFUL CASE OF REMOVAL OF A LARGE BRAIN-TUMOR FROM THE LEFT FRONTAL REGION—OPENING AND PACKING OF THE LATERAL VENTRICLE WITH IODOFORM-GAUZE.

By H. M. Thomas, M.D.,
CLINICAL PROFESSOR OF NERVOUS DISEASES IN JOHNS HOPKINS UNIVERSITY, NEUROLOGIST TO THE JOHNS HOPKINS HOSPITAL, BALTIMORE;

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History by Dr. Thomas.

E. de B., aged seventeen years, was referred to me by Dr. George Reuling on March 27, 1896, with the request that I should examine him as to his nervous symptoms, double optic neuritis being present. The young man at that time complained of having had headaches, sick stomach, and some difficulty in seeing.

His family history is exceptionally good; both his father and mother are alive and in good health; neither of them knows of any hereditary disease in their families. The occurrence of syphilis, tuberculosis, and malignant growths was especially inquired for. One brother of the patient died from an infectious fever, when a child, in Cuba. The other brothers and sisters are unusually strong and vigorous.

The patient himself is the youngest child of seven. He was a strong baby and child; had measles and mumps, but no other infectious diseases of childhood. Other than this, he has enjoyed exceptional health. He has been active and very fond of outdoor sports, at which he excelled. When about eight years old he received a cut on the head by running through a glass door. The wound was not serious, and healed quickly under a dressing applied by his father. The scar is still evident. Three years ago he was struck on the left side of his forehead by a baseball, thrown by one of his companions. He says the blow was a hard one, and that he felt badly in consequence of it for a day or two. These are the only injuries he has received that could bear any causative relation to the development of his trouble.

He never complained of headache until the beginning of his present trouble. The patient spent last summer at the seashore, and was apparently in robust health. In September, on two occasions, while shooting reed-birds, he was obliged to stop on account of severe pain in the head. He attributed the pain to the sun and the constant discharge of

his gun. Such an occurrence had never happened in previous seasons. In the autumn it was noticed by his family that after an afternoon's tennis he would seem tired, spending most of the evening on the lounge.

He entered a new school and did his work satisfactorily, although he has never been an enthusiastic student. He began to have difficulty with his eyes during the late autumn, finding that if he studied much at night they would pain him. This was not very pronounced, being only sufficient to cause him to do his work during the daylight.

On December 20, 1895, he had a very severe attack of pain in the head and eyes. He was dull and somnolent, could eat nothing, and vomited a great deal. He remained in bed until Christmas-day, and even then felt badly. About this time Dr. Reuling made his first examination of his eyes, and he has kindly allowed me to use his notes, which are as follows:

December 24, 1895. Complained of visual fatigue after reading, and occasional frontal headaches.

Examination. Hm. 0.67 each. No abnormal condition. Fundus normal.

Treatment. + 0.67 R. L.

After the holidays he returned to school, but on January 10th he had another attack of severe pain in the head accompanied by vomiting. He was confined to his bed for a week; during this time Dr. Reuling made his second examination and then found double optic neuritis. His notes at that time are:

January 24, 1896. Complains of frequent headaches, slight dizziness; had an attack of nausea.

Ophthalmic Examination. Neuritis optica descendens partial in right, complete in left. In the right eye inner margin of disk yet normal, outer margin indistinct and considerably more peripheric; veins of this section large and tortuous. Left eye: the whole discus opticus enlarged, its periphery considerably extended; infiltration causing considerable prominence. Several of the tortuous veins show distinct thrombi; arteries slightly covered by the infiltration. Diagnosis: tumor cerebri. V. with + 0.67 D. 20/20. General vision remarkably good; reads No. II. with + 1.25 D. with each eye. Focal vision not defective.

After this attack he had no very severe headache, but was never free from more or less pain, which he localized as being above and back of his eyes. Indeed, all the pain that he has ever had has been entirely frontal, but not more on one side than the other. His mental condition was changed, and he was dull, often spending most of the day on the bed, and he was somewhat self-willed. It was noticed that at times he staggered and seemed to have difficulty in walking.

About February 25th his sister noticed that in speaking he used the left side of his face more than the right, and it had been noticed for a day or two that the left eye was slightly more prominent than the right and was somewhat bloodshot. In March he left the city for a week and was very uncomfortable; he vomited every morning when his coffee was brought to him, and had difficulty in standing or walking. For a month before I saw him he had complained of momentary loss of vision, and he gave an indistinct history of having seen double.

The examination made on March 27th showed the patient to be a tall, well-developed young man. His intelligence seemed fairly good, although he was unable to remember certain facts in the history of his disease,

and often contradicted his mother and aunt, who were with him. His voice was normal, although a little loud, and there was no sign of aphasia. He was apparently able to distinguish odors.

His left eyeball was somewhat more prominent than the right, and in the inner canthus there were some superficial bloodvessels, which gave a dark appearance to this portion of the eye. The eyeballs were steady and freely movable in all directions. There was no ptosis. The pupils were moderately dilated, round, and equal; they reacted to light and during accommodation. The vision was practically normal in both eyes (20/30 in each), although he said he saw a little better with his left than with his right eye. The visual fields, tested quickly, showed no abnormality; the colors were seen in the usual order. An ophthalmoscopic examination revealed the presence of well-marked neuritis in both eyes, more intense in the left eye.

Sensation was unaffected over the face. Muscles of mastication acted well and equally on the two sides.

When the patient's face was at rest, the left naso-labial fold was more marked than the right, and in speaking the left side of the mouth was used more actively than the right. He elevated and contracted his eyebrows normally, closed his eyes well and forcibly. In elevating the upper lip the left side was drawn higher than the right, although when strong effort was made very little difference could be perceived. He puckered his lips well and was able to whistle.

Hearing was acute in both ears.

His sense of taste was unaffected.

The movements of the soft palate, pharynx, larynx, and tongue were perfectly normal. The pulse was counted, and nothing abnormal was noted.

There was no paralysis or incoördination in any of the muscles of the trunk or limbs, and sensation was unaffected. The deep reflexes were normal. The patient walked well, stood steadily with feet together and eyes closed.

Neither pressure nor percussion caused pain anywhere over the skull. The urine had been examined on several occasions, and nothing abnormal found.

There could be hardly a doubt that the patient was suffering from a brain-tumor, which fact Dr. Reuling had already told the boy's family. As there was no history of tuberculosis or syphilis either in the family or in the patient himself, the patient stating that he had never been exposed to venereal contagion, it seemed more probable that the growth was either a sarcoma or a glioma; but, to give him the benefit of every doubt, he was put on increasing doses of iodide of potassium and was directed to be rubbed every night with mercurial ointment.

The patient took the medicine very well, but there was no change in his symptoms. Dr. Osler saw him on April 10th, and confirmed the diagnosis of brain-tumor. He dictated the following note in regard to his heart and bloodvessels: "Pulse is difficult to compress; no definite sclerosis of the radial. Cardiac impulse is seen just beneath and within the nipple, better felt just in the same situation. Heart-sounds are clear at apex; first perhaps a little murmurish. Aortic second is decidedly accentuated."

Dr. Osler advised pushing the iodide and mercury.

I made urinary analyses at four different times; the first, when the

patient had been taking the treatment about three weeks. At that time there was a considerable quantity of albumin. On the next occasion, about four days later, there was less albumin; the third time, only a trace; and at the fourth analysis, which was made for me at the Johns Hopkins Hospital, there was no albumin. Tube-casts were looked for at each examination, and were not found. There was never any sugar present.

On April 17th, at which time the patient was taking 80 minims of iodide of potassium three times daily, he became sick at his stomach and vomited frequently. The sickness lasted most of that day and was unaccompanied by any severe pain in the head.

This was on Friday; he was better on Saturday, Sunday, and Monday; on Tuesday he was very restless, always moving about. He took a long walk on that day. On Wednesday morning he awoke with sick stomach and vomited a good deal. At this time he was in the country under the care of another physician. When I saw him on Sunday, the 26th, he had been in bed since Wednesday. The iodide and mercury had been stopped, but the sick stomach still continued. He was dull and often somewhat delirious, having, on one occasion, endeavored to get out of the second-story window, in the middle of the night, under the idea that he wanted to go to the garden. He several times passed his urine in bed, apparently without noticing it. The sick stomach was almost constant, and he vomited nearly everything that he took. It was noticed that when he sat up in bed he would become dazed and seem to lose consciousness. At these times his pulse was said to be very weak. Once or twice, when endeavoring to drink from a cup, his right hand shook a good deal, and he was unable to raise the cup to his mouth. This disability lasted for a few moments, and he was then able to move the right hand normally. Upon examination the only change in his symptoms that I noted were the increased mental dulness; a slight thickness in speech, wrong words having been used on one or two occasions; decided loss of vision in his right eye, he being barely able to see at all with that eye; and a peculiar uneasiness of the right hand. This was constantly in motion, picking the bedclothes, drumming on the bed, etc. When asked to make any movement with that hand he performed it accurately and well. The muscular strength was unimpaired. He said that he suffered very little pain. His pulse was somewhat weak and slow, beating between 52 and 60 to the minute. Temperature was normal, and respiration 14. He was given strychnine and small doses of bromide.

April 27th. Dr. Reuling reported: "Vision in right eye reduced to quantitative perception of light. Left eye: fingers at twenty feet by peripheric fixation. Ophthal. stat. idem."

The exophthalmos of the left eye, the mental dulness, the slight paralysis of the right side of the face, and the peculiar uneasiness of the right hand, taken together with the absence of other symptoms, led me to the belief that the tumor was in the left frontal lobe, and I told the boy's parents of my belief and suggested an exploratory operation.

Dr. Osler saw him again with me, and urged the operation. On May 4th Dr. M. Allen Starr, Dr. Reuling, and myself saw him together. Dr. Starr's examination and opinion, which he kindly allows me to use, are as follows:

"The general symptoms and course of the case make it evident that Mr. de B. is suffering from a tumor of the brain. The existence of a right facial paralysis, a thickness of speech, of a protrusion of the left

eyeball, with greater degree of optic neuritis in the left eye, and very marked change in mental characteristics and mental activity, the hebetude and indisposition to move about, with some decided instability in motion, point to the left frontal lobe as the seat of this tumor. The slowly progressive character of the symptoms, with lack of great variability in their character, and the absence of headache and tenderness on percussion, make it seem probable that the tumor is of a hard sarcomatous character rather than a vascular glioma, and make it open to operation. Such an operation is necessarily exploratory, and it seems likely that the best point for exploration will be over the second frontal convolution about its middle, the probable situation of the tumor being subcortical within the white matter of the frontal lobe, pressing backward upon the motor tract and upward toward the cortex of the posterior part of the second frontal convolution.

"It is the absence of epileptic attacks which leads specially to the idea of the tumor being subcortical. If exploratory operation is undertaken, I suggest that the method employed be that of a large bony flap, in order that the surface exposed may be as large as possible. If, after the opening of the dura, nothing is found at the spot indicated, and palpation at the bottom of the deepest fissure accessible fails to reveal any growth, I suggest that the base of the frontal lobe over the orbit be investigated, if possible, by lifting the entire lobe and exploring with the finger beneath.

"From the fact that destructive lesions of the forward tip of the frontal lobe appear to give rise to few symptoms, I think it would be justifiable to make an incision into the frontal lobe for the purpose of exploring the white matter in case the tumor is not found at either of these two positions."

After a good deal of discussion the boy's family decided to have the operation done. Dr. W. W. Keen was asked to perform it, which he did on May 10th. For a week before the operation the patient's condition remained about the same, except that vision in the right eye became entirely lost, and in the left eye began to fail, especially for near objects. In the distance he had approximately fifteen-thirtieths vision. Both pupils were dilated, but reacted to light. There was no marked change in the condition of the optic nerves. His general condition improved somewhat; he vomited very seldom, and was able to take more nourishment. The pulse varied between 52 and 70, and the temperature was normal. The uneasiness of the right hand persisted and extended to the right foot; his nurse said that she had noticed it during sleep.

The Operation by Dr. Keen.

May 10, 1896. I first saw the patient to-day, and found his condition as follows: A tall, muscular young man seventeen years of age; vision was lost in the right eye, but he could read test-letters with the left. Both pupils were widely dilated, but reacted to light. The left eyeball was protuberant to a moderate extent, the upper lid having the appearance of being swollen. On the left forehead, an inch to the left of the median line and just at the border of the hair, was an irregular scar about an inch long, which was stated to have been caused by striking his head against a glass door with some force about ten years ago. No evil consequences followed at the time. It is doubtful whether this has any relation to the tumor, as the operation did not disclose any special injury to the bone either externally or internally, nor did the tumor found later

start apparently at the corresponding point in the brain. Possibly the blow with the baseball may have been the cause of the tumor. His right lower face was slightly changed in expression in repose by a moderate paresis; when he smiled the paresis was very evident. I was not able to examine the skull by percussion, as he was already prepared for operation. His mental condition was rather dull; but, at the same time, he appreciated who I was and that an operation was about to be done. His speech was not very thick.

I was ably assisted surgically by Prof. L. McLane Tiffany and Drs. Martin, Lanier, and William J. Taylor. Drs. Thomas, Osler, and Reuling also were present, and advised us from time to time.

Operation, May 10, 1896. An incision was begun 1.5 cm. below the temporal ridge. This was extended 6.5 cm. horizontally a little more than 2.5 cm. above the upper border of the orbit to within 1.5 cm. of the median line. It was then continued posteriorly parallel with the median line for a distance of 12 cm., where it reached a point 2 cm. in front of the Rolandic fissure. From this point it passed downward nearly parallel to the Rolandic fissure a distance of 12.5 cm., which brought the termination of the line again 1.5 cm. below the temporal ridge. (Figs. 1 and 6.) This large bony flap was chiselled loose and turned downward, breaking through the bone just below the temporal ridge. So great was the intracranial pressure that when I had completed the chiselling of the bone, before fracturing its base, its internal edge was lifted above the level of the skull more than half a centimetre. The moment that the bone was reflected the dura bulged at least half a centimetre above the level of the opening. By touch it was excessively tense and elastic. Pulsation was evident. At no point over the dura was there any such special hardness as to indicate a tumor. Accordingly, in view of the early beginning-symptoms in the left eye and the possibility, therefore, that the tumor might be on the orbital aspect of the frontal lobe, I decided to explore first the inferior surface of the frontal lobe. My incision in the bone above the orbit had been purposely placed at a point high enough not to invade the frontal sinus. I now gnawed my way cautiously downward toward the orbit by the rongeur-forceps, so as to enable me to explore the under surface of the frontal lobe. The frontal sinus was not opened; but had a small opening been made in it, it was my intention to have puttied it up with Horsley's wax, so as to prevent infection. I was soon able to lift the frontal lobe sufficiently to feel the crista galli, and also to see as well as feel the curved lesser wing of the sphenoid and the dura over the temporo-sphenoidal lobe beyond the lesser wing. Had there been any reason for it, I am sure I could have seen the anterior clinoid process without difficulty. Nothing abnormal was seen on the under surface of the frontal lobe, in or under the dura. I next passed my finger under the frontal lobe, but could feel no abnormal hardness or softness. Accordingly, I decided to open the dura on the superior aspect of the brain. I made my incision parallel with the borders of the bony opening. As soon as the dura was opened the brain bulged far above its level; inspection showed a dark area at a point just above and in front of the junction of the second frontal sulcus with the precentral. This dark-colored area was evidently the tumor protruding through the ruptured cortex. (Fig. 1 ⊕.) As the tumor evidently extended posteriorly and inferiorly beyond the limits of my bony opening, I now gnawed away some bone downward into the temporal fossa and back-

ward till my opening reached the line of the Rolandic fissure, or possibly a little back of it. Extending the incision in the dura, I was now able to see normal brain-tissues posteriorly and inferiorly, showing that the visible limits of the tumor had been reached. Four large vessels which ran toward the tumor were now tied in the peripheral normal brain-tissue. During these manipulations the rent in the cortex at the point already specified had extended anteriorly, and showed that the tumor was much larger in the subcortical tissue than on the surface. I, therefore, attempted to enucleate it, and was quite surprised to find the ease with which by three fingers I finally scooped it out of its bed, much as one would scoop an egg out of its shell with a spoon. No serious hemorrhage followed the removal of the tumor. In order to check what hemorrhage did occur I packed the cavity for a few minutes with iodoform-

FIG. 1.

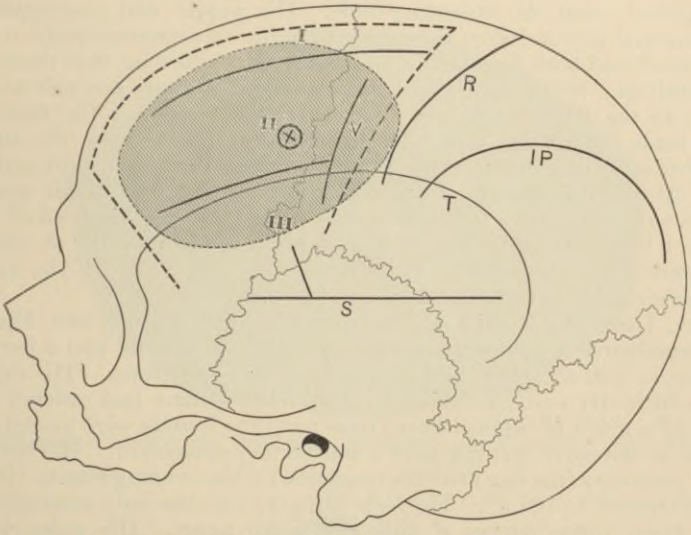


Diagram to show approximately the relations of the tumor, which is represented by the shaded area. The interrupted line represents the osteoplastic flap. I, II, and III are the three frontal convolutions. ⊕ represents the place where the tumor had broken through the cortex. R. Fissure of Rolando. V. Vertical or precentral sulcus. IP. Intraparietal sulcus. S. Fissure of Sylvius. T. Temporal ridge.

gauze. Meanwhile, while waiting for the hemorrhage to be arrested, Drs. Thomas, Osler, and Reuling examined the tumor carefully, and in their opinion it was a well-delimited sarcoma of rather hard texture, and they believed that the entire tumor had been removed. I next removed the gauze-packing, and, to make sure that all the tumor was removed, I inspected very carefully the walls of the cavity in which it had lain.

These, apparently, were entirely normal; no appearance of sarcomatous tissue existed at any point. At the bottom of the cavity lay a clot as large as the end of my thumb. This, I thought, should be removed, lest it should undergo decomposition after closing the wound, and, accordingly, with a curette and finger, I lifted it out. During the removal of the tumor, I should have stated that when my fingers reached its base

there was a considerable gush of fluid mingled with the blood, which I suggested came from the lateral ventricle. When I removed the clot, therefore, I was not altogether surprised at the fact that I looked directly into the lateral ventricle, which was widely open anteriorly at about the point where the anterior cornu joins the main cavity of the ventricle. I saw clearly an opening which I took to be the mouth of the middle or that of the posterior horn, though it may have been the general cavity of the ventricle. I packed a small strip of iodoform-gauze into the cavity occupied by the tumor, the end of the gauze filling the anterior portion of the lateral ventricle to prevent blood passing into that cavity. (See Remarks.) As there was now but little hemorrhage, I closed the wound, suturing the dura excepting where the gauze-drain came out, and then secured the flap in place by silkworm-sutures.

When the operation was over, although it had lasted for two and a half hours, the condition of the patient was quite as good as when he was placed upon the operating-table. His pupils had contracted to their normal size and were responsive to light. He unconsciously moved both arms and both legs before he left the table, showing that there was no paralysis. So far as his face was concerned we were not able to tell, as up to the time I left him no conscious movement of the face had been made. This was especially gratifying to me, because the tumor had evidently displaced the pre-Rolandic convolution backward and the third frontal downward. I was not able to judge well of his speech, for he only muttered a half-intelligible reply to a question I asked him before I left. His pulse was good and respiration tranquil. A culture was made from the surface of the brain and sent to Dr. Kyle, with a negative result.

12*th*. I saw him again this afternoon with Drs. Thomas and Martin. He passed quite a comfortable day yesterday, and had not had a particle of pain, so that no opium had been given him in any form. His tongue was a little dry and coated, and for this Dr. Tiffany had ordered one-tenth of a grain of calomel every hour until the bowels were moved; an enema in the early evening gave a satisfactory movement. His temperature yesterday (the day after the operation) in the evening rose to 102.4°; this afternoon to 101.4°. He feels hungry, but has only been allowed from three to five ounces of milk every two hours. His pulse, which had been 150 after the operation, fell to 120 yesterday, and to 104 to-day. His skin is in good condition. The wound had been dressed on the evening of the day of operation, when the dressing was quite saturated, and again yesterday, when the discharge was much less. I dressed it myself when I saw him this evening, and found the dressings but slightly saturated. Both the gauze-drain, the inner end of which lay in the front part of the lateral ventricle, and a silkworm-gut drain in the forehead were removed. A very small amount of blood-stained serum escaped from both apertures. Small bits of gauze were introduced a slight distance into the two openings merely to keep the skin from uniting. The wound in every respect looked normal. Instead of the depression of the flap which existed immediately after the operation, there was distinct rounding of the head, and pressure on the flap disclosed a moderate amount of resistance underneath. He had had some bromide for sleep last night, and fifteen grains of trional were ordered for to-night. Saving this moderate rise of temperature, his condition leaves nothing to be desired.

14*th*. His temperature in the morning has been usually a little above 99°, and to-night is 100.5°. He is hungry, has eaten an egg this morning, has had the bowels opened by an enema. His intelligence is quite marked, though he is not very talkative. He appreciates his surroundings and the gravity of the operation, and is anxious to see his parents. The pupils are again dilated, but mobile to light. His right lower face is slightly paretic, the arm and leg not at all so. There is no aphasia. The wound looks perfectly well. Slight bulging of the flap still continues. The drains are out and the wound entirely united by first intention, excepting at the two points where the drains were.

24*th*. He is out of bed to-day, the fourteenth day after operation, and able to walk about; his appetite is excellent, and he is on full diet. His temperature slowly but steadily decreased, reaching the normal at the end of a week.

FIG. 2.

The external appearance of the tumor. Natural size. (Drawn by Dr. J. M. TAYLOR.)

FIG. 3.

Antero-posterior section of the tumor. Natural size. (Drawn by Dr. J. M. TAYLOR.)

The tumor was oval-shaped, 7.5 cm. long, 5.5 cm. broad, and 4 cm. deep ($3\frac{1}{2}$ inches by $2\frac{1}{8}$ inches by $1\frac{9}{16}$ inches), and weighed $2\frac{1}{2}$ ounces.

*

The surface of the tumor was somewhat lobulated and its color darkish-gray. On section it showed a point of yellowish discoloration toward the posterior portion about its middle, from which distinct rays of tissue proceeded as from a focus in all directions.

FIG. 4.

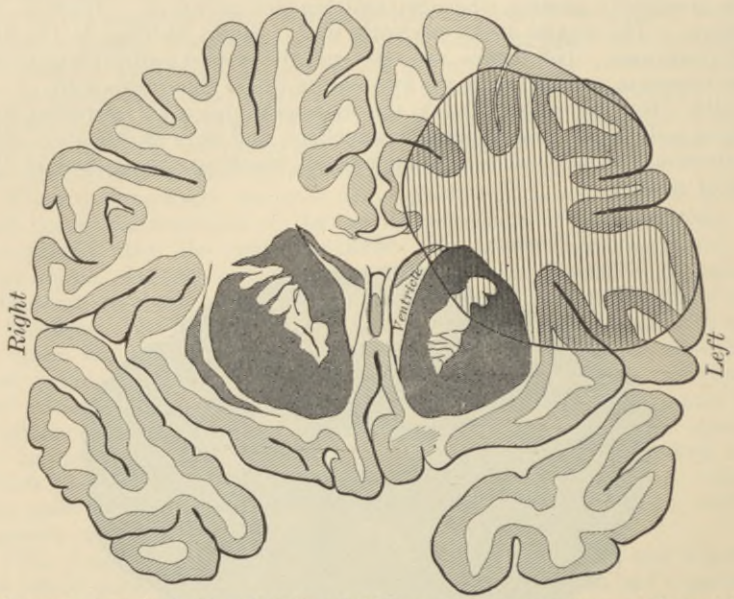


Diagram to show the depth and relation of the tumor to the convolutions and the ventricle. The shaded portion represents the tumor. (The section is from *Dalton's Topographical Anatomy of the Brain.*)

Fig. 4 shows the relative position and depth of the tumor in a cross-section of the brain, and that it involved all three of the frontal convolutions and the ventricle. The corpus striatum may have escaped entirely; but, if it was involved, it was presumably displaced rather than destroyed.

AFTER-HISTORY AND REMARKS BY DR. THOMAS.

After the removal of the tumor, and the patient had recovered from ether, his mental condition was much improved. It was noticed immediately after the operation that his pupils, which were widely dilated before, were of normal size. At the first dressing it was noted that the pupils were again widely dilated, and they have remained so ever since. Since then there has been very little to note, as he had an uninterrupted convalescence. His vision has become progressively worse. Dr. Reuling's notes are:

"*May 28th* (eighteen days after removal of tumor). Right: vision almost *nil*, slight perception in extreme outer corner. Ophth.: papilla

optica flat, grayish, discolored, showing proliferation of connective tissue and atrophic nerve-fibres in radiating arrangement. Arteries very thin. Left: neuritis optica degenerativa, some swelling and redness. Pupils of both eyes dilated almost *ad maximum*. No central fixation, no accommodation, and almost no reaction to light. Eserin brings on contraction and greatly increases reaction to light. Left: fingers at eighteen feet. Right: *nil*. As the patient's eyes were going from bad to worse, at Dr. Reuling's suggestion, Dr. de Schweinitz, of Philadelphia, was asked to see him. This he did on June 3d, and the result of his examination is abstracted from his letter as follows:

"I regret to say that he is entirely blind in the right eye; in the left eye his vision is eccentric, and amounts to reading very large letters at about 1 metre—actually, 1/60. The field of vision is markedly contracted, only a small patch being preserved on the temporal side. Both optic disks show subsiding neuritis, the swelling being 3 D. The vessels are shrinking, particularly the arteries, and there are here and there throughout the retinas splotches of fatty degeneration. The pupils in ordinary light are dilated *ad maximum*. They do not respond to the strongest artificial light-stimulus, but when exposed to bright sunlight, or the white light reflected from a cloud, they slowly contract to nearly their normal size, and in this same light still maintain, unstably, this contraction. This curious phenomenon, for which there is no adequate explanation, has been observed in cases of optic-nerve degeneration a number of times. There is no color-perception for even very large colored objects, red being called gray, green black; there is no attempt to name the other colors. The prognosis is exceedingly bad. The exudation into the nerve has evidently been very extensive, and atrophy of he fibres is now rapidly taking place.

"Very unusual features in this case, so far as my experience goes, are the rapidity with which the optic neuritis developed and the resulting early blindness. Clinically, it is well known that cerebellar growths are associated with papillitis, which quickly develops into that type which was at one time known as "choked disk," and in which blindness quickly takes place even before the stage of the subsidence of the inflammatory process. These same phenomena in growths situated in the frontal region, as in the present case, must be rare."

The diagnosis in this case, as has already been said, was based, first, on the general symptoms of brain-tumor combined with mental dulness, the protrusion of the left eyeball, the slight right-sided facial paralysis, and the peculiar uneasiness in the right hand and foot. The remarkable disturbances of locomotion which are often associated with tumors of the frontal lobe were present in only a very slight degree. The patient did at times complain of difficulty in walking, but this was not seen during any of the examinations, except, perhaps, when he was gotten out of bed during Dr. Starr's examination; he was then very weak, and walked in a tottering, unsteady fashion. This symptom—frontal ataxia—to which Bruns[1] has called particular attention, is of very

[1] Bruns: Deutsche med. Wochenschr., 1892; and Real-Encyclopädie (Eulenberg), 1895, Bd. viii. p. 663.

great interest, and at times complicates the diagnosis between tumors of the frontal lobe and those of the cerebellum. The mental disturbances consisted in a general dulling of his faculties and the occurrence of mild delirium on one or two occasions. He was never guilty of making puns, nor did he indulge in witticism (Bruns: Oppenheim, *Arch. f. Psych.*, xxi. and xxii.), and, so far as was evident, he had a proper appreciation of his personality.

The unilateral exophthalmos which assisted in the diagnosis is not easy to explain, as it is generally believed that the intracranial pressure is the same throughout the skull-cavity; it may possibly have been due to some local disturbance of the circulation. The condition has persisted since the operation, but is less marked.

October 1, 1896. Patient was seen to-day. He states that he has passed the summer without any symptoms referable to his head. He has been perfectly free from headache, and seems in excellent health and spirits. The scar is hardly noticeable on his forehead. There is no longer any exophthalmos of the left eye, and the muscles of the face act equally on the two sides. He thinks that the vision of the left eye has improved somewhat, but he is still unable to see sufficiently well to walk alone.

It is interesting that after such an extensive destruction of the left frontal lobe that there should be so few symptoms; indeed, except for the slight remains of the paralysis on the right side of the face and the symptoms referable to his blindness, the boy seemed perfectly normal. The functions of the frontal lobes have always been a fruitful field for speculation, but they have become especially interesting at this time through the recent experimental work of Bianchi, of Naples, and particularly so through the brilliant investigation and deductions of Flechsig.

Bianchi (Winter, *Brain*, 1895, p. 497), experimenting on dogs and monkeys, believes that he has arrived at definite conclusions. He determined the limits of the excitable areas by electrical stimulation, and extirpated all of the lobes in front. When one frontal lobe was removed, he very generally noticed some motor symptoms during the first week or two, but after this time the animals seemed to be perfectly normal. The motor symptoms consisted in rotary movements (the truncal concavity being toward the mutilated side) and a paresis of the opposite arm for delicate movements. In all the animals he was able to demonstrate visual disturbances, consisting in an inability to recognize objects in the temporal half of the visual field of the opposite eye. Thus, if the eye on the mutilated side was closed, the animal would walk and run about without ever coming in contact with objects placed in his way; but if his attention was fixed, and some food of which he was very fond was brought into the field of vision from the temporal side, it was not noticed until it was in a line with the visual axis, when it was quickly

seized and eaten. When the eye on the operated side was tested, the animal grasped the object as soon as it came within his visual field. The visual disturbances lasted for two and sometimes three weeks.

Bianchi found, when he extirpated but one frontal lobe, that there was no discoverable change in the animal's behavior, or psychical manifestations, but that when both lobes were removed the animals were very markedly changed. They became inert, dirty, forgot their playmates and friends, and were indifferent as to what they ate, etc.

Bianchi believes that the whole nervous system takes part in the formation of the psychical personality, and that there is no such thing as a centre for intelligence. Still, he insists that these phenomena which he has observed after the destruction of the frontal lobe must be accounted for. His hypothesis is " that the frontal lobes are the seat of coördination and fusion of the incoming and outgoing 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 motive states which accompany all the perceptions, the fusion of which constitutes what has been called the psychical tone of the individual."

He attempts no explanation of the curious visual disturbances.

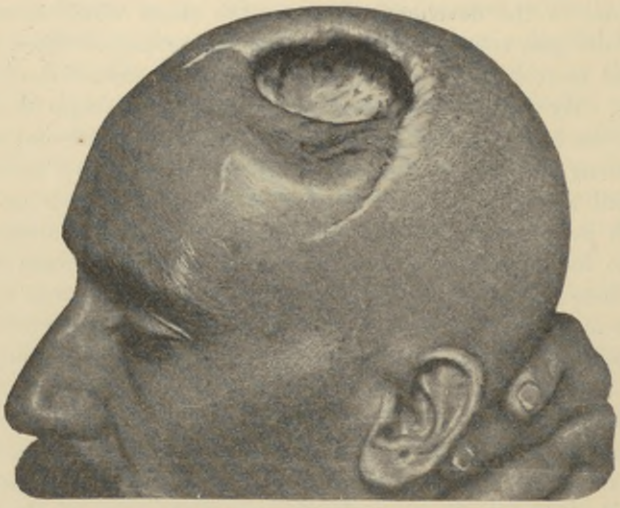
Flechsig, in his recent address, " Gehirn und Seele," and particularly in the notes which he has just now published with the second edition, gives the result of many years of work upon the appearance of medullated fibres in the developing brain. The tracts which connect the cortex with gray masses below, the so-called projection-fibres, develop early, and first of all those which serve for the conduction of sensory impulses. By the study of many brains in different stages of development he has been enabled to mark out accurately the different sensitive areas, among which, it may be remarked, that he includes what we commonly call the motor region. Between these sensitive areas are regions in which no projection-fibres either enter or leave the cortex, but in which he has been able to trace fibre-tracts from the different sensitive areas ; these regions he has designated association-centres, and he thinks that it is upon their development that the intellectual power of the individual depends. He prophesies that, by careful study of the intellectual activity of normal and diseased individuals and a thorough anatomical investigation of their association-centres, we will be able to arrive at a scientific basis for the localization of these mental characteristics. He thinks that he has already been able, in cases of general paresis, to explain the peculiar symptoms by the areas which are involved in the morbid process. Flechsig's association-centres are what have been called the silent areas of the brain ; but we are forced to believe that they are silent, not because they do not speak, but because we are too dull of understanding to hear what they say. The frontal lobe corresponds

to Flechsig's anterior association-centre. In this region, although no projection-fibres reach the cortex, a band of such fibres does run in the white matter of the lobe, and, turning back, enters the cortex of the somatic sense-area (körperfühlsphäre), which includes what we commonly know as the motor area of the cortex. It may be that it is the involvement of this tract which is the cause of the motor symptoms, the paresis, and the ataxia. Flechsig has demonstrated that the cortex of the lobe itself is in connection with the olfactory centre and with the somatic sense-area, and probably with the other sense-centres, and he believes that we have stored here the memories upon which the idea of individuality of the person depends. It will be seen that the views of Bianchi and Flechsig in regard to the function of the frontal lobe agree fairly well.

Remarks by Dr. Keen.

Size and Weight of the Tumor. The present tumor is the second largest I have ever removed. The largest and my very first modern brain-operation was done on December 15, 1887; therefore, nearly nine years ago (The American Journal of the Medical Sciences, October, 1888). That patient I saw recently. His appearance two years ago is seen in Fig. 5. His eyesight is quite imperfect. His epileptic attacks occur at intervals of about a year. He is still, however, very nervous and unable to do any work.

Fig. 5.



Result seven years after the removal of a large fibroma of the brain.

In that case the tumor, a fibroma, measured two and seven-eighths by two and one-half inches and one and three-quarters inches in thickness, and weighed 3 ounces and 49 grains. The present tumor, therefore, is

nearly as large, but is much less in weight, because of its different character. Pasting on the skull a piece of paper which shows the size of the present tumor, it is seen to occupy the second frontal, encroach on the first, and practically to occupy nearly all of the third frontal convolution and very largely the area of the pre-Rolandic convolution. In fact, I judge (though the surgical exigencies of the moment did not allow me to determine it absolutely) that the tumor extended all the way back to the fissure of Rolando. It is another illustration of even how direct as well as distant pressure is compatible with but very slight symptoms. That there was no more marked aphasia is surprising.

It is also extremely gratifying to observe that the mechanical injury done to the rest of the brain in removing the tumor and the later necessary pressure from swelling and accumulation of wound-fluids, a swelling so marked as to lift the flap very distinctly above the level of the scalp and to make it quite tense to the touch, were not followed by either any increase in the aphasia or in the motor paralysis of the face, and did not produce any paralysis in the right arm or leg.

At least seven tumors larger than the present one and one equally large have been removed from the brain.

First, the largest tumor of all by Bramann, nine ounces, followed by recovery. (*Annals of Surgery*, 1892, vol. vi. 378.)

Second, Bramann, five and a half ounces; recovered. (*Annals of Surgery*, 1892, vol. xvi. 378.)

Third, Durante, the size of an apple; recovery. (*Lancet*, October 1, 1887.)

Fourth, Weir, five and a half ounces; died. (*Medical News*, April 16, 1887.)

Fifth, Horsley, four ounces; result not stated. (The American Journal of the Medical Sciences, April, 1887, 362.)

Sixth, Czerny, nearly seven ounces; died. (*Beitr. klin. Chir.*, 1894, xii. 107.)

Seventh, Keen, three ounces and forty-nine grains; recovery (*loc. cit.*).

Eighth, Starr and McBurney also reported the removal of a tumor which was a little longer, but not quite so wide as the present one, measuring three and a half by two inches; died in eight hours. (*New York Medical Record*, January 21, 1893, 87.)

Ninth, the present case.

It will be seen that of these nine large tumors weighing from two and a half to nine ounces, four recovered and four died, while in one the result is not stated. It would seem almost as if large removable tumors were scarcely more dangerous than small ones.

Mode of Access. The osteoplastic flap which I raised was the most extensive resection of the skull I have ever done. I have not quite reached the point in audacity of Doyen, of Reims (*Rev. de Chirurgie*,

1895, p. 900), who advocates and has practised the removal of one entire hemisphere of the skull. He even declares that cerebral localization in future is only of physiological interest and is not necessary to the surgeon. I was, however, very much pleased with the extensive view of the brain which I got, a view which in this case was needful to the proper treatment. It was desirable that the orbital surface of the frontal lobe should be examined. This is the first case in which I ever had occasion to examine it, and I was very much struck with the ease of access and the extensive view that I had. Should it have been necessary to open the dura before lifting the frontal lobe, I think there would have been no difficulty in seeing the pituitary body and the vessels. At the best, manipulations here would have been, however, of course, much more dangerous than on the free surface, by reason of the relative inaccessibility. If in future I should have a case in which an extensive frontal operation is necessary, I should make, if needful, an osteoplastic resection of the whole forehead, either in one piece or bilaterally in two. There would be no difficulty, of course, in separating the superior longitudinal sinus from the skull after the first flap had been resected and drawn back.

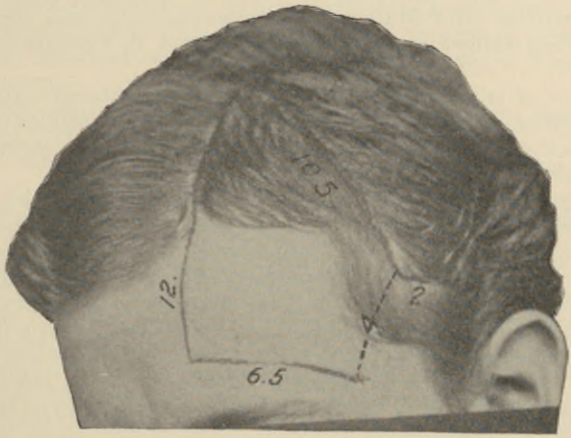
Removal of the Tumor. Fortunately, the tumor was not an infiltrating sarcoma, but well delimited. As in my case of the large fibroma above alluded to, I was able to scoop it out with perfect ease, because of its lying loose in its bed. The hemorrhage after the enucleation was very much lessened by the prior ligation of the vessels connecting the tumor with the cortex at the point where it had broken through the cortical layer.

Prognosis. The apparently non-infiltrating character of the tumor, which was confirmed by Dr. Flexner's examination, would also lead us to take a much more hopeful view of the future of the patient, as to non-recurrence of the growth. As it may take, however, some years to determine these facts, it seemed desirable to report the case at once and then supplement it at a later period. It is encouraging to remember that in Durante's well-known case a fibro-cellular sarcomatous tumor the size of an apple was removed from the left anterior lobe, and in spite of its character the patient was in good health four years later.

Opening and Packing of the Lateral Ventricle. This is the first case in which I ever have actually looked into the lateral ventricle in the living, and, so far as I know, is the first in which the ventricle has ever been packed. The entire cavity was disclosed, so that I could see certainly into the cavity and possibly into the opening of the middle or posterior horn. In view of the free opening and, of course, of the gradual oozing of blood which would take place after the flap was replaced, I was fearful lest the blood might flow from the lateral into the third ventricle and then through the Sylvian aqueduct reach the fourth ven-

tricle, where any pressure would be excessively dangerous and possibly fatal. This accident, I discovered later, actually occurred to Horsley, and the patient died from pressure on the respiratory centre from the blood which reached the fourth ventricle from the lateral (*British Medical Journal*, 1893, ii. 1367). For a moment I hesitated, I confess, to place any packing in the ventricle; but I thought that this would be less dangerous than allowing the blood to accumulate in that cavity, and so I packed rather lightly a strip of gauze a little over an inch wide and several inches long into the anterior part of the ventricle and the adjacent part of the bed in which the tumor had lain, thus shutting off the ventricle, and brought the other end of the gauze through the incision in the scalp. It drained very well, and after forty-eight hours was removed. The amount of cerebral spinal fluid to which it gave exit was not very large. The dressing had to be changed the same evening, and again on the next day. It was but slightly saturated on the third day, and by the fourth, two days after the drainage was removed, was scarcely soiled at all.

FIG. 6.



From a photograph four months after the operation. The figures are in centimetres.

The facts proved by this case as to the bolder surgery of the lateral ventricle which may be indulged in with impunity, are very encouraging for the future.

That the patient made so admirable a recovery is largely due to the extremely kind and careful attention of Dr. Tiffany and his assistant, Dr. Martin, as well as, I may add with propriety, to the discreet judgment of my colleague, Dr. Thomas.

Fig. 6 shows the present appearance of the scar (Sept. 1, 1896), four months after the operation.

MICROSCOPICAL EXAMINATION OF THE TUMOR BY DR. FLEXNER.

"The specimen is in two parts which can be more or less closely approximated. Besides the sides, which had been united and present uneven surfaces, the external surface generally has a lobulated appearance. This does not, however, resemble to any great degree the convolutions of the cerebral cortex. Adhering to a portion of the mass are shreds which are taken to be portions of the cerebral membranes.

"Müller's fluid has been employed as the hardening-agent, and the specimen is well hardened and preserved. For the purpose of the histological examination portions were removed from several situations, including a portion of the tumor to which the membranes adhered. A separate piece of membrane was also studied.

"On making the incisions for the purpose of removing pieces for microscopical examination it was noticed that not infrequently small, whitish or grayish-white, opaque foci occurred at variable distances, but usually not more than 5 to 6 mm. below the surface. As it was desired to preserve the specimen the incisions were not carried entirely through the tumor. The impression obtained, however, was that these patches became more numerous in the deeper parts. They were irregular in shape and averaged about 2 mm. in width and several in length.

"The tissue was imbedded in celloidin, sectioned, and stained in Upson's carmine and Mallory's phospho-molybdic and hæmatoxylin stains. The stained sections were examined in Canada-balsam and glycerin.

"The tumor is composed of cells, intercellular substance for the most part fibrillated, strands of fine fibrils and bands of coarser ones. The latter consist of homogeneous connective-tissue bundles carrying many bloodvessels.

"The greater part of the tumor is made up of cells, which, however, are not scattered uniformly over the field, but are collected into more or less definite groups, some round, others oval, and still others elongated in form. The cell-groups are separated chiefly by the strands of fine fibrils described. As regards the cells themselves, they vary somewhat in form, the majority being round or oval, about the size or a little larger than the normal glia-cells; but a few are distinctly elongated, and rarely a cell two or three times the average one is met with. The larger cells are found at times to form small cell-groups or to lie two or three in one place.

"Now and again an area of the section of the extent of a dozen or more cell-groups will refuse to stain, appear pale and granular, or perhaps a stained cell here and there will stand out in sharp contrast to the remainder. These places correspond with the opaque and degenerated spots already mentioned. They are composed of cells, fragments of cells, granules, and fibrils. The cells which do not stain are indistinct in outline and irregular in size. The few staining-nuclei belong to leucocytes. Not infrequently red blood-corpuscles, outside of vessels, are present intermingled with the other elements. The intercellular material is also more or less indefinite, chiefly irregularly granular, but at times showing a few fibrils.

"The non-degenerated portions of the tumor are much more uniform in appearance and structure. They consist of groups of cells, as described, separated by bands of fibrils. The cells, it is true, are not

sharply cut off from the fibres, for now and again the same cell-forms are found lying among the fibrils in the peripheries of the groups. The individual cells in the groups are separated from each other by single or small clusters of fine fibrils which often appear to be continuous with the thicker strands separating the large groups. In these portions very little only of the intercellular substance is of a granular nature.

"Not infrequently these fibres present an appearance suggesting a union with or origin from the cells. The elongated cells are seen to send off streaming fibrils from each extremity, and the round or oval ones appear as if surrounded by hair-like processes, or to give off a bunch from one or two sides. Moreover, a part at least of these fibrils appear to pass into the strands separating the cell-groups from one another.

"Cells having the size and form of ganglion-cells were not encountered.

"The tumor is moderately vascular, and bloodvessels are met with within the substance of the tumor, running amid the fine fibrils or surrounded by round and oval cells. These vessels are distinguished by their very thin walls and from an outer investment of fibrils such as are present between the cells. The bloodvessels in the coarser bands have thick and well-formed walls. Punctiform hemorrhages occur in the tumor, but chiefly in the degenerated areas.

"At one point of the section the meninges are still attached to the surface of the tumor, and the cells from the latter can be traced directly into the membranes in this situation. The separated piece of dura mater shows adherent cerebral cortex. It is free from infiltrations with tumor-elements.

"A small amount of coarsely fibrillated fibrin also occurs in the degenerated portions.

"From this description it is considered that the tumor is a glio-sarcoma.

"It may be worth while to speak on one or two points regarding the foregoing description in the light of the more recent studies of neuroglia, especially in view of the fact that a considerable part of the tumor is composed of the so-called glia or Dieters cell. The opinion ventured by Boll (1874), that the fibres of neuroglia pass by and actually do not emanate from the cells, received later (1883, 1892) the support of Ranvier, whose well-known studies led him to regard the fibres and cells of the neuroglia as independent structures. This view, which was opposed to many of the older conceptions, was not borne out by the application of the method of Golgi to the study of the question. On the other hand, the elaborate study of Weigert (*Beiträge zur Kenntniss der normalen menschlichen Neuroglia*, Frankfort-on-the-Main, 1895), just published, has led to confirmation of the view advanced by Ranvier. Through the use of a new method of staining devised by him Weigert has succeeded in demonstrating the fibres in neuroglia independently of the cells over and next to which they may be observed to pass. He believed that he could exclude definite connection between these processes or fibrils and the cell-protoplasm. Mallory independently and at almost the same time (*Centralblatt für Pathologie*, 1895, Bd. vi. p. 753) arrived at a similar conclusion, having used a method in some respects similar to Weigert's. Mallory further found that the glia in sclerotic conditions of the cord and brain of human beings was of essentially the same constitution. Recently I have received from Dr. Mallory a specimen of glioma

in which the independence of the fibres and the cells of the tumor is well shown.

"Unfortunately the method employed for hardening the tumor in this case did not suffice for the use of the staining-methods suggested, especially for the demonstration of the glia. The phospho-molybdate stain, while staining glia-elements, stains other structures as well. In view of these facts it is clear that in the description of the tumor only such appearances as could be obtained by the methods at command are given; and with respect to the ultimate question of actual union between the cell-protoplasm and fibrils no statement is ventured."