of the specimen passes over the orbit and is also divided into several pockets.

The skull pictured in Figures 17, 18, 19 and 20 has the largest pneumatic spaces of any skull I have dissected, not only of the frontal sinus, but of the supra-orbital, ethmoidal and maxillary sinuses. The frontal sinuses may be described as commencing in the right temporal fossæ at a point near the articulation of the frontal bone with the great wing of the sphenoid (see point marked 8, Fig. 18). It extends forward and across the skull to the opposite side, then a little backward, terminating near the left great wing of the sphenoid (see point marked 4, Fig. 19). The frontal portion of this great space is divided into four compartments, three of which have a separate outlet, while the fourth is connected to one of the others by a small foramen which is placed low down in the sinus.

As already stated, the right frontal sinus commences at a point marked 8, in Figure 18, in the temporal fossæ and extends upward, forward and inward to near the nasion, measuring 55 mm. The right supraorbital sinus commences in the zygomatic fossa (see point marked 9, Fig. 18) or in the right wing of the sphenoid bone; it passes upward, forward and inward over the orbits (see point marked 7, Fig. 20). Its outlet is in the anterior and lower portion of the right frontal sinus. It measures in length 55 mm. There are also several other sinuses or cells over the anterior portion of the orbits with independent outlets (see points marked Nos. 2, 4, 5, 6, Fig. 20).

The left frontal sinus commences in the temporal fossa at a point marked 4, in Figure 19. It then passes upward, forward and to the right to the wall forming an intermediate frontal sinus. It measures 48 mm. The sinus is divided into two compartments by a septum lying at an angle of 35 degrees from the horizontal. At the lower and median end of this septum there is a small foramen which allows the two compartments to communicate with one common outlet into the nasal chamber. The left supraorbital sinus commences in the great wing of the sphenoid bone and passes slightly upward, inward and forward over the orbits. The outlet empties into the anterior portion of the nasal chamber. Immediately back of the nasion and glabella there is an intermediate sinus with an independent outlet. It is cuboidal in shape, its lateral and anteroposterior measurements are 10 mm.

The sphenoidal sinuses are large, extending well forward and laterally over and under the optic nerve, leaving but a thin portion of bone separating the nerve canal from them. The sinus extends backward and downward to the basilar process of the occipital bone (see points marked 3, 8, 9 and 10, Fig. 20). The two sinuses measure laterally 44 mm., anteroposteriorly 33 mm., depth 44 mm. The maxillary sinuses are extraordinarily large. In one there is a large, incomplete, membranous septum. The right sinus measures in its greatest depth 44 mm. and diagonally from before upward and backward 55 mm. The left sinus is 55 mm. in its greatest height and diagonally backward, upward and forward 65 mm.

It will be claimed by some that the specimens here illustrated are freaks or great exceptions. I can not so classify them. They are all from my own dissections within the past 15 years. I regret that I have no means of knowing how many skulls have been sectionized during that time, but I believe that if a thousand of the skulls which come to our dissecting rooms were examined

by sectioning, a collection showing equal variations with those here described would be made; and if a thousand skulls of persons affected with diseased pneumatic sinuses were examined the variations would be found much greater and more common. If surgeons who treat this region had some way of determining the character of these sinuses in the patient their treatment could be given on a more scientific basis.

External "landmarks" to indicate the true character of these sinuses are commonly lacking, and examination through the nasal fossa will give but a slight idea. Transillumination has been used with some success, but it is not sufficiently accurate for complicated cases.

RADIOGRAPHY.

Radiograms of this region have been made for several years with much improvement. Dr. Coakley, of New York, showed some very fine ones in Philadelphia last year. Several radiographers in Philadelphia are doing good work along this line.

It has been demonstrated by all who have investigated the pneumatic spaces intimately that they exist in an infinite variety of sizes, shapes and positions, so that even clinical experience counts for little, as no two cases present like conditions. It is evident that a good radiogram, if stereoscopic so much the better, is one of the most reliable witnesses for the surgeon's dependence in diagnosing the character and the disease of the frontal sinus region.

1623 Walnut Street.

FOR THE DISCUSSION, SEE PAGE 358.

TUMOR OF THE RIGHT VERSUS TUMOR OF THE LEFT FRONTAL LOBE OF THE BRAIN.

A COMPARISON OF THE SYMPTOMS OF THE PREFRONTAL AREAS.*

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At the meeting of the American Neurological Association, Washington, D. C., May 4 to 6, 1897, I presented a paper¹ and specimen showing a glioma situated at the base of the second frontal convolution on the right side of the brain; to-day I present a glioma occupying the same relative position on the left side of the brain. The specimen exhibited to-day, however, is a recurrence of the growth, the original tumor having been removed by operation Nov. 10, 1905, by Dr. Roswell Park of Buffalo, N. Y.

In comparing these two tumors or lesions of the frontal lobes of the right and left hemispheres respectively, I wish to call attention to the fact that while the right frontal tumor called forth no localizing symptoms, the left frontal tumor was characterized by pronounced mental disturbance and loss of the capability of writing and printing.

CASE REPORTS.

AUTOPSY.

CASE 1.—Glioma of the Right Frontal Lobe of the Brain. Autopsy. (Abstract.)

Patient.—A carpenter, aged 31, suffered with pain in the

* Read in the Section on Nervous and Mental Diseases of the American Medical Association, at the Fifty-seventh Annual Session, June, 1906.

1. "Glioma of the Right Frontal Lobe of the Brain." Trans. Am. Neurol. Assn., 1897; also, Jour. of Nervous and Mental Disease, February, 1898.

head for two years, accompanied with dizziness and nausea. During the intervals he would be occupied in a pharmacy, copying labels (Fig. 1). The pain becoming more severe and oftener, he was brought to me for examination, September, 1896. Mental faculties were intact, demeanor was normal; optic neuritis was more pronounced in right eye; there was no deviation of tongue; no paresis of any extremity. Diagnosis was made of brain tumor, probably in the right frontal lobe. Death occurred, and autopsy revealed a glioma of the right frontal lobe.

In reporting the case I said: Inasmuch as the left side of the brain, especially the frontal and temporal lobes, contains important centers not present on the right side, may not the centers presiding over reason, memory, intelligence, or the higher psychical states be more localized in the left frontal lobe close to the centers of speech and writing, which are the two great channels through which the intelligence of the being is made manifest to the external world? The close proximity of the centers of speech and the centers presiding over those organs (articulatory) by means of which speech is possible; also the proximity of the centers of writing and those presiding over the movements of the fingers by which writing is possible, might suggest a like proximity of the centers of intelligence, and those centers through which the intelligence of the individual is expressed, namely, of speech and writing; all these are located in the left frontal lobe of the brain.

CASE 2.—Glioma of the Left Frontal Lobe of the Brain; Operation; Removal; Recurrence; Autopsy.

Patient.—J. P., aged 35, farmer, married, was admitted to the Buffalo General Hospital Oct. 10, 1905, suffering with "terrible headaches and some loss of reason."

History.—No reliable or complete family or personal history

Fig. 1.—Case 1. Glioma of second frontal convolution; right hemisphere. Specimens of handwriting.

could be obtained from the patient, on account of his mental dullness and lack of memory, and it was a question whether the State Hospital was not the proper place for his confinement. The following family history was obtained from an old school friend, and the history of the disease from his physician, Dr. McKee, Sugar Grove, Pa.:

Family History: Father died suddenly at 60 from kidney trouble, probably Bright's disease. Mother is living, in fairly good health, but presents a neurotic history. One brother is living, aged about 50, always deaf; is a bachelor and of retiring disposition. Three sisters living; one is married and is subject to epilepsy "heart spells." She has distinct aura and epileptic seizures and has one child with similar attacks. She had one son 22 years old, who died this last summer in an epileptic seizure. He was free from these attacks until 15 years old, when he had some accident. One sister is unmarried, odd, peculiar, not bright; has probably hysteria and epilepsy. The third sister is married, but not much is known about her. Nothing is known of maternal or paternal ancestors.

Personal History: Patient had rubeola and parotitis early, probably scarlatina, without any complications; has had no illness of any importance since childhood. Positively no history of syphilis or gonorrhea is obtainable. Patient has always been of regular habits, not a drinking man, but has smoked considerably for years. There is no history of any injury to head. Patient had a convulsive seizure seven or eight years ago, cause unknown. He was always odd or peculiar, but good-natured; has always been a farmer, was married at 23, had one child 3 years old, and separated from his wife after 5 years.

Wife has the child; it is not known if his health has been worse since. His nephew died this summer in an epileptic seizure, and patient's condition has been growing worse.

Present Illness.—This began about nine months ago (January or February, 1905), with intense headaches, marked biliousness and periods of unconsciousness, one spell lasting about 24 hours. He suffered no other pain save the persistent headaches, which continue up to the present time. His appetite was good, even voracious at times. There was no history of nausea or vomiting or of any dizzy spells. There had been no weakness of the extremities. He had been able to walk for miles and has done hard work on the farm for years.

Examination.—This shows a well-nourished, well-built man, weighing about 160 pounds, 5 feet 10 inches in height.

Face: Features were blank, the lines of intelligence were somewhat effaced. Pupils were equal, but reacted sluggishly to light. Movements of orbits were normal. Tongue was heavily coated; no deviation; breath was foul, teeth were in good condition. Uvula hung in median line. No facial asymmetry

Fig. 2.—Case 2. Glioma of second frontal convolution; left hemisphere. Specimen of patient's writing several years before the onset of symptoms.

existed, both sides functionated equally; there was no difficulty in swallowing. Heart and lungs showed nothing abnormal; abdominal organs offered nothing noteworthy.

Extremities: Muscles were fairly well developed; there was no edema of ankles or legs.

Reflexes: Patellar tendon reflex of right leg was normal, that of left slightly exaggerated. No ankle clonus nor Babinski's sign was obtainable; strength of both legs was about equal. There was no disturbance of sensation about legs or body. The gait was somewhat staggering, unsteady, mildly atactic. Speech was slow, measured scanning, as if the words did not come freely. Inquiry into the mental condition failed to reveal any delusions or hallucinations; there existed, however, a mental obtuseness, dullness, with loss of memory, mental confusion, loss of attention, with perseveration and verbigeration. For example, asked when he was born, he replied "1864"; asked when he was married, he replied "1864," when he

Fig. 3.—Case 2. Before operation. Patient's attempts at (A) writing and (B) printing.

entered the hospital, he replied "1864." It is impossible to convince him of his error in regard to this date. The mental confusion along with the severe headaches, which were frontal, led to a suspicion of brain disease, and an eye examination was made by Dr. Lucien Howe of the hospital staff, who reported:

October, 13, 1905: "Right eye, optic neuritis, first stage; swelling does not extend far into the retina. Hemorrhages are not abundant. Right vision = $\frac{1}{2}$ with atropin + 1.25 diop. sph. vision = $\frac{1}{2}$. Left optic neuritis second stage; swelling extends into retina. Hemorrhages into retina abundant, extending to equator of the globe. Left vision = $\frac{1}{6}$ + 1.25 diop. sph. vision = $\frac{1}{6}$. Replies of patient are not sufficiently reliable for test of field of vision."

October 14, patient declared that he saw better with the right than with the left eye. Romberg's symptom was slightly present. The right patellar reflex was normal; the left, how-

ever, absent. No difference in the gait was noted. He walked about the ward and by-rooms with the same atactic movements, staggering at times, but prevented from falling. Blood examination showed: Erythrocytes, 6,150,000; leucocytes, 11,500; hemoglobin, 85 per cent. Repeated examinations revealed no abnormal constituents in the urine.

October 22: Patellar reflexes were present on both sides; there was no ankle clonus nor Babinski's sign, and no evidence of any paralysis of the face or extremities. A marked dementia was present.

During the following week no marked change was noted, except that the patient fell to the floor several times. On October 30, I made a careful examination with the following results: Mental condition was approaching a dementia. Head was not specially sensitive to percussion, but was sore, especially over the left frontal region; head was symmetrical; no scars were present on the scalp. Face was regular but expressionless. Facial muscles contracted equally on both sides; tongue was protruded without deviation, the uvula was not deflected; swallowing was not difficult; respiration was regular; there was no disturbance of the senses of taste, smell or hearing, nor of sensation in the face, eyeball, mouth or pharynx. Arms were well developed, equally strong, no evidence of any localized atrophy; grip of hands was good, about equal on both sides. No tremor of the hands was visible; fingers were mobile; there was no atrophy of the thenar, hypothenar eminences or of the interossei muscles. Ophthalmoscopic examination revealed a double optic neuritis, more marked on the left side. There was nothing further abnormal about the eyes. The patient answered all questions slowly, carefully, and with deliberation. He read aloud the words in a newspaper distinctly and named correctly objects shown him. No alexia was present. He said he had always been able to write and print distinctly, and was given a pad and pencil which he took in a natural manner with the right hand (being right-handed)

Fig. 4.—Case 2. After operation. Patient's attempts at (A) writing and (B) printing.

and made efforts to write; after some seconds the hand moved without tremor, and after much hesitation and with constant urging, the attempt was made, the last four letters of the word Platt were alone legible; the other letters were merely connected, more or less curved lines. Five minutes were allowed for this attempt. Patient was then asked to print his name, and the result after five minutes' interval was a perfectly illegible tangle of strokes. The patient appeared confused and ill at ease during these trials. He acted as if he knew but could not execute.

Abdominal and cremasteric reflexes were present; there was no loss of power of legs. Gait somewhat atactic, resembled that of cerebellar disease, and has been described by Bruns as due perhaps to a partial or complete interruption of the fibers of the frontocerebellar tract, which brings into association the prefrontal lobe with the opposite cerebellar hemisphere.

Diagnosis.—A brain tumor affecting the left frontal lobe, and especially the first and second convolutions, was the diagnosis made and reported to the house staff. A consultation was held the following day, attended by Drs. Stockton, Cary, Rochester, Long, Putnam and myself. My colleague, Dr. Putnam, and myself strongly urged the necessity of an operation, and steps were taken to secure consent of the relatives. On November 1 he was presented before the College Clinic by Dr. James W. Putnam, who noted the following facts: Right patellar reflex was somewhat sluggish; left, somewhat exaggerated. There was hesitancy of speech of the explosive type. Patient stated that he was born in 1864, married in 1864, that current year was 1864 and that father and mother both died in 1864 (mother was then living). Dr. Putnam's conclusion was that the patient was afflicted with a tumor of the frontal lobe of the brain.

On November 6, patient was visited by his wife and sisters

during the afternoon. When asked at eight o'clock that same night, he said he "did not know who was here," and when questioned specifically, said he did not remember that his wife or sister had been to see him.

Operation.—Consent having been obtained, he was transferred to the surgical ward and placed under the charge of Dr. Roswell Park, whose report follows:

Operation.—Nov. 10, 1905, at Buffalo General Hospital, in clinic, under chloroform, I laid up a large horseshoe flap over the left frontoparietal region, including skin and periosteum. Then, with Doyen instrument, I made four openings, finding the skull very thick and very hard, so much so that it was impracticable to raise a bone flap, even if I had desired. These openings were connected by chisel and, in this way, I exposed an area of dura, irregularly, nearly two inches square. The dura seemed somewhat discolored. Opening it, I came down on a soft tumor, which apparently had not so much displaced the brain substance as involved it, since all around the margin I could distinguish between normal brain tissue and diseased. The growth was soft and vascular, and was connected with the overlying dura by slight adhesions, there being no firm union between them. I began removing this morbid tissue with a large sharp spoon, and by the time it was all removed had made a cavity in the frontal lobe of the size practically of a pullet's egg. With sharp spoon and with scissors I cut away that which seemed diseased and came down to brain which seemed healthy, but there was no abrupt line of demarcation. Hemorrhage was at no time serious and yet oozing was copious. I used adrenalin two or three times and checked

Fig. 5.—Case 2. Glioma of left frontal lobe.

the oozing, and finally put in a tent of gauze which was packed with other gauze slightly sopped in balsam. This was all brought out through the opening on the dependent side of the incision. The dura was closed with secondary sutures, as was also the scalp, the bone between having been entirely removed. During the afternoon, patient required salt solution twice—not that his condition was alarming, but it seemed wise to administer it. Examination of the tumor substance showed it to be a vascular glioma.

Following the operation, the patient seemed to clear up mentally somewhat; so that he answered questions with more responsiveness than before the operation. Headaches disappeared, pupils were normal, strength of arms and legs was good and equal on both sides. There was still a constant repetition of the number 1864 as before the operation.

November 26: General condition was improved; wound externally was nearly healed, but a bulging about the size of a hen's egg was palpated at the site of the previous tumor. (See specimen of writing.)

Dec. 3: The tumor over the site of operation increased steadily in size, pulsated and was soft and fluctuating. A considerable discharge of debris resembling broken down brain substance trickled from the dependent portion of the wound. Temperature was 104; pulse, 100.

December 6: Patient lay in a semi-conscious condition, and did not reply to questions. Temperature was 103; pulse, 100.

December 10: General conditions were rapidly failing; there was profuse discharge from the wound. Patient did not reply to questions; seemed to have some pain. Temperature was 104.5; pulse, 120.

Gradually the symptoms increased, and the patient died on Dec. 15, 1905, of a secondary meningitis.

Autopsy.—This was made the following day by Dr. Nelson G. Russell whose report follows: "Depression about 2 inches in diameter with lower margin about $1\frac{1}{4}$ inches from median line. Scar of incision about 4 inches long, semi-circular, beginning about 3 inches above and 1 inch anterior to external auditory meatus, extending almost to median line, with discharge of creamy looking material. On removing scalp an opening in skull about $2\frac{1}{2}$ inches in diameter was found; adhesions of dura to scalp; considerable greenish yellow pus. Dura adherent around edges of wound. Surface of brain seemed a little opaque. Considerable purulent exudate at base, extending down the cord. Left frontal lobe showed an irregular, soft mass, about size of hen's egg. Externally, soft and exuding considerable purulent material.

Anatomic Diagnosis: Septic meningitis and tumor of the left frontal lobe."

The tumor consisted of an irregular rounded mass occupying the prefrontal lobe of the left hemisphere, extending laterally from the basal surface of the hemisphere to the precentral convolution. In its cephalocaudal diameters it occupied the whole of the second, or medifrontal convolution and part of the first or superfrontal convolution. It measured 7.5 cm. laterally and 6 cm. in its cephalocaudal diameter. It did not in any way impinge on the third or subfrontal convolution (cap of Broca) nor on the hemisphere of the opposite side. The tumor was dense, firm, the etal surface roughened with shreds of dural tissue and products of suppuration attached to it. In contrast to the original tumor which was infiltrating, this recurrent tumor was distinctly enucleable with rounded, smooth surfaces from the adjacent healthy brain tissue. (Fig. 5). The other lobes as well as the base of the brain presented no anomalies. The convolutions were distinctly marked and well rounded, the arteries of the base and cortex were not atheromatous and no signs of any previous brain lesions were discoverable. A microscopic examination of this secondary or recurrent tumor has not yet been made. The original tumor was a very vascular glioma.

In this case two sets of symptoms are present: First, general, and second, special or localizing, which point decisively to a brain tumor, involving the second frontal convolution of the left hemisphere of the brain. The general symptoms, headache and optic neuritis, in a measure were also localizing, inasmuch as the left frontal region was more sensitive on percussion than the right; although this is not to be considered with too much attention, and existing alone and by itself, would not be of any significance, yet when considered with the other symptoms, it is important.

The early appearance of choked disc and especially the advanced degree of the optic neuritis of the left disc, as compared with the right, is an index of localization well recognized by all workers in brain pathology. Nausea and vomiting and dizziness were not reported or complained of at any time, but a symptom perhaps allied with the vertigo, namely, the atactic gait as pointed out by Bruns existing in frontal lobe tumors, was a noticeable feature in this case. The ataxia and unsteadiness became so intense that the patient repeatedly fell to the floor and was eventually restrained in bed.

The localizing symptoms were very manifest. The existence of mental apathy and severe headaches, were the symptoms which brought the patient to the hospital. The mental apathy resembled a mild type of acute dementia without delusions or hallucinations. Perseveration and verbigeration were present throughout his stay at the hospital both before and after the operation, and are well recognized symptoms of mental hebetude.

Loss of memory, of ideation and the lack of expression of the face, were features pointing to mental involvement, more pronounced than the ordinary mental symptoms generally present in brain tumors wherever situated. There was no distinctive aphasic condition. The speech was slow, hesitant, somewhat scanning—not due to any disturbance of the motor speech center, but to the mental sluggishness. A very important symptom, and one which makes the case almost the counterpart of the one reported by Herman C. Gordinier of Troy, in which a localizing center for writing was not only assumed but accepted in the second frontal convolution of the left hemisphere, was the *agraphia*² which was present both for writing and printing, but more marked for printing, before operation. After the removal of the tumor, the *agraphia* partially subsided, although a goodly portion of the base of the second frontal convolution was excised at the operation—whether transference to the right side, as in cases of aphasia, with injury to the third left frontal convolution took place, must remain conjectural.

At no time was there any paralytic condition of the right arm, hand or fingers, or any localized epilepsy of these parts. The condition of the patellar tendon reflexes varied somewhat, but there was no persistent exaggeration, ankle clonus or Babinski's sign. Compared with the tumor of the right frontal lobe, it differed in two important particulars: First, in regard to the mental condition; second, in regard to the condition of *agraphia*.

I. MENTAL CONDITION.

The interest attached to cerebral localization has been absorbing to a large number of investigators, each of whom has labored faithfully to map out some particular field as the center of some special function. To Gall, and later to Spurzheim, much credit is due for their efforts to connect function with brain development. Gall succeeded to his own satisfaction in labelling the regions of the brain with the names of the habits or actions he found associated with the development of the special parts, Spurzheim labored for a more abstract conception of the functions of the cerebral areas, and declared that Gall studied merely the abuses of the mental faculties; thus phrenology, a much-abused but useful science, became the forerunner of the modern conception of brain localization. The point of departure or the leave-taking of the two, however, was most abrupt. The former regarded external contour only in its relation to underlying attributes, or the exposition of character by the development of the brain and skull; the latter sought by experimental researches and clinico-pathologic deductions to connect certain areas of the brain cortex with physical and psychic activities and functions inherent in all, according to the scale of development and special aptitude of the organism under observation. The regions of the brain presiding over the psychic functions have been gradually narrowed down by exclusion, to the prefrontal and the occipital lobes. The cerebellum was early excluded, and all observers from the days of Willis and Flourens are practically agreed that the cerebellum plays no part whatever over the mind, instinct, intelligence, sensibility or special senses; these functions belong to the cerebrum alone, and remain unaffected even in the most severe of cerebellar affections.

Tumors located in the cerebrum call forth certain peculiar mental symptoms, which are common to all lobes with the possible exception of the prefrontal, and

2. Am. Jour. Med. Sci., September, 1903 and May, 1899.

here these symptoms in many cases appear to be accentuated. Mendel³ describes these symptoms as follows:

1. **Hallucinations**, appearing at different times and quickly disappearing, sometimes connected with the localization of the tumor (visual hallucinations in tumors of the occipital lobe, etc.), and are often recognized as deceptions.

2. The diminution of intelligence and of memory, often expressed as a certain laziness and indolence, easy forgetting, a certain stupidity with a peculiar blank expression of the countenance. Sometimes a silly, foolish state, moria, appears.

3. A certain yielding disposition, facile irritability, laughing, weeping.

Perfect clinical types with massive hallucinations, with melancholic or paranoic delusions, epileptoid twilight states are rare; oftener there is progressive dementia, especially when there are multiple foci. As a rule, the psychic disturbances of brain tumors are distinguished by being generally connected with considerable feeling of disease and by the appearance of more or less clearness in the intervals between the attacks, in cases in which delusions and sense deceptions are abundantly produced. A local diagnosis cannot be made from the psychic disease unless it may be said in general that focal diseases of the frontal lobes very frequently call forth psychic alterations.

Broca was the first definitely to establish a constant relation of a special center to a special function, and the cap of Broca, or the base of the third left frontal convolution, is synonymous with motor speech. Hughlings Jackson asserted that limited areas of cortex would be found to preside over special organs, and that the destruction of these areas would result in loss of the corresponding function. Soon thereafter Fritsch and Hitzig demonstrated the centers for voluntary motion, and exempted the region about the central or Rolandic fissures from participation in the purely intellectual functions of the mind. Charcot and the School of the Salpêtrière; the English school, led by Ferrier, Horsley, Beavor, Semon, Schäfer and others; the German school, with Wundt, Munk and Goltz at the head, further exempted the parietal, temporal, sphenoidal, and probably the whole of the occipital lobes. The field then has been narrowed down to the prefrontal lobes as the seat of the intellect. This theory, advocated early by Wundt, has been accepted for many years, and has been borne out by anthropologic research, by clinical pathology, by comparative anatomy, and by physiologic deductions. Of late years, the limitation of the intellectual faculties of the mind to the left prefrontal lobe has been argued; among others, by myself in 1897;¹ by Charles Phelps⁴ in 1902; by Charles W. Burr⁵ in 1903; and by Mills and Weisenburg⁶ in 1906.

Phelps made a very careful review of the work done by observers in this field, beginning with Bouillaud in 1825, citing many cases of others, and reports in detail 18 additional cases to those already published by him in which traumatic or pathologic lesions of the frontal lobes resulted in varying phases of mental derangement. Seeing that the posterior portions of the frontal lobes are known to control special motor functions, mental control becomes localized to the prefrontal region, while the con-

clusions from previous investigations point to the seat of such control as being in the prefrontal region of the left lobe rather than the right. Also laceration of the left frontal lobe appears to be the only traumatic lesion occasioning direct loss or derangement of intellectual function, and the deeper the laceration the more mental default preponderates over mental aberration; while in recovering cases, in which the lesion may be regarded as irritant rather than destructive, mental aberration is more frequently noted than mental default. Three cases reported by other observers are quoted in which extensive destruction of the right frontal lobe occurred without alteration of the mental faculties, while the famous "crowbar case," in which the lesion was in the left prefrontal region, and a case reported by Obici and Tambroni of glioma of the left prefrontal lobe, are referred to as showing mental disturbance. In every instance but two out of 295 cases, in which the history was verified by necropsy, extensive laceration of the prefrontal region of the left frontal lobe was characterized by abrogation of mental power, while more superficial injury manifested itself by mental aberration.

By the study of these cases Phelps feels justified to present three propositions: 1. The more absolutely the lesion is limited to the left prefrontal lobe, the more positive and distinctive are the symptoms of mental default. 2. The integrity of the mental faculties remains unimpaired in right frontal lesion, though it involves the destruction of the entire lobe, or even extends to the entire hemisphere. 3. The exceptional instances in which seemingly opposite conditions exist, are always reconcilable on more careful examination, with the assertion of an exclusive control of the mental faculties residing in the prefrontal region of the left side. He says:

If, then, the same nature and degree of proof which is deemed sufficient for the localization of other cerebral functions, may be accepted in case of the mental faculties, their center of control has been established.

After a critical review of the subject and the study of a case of unusual interest because of the strict limitation of the lesion to the prefrontal lobe, Mills and Weisenburg say:

We hold to the view that the highest mental faculties or functions have their material representation in the prefrontal lobes of the brain, and especially in the left prefrontal lobe.

In fifty cases of tumor of the prefrontal area analyzed by Williamson,⁷ the mental symptoms were generally well marked, and in many cases were the most prominent and earliest symptoms. His results are as follows: There was a condition of mental decadence with a dull mental state, a loss of power of attention, a loss of memory, a loss of spontaneity; the patient took no notice of his surroundings and slept during the greater portion of the day, or was semi-comatose in thirty-two of the cases. There was loss of memory, mental failure, but the patient was cheerful in six cases. The patient was suspicious and suffered from delusions, which were occasionally violent in one case. The patient was irritable and violent in one case. The patient was generally asleep, and irritable when awake in two cases. The patient was ambitious, excitable, and had loss of memory in one case. There was slowness of mental processes, and the patient was simple and childish in one case. There were mental anxiety, childishness, hallucinations, suicidal tendencies in one case. The mental condition was not stated in five

3. Text-book of Psychiatry (Translation by Krauss).

4. Am. Jour. Med. Sci., April and May, 1902.

5. Philadelphia Med. Jour., Jan. 31, 1903.

6. THE JOURNAL A. M. A., Feb. 3, 1906.

7. Brain, 1896, p. 346.

cases. Seventeen of these lesions involved the right lobe, twenty-two the left, and eleven both lobes.

Ferrier⁸ states the symptoms of disease of the frontal lobes as follows: Mental inactivity, forgetfulness, lack of judgment, decided change in character, irritability of temper and unusual stupidity, an inability to concentrate the attention, to think connectedly and continuously, to learn easily, to exercise self-control, and lastly, a state approaching mild dementia without delusions, in which the patient may become dirty and disregard all restraints of decency.

Naturally some opposition has developed to this localization of the intellectual faculties. In 1902 Müller⁹ and Schuster,¹⁰ and in 1904 von Monakow¹¹ each dissented from the view that the prefrontal lobes are more interested in mental activity than other parts of the brain, and that tumors situated in this area need not cause disturbance of the higher psychic function. Mills and Weisenburg⁸ claim that clear distinctions are not made as to the character of the psychic disturbances caused by tumors located in various parts of the brain. The chief sources of fallacy would seem to be: 1, that sufficient stress is not laid on the fact that owing to the painful and exhausting character of brain tumors, mental disturbances in the broad sense may occur because of the irritation and exhaustion produced by these lesions; 2, it is not clearly brought out that tumors of the posterior association area or concrete memory field of the brain will necessarily cause some disturbances of mentality, especially those in the domain of orientation and in the sensorial field; 3, that tumors anywhere situated may cause mental disorders simply through the disturbance or impairment of association which must result; 4, sufficiently close attention is not paid to the particular point that the psychic disorders caused by prefrontal tumors are especially those of the higher intellectual functions, and that in many of the cases studied the normal mental status of the individual is not properly taken into account; and, 5, the fact is not recognized that in tumors situated in one of the prefrontal regions, especially in the right, the individual's intellectual faculties may be largely preserved because of the integrity of the corresponding region of the other side.

The argument has been advanced that inasmuch as insanity is a disease of the mind, it must therefore be limited exclusively to the prefrontal lobe of the left hemisphere, if this theory be correct. But the mind is the sum total of the faculties and functions of the brain cortex; therefore, insanity must be considered a diffuse disease of the brain cortex with special exaggerated phenomena due to irritation of the different cortical centers, as e. g., the optic center, the auditory center, or motor centers, thereby calling forth the special function of these centers as visual hallucinations, auditory hallucinations, motor unrest and the like. Although the pathology of the functional psychoses is still undecided and unsettled, there are organic brain diseases producing grave mental disturbances which have a definite and constant pathology, and among these none is better known and understood than paresis. The symptomatology of this disease is a typical decadence of the intellectual faculties, terminating in a profound dementia or even amentia. The lesion in paresis, as determined by the investigations of Mendel, Mott, Mickle and others, is situated exclusively in the

frontal lobes and the left is more affected than the right. In speaking of the pathology of paresis Mendel says:

The weight of the brain in paretics is generally diminished, and as a rule, the right hemisphere weighs more than the left.

Of late there has been some trend of opinion favoring the posterior or occipital lobes of the brain as being those chiefly involved with the higher mental processes. This view is based on the following claims: First, as Gratiolet pointed out, the posterior lobes are of later development in the individual man, and thus it is inferred they are the least needed for the purely animal functions;¹² second, they are proportionately more developed in man than in the lower animals, and they exist only in the higher vertebrates; third, in intellectually lower races the posterior lobes have been observed to be proportionately smaller; in some of the bushmen they fail to cover the cerebellum; fourth, in some of the lowest mental grades within the lines of civilization, the posterior lobes are the smallest, especially so among idiots.

That the occipital lobes are concerned in the higher psychic activities is the opinion of many of the English investigators. For instance, Bevan Lewis¹³ says:

I have repeatedly observed in cases of senile insanity, with excessive wasting of these regions, such as results in a peculiarly pointed frontal lobe, an association during life of extreme torpor and somnolence.

He further says:

There are cases in which, as Hughlings Jackson teaches, profound dementia accompanies lesions of the posterior parts of the brain, confirming the observation of Rosenthal, that the psychic disturbances resulting from tumors in the posterior lobes are far more frequent than from corresponding growths in the anterior and middle lobes.

Professor Carpenter, Bastian, Schäfer and others contend that the posterior lobes are the most important parts of the brain for intellectual purposes.

In the majority of instances animal experimentation has favored the frontal lobes as the seat of habits or tricks taught them, or perhaps we may say instinct.

Very recently Mr. Shepherd Ivory Franz¹⁴ has published some very interesting experiments on cats from the physiologic laboratory of the Harvard Medical School. He taught the animals simple habits and then cut away portions of the brain. His conclusions are:

1. After a bilateral lesion in the frontal lobes the habits are lost.
2. The effect can not be explained as due to "shock," for other brain lesions are not followed by loss of habits.
3. Unilateral lesions of the frontal areas are usually followed by a partial loss, or, rather, a slowing of the association process.
4. Habits once lost after removal of the frontal lobes may be regained. After a second operation they are again lost, and may be regained a second time.
5. Only newly formed habits are lost after such lesions. Inherited and long standing habits seem to be retained.
6. The emotional condition of the animal is practically the same after as before the operation.

It is generally conceded, however, that the frontal lobes alone are an index to a person's intellect, and their mass has to be judged by all the measurements which are used for the estimation of the size of the body; that the head may be small in a person of wisdom, provided frontal lobes are relatively the most prominent.—(Hollander.)

From a careful observation and intimate knowledge of the illness of the two patients whose histories I have presented, and without reiterating, but simply emphasizing the argument made in 1897 anent the contiguity of the

8. Quoted from Starr, Dercum's "System of Nervous Diseases."

9. Deutsch. Ztschr. f. Nervenheilk., 1902, xxi 3 and 4.

10. "Psychische Störungen bei Hirntumoren," Stuttgart, 1902.

11. Ergebnisse der Physiologie, iii No. 2, 1904.

12. In apes, however, they are the first to develop.

13. Brit. Med. Jour., Sept. 29, 1883.

14. Am. Jour. Physiol., Oct. 1, 1902.

centers of the intellectual faculties, and the articulatory and motor centers of the right hand, and wedged between these the centers of speech and writing, all located in the frontal lobe of the left hemisphere, it is only logical, therefore, to assume that the center of the intellectual faculties is here located, and I believe that future clinico-pathologic studies and results of animal experimentation will confirm this view.

It would be an interesting clinical fact to prove whether in left-handed individuals this center would be found in the right prefrontal lobe, the same as we assume that the center of speech is there located in left-handed individuals, and whether in slowly progressing disease of the left frontal lobe it will be possible for the right lobes to take on the functions which we are trying to make the left frontal lobe possess. These are interesting clinical questions, and no doubt will be as conclusively solved some day, as was Broca's theory regarding the center of motor speech.

II. AGRAPHIA.

In the exhibit of handwriting, the patient suffering from glioma of the right frontal lobe (Case 1) was able to write distinctly, correctly and legibly. The labels which he copied the day previous to his death are models of penmanship and intelligence, and I doubt not but that they are more legible than the physician's prescriptions which served as the copy (Fig. 1).

In the patient suffering with glioma of the left frontal lobe (Case 2) the attempt at writing before the operation resulted in a series of connected, ill-formed lines, with only the last four letters of his name legible; while in attempting to print his name it ended in an absolute impossibility. Five minutes were allowed him for each attempt. After the operation some improvement was noted in writing; although crude and irregular, it is possible to read the same. In printing he has recovered the shape and form of the letters, and although repeating some, which may be a mental difficulty, the same is also legible (Figs. 2, 3 and 4). The literature on this subject has been carefully scrutinized of late by Dr. Gordnier of Troy, N. Y., and it is unnecessary to repeat what he has so well written. This case seems to help to prove the existence of a writing and printing center in the base of the second frontal convolution of the left hemisphere, in close proximity to the center of the right hand, through which writing is ordinarily made possible.

CONCLUSIONS.

1. The prefrontal lobe of the left hemisphere is in all probability the seat of memory, reason, intuition and judgment or the higher intellectual faculties.

2. A distinct center for writing and printing exists in the base of the second frontal convolution of the left hemisphere.

FOR THE DISCUSSION, SEE PAGE 359.

Effect of Posture on Kidney Functioning.—Some recent experiments by Jaques are related in the *Province méd.*, No. 35, 1906, which show that kidneys enfeebled by disease functionate differently as the patient stands or reclines. It is important to examine the urine after the patient has been standing or walking and again after he has been reclining. In 14 out of 15 nephritic patients the amount of urine increased to three times its former amount as the patients reclined, and the elimination of urea and of chlorids was increased in 14, and of the phosphates in 5. In 9 patients the proportion of albumin in the urine also subsided to a marked extent. As convalescence progresses the difference between the urine of the various postures becomes less and less pronounced.

SOME WAYS TO PREVENT THE SPREAD OF TUBERCULOSIS.*

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At present, the importance of this subject is sufficiently recognized as to require no discussion in a paper before a body like this. The literature of the subject is so great and the time at our disposal so short that no attempt at completeness of review is justifiable. Especially, it is impossible within the time limit to present any statistical study or to give the data on which our opinions may be founded. Therefore, I shall briefly discuss some features of the following three topics:

1. The direct reduction of the opportunities for infection.
2. The promotion of the individual powers of resistance.
3. Educational influences at our disposal.

REDUCTION OF OPPORTUNITIES FOR INFECTION.

The tubercle bacillus is now almost unanimously accepted as the efficient and the specific cause of tuberculosis. The few dissenters from this accepted view may be ranked with those championing the antivaccination fight and the antivivisection fanaticism—individuals whose training in both logic and the biologic sciences is so deficient as to deprive their utterances of all weight of authority.

It is not here necessary to enter into any discussion of the biologic characteristics of the tubercle bacillus, its pathogenetic properties, and the anatomic results of infection with it. It may be assumed that we are all sufficiently familiar with them for the purposes of this paper.

The antituberculosis propaganda to-day is very largely a war against the tubercle bacillus, efforts being devoted to its destruction and to the reduction of opportunities for infection with it. The success of the plan as adopted in New York City and in some other cities, the former being the most notable—with the general principles of which it may also be assumed we are all familiar—has been so striking that it may now be fairly questioned whether any community is justified in further hesitation in putting it into operation. Beginning with a tentative request for voluntary notification, it now includes compulsory notification of all cases of tuberculosis and the coöperation of the board of health with the physician whenever this is desired in matters of diagnosis, education, supervision and care, not only of the patient, but also of his family, and the improvement of his surroundings.

The opening wedge is the question of notification. In many communities, professional opinion will not support compulsory notification. Of course, without this support any attempt at compulsory notification will be a failure. The experience of New York, however, demonstrates that a short period of voluntary notification may be shortly followed by compulsory notification with practically the unanimous commendation of the medical profession. In every community, therefore, the consensus of professional opinion should be obtained and that form of notification receiving its approval promptly put into operation. Notification alone, however, ac-

* Read in the Section on Hygiene and Sanitary Science of the American Medical Association, at the Fifty-seventh Annual Session, June, 1906.