Temporal.

123. Baer and Nicoll: Brit. Med. Journ., October 16th, 1897.
124. Nicoll: Lancet, October 29th, 1898.
125 Stewand: Northwestern Lancet, 1897.

Cerebellar.

126. Collins and Brewer: Med. Record, 1897.
127. Gibson: Edin. Med. Journ., February, 1896.
128. Guthrie: Prectitioner, lxi., 69, 1898.
129. Moran and Kerr: Virginia Med. Semi-Monthly, July, 1897.
130. Munn: International Journ. of Surgery, 1895.
131. Murri: Lancet, January 30th, 1897.
132. Parkin: Brit. Med. Journ., 1896.
133. Pershing: Medical News, March 26th, 1898.
134. Stewart and Annandale: Edin. Hosp. Rep., 1895.
135. Steele: Chicago Clin., xiii, 1-7, 1900 (death).
136. Hirmanidas: Neurolog. Centralbl., 1896.
137. Stewart and Annandale: Edin. Hosp. Rep., 1895.
138. Fisher: Tr. Med. Soc., New York, 1896.

To these may be added the following list of cases, also collected by Knapp, in which an operation was attempted, but removal of the tumor found to be impossible:

Aldibert: Revue de chir., p. 158, 1895.
Beck: In Auvray, pp. 359, 360, 361.
Bruns: Brain Tumors.
Carson: Annals of Surgery, xxviii., 328.
Chipault: Gaz. des hôp., lxxi., 597., 1898.
Collins: Tr. Amer. Neurol. Assn., 1895.
Dinkler: Neurolog. Centralbl., xvi., 611, 1897.
Eskridge: Denver Med. Times, June, 1896.
Fisher: N. Y. Med. Journ., April 16th, 1898.
Gardiner: Amer. Journ. Med. Sci., May, 1899.
Hermanides: Operative behand. van husengezwellen, 1894.
King: Chicago Clinical Review, April, 1897.
Kraus: N. Y. Med. Journ., July 30th, 1898.
Lanphear: Journ. Amer. Med. Assn., April 28th, 1895.
Rose: Medical Press and Circular, i., 175, 1894.
Rossolimo: Arch. f. Psych., xxix., 528, 1897.
Schultze: Deutsch. Zeitsch. f. Nervenheilk., ix., 217, 1896.
Sonnenburg: Berlin. klin. Wochenschr., p. 969, 1894.
Starr: Med. Record, i., 145, 1896.
Starr: Brit. Med. Journ., October 16th, 1897.
Stieglitz: Amer. Neurol. Assn., 1895.
Taylor and Elliott: Boston Med. and Surg. Journ., 1896.
Winkler: Bijdrage tot de Husenchirurgie.

The later operations have not been able to modify the percentage arrived at in 1893, for in 1897 Bruns, after a somewhat complicated calculation from statistics, concluded that the number of successful cases was not higher than six in a hundred.

Bruns, however, does not hesitate to advise the operation whenever the tumor can be exactly localized in an accessible part of the brain. For even when it shall have been found irremovable, the operation may serve to relieve the frightful pain, or even to arrest the progress of choked disc toward blindness, and it seems to be the undercurrent of Bruns' thought that in a disease like brain tumor, which he calls the most frightful of all diseases for the suffering it entails, it were really better that the patient should die in the attempt to secure relief, than that he should be abandoned to his suffering.

Quincke's lumbal puncture has been practised for the purpose of lessening intracranial pressure, but has often failed, perhaps from obstruction in the communications between the brain and spinal cord. The puncture has several times been immediately followed by death.

The intellectual, philosophic, and even romantic interest attaching to the operations for brain tumors much exceeds their actual practical importance. The attempt has been made to estimate this from analysis, not only of the operations which have been performed, but also of the fatal cases of brain tumors on record, not operated, but submitted to post-mortem examination. The latter has shown that a very large proportion would have been inoperable, either because a local diagnosis could not have been made, or because the locality, though diagnosed, was inaccessible; or because the tumors were multiple or malignant; or, finally, because they were too large for extirpation. The last objection can often be met by the observation that an early operation might have proved successful, though by delay the tumor had grown beyond the bounds of surgical possibilities. This observation, however, holds good for tumors in any part of the body.

Tuberculous tumors—the most common variety by far in childhood—are frequently multiple, either at the time of operation or by recurrence shortly after; and are then, of course, unfavorable for operation. For extremely malignant tumors (carcinoma) the prognosis is naturally as hopeless when the growth is situated in the brain as when it exists in other organs. On the other hand, sarcomata, when primary, have not unfrequently been removed with success.*

A table quoted by Keen, in the article on *Brain, Surgery of*, in this volume (p. 416), shows the relative proportion of different varieties of brain tumors in a total of 580 cases collected by Hale White and Bernhardt. Nearly a quarter of all (23 per cent.) were tuberculous, only 4 per cent. were carcinomatous. In 22 per cent. of the cases cited the nature of the tumor is not stated.

Hale White estimates that only 9 of his 100 cases could be considered as operable. No tumor, even the most benign, could be considered operable which is situated at the base of the brain, or in the cerebral axis (Starr), which is widely infiltrated, or which, as already noted, is multiple. Out of 300 brain tumors in children collected by Starr, one-third were in the cerebral axis. Tumors of the cerebellum are fairly accessible, but operations upon them have proved very much more dangerous than operations upon the cerebrum. The space for operation is much narrower; precise localizing symptoms are much less distinct and frequently fail altogether. On the other hand, the general symptoms are especially severe, owing to the excessive intracranial pressure; and this same condition endangers the operation by causing the brain to bulge through the opening. The close proximity of the affected part to the most vital organs of the cerebro-spinal axis renders shock imminent. The tumor is very frequently tuberculous, and finally optic neuritis has nearly always reached an advanced stage before the operation is undertaken, so that when, by exception, the patient has survived the operation, he has remained blind.†

Out of the 300 cases of tumor in children, 96 were situated in the cerebellum. This single fact suffices to establish a relatively unfavorable prognosis for brain tumors in childhood.

In this same list were found 56 cases of tumor of the cortex and centrum ovale, localities favorable for operation; 16 of these, however, were not correctly diagnosed, and therefore could not have been operated on, even if the operation had been suggested.

Out of the 40 which remain, localizing diagnosis would have been impossible in 21, though the autopsy showed that in some of them an operation would have been possible. In 19 cases the tumors were in the central convolutions, or in the subjacent centrum ovale, and in 13 of these local spasm followed by paresis made the precise diagnosis sufficiently clear. In the remaining 6 the locality was established by the symptom hemianopsia. The author estimates, however, that in only 16 of these cases could an operation have been undertaken with much hope of success, and as 10 of these were tuberculous, the number of cases in which even this new and heroic remedy offered hope of complete recovery was reduced to 6 out of a total of 300.

The statistics for adults, as regards localization, differ somewhat from the above. A table of 644 cases, compiled from the cases of Ladame and Bernhardt, shows the different localities in which the tumor was found. It was situated in the—

Centrum ovale in	192 cases	= 29	per cent.
Cerebellum in	162 "	= 27	"
Cortex in	74 "	= 11	"
Pons in	56 "	= 8	"
Basal ganglia in	36 "	= 5	"
Medulla in	30 "	= 4	"
Corpora quadrigemina in	13 "	= 2	"
Cerebral peduncle in	10 "	= 1	"
Extra cerebral in	71 "	= 11	"

* In the case reported by Weir and Amidon the cerebral symptoms occurred after the patient had already been operated upon for sarcoma of the neck (Annals of Surgery, June, 1887).

† The symptom of choked disc, when present, has long been considered more nearly pathognomonic than any other of cerebral tumor. Seguin has, however, recently declared that many cases of enormous

This table can be compared with Starr's, as follows:

Tumors situated in	Children.	All cases.
Cerebellum	96 cases = 32%	162 cases = 27%
Cortex and centrum ovale	56 " = 18%	266 " = 41%

Thus consideration of the prevailing situation of brain tumors alone would seem to justify Bergmann's dictum, that the field for successful operation is very narrow, the reverse of what can be now affirmed of trephining for brain abscess. Examination of the 85 cases in which operations have been performed between 1884 and 1893 gives a more favorable view. The record shows that there were 39 successful operations against 46 unsuccessful cases, and one trephining to relieve intracranial pressure. These were performed in all parts of the world, even British Guiana having contributed a successful case in 1888 (Rannie, *British Medical Journal*, 1888). The following table summarizes these results. "Successful" implies that the tumor was found and removed, that the serious symptoms subsided, and that the patient lived more than two months, or even recovered completely. "Unsuccessful" refers, not only to the death of the patient from the immediate consequences of the operation, but also to the impossibility of completing this, either because the tumor was not found at the locality supposed, or proved too large or too deeply seated to be completely removed; finally to the speedy recurrence of the tumor so as to cause the death of the patient in a short time, notwithstanding the immediate success of the operation.

Successful		39
Unsuccessful:		
Tumor not found	20	
Tumor not removed	10	
Death from operation or speedy recurrence of neoplasm	16	46
		85

In 1888 Dr. Keen wrote (REFERENCE HANDBOOK, *Brain Surgery*) that the percentage of mortality was 35 per cent. This calculation was based upon the 17 operations which had then been performed, with 6 recoveries, and included among them one case (Heath, *Lancet*, 1888, Case 27 of table), which we have placed among the unsuccessful cases, because, although the patient survived the operation and was relieved, the tumor was too large for removal. The percentage of successes (11 cases out of 17) was nearly 65. To-day, the larger number of cases yields as successful about 46 per cent., as failures nearly 54 per cent. The less favorable result is not surprising, for the operation has been attempted under a much greater variety of circumstances, so that a greater number of unfavorable conditions have been encountered. For this reason the estimate of the operation has varied in the same way as did that for tracheotomy. This operation on its first suggestion excited unbounded enthusiasm, until experience showed how numerous conditions of failure were inherent in the disease for which the operation was performed, and which could not be overcome by any degree of perfection in its surgical technique.

The precision is surprising with which small tumors have sometimes been localized for removal. In Seguin and Weir's case (No. 24) the neoplasm was only the size of an almond, and lay an inch below the surface. In another case, however, reported by Seguin, a glioma one-half inch in diameter escaped detection. It was found at the autopsy at the locality diagnosed, under the motor centre for the left leg, but its consistency so resembled that of the brain tissue that it could not be differentiated (Case 63). The writer remarks that an operation may be undertaken too early on the brain—*i.e.*, before the tumor has grown sufficiently large to be appreciable, even although it may have occasioned pathognomonic symptoms.

In 19 other cases in which the tumor was not found, the reason for the failure was quite different. In Keetley's case (41) the pons was found enlarged to three times its natural size by an infiltrating glioma. The only localizing symptom presented had been a slight internal strabismus of the left eye (paresis abducens). This fact should have suggested a pontine, and consequently inoperable tumor, as also the fact that the knee-jerks were exaggerated, while absence of paralysis, and existence of vomiting, giddiness, and staggering pointed to a tumor of the cerebellum.* With the latter, however, the knee-jerks are habitually diminished, and this special combination of negative and positive signs should suggest a lesion of the pons, in spite of the absence of many of its characteristic paralyses. The patient, a child of seven, who had had a fall fourteen days before the onset of the symptoms, had an attack of collapse followed by a subnormal temperature just before the operation, another circumstance pointing to the pons. An exploratory operation was made through the left squamous bone, but nothing was found, and the child died two days later.

In Pilcher's case (31) there was a scar (after an injury) situated over the left angular gyrus, and the skull was trephined at this point. The patient had marked mental impairment, epileptic attacks, beginning in a conjugate deviation of head and eyes to the left, and tonic hemispasm on the right side. Schäfer (*Brain*, April, 1888) claims that excitation of the brain near the angular gyrus produces conjugate deviations of the eyes to the opposite side. The centre for such deviation is placed by Horsley at the posterior extremity of the middle frontal gyrus; and the autopsy in this case would seem to confirm that localization. A glioma was found on the left side, in the occipital lobe, but extending forward as far as the frontal lobe. The island of Reil was softened. The mental impairment, taken together with the conjugate deviation of the eyes, pointed to the frontal lobes, where also the headache was situated. Nothing indicated the occipital lobe, and at the angular gyrus nothing was found. In Sciammana's case (3) also the patient was trephined, unsuccessfully, at the seat of an injury to the head in the right parietal region. The tumor was a glioma, lying in the right centrum ovale and extending from the right inferior cornu to the corpora quadrigemina. Crossed paralysis had existed, left hemiplegia, followed by right oculo-motor and facial paralysis. This is not explained by the autopsy.

Kerr's operation (58) is the third on the list misled by a scar. The indication was the more plausible because the scar was situated over the upper part of the left fissure of Rolando, in a patient suffering with hemispasm and hemiparesis. A glioma was found in the left corpus striatum and optic thalamus. This is the only case on the list in which a tumor in this situation had simulated a cortical tumor.

In Knapp's second case (65), the trephine was applied over a tender spot in the right temporal region, although there were well-marked symptoms of a cerebellar tumor. After death, ten weeks after the operation, the tumor was found in the left lateral lobe of the cerebellum. In this case the left knee-jerk was absent, and there was slight paresis of the left hand, symptoms which, together with the characteristic symptoms of tumors, might have sufficed to indicate the cerebellum.

In seven other cases an erroneous diagnosis was made of tumor of the cortical motor centres (Fraser, Hammond, Amidon, Stokes, Walker, Dobson, Twynam), and in one (Beach) of tumor of the frontal lobe pressing on the central convolutions (Cases 5, 7, 8, 51, 55, 73, 80).

In Fraser's case (5) the localizing symptoms were right hemiplegia and contracture, indistinct speech, amnesic

tumors do not present choked disc, and, on the other hand, this ocular lesion occurs in persons who have no intracranial disease. "Indeed, in my experience as regards tumors of the hemispheres, the rule is that the optic nerves are normal" (Boston Medical and Surgical Journal, February 5th, 1891).

* The knee-jerks are usually diminished in tumors of the cerebellum, whereas they are exaggerated in tumors of the pons. This may be a useful detail in distinguishing between these two lesions, whose symptoms often resemble each other.

aphasia, agraphia. The error depended on the duplicity of the lesion. There was a tumor in the middle of the right ascending parietal convolution, and another in the left temporal lobe involving the ascending convolutions. The amnesic character of the aphasia really pointed to the left temporal lobe rather than to the neighborhood of Broca's convolution. It is difficult to understand the failure in Hammond's case (7), as the autopsy revealed three cysts in a line in the anterior central convolution precisely where the lesion had been diagnosed. In Amidon and Weir's case (8) the tumor was found in the cerebellum at the autopsy, although the patient had had left hemispasm and paralysis of the left arm. Two circumstances, however, pointed to the cerebellum—with the left-sided paralysis coexisted a paresis of the right arm, thus a bilateral motor defect, and there was also optic neuritis on the left side. Stokes' case (51) shows, as the author remarks, that the motor centre for the leg extends farther back than is usually assumed, or else that pressure transmitted from a distance may cause the same symptoms as a lesion at the centre. A spindle-celled sarcoma was found in the parietal lobe, just behind the leg centre, and being of the same consistency as the brain, could not be distinguished.

In Walker's case (55) the symptoms were very confusing. Staggering seemed to indicate a cerebellar tumor, as did also the vertigo and vomiting. But a marked mental defect pointed to the frontal lobes, and motor aphasia to a lesion on the left side. On the other hand, left hemispasm and hemiplegia were to be referred to the right side of the brain, and hemorrhage and an offensive discharge from the right ear seemed to localize the disease more precisely near the petrous bone. Paresis of both hands pointed to the cerebellum; exaggeration of the left tendon reflex, on the contrary, confirmed the indications offered by the left hemiplegia. An exploratory operation was performed over the left ascending frontal with negative result. At the autopsy a cystic mass was found at the left of the sella turcica, springing from the apex of the petrous bone. The record leaves unexplained why this should have been associated with discharge from the right ear.

Dobson's case (73) exhibited an apparently exquisitely precise symptom, namely, twitching attacks in left arm, beginning in thumb and first finger, with sensory aura in same parts. Horsley has located the thumb centre just behind the middle of the ascending parietal convolution, and a signal symptom in Jacksonian epilepsy, initiated at this point, has several times guided to an exact diagnosis. But in this case the centre was evidently irritated by pressure from a distance. There were multiple cerebral tubercles in the right hemisphere. This is the second case of multiple tumor on the list.

In Twynam's case (80) the tumor seems to have escaped detection, partly because it lay too far below the surface in the medullary substance, partly because, as in Stokes' case, the tumor, though pressing on the central convolutions, lay behind them, in the parietal lobe. Besides the hemiparesis there was some loss of sensations, and this symptom, as well as the loss of muscular sense, seems to point to the parietal lobe rather than the central convolutions. Another fact in the same sense was the incomplete nature of the paralysis. The tumor found on autopsy was very large, 68 by 57 millimetres, extending from the Rolandic fissure to the parieto-occipital, and bulged into the roof of the lateral ventricle.

In Beach's case (52), finally, a tumor was diagnosed in the left frontal lobe, pressing on the lower part of the central convolutions. The first local symptom had been a motor aphasia, followed by tremor, then twitching of right hand and eyelid, then paresis of righf hand. The tumor was found at the supposed level, but, as in Cases 51 and 80 (Stokes and Twynam), it lay in the parietal lobe behind the motor convolutions and between the posterior ascending branch of the Sylvian fissure and a small sulcus anteriorly which separated it from the ascending parietal convolution. There were no sensory symptoms to aid the diagnosis.

In Wille's case (25) a tumor of the left parietal lobe was diagnosed, but the diagnosis was guided by the existence of a swelling over the left parietal bone. Only after this had been incised did right hemiparesis appear, including the facial nerve. In a second operation subdural pus was evacuated, but no tumor was found. At the autopsy was discovered a tumor the size of a pigeon's egg in the posterior part of the left paracentral lobule, extending into the upper part of the ascending parietal convolution. Also, and this makes the third case of multiplicity, a second tumor was found in the middle of the ascending parietal convolution. In two other cases on this list the tumor lay in the cerebellum. In Wyman's case (53) it had been diagnosed in the sella turcica, because, in addition to the general symptoms, the patient had a divergent squint (paralysis of the motor-oculi), anosmia, and slight movement of rotation at the beginning of the convulsive attacks. There was great muscular weakness, but neither hemiplegia nor staggering. A tumor three-quarters of an inch long was found in a cavity hollowed out in the left hemisphere of the cerebellum. All the ventricles were distended with fluid. The great frequency of cerebellar tumors might, it would seem, have decided the surgeon to operate, if at all, in their locality. But instead of this he trephined the frontal bone above the supra-orbital ridge and passed a probe over the orbital plate to the sella turcica with necessarily negative result.

In Springthorpe's case (47) a cerebellar tumor was correctly diagnosed, and several symptoms pointed to pressure on the right lobe of the cerebellum. In the fits there was conjugate deviation of the head and eyes to the right side; the right ear was moderately deaf, and the patient fell backward and to the right side. An opening was made over the right lobe of the cerebellum, clear serous fluid escaped, but no tumor was found. At the autopsy a glioma with a central cavity was found to occupy the middle lobe of the cerebellum. All the ventricles were full of blood-stained fluid. The main pressure was upon the right side.

The last case was reported by Gray and operated by Wyeth (84). The exact locality of the tumor was correctly diagnosed, but it lay one-quarter inch below the surface (as had been expected from the absence of convulsions), and the consistency so closely resembled that of the medullary brain tissue in which it was embedded that an exploring needle passed through it without detecting its presence, and it was discovered at the autopsy with difficulty, and only by careful slicing of the brain.

Nearly all the cases in which the tumor was not found at the site of operation proved fatal, the operation seeming to accelerate the natural march of the disease. One patient, however (Amidon and Weir), survived ten weeks, another (Dobson) a month. Four cases illustrate the now accepted rule, that a scar, and still less a tender point on percussion, must not be selected as a site of operation, unless focal symptoms point to the same locality.

In the five cases of cerebellar tumor a retrospect of the symptoms, after the autopsy, makes them seem more significant than they had appeared before the operation. Cases 47 and 53, as do many other cases which have not been operated on, show the impossibility of distinguishing with certainty whether a tumor of the cerebellum be situated in its lateral or its middle lobe. Nothnagel's law of the frequent latency of tumors of the lateral lobes should always incline the diagnosis in favor of a central lesion, unless lateral symptoms are very well marked. The danger of hemorrhage, however, from trephining over the centre of the cerebellum, *i.e.*, of the sinus, is very great, and, on the other hand, a tumor of the middle lobe is sometimes accessible from the side.

Operations on tumors too large for removal, when the cranial opening was really made over the seat of the lesion, have not always proved so dangerous as in the class of cases just described. Thus, Horsley (Case 45) removed first one-half of the occipital bone, then the other, where an inoperable tumor of the middle lobe of the cerebellum existed. The patient had suffered for a

long time from epileptiform fits, with violent rotary movements, from severe headache and distressing attacks of dyspnœa. All these symptoms disappeared after the operation, and the patient's life was prolonged in comfort for two years.

In Heath's case (27), also, there was found, over the posteriorly ascending frontal convolution, a large adherent growth which could not be removed. Localized tenderness had existed over the site of the tumor. The patient was relieved of his headache by the operation, and, at the time of reporting, had made a good recovery. In Case 35 (Limont and Page) a portion of a large glioma was removed, with temporary recovery, but the growth recurred.

In Case 39 (Kocher) tumor of the cerebellum was diagnosed from the four classical general symptoms, in the absence of focal symptoms. A double trephine opening was made to relieve intracranial pressure, one posteriorly on the right side below the tentorium, one anteriorly on the left side. In four days congestion of the optic discs had disappeared, but there was no improvement of vision.

In Maudsley's case (42) a tumor had been diagnosed in the left lobe of the cerebellum, the trephine was applied at this locality and a tumor found, but it was a solid nodule, irremovably attached to the temporal bone. The patient recovered from the operation. Five other cases proved rapidly fatal. The entire list of ten cases is summarized in Tables III. and IV.

Death occurred after removal of the tumor in sixteen other cases. The causes may be thus tabulated:

Five out of these 16 cases are tumors of the cerebellum; 5 cases on Table II., 1 on Table III., and 1 on Table V., were also cerebellar; thus 12 out of the total number of 46 unsuccessful cases, or 26 per cent.

The death from diphtheria (Castro) and that due to accidental opening of the cerebellar sinus (Bullard and Bradford) are theoretically avoidable. The case of glio-sarcoma removed by McBurney had been correctly diagnosed eleven months before, and the operation then advised. At that time it might have been successful, so that in this case the fatal issue may fairly have been attributed to the delay. It may perhaps be assumed that the five deaths caused by septic meningo-encephalitis could have been avoided by more perfect antiseptic precautions.

The fatal issue is not clearly explained in the cases reported by Gray, Thomas, and Keen. The last case is particularly interesting, because the tumor had been correctly localized in the cuneus on account of the symptom of hemianopsia. It is the only case in the entire collection (before 1894) in which this symptom was thus rendered available.

In 39 cases the operation was successful. The situation of the tumor in these cases is shown in the next table.

These cases of recovery include one, and only one, case of tumor of the cerebellum, and that was a cyst. This is to be reckoned against 12 fatal cases of cerebellum tumor, already noted. As might be expected, in the immense majority of successful cases the tumor is situated in the motor convolutions (29 out of 39 cases). This region unites all the conditions of success—facility of diagnosis, facility of operation, relative freedom from danger of shock. Among the unsuccessful cases the tumor was situated in the central convolutions only seven times, and in one of these the death was purely accidental, due to an epidemic diphtheria. In all the others death was due to septic meningitis, in one case complicated by syphilis. In one a communication existed between the tumor and the ventricle; in another, there was an adhesion to the longitudinal sinus.

The symptoms of lesion of the central convolutions are so well marked that when the tumor exists in this locality it cannot easily be overlooked. It sometimes happens, however, that tumors in other localities simulate the symptoms proper to disease in the cortical motor centres. Thus: 1. The tumor may be situated in the subcortical region of the centrum ovale, as in Gray's case (84). The diagnosis in this case, notwithstanding the monoplegia, was correctly made as subcortical, on account of the absence of spasm or convulsion. 2. The tumor may lie in the frontal, parietal, or temporal lobes, and by transmitted pressure excite the symptoms proper to the motor area. The diagnosis, when possible, is made out by observing that lesions of intelligence, or speech, or sensibility, or vision, especially hemianopsia, have preceded motor symptoms, and that the latter remain incomplete—paresis, not paralysis. 3. Tumor of the basal ganglia may simulate cortical tumor. This occurred in Case 58 (Kerr). It is rather surprising that the mistake has not been made more frequently. That it has not, is due to the enormously valuable studies in "Jacksonian epilepsy," that may be ranked as the second link in the chain of investigation which, beginning with the researches of Hitzig and Ferrier on brain localization, have so rapidly led to brain surgery. Only one tumor of the occipital lobe has been operated on at its site, the diagnosis having been guided by the remarkable symptom hemianopsia (Birdsall and Weir, 15).

In Pilcher and Dana's case (31) the tumor occupied the left occipital lobe, but the operation was made at the site of a scar corresponding to the angular gyrus. The tumor, therefore, was not found. It is not stated whether the patient was examined for hemianopsia.

It is claimed, especially by Starr, that an onset of symptoms with psychical changes is very characteristic of tumors of the frontal lobe. Such mental depression, however, is apt to occur with intracranial tumors in any locality, and cannot be considered a distinct indication of frontal-lobe localization until, by extension backward, motor symptoms begin to complicate the mental; or until conjugate deviation of head and eyes has become a signal symptom in convulsive attacks; or until anosmia be discovered. In several of the frontal-lobe tumors here recorded an external lesion coexisted and guided the operator to the exact locality.

It seems to have become accepted that a fairly large opening through the skull is preferable to the small trephine openings originally chosen. With such large flaps much greater facility is offered for detecting a tumor, whose remote pressure symptoms had confused the preoperative diagnosis (see Gray's case).

From the foregoing record of cases we may deduce several propositions.

In the first place, it has been demonstrated that it is practicable to open the cavity of the cranium, to penetrate the dura mater, to lay bare the brain, and even to excise portions of its tissue. The successful removal of brain tumors has restored to favor as a legitimate surgical procedure the old operation of trephining, which had fallen into desuetude.* So far this surgical restoration has proved more useful in other cases of brain disease than in that which is the subject of the present article (see article on *Brain, Surgery of*). But the fact will always remain interesting, that it was the greater exploit of excising a cerebral neoplasm, which has, in entirely modern times, encouraged surgeons to the lesser effort of trephining for cerebral abscess and traumatic hemorrhage; and revived the old rules of unhesitating trephining in traumatic cases with depressed fracture.

Again, when Hughlings Jackson first began to study the precise order of development of the sensori-motor phenomena in the class of convulsive attacks which now bears his name, their habitual dependence upon organic brain lesion had not yet been established. This has now been shown, and the cases of brain tumor attended by attacks of Jacksonian epilepsy have assumed the most favorable prognosis, because the fact of the attacks usually indicates that the tumor is situated in the cortex of the central convolutions, and from the details of the attack the exact motor centre may be inferred. Pursuing still further the line of thought, neurological surgeons have argued that if a tumor in the motor area determines

* Horsley, in a learned lecture, claims to have found evidence of operative trephining on the skulls of prehistoric men.

a definite series of explosive symptoms—sensori-motor irritation followed by sensori-motor paralysis—the occurrence of such symptoms, apart from indications of intracranial tumor, implies that the same motor region is irritated, though in some other way than by a neoplasm. Many cases of epilepsy, hitherto considered a functional disease,* have therefore been trephined, and in many of these, organic lesions, as cicatrices, have been removed from the surface of the brain or meninges, with the result of allaying or arresting the convulsive attacks. Finally, even in the absence of all visible lesion, portions of cortical tissue, containing the centres of motor representation corresponding to the limb segments whose spasm initiates the attack, have been excised.

It is not within the province of this article to discuss this latest and most interesting development of surgical method, which began with removing the tangible organic causes of epilepsy. We may observe, however, that the signal symptom of the attack (the felicitous expression is Seguin's), which is held to localize the lesion, because indicating the point of earliest and most intense irritation, does not necessarily show that the irritation originates at this point. It is quite as possible that the nerve tissue has received an irritation propagated from some distant region, but not manifest until it has spent itself upon a motor centre and thence determined a nervous discharge. Excision of the motor centre, therefore, would remove, not a cause of the spasm, but only the first effect of some possibly inaccessible cause.

From the frequent failure of the operation as a cure for epilepsy, one may suspect that some such condition of things often exists. The difficulty in these non-organic cases is paralleled in cases of tumor, when, though the convulsions are immediately initiated by irritation of the cortical motor area, the causal lesion is situated in some other part of the brain and cannot be found.

Another parallel has a more hopeful aspect. It has sometimes been found in cases of inoperable tumor that the symptoms due to pressure—vomiting, headache, and convulsions—could all be relieved when the pressure was lessened by trephining or removal of large pieces of cranial bones.† It seems therefore possible that in cases of epilepsy without gross or focal lesion, and before irremediable degeneration had set in, similarly afforded relief of intracranial pressure might arrest the disease.

Traumatism, even when not more severe than that of a fall on the head, has always been recognized as an important factor in the etiology of brain tumors. Out of the 85 cases of operation on record, there is a history of a fall or a blow in 20.‡ Morbid symptoms rarely develop very soon after the accident; months, sometimes years, intervene. In the light of the experience now accumulated, it is indicated to operate very early after the appearance of symptoms indicative of intracranial neoplasm; and the indication is especially formal if there is a history of previous traumatism. It is possible, as Seguin's case shows, to operate so early that the tumor has not yet grown large enough to be found at the operation. This is, however, the only case on the list in which the operation failed from this cause; only when the tumor is situated entirely on the surface of the cortex is it liable to excite convulsive twitchings while yet very small; but in such a situation the tumor should be easily found.§ The danger of delay in operating is well shown in the first case of Starr and McBurney (Case 81). Eleven months intervened between the establishment of the diagnosis (when the operation was first proposed) and the time when the patient's consent to the operation was secured. In that time the tumor grew to such a size that its removal was followed by death from shock in a few hours.

The development of optic neuritis is not always proportioned to the size of the tumor, but much more to its situation. Hence, as has long been known, optic neuritis appears early and advances rapidly with tumors of the cerebellum, where the intracranial pressure is at its maximum. An early operation is often indicated to relieve this pressure before the optic nerves should have atrophied, in which case the patient would remain blind, even though he survived the operation and were relieved of other urgent symptoms.

An important decision formulated by Horsley is that syphilitic tumors should be operated on, and not left to the uncertain influence of internal treatment. Bergmann, on the other hand, maintains the sufficiency of this treatment, and the superfluous risk of the operation.

If it be assumed that all tumors of the cortex and centrum ovale are conceivably operable, the proportion of operations to cases would be 41 per cent., since 266 out of 644 cases of tumor are situated in these two localities. If to these be added 162 cases of the cerebellum, the proportion would rise to 65 per cent.

The special difficulties surrounding tumor of the cerebellum have already been emphasized. The general diagnosis is relatively easy, that is, it is usually easy to diagnose a tumor of the posterior cranial fossa and subtentorial. It is often difficult to distinguish between the middle lobe of the cerebellum and a lateral lobe; and usually impossible to distinguish between tumor of the bone compressing the cerebellum and tumor of the organ itself. A precious aid in diagnosticating tumors of the occipital lobe from those of the cerebellum is the existence of hemianopsia in the former, as against optic neuritis in the latter. Case 41 (Keetley) shows how a tumor of the pons may be mistaken for a cerebellar tumor, when by exception the paralyses of cranial nerves, so characteristic of pontine tumors, are lacking. The prognosis in cerebellar tumors, however, is rendered bad far less by the difficulties of diagnosis than by the special dangers of the operation which have already been mentioned. In the centrum ovale and cortex, on the contrary, the dangers of the operation are at the minimum, provided the tumor can be found. The difficulty of finding it depends upon: 1st, whether it lie in a latent zone or in one whose symptomatology has been determined; 2d, upon its proximity to the surface; 3d, upon the differentiation of its consistency from that of the brain.

The accessible regions of the cerebrum whose lesions have so far been connected with sufficiently definite differential symptoms are: The frontal lobes, the central convolutions, the parietal lobes, the occipital lobes, the left temporal lobe, and the left insula. The differentiating signs have been sufficiently emphasized in the text. Tumors of the centrum ovale are always latent as to their locality—being indicated by general symptoms alone, unless they come near enough to the surface to irritate the cortex. In Gray's case (86), Table I., the position was made out with great precision, but the failure was due to the third operative difficulty which has been mentioned, namely, the extremely soft consistency of the tumor.

This difficulty can never be foreseen in advance, and seems to be as much to be feared with large as with small tumors.* Possibly some future therapeutic resource will enable the surgeon to prepare his patient for operation by the ingestion of some food or drug which should change the consistency of the tumor.

Medical resources at present are extremely meagre—after we have mentioned the use of mercury and iodide of potassium in cases of syphilitic tumor. An energetic inunction treatment is required. 4 to 5 gm. mercurial ointment daily for six weeks—followed, after a pause, by a course of iodide of potassium, 5 to 10 gm. to 200 gm. of water, of which a tablespoonful three times a day.

For vomiting, pain, and convulsions, morphine, chloral, and bromide of potassium are the three remedies, and the greatest of these is morphine. For details of craniotopography, operative procedure and technique, and the special dangers incident to the operation for brain tumor, the reader is referred to the article on *Brain, Surgery of*, by Dr. Keen, in the present volume.

Mary Putnam-Jacobi.

* According to the present view, non-localizable, i.e., generalized epilepsy depends upon a diffused microscopic sclerosis (Féré, "Les epilepsies") or a degeneration and vacuolation of ganglion cells (Dana, "Treatise on Nervous Diseases").

† Horsley (see Case 45) removed first one half, then the other half of the occipital bone, "and the patient lived in comfort two years."

‡ Cases 1, 3, 5, 16, 18, 24, 31, 37, 38, 41, 49, 55, 58, 68, 74, 75, 76, 80, 82. Case 38 is particularly interesting. It is that of a little girl in a Swiss school who was struck on the head with a ruler by the teacher.

§ In Case 50 (Church) the tumor was a spider-like, filiform growth, extended on the surface of the central and frontal gyri.

* It is characteristic of gliomata.

BRANCHIAL CYSTS.—Branchial cysts are cystic tumors of the neck and some parts of the head, originating from congenital defects of development, their matrix being composed of fœtal epiblastic or hypoblastic tissue which remains in its embryonal state for an indefinite time, and later, by proliferation of its epithelial elements, gives rise to a distinct and characteristic type of cystic tumors. They have been variously designated as branchial cysts (Roser), dermoid cysts of the sheath of the internal jugular vein (Langenbeck), deep-seated atheromatous tumors (Schede), tumors of the branchial clefts (Virchow), hydrocele colli congenita (Maunoir), hygroma colli (Luschka), and atheromatous cysts of the lymphatic glands (Luecke), in accordance with the nature of the contents of the tumor or the peculiar etiological views entertained by the different authors. It appears to me, however, that "branchial cysts" is the most appropriate term, as it expresses at once both the location and the character of the tumor.

Toward the end of the first month of fœtal life we see, under the frontal process, open in front and bounded on the sides by four plates, the pharyngeal cavity. The upper pair of plates constitutes the first branchial arch. The next three pairs of plates make up the second, third, and fourth branchial arches, which decrease in size from above downward, so that their median interspaces in front are narrow above and wider lower down. Between any two individual branchial arches, on each side, remains a transverse cleft, and, during early fœtal life, these branchial clefts, with the exception of the first one, from which the external auditory canal, the cavity of the tympanum, and the Eustachian tube are developed, unite. The neck is thus built up of continuous lateral walls. From the second branchial arch are developed the styloid process, the stylo-hyoid ligament, and the lesser cornua of the hyoid bone; the third arch forms the large horns and the body of this bone; the fourth arch assists in forming the soft tissues of the neck. The larynx, trachea, and adjacent glands are developed from other centres of fœtal growth. The primary origin of these tumors necessarily must correspond to the location of one of these branchial clefts, and clinical experience has demonstrated that they are most frequently found in the region of the second and third branchial clefts, in the vicinity of the larynx and pharynx, and in intimate relation with the sheath of the large vessels of the neck, in contradistinction to dermoid cysts about the orbits and in the scalp, which are more superficially located. In the case of a young lady, Langenbeck observed a cyst situated on the left side of the epiglottis and pharynx, which occupied one-half of the floor of the mouth, and which projected from underneath the chin on that side in the shape of a smooth tumor of the size of a fist. Respiration, deglutition, and the motions of the tongue were greatly impeded. The cyst contained eight ounces of atheromatous matter. The same author states that he has frequently found these tumors attached to the greater horn of the hyoid bone or to the thyro-hyoid ligaments, localities which plainly indicate that they originated from remnants of former branchial clefts.

As they are often in intimate connection with the sheath of the large vessels of the neck, it is very important to study their anatomical relations to these important structures. The jugular vein is surrounded, throughout its whole course in the neck, by a distinct and separate sheath of areolar tissue which, on the outer side of the artery, penetrates into the deep tissues of the neck, thus completely separating the two vessels. The jugular, enclosed in its sheath, may be easily drawn over the artery toward the median line without producing any change of location of the artery. The vein being in front of the artery and covering half of the lumen of the latter, it can be readily understood that when the vein is drawn forward, with its sheath, it can be injured, while the artery is not exposed to the same danger. Branchial cysts of the second and third clefts are always observed in the sheath of the large cervical vessels, usually in the carotid triangle above the omo-hyoid muscle. They appear to occur more frequently on the left side of the neck. Their shape is invariably round or oval, with a smooth surface. The contents of these cysts being either fluid or semifluid, fluctuation can be felt, more particularly if the tumor is palpated between two fingers, one of which is placed in the pharynx or on the floor of the mouth, and the other on the external surface. Only lateral motion of the tumor is possible, on account of its peculiar attachments to the deep tissues of the neck. If the tumor is of only moderate size the pulsations of the carotid artery can be felt on its inner margin. If it is large it overlaps the artery, in which case the pulsations of the vessel are communicated to the tumor. Smaller tumors can be made to pulsate by bending the head backward and in a direction opposite to the tumor.

Branchial cysts should be classified according to their contents. The cyst walls being lined with epithelium, the only histological elements in the contents are epithelia. In most instances the epithelia lining the cyst belong to the tessellated variety, but Rehn discovered, in a blind congenital fistula ending near the mucous membrane of the pharynx, ciliated epithelium; and Neumann found cylindrical and pavement epithelium in two cystic tumors of the neck, one of which was congenital while the other was developed in later years. The physical and chemical properties of the cyst contents will depend largely on the amount and degree of activity of the retrograde processes which may have taken place in the epithelium.

Clinical experience and pathological examination have shown that these tumors, according to the physical properties of their contents, may be divided into the following four principal varieties:

1, Mucous cysts; 2, atheromatous cysts; 3, serous cysts; 4, hæmato-cysts.

Variable as the contents of these varieties may be, more uniformity is observed in the structure of the cyst wall. In the primary stage of the affection it consists of a connective-tissue capsule with an epithelial lining on its inner surface, and a delicate layer of a loosely connected reticulum of connective tissue (pericystium) which is very vascular, and covers the outer surface of the cyst. A high degree of intracystic pressure may cause atrophy of the epithelial lining and thinning of the walls of the sac, and, on the other hand, inflammatory proliferation produces great thickening of the cyst walls. While dermoid cysts contain the characteristic secretions of the skin and its appendages, the branchial cysts contain only the products of the epithelial cells, because their walls do not contain any hair follicles, sebaceous or sweat glands, as the branchial clefts close before these appendages are formed.

1. Mucous Branchial Cysts.—As a primary formation, this form of branchial cyst is usually found in the upper branchial clefts. Their origin is attributable to an imperfect closure of the upper portion of the branchial tract; consequently the cyst wall may derive its lining from the mucous membrane of the pharynx, and the retention of the physiological secretion produces a mucous cyst. Many of the so-called ranular cysts, about the base of the tongue, belong to this variety of tumors.

2. Atheromatous Branchial Cysts.—This form of branchial cysts has been described by some authors as deep-seated atheromatous cysts of the neck (Schede), and dermoid cysts of the sheath of the large vessels of the neck (Langenbeck). They are usually located in the second and third branchial tracts in the region of the hyoid bone, and are intimately connected with the sheath of the large cervical vessels. These cysts contain an atheromatous material resembling the contents of an ordinary retention cyst of the skin, with this difference, however, that they never contain anything which would