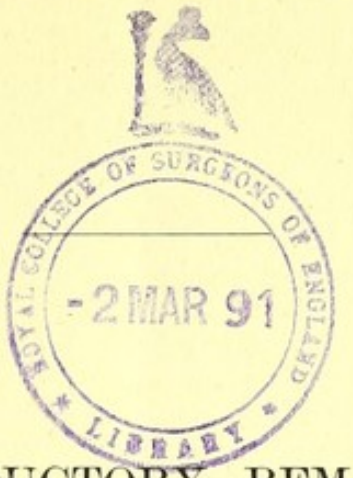
Intra-cranial lesions : introductory remarks on the following questions / by W.W. Keen.

INTRA-CRANIAL LESIONS.



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INTRODUCTORY REMARKS ON THE FOLLOWING QUESTIONS.

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DISCUSSION ON INTRA-CRANIAL LESIONS.

October 22, 1890.

QUESTION I.

WHAT ARE THE MEANS OF LOCALISING INTRA-CRANIAL LESIONS?

QUESTION II.

WHAT IS THE NATURE OF THE CHIEF INTRA-CRANIAL LESIONS (HAEMORRHAGE, ABSCESSES, TUMORS), AND HOW CAN THEY BE DISCRIMINATED?

QUESTION III.

WHAT ARE THE INDICATIONS AND CONTRA-INDICATIONS OF OPERATIVE INTERFERENCE IN CASES OF INTRA-CRANIAL LESIONS?

QUESTION IV.

WHAT ARE THE BEST MODES OF OPERATING IN CASES OF INTRA-CRANIAL LESIONS?

QUESTION V.

WHAT ARE THE IMMEDIATE AND ALSO THE REMOTE RESULTS OF OPERATIVE TREATMENT IN CASES OF INTRA-CRANIAL LESIONS?

INTRODUCTORY REMARKS ON THE FOREGOING QUESTIONS.

The programme proposes five questions for discussion. I feel that it will be better for me to leave the first two, con-

cerning cerebral topography and the nature of the lesions, to the able neurologists who are to take part in the discussion, rather than to attempt to treat them so briefly and imperfectly as I should have to do in this paper. I shall therefore content myself with some observations on the last three subjects, which are strictly surgical.

ROLANDIC FISSURE METER.

Before doing so, however, I desire to show to the Association Mr. Horsley's new Rolandic Fissure Meter, which I have lately obtained through his courtesy. Heretofore we have assumed, as shown by Thane, that the fissure of Rolando runs downward and forward at an angle of 67° with the middle line. Mr. Horsley's observations have convinced him that the angle varies with the shape of the head, that is to say, with the cranial index. The higher the cranial index, the greater the angle; the lower the index, the lower the angle. Mr. Horsley assumes a standard for the cranial index of 75 as established by the caliper of Broca, and for the angle of the fissure of Rolando 69° instead of 67°, and for every two integers of variation in the cranial index he assumes one degree of variation in the angle of the Rolandic fissure. Hence, if the cranial index is 77 instead of 75, the angle for the fissure would be 70° instead of 69°, and if the cranial index is 73, the angle for the fissure would be 68°, and so on. Based upon this, he has devised the instrument which I show you, and which differs from the ordinary fissure-meters or cyrtometers in being provided with means for rotating the arm representing the fissure of Rolando.

TOPIC III.—INDICATIONS FOR OPERATIVE INTERFERENCE.

In considering the Indications for Operative Interference in the brain, we must bear in mind, first, the peculiar physical character and relations of the brain, and the mechanical and physical disturbances to which it is subjected; and, secondly, its functional disturbances.

The brain differs from all other organs of the body in its physical character and relations. It is softer, and its functions are more easily deranged by pressure, especially if that pressure increase rapidly. Its texture is of a more delicate organisation, and the continuous and undisturbed performance of its functions are more vitally important to the ordinary activities of life than those of any other organ. It is also more closely and firmly encased than any other organ. It is perfectly true that other organs have an envelope of greater or less resistance and density. For example, the eye is enclosed in the sclerotic, the testicle has the tunica albuginea, the structures in the palm are protected and to a certain extent enclosed by the palmar fascia, and the organs of the abdomen and pelvis and those of the chest are enclosed partly by bony and partly by muscular walls. If there is any increase in the contents, and therefore in the pressure, within the eyeball, or within the tunica albuginea, either by inflammatory exudation, by suppuration, or by a new growth, it is true that the envelope restrains them and produces compression; but the envelope will either yield or will be perforated with comparative ease; and, besides, even should these organs be destroyed, this does not involve life. If there is any similar increase in the contents, and therefore of the pressure, within the chest or abdomen or pelvis, there is plenty of room for any exudation, for pus, or for a tumor, without producing fatal pressure on the contained organs. If an abscess forms under the palmar fascia, it can escape either under the annular ligament into the forearm, or posteriorly between the bones, and so relieve the pressure.

In the brain it is different. Not only is it a delicate organ, the integrity and function of which are destroyed to a greater or less extent by any pressure unless quickly relieved, but the bony case which protects it is so firm and strong, that, as a rule, long before it can be perforated and the dangerous pressure thus be relieved, the brain will be rendered incapable of performing its functions, or life itself be destroyed.

In cases of increased pressure, both the brain and the skull

vary very much in their behaviour when the pressure increases acutely and when it increases slowly. For instance, when we have a rupture of the middle meningeal, or acute hydrocephalus, the pressure will quickly cause coma and death; but in a case of chronic hydrocephalus, or sometimes of tumor, the increase is so slow that the brain accommodates itself even for a number of years to a gradually increasing pressure; and, if the patient be young, even the bones of the skull will yield without producing a fatal result, except after a long interval. These considerations must weigh much in forming our decision.

In addition to these mechanical disturbances, there are certain functional disturbances not caused by increased pressure, and probably the result of microscopical, and even as yet undiscovered, changes in the brain, which lie in another category.

Hence, in considering the question of operative interference from a clinical stand-point, the first great class of cases are those which have to do with *pressure symptoms;* the second great class have to do with what we may name, in default of a better term, *functional disturbances.*

In the first class, or *alterations producing pressure*, we may include abscess, tumor, effusions, and haemorrhage. To these pressure-producing intra-cranial lesions (which are the only ones to be considered in the present discussion) should be added fractures attended by depression.

There is also another class of injuries, such as gun-shot or other penetrating wounds, and lacerations of the brain substance resulting from contusion, which produce very many of the same symptoms as the lesions mentioned in the first class, as well as additional symptoms peculiar to these lesions.

Among the *functional disturbances* may be mentioned epilepsy, arising either from traumatism, and attended therefore usually with gross appreciable changes in the brain, though not necessarily with increased pressure; and, again, functional epilepsy, in which there are no gross lesions. In the

same class we should include inveterate headache, insanity, and other mental disturbances and arrested development.

I will therefore briefly discuss, first, the indications for operative interference in the class of lesions attended with pressure symptoms, and, secondly, in those which are functional in character.

First, lesions attended by increased intra-cranial pressure.— We can in a few words discuss the phenomena which attend increased intra-cranial pressure. First, the *intellectual function* suffers, and the patient becomes dull and stupid, and this stupor may gradually deepen into coma and total unconsciousness. Or, while consciousness is not affected, the faculty of language may suffer, or ocular or auditory appreciation may be disordered. Secondly, there will be disturbances of *motility*, resulting either in paresis or paralysis of certain muscles or groups of muscles, for example, in hemiplegia, monoplegia, or ophthalmoplegia. Thirdly, there may be changes in *sensation*, either over smaller or larger areas. Fourthly, there will be changes in a majority of cases in the *optic discs*, and possibly of other parts of the eye-ground.

These phenomena will vary in detail with the case, will be more or less pronounced, and any one may be absent, but in no case can there be increased intra-cranial pressure to any extent without producing, wholly or in part, the picture I have so briefly drawn.

If to these pressure symptoms there be added the phenomena peculiar to any one lesion, the diagnosis is well established. For example, in tumor we will have the so called cerebral vomiting, and generally headache and convulsions. In abscess we will have very likely a sub-normal temperature and cerebral vomiting, a demonstrable cause in a long-standing otitis media, or a preceding severe fall or blow. In haemorrhage from the middle meningeal, the history of a distinct traumatism, followed by that most important sign, an interval of lucidity, after which the coma will come on; while in ordinary apoplexy we have the age, the existence of atherom-

atous arteries, and, what is usually equally important, the absence of traumatism. Besides all these general symptoms, there will be the localising symptoms, which are of the greatest value.

If any lesion which produces increased pressure—which pressure, if unrelieved, will prove fatal—can be located, and, with reasonable certainty, can be differentiated from other conditions which produce more or less similar phenomena, and if the location is such as to render it accessible, our duty is clear. We should open the head and remove the cause of the dangerous pressure, just as we open the abdomen, the chest, or the palm to remove pus, an effusion, a clot, or a tumor. The head has been too long regarded as something apart, something different, from other portions of the body, with peculiar and anomalous rules as to surgical interference. What I wish to urge is, that it shall fall into line with the other cavities of the body. Subject, as it is, to the same diseases and injuries, it must be subject also to the same rules for surgical interference,—modified in detail, it is true, but in no wise differing in principle.

It is perfectly true that our means of making a diagnosis are, in the head, greatly limited as contrasted with other parts of the body. For example: Inspection as a rule reveals nothing, whereas inspection of the abdomen, palm, or chest reveals a great deal. We are cut off from the use of touch by reason of the hard, bony skull. For a like reason percussion is almost valueless, and auscultation does us no good. But we have, on the other hand, changes in far distant organs which do not exist in other lesions. The paralysis of the hand, the arm, or the leg helps us to recognise and to locate the lesion in the brain with an accuracy which now, though not unimpeachable, is becoming more and more marked from year to year. So, too, the alteration of sensation in distant parts and the lesions of the eye-ground are often equally valuable and equally certain.

Secondly, functional disorders.—There are certain functional disorders, also, in which we ought to interfere, and can

often do so with advantage, though the indications in this class are as yet far less clear than in the case of pressure-producing lesions. Our ability to decide this often difficult question is also gradually but surely increasing.

The indications for operative interference may be thus briefly summed up: The disease must be, first, a grave danger to life, growth, mental development, or so destroy the comfort of living that life is not worth having. Secondly, it must be established in each case that the ordinary medical means have been exhausted, and that nothing further can be expected from drugs, from diet, hygienic care, etc. Thirdly, the danger to life from an operation must not be so great that we may not rightly run this reasonable risk in the hope of a greater gain. It has been amply proved of late years that trephining *per se* is not an especially dangerous operation, provided it be carried out with modern antiseptic precautions. When we go beyond simple trephining and open the dura, it adds a little, but not a great deal, to the danger. When we take a further step and excise a portion of the tissue of the brain, the danger is increased, and may be even greatly increased, it is true, but not to such a degree as to prevent our taking this step in case a great gain is to be reasonably hoped for, and in case there is certain danger of deplorable and probably permanent mental and physical loss and deterioration without such interference.

Thirdly, exploratory trephining.—In both classes of disorders, however, there are a considerable number of cases in which we are in doubt, either of the character of the lesion, of its extent, its location, or its physical characteristics. In these cases the same rule again should hold good in the head as in other parts. If the danger is great, and especially if the result without interference is almost sure to be fatal, as is so often the case, intra-cranial lesions must now fall into line with lesions elsewhere, and we should do an exploratory trephining in order to make a correct diagnosis; and if the exploratory operation shows it to be possible, we should remedy the condition found. The vital importance of the brain,

and the gravity of its lesions, while they should make us cautious, should also make the rule of exploratory operation even more imperative here than elsewhere.

This rule, however, must be modified in intra-cranial lesions in one important respect. In the abdomen, for instance, we need not be absolutely sure of the location of the lesion, as, once that the belly is opened, its entire cavity is at our command. In the brain the conditions are far different. Exploration is limited to the exposed area and its vicinity: hence the location of the lesion should at least be *probable* before we operate. But the extreme gravity of these intra-cranial lesions should embolden us to operate when the location *is* probable. If we wait until it is ascertained with certainty, we must wait till a post-mortem clears up the diagnosis.

I should be loth to give the impression that I recommended reckless or indiscriminate trephining to any surgeon, even to the best. Each case must be carefully considered, all the facts elicited, and the possibilities weighed, the advantages and the dangers; and if, having faithfully done this in each obscure case, the possibilities of gain outweigh the possible or probable dangers, exploratory trephining is clearly indicated.

TOPIC IV.—THE TECHNIQUE OF OPERATIONS ON THE BRAIN.

Shaving.—Under this head I wish to insist primarily on the need of shaving the head, in order to determine the existence, number, and position of any scars. I have almost never shaved a head without finding several scars, with perhaps the history of only a single known traumatism.

I cannot better illustrate this, I think, than by narrating briefly the following case, in which I have also the pleasure of showing you the result in the person of the patient himself:

W. A., aet. 15, weight 97 lbs., was seen in consultation with Dr. B. A. Watson, in Jersey City, September 28, 1888. A little over two years before, he fell out of a swing on a

stone step, striking on the top of his head, and cutting the scalp badly. He thinks he was not unconscious. The wound healed in four weeks. Two months after the fall his first epileptic fit occurred. The bromides reduced the number of them to about one in a month, but when not taking them he had a fit nearly every day, beginning usually in the hands, on which side could not be determined.

Four scars were discovered on shaving his head, the principal one an inch and a half long, beginning at the fissure of Rolando, a quarter of an inch to the left of the middle line, extending across the right side one inch and a quarter to the right of the middle line, the direction being slightly oblique backwards. A second, smaller scar was one inch and three eighths back of the fissure of Rolando, two and seven eighths inches to the left of the middle line; and a third, still smaller, at the same distance back of the fissure of Rolando and three eighths of an inch to the left of the middle line. The fourth small scar was just above and one inch to the left of the inion. The size of the scars was in the order in which they are named, all but the first being small. All of them were slightly tender, the tenderest being the third named. Under it, also, an obscure indentation of the bone could be felt. Naturally one would suppose here that the largest scar was the one acquired at the time of the only known accident in his history, and which was followed so promptly by epilepsy.

It will be noticed that the history of the fits gave no indication as to the location of the cortical lesion. There had been no motor phenomena in the legs, though the principal scar was over the leg centre, nor had there been any sensory or mental phenomena, such as word-blindness, word-deafness, agraphia, etc. The eye-grounds were not altered. I should add, also, that the boy had been kept in the hospital under Dr. Watson's observation, but on no occasion could a fit be observed.

In view of the difficulty of localising any lesion by the symptoms, and of the tenderness of the scars, I determined

first to excise the scars themselves and examine the bone, and if I saw reason, to trephine at any point where the bone seemed to have been injured. If the bone was found normal, I would do nothing at this time but excise the scars and await the result.

September 28, 1888, the scars were excised. The bone appeared uninjured, and nothing else was done. For a short time after the operation the fits were absent, but then returned, and for months after occurred from one to three or four times a week. Observation in the hospital again failed to determine their character, but the mother was now quite confident that the right side of the body was more affected than the left. Moreover, the boy had developed homicidal and suicidal tendencies. Accordingly, on September 7, 1889, at his own and his mother's urgent request, I did the following exploratory operation:

Though the principal scar was chiefly on the right side, the symptoms seemed to point to the left side of the brain as the region of the trouble. I trephined, therefore, at the left end of the principal scar, a half inch to the left of the middle line, as close as I deemed prudent to the longitudinal sinus. A one and a half inch button of bone removed showed nothing abnormal in the bone. In order next to determine whether there was any lesion of the skull on the right side under the scar, I took Horsley's dural separator and swept it carefully backward and forward, hugging the bone very closely with the advancing edge, lest I should penetrate or tear the sinus, and thus I worked slowly from the left side across the sinus an inch and a quarter to the right side of the middle line. I found the manoeuvre not difficult, and perfectly successful. I separated the sinus from the bone, the adhesions of the dura being much greater there than on either side of it. I also loosened the dura on the opposite side, and was able by the separator to determine that there was no irregularity on the under surface of the skull corresponding to the principal scar, as far as one and a quarter inches to the right of the median line, and

one and three quarters inches from the edge of the trephine opening. The history and this examination convinced me that most likely the two small scars to the left of the trephine opening were possibly, if not probably, the site of the mischief.

Accordingly, I first exposed the brain under my first opening. This appeared normal. Biting away the bone in the direction of the lesser scars and opening the dura, the brain was soon seen to be abnormal over an area an inch in diameter, and corresponding to the second scar. The abnormal area was whitish, as from an old inflammation, with at one point apparently a small cyst. In front and to the left was a distinct area of redness one third of an inch in diameter. The whole of the abnormal area, also, was slightly depressed.

Unfortunately the battery which we had at hand, at the moment when we wanted to use it, would not work, and I was unable to determine the possible motor value of the convolution. As nearly as I could judge it corresponded to the supra-marginal or possibly to the angular gyrus, but it could not be distinctly recognised.

I then excised the abnormal part, measuring one inch antero-posteriorly, one and a quarter inches transversely, and scant three eighths of an inch in thickness. Immediately under this area removed, but half an inch deeper, I thought I felt a spot of hardness, which I removed with a Volkmann spoon. Examination of this afterwards convinced me that my touch had been at fault, and that I had needlessly removed normal tissue.

The dura was now sutured, the large button and a number of small fragments of bone were laid upon it, and the wound dressed as usual. The boy's highest temperature was only 100.6° on one occasion, and in a week it fell to normal. His recovery was very speedy, a slight paresis of the right hand being the only apparent motor phenomenon.

Dr. Watson had his eyes carefully examined, as I feared I had injured the visual centre or its radiating fibres, but neither was there any ordinary blindness nor any word-blindness nor apraxia.

December 11th, 1889, three months after the operation, I received a letter from the boy expressing his thanks, and adding that he had had no fits, and was at work in an express company. Since then he has followed the sea and been exposed to all its hardships. He has had no homicidal or suicidal tendencies. His attacks in nearly fourteen months have only been four, and the last one was over three months ago. He has grown tall and robust. His hand, as would be judged by his occupation, is entirely well.

This case illustrates well the point I have made, that shaving the head is an essential preliminary. With the history of only one accident, four scars were found, and the principal scar was evidently not the one corresponding to the cerebral lesion. In addition to this it shows, as an operative point, that by the means I have described we can separate a sinus from the skull, and reach across it to examine at least the bone, far away from the trephine opening.

Sublimate Solution. In connection also with the preliminary preparation of the patient, I desire to emphasise the fact that the corrosive subiimate should not be used on the freshly shaven scalp stronger than 1 to 2,000, for I have found that the ordinary 1 to 1,000 solution pustulates the scalp; and even if there be no danger from it, it is the source of great annoyance which may easily be avoided. Once that the brain is exposed, I discard all antiseptics and use only boiled water, not so much on account of the possible danger of poisoning as because the antiseptic lessens the reaction of the cortex to the electrical current.

Haemorrhage. The position of the patient is important. Mr. Horsley always operates with his patient reclining, not very far from a sitting posture; and I think the point is well made, as it diminishes the danger of haemorrhage, which, with shock, constitute the two great dangers of cerebral surgery. The preliminary use also of morphia and ergot will diminish the calibre of the blood vessels, and is certainly of value. The application of antipyrine and cocaine (ten per cent. sol.), is of undoubted value, I think, in checking gen-

eral oozing, but I doubt if they are of any more value than hot water, and, after all, it is not the general oozing that troubles us so much as the large veins. Hence I think they may both be dispensed with.

For the arrest of the haemorrhage our chief reliance, however, must be placed on the ligature by catgut. In doing this the large vessels and especially the large veins should be double ligatured before division. Once they have been cut it is very much more difficult to tie them than before. The haemostatic forceps sometimes hold, but more commonly they tear away, producing renewed haemorrhage, often controlled with great difficulty. The greatest care must be used that the action shall be equal upon the two ends, and that it shall not be too great: just enough to occlude the vessel and to retain their hold is sufficient. To have room to cope with this formidable danger, also, the opening in the skull must be ample. No vessel should be cut near the edge of the opening. If needful to cut it there, the opening should first be enlarged by the rongeur forceps.

In addition to the ligature, hot water has yielded me very good results in many cases. But I am convinced that in at least one case I have used too hot water, and produced cerebral disturbance, which contributed to the fatal result. It should not be over 120°, if indeed so hot.

Haemorrhage from the superior longitudinal or lateral sinus is always an alarming event, and may make the operation speedily fatal, not only, I may even say not so much, directly from loss of blood, as from the shock and loss of vitality of the nerve-centres. It happened to me recently in one case, to wound one of the large veins at its junction with the superior longitudinal sinus, in spite of the fact that I thought I had gone quite far enough away from that dangerous region. The reason for my being so unexpectedly near it was, that, in consequence of a defective development, the sinus lay a half inch to one side of the middle line. I had recognised the defective development and had allowed for the displacement of the sinus, but, as the result proved, I had not allowed

enough. The haemorrhage was very severe, but was quickly controlled by a pair of haemostatic forceps. During the later manipulation the forceps became detached, when another rush of blood came, and although this was controlled in the same way, in a few minutes the patient became moribund, and died in fifteen minutes after the speedy termination of the operation, about half an hour after the haemorrhage occurred. The amount of blood lost was perhaps not more than from eight to twelve ounces, an amount that the patient could easily have lost from the arm or from a wound in the scalp without such direful consequences. Hence, if possible, these large veins should be carefully avoided, especially near the middle line where they empty into the sinus, and if they must be divided it should only be after double ligature

Should the sinus itself be wounded, one of three courses is open to us. The first, as my friend Dr. W. J. Taylor did during the past summer, is to seize the edges of the sinus by the haemostatic forceps, as above narrated, and let the forceps remain *in situ* for two or three days; secondly, to pack the sinus, as many surgeons have done, and in most cases successfully; thirdly, as has been done in a few cases, to tie the sinus with two ligatures, one on each side of the wound.

This last manœuvre, however, is much more difficult in a case of an abundant haemorrhage which follows a wound of the sinus, than as a prevention of haemorrhage when the sinus is to be deliberately cut across. The deliberate ligation of the sinus has been done a few times, one of them being a recent very remarkable case related to me by Mr. Horsley, in which he removed a large part of the frontal and of the squamous portion of the temporal bones, tied and divided the sinus, and lifted the frontal lobes, thus gaining access to an aneurism at the base of the brain pressing on the optic chiasm, for which he ligated both carotid arteries, a surgical feat only equalled in its daring by the brilliancy of the diagnosis, which was verified by the operation. The patient at last accounts was recovering from the operation.

Whether he recovered from the aneurism or not, time will have to show.

Not uncommonly, after trephining, the cut edge of the bone bleeds very freely. To arrest this Mr. Horsley informs me that he uses the following paste or putty: Melt repeatedly one part of yellow wax to four of vaseline. Next, add carbolic acid one to twenty and mix intimately. Then add sufficient white wax to make a mass that will be hard when cold, but be quickly softened by the fingers. With this (kept disinfected, of course) he putties up the vessels in the edge of the bone.

Drainage.—Whether drainage shall be employed or not is an important question. Of course in abscesses and other suppurative cases continued drainage must be employed; but in ordinary operations I think the question must be decided in each case chiefly by the haemorrhage. If this has been so far arrested that the wound is almost dry, drainage may be safely omitted altogether. Mr. Horsley tells me that he has operated in all his recent cases without drainage. This is certainly the ideal operation, and the end toward which we all strive. In order, however, that we may do without drainage, the haemorrhage must be arrested to such a degree that only slight oozing, if any, shall remain when the wound is closed.

EXPLORING FOR ABSCESS.

This, as I have pointed out in former papers, should not be done in obscurely described directions "downward and a little inward and forward," etc., but from the opening always in a definite direction, *e. g.*, in the direction of the external angular process, the opposite pupil, an inch above the opposite external auditory meatus, etc. The reader then can locate the abscess when he knows the point of departure, the direction of the puncture, and its depth. I have also given my reasons for preferring a grooved director to a needle in such explorating punctures. (Trans. Tenth Internat. Med.

Cong., Berlin, 1890, and Med. News, Dec. 1, 1888, and Sept. 20, 1890.)

THE AVOIDANCE OF SHOCK.

I am persuaded, by no little experience, that in the head more than in any other part of the body we must bear in mind the lessons taught us by Dr. Cheever in his admirable paper on Shock, read before the American Surgical Association in May, 1888. He there urged that one of the important elements of shock was the time consumed in operation. This applies especially to operations on the brain. A cerebral operation is always time-consuming, and this is especially bad in view of the prolonged anaesthesia. It is of the greatest importance, therefore, that wherever we can abridge this time it should be done.

Accordingly I always raise the periosteum along with the flap, instead of dissecting the two separately. Next, one of the most important elements in time is that required for trephining. The tendency has been of late to use very large trephines. I have commonly employed the one and a half inch trephine, and I am persuaded that anything larger than this cannot be used with advantage. I have tried a two-inch trephine, but have found that it required a longer time than if I had made two or three one-inch trephine ope ings, and then bitten away the bone with the rongeur forceps to any further required extent. This arises from its becoming fastened in the bone, and from the impossibility of adapting it well to the curved surface of the skull, and to the different thicknesses of the bone in different parts of its circumference. I have tried also to hasten the operation by using the surgical engine, but have found it not a practicable instrument. Mr. Horsley has recently devised an adaptation of the electric motor for working the trephine, with what success I do not know. The brace of a "brace and bit" has also been adapted to the trephine, with what advantage I cannot say. I am greatly inclined, however, to the opinion that the small trephine, an inch or an inch and a quarter,

and the later use of the forceps to bite away the intervening bridge and afterward, if needful, still further to enlarge the opening, is the better practice, especially with a view to speed.

It is all-important also to use the battery in every case to identify the convolutions which are exposed, in order to determine in the human brain the motor value of the convolutions, if possible. In doing so the graduated band of the fissure-meter should always be used to measure the distance of the convolution stimulated from the middle line, and from the fissure of Rolando or other well recognised fissure. I mention this exact measurement to determine the situation of the stimulated area, because, in a number of recorded cases, including some of my own, the value of such determinations is practically lost by the inexactness with which the centres were located. But while such determination of the motor value is important, it should not be made with too strong a current; it need only be such as would freely move the operator's thenar eminence, but no more. Nor should time be wasted in repeated applications further than is necessary to determine the facts.

The dura may be sutured either by interrupted or continuous sutures, whichever will enable the operator to terminate the operation most speedily.

In addition to this, the use of rest, of external heat from the very beginning of the operation, and of strychnia to prevent shock, and of alcohol, digitalis, and atropia to relieve it, have been forcibly advocated by Dercum (Med. News, Sept. 21, 1889), and should certainly be tried.

REPLACING THE BONE.

The question of closing the trephine opening by bone is still in my mind a somewhat undecided one. In all the cases in which I have done it, there is a flat surface instead of the normal arched contour of the skull. I have not been able to see, however, that it has produced any trouble, and it certainly acts as a valuable protective. In those rather obscure

cases of headache and allied disorders, in which perhaps the chief value of the trephining lies in the alteration of intracranial pressure, the bone should not be replaced. In all other cases I have replaced it without at least any deleterious results, and I am inclined to think with advantage.

If the bone is to be replaced, provision must be made beforehand for its care by placing it in a 1–2,000 sublimate solution, and it should be the sole duty of one assistant to see that this is kept at a temperature of 100° to 105° F. by means of hot water outside the cup or bowl in which the bone is placed. I have never had any trouble in replacing a disc as large as an inch and a half, and I prefer to do this rather than to spend time in chipping it up. But if the bone be greatly thickened, it should not be replaced in mass, but either bitten into small pieces, or, if the bone be diseased, it should be rejected entirely. The suggestion of Senn to close the opening by means of decalcified bone is a valuable one, especially where there has been a prior loss of substance. It has also one marked advantage in that it can be better fitted to the opening than ordinary hard bone.

TOPIC. V.—RESULTS.

These I will consider as to each disease or injury as briefly as possible. I shall not use the statistical method, but rather give the general conclusions I have reached, based both on my own experience and on a fairly thorough acquaintance with the literature of the subject. The topics as announced exclude from this paper the consideration of fractures of the skull, but I cannot help congratulating the profession on the development of cranial surgery in the treatment of these extremely serious injuries, and to urge that operative treatment shall be used more freely than was formerly the case, not only with a view to the immediate saving of life, but to the prevention of later disorders, especially of epilepsy.

ABSCESS.

No good surgeon will now hesitate to operate in a case of abscess of the brain. If there have been chronic middle-ear

diseases or a serious local traumatism, followed by stupor and other evidences of intra-cranial pressure, paralysis of the oculo-motor nerves, choked discs, sub-normal temperature, and possibly hemiplegia, the surgeon should undoubtedly trephine, puncture, evacuate the abscess, drain and dress in the usual way. It is not so much a question of percentages as it is that every case which recovers is just one life saved which under the old method of treatment would inevitably have been lost. The question Where shall we trephine? again starts the urgent cry for more accurate means of diagnosis,—a cry that will not be suppressed until the neurologists answer it satisfactorily.

TUMORS.

Practically the same remarks will apply here as in abscess. Every case that recovers is a life saved from inevitable death in case we do operate. The results have been on the whole thus far encouraging. Even very large tumors have been removed successfully, and a number of patients are still alive after several years. On the other hand, while a moderate number have died, there is again a not inconsiderable number that have suffered from a return of the original disease, and, what is still more mortifying, there have been a number of tumors sought for, and either have not been found, or have not even existed.

Here again we must ask most earnestly for the help of our neurological brethren, and happily we are not asking in vain. You will hear from some of them about to follow me the means for determining the location, the size, the number, and other characteristics of tumors and other intra-cranial lesions,—means which are becoming year by year more and more exact. We learn by our failures more than by our successes. Each case should be put on record therefore, as a means of avoiding similar pitfalls. The technique of operation is now fairly satisfactory, though not yet perfect, and its dangers have been minimized, so that we no longer fear the operation. But what we need above all else to-day is a more accurate means of diagnosis.

Tumors will sometimes be met with that are too large for removal. It is extremely desirable therefore that the neurologist shall be able to make a diagnosis of the approximate size of the tumor, if possible, before the operation. But with our present knowledge it is too much to ask that this shall be done with absolute accuracy. Hence, unless it is almost certain that the tumor is too large, it would be justifiable at present to attack it, for we may be mistaken,—the tumor not being as large as had been anticipated, and its relations with the brain much less intimate than had been supposed. If so, we may be able to remove it successfully, and if not, we can at least desist from the operation, and with modern methods, in most cases, the patient will recover from the operation; and in several recorded cases they have been bettered by the attempted yet abandoned operation.

And again: It may be that tumors are erroneously suspected to be multiple, and if so not amenable to operation. Here again it is sometimes wise, inasmuch as tumor of the brain is a certainly fatal disease, at least to attempt the removal for the same reason as just stated.

Again: Tumors may be of such character that presumably they have infiltrated the tissues, so that a return will be certain after a very short interval. Here, too, we may be in error. Even in the case of a sarcoma no infiltration may exist. I have lately had a case in point. Although the fall which was its probable cause had left no scar to locate the site of the blow, the diagnosis of the location of the tumor was exact. It was a large tumor, and the diagnosis had been either one large tumor or two smaller ones. The nature of the tumor was doubtful, but presumed to be tubercular; but the grounds upon which this diagnosis was made were not very certain. The post-mortem showed that the tumor was large, was situated in the area in which it was believed to exist, but also showed that even the slight manipulation for the removal of the brain produced auto-enucleation of the tumor. That it could have been removed by operation is very certain, and I have deeply regretted since that I declined to

operate. The tumor was a sarcoma, and the microscopical examination showed that the walls of the cavity in which it was contained were not infiltrated with the sarcomatous growth. Whether in spite of this the removal would have been followed by permanent cure is doubtful, but the patient at least should have been given the chance.

Much doubt has been expressed as to the advisability of operating upon tubercular and syphilitic growths, but cases have been reported where both have been removed successfully. The argument in favour of operating on syphilitic growths is stronger than in the case of tubercular tumors, for the reason that tubercular tumors are more likely to be multiple than any other variety.

The depth at which a tumor lies is another important point. The deeper it is situated the less accessible it is to operation: and here again we must invoke the aid of the neurologists. I have operated myself on one case in which the evidence seemed to be pretty clear that it lay in the cortex of the angular and supra-marginal gyri. At the operation it was found to lie underneath these gyri, but at such a depth as to render its extirpation impossible, and the patient died a few hours after the operation.

Perhaps the greatest opprobrium of cerebral surgery and the best proof of the need of more exact means of diagnosis, is in the number of operations in which either no tumor was found, or it lay in a wholly different position from that which had been diagnosticated. I have never yet operated in any case in which no tumor existed, but in one case the tumor was diagnosticated in the cerebellum, and the post-mortem showed that it was in the floor of the third ventricle.

In one locality it is a question whether tumors, unless they are small and accurately diagnosticated, can be removed with safety, namely in the cerebellum. A few such have been operated on, but all have proved fatal. In one case (Trans. Internat. Med. Cong., Berlin, 1890; Med. News, Sept. 20, 1890) I suspected a tumor and sought for it, not by a formal operation, but by a slight opening in the skull and prob-

ing of the cerebellum, both through the exposed lobe and obliquely into the opposite lobe without any resultant inquiry. The post-mortem showed that the tumor was a soft sarcoma, and my probe had passed through it without detecting its presence. But had I detected it and attempted its removal, the large vessels supplying it and its intimate relations to the fourth ventricle make it probable that the patient would have died upon the table. The structures in the neighbourhood of the cerebellum and fourth ventricle are so vital that I doubt whether we shall be able to cope with their dangers successfully, except, as I have said, in the case of small tumors situated well back in the cerebellum, and indicated by such symptoms that we can diagnosticate them accurately.

EPILEPSY.

The most frequent disorder in which our advice is sought as to the propriety of operation is epilepsy. In cases of traumatic epilepsy, the results have been on the whole very encouraging. A considerable number of cases are on record, some of them very severe, in which the patient has been relieved entirely of his dreadful malady, and while idiopathic epilepsy has not yielded such good results, they have been sufficiently encouraging to warrant our persisting to operate in well selected cases.

The results, I think, in general may be summed up as follows: First, taking one operator with another, a small percentage will die from the operation. Secondly, in a small but somewhat larger percentage, absolutely no result, good or bad, will follow recovery from the operation. Thirdly, in a large percentage of cases the patient, while not cured, will be benefited, the fits persisting, but with lessened frequency and violence. Fourth, perhaps in 20 per cent. or less the result will be practically a cure. If I may judge from the feeling of the parents and of the patients also, the judgment of those most interested is that the operation is justifiable, because the malady is so dreadful. Even if the patient is not benefited no harm is done, and whether he is benefited, is cured, or dies, both he and his friends are content.

One thing especially should be noted. It has been used as an argument against operation, that the removal of diseased tissue will result in a permanent paralysis, and that the patient pays dear for the cure by the penalty of paralysis; and he may not even be cured, but have the additional affliction of a useless arm or leg. This is not my experience. The paralysis which follows the excision even of a motor centre is only temporary. One of my patients, whose hand was absolutely paralysed immediately after the operation, had so far recoved its use after between three and four months, that he could play base ball; another is able to use his hand well, though it is slightly paretic; and a third is scarcely conscious that his hand was ever affected.

Whether, as is most likely, this recovery of function is due to the development of the bilateral function of the corresponding centre on the other side, or whether, as seems less likely, though not impossible, new cerebral tissue has been developed, is not certain. The recent experiments of Prus,[1] Salviati,[2] and Gilman Thompson[3] show that portions of the cerebral cortex can be successfully transplanted from one animal to another. Possibly hereafter this may lead us to a more perfect restoration of motor function by a similar transplantation from an animal to man.

HAEMORRHAGE FROM THE MIDDLE MENINGEAL ARTERY.

Haemorrhage from the middle meningeal artery, even without fracture, is now an accident amenable to operation, and not uncommonly with success. I would especially urge that if the clot is not found by the first trephining, a second trephine opening should be made, as is advocated in the able paper of Krönlein (Deutsch. Zeitschr. f. Chir. Bd. 23 Heft. 3 and 4, 1886). The site of these openings should be, as he has indicated, first, one inch behind the external angular process at the level of the upper border of the orbit, and failing

[1] Annals Surg. IX. 225.
[2] Wien. Med. Presse, 1889, No. 20, p. 838.
[3] N. Y. Med. Jr., June 28, 1890.

to find the clot, secondly, at the same level and just below the parietal boss. The two openings give access to the two branches of this vessel.

The accident, if untreated, is necessarily a fatal one. The operation, while by no means always a success, has resulted most brilliantly in several cases, and its lesson is evident,—that the surgeon should always at least endeavour to save life by trephining and ligature of the bleeding vessel.

SURGERY OF THE LATERAL VENTRICLES.

I have so recently and fully considered the question of the surgery of the lateral ventricles (Trans. Tenth Internat. Med. Cong., Berlin, 1890; Med. News, Sept. 20, 1890), that I need not here repeat what I have said in that paper, saving to urge that a trial be given to the method I have advocated, until its value or its worthlessness shall be determined.

INVETERATE HEADACHE.

Cases of inveterate headache, which have resisted all other known means, and still make life unbearable, are as yet in the category of undecided questions, judged by the results. Enough cases, however, have been recorded to show that it is well worth a trial, until the value of trephining shall be rightly determined.

MANIA.

In mania following traumatism it is certainly right to attempt relief by a carefully conducted exploratory trephining. Should death follow, it is a relief from a condition worse than death; and should relief and cure follow, as has already been the fact in a number of cases, it is a brilliant triumph. The evidences of the site of the injury guide us as to where to operate.

ARRESTED MENTAL DEVELOPMENT.

In cases of imperfect mental development from arrested growth, or, as in the case of Hare and Felkin (Manchester

Med. Chron., Oct. 1889), from a cyst following an injury, the result of operation has been such as to encourage us ; but excepting those cases which follow traumatism, I cannot look with great encouragement to the future of cerebral surgery in this direction. Whether or not the remarkable result of Craniectomy recently recorded by Lannelongue (L'Union Méd. Paris, July 8, 1890) will show that we ought to give room for the growth of the repressed organ, must remain for some time, in the absence of further evidence, an open question. The same remarks apply to trephining for general paralysis.