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ARTICLE I.

ON OPENING AND DRAINAGE OF ABSCESS CAVITIES IN THE BRAIN. ILLUSTRATED BY A CASE. By CHRISTIAN FENGER, M.D., Professor of Pathology and Pathological Anatomy in the Chicago Medical College, Surgeon to Cook County Hospital, and E. W. LEE, M.D., Consulting Surgeon to Cook County Hospital, Chicago.

THE antiseptic method of operating and after-treatment, which has been so great a gain to the art of surgery, has not as yet been tested to a full extent in operations upon the brain. This is natural, for not only have we inherited a just dread of dealing with an organ, the large majority of whose diseases are dangerous or fatal, but, our knowledge of the physiological functions of the brain and of their pathological modifications being extremely limited, we are not in a position to form an accurate diagnosis of such pathological conditions of the organ as call for surgical interference. However, during the latter decennium, science has vigorously attacked the problem, and the brilliant monograph by v. Bergman *On Injuries to the Head*, gives promise that exact observations and pathological experiments will, in time, enable us somewhat to penetrate the obscurity in which the subject now lies.

We shall, in this paper, confine our remarks to traumatic cerebral abscess and to such surgical points, their diagnosis and treatment, as may receive some elucidation from the following case.

The principal authors who have written on abscess of the brain (Abercrombie, Lallemand, Griesinger, Bruns, Lebert), nearly all come to the
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conclusion that it is a necessarily fatal disease. Although some of them, and among them Bruns, were unwilling to deny the possibility of a spontaneous resolution, yet nobody had ever been able to furnish a proof thereof, until Rose, of Berlin, formerly of Zürich, published a case (Langenbeck's *Archiv f. kl. Chir.*, Bd. 27, Heft 3, S. 529, Ueber Trepanation beim Hirnabscess), in which Wilms had made a diagnosis of cerebral abscess consequent upon internal otitis.

The patient, who was a child, recovered. Many years afterwards the patient died as an adult of croupous pneumonia. The *post-mortem* examination revealed five or seven cavities in the brain, the remains of multiple abscesses; these cavities were lined with a thick connective-tissue membrane and filled, one with a serous fluid, the others with cheesy matter. Rokitsky, as early as 1846, writes (*Path. Anat.*, Sydenham ed., vol. iii. p. 414), that cerebral abscess, though usually fatal, may be completely cured.

This possibility of spontaneous resolution, together with the possibility of spontaneous evacuation by ulceration upwards through the vault of the cranium, or downwards into the orbital or nasal cavity, furnish the best justification of the surgeon's non-interference with the disease; but when we consider how exceedingly rare is the spontaneous cure of brain abscess, this justification must appear rather slender. In the great majority of cases, the surgeon is deterred by the difficulties of the diagnosis. The symptoms of commotion of the brain and of fractures are recognized with comparative ease, but the symptoms of lepto-meningitis (inflammation of pia mater), and of emollition or encephalitis proper so closely resemble those of cerebral abscess that the formation of an accurate, differential diagnosis often becomes an impossibility. Thus we read of a number of cases in which trephining was performed with a view to evacuate an abscess, and in which the disease afterwards found to exist was meningitis or encephalitis. In not a few of the cases of meningitis (Rivington, Gross, Shallen) the patients died in from three to twenty-four hours after the operation. Such experience naturally makes the surgeon reluctant to have recourse to the trephine, and it does so, perhaps, more than is justifiable, acute lepto-meningitis being as necessarily fatal as cerebral abscess, if not even more so. Under such doubtful circumstances the operation of trephining will, in case the disease be lepto-meningitis or encephalitis, cut off some hours of more or less unconscious life, but, on the other hand, if an abscess should be present, it may save the patient's life. The aspect of things is widely different in such cases as Dentu's, in which trephining and opening of the dura mater may be assigned as the causes of a subsequent and not pre-existent fatal lepto-meningitis.

We are, however, convinced that such disastrous consequences can be prevented by antiseptic precautions, at all events in cases in which it is possible strictly to observe them. This may, indeed, considering the insane violence of patients suffering from brain disease, in many instances prove

a matter of exceeding difficulty. We shall consider this point thoroughly in another place. Bergman, in discussing the treatment of cerebral abscess, unhesitatingly sets it down as an axiom that wherever there is an accumulation of pus, trephining is most clearly and indubitably indicated, for the opening of an abscess in the brain is as necessary as in any other part of the body," and we would add, even more so. A correct diagnosis of abscess having been made, the further difficulty presents itself of locating it with sufficient accuracy, so as to be able to find it. A number of cases are on record (Bergman cites more than half a dozen), in which a correct diagnosis had been made, the trephine also put on more or less at the right place, but the knife or trocar, the instruments usually employed for the purpose, passing into the brain and near the walls of the abscess, nevertheless missed it. We intend to show by the following case, that this difficulty can be obviated by multiple exploratory aspirations, performed at interstices sufficiently small to prevent any abscess from escaping detection; even if the trephine opening should not have been made at the point of the skull nearest the abscess.

There still remain to be considered a large number of cases of cerebral abscess on record, in which trephining was performed, pus evacuated, and temporary relief obtained, even commencing convalescence; but later on relapse followed, and the cases came to a fatal termination. It is possible, judging from the success the practice has met with in the treatment of abscesses in other situations, that drainage of the cerebral abscess-cavity, with or without washing out, would have saved some of these cases, by preventing the reaccumulation of pus and the continuous infection of the surrounding brain tissue, the acute œdema of which is well known to be, as a rule, the final cause of death. As far as we are aware, draining and washing out of cerebral abscess-cavities has heretofore not been tried; that it can be effected and, to say the least, without any detriment to the patient, will be shown by the following case:—

CASE.—Police officer Pat. Mulvihill, of the Chicago police force, received, on December 3, 1882, about two o'clock P. M., while attempting to effect the arrest of a criminal, a pistol-shot-wound over his left eyebrow. The bullet, as near as could be ascertained, of calibre 32, struck the barrel of Mulvihill's pistol, and glancing off, entered the left supraorbital region. The shot had been fired at a distance of ten or fifteen feet. Patient felt the bullet strike his head, and immediately fell to the floor insensible. He lay thus for about a minute, when, coming to, and feeling but slight pain, he arose and walked up and down the room. A patrol-wagon was called, patient walked up to it, got in, and was taken to his residence, about one-half a mile distant, where the wound was dressed. At that time patient could still see with his left eye.

Dr. Howe, who was called, found a small wound of entrance over the left supraorbital margin where its middle and outer third join. He introduced a probe and discovered that the bone of the margin had been fractured; following the subcutaneous track of the bullet upwards and outwards for about 2 cm., he distinctly felt a hard body lodged beneath the

skin. This was cut down upon, and an irregularly shaped piece of lead extracted. The wound was washed out with a $2\frac{1}{2}$ per cent. solution of carbolic acid, a small drainage-tube drawn through the whole length of the canal, and an antiseptic dressing applied. Towards evening the lids of the left eye had become œdematous to such a degree that, their separation being impossible, the doctor was compelled to refrain from making an examination of the eyeball.

No unfavourable symptoms appeared for 48 hours; patient had no pain, and pulse and temperature remained normal.

Dec. 6. In the morning patient complained of intense headache, especially on the left side of the head, and of pain in the depth of the orbit. Temp. 99.5° . He had vomited once the night before. On removing the dressing, no evidences of suppuration were seen; a slight swelling was noticeable along the track of the wound; the œdema of the lids was considerable. Prof. Holmes, of the Eye and Ear Infirmary, examined the eye afterwards, and found, on separating the lids, a moderate degree of exophthalmus. Patient stated that he had lost vision in his left eye; solution of atropia was dropped into it.

During the subsequent two days the orbital pain and headache continued to increase; but there was no vomiting; nor did other brain symptoms appear. The wound now commenced to discharge freely. Patient was placed under the care of Dr. Lec, who called in Dr. Fenger.

9th. Temp. 102.5° . Headache steadily increasing. On account of these symptoms, we anæsthetized patient and operated upon him, assisted by Dr. J. B. Murphy, who had just returned from Vienna, as follows: An incision starting from the entrance-opening was carried forwards for an inch through the canal of the wound, ending at the point where the bullet had been excised; a second one, beginning at the entrance-opening, was made half an inch downwards through the eyebrow, and running under the margin of the orbit. This revealed a comminuted fracture of the supraorbital ridge. A number of small pieces of lead were found among the fragments of bone, and a few of them, impacted in fissures of the ridge, could be removed only by chiselling off the irregular edges of the fracture. An opening was then discovered leading into the frontal sinus; but the probe failed to detect any fracture of, or to find any passage through, the lamina interna into the cranial cavity. A small abscess-cavity in the roof of the orbit gave exit to about two drachms of pus; but no fracture could be detected there. After washing the wound with a $2\frac{1}{2}$ per cent. solution of carbolic acid, a large drainage-tube, 7 mm. in diameter, was inserted in the abscess-cavity, and a smaller one along the track of the wound, the edges of which were united over the tube by sutures. An antiseptic dressing was put on, and the wound syringed twice daily with a $2\frac{1}{2}$ per cent. solution of carbolic acid.

10th. Temp. 100.5° . A little sickness caused by the ether, otherwise patient has improved; orbital pain and headache have greatly diminished; œdema of the eyelids and conjunctiva bulbi as before.

14th. Pulse and temp. normal; no headache, no pain; discharge from wound has diminished.

24th. Patient feels perfectly well; sleeps quietly all night; has a good appetite; leaves his bed and walks about the house, even up and down stairs. Now and then, but not every day, he is seized with slight attacks of headache, extending over the left side from the frontal to the occipital

region. This headache, never accompanied by vomiting or dizziness, would last from two to four hours. Patient's eye could perceive light.

30th. Pulse and temp. normal. Patient complains of headache and nausea; he is put on liquid diet and physic.

31st. Headache and nausea have disappeared.

1883. Jan. 5. Pulse and temp. normal; no headache since; the wound has healed down to the apertures for the tube.

As the patient felt restored, he went out of doors for the first time since reception of the injury, intending to take a ride in a cutter. While in a police-station which he visited, he began to feel faint. This was about 1 o'clock P. M. He then took a car and rode home. He subsequently vomited, and, feeling a pain in the left half of his head, went to bed. In the evening, pulse 70, temp. normal; he complained of headache and of a feeling of depression; he frequently sighed, but when questioned answered intelligently.

6th. Pulse 68, and full; temp. normal; headache and nausea persistent; intellect rather dull, but answers still intelligible.

7th. Headache continues; nausea has somewhat diminished; pulse 63, and increasing in volume; temp. normal; intellect exceedingly dull.

The pulse now kept falling slowly, the temperature remained normal, and patient became more and more comatose. However, he still answered questions. There was no aphasia, and no paralysis.

11th. Evening. Pulse, 54; temp. 99.5°. The coma had reached such a degree that patient could be roused only with difficulty.

12th. Patient is in profound coma, and has involuntary discharges of urine. Pulse, 56; temp. 99°.

The Operation.—Increasing coma, accompanied by a slow pulse and almost normal temperature, clearly indicated augmented intercranial pressure. This might have been due to:—

1. An abscess or collection of pus which had formed between the cranium and dura mater, somewhere in the vicinity of a possible fracture at the seat of the injury; or,

2. An acute meningitis spreading from the seat of the injury; or,

3. An abscess of the brain, in spite of the absence of local symptoms. Such an abscess would probably be located in the frontal lobe, not far from the seat of the injury.

In our opinion, the normal state of temperature pointed rather to an abscess than to meningitis. Under these circumstances, we deemed it advisable to resort to trephining.

Patient was laid on a table. As the coma seemed sufficiently profound to substitute anæsthesia, no ether was administered. The left eyebrow and the left half of the head were shaved, and the skin cleaned with soap and nail-brush and a 5 per cent. solution of carbolic acid. The knife was entered at the original wound of entrance, 2 cm. to the inner side of the linea semicircularis superior, and then passed directly upwards for a distance of two inches, cutting through the galea and periosteum. The trephine employed had a diameter of 17 mm.; it was placed as follows: its lower border 2 cm. above the supraorbital margin, in order to be sure of avoiding the frontal sinus; its inner border 4 cm. to the left side of the median line, and its outer border 1 cm. to the inner side of the linea semicircularis.

The piece of bone removed presented no fracture, and was perfectly healthy; the underlying dura mater was of normal colour, but tense, so as

to protrude into the trephine-opening; no distinct pulsations were visible. A crucial incision was made in the dura mater, but no pus met with between it and the arachnoid. The arachnoid and pia mater presented their normal color, and there was no trace of meningitic exudation. A hypodermic needle, attached to an ordinary hypodermic syringe, was now used to make a succession of exploratory punctures. We first pushed the needle downwards towards the roof of the orbit, whence nothing was withdrawn but a little blood and débris of brain-substance. We then introduced it successively in a horizontal, backward, inward, and outward direction, the result remaining the same. Concluding that the abscess lay at a depth beyond the reach of our needle, we exchanged it for one of greater length. This long needle was entered in a direction backwards, slightly inwards, and perhaps a trifle upwards; on reaching a depth of $2\frac{1}{2}$ inches, the syringe filled with a thin, palish-red, and semi-transparent fluid. Poured into a wineglass, it emitted a peculiar odour, not distinctly fetid, and somewhat phosphorescent. The needle was pushed in a second time, in the same direction and to the same depth, and again the syringe filled with the same fluid. The needle was now used as a guide, along which the closed blades of a pair of narrow operating forceps were pushed in, and were then withdrawn. On separating the blades of the forceps, $1\frac{1}{2}$ ounces of the above-described reddish, opaque, thin fluid spurted out with some force, followed by at least a teaspoonful of thick, yellow pus. A fenestrated tube, 10 cm. long, 8 mm. in diameter, and 6 mm. lumen, was introduced into the wound in a direction backwards, a little upwards, and somewhat towards the median line. This tube lay within the dura mater to the extent of 8 cm., and immediately discharged four or five drops of pus; its free end was secured with a disinfected safety-pin. A second drainage-tube was inserted along the roof of the orbit, where, however, no additional pus was discovered. The superfluous borders of wound were stitched together, and a thoroughly antiseptic dressing applied, the opening being covered with a piece of protective silk. The external wound and drainage-tubes were dusted over with iodoform, and patient put to bed.

Two hours after the operation, the pulse had risen to 64; three hours later, consciousness returned; and patient answered questions in a slow but coherent manner.

13th. Pulse, 68; temp. 101.5° . No headache; no nausea. Patient is dressed in a recumbent position, as he feels faint when attempting to assume a sitting posture. The abscess-cavity was washed with a saturated solution of boracic acid by means of a gentle stream from a fountain-syringe. The drainage-tube was taken out, cleaned, and replaced.

Patient was dressed twice daily for two weeks. From Jan. 15 to Jan. 30, patient improved steadily; pulse and temperature had become normal and intelligence perfect. Patient no longer complains of headache, sleeps well, and has an excellent appetite. His bowels being somewhat constipated, an aperient had to be given every other day, else a slight headache would reappear.

He was kept on liquid diet and maintained in a strictly recumbent position. The drainage-tube was gradually shortened down to 4 cm., attempts to push it in deeper meeting with resistance.

Feb. 12. Although patient has strictly kept his bed, he again begins to complain of slight headache and nausea, for which there is no apparent provocation. Morning temp. 98.5° ; evening temp. 99.5° .

A week later patient's pulse began to fall slowly but steadily, at the same time increasing in volume; patient was relapsing gradually into a condition of stupor.

20th. Pulse, 64; temp. 99°. Patient complains of headache and nausea, and is in a semicomatose condition.

Operation.—We inferred, from this reappearance of brain symptoms, that the remaining length of the tube, 4 cm., was insufficient to drain the cavity of its pus; or that some pocketing of matter had taken place, causing intracranial pressure and coma.

Patient was slightly anæsthetized, and the wound dilated from the opening for the tube. The long hypodermic needle, attached to a syringe, was then introduced four or five times in different directions to a depth of two and a half or three inches; nothing was drawn but a little blood and some débris of brain-substance. Finally, the needle being directed towards the old cavity, about half a teaspoonful of thick, yellow pus entered the syringe. A drainage-tube 6 cm. long was inserted in this direction, the wound dusted over with iodoform, and an antiseptic dressing applied.

21st. Pulse, 66; temp. 99.5°. Some nausea, possibly caused by the ether; less headache.

22d. Pulse, 66; temp. 99°. Still less headache; no nausea. Now and then, for about a week, patient has had an involuntary passage of urine.

23d. Pulse, 70; temp. 98.5°. Intelligence begins to return, but slower than after the preceding operation.

The discharge from the abscess-cavity now steadily diminished in amount, and grew more serous. In two weeks, however, it began to re-assume a more purulent character. We therefore discontinued the use of boracic acid in washing out through tube, and substituted a weak solution of carbolic acid and thymol, which again reduced the quantity of the discharge. The drainage-tube was shortened every third day. Patient progressed steadily.

April 10. Drainage-tube is removed.

15th. Patient leaves his bed.

30th. Patient takes a walk out of doors.

May 15. Patient attends to his duties as a police officer. He complains of no headache, has no feeling of weakness in his head, and thinks it is as strong as ever; he has an unnatural sensation, but no pain in the left parietal region; no swelling of the eyelids is seen, but there is ptosis of the upper one, which, however, is diminishing steadily. There is no strabismus; conjunctiva, cornea, and iris are of normal appearance. Patient has a feeling of slight tenseness over the left eyebrow; he is unable to use his left eye in reading, but can count fingers at a distance of 2 feet and a half. A red cicatrix, 5 cm. long, stretches from the supraorbital margin upwards and a little outwards over the frontal region. There is a pulsating defect in the cranium where the trephine was applied, 2 cm. above the superior margin of the orbit and 4 cm. to the left of the median line; this defect has a diameter of one cm.; pressure upon it causes no pain. Memory and speech, and all faculties of the brain, are as good as ever. Patient states that he gets tired in a shorter time than before sustaining the injury, and that, as yet, he feels a little less lively than he used to. His appetite is good, and his bowels move regularly.

Patient continued to do light in-and-out-door policeman's work. In

July, 1883, he was laid up for about ten days, having had three epileptic fits; he also complained of headache over the left frontal region.

In December he was again seized with a fit of epilepsy; he fell while about to take a scat at the supper table.

Since that time patient has had no fits, and he has been able to attend to his work as usual. During the last two months the pain in the frontal region has become less frequent and diminished in intensity. It now comes twice or three times a month and lasts from three to four hours.

He sleeps well and eats well. His memory and all cerebral functions are unimpaired. He complains of loss of endurance; says that he is easily fatigued. On March 2, 1884, a fistula presented itself where the trephine opening had been made. This fistula discharges five to ten drops of pus in the twenty-four hours.

Discussing cerebral abscess with regard to the above case, we shall treat of—

1. Symptoms and diagnosis;
2. The operation of trephining;
3. The exploratory puncture and aspiration;
4. Drainage of brain abscess.

1. *Symptoms and Diagnosis.*—Without going into unnecessary details concerning cerebral abscess in general, we shall merely call attention to the main points touching our case which, with Bergman, we will call one of chronic traumatic abscess. As might have been expected from a case of limited injury to the brain with slight impetus, the primary cerebral symptoms were, unconsciousness of little more than a minute's duration. The so-called latent period devoid of all brain symptoms, continued about four weeks. The third stage then set in with secondary brain symptoms, headache and coma. Thus far the course of symptoms indicated that we were dealing with a case of cerebral abscess, but in this, as in so many other cases of its kind, there appeared nothing in the secondary brain symptoms sufficiently characteristic to enable the diagnostician to distinguish them clearly from the similar symptoms of encephalitis or secondary meningitis. The headache was not distinctly more intense in the region of the wound than in the entire left half of the head. The rise in temperature was slow, taking three days to reach 102.5° , in no respects differing from the rise in temperature in incipient meningitis; differing, however, from what would take place in a case of pyæmia.

The principal clinical symptoms of cerebral abscess are besides headache, vomiting, coma, and fever, according to Bergman local symptoms (Heerdsymptome, focal symp.); more or less complete paralysis, usually of the opposite, more rarely of the corresponding side of the body, epileptic fits, spasms, etc. The paralysis or paresis, as is well known, is especially valuable, when limited or gradually increasing. Local symptoms (Heerdsymp.) were altogether absent in our case; but it should be remembered that we can understand and interpret them only when coming from the comparatively small area in the middle third of the brain, called the psy-

cho-motor centres. And in lesions of the brain on the left side which, on account of the centre for speech, is the more favourable, local brain symptoms from this circumscribed region, will, as seen in our case, fail to appear, unless the abscess affect the gray substance of those very convolutions.

Recent observations have furthermore shown that local brain symptoms (Heerdsymp.) may be met with in cases of meningitis, originating in the psycho-motor area. It is readily seen that, if an unerring diagnosis is required of the surgeon who proceeds to trephining for cerebral abscess, abscesses in the brain will be evacuated only when pus presents itself at the bottom of the wound, either spontaneously, or on removal of a depressed, penetrating spicula of bone. Indeed, a great number of successfully opened abscesses were just such cases.

Of the opening of abscesses that do not thus visibly present themselves, or are, furthermore, located at some distance from a pre-existent wound, we shall more properly speak under the head of—

2. *The Operation of Trephining.*—Is trephining at the present day, aided, as we are by the antiseptic method, still so formidable an operation that, considering the unavoidable uncertainty of the diagnosis, its performance for deep-seated cerebral abscess cannot be pronounced justifiable? Estlander tells us (Virchow and Hirsch, *Jahresbericht.*, Jahr. 1879, Bd. 2, Abth. 2, S. 390), that, since the introduction of the antiseptic method, the percentage of deaths in cases of cranial fractures with cerebral injury, has fallen from 66 to 17; and there is good reason for trusting that thoroughly aseptic wounds will depress the rate of mortality considerably below this figure. In these operations, life and death are, of course, to a certain extent in the hands of the operator.

We learn from statistics published by Blum (Langenbeck's *Archiv*, Bd. XIII. S. 489) that out of 44 cases in which trephining was performed for abscess of the brain, 22 recovered.

The fatality of the disease, when left to itself, comes near 90 or even 100 per cent. A reduction of this frightful death-rate by almost one-half clearly seems to advocate the operation. Still, as to the advisability of this operation, surgeons will take opposite sides, and Sir A. Cooper's dread of even removing a depressed spicula of bone from the brain, a consequence of disastrous experience, can be traced through surgical literature down to the present day. Rose, as late as 1881, tries to avoid trephining for cerebral abscess (*l. c.*, p. 558), trusting to the faint hope of resolution or spontaneous evacuation. Aseptic trephining, and we should remark that Rose invariably uses the open-air method of treating wounds, undoubtedly deserves to be given an impartial trial, before abscesses in the brain, left to themselves, are allowed to run their fatal course.

We conclude from prior reasons and learn from experience, that if the brain be healthy, the dangers of aseptic trephining can be greatly lessened

by the care and skill of the surgeon. But the objection to operative interference in cases of suppurating leptomeningitis or emmollition, *i. e.*, encephalitis, are to be seriously considered. How large a proportion of deaths is to be attributed to the incalculable influence of the shock, in giving additional impetus to an existing meningitis or encephalitis it is, of course, impossible to determine. However, it should not be forgotten first, that these diseases are in themselves exceedingly grave, the prognosis of (Bergman, *l. c.* 155), traumatic diffuse, suppurating leptomeningitis being the worst imaginable, namely death; and second; that trephining performed under the gravest, we should say, premortal symptoms of intracranial pressure from abscess, has, in a number of cases, been followed by prompt relief. The dangers, apart from the shock, cannot very well have any other source than phlogogeneous substances introduced into the diseased organ through the trephining wound. It is more than possible that the antiseptic method will prove no less preventative of additional inflammation in cerebral operations than it already has done and does, as seen in every day's experience, in the opening of cold abscesses from caries of deep-seated bones, of hepatic abscess, of empyema, etc.

As to the place where the trephine should be applied, we can only say that it should be chosen as near the seat of the presumed abscess as possible. The difficulties of finding the right place culminated, so to speak, in a case cited by Gross (*System of Surg.*) A soldier had received a gunshot injury, and 17 days afterwards was suddenly taken with convulsions and coma; five perforations were made with the trephine, but no pus evacuated. The autopsy revealed diffuse leptomeningitis and no abscess.

We believe that the object of multiple trephining—for ascertaining the seat of a deep abscess—can be attained with greater ease and safety by the following procedure:—

3. *The Exploratory Puncture and Aspiration.*—This procedure is not exactly new, but we are not aware that it has ever before been brought into methodical connection with the operation of trephining for the purpose of ascertaining the seat of an abscess. W. Th. Renz published a case in 1867 (*Erste Heilung eines traumatischen Gehirnanabscesses durch consequente Aspiration des Eiters, ohne vorhergehende Trepanation. Tübingen, 1867*), in which a punctured wound from a knife, in the right frontal region, had produced traumatic cerebral abscess. Eleven days after the injury, the wound which had almost healed, was re-opened on account of symptoms of compression. The point of the knife was liberated by means of hammer and chisel, and its extraction was followed by the escape of a considerable quantity of fetid matter. An exacerbation of brain symptoms, accounted for by imperfect evacuation, induced the author, some time subsequent to the operation, fearing that trephining might cause prolapse of the brain, to avoid trephining and evacuate the pus by methodical aspi-

rations with a hypodermic syringe. The aspirations were continued twice a day for six weeks. The pus aspirated gradually grew less in quantity and thinner, till, at last, the syringe only drew a few drops of a yellow, serous fluid. Three weeks of this treatment had effected an entire disappearance of cerebral symptoms. The aspirations were discontinued in the sixth week, and the patient resumed hard, manual labour; however, in only five days, pain, somnolence, vomiting, and slow pulse recurred. Aspirations were resumed for six weeks, and, as in the author's opinion, diffuse leptomeningitis had now become the cause of these symptoms, mercurial inunctions were prescribed. The patient recovered in half a year, perfectly and definitively. Renz recommends the use of a golden needle, with a shaft rounded up to the point, *i. e.*, not cutting, and of a syringe provided with a somewhat complicated mechanism, to do the work of the hand in moving the piston.

Renz published his case fifteen years ago. His mode of aspirating, without trephining, has, as far as we are aware, found no followers in the profession. The reason for this is probably to be sought in the tendency of modern surgery to give free vent to pus wherever met with. Thus Renz's method of curing abscess in the brain by continued, repeated aspirations has shared the fate of the same treatment of abscesses elsewhere. After sufficient trial, aspirations have, on the whole, yielded to free incisions.

J. Whitaker Hulke (case of secondary trephining for traumatic abscess of the brain; recovery. *Med.-Chirg. Trans.*, vol. lxii. 1879) proceeded to ascertain the seat of an abscess through a trephine opening and healthy dura mater in a manner very similar to ours; but he did not develop it systematically. He introduced a fine trocar into the brain to the depth of about an inch, and removed a little green pus with the aspirator. A narrow-bladed knife pushed in along the canula, opened the abscess and three or four ounces of pus escaped. The longitudinal sinus, which had been opened by the knife, was closed by the double means of suture and ligature. After eight months of intercurrent brain symptoms, among them complete blindness, recovery took place; but the blindness persisted.

Footing on the experience of our case, we propose methodical exploratory puncture and aspiration as a means of ascertaining the seat of the abscess through the trephine opening. The ordinary hypodermic needle, an inch or an inch and a half long, is too short. The one we employed was four inches long, its diameter was between one and two mm., and its bore half a mm. The needle may be set in an ordinary hypodermic syringe, but one a little larger, of about three c. cms. capacity, is preferable. This little apparatus is convenient for exploratory aspirations of deep-seated abscess or other accumulations of fluid in any part of the body.

In operating upon the brain it may be well to take Renz's advice, and to use a trocar with a rounded, instead of an ordinary cutting point. Division of small bloodvessels may thereby be avoided. We used a cutting point and without any appreciably bad effects.

As to the manner of executing this exploratory puncture, we offer the following suggestions: A well-disinfected needle is pushed in straight in a certain direction, for about half an inch or an inch; the piston of the syringe is then drawn a little; if no pus follows, the needle is pushed in half an inch or an inch further and the piston again drawn a little, etc. The depth to which it will be permissible finally to push the needle, will, of course, vary with the situation of the trephine opening and the direction of the puncture. In this respect the surgeon will be guided by the anatomy of the brain. The punctures are to be executed at interstices of half an inch or an inch, the utmost care being observed to push the needle in straight and to avoid all lateral movements. If, after a reasonable number of punctures, no pus is drawn, the operator may feel convinced that no abscess is present.

As an abscess is generally about the size of a walnut, and it is seldom smaller, it will necessarily be detected by this procedure. We are convinced that, in a number of cases on record, failure to find the abscess might have been prevented by methodical exploration.

Puncturing of healthy brain substance with a fine, perfectly aseptic needle can do but little mischief. We know from our writers, as well as from our own experience, and we intend to publish a case in point, in connection with another subject, that puncturing of a brain in which no inflammation is present, does not give rise to even the slightest untoward symptoms. But how does the matter stand when the brain is affected with diffuse leptomeningitis or abscess? A needle passing through a focus of inflammatory products and entering healthy tissue, may, undoubtedly, carry bacteria or phlogogeneous substances from the former into the latter. This would, in the worst case, produce encephalitis or secondary abscess. In case of meningitis the life of the patient will, in all probability, terminate, independently of the puncture, before such a consequence has time to develop sufficiently to attract our attention. In case of abscess, our manner of exploring, pushing the needle gently and gradually from the superficial into the deeper parts, can hardly be said to be attended with any great risk of such a result. A third possibility is that the needle may run into a ventricle and draw off some cerebro-spinal fluid. Detmold (*Am. Journ. of Med. Scien.*, 1855, p. 86) opened the lateral ventricle with a knife and evacuated a quantity of pus. His patient died five days afterwards. But opening a ventricle with so coarse an instrument as a knife, and puncturing it with a fine needle, drawing only a few drops of the contained fluid, are proceedings that scarcely admit of comparison. As to this point, however, we must wait to be taught by further experience.

Having ascertained the site of the abscess, the next question is how to open it. This has commonly been done with a knife; but we should avoid the use of cutting instruments, in order to preclude the possibility of hemorrhage. The soft substance of the brain is easily penetrated with a probe or a pair of forceps, or any other sort of blunt instrument, which may be pushed in along the needle as a guide.

The question that still remains to be considered is the advisability of draining cerebral wounds.

4. *Drainage of Brain Abscess.*—*A priori* reasons do not plead in favour of drainage of the brain with tubes. A drainage-tube is a foreign body, and we know that the presence of a foreign body, even when perfectly aseptic, *e. g.*, a depressed fragment of bone in a case of subcutaneous fracture, penetrating the dura mater and entering the brain tissue, is apt to give rise to general as well as local brain symptoms, although no suppurating inflammation may have set in. But a depressed spicula of bone still connected with the immovable skull and descending into the movable brain-substance, is certainly very unlike a free drainage-tube running into an abscess through a trephine opening. As in most cases in which trephining was performed, the symptoms caused by the irritation of the foreign body disappeared on its removal, the introduction of a new foreign body, in the shape of a drainage-tube, may have seemed a little paradoxical, and this may help to explain the fact that, as far as we have been able to learn, no attempts have been made, with the exception of one, to employ drainage-tubes in the treatment of brain lesions. In the one instance which has come to our knowledge—a case of pistol-bullet wound of the brain related by Burchard—it proved a remarkable success (Burchardt, *Deut. Zeitsch. für Chir.*, 1881, Bd. 15, S. 582. Ein Beitrag zur Casuistic der Schusswunden des Gehirns mit Einheilen des Projectils). A man of 62 years, attempting to commit suicide, inflicted a gunshot injury upon himself in the right parietal region. The cranium was trephined, but the bullet was not extracted. A drainage-tube was inserted along the track of the projectile, the wound stitched together, and an antiseptic dressing put on. A capsule formed around the bullet, and the wound healed without suppuration. The symptoms in the case were paresis, anæsthesia of the opposite half of the body, and traumatic insanity. The man recovered. Twenty months later he succeeded in committing suicide. The autopsy revealed a band of connective tissue filling the canal of the bullet and running transversely from the parietal bone to the falx cerebri. The greater portion of the bullet was found encapsulated near the latter, and a few bits of lead imbedded in the connective tissue filling the canal.

These two cases, Burchard's and our own, are of course too isolated to prove that cerebral drainage will always turn out as a safe proceeding, but they certainly justify further trial, especially when we consider that, under the old treatment, after successful opening of the abscess, the patients

succumb at the rate of 50 per cent. Moreover, drainage is, at the present day, recognized to be an all-important factor in the treatment of abscesses in general.

Whether it is essential or advisable to wash out an abscess in the brain, after drainage has been established, is a matter of some doubt. Opinions as to the washing out of abscesses in general somewhat diverge, and it need hardly be remarked that an organ as delicate as the brain should be interfered with as little as possible. The majority of surgeons, however, doubtless favour washing out of fetid abscesses wherever else found, and already Rokitsky states (*L. c.* p. 413) "that the thick green pus contained in an abscess of the brain is extremely fetid and phosphorescent." We may entertain a reasonable hope that washing out (*i. e.*, disinfecting) fetid abscesses of the brain will prevent the setting up of œdema or encephalitis in the neighbouring tissues, which secondary diseases are well known to be far more dangerous than the abscess itself. In fact, in the majority of cases, they constitute the final cause of death.

As to the wash employed, we first chose boracic acid, it being of all disinfectants the most harmless; but we were compelled, at least we so believed, to substitute the stronger antiseptic, carbolic acid, and the change was apparently followed by good results.

In conclusion, supported as we are by a single case, we do not wish to recommend any unreasonably bold or hazardous proceedings in so difficult and delicate a matter as the surgical treatment of cerebral abscess. We think, however, that the procedures instituted in the above case strictly conform to the rational methods of modern surgery in treating abscesses in general; and because of this, and not because our patient recovered, we regard the above case as answering in the affirmative the question: Is it probable that abscesses in the brain can be treated advantageously on the same principles as abscesses in other parts of the body?

ARTICLE II.

PERSISTENT OMPHALO-MESENTERIC REMAINS; THEIR IMPORTANCE IN THE CAUSATION OF INTESTINAL DUPLICATION, CYST-FORMATION, AND OBSTRUCTION. By REGINALD H. FITZ, M.D., Shattuck Professor of Pathological Anatomy in Harvard University.

THE pouch-like formation of intestine occasionally seen projecting from the lower portion of the ileum, is universally known as Meckel's diverticulum. Not that this distinguished anatomist was its discoverer, for early in the eighteenth century Ruysch¹ presents an admirable illustration

¹ Ruysch, *Thesaurus Anatomicus*, 1701, vii. fig. 283.