NOTES ON PENETRATING WOUNDS OF THE BRAIN.

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In the later part of July three contiguous casualty clearing stations in a certain army area were designated as a centre for the reception of all wounds of the head occurring during an expected period of military activity.

To one of these hospitals the writer was attached for three months, and on taking up his duties endeavoured to make an estimate of what might be:

1. The operation mortality at all three hospitals combined.
2. The proportion to one another of simple scalp wounds, cranial injuries without dural penetration, and cranio-cerebral wounds, respectively, among all the cases forwarded from the field ambulances on the front concerned, with an initial diagnosis of "head or scalp wound."

Toward this end a combined record was made of all cases admitted with the above general diagnosis during the first two weeks of the three-month period, verifying it and particularizing it in each case whenever an operation or other circumstance rendered this possible. This actually proved to be possible in only about half the total, as in times of pressure many of the lighter cases were of necessity immediately evacuated. It is probable that the majority of the wounded, thus passed on without operative investigation, had injuries confined to the scalp, or to the scalp and cranium, though it must be admitted that among walking wounded it is not uncommon to find men with penetrating wounds of the brain.

The net results of the study were as follows: Taking as 100 the total number of cases admitted with an initial diagnosis of some form of "head wound," the percentage with dural penetration was 23.5. Taking the verified cases alone, the percentage with dural penetration was 49.3.

Of these 49.3 per cent. verified cases approximately one-third died without operation, their injuries being either of extreme gravity or multiple. Of the remaining two-thirds, all were submitted to operation, and exactly half of the patients subsequently died, thus giving the generally accepted 50 per cent. operation mortality for wounds of this type.

The foregoing figures relate, as has already been indicated, to all the three hospitals during the first two weeks of the three-month period. For comparison the following figures covering the whole three months may be given for the cases that came under the supervision of the writer's team. Of the cases submitted to operation, 10.9 per cent. proved to have merely scalp wounds, 23.7 per cent. cranial wounds with intact dura, 60.7 per cent. cranial wounds with dural penetration, and 4.5 per cent. bursting fractures of the cranium but with the scalp and dura both intact. In most of the cases with simple scalp wounds or depressed fractures the conditions had been such as to lead us to anticipate finding a dural penetration.

During the initial two weeks to which reference has

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been made, the operation mortality for the writer's own team was above the average figure for all the hospitals together. This may be accounted for in some measure by the fact that during this period, as also during the entire three months, wounds of the more serious type were deliberately selected from among the cases retained at the hospital. This is indicated by the relative height of the percentage of cases with dural penetration (60.7) as compared with the corresponding percentage (49.3) for the whole of the verified cases during the first two weeks.

It was with the penetrating wounds, in short, that we were chiefly concerned, and a serious effort was made to see whether the accepted mortality figure of *circa* 50 per cent. could not be lowered by improvement in technique, and a more intimate supervision of each individual case from start to finish. Careful records have been kept of the 225 cases which came under the care of the team; of these 6 died without intervention, the remaining 219 were operated upon, and 133 proved to have dural penetration. The net results are best shown by dividing these 133 cases into thirds roughly corresponding with each consecutive month of service.

First	44 cases with	24 deaths =	54.5 per cent.
Second	44	18	= 40.9 "
Third	45	13	= 28.8 "

These percentages, which are practically end results, for no cases were evacuated until they had passed the stage of conceivable complications, are sufficiently encouraging to justify the hope that a still further lowering of the mortality may be attained, and that in an advanced hospital 75 per cent. of recoveries is not too large a figure to be set as a goal.

The improved figures do not mean that more favourable cases were selected as time went

on, for, on the contrary, as the results improved the general tendency was to undertake operations on more and more unpromising injuries, particularly of the cranio-cerebro-facial type, in many of which radical measures in the earlier weeks of the service would hardly have been attempted. Indeed, on two occasions six consecutive deaths occurred in the series, due to an uncontrollable gas encephalitis which had become established in cases "lying out" for two or three days after a battle.*

* In computing these mortality figures no cases whatever have been eliminated, even when the ultimate cause of death—including tetanus, gas poisoning, complications from wounds elsewhere, spinal cord transection, and so on—was obviously unrelated to the cranio-cerebral injury. Should one begin to eliminate these complicated cases in making out his mortality percentages the figures would lose all their comparative value, for there can be no agreement as to what conditions may justifiably be excluded.

Detailed mortality figures for penetrating wounds of the dura are rarely given, and when given are variously computed. This is unfortunate, for it is only by comparison with such estimates that one can tell whether his end results are better or worse than the average.

That the mortality percentage is high is commonly admitted. Colonel Sargent has made the statement in an unpublished address that "in the first two years of the war 45 per cent. of patients with perforating (penetrating?) wounds operated upon in field ambulances and casualty clearing stations died in the base hospitals." If, therefore, nearly half of the cases operated upon succumbed at the forward hospitals before evacuation, as is more than likely, and nearly half of those evacuated subsequently died at the base, the total mortality must have been in the neighbourhood of 70 per cent.

Colonel Gray, however, in his paper (BRITISH MEDICAL JOURNAL, February 19th, 1916) states that in 392 cases trephined in the base hospitals at R—there were 58 deaths, a mortality rate of 14.8 per cent. He adds that if 12 "hopeless" cases which died within forty-eight hours of admission are excluded from the series, the mortality is only 9 per cent. This estimate is lower than the mortality figures at a casualty clearing station, for the non-penetrating cranial wounds

The surgical care of the wounds of modern warfare is very much of a specialty, and, no matter what may have been an operator's previous training and experience with traumatic surgery, he finds himself ill prepared for his tasks; indeed, his fixed habits of work acquired in the favourable surroundings of a civil hospital and his unfamiliarity with infections may prove a handicap rather than an asset. This applies possibly even more to the surgeon who in civil practice has specialized in a comparatively narrow field than it does to the surgeon whose work has been more generalized.

However, during the three-month period an operation, with certain technical devices applicable to the average penetrating wound, was gradually evolved; and as the lowered mortality percentages of the later series can be ascribed to it, the method may deserve description. Aside, possibly, from the principle of track suction there is nothing original about the procedure, nor are the instruments new, though they do not seem to have been commonly utilized, at least in the British overseas hospitals.

The main features of the procedure lie:

1. In the removal *en bloc* rather than piecemeal of the area of cranial penetration.

2. In the detection of the indriven bony fragments by catheter palpation of the track rather than by the exploring finger.

3. In the suction method of removal of the disorganized brain, thereby cleansing the track of the so-called pulped or devitalized tissue, whose retention, as is the case with dead tissue anywhere, favours infection.

4. In the use of *dichloramine-T* in oils as an antiseptic particularly suitable for infections in the central nervous tissues.

In addition to these more essential features of the performance, the routine pre-operative neurological study of the case stereoscopic x-ray negatives, the shaving of the

entire scalp, the invariable use of local anaesthesia, preferential radial (tripod) rather than flap incisions, foreign body extraction with the magnet when possible, closure of

the wounds with buried sutures in the galea, the dressing of all serious cases in the operating room rather than in the wards—all these steps, though less novel, were, nevertheless, contributory to the successful outcome of the more severe cases.

1. THE ORGANIZATION OF THE OPERATING TEAM.

At a casualty clearing station, where at times wounded may be admitted in great numbers, team work, particularly when

serious cranial procedures are to be covered, is of prime consideration. At best most of the more critical operations deservedly require upward of a two-hour period; and as one team, eliminating all delays, can hardly expect to do many more than eight major cases a day, the greatest possible economy of time must be practised.

Each team should be provided with an extra wooden table, indeed, if there is sufficient space, with two extra tables or trestles to support the stretchers. In this way a series of cases can be continually fed in, and the patients be more or less under the surgeon's eye while the neurological examination, the x-ray exposures, the shaving of the scalp, the giving of the primary drug and the novocainization of the field, all of which is time-consuming, can be carried out, and the next patient be ready to supplant the preceding without the usual loss of time between operations. An extra table is almost as valuable to a team as an extra medical officer.

2. THE NEUROLOGICAL EXAMINATION AND THE X RAY.

It is generally conceded by the majority of those

who have written on the subject that serious cranial operations should not be undertaken without a preliminary neurological study. It unhappily is not universally

It would be desirable if we could all come to record our cases from the same standard, whether from a forward or base hospital, and as a temporary basis for comparison, it may be suggested that all cases of dural penetration, regardless of complicating factors, be included in future reports. Only by the establishment of some accepted standard will it be possible to compare the efficacy of operative methods advocated by different individuals, or for one individual to appreciate an improvement in his own results as he gains experience.

FIG. 2.—Unilateral occipital flap for penetrating wound of right cerebellum. Wound of entrance unexcised. Condition on sixth day. Sutures should have been removed earlier. Those of silk worm-gut are deeply cutting; those of black silk remain dry.

FIG. 3.—Tripod incision for small irregular wound of vault. Dotted lines indicate area of reflection of flaps.

FIG. 4.—Three-legged (Isle of Man) incisions for larger wound of cranial vault.

taken by themselves. Abadie's statistics (*Presse Médicale*, September 25th, 1916, p. 421) for 102 cases with opened dura gave 56 per cent. mortality. Cunéo (*Presse Médicale*, July 6th, 1916, p. 229) estimated a mortality of 60 per cent. for cranio-cerebral wounds. Lapeinte's figures (*Journ. de Chir.*, 1915, xiii, 241) for all cranial injuries treated at a forward hospital early in the war were 58.75 per cent. Sencert's figures, also from a hospital at the front (*Ann. Chirurg.*, March-April 1916, T. xiii), including the 24 deaths recorded as occurring after evacuation, are in the neighbourhood of 63.5 per cent.

observed. Without such an examination and the careful recording of the positive neurological findings, an operator can never be sure whether the paralyses which are subsequently observed were pre-existent, or were due to or increased by his surgical manipulations. Certainly any immediate post-operative increase in pre-existing symptoms, whether in the sphere of speech, vision, motion or sensation, should be regarded as an evidence of faulty technique. Moreover, if pre-existing palsies, the presence and grade of which, except in the profoundly unconscious cases, can easily be determined, fail to

subside with considerable rapidity, the fact can be interpreted as an evidence of an incomplete operation, and complications may be anticipated. Furthermore, the question of justifiable opening of an intact dura in the course of an operation, or the need of a secondary operation for symptoms of a presumptive abscess may depend entirely upon the original neurological symptoms and their post-operative increase or subsidence.

Stereoscopic radiograms are of course invaluable, not only for the

FIG. 6.—Cranial perforator (seven-eighths natural size).

localization of a penetrating missile, but for the detection and enumeration of all indriven bone fragments.

3. THE PREPARATION OF THE SCALP.

The entire scalp should be shaved—no easy task when an uncropped head of hair has become caked with blood and mud. A close haircut before going into battle, and the application of a warm soap poultice at a field ambulance would not only help toward preventing infection but would also make the preparation for these operations a less arduous matter. The partial shaving so commonly employed is undesirable, for one can rarely tell beforehand how extensive may have to be the incisions necessary for closure.

Shaving of the scalp is an art and requires a good barber, but it is indispensable to a proper preparation of the field. The preliminary use of clippers is to be avoided, for they leave the scalp covered with short hairs difficult

to remove. As a final step the mere sponging with alcohol and a mercuric bichloride solution is preferred to any of the staining solutions such as iodine or picric acid, which are apt to leave the epithelium scaly or encrusted.

4. THE ANAESTHETIC.

During the shaving of the head, possibly an hour before the patient's turn will come, a sedative is given, a third of a grain of omnopon usually being sufficient, though this may be repeated if the patient is very restless or obstreperous. Then fifteen or twenty minutes before the operation, in the lines of proposed incision,

the scalp is infiltrated with a 1 per cent. novocain and adrenalin (15 drops to 30 c.cm.) solution, injected in the sub-aponeurotic layer.

There exists a difference of opinion regarding the relative merits of a general *versus* local anaesthesia for cranial operations. The writer confesses to an original prejudice in favour of inhalation narcosis, but experience has led him completely to alter this view.

General narcosis increases intracranial tension, which exaggerates the difficulties of an operation already difficult enough. It increases bleeding from the scalp, which, with the adrenalin-novocain solution, is rendered negligible. It encourages the use of rougher methods, which a patient under local anaesthesia would not tolerate, and which therefore are in all likelihood

harmful. It encourages speed, which is to be decried if employed at the expense of delicacy. It leaves many patients, particularly those with threatened respiratory difficulties, in a condition in which inhalation troubles are prone to occur.

Until recovery from a general anaesthetic is complete every patient should be under close observation, and this, at

a casualty clearing station at least, is an impossibility. It is very rare, and then only in the case of semi-conscious patients or those with restless irritability, that the operation cannot be carried through under local anaesthesia, though this necessitates more gentle manipulations than

FIG. 5.—A typical tripod incision (after five days) for penetrating wound in the mid-occipital region. To show character of wound healing when flaps are held by buried Galen sutures and superficial sutures are removed early.

FIG. 7.—Burr to follow perforator (seven-eighths natural size).

FIG. 8.—Montanovesi linear cutting forceps to follow burr (seven-eighths natural size).

those usually employed, particularly during the process of removing the area of cranial involvement.

5. THE PLOTTING OF THE INCISION.

Many procedures have been advocated. They necessarily vary greatly, according to the likes and practices of different surgeons, and for different wounds in different areas. As in plastic operations elsewhere, success in closing defects is the offspring of ingenuity and experience.

Flap incisions, which leave the wound in the centre of the flap, are suitable for some of the penetrating wounds through muscle in temporal or suboccipital regions (Figs. 1 and 2) but for ragged or gutter defects over the vault what may be described as a "tripod" (Fig. 3), or for more extensive defects a "three-legged" (Isle of Man) incision (Fig. 4) has come to be the preferential one in the writer's hands.

When the three flaps are reflected, ample exposure of the field necessary for the trepanation is afforded, and if the flaps have been sufficiently undermined in the subaponeurotic layer the corners may usually be brought together without undue tension. It is the writer's custom to bring the edges of the galea together by a layer of buried fine black silk sutures, so that the external sutures used to approximate the cutaneous edges may be safely removed on the second day. The heavy silkworm-gut sutures usually employed in a single layer, particularly if tied under tension, rapidly cut through and make an uncomfortable wound, an ugly scar, and encourage infection.

These tripod incisions (Fig. 5) with the focal point of the closure directly over the dural defect, have come to be preferred to the switching of a flap over the centre of the field, owing to certain trying experiences with an infected hernia cerebri in cases in which the track of the missile has been incompletely cleansed. The surface of such a fungus is much more difficult to treat when partly overlain by a flap than if it were allowed to present in the centre of radiating incisions.

6. THE TREPANATION EN BLOC.

The method usually advocated is to make with a trephine an opening to one side of the depressed area, and with rongeurs to nibble away fragments of bone until an opening of sufficient size is secured. Even with rongeurs of the best pattern this necessarily means not only working across an infected field, but the jar of breaking out the fragments with the ordinary forceps entails an amount of trauma which is more than a patient not under a general anaesthetic will tolerate. Moreover, there are certain areas of the skull where even the most expert runs a risk of cutting the dura when using a trephine.

A far more simple and satisfactory procedure is to encircle the area of depressed bone with a number of small punctures made with a perforator and burr* (Figs. 6 and 7),

and then to connect these small primary openings with a linear cut, thus excising the soiled area of depressed fracture in the bone, just as the soiled scalp wound is excised. The linear cut may be made with the instruments designed by De Vilbiss or Dahlgren, but a far more effective tool for the purpose is the Montenovesi cranial forceps (Fig. 8). This instrument, when of proper pattern, inflicts far less

jar, its beak can be inserted through a smaller hole, and with it a corner can be more easily turned. When the area has been encircled, the bone disc is tilted out in one piece (Fig. 9).

The depressed fractures thus disclosed are of two main types: (1) With the fragments still adherent (Figs. 9 and 10), or (2) with the fragments completely detached and "showered" to a greater or less depth into the brain (Fig. 11). The preservation of the mosaic of fragments in the first type is often a matter of importance, for when incomplete it is evident that one or more fragments are indriven and must be secured before the operation can be regarded as complete.

Particularly when working over a sinus is this method of bone removal to be favoured, for if the sinus happens to be torn by a bony spicule, as it so often is, the withdrawal of this particular spicule before complete exposure of the area may provoke haemorrhage which may be very difficult to control. On the other hand, with the entire field exposed by the careful tilting outward of the entire block in one piece (Fig. 9), the bleeding point is fully bared, and can be quickly and easily sealed, preferably by a muscle graft.

7. THE TREATMENT OF THE TRACK.

In penetrating cases the proper and thorough cleansing of the track is the most important step of the operation.

In the earlier cases in the series it was the custom to enlarge the dural opening by cutting away its torn and ragged margin. This has since been abandoned, for it is

a procedure which often causes troublesome bleeding from the unavoidable fresh division of the vessels in the torn pia arachnoid, for the two membranes quickly adhere after the injury, a matter of hours rather than days, as is often stated. Even though bleeding from these vessels can be readily checked by the placement of "silver clips" (Fig. 12), it has been found unnecessary to practise routine re-

moval of the dural margin, for it does not appear to be a source of infection which need be seriously feared.

Much more serious is the retention of the disorganized and devitalized cone or cylinder (Fig. 13) of cerebral tissue which lines the track, and in which the indriven bone fragments are embedded. Though extraction of these fragments is advocated, no special emphasis has been laid on the desirability of thorough removal of the pulped tissue which surrounds the pathway of the missiles, and which, like devitalized tissue of any kind, is a soil favourable to the growth of organisms.

As Colonel Gray has suggested, if the patient is encouraged to cough, clots and cerebral debris oftentimes

FIG. 9.—Showing the turning back from the mid vertex of an area of depressed fracture (actual specimen), disclosing a dural laceration with tear to the margin of the sinus.

FIG. 10.—Specimen of depressed fracture removed *en bloc*, showing adherent fragments with mosaic complete (natural size).

* These instruments are almost as ancient as the trephine. Though commonly ascribed to the late Dr. Doyen, the brace and bit and various forms of burr were fully pictured by Barengar in the sixteenth century.

may thus be expressed, and some have employed gentle curettage or irrigation; but if a finger is introduced in the track for purposes of exploration, the disorganized and soiled cerebral tissue lining its walls will be crowded inward, whereas every effort should be made to get it out.

Almost from the outset reliance was placed on the use of a flexible, soft-rubber catheter as a means of determin-

ing the exact direction taken by the missiles, whether a metallic body, or bone fragments, or both (Fig. 13). Without the production of additional trauma one may investigate in this way even the narrowest track, and it will be found that the presence and situation of any indriven bone fragments can be detected with almost as great delicacy as by direct palpation.

FIG. 11.—Specimen of cranial gutter wound removed *en bloc*. No fragments adherent, all having been detached and driven into brain.

By attaching to the end of the catheter a Carrel-Gentile glass syringe with its rubber bulb (Fig. 14) it is possible to suck up into its lumen the softened brain, which can then be expelled from the catheter as paste is expressed from the orifice of a tube. The process should be repeated until the cavity is rendered as free as possible of all the softened and infiltrated brain. It will be found that the adjoining normal cerebral tissue, unaffected by the original contusion, will not be drawn into the tube by the degree of suction which can be applied by the average rubber bulb.

Not infrequently bits of bone come away in the eye of the catheter, and on one or two occasions a small foreign body has thus been withdrawn. Meanwhile, as the track becomes clean and the tension and tendency of the brain to herniate subsides, it is possible with delicate duck-billed forceps to pick out from the track one by one the bone fragments, whose depth and position can be determined by the unmistakable sensation they impart to the catheter, which thus supplements the information given by the x-ray plates. The technique of the performance will quickly be acquired by any one who may wish to put it into practice.*

Any procedure is capable of being abused, and even a soft flexible catheter may possibly be forced to do damage. Even those who advocate digital exploration admit that damage may be done thereby unless the greatest care is exercised, but

* In not a few cases in the series the missile and bone fragments have been driven through into the ventricle, and in the process of suction the cerebro-spinal fluid spaces have been sucked completely dry. These ventricular penetrations have been met with in twenty-five cases, and it is by no means as desperate a condition as is generally supposed. Many cases with opened ventricle, when treated in this way, have made perfect recoveries, as will be related in a more detailed communication which will permit of case reports.

8. PURPOSEFUL INCISION OF THE DURA.

This procedure, in the case of the usual subtemporal decompression through an intact scalp, need not concern

FIG. 12.—Showing the method of placing silver clips on the vessels of dural or meningeal margin.

us, but when performed in the area of a dirty wound it is a different matter. Under these circumstances it must be undertaken with great hesitation, and only in those cases in which the neurological symptoms indicate a serious local loss of function, or in which the exposed and undamaged dura is tense and evidently overlies a clot or severely contused area.

If the dura is opened under these conditions, if the disorganized area is washed and sucked away until normal tension is restored, and if the membrane is then accurately closed with delicate fine black silk sutures passed on curved French needles, there is practically no risk of infection. Needles with cutting edges and heavy suture material are unsuited to this delicate procedure.

There can be no doubt but that the period of convalescence and its attendant discomforts in this particular group of cases can be greatly lessened by opening the dura, but if the surgeon has any doubts of his technique or of the cleanliness of the wound, he had far better give the patient the chance of recovery afforded without incising the membrane.

9. RETAINED MISSILES.

It goes without saying that it would be the ideal treatment, at a primary operation for a penetrating wound, if the foreign body could always be removed. Otherwise the operation must be regarded as incomplete, with a far greater likelihood of subsequent abscess formation than if removal of the missile has been accomplished. It is equally true that foreign body extraction, no matter how desirable as a means of avoiding these possible secondary complications, should never be forced to the point of increasing the damage to the nervous tissues already done by the penetration. Some say "avoid infection at any cost"; others "better a fatality from infection than the certainty of perpetuating paralysis." Between these two schools one must decide in the individual case.

It is well known that many, even sizable bodies—a shrapnel ball, for example—may be retained without provoking symptoms, but even so, the writer has known of

FIG. 13.—Diagram to show the insertion of a catheter in the track of a penetrating missile.

abscess formation around such a missile first giving evidence of itself a year after the injury. The middle ground position is the safest one—namely, always to extract a foreign body if it can be accomplished without increasing the damage already done.

This discussion applies solely to deeply implanted missiles, for all agree that superficial and easily accessible ones should of course be removed. Extraction with a magnet is the only justifiable method applicable to deep-seated bodies and can often be accomplished after suction of the track in the usual method by gently sliding into it, to the proper depth, a French wire nail with rounded point. Contact with the proximal end of the nail is then made with a portable electro-magnet, which need not be a weight greater than can be easily handled, and if the foreign body is magnetizable and proper contact secured it will be withdrawn along its own track of entry.*

All of the foreign bodies from which cultures were made gave a growth of organisms—usually streptococcus, staphylococcus, or some gas-producing bacillus.

10. THE USE OF ANTI-SEPTICS.

The use of watery solutions of antiseptics in the brain is disappointing, for they lead to oedema with swelling of the tissue and an increased tendency to herniate. It was not until Dakin's dichloramine-T in eucalyptus oil came to be utilized as a routine during the latter weeks of our service that there was a notable diminution in the number of infections.

It is true that the technique of the procedures had greatly improved at this time, and true also that we can record no thoroughly conclusive bacteriological studies, though cultures of many of the wounds and foreign bodies were made. With the dichloramine-T, in not a few cases in which an infected foreign body was removed and in which bone fragments as well gave an abundant growth, no symptoms whatsoever followed closure of the wound without drainage. In two instances the cultures showed the presence of the pneumococcus in the ventricular fluid, and the only patients in the series who have recovered from active gas infection of the brain were treated with this drug.

As the terminal step of cleaning out the contused pathway of the missile a small amount of the oily solution is injected along the course of the track through a small catheter, and, just before final closure of the scalp, the dural surface of the wound is moistened with the same solution.

CONCLUSION.

This bare recital of an operative method for a certain type of the many wounds which occur in warfare makes dull reading. It is hoped that it will nevertheless carry some suggestions to others who, like the writer, without preliminary instruction, may, by force of circumstance, have to undertake similar tasks. Much admirable work directed toward the improvement of cranial operations has been done by surgeons in the allied armies—in the British Forces notably by Sargent, Gray, Anderson, Grahame, and Wagstaffe. Unfortunately, however, there have been few, if any, detailed reports of a series of cases, either from front or base, and the underlying principles of treatment

* The extraction was successful in eleven cases in the series in which the missiles would otherwise have been inaccessible. It would have been preferable to place the interposed nail in exact contact with the foreign body under the direction of a fluoroscope, but our situation did not permit of this. The procedure is capable of great development, and next to the eye the brain is the most favourable place for employing the magnet.

of these penetrating wounds has been the source of some disagreement. A surgeon naturally becomes wedded to the particular procedure which he happens to have developed and is more likely to succeed therewith than by adopting the methods of others.

There can be little doubt but that, as is the case with thoracic, abdominal, and joint injuries, the earlier a cranial operation is performed the less likelihood there is of sepsis. The mortality, however, in a hospital near the front is, in the natural course of events, almost certain to be greater than the mortality of operations for similar conditions at the base, for delay always serves to eliminate a certain percentage of the more desperately injured. For this all allowances must be made.

A distinguished surgeon once seriously advocated operating upon typhoid perforation in the second rather than in the first forty-eight hours, because the collected statistics had shown that a larger percentage of cases operated upon in the second forty-eight hours recovered. In the difficult task of dealing honestly with statistics fallacies of this kind at least can be avoided.

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who from time to time were assistant members of the surgical team on whose shoulders fell the larger part of the work.

NOTE ON THE EXTRACTION OF A FOREIGN BODY FROM THE BRAIN.

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THE damage necessarily done to the brain structure in the removal of a foreign body, coupled with the fact that experience has shown that fragments lodged in the brain may give rise to very little disability, argues for leaving deep-seated ones in position until such time as it becomes evident that their presence is the cause of the symptoms and that removal, if it can be effected, will lead to an improvement in the patient's condition. The following is a report of a case in which the attempt to remove a foreign body from the brain was considered to be indicated and was justified by the result.

History of the Case.

T. K., a man aged 20, was wounded on February 7th, 1917. The note from the casualty clearing station was: "Several small wounds in neck and back of head. Semi-conscious and suffering from shock. Vomited on the way down to the casualty clearing station. X-ray report stated that there is a small foreign body in the brain and that there is some damage to the occipital bone." He was kept in the casualty clearing station and base hospital in France for seven weeks and improved considerably; he was then transferred to England. On admission to the 2nd Western General Hospital his condition was poor; there was marked mental dullness, slowness and hesitancy of thought and speech, and he was somewhat childish mentally. He could not sit up for more than a few

FIG. 14.—Sketch illustrating the method of suction of the track of a penetrating wound.