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AN INQUIRY
INTO THE
CAUSATION, DIAGNOSIS, AND TREATMENT
OF
FRACTURE OF THE INTERNAL TABLE
OF THE SKULL.

BY

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[Reprinted from the *British and Foreign Medico-Chirurgical Review*
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1865.

An Inquiry into the Causation, Diagnosis, and Treatment of Fracture of the Internal Table of the Skull. By WILLIAM FREDERIC TEEVAN, F.R.C.S., B.A., Surgeon to the West London Hospital, &c.

[*Reprinted from the British and Foreign Medico-Chirurgical Review for July 1st, 1865.*]

It is, firstly, necessary to establish the existence of fracture of the internal table only, resulting from violence applied to the exterior of the skull, inasmuch as it is denied by some, doubted by many, and admitted by but few, English Surgeons. I will, therefore, adduce not only many well recorded cases, but, also refer to such pathological specimens, illustrative of this particular inquiry, as I have been able to discover during a personal examination of all the pathological museums in London, the museum at Netley, and the Musée Dupuytren in Paris.

It has, by some, been supposed that this variety of fracture was known to Hippocrates; this, however, is incorrect, as a careful examination of his works will shew. One of the earliest writers who was aware of this lesion was Jacobus Berengarius Carpinensis, who stated, at page 6, of his work, "*De Fractura Cranii*," published in Bologna, in 1535: "*Est alia species in qua os frangitur tantum inferius versus panniculum, et dicitur Marusis ab Haly, in Pantœgni vero Monesis vel Marusis. Hanc speciem credo ego esse plicaturam ossis, quando os plicatur, et intra tantum rumpitur et non extra.*" However, the earliest recorded case I have been able to find is that by Ambrose Paré, at page 225, of the tenth volume of his works, published in 1652: "*Ce que j'ay veu aduenir à vn gentilhomme de la compagnie de monsieur d'Estapes, lequel fut blessé sur la brèche du chasteau de Hedin, d'un coup d'arquebuse qu'il reçeut sur l'os pariétal, ayant vn habillement de teste, lequel la balle enfonça sans estre rompu, ny pareillement le cuir, ny le crâne extérieurement, et le sixième jour mourut apoplectique.* Donc

aduint que pour l'ennuie que j'auois de cognoistre la cause de sa mort, je lui ouuris le crâne auquel trouuai la seconde table rompue, avec esquilles d'os qui estoient insérez dans la substance du cerueau, encore que la première fust entière. Ce que pareillement atteste auoir veu et monstré à messieurs Chapelain, premier médecin du roy, et Chastelan, premier de la reyne, à vn gentilhomme qui fust blessé à l'assaut de Roüe." Saucerotte, in his essay on "Contre-Coups," at page 415, of the fourth volume, of the Memoirs of the Royal Academy of Surgery, mentioned instances of this fracture which occurred to Tulpius, Mery, Le Dran, and Soulier. Pott, at page 273, of the second edition, of his work, "On the Injuries of the Head," related two cases which fell under his own notice. In Velpeau's well known work, "De l'Opération du Trepan," at page 29, of the edition of 1834, two examples are recorded which happened to Bilguer. In the Handbuch der Praktischen Chirurgie, by V. Bruns, page 297, vol. 1, references are given to twenty cases; and, in the "Archiv für Pathologische Anatomie," vol. 22, page 80, two instances are given. Mr. Guthrie, at page 329, of the fifth edition of his "Surgical Commentaries," gave an account of an interesting case which occurred to Mr. Dense. In the "Archiv für Klinische Chirurgie," page 547, of the second volume for 1862, there is an article entitled, "Ueber isolirten Bruch der Glastafel," by Dr. B. Beck, who brings forward an instance which fell under his care at the Battle of Vicenza, in 1848, but it is not a strictly correct specimen of the fracture as there was a fissure in the outer table. I shall, however, allude to his explanation of the cause of the fracture at another page. A very interesting case, which has been referred to by many continental surgical writers, occurred to Mr. S. Cooper, at the Battle of Waterloo, and was narrated by him, at page 1270, of the seventh edition, of his Dictionary of Practical Surgery. Very recently, an instance, in which fracture of the internal table produced laceration of the middle meningeal artery, and fatal extravasation, happened to Mr. Edwards, and is recorded, at page 191, of the eighth volume of the Edinburgh Medical Journal. But, perhaps, the most interesting examples, inasmuch as the crania are preserved,

occurred, respectively, to M. Denonvilliers in Paris, and Dr. Cowan in the Crimea. In the first instance, a young man was struck on the head by a bullet, which wounded the scalp, but not the bone. He remained well for a fortnight, when symptoms of encephalitis came on, and M. Denonvilliers trephined him, on the 25th day, at the spot struck. The disc of the external table came away in the trephine, and a piece of the internal table was then seen lying on the dura mater. The detached portion had to be broken in pieces before it could be withdrawn through the trephine hole. Temporary relief only followed the operation, for the man died a week after its performance. Dr. Cowan's case is thus related in Holmes' System of Surgery, vol. 2, page 47: "Fissured fracture of the inner table may also occur from the action of a ball without external evidence of the fracture. Such a case occurred in the 55th Regiment in the Crimea. The soldier had a wound of the scalp along the upper edge of the right parietal bone. The ball in passing had denuded the bone, but there was no depression. The man walked to the camp from the trenches without assistance, and there were no cerebral symptoms on his arrival at the hospital; but five days afterwards there was general œdema of the scalp and right side of face, the wound became unhealthy, and slight paralysis appeared on the left side. The next day, hemiplegia was more marked, convulsion and coma followed, and he died on the thirteenth day after the injury. Pressure from a large clot of coagulum, and extensive inflammatory action, were the immediate causes of death; but a fissure confined to the inner table, running in line with the course of the ball, was also discovered. A preparation of the calvarium in this case was presented, by Dr. Cowan, 55th Regiment, to the museum at Fort Pitt." I could refer to many other undoubted cases of fracture of the internal table only, but it would be superfluous to do so.

I have only been able to find two pathological specimens, illustrative of this variety of the fracture of the skull. The first specimen, numbered 29 A, in the Musée Dupuytren, at Paris, is the calvarium taken from the man who was trephined by M. Denonvilliers, and is a very well marked case of a detachment

of the internal table only. The second specimen, which is in the museum at Netley, is the skull cap taken from the soldier who was under Dr. Cowan's care, and it shows a straight fracture a few inches long, with slight separation of its edges, affecting the internal table only, of the right parietal bone. In each instance there was no fracture nor fissure of the external table, and in each the condition of the bones was quite normal. I have purposely excluded all references to those specimens of fracture of the internal table in which there were any fissures in the external as being imperfect illustrations, for, if the case be one of fracture of the internal plate with a fissure in the outer, it is, in reality, a complete fracture of both laminæ. It will often be found, in complete fractures of both tables, that there are certain fissures or fractures in one table without any corresponding ones in the other; but they have no bearing whatever on the present subject.

Thus, it will be seen that the occurrence of fracture of the internal table, without the slightest injury whatsoever to the outer table, from violence applied to the exterior of the skull, is placed beyond all doubt.

It is here necessary to make some remarks regarding the physical properties of the skull. It may be, temporarily, depressed at a spot without any fracture being produced, as is well seen when a dry skull cap, being allowed to fall on a stone floor, rebounds without any fracture taking place. This can only result from the elasticity of the bone, which implies that there was a certain amount of depression, or flattening, of the part struck, at the moment of impact—it is the act of the depressed bone in recovering its former position which causes the rebound. It is imagined that, on account of the arched form of the skull, the effects of violence on the inside of the cranium must be very dissimilar to those on the outside. Now this is certainly true regarding those bodies which act over a large portion of the head, but small bodies, such as bullets, which only strike a very limited part of the skull, produce exactly similar effects, whether they act on the inner or outer surface of the calvarium, supposing always the amount of force similar, inasmuch as every point on the inside or outside of the

skull is virtually a flat surface. It must also be premised that, with the exception of those places where there are sinuses, there is, physically speaking, no such thing as a distinct and separate inner or outer table. The two laminæ and intervening diploë are inseparably blended together, and are one and indivisible.

It is asserted, in most surgical works, that because the inner table of the skull is more dense than the outer, it is necessarily more brittle. Now it is a fact, in physics, that if a given body is more dense than another, it does not consequently follow that it is more brittle, and I have already shown, and will still further show, in this enquiry, that the inner surface of the skull is not more brittle than the outer—the fact implied in the term “*lamina vitrea*” is founded on an assumption which cannot be supported.

What is the causation of this fracture?

Most of the French surgeons regard this fracture as an example of *contre-coup*, resulting from the greater brittleness of the inner table, as will be seen by the following quotations. “*Premier cas. La table externe percutée, peut résister, tandis que la table interne se fracture immédiatement au-dessous parcequ’elle est plus cassante, aussi l’a-t-on appelée vitrée.*”* Velpeau assigns a similar reason: “*Plus mince, moins étendue en surface, plus irrégulière, plus dense que la table externe, la couche vitrée éclate et se fendille sous un effort manifestement moindre que la précédente.*”† It would, indeed, seem as if most of the French writers had adopted the views of Saucerotte, who regarded the fracture as a variety of fracture by *contre-coup*, and in the following words gave his explanation of it: “*Qu’un instrument contondant soit appliqué, avec violence, sur un os de la tête où les deux tables soient distinctes l’endroit frappé, de convexe qu’il étoit, deviendra concave; par conséquent il y aura un grand déplacement dans ses parties intégrantes: car une voute menace de la plus prochaine destruction, lorsqu’un corps quelconque, qui, par sa masse ou sa vitesse surpasse sa résistance, tend à l’enfoncer. Or, il n’est plus étonnant que la table vitrée se rompe, parce qu’elle est*

* Vidal, de Cassis, *Pathologie Externe*, tome, 2, p. 545.

† De l’Opération du Trepan, p. 29.

mince, sèche, et fragile, quoique l'externe, par sa souplesse et son élasticité, prête à l'effort du coup.* Legouest, who is one of the most recent writers on military surgery, considers it an instance of direct fracture, at the same time he ascribes its occurrence to the greater brittleness of the inner table: "Lorsque l'os frappé est épais, résistant et à diploë solide, la table interne, plus mince et plus friable que l'externe, se rompt quelquefois, cette dernière restant intacte."†

The German surgeons are of opinion that fracture of the internal table occurs from its greater brittleness, and Dr. Bernhard Beck, in the article I have already alluded to, assigns an additional reason—the shortness of the inner table. He states that the outer table has a much larger superficies than the inner, and, therefore, a greater faculty of extension from the shorter and more brittle *tabula vitrea*, and, consequently, when a projectile hits the outer table obliquely and sets it in vibration, it suffers a stretching and displacement of its tissue: the shorter brittle table follows the process in like manner, but not quickly enough, and is, therefore, broken. It is the shortness and brittleness of the inner, not any depression of the external, table, which cause it to break. He also tried many experiments on the dead body, striking the head with bullets, and often produced fracture of the inner table, when the outer was neither depressed nor fractured. According to his experiments the outer table can be depressed from half-a-line to one line without breaking.

Those English surgeons who have admitted the existence of this fracture state that it occurs from the greater brittleness of the inner table. Sir B. Brodie's words express the English belief: "The greater elasticity of the outer table of the skull, and the greater brittleness of the inner table, seem to afford the only reasonable solution of these phenomena."‡ It will thus be seen that all surgeons assign, as the cause of this fracture, the greater

* *Mem. sur les sujets proposés pour le Prix de L'Acad. Royale de Chir.* tome IV, p. 374.

† *Traité de Chir. d'Armée*, p. 283.

‡ *Med. Chir. Trans.* vol. 14, p. 331.

brittleness of the inner table, and Dr. B. Beck gives an additional explanation—its shortness.

I will now show that the cause of this fracture is not to be sought for in any of the reasons given, but that it occurs in obedience to a well known physical law—that fracture commences in the line of extension not that of compression.

If it were true that the shortness and brittleness of the inner table were the cause of its fracturing, then it would follow that, if violence were applied to the inner surface of the skull, it would be impossible to produce fracture of the external table only, without any injury whatsoever to the inner. Now what are the results of my experiments on this point? Why, they show that, if the inside of the skull be struck, the external table can be fractured without any injury whatsoever to the internal table—thus proving that the alleged shortness and brittleness can have nothing to do with the causation of this fracture. I give the following details of an experiment, which any one can, with a little practice, perform. A skull cap, stripped of all its soft parts, with a wet cloth inside it, is to be laid with its convexity in the palm of the left hand, which is to be protected with several layers of a moist cloth, to obviate an inconvenient amount of pain. If the inside of the skull be now struck by a hammer, with a slight degree of force, fracture of the external table will be produced, without any fracturing or fissuring of the inner. I have performed this experiment several times, and exhibited some of the specimens at the Pathological Society. *I would here refer to a specimen, which is quite unique,

* Since the above was in type I have met with another case:—"Mr. TEEVAN exhibited a calvarium, shewing a fissured fracture of the *external table only*, produced by a bullet striking the *inside of the skull*. The skull cap was taken from a Swiss, who shot himself a few weeks ago, and died in one of the London Hospitals. The bullet entered the right parietal bone, traversed the brain and its membranes, struck the inside of the left parietal bone, and remained imprisoned in the cranium. There was no fissure or fracture at the spot on the inner surface of the left parietal bone where the bullet struck, but at the corresponding spot in the outside of the bone there was a starred, fissured fracture of the external table only. Mr. TEEVAN remarked, that this variety of fracture had never been described, and that he brought forward the specimen to corroborate his own experiments on this subject, and in support of the statement which he had made to the Society on a former occasion—that, whether the inside or outside of the skull be struck, fracture of the distal table only, without injury to the proximal one, can be produced in either case, and that such fracture occurred in obedience to a well-known physical law—that fracture commences in the line of extension, which is the distal side, and not in that of compression."—*Lancet*, Nov. 8th, 1865.

of a certain fracture of the skull, which has never been described by any surgical writer. In Guy's Hospital Museum, No. 1082⁷⁰, there is the calvarium of a man who committed suicide by shooting himself. The bullet entered the skull in the right temporal region, traversed the brain and its membranes, struck the inside of the left part of the frontal bone, and remained imprisoned in the cranial cavity. At the spot on the inner surface of the left frontal bone, where the bullet struck, there was a black mark, but no fissure nor fracture, but, at the corresponding point outside there was a starred, fissured fracture of the external table only. Here, then, was produced, accidentally, a similar kind of fracture to that which I had caused experimentally.

Thus, therefore, whether the inside or outside of the skull be struck, fracture of the distal table only, without any injury to the proximal table can be produced in either case.

I will show the causation of the above facts.

If a stick be bent across the knee, until it commences to break, it will be found that the fracture begins, not at the spot where the knee is applied, but at a point exactly opposite on the other side, and the fracture commences there in obedience to a well-known physical law that, when pressure is applied to a body till it breaks, the fracture commences in the line of extension, not that of compression. Now, when a stick is bent, the atoms along the proximal curve at which the pressure is applied are brought nearer together or compressed, and the atoms along the distal curve are separated or extended; therefore, if the pressure be continued till the stick breaks, it follows that the rent or fracture must commence at that spot in the distal curve where the greatest extension is going on, which point will be found exactly opposite to where the pressure is applied.

The annexed diagrams show the *rationale of Fracture of the Internal Table only, produced by a blow on the outside of the skull.*

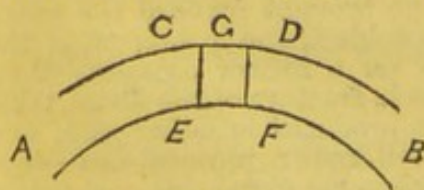


Fig. 1.

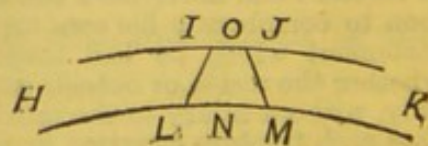


Fig. 2.

Let A B (Fig. 1) be a section of the skull. Draw two vertical lines, C E and D F, parallel to one another. Now, if pressure be applied at G, temporary depression takes place, and the bone assumes the shape of H K (Fig. 2), and the lines C E and D F, are no longer parallel to each other, but converge towards each other at the upper surface, I L, J M, so that the distance from I to J is less than that from C to D, but the distance from L to M is greater than that from E to F, signifying that the atoms of bone in the upper surface from I to J have been brought nearer to each other, or compressed, whilst the atoms of bone in the lower surface from L to M have been extended or separated from each other; therefore, if any fracture take place, it is clear it must do so in the line of extension L M, and at that point in the line where the greatest extension is going on, which is at N, exactly opposite the spot O, where the pressure was applied.

Proof: Take a cane, slightly bent, say A B (Fig. 1), and insert two pins or wires, C E, D F, vertically, and parallel to each other: the more the pins project at each surface, the more manifest will be the result. Exert pressure at G till the cane is made flatter, H K. It will now be found that the wires are no longer parallel to each other, but converge along the upper surface, so that the distance between them from I to J, is less than that from C to D; but the distance from L to M is greater than that from E to F, showing clearly that the atoms along the lines I J have been compressed and brought nearer to each other, whilst those along the line L M have been extended; consequently, if any fracture take place, it must commence at N. If the pressure on the cane be continued till it breaks, it will be found that it commences to break at the point N.

A familiar instance of a fracture accidentally occurring in nature, similar to fracture of the internal table only, is when the ice cracks under pressure. It will often be seen that there are cracks in the under surface of the ice and none in the upper, and it will always be found that when a crack takes place it commences in the under surface, thus illustrating the fact that the fracture commences in the distal side, which is the line of extension.

The next diagrams show the rationale of *fracture of the External Table only, by a blow from within the skull.*

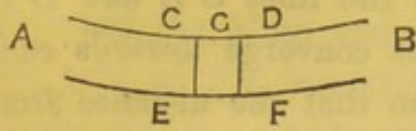


Fig. 3.

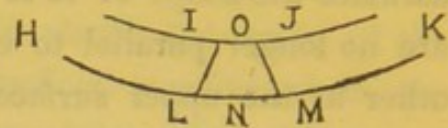


Fig. 4.

Let A B (Fig. 3) be a section of the skull. Draw two vertical lines parallel to one another, C E, D F. When pressure is applied at a point, G, on the inside of the skull, the bone is temporarily depressed very slightly and assumes the shape H K (Fig. 4), and the lines C E, D F, are now no longer parallel to each other but converge at O, so that the distance from I to J is less than that from C to D, but the distance from L to M is greater than that from E to F; therefore, the atoms of bone from I to J have been brought nearer to each other by being compressed, whilst those from L to M have been extended. If any fracture should take place it must do so in the line of extension L M, and at the point in the line where the greatest amount of extension is taking place, N, which is in the outside of the skull.

Proof: Take a cane and bend it slightly, A B, (Fig. 3.) Insert two pins or wires, C E, D F, vertically, so that they may be parallel to each other—the longer the pins, the more manifest will be the result. Exert pressure on the concavity at the point G, so that the cane assumes the shape H K (Fig. 4). It will now be found that the wires are no longer parallel, but converge towards each other at O in the upper surface, and that the distance from I to J is less than that from C to D, but that the distance from L to M is greater than that from E to F, showing that the atoms along the line I J have been brought nearer to each other by being compressed, whilst those along L M have been extended. Therefore, if any fracture takes place, it is clear that it will commence along the line of extension, L M, and at that point, N, in the line where the greatest extension is going on. Consequently, if the pressure at O be continued till the stick begins to break, it

will be found that the fracture commences at N. It is stated by Dr. Beck, that fracture of the internal table only occurs in those parts where there is but little diploë. I, on the contrary, could only produce the fracture where the diploë was abundant, and, certainly, nearly all the cases recorded, and also the pathological specimens, shew that hitherto the fracture has nearly always taken place on the inside of one of the parietal bones, which, as is well known, contain a thick diploë. It is very difficult to produce an incomplete fracture of a thin body, for, if the pressure be sufficient to cause fracture, that fracture will not be limited to one surface, but will affect both; whereas, if the material be thicker, it will be found, although a much greater pressure will be required to effect fracture than in the former case, yet, that fracture, limited to the distal surface, may be brought about. Hence, fracture of the internal table only is, in reality, an incomplete fracture of the skull, for, as fracture always commences in the distal table first, whether the violence be applied to the inside or the outside of the skull, it follows that, if the force exerted be not sufficient to cause a complete fracture of both tables, the effects of the violence are spent on the distal table.

Legouest states: "Ces fractures de la table interne, mises hors de doute aujourd'hui, ne peuvent être produites que par l'action obliquement dirigée d'un projectile, ou par le choc médiocre d'un corps à surface étendue, plane et régulière," and Dr. B. Beck also states that when the fracture takes place it is produced by a body striking obliquely. It is manifest, however, that it is not necessary that a bullet should hit obliquely in order to fracture the internal table only. What is necessary is that the bullet should not strike with much force. Now, a bullet striking at right angles, when at full speed, does not bend the part it hits, but carries away bodily all that bone which is immediately in front of its path, whereas, when it hits slantingly, it acts with but little force on the point of impact, and very slightly depresses the bone, temporarily; consequently, if a spent bullet strike, at right angles, it may cause this fracture. In every case in which I produced it, it was by hitting the skull at right angles with but little force. Hence, the kind of

violence likely to cause fracture of the internal table only is that resulting from a small stone, spent bullet, stick, or some body acting with a slight amount of force on a limited part of the skull; merely temporarily depressing or bending the part struck.

I now proceed to the diagnosis and treatment of the fracture in question. This lesion is not necessarily followed by any bad consequences, but should it cause damage to the cranial contents, it would be in one of the following ways:—

1. The spiculæ, or jagged edges of the fracture, may irritate, or lacerate, the brain and its membranes, and thus cause acute or chronic encephalitis. This is the most likely result to follow, inasmuch as the edges of the bone are very thin and sharp, and an entire piece of the internal plate is sometimes detached, and may thus irritate, but not compress. It will be observed that the symptoms of this fracture are more likely to resemble those following the *punctured fracture* than any other.

2. The line of fracture may cross the courses of the middle meningeal artery, lacerate it, and so allow extravasation of blood to take place. The sinuses may also be torn in the same way.

3. Part of the inner table may be depressed in such a manner as to cause compression of the brain. Thus, this injury may cause inflammation or compression of the brain, and the symptoms may therefore vary in different persons. Now, as this fracture can never be seen during life, it is obvious that its diagnosis must often be doubtful, and sometimes impossible, for it is only by the occurrence of certain symptoms, after a certain injury, that its existence can even be suspected. It is, in the first place, requisite to pay attention to the kind of instrument which may have struck a person in a given case, for as I have already pointed out, this fracture has hitherto been caused by a small body, such as a stick, stone, or bullet, striking with but slight force, and it must be remembered that there is, generally, no injury whatsoever to the part of the external table which is struck, and that the fracture always occurs at a point in the internal table corresponding to the spot struck externally. Concerning this last statement, I may mention that all evidence is conclusively confirmatory, and not-

withstanding Saucerotte's assertion that the fracture in the internal table may occur at some distance from the point struck. Thus, as every fact shows that should fracture of the internal table happen, it will be found at a point corresponding to the spot struck externally, it follows that should the trephine be required, it must always be applied to the spot which was struck.

I will enumerate those symptoms which are sometimes diagnostic of the occurrence of fracture of the internal table only, but it is very rarely, indeed, that its existence can be absolutely determined.

If a person, after receiving a blow of the description I have already mentioned, should, in the course of some days, or weeks, begin to complain of a fixed pain at the spot struck, and be finally attacked with encephalitis, we may conclude, if on examination no injury can be detected to the bone struck, that some spiculæ of the inner table, or the ragged edges of the fracture, are scratching the membranes, and giving rise to an amount of mischief which will very probably terminate in intra-cranial suppuration. No acute symptoms may perhaps arise in a given case, but it may degenerate into chronic cerebral irritation. In those cases where the symptoms of the formation of pus are well marked, with paralysis of the side opposite to that struck, the diagnosis would be very probable.

If a person should show the symptoms of compression, with paralysis of the side opposite the injury, a few hours after receiving a blow in the neighbourhood of the middle meningeal artery, and on examining the bone struck we can detect no injury to it, although there may or may not be a scalp wound, we may infer that the vessel has been torn by a fracture of the internal table running across the direction of the artery, and that extravasation of blood is going on.

When compression of the brain is caused by a depression of the internal table alone, the patient may become insensible on the receipt of the blow and remain so. There would be paralysis, more or less, of the side opposite to that struck, but generally the symptoms of compression are not well marked. There might, or might not be, a scalp wound, but there would be no injury whatsoever

to the external table ; if there was a fissure the case would be one of complete fracture of both tables, with depression of the inner one only. Now, if the patient was insensible from the first, it is evident that the above symptoms might result from an intra-cerebral extravasation of blood on the side on which the blow was received and hence a diagnosis would be impossible. But it must be recollected that the compression produced by depressed bone is rarely so complete as that caused by an extravasation of blood, and that when the internal table only is depressed, the symptoms of compression will not be nearly so strongly marked as when both tables are driven into the brain. Hence, the less definite the symptoms of compression, the greater the reason to believe that they are caused by the internal table only.

There are two cases in which the diagnosis may be made with almost certainty. Firstly ; when a person recovers immediately after the blow, but finds there is paralysis of some part of the body opposite to the side struck, and examination fails to detect any injury to the bone. Secondly ; when, after the blow, no evil consequences arise at first, but, in the course of time the patient begins to complain of fixed pain in the part struck, and all the symptoms of chronic cerebral irritation show themselves, although the surgeon cannot find any injury to the external table.

Inasmuch, therefore, as fracture of the internal table only, can never be seen during life, and can only be diagnosed by the occurrence of certain symptoms after a certain injury, it is evident that its treatment can never be preventive.

There can be no doubt that there is, both at home and abroad, a yearly increasing dislike to resort to the use of the trephine, resulting not only from the very great mortality which attaches to every violence, whether surgical or accidental, to the head, but also from the fact that the patient will often die, although the trephine may have effected the end proposed, and it is very certain that, in the present day, lives are saved, which, in time past would have been lost. But, inasmuch as the treatment now pursued is chiefly one of expectancy, it is necessarily fraught with much danger in certain cases. Surgeons of the present time are

unanimous in stating that no such success follows the use of the trephine in their hands as attached to its employment by surgeons of the past, and they explain the discrepancy by alleging, what is no doubt perfectly true, that the operation was often unnecessarily performed on persons who had nothing the matter with them. If, therefore, that were so, it would clearly prove that the use of the trephine, on a healthy subject, is not, *per se*, the very dangerous operation it is stated to be. All surgical experience shows that the mortality which will attach to an operation performed on parts before they are in a state of inflammation, must be very much less than that which will follow interference with parts acutely inflamed; consequently, the use of the trephine as a preventive means is widely different from the employment of the same instrument as a *dernier ressort*. In the present day surgeons rarely apply the trephine at once except in cases of punctured fractures. Now, I have already stated that the effects produced by a fracture of the internal table, are most likely to be similar to those caused by the punctured fracture, but we cannot thereupon follow the treatment adopted in the latter case, inasmuch as fracture of the internal table can never be seen on its immediate occurrence, but only suspected at a later period by the advent of certain symptoms. Hence, the urgency, or persistency, of the symptoms can alone justify the use of the trephine in suspected instances of fracture of the internal table; consequently a surgeon would be warranted in trephining, on the spot struck, if all the symptoms of intra-cranial suppuration were well marked, and there was paralysis of the side opposite to the injury; so also if the violence had been applied in the course of the middle meningeal artery, and the symptoms of compression were urgent and persistent, together with paralysis of the opposite side; and, likewise, if the patient had been insensible from the first, with obstinate symptoms of compression and paralysis of the side opposite. It happens sometimes that a patient is never rendered insensible by the blow, but finds he has paralysis of some part of the side of the body opposite to that struck. Now, if, in the course of some weeks, the paralysis does not disappear, the use of the trephine, to the part struck, would be indicated.

A man occasionally receives a blow on the head, from a stick, or stone, which causes no inconvenience at first, but, in the course of some days, or weeks, he begins to complain of pain in the part struck, and is finally attacked with chronic cerebral irritation. On examination, no injury can be detected to the part hit, and if, in the event of there being no scalp wound, an exploratory incision be made down to the spot no fissure nor fracture be found in the external table, but the symptoms persist, and the patient continue to suffer from fixed pain in the part struck, we may suspect that there is a fissure or fracture implicating the internal table only. Now, if, after a persevering use of those means fitted for such a case, the symptoms above described do not disappear or abate the use of the trephine, to the part struck, will become necessary. A labouring man, suffering from chronic cerebral irritation, must be considered virtually dead, for, not only is he completely incapacitated for supporting himself and family, but he is unable to enjoy life, and becomes a burden to himself and others. The question ought to be, not whether, in a solitary case, the trephine can effect a cure, but whether, out of one hundred cases, it can restore some. No answer can be given to the first proposition, but the second can be answered, and that, too, affirmatively.

HOW WERE THE FRACTURES OF THE ORBITAL PLATES OF THE FRONTAL BONE OF THE LATE PRESIDENT LINCOLN PRODUCED?

To the Editor of THE LANCET.

SIR,—In the record of the post-mortem examination of the late President Lincoln, drawn up by Acting Assistant-Surgeon Taft, of the United States Army (*vide* THE LANCET, June 17th), it is stated that the bullet—a round one—entered the occipital bone one inch to the left of the longitudinal sinus, and was found imbedded in the right anterior lobe of the brain, immediately behind, but not in contact with, the orbital plate. The following facts are given:—

“The hole made through the occipital bone was as cleanly cut as if done with a punch. The orbital plates of both orbits were the seats of comminuted fracture, the fragments being forced inward, and the dura mater covering them remaining uninjured. The double fracture was decided to have been caused by *contre-coup*.”—*Philadelphia Medical Reporter*.

For the production of fracture by *contre coup*, it is absolutely necessary that force be transmitted from the spot struck; and if no such transmission took place in the case under consideration, it is clear that the fractures cannot be regarded as examples of fractures by *contre coup*. Now it is stated that the aperture of the bullet's entry was only half an inch in diameter, and as cleanly cut as if done with a punch. These facts resulted from there having been no transmission of force. The following words of mine (*British and Foreign Medico-Chirurgical Review* for July, 1864, p. 213) explain the reason why:—

“The bullet going at full speed affords no time for the part which it strikes, and puts into motion, to transmit motion to the surrounding bone, and hence merely cuts out a piece of bone its own size; whereas the bullet whose rate of velocity is low allows time for the part which it strikes to communicate force to, and set in motion, a considerable portion of the contiguous bone not struck; and consequently, the lower the rate of velocity, the larger will be the wound, for as more time is given, more particles will be set in motion.”

Consequently the fractures of the orbital plates could not have been produced by *contre-coup*, as there was no transmission of force.

Prof. Longmore, in a communication to THE LANCET of June 17th, considered that the fractures were caused by the brain being driven, by the impetus communicated to it from the bullet, against the orbital plates.

I, however, am of opinion that the fracture of the right orbital plate was produced by the direct action of the bullet, and that the left orbital plate was broken by an extension of the fracture into it from the adjoining plate. The

fact of the dura mater covering the orbital processes not being injured proves nothing, inasmuch as it is, I should suppose, well known that when a spent bullet strikes a bone protected by a cloth, skin, or membrane, the bone is often fractured, whilst the covering remains uninjured. It was assumed, that because the bullet was not found in contact with the orbital plate, it had, therefore, never struck that bone. The bullet, however, was discovered in the very position I should have supposed; for I have ascertained from repeated experiments on the dead body, that when a round ball is fired from a pistol, at the distance of only a few feet from the head, it makes a clean-cut aperture of entry, traverses the brain, strikes a spot on the inner surface of the skull, immediately opposite the aperture of entry, and then recoiling into the brain, remains imprisoned in the cranium. The conical bullet, however, fired at a short distance with a full charge of powder, from a revolver, not only generally enters the head, but also makes its exit from it. Inasmuch, therefore, as the injuries sustained by the late President Lincoln were exactly similar to those which follow the use of a similar weapon on the dead body, I am unwilling to believe that there was any departure from well-ascertained causes and results, and that any apparently inexplicable circumstance arose from some imperfection or want of minuteness in making the post-mortem examination, rather than from any deviation in the action of physical laws.

I am, Sir, your obedient servant,

W. F. TEEVAN, F.R.C.S., B.A.,

Surgeon to the West London Hospital.

Portman Square,

July, 1865.