

congestion is without any scientific evidence as to its action. Its clinical value, however, is still an open question. When the ice-cap is used, it should always be applied to the shaven scalp. In headache from cerebral anemia, rest in bed with the head low, and special attention to the cause (which is usually general anemia) are of prime importance. The administration of cardiac tonics, and the use of iron and easily assimilated food, generally prove successful when organic visceral disease is absent. In every form of headache we are often forced to resort to the temporary use of local applications of dry or moist cold or heat, or some form of anodyne or counter-irritant. Antipyrin, acetanilid, phenacetin, caffeine with bromide of potassium, etc., or diffusible stimulants such as aromatic spirits of ammonia, tincture of valerianate of ammonia, etc., often prove serviceable as symptomatic remedies, but their selection must be left to the judgment of the physician. When headache accompanies the infectious or malarial fevers, the reduction of the temperature by hygienic or other appropriate measures, or the use of quinine, usually proves efficacious. In headache due to cerebral tumor, free catharsis from time to time, the avoidance of cerebral stimulation or of causes known to produce interference with the intracranial circulation, the administration of the drugs above mentioned, or morphine if necessary, constitute the essential features in the medical treatment. The operation of trephining the skull should be resorted to if other methods fail to relieve the pain. This is often followed by decrease in the intracranial pressure and cessation of the headache. When the tumor is accessible to surgical measures, it should be removed as soon as its location is established. It is customary, before operating, to institute a thorough course of antisyphilitic treatment in order to give the patient the benefit of any doubt as to the possible gummatous character of the growth. The subsidence of headache and other general symptoms of cerebral tumor during the administration of mercury and iodide of potassium does not necessarily imply that the neoplasm is syphilitic, for the irritative symptoms of sarcomatous and other processes have been known to undergo retrogression under this plan of treatment. Headache due to syphilis (gumma, meningitis, periostitis) is rapidly relieved by mercury and iodide of potassium. In cerebral abscess, correct localization and immediate surgical operation constitute our only hope.

William M. Leszynsky.

HEAD, WOUNDS OF.*—Certain features in the anatomy of the skull are of great surgical importance when considering the nature and occurrence of wounds of its component bony parts and of injury to the brain. The periosteum of the cranium—called usually the pericranium—is not thick, but is strong and resistant. Except over the sutures and the great foramina, it can be easily stripped off, or even made to glide over the bone; though in the aged its connection with the underlying bone is more firm. It is nourished principally by vessels from the bone. The internal periosteum of the cavity of the cranium is the dura mater, which is thicker and tougher than the pericranium. Concerning the cranial bones themselves, it should be remembered that the diploë exists only during middle life, and is not to be found in the very young or very old. The amount of space which the frontal sinus may occupy should always be borne in mind.

Of great importance are the connections which the veins of the superficial soft parts enjoy with the deep sinuses and the veins of the diploë through the emissoria Santorini. The most important of these anastomoses are: (1) Among the occipital veins, which connect with the lateral sinus through the mastoid foramen; (2) along and around the interparietal suture, especially its posterior extremity, where numerous openings connect with the

* Use has been made in this article of a portion of that which appeared in the first edition of this work on "Skull, Fractures of the Base of," by Dr. Thomas H. Russell, of New Haven, Conn. The part thus used is enclosed in quotation marks.

superior longitudinal sinus; (3) the ophthalmic veins, according to Sesemann's investigations, empty into the cavernous sinus as well as into the facial veins. It will thus be seen that the sinuses of the brain have their overflow outlets, or "waste weirs," in abundance. Nevertheless, this freedom of venous connection enhances materially the danger from pyæmic or thrombotic trouble in case of erysipelas or phlegmon of the external soft parts.

It will be well, at the very outset, to give here the greatest possible prominence to the classical dictum (so often ascribed to Sir Astley Cooper, but really clearly enunciated by Hippocrates): "No injury to the head is too slight to be despised, nor too severe to be despaired of." There is a great temptation to ignore trivial scalp-wounds, to cleanse them insufficiently, or to dress them carelessly. If nothing else teaches the danger of carelessness in these cases, the experience gathered from the sword-duels of German students should be convincing, since each year several deaths are caused by comparatively trivial scalp- or face-wounds.

SUPERFICIAL WOUNDS.—Bruises and contusions need only slight attention besides rest: evaporating lotions, cold applications, or, if the patient is not seen till after swelling and ecchymosis have taken place, then hot applications constitute all that is required. Upon a superficial abrasion some antiseptic should be used. Any ordinary effusion of blood between scalp and bone will be checked, and then reabsorbed, under this treatment. The hair may be cut short or shaved if required; this should be done if the wound has been in any sense severe. If effusion be very great, and apparently unchecked after prolonged trial with simpler measures, then it would be right to make a free incision, turn out the fluid or solid blood, search for bleeding vessels, twist them or tie them with catgut, cleanse thoroughly, wait till all bleeding has stopped, and then neatly approximate the edges of the incision with fine silk or catgut, with the insertion of a few threads of horse-hair or catgut for drainage, and with a firm compress over all. Of course all this should be done under antiseptic precautions, with clean hands and instruments, etc.

Small punctured wounds need only antiseptic occlusion after their freedom from foreign matter has been secured. Small instruments and weapons sometimes make small punctures, yet wound a vessel of some size. Numerous cases of aneurism of terminal vessels have been reported from such causes. From such a wound hemorrhage would be free, while it would be easy to recognize whether an artery or a vein, or both, had been injured. If a vein, pressure would in most cases suffice; this should be made a part of the antiseptic occlusion, being maintained by an elastic bandage or by some mechanical device.

But if an artery be wounded and such pressure be insufficient, it should be included in a deep suture or occluded by acupressure. This might need to be done on either side of the cut, which should then be cleaned and occluded as before. In other cases it might be well to clip off the hair, shave the part, and enlarge the opening so that the bleeding vessel may be caught and secured.

Extensive lacerations or complicated incised wounds are often received, by which large skin flaps are torn up and the periosteum is stripped rudely off, and yet with only temporary concussion or "stunning."

In such cases the attendant should satisfy himself that the bone has received no such injury as may call for operative interference. He should first check hemorrhage, next shave the parts, and then, with sponge and forceps, address himself to removing every particle of dirt and every loose hair. Shreds of tissue whose vitality is doubtful had best be removed. It then remains only to close the wound. If periosteum have been torn and raised, it is best to readapt the torn edges with fine catgut sutures. Then the superficial wound edges are carefully approximated by silk or catgut sutures, continuous or interrupted. At each angle a stitch may be

omitted for the escape of serum, or a few catgut threads may be inserted for capillary drainage.

In the dressing of such wounds, gentle compression should be so exerted as to compel approximation of raw surfaces. For small wounds collodion makes a very serviceable application, the parts being first thoroughly dried and dusted with an antiseptic powder. When a moist dressing is used about the scalp or hairy face, the writer usually prefers a glycerin dressing; *i. e.*, some antiseptic in glycerin solution or emulsion, since whatever serum exudes from the wound will be readily taken up, and the dressing cannot dry and so stick to the parts that its removal will be very unpleasant to the patient.

For all dressings about the head, the writer esteems naphthalin very highly, since it seems to be particularly prophylactic against erysipelas; the latter being more common after head injuries than after those of any other part of the body. Should there be any special reason to fear inflammation, as meningitis, an ice-bag may be applied outside the dressing.

Cases occasionally occur in which some part, or nearly the whole, of the scalp has been torn off or torn loose, as by machinery or "scalping." If the patient be seen in time an effort should be made to replace the loose portion. Astonishing successes have been reported in injuries of this nature, and the case must indeed be very severe which does not justify a trial. The general rules given above are sufficient to guide the reparative effort; perfect cleansing, proper antiseptic, accurate approximation, and judicious pressure constituting the important canons of treatment. Should the effort partially succeed or fail, if the loss of substance be not too great, a plastic operation may be attempted: otherwise the bare or raw surface must be kept clean, and healthy granulations stimulated by such dry applications as zinc oxide or boric acid, or compresses soaked in a saturated solution of potassium chlorate. The healing process may be further hastened by Thiersch skin-grafting. No case of this kind, which is not speedily and primarily fatal, need be despaired of.

The soft spots about the head and face possess great reparative and recuperative power, and pieces which have been severed may yet unite by adhesion if properly and quickly reapplied. Thus, by bites and by various accidents, portions of the nose and ears may be nearly or quite detached. Unless the circumstances be very unpropitious the attempt should be made to restore them. Careful cleansing and perfect approximation are here, as elsewhere, essential to success.

Ragged lacerations of the lips and cheeks may sometimes be cleaned and sewed up; at other times it will be best to trim or pare their edges, and then neatly close the wound, this procedure causing less scar or disfigurement.

It may happen that we are called upon to deal with parts which have already become inflamed, or, perhaps, erysipelatous. In such case we should proceed as follows: The hair or beard should be closely removed. If the appearance of the part or the general condition of the patient indicates any septic process, the wound should be opened, its interior freely exposed to examination, and a most painstaking disinfection of its entire surface made. Foul spots or suppurating surfaces should be treated with an eight-per-cent. solution of zinc chloride, new openings made for drainage at the most dependent parts, and, according to circumstances, the edges reunited or the whole left open to close by second intention, putrefying and necrotic tissue being removed with knife, scissors, or curette. Abscesses should be laid freely open and their cavities disinfected. If erysipelas have supervened, the whole scalp may be covered with antiseptic poultices, of which the best is made of common brewers' yeast, to be soon followed by the Crèdè silver ointment, or one containing two per cent. of guaiacol and ten per cent. of ichthyol. Few surgeons would feel justified in making ice applications in such a case unless cerebral complications were extremely severe. It will of course be remembered, in the light of the vascular connection between the scalp and deeper parts (*vide* above),

that all cases of erysipelas of the head are at least serious.

With reference to later results of former injuries in the way of granulating or indolent ulcers, caries, necrosis, etc., there are no indications calling for treatment different from that generally resorted to for similar conditions elsewhere about the body. A healthy ulcer may be covered by skin grafts, or by a plastic operation; an unhealthy one should first be made healthy. All dead or dying bone should be removed with curette or chisel, and its surface allowed either to heal by granulation or to be covered by a plastic operation.

The soft parts about the head and face are, if possible, more vascular than in other parts of the body. This means, on the one hand, that life may be lost by neglect or from ignorance. Thus, within a short time, the writer has seen a drunken man so completely exsanguinated by hemorrhage from a superficial scalp wound only 2 cm. long, that it was with the greatest difficulty and care that he was recalled to life. On the other hand, by virtue of this excessive vascularity, reparative processes go on more rapidly; and, provided that proper precautions have been taken, it is the rule for most extensive solutions of continuity to heal *per primam*.

Superficial gunshot wounds should be treated on general principles. It must be remembered that a bullet may not only pursue a most tortuous track, but may carry in foreign matter. Such a wound should either receive primary antiseptic occlusion, without the slightest exploration or disturbance, or its track must be carefully cleansed and drained, being laid open for this purpose if necessary. After it has been interfered with or explored it differs in no wise from other wounds, so far as indications for treatment are concerned. There is seldom any positive indication for removal of a deeply buried bullet, save the anxiety of the patient, and this of course is a minor consideration.

DEEP WOUNDS WITH INJURIES TO THE BONES.—Like all other wounds, these call at first for hæmorrhage, then for perfect cleanliness, with removal of the hair in the neighborhood. This completed, exact exploration should be made. Should it appear that underneath a small external lesion extensive damage is concealed, then by free incision the whole must be exposed to touch, if not to sight. According to the extent of these deeper lesions the superficial wound, as thus extended, should or should not be reunited.

It may happen that one or more pieces of the external table, or of the malar or other bones, may be chipped off or entirely separated from their bony basis, and held only by their connections with the periosteum and soft parts. Not forgetting that they may still be nourished by these connections, it is, on the whole, the safest plan to remove them, leaving if possible the periosteum. But should a prominent process of bone be thus detached from its seat, *e. g.*, a part of the supra-orbital ridge or margin of the orbit, or even the mastoid process (and such cases have been reported), it would only be proper to make every effort to save it. Such a fragment is to be held in place by pressure, by stitches in the periosteum, or by drilling and suturing with catgut or silver wire. Pieces of bone that lie quite loose must unhesitatingly be removed, even if dura mater or brain be thereby exposed.

Hemorrhage from a denuded bone surface, and oozing from a deep wound, may commonly be checked by ice-water or hot water and pressure. A solution of antipyrin (five per cent.) makes a most excellent styptic, while suprarenal extract or "adrenalin" furnishes almost an ideal remedy in this regard. Once checked, the bleeding is not likely to recur after the wound is protected from the air and dressed with suitable compression.

Aside from leaden projectiles, a great variety of foreign bodies may not only injure the cranial bones and those of the face, but parts of them may even become embedded or disappear from sight—as, for example, workmen's pointed tools, knife-blades, bayonet, sword or foil points, arrow-heads, hatchet or tomahawk points,

pieces of glass, splinters or chips of wood, etc. The deeper they penetrate the greater the gravity of the case; the greater also the possibility of perforation or depression of the inner table of the skull. Thus fatal injury of the

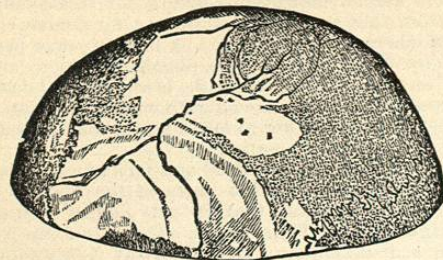


FIG. 2538.—Lines of Fracture Visible on the Outside of a Skull. (After Hewett.)

brain is not so rare in connection with a wound of the orbit, and the condyle of the inferior maxilla has been forced through into the cavity of the cranium. By means of a wound in the oropharynx, death, with literally no external injury, has been caused. In all these cases the indications for treatment are general, yet explicit. Obviously, removal of a foreign body is called for in almost every case, and this should be accomplished with the least possible disturbance. The only exception would probably be when it has totally disappeared within the brain substance. If simple traction be insufficient to dislodge it, enlargement of the external wound and instrumental aid must be resorted to. Strong forceps, a pointed elevator, the chisel and gouge, the trephine, or even the surgical engine may be called for. Thus the writer has had to resect almost the entire upper jaw to get away a piece of wood which had been deeply driven into the skull as it flew off from a circular saw. The more recent the case the better, as a rule, the results. If a pointed object have penetrated the cranium, it should be removed by traction in the direction of its line of entrance, so that further injury to the brain or its coverings may be avoided. In such a case it would, in many cases, be well to trephine at the site of its entrance into the skull, in order to remove any depressed bone, and smoothly to round off the opening; by means of the free opening thus made hemorrhage can be more easily checked. Bullets have occasionally been more easily removed by making a counter-opening. This is more easy now than

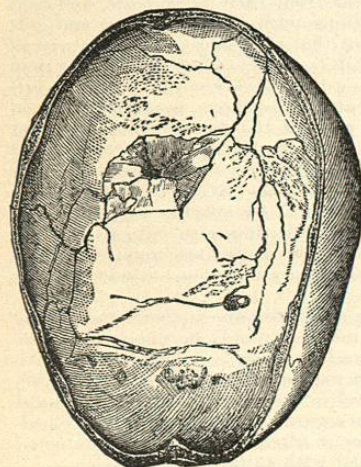


FIG. 2539.—Lines of Fracture Visible on the Inside of the Same Skull. (After Hewett.)

a few years ago when the telephone probe and the Röntgen rays were not available.

In every case in which solution of continuity of the external table has taken place, the attendant should bear in mind what a vantage ground the diploë offers for the lodgment of septic germs, and for the development of inflammatory and septic thrombotic processes which may greatly militate against the safety of the patient; and he should in such cases omit no precaution which may tend to avert their destructive tendency. Rigid anti-sepsis, or, if it can be secured, rigid asepsis, must be

our motto; without it no such wound can be properly treated.

The possible remote consequences of a blow on the head should not be lost sight of. Inflammatory hypertrophy of the bone may be the result, or caries or necrosis may ensue. These latter may be limited to the part injured, or may be very widespread, affecting one table or both, and even involving the whole vertex. Extensive destruction of the inner table alone has been known, and Saviard's celebrated case proved that the entire vertex might separate, since in his patient, two years after a blow, the whole skull cap came away. Not to speak of other bone lesions, we must also remember the remote results of hemorrhage, as when a clot organizes into a cyst, etc. (*vide Brain, Tumors of*). For every reason, then, we should endeavor to diagnose at the time, if possible, the nature of the injury, and to meet the indication at once, in order that untoward after-consequences may be avoided.

FRACTURES OF THE SKULL.—General Considerations.—Those of the vault are usually direct, the result of the force applied, whether the head have been struck, or whether the patient have fallen upon it, and they consist at one time of a depression (in a yielding skull, akin to

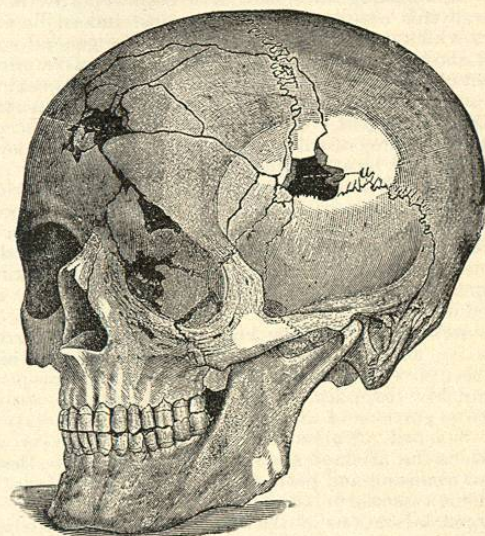


FIG. 2540.—Comminuted Fractures of Vertex of Skull and of Superior Maxilla. (After Bergmann.)

green-stick fracture), at another of an abrupt perforation, of a linear, a stellate, or a comminuted fracture. Fractures may here, as elsewhere, also be simple or compound. If the fracture be fissured the fissure may be short, or may pursue a long devious line, even to the base of the skull, extending through two or three bones. The comminuted fracture is usually less extensive as far as lines of cleavage are concerned. Fractures of the vertex also involve either one or both of the tables. Thus we often have fracture of the external table alone, and fracture of the inner table without visible lesion of the outer is known. Displacement may occur outward or inward. The lines of fracture visible on the outside of a given skull are seldom any index as to what may be found on its inner surface.

Figs. 2538 and 2539, from Hewett's monograph in Holmes' "Surgery," third edition, illustrate this fact; they represent respectively the outer and inner aspects of a vertex thus injured. A large number of similar illustrations may be found in their appropriate places in the "Surgical History of the Civil War." On the other hand, Fig. 2540, from Bergmann, will give an idea of the extent of some fractures of this kind.

There is, further, the possibility of fracture by *contre-*

coup. By this term is meant fracture by violence transmitted by the arched construction of the skull to a point more or less opposite to that injured. It is known that in cracking a coconut, for instance, the shell is not always broken at just the point where the hammer strikes it, but often at some other place. So a blow on the right side of the head may cause fracture of the left side, or in both places. Thus may be explained those cases in which a man sustaining injury, as by a kick of a horse, on the right side, is a little later found to have paralysis of the same side of the body; the explanation being fracture of the left side of the skull by *contre-coup*, with rupture of vessels and formation of a clot (or even rupture of vessels without lesion of the bone), with paralysis consequently on the side opposite the clot as an ordinary compression symptom. There is no limit to the peculiarities of fracture by *contre-coup*, save that it is never depressed.

Concerning the diagnosis of fractures of the vertex, it is not paradoxical to say that it is easy in proportion to the severity of the case, and most difficult when the injury is most trivial. The merest novice may recognize the ordinary compound fracture at a glance, while the expert may be at a loss in some cases of simple linear fissure.

Doubtless many cases of concussion of the brain following head injury are accompanied by some fissuring of one or both tables, yet, while we may suspect this, there is no way of proving it. Even a compound fracture is sometimes overlooked when the broken bone lies deep under the temporal muscle. Mistakes occur in the opposite direction also; thus, mere extravasation of blood has been mistaken for fracture with depression, and pre-existing abnormal depressions have been deemed to be the result of recent violence.

Fractures at the Base of the Skull.

"If we view the skull as a whole from either side, and especially from the rear, it will be noticed that while the upper and posterior surfaces have a dome-like arch the shape of which is well calculated to resist any ordinary violence, the base or under surface, especially viewed from the rear, is nearly flat. This is more strikingly apparent if we make a transverse and vertical section just

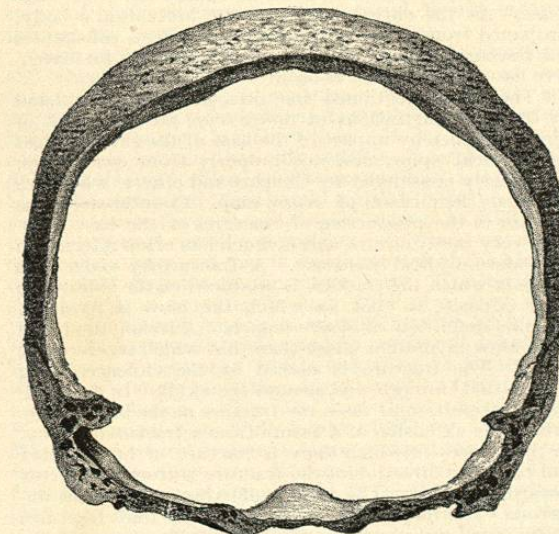


FIG. 2541.—Transverse Vertical Section of Skull through the Foramen Magnum, at Junction of its Middle and Posterior Thirds: showing thinness and flatness of the base in contrast with the thickness and convexity of the vertex. (Thomas H. Russell.)

back of the foramen magnum. This will show that the base of the skull at that point is almost exactly flat, and lacks the arched contour calculated to withstand blows or pressure. This will be made evident by reference to

the accompanying illustration (Fig. 2542) of a transverse vertical section just back of the foramen magnum.

"A glance at the under surface from without will show that it is weakened, not only by the large foramen magnum, but by the numerous foramina on either side and in front of it. If the base be viewed from within, being held between the observer and a moderately strong light,

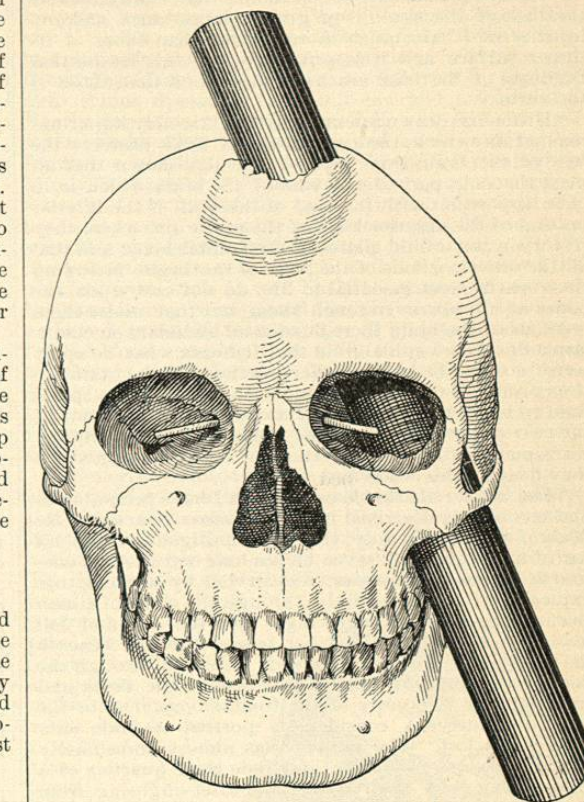


FIG. 2542.—Case Reported by Dr. Bigelow, of an Iron Bar (43 inches long and 1 1/4 inches in diameter) Driven Upward through the Skull. Recovery.

a considerable portion of the entire base will be found to be quite translucent, and some portions almost transparent, owing to their extreme thinness. The posterior fossa of a skull before me is thinner than at any other portion of its entire contour. In this specimen it is easy to distinguish through the posterior fossa small objects held on the other side of it, the bone here being as thin as the thinnest paper.

"While it would appear that the thicker portions of the base—as, for instance, the condyles on either side of the foramen magnum, the mastoid portions of the temporal, the median portion of the sphenoid, and the elevated ridges on the occipital bone—add considerable strength, in reality they do not furnish as much additional support as would at first appear; for if we make sections of these above-mentioned thicker portions, we shall find that they have only an extremely thin layer of outer and inner table or solid bone, and that almost their entire thickness is made up of diploë. They do not nearly compensate for the extreme thinness of the greater portions of all the fossæ and for the numerous foramina. It will therefore appear evident that the base of the skull is relatively weak, and not calculated to withstand more than a moderate amount of violence. The greater portion of the base has little or no diploë. No diploë is to be found in the posterior fossa and in the orbital plates of the frontal bone.

"If it were not for the fact that the base of the skull, from its less exposed position and from its being to a great extent protected from direct violence by being enclosed by the structures of the neck beneath, and for the fact that its great mobility upon the cervical vertebrae lessens the danger from any direct violence, it would be much more frequently fractured.

"The under surface of the brain, that contiguous to the base of the skull, is of greater importance, and any injuries of it are much more serious than those of its upper surface, and it is principally for this reason that fractures of the base are more disastrous than those of the vertex.

"Hilton has drawn attention to the extremely important manner in which the cerebro-spinal fluid protects the base of the brain from injury. He has shown that almost the only part of the base of the brain which is in close apposition with the base of the skull is the inferior portion of the anterior lobes of the cerebrum, where they rest upon the orbital plates of the frontal bone, and that all the other portions of the base of the brain, including those parts most essential to life, do not rest upon the bones at all, nor even touch them, but that under these portions of the brain there is such an abundant accumulation of cerebro-spinal fluid that it forms what he aptly terms a water-bed. No other portions of the brain are thus protected by an abundant supply of cerebro-spinal fluid to break the force of any violence. The contour of the two posterior lobes of the brain does not, therefore, correspond to that of the portions of the skull over which they float on this water-bed.

"The most remarkable case which I have been able to find recorded is described in the *American Journal of the Medical Sciences* for July, 1850, by Dr. Bigelow. A solid bar of iron, three feet seven inches long and one and one-fourth inches in diameter, was driven by a premature explosion of a blast entirely through the skull of a man twenty-five years of age, high into the air, and fell several rods distant. The bar passed upward beneath the zygomatic process on the left side, and through the floor of the anterior fossa of the base of the skull, and emerged near the centre of the frontal bone close to the coronal suture. A considerable portion of brain substance was lost. The patient was almost immediately able to converse rationally, and rode three-quarters of a mile, sitting erect in an oxcart, and after alighting from the cart without aid walked up a long flight of stairs. His recovery was complete in all respects, excepting the loss of sight in the left eye (Fig. 2542).

"Perforations have also occurred in various parts of the base of the skull from gunshot wounds. Wounds from direct violence of this kind are much more common in the anterior fossa than in other portions of the base, its floor being so thin that but little force would be required

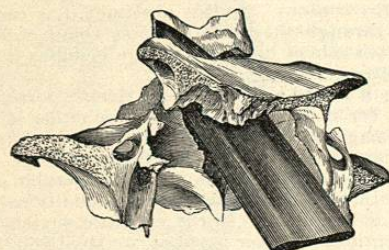


FIG. 2543.—Fracture of Clinoid Process by Sword Thrust. (From "Surgical History of War of Rebellion.")

to thrust any of the above-mentioned foreign bodies through into the brain. Punctured wounds through the anterior portion of the orbit by small slender instruments or weapons leave but very little external evidence of injury. If slender weapons be introduced under the upper lid, nothing is visible but a slight amount of ecchymosis of the conjunctiva. If the wound be external to the lid,

there will be nothing visible but the small wound in the region of the eyelid or eyebrow; and as the brain symptoms from such a wound of the anterior portion of the brain may not appear for several days, the gravity of the case or the nature of the injury may be entirely overlooked.

"Nancrede has called attention to the fact that murderous wounds leaving no trace that can be detected, ex-

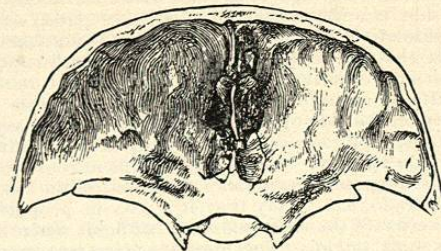


FIG. 2544.—Fracture of Anterior Fossa from a Blow on the Nose. (Bryant.)

cept upon a very careful examination, could be readily effected by passing a small pointed instrument through the retrotarsal conjunctival fold, and then penetrating the delicate orbital roof and superjacent brain. While this would not be difficult in an adult, it would be especially easy in children.

"The ethmoid bone has been fractured by a blow upon the nose, driving it upward against the brain.

"The squamous portion of the temporal bone has been fractured by a blow upon the chin, driving the condyle of the lower maxilla through the glenoid fossa.

"It is easy to appreciate how, if a man fall from any considerable height, and especially if, falling upon his head, he strikes upon any soft surface, thus distributing the force of the blow over a considerable area of the vertex, the weight of the body being projected like a blow from a hammer, with the momentum gained by a descent of many feet, against the base of the skull, an extensive fracture of the base might easily be produced. These fractures should be considered as caused by direct violence. As the entire weight of the individual's body, projected from a height of a number of feet, constitutes the fracturing force, it would seem very easy for extensive fissure of the base to occur.

"The above-mentioned fractures, although considered by some as illustrations of *contre-coup*, are the result of direct violence by impact of the base of the skull against the cervical spine, and not properly from *contre-coup*, as formerly considered by Chopart and others, who have recorded their cases of *contre-coup*. Counter-stroke as a factor in the production of fractures of the base probably very rarely occurs, and is much less often referred to in modern medical literature. A fracture by *contre-coup* is one in which the fracture is produced on the side of the head opposite to that on which the blow is received. Grima's definition of *contre-coup* is: 'A lesion produced by a blow in another place than that which received the blow.' The fracture is caused by the violence being transmitted through and around the skull. In a considerable proportion of cases the fracture at the base is a result of the extension of a fissure from a fractured vertex. In those cases in which there is fracture of both vertex and base, the direction of the fracture is from the vertex toward the base. The theory of Aran, who made numerous experimental investigations, was that fractures of the base are always connected with fractures of the vault from which they radiate, following a line within the zone in which the former occurred, and taking a course which corresponds with the shortest route to the base. Aran based his theory upon numerous experiments with dead bodies, and upon old dried skulls.

"Fractures of the base are generally, if not in all cases, only fissured and without marked depression, as in fractures of the vertex.

"SYMPTOMS.—The symptoms are often obscure, and the diagnosis may not be made out with certainty at the outset. Symptoms usually appear early, but may be long delayed, and all may be absent until three or four hours before death, as in a case recorded by Jackson. Hilton mentions an interesting case of a gentleman who was thrown from his horse, striking upon the back of the head, and he was dragged by his foot catching in the stirrup. He subsequently disentangled his foot, mounted his horse again, and rode several miles home. He occupied himself about his usual duties for the following thirteen days, driving, walking, and attending to various business matters, previous to coming under Hilton's care. He then began to suffer from indications of paralysis and subsequently died, and an examination of his skull showed that he had suffered a fracture at the base. Yet during the thirteen days following the injury there was not the slightest evidence of any brain lesion.

"Owing to the location of a fracture of the base, and to the fact that such fractures are only fissured and with little or no depression, it is not possible to make out by inspection or palpation the lines of fractures, as can be done in those of the vertex. The manner in which the violence has been inflicted would guide us very much in our diagnosis, and the symptoms will depend upon the portion of the base which is fractured.

"Hemorrhage from the ears alone is of only moderate importance, for it may occur without fracture, simply from any laceration of the small vessels of the external auditory meatus or the membrana tympani; but if the hemorrhage be prolonged and copious, and especially if it be evidently arterial, as shown by pulsation, and if it be accompanied by other symptoms, or the nature of the accident be such as would be likely to produce fracture of the base, it is a symptom of considerable importance, but is not alone quite conclusive. Severe hemorrhage from the ear has occurred without fracture of the base. This symptom does not occur even in all fractures of the middle fossa, but only when a fracture through the petrous portion of the temporal bone establishes a communication between the injured intracranial vessels and the cavity of the tympanum, the membrana tympani being also ruptured. If, in such cases, the membrana tympani was not ruptured, the blood would escape through the Eustachian tube into the throat.

"Serous discharge from the ear is the most important and almost characteristic symptom of fracture of the base. This discharge is sometimes very copious, so much so that it is recorded that as much as a tumblerful has been discharged in a short time. It has been pretty conclusively proven that this consists of cerebro-spinal fluid, for its composition, whenever examined, has proved to be the same, and there would appear to be no other possible source for such a copious discharge of fluid corresponding in chemical composition. It was at one time erroneously supposed that it was the serum of the blood, or the fluid secreted by the internal ear. The cerebro-spinal fluid is a perfectly clear fluid of a very pale yellow color, and having a specific gravity of about 1.010. It has a saltish taste and its reaction is alkaline. It contains a substance which, according to Foster, although not sugar, acts like dextrose when tested with Fehling's solution. Five cases have been recorded by Wilder (*Medical News*, Philadelphia, 1885, vol. xlvi, pp. 625-627), in which brain substance escaped through one ear. Of these, three were fatal and two recovered. The discharge of cerebro-spinal fluid is possible only when there has been a fracture of the petrous portion of the temporal bone, with rupture of the dura mater and arachnoid, and of the membrana tympani. Cerebro-spinal fluid has rarely been discharged through the nose, when the line of fracture extends through the anterior fossa. In a case recorded by Cameron in *The Lancet* (London, 1884, vol. i., p. 205), there was copious discharge of cerebro-spinal fluid through the nostril and one ear; but the patient, although seventy-five years of age, recovered. Erichsen reports a case (fatal) of a boy who re-

ceived a wound on the back of the head, with depressed and comminuted fracture of the skull, through the wound in whose scalp a large quantity of cerebro-spinal fluid escaped. This discharge of serous fluid by itself is a very characteristic symptom, and when taken in connection with an accident the nature of which would be likely to produce fracture of the skull, would constitute almost positive proof. A very noteworthy case has, however, been reported by Page (*London Lancet*, 1888, vol. i., p. 774) of a sailor who, after a fall of twenty feet, had ptosis of right eye, partial loss of vision in left eye, and hemorrhage from left ear and nose, followed by copious, clear serous discharge from left ear, and insensibility. Nearly complete recovery soon followed, but he died seven weeks after the accident, and at the autopsy no fracture could be found, but only purulent meningitis. Paralysis of one or several cranial nerves has occurred as a result of fracture of the base. Hemorrhage from the nose and mouth, and subsequent vomiting of blood, may arise in many cases in which there is no fracture. But if the hemorrhage be considerable, and if the nature of the accident were such as was likely to cause a fracture of the base, it may be supposed that the source of the hemorrhage is probably from rupture of an intracranial vessel, the blood escaping from a fracture of the sphenoid or ethmoid bones forming the roof of the nasal fossa. Vomiting of blood in considerable quantity, without hemorrhage from nose and mouth, has occurred from fracture of the base, the blood having been previously swallowed.

"Hemorrhage into the orbit may occur to a very noticeable extent when a fracture implicates the orbital plates, the blood then escaping from the intracranial vessels into the areolar tissue of the orbit, and appearing very noticeably under the ocular or palpebral conjunctiva. The discoloration of the lids from such a cause would not usually make its appearance as promptly after the injury, nor be accompanied by as much swelling, as when due to contusions of the lids from direct violence.

"Loss of vision from hemorrhage into the orbit may occur, as recorded by Rohrbach.

"The only objective evidence of hemorrhage from fracture of the base may be the appearance, after a number of hours, of extravasated blood beneath the skin on the back or side of the neck. In such cases the blood flowing from the broken skull finds its way down along the cellular tissue until it appears beneath the skin, in the neck. Such extravasations beneath the skin are of considerable diagnostic importance, if there has been no direct violence at the location of such extravasations to account for them.

"Vertigo, deafness, otorrhoea, hemiplegia, impairment of vision, and priapism have also been recorded as symptoms. There is no one symptom constantly present in all fractures of the base.

"PROGNOSIS.—Fractures at the base are not as invariably fatal as was formerly supposed. There can be no doubt that recovery occasionally occurs. The prognosis as to the injury of this portion of the skull itself, if there were no accompanying lesion of the brain, would not

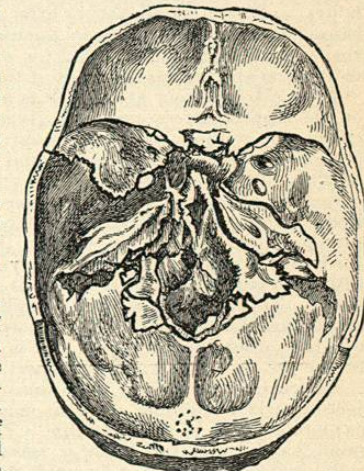


FIG. 2545.—Fracture of the Base by a Fall on the Vertex, which was Fissured. (Erichsen.)