LECTURES

ON THE

PRINCIPLES OF SURGICAL DIAGNOSIS:

ESPECIALLY IN RELATION TO SHOCK AND
VISCERAL LESIONS.*Delivered at the Royal College of Surgeons of England.*

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LECTURE IV.

Lesions of Encephalic Nerve-centre—Introductory Remarks—Objective and Subjective Indications—Fracture of Skull; its Detection and Importance—Use of Trephine—Depression without Fracture—Fracture of Base; its Diagnostic Signs and Symptoms—Inquiry respecting Fracture by Contre-coup—Means of determining the nature of a Fracture of the Base—Recovery after such Fracture.

MR. PRESIDENT AND GENTLEMEN,—Whilst natural science has been developed chiefly by accurate observation of facts, that development has, by a necessary and happy reaction, induced more caution in generalising from those facts, and more critical exactness in the definition and use of words. The vague mysticism of our past nomenclature has given place to intelligible precision of language; and an affectation of learning is no longer tolerated as the substitute of that wisdom which can afford a confession of ignorance, and, in so doing, takes the first step towards renewed exertion.

It may seem a trite remark,—it is certainly one which needs little exemplification,—that our knowledge of many subjects associated with the laws of life is still very imperfect. Much light has been thrown upon the conditions on which life is maintained, but we are still in ignorance of what life is. Many changes which we formerly believed to be vital are now proved to be chemical; and physical and vital energy have been shown to be more closely associated than was formerly supposed: but this scarcely brings us nearer to the demonstration of their identity. The capacity of the living germ for the conversion of physical into vital force or energy, under favouring circumstances, implies the existence of a quality which distinguishes it from inorganic matter; and this property or endowment, whatever it may be, still eludes our research. Whether the assumed inseparable association between matter and force is a step towards the solution of this problem, I do not venture to conjecture; and it would assuredly be an idle speculation to define any limit to the results of physical investigation.

Whatever life may be, we know that it exercises an all-pervading influence throughout the frame; that it endows organs with attributes which fail on its withdrawal; that the chemistry of inorganic matter is modified or suspended by its agency; that physical laws obey its behests; that it possesses its well-organised system of intercommunication, by which all parts of the frame are coerced into unity of action, and bound together by an invisible cord; that it resides nowhere, and yet is everywhere; that its presiding influence may be cut off, by violence, from a section of its dominions, without interference with the rest; that it will resist the rudest shock, or may succumb to one which could be supposed scarcely capable of disturbing its equilibrium;—exhibiting thus a sensitiveness which might be mistaken for inconstancy, if modesty did not prompt us rather to ascribe the apparent incongruity to our own ignorance.

Although the dominion of vitality is everywhere apparent in the animal organism, pervading or influencing every part, there are certain organs through the medium of which its phenomena find special expression; and the centres of nervous influence are the favoured agents in this mission. Theirs also is the still higher attribute of being the material medium by which the mind is brought into relation with the external world. Thus, in the diagnosis of the various lesions to which the nerve-centres are obnoxious, we are compelled to extend our survey over a large field, and to take cognisance of many associated circumstances, which are indirectly indicative of functional disturbance or of organic mischief. These lesions constitute a branch of practical medicine which is shared between the physician and surgeon; but the line which separates the two sections is conventional rather than real. The results of violence cannot be profitably studied, apart from those conditions of the brain, for example, which are the concomitants or consequences of diseased action; and the converse may be affirmed with

equal truth. Yet, I need scarcely observe that the scope of these lectures will compel me to limit my observations almost entirely to those conditions of disease or injury which fall within the special province of the surgeon; and to treat even these briefly and suggestively, as far as my experience has taught me to associate symptoms or signs with particular lesions.

And here I may at once remark that our knowledge is still very defective, perhaps necessarily so, from the difficulty which attends investigations of this nature, and the fact that there are unfortunately but few whose special education has endowed them with tact of hand and observation, to qualify them for the task of examining and reporting, in a trustworthy way, upon the delicate microscopic changes which disease produces in tissues, the actual healthy condition of which is not familiar to many. The intimate mutual relations of the various nerve-centres and of individual parts of each centre; our imperfect acquaintance with the localisation of special functions; our ignorance of what nerve-force is; the delicacy of the texture which is the subject of accidental injury or of experiment; the multitude of complicating circumstances which are often present, and the frequent incapacity of the patient to aid by replying to inquiries—altogether constitute a serious obstacle to correct diagnosis in these injuries. But, on the other hand, physiology and morbid anatomy have promoted our acquaintance with pathological changes; and thus, by establishing principles of more accurate diagnosis, have conduced to the introduction of a more settled—we may hope a more successful—system of treatment. Yet, I am bound to say, in reviewing my own experience and referring to the recorded observations of others, that, notwithstanding the obstacles to which I have alluded, I am disappointed to find that the advance made of late years in the special diagnosis of nerve lesions is so limited.

I should have been glad to introduce this subject by a review of the existing anatomy and physiology of the nervous system,—a course which, I apprehend, the conditions of this professorship would justify; but I fear, for the reason already assigned, that I must content myself with such brief allusions as may assist me in the object I have more directly in view. It is my purpose to briefly exemplify, as far as opportunity has enabled me, the various lesions, to the diagnosis of which I shall refer.

The diagnostic indications of injury to the Encephalic centre are both objective and subjective. The skull may be fractured; or functional derangement may denote that the brain has received a shock or hurt. Nevertheless, such injury to the bone by no means necessarily implies the co-existence of lesion of the contained nerve-centre; and the latter may exist, even to a fatal extent, without actual breach of texture of the osseous case. It is scarcely necessary to remark that fracture or other injury to the skull is, as such, comparatively of little importance, except in so far as it is accompanied by, or entails as a sequence, mischief to the brain. It may be accepted, therefore, as a *general* principle, that the presence of fracture, which is unattended by cerebral symptoms, rarely requires or justifies surgical interference. I speak of the principle as *general*, and of interference being *rarely* demanded, because instances do occur in which extensive fracture with depression exists, without producing immediate cerebral symptoms of urgency or even of importance, but which, nevertheless, call for surgical assistance. This apparent anomaly, of osseous textural lesion without immediate interference with any special function, seems to be due to the absence of compression of the brain, and to the duality of the cerebral hemispheres. I may mention one striking example of this, among many of the same class which have come under my notice.

A workman in a factory, whose business it was to clear away the dust produced by the action of a revolving saw, had his skull cloven whilst he stooped at his work. The saw cut through the skull parallel to, and a short distance from, the longitudinal sinus, tearing it open, shattering the bone from the centre of the forehead to the occiput, and driving several fragments into the brain, which was ploughed up and extruded from the cranium in considerable quantity, passed out through his nostrils, and adhered to the temporary dressing which had been applied. Although the longitudinal sinus was freely laid open, hæmorrhage from it was readily controlled by a compress. He recovered consciousness on the following morning, vomited constantly for three days, and then began to take food. Even subsequently, this injury was unaccompanied by any manifest evidence of its severity, except partial hemiplegia. The patient remained conscious till he died; replied to questions with perfect intelligence; described his accident; took food freely; and attempted to sit up in bed. He survived ten days, and then died suddenly from hæmorrhage into the brain.*

[Since this lecture was delivered, my late dresser, Mr. Frederic Ward, has communicated to me the following case, which, from the similarity

* See *Medical Times and Gazette*, Clinical Lecture, Nov. 10th, 1866.

of the accident and the recovery of the patient, I think worthy of record:—"J. S., aged 14. Three years since, his head came into contact with a circular saw in motion; and the consequence was an extensive laceration of the scalp and fracture of the skull. The direction of the injury was from the right eye backwards; and several fragments of bone were removed, and some extruded brain subsequently sloughed. The extent of the injury is shown now by a cicatrix over the frontal and parietal bones, measuring six inches; the greater part firm, but presenting a space, both anteriorly and posteriorly, closed only by soft tissues, which rise and fall considerably with each beat of the heart. Since his recovery, his mother states that he has become forgetful, passionate, and very mischievous and untruthful. The temperature of the left side (hands and arms) feels perceptibly lower than that of the right. The vision of the left eye and hearing of the left ear, as well as the discriminating power of taste, are very sensibly impaired; and extremes of temperature are not perceived. His sleep is unsound, and he frequently talks incoherently." This patient was under the care of Mr. Corner of Poplar, who kindly sent him to me for inspection.]

It must have occurred to many of my hearers, as to myself, to raise large fragments of bone which have been driven into the brain; the patient meanwhile being conscious of all that was going on. But such lesions necessarily entail, sooner or later, consequences of imminent peril; and, therefore, steps must be taken to limit the risk in these cases, as far as practicable and safe, by raising depressed fragments of bone.

There is also another class of cases in which the question of primary interference with the trephine may be entertained: I mean those in which a limited and penetrating wound of the skull can leave but little doubt in the mind of the surgeon that the brittle internal table has been splintered. Of course, the presence of symptoms of compression, under such circumstances, demands interference; but, in my experience, the occurrence of such an injury without some symptoms of compression is rare; and, when such cases do occur, I cannot say I am disposed to subscribe to the doctrine that so serious, and in itself dangerous, an operation as trephining should, as a rule, be resorted to. I cannot recall a single instance in which I have felt myself justified in performing this operation where no symptoms have been present, or in which I have had occasion to regret such abstinence. I must, however, admit that fatal mischief does sometimes supervene from inflammation and suppuration between the dura mater and bone, or even in the substance of the brain; and then the use of the trephine rarely affords more than temporary relief. This secondary form of mischief is occasionally exemplified where there is no depression of bone, and where, therefore, the alternative of primary operation could not be entertained.

I have thought it expedient to make the foregoing remarks, with a view of avoiding subsequent reference to the questions involved, which possess a general rather than a special interest in relation to diagnosis. But it is essential to bear in mind that there is no direct proportion between the extent of actual breach of texture in the brain and the accompanying or even consequent symptoms.

In the absence of cerebral disturbance, the existence of fracture can be determined only by objective signs, which are sensible to the touch or to the sight. These are generally at once apparent, or may be ascertained by careful examination; but, as the importance of diagnosing fracture is to be measured by its actual or contingent implication of the brain, caution must be exercised in seeking, by any operative interference, for confirmation of suspected injury to the skull. Thus it may be difficult even for the experienced surgeon to distinguish between a puffy circumscribed tumour of the scalp with sharp and well-defined circumference, and actual depression of bone; but his acquired knowledge will probably have taught him that, in the absence of cerebral symptoms, he is not justified in gratifying his curiosity by an incision. Nay, I would say further, that such incision should not be practised even when early symptoms indicate functional disturbance of the brain, which may be due exclusively to shock or concussion. The same rule should, in my opinion, apply even where the scalp is wounded. Extended incisions, made with a view of discovering fracture, are, under the above circumstances, mischievous, by denuding the pericranium, and thus aggravating the risk to which the patient is exposed. It therefore behoves the surgeon to discriminate between symptoms which are due to depressed bone, and those which may be explained by a blow upon the head, without such complication; and it is preferable to await the development of the case, than to be precipitate in acting.

Fissure of the skull, without displacement, may be detected where the scalp is wounded. Thus a patient was admitted into the hospital, under my care, who had been struck on the head by an iron girder. He was stunned, but soon recovered consciousness, and walked to the hospital. He was very sick on his admission. He had a scalp-wound over the right parietal bone, and a distinct fissure of the skull, without

displacement. He had no subsequent head-symptoms, and the wound healed kindly. He was watched for a considerable time, and then allowed to go home. Or, again, inequality of the line of fracture may be detected, indicating some depression of bone, without any attendant symptoms of injury of the brain. In such a case, the depression may be of the outer table only. Thus a middle-aged man was recently under my care, who had been struck down with a bludgeon, and robbed. A contused wound of the scalp enabled me to feel a fracture, with irregularity such as I have described; yet, after recovering from the shock of the blow, he walked home, and was then brought to the hospital. There was entire absence of cerebral symptoms, beyond such as would be accounted for by reaction after shock. I was, of course, alive to the possible contingencies in this case, and kept the patient for a long time under my notice. He suffered at times severely from pain in the head; and a small wound continued to discharge, until I satisfied myself that the proper time had arrived to enlarge this opening, when I removed a loosened fragment of the outer table of the skull, and the patient recovered speedily and permanently.

Such an injury may present an extent of depression which compels the conviction that both tables are fractured; yet, as I just now remarked, symptoms of compression may not be present. I remember a well-marked exemplification of this condition, occurring in a young man under my care some five or six years since. He was struck down by a blow on the forehead from a falling box of bricks. He rallied speedily from the stunning effects of the blow, and his only symptom, on admission into the hospital, was a little drowsiness. About two inches above the orbital ridge, and near the centre of the os frontis, the scalp was lacerated, and a fragment of bone, about half an inch in breadth, and two and a half inches in length, was driven in and depressed, so as to place the outer table on a level with, or even a little beneath, the inner table of the surrounding bone; moreover, it was evident that the inner table of the fragment covered a larger area than the outer, being fractured with a squamous or bevelled edge. Pulsation, synchronous with the heart's action, was apparent in the wound as the blood welled up. Yet this patient never had any brain-symptoms; but after five weeks, a thin plate of bone exfoliated, evidently the outer table only. I anxiously weighed the risk of secondary mischief in this instance against that of trephining; and the extent of depression, together with the healthy youth of the patient, and entire absence of symptoms, determined me in abstaining from interference. I have the notes also of another case, which presented a remarkable feature, the explanation of which can only be conjectured. A boy of 14, was struck by a falling rocket-stick on the right temple. There was a double fissure in the frontal bone; one extending directly upwards from the superciliary ridge, the other outwards. He was insensible, with a short interval of consciousness, for some hours after the accident. The eye was closed, but uninjured; this was particularly noticed. He rallied without head-symptoms, after recovering consciousness; but the eye was lost by sloughing of the cornea and suppuration. Was this due to injury of the fifth nerve?

Although I regard the use of the trephine as an expedient fraught with danger, there can be no doubt about the propriety of using it to afford the chance of relief in intracranial suppuration. That its employment is so often unsuccessful, is probably due to extension of mischief, consequent on violence to the brain-substance. Although the diagnostic signs of compression from intracranial suppuration in disease are identical with those which arise secondarily from injury, I should be disposed to have more confidence in the result, and for the reason assigned, in the former than in the latter condition. An interesting case of syphilitic necrosis of the os frontis was under my care about six years since; the patient, whilst under treatment, became dull, and complained of headache. In the course of two or three days, coma seemed imminent; and, on applying the trephine, both tables of the skull were found to be necrosed, and pus was deposited between the bone and dura mater. The operation was succeeded by immediate relief of the symptoms; but sloughing of the dura mater ensued, followed by protrusion of the brain. This was cautiously controlled by pressure, but continued for many days. He struggled through; and I afterwards removed a large fragment of the entire thickness of the frontal bone. Ultimately he quite recovered, without any apparent deterioration of brain-function, but, of course, with a gap whence the necrosed bone had been removed.

Fracture, with depression, may occur over the frontal sinus, and then we should not expect brain-symptoms. In a case of this kind, where a considerable portion of the front wall of the sinus was driven in, the only memorandum I have is, that air was freely extravasated into the areolar tissue of the eyelids. It is not infrequent to find the frontal sinus involved in other fractures of the skull.

Fissure of the skull, accompanying scalp-wound, but unattended by brain-disturbance, after subsidence of shock, and followed by rapid recovery, is by no means an infrequent occurrence. These cases are sug-

gestive of extreme caution in prognosis, and demanded long-continued abstinence from any and every source of excitement on the part of the patient. Of such fissures as associated with fracture of the base of the skull, I shall have to speak presently.

In diagnosing the presence of fissure, the error of mistaking for this condition a suture or Wormian bone must be guarded against. The sutures are rarely separated to any extent, except in severe and crushing injuries of the skull. Of fissures of the inner table only, I have no record.

In children, there seems to exist a mutual accommodating property between the skull and brain, admitting of considerable depression of bone, without the co-existence of any symptoms of compression. I remember witnessing a remarkable instance of this kind many years since in one of Mr. Green's patients; and an equally striking illustration occurred in my own practice. I was requested, when in South Wales about ten years ago, to see, with Mr. Chater of Tenby, a child who had been injured on the head by a fall. Although I retain an accurate recollection of the chief features of the case, I have recently sought and obtained an interview with the boy and his parents, and have procured the following information from them and from my own observation.

C. F. is now a little over ten years of age. When about six months old, he sprang from his sister's arms and fell, striking the ground with the left side of the head. He had on a thick hood at the time, so that the skin was not broken, but a deep indentation was caused by a pebble with which the head came into contact. The indentation was oval, about three quarters of an inch deep in the centre, and looked as if half an egg had been pressed in; the end of the thumb might easily have been buried in it; this depression presented no sharp edge to the touch, and was situated a little posterior to the parietal eminence. How long it lasted the parents are unable to say; but the depressed bone appears gradually to have risen to its former level; neither indentation nor roughness can now be felt; but the parietal eminence on that side is flat when compared with the other. The child was not unconscious at the time, smiled soon afterwards when spoken to by its mother, and recognised her; it had no head-symptoms, and soon recovered. The boy is now at school, is sharp at his lessons, and has a good memory, and is reported as being rather mischievous—not a very rare trait in a boy of ten. Of course, I recommended that nothing should be done in this case, and predicted an early recovery of the normal form of the skull.

In fracture of the base of the skull, the objective signs are indirect and equivocal; most of them are rare. Thus, ecchymosis in the mastoid region, or in the pharynx, or in the eye, may be due to other causes. Of these, probably, the pharyngeal extravasation is most to be relied on, but it is infrequent or but rarely observed. In one instance which came under my notice, hæmorrhage from the pharynx accompanying cerebral mischief, was suggestive that the injury was in the base of the skull; this patient recovered. Ecchymosis, and even abscess, may occur over the mastoid region without necessarily indicating fracture. About a twelvemonth since, a boy was under my care with head-injury, who recovered in a few weeks so far as to be convalescent; and then he had a relapse. He became drowsy and irritable, and complained of severe pain over the mastoid process; after a few days an abscess declared itself, and was opened. I could not satisfy myself that this suppurative was associated with the original injury, though I thought it not improbable. He obtained immediate relief, and soon made a good recovery.

In a young woman, recently under my care, remarkable tenderness over the mastoid process suggested to me that fracture of the base existed, even before other symptoms had become sufficiently developed to excite alarm. A *post mortem* examination after survival for a fortnight, revealed fracture of the petrous bone.

In another of my patients, who had fallen into the hold of a ship, and was brought to the hospital, where he died in a few hours, the only external indication of injury was ecchymosis in the occipital region. The base of the skull was found fractured across, the injury involving both petrous bones.

Although ordinary ecchymosis affecting the eyelids, or even the surface of the eye, is not to be depended on as characterising fracture of the base in which the orbit is involved; yet the occurrence of this condition, under certain circumstances, is pathognomic of this special form of fracture. The circumstances to which I allude are, that an interval of some thirty-six hours after the injury should elapse before the ecchymosis makes its appearance; and then that it should be first apparent on the ocular conjunctiva, and subsequently spread to the lids.

Bleeding from the nose is so frequent a concomitant of injury to the head, that its occurrence can scarcely be regarded as of diagnostic value in fracture of the base, unless persistent, and under circumstances to excite suspicion.

Of serous discharge from the nostril I have no record among my own cases; but a child was recently under the care of my colleague, Mr.

Solly, in whom this occurrence succeeded epistaxis, consequent on injury to the head. The child had been run over, was unconscious for some time, and subsequently had a succession of fits. Nearly a month after the injury, the little patient had recovered from the more urgent head-symptoms, but continued fretful in temper; there was marked facial paralysis, with much serous discharge from both right ear and right nostril: the pupils were equally active.

I may remark that force directly applied to the face may involve the base of the skull. This occurred in the case of a gentleman, who was struck by the shaft of a cab in rapid motion, on London Bridge, and was immediately brought to the hospital. The nasal region of the face was driven in, whereby frightful mutilation was produced, but the patient's condition did not excite immediate apprehension. Cerebral symptoms, however, supervened shortly afterwards, and death ensued. These symptoms indicated the condition which was verified at the *post mortem* examination; viz., that injury to the cribriform plate of the ethmoid bone had involved, secondarily, the anterior lobes of the brain in the inflammation which followed this lesion.

I have already mentioned one case in which the escape of cerebral matter by the nostrils proved fracture of the cribriform plate of the ethmoid bone. In another patient, whose head was crushed between a falling weight and the axle-tree of a railway carriage, cerebral matter was found mixed with the blood which was vomited. The ethmoid bone was involved in an extensive fracture, and the inferior surface of the anterior lobe of each hemisphere was lacerated. Yet this patient survived till the fifth day, and was rational till the morning of the third. The vault was also extensively fractured.

Much importance has been attached to the oozing of fluid from one or both ears, as a diagnostic sign of fracture of the base of the skull, crossing the petrous bone. Such fluid may be blood, or serum, or a mixture of the two. Blood must, of course, be derived from lacerated vessels; pure serum, or a limpid liquid closely resembling it, has its source in the subarachnoid space; sero-sanguineous fluid may consist of a mixture of blood and cerebro-spinal fluid, or it may be blood combined with the labyrinthine secretion, if the quantity be limited; or, again, it may be, and probably most frequently is, such a dilution of blood with serum as is met with in subsiding hæmorrhage from an external wound; this last is probably always the explanation of such mingled oozing when it succeeds, as is so frequently the case, the escape of pure blood. My own experience has taught me to attach but little importance to bleeding from the ears, and succeeding sero-sanguineous oozing. Cases presenting this condition so frequently recover, and in so short a space of time, as to forbid the supposition that the base of the skull had been fractured; under such circumstances the blood is probably derived from the auditory canal, or from the tympanum. But, in combination with other associated signs, it may assist in supporting the supposition that the petrous bone has been fractured; although the recovery of the patient, in the absence of such allied indications, might reasonably suggest serious doubts on the subject. An interesting case, exemplifying this remark, came under my notice about four years since. I was asked by Mr. Mitchell, of Clapham Road, to see with him a young lady, who had imprudently jumped from a carriage in rapid motion, and, her dress becoming entangled in the door, she was thrown with violence on her head; the only mark, indicating where the blow was received, being behind the left ear, just above the mastoid process: this part was contused, but the skin was not broken. The insensibility which ensued was very transient, but the patient remained in a state of collapse for some hours; reaction was moderate. There was bleeding from the ear, mouth, and pharynx, which persisted for several days; there was complete paralysis of the muscles supplied by the portio dura, and hearing on the same side was entirely suspended. Six weeks elapsed before these nerves recovered their functions. This young lady's recovery took place without the occurrence of any serious brain-symptoms. In such a case as this, there is no demonstrative proof that the petrous bone is broken; but the combination of circumstantial evidence is very much in favour of the supposition that it was so in this instance. Possibly the pharyngeal hæmorrhage was from the Eustachian tube.

Persistent arterial bleeding from the ear, especially where such hæmorrhage recurs after an interval of some days, is suggestive of fractured petrous bone as its source. I shall presently cite a case exemplifying this condition.

A limpid fluid, supplied in abundance, can have but one source, the subarachnoid space. Frequently, the flow lasts for several days, and saturates the pillow of the patient. I apprehend that this sign may be regarded as unequivocally diagnostic of fractured petrous bone. Under these circumstances, reaction may be accompanied by hæmorrhage; in which case the mixture of blood and serum is to be viewed in a different light from the same coincidence, when it occurs primarily; the

latter, condition may accompany fracture of the base; but as an element in diagnosis it is not to be depended on.

The absence, except in small quantity, of albumen, and the presence of an excess of chloride of sodium, in the cerebro-spinal fluid, has been repeatedly shown by analysis. I have on the table some fluid removed, by tapping, from the head of a hydrocephalic child; and it is characterised by the peculiarities above mentioned; there is a trace of albumen, but chlorine is present in unusual quantity.

The occurrence of paralysis of the facial and auditory nerves, as exemplified in the case I have just narrated, is a consequence of fracture; but it may also depend on pressure resulting from hæmorrhage; it is, however, a suspicious symptom, especially in connexion with others indicative of fracture. Yet this paralytic condition is not always an immediate sequence of the injury; it may supervene after the lapse of some days. In such case it seems more probable that this symptom may be due to inflammation; and it might be inferred, therefore, that it is not characteristic of fracture: but this would be an illogical conclusion, because the inflammation, if the cause of the paralysis, may have been induced by the proximity of a fracture. The following case illustrates this condition. A workman, in the employ of Mr. Penn, the engineer, was struck on the head by the revolving arm of a crane. He was quite insensible when admitted into the hospital, and in a state of collapse, bleeding profusely from the left ear. There were three scalp-wounds: one on the forehead, where the crane struck him, and two on the occiput, caused apparently by the fall. The hæmorrhage, which was abundant and arterial, continued for eight hours after his admission. On the fourth day he began to have transient gleams of consciousness, and then the bleeding from the ear recurred, and lasted for some hours. On the following day there were indications of facial paralysis on the injured side; this was limited to the muscles supplied by the portio dura. As the stupor diminished the paralytic condition became more decided up to the tenth day. The subsequent history of the case is replete with interest, and left but little doubt in my mind that there had been fractured base, accompanied by other serious lesion. The patient made a slow recovery; and when I saw him some months after he left the hospital, he continued feeble and incapable of exertion, with some hesitation of speech, though he had to a considerable extent, but not entirely, recovered from the facial paralysis. Serous oozing from the ear, which succeeded the bleeding, continued even at the expiration of the second month.

In singular contrast with the foregoing case, except in the special feature which induces me to cite it, is that of a young woman recently under my care. She was thrown from a cab, and it is presumed that she struck her head, though no indication of a contusion could be discovered. When brought to the hospital she was insensible, but not collapsed. On the following day, sero-sanguineous oozing from the right ear aroused suspicion, but there were no head symptoms, except drowsiness, to excite even anxiety. Facial paralysis gradually supervened, after the lapse of some days, but so imperceptibly at first, that it escaped notice unless specially looked for; there was also much tenderness over the mastoid process. Subsequently the right eye was inverted, and the intellectual faculties became torpid; and she died on the thirteenth day, in a state of muttering delirium; the temperature having risen to 106° 2 Fahr., an hour before death. The *post mortem* examination revealed the presence of pus in the right posterior fossa of the skull. There was slight laceration of the left middle cerebral lobe, with some extravasation into the arachnoid at that spot; there was also fracture of the right petrous bone, taking a somewhat unusual course.

As the specimen is a recent one, I have placed it on the table, as a good illustration of this form of injury. The line of fracture extends from the posterior inferior part of the right parietal bone to the front of the base of the mastoid process; thence forwards and inwards in the long axis of the petrous bone, crossing the auditory meatus and tympanic cavity, and separating the ossicula. The membrane of the tympanum is torn, and the bony part of the Eustachian tube divided. I attribute the deafness and facial paralysis, in this instance, to the extension of inflammation, by contiguity, to the Fallopian tube.

From this class of cases, of which the preceding are typical examples, I conclude that facial and auditory paralysis is not necessarily indicative of fracture of the petrous bone, when unsupported by other confirmatory symptoms or signs; that, in combination with serous, or even sero-sanguineous discharge from the ear, the existence of fracture is very probable; and when both these signs coexist, with cerebral symptoms, either primary or secondary, there can be little, if any, doubt that there is fracture of the petrous bone. It is not, however, necessary that the signs of nerve lesion should correspond with the side on which the injury is received. I have the notes of one of my cases in which defective hearing and vision occurred on the left side, the blow having been inflicted behind and above the right ear. There was no paralysis in this

case; but defective articulation and great hesitation in expression, which persisted for some months afterwards. This is a condition suggestive rather of extravasation of blood or some cerebral pressure, than fracture of the base.

I have never seen actual laceration of the seventh nerve; and probably this is a rare occurrence, and by no means necessary to account for persistent loss of function, even when the immediate sequence of injury to the head. Displacement of bone or extravasation of blood, and consequent pressure on the nerve are, in such instances, the more probable explanation.

Under what circumstances does fracture of the skull occur, at a spot remote from the part which is struck? And how far are we justified in forming an opinion as to the position of fracture in the base, from the part of the head on which the blow is inflicted? It cannot be affirmed that, for therapeutic purposes, such diagnosis is very important; but it is an interesting inquiry; and, as I believe it touches an error which has been generally accepted, I will venture to devote a short time to the consideration of the subject.

The doctrine of fracture by *contre-coup* has been generally taught, without, as it appears to me, satisfactory proof of its actual occurrence, or a sufficient consideration of the mechanical force by which it is supposed to be produced. Indeed, I think it may be questioned whether the term "*contre-coup*" is admissible in physics; certainly the conventional meaning which is attached to this adopted word in surgery is very loose, and does not bear a careful examination. It is employed to define the force by which fracture of the base is produced by a fall on the head; yet, in analysing the mode in which fracture occurs in this accident, we find that the application of the force is as direct as if the vault of the skull be driven in by a sledge-hammer. The plunge of the body is suddenly arrested by the vertex coming in contact with the ground; and the entire superincumbent weight, with the superadded momentum acquired by the velocity of the fall, is concentrated around the condyles of the occipital bone, and the central compartment of the base of the skull is thus broken across. Or, this result may be varied by the blow being received on the forehead or occiput; the anterior or posterior divisions being then, severally, more obnoxious to fracture. But it is surely incorrect to say that these fractures are the result of a "*contre-coup*." I do not cavil about the employment of the word in this sense, although I think it incorrect, provided the conventional meaning be clearly understood; and that an admitted lesion, albeit improperly designated, be not confused with an asserted form of injury, the reality of which I think it would be difficult to demonstrate in fact or experimentally.

It has been affirmed that a blow received on one side of the head may produce fracture on the other; or that a blow on the frontal bone may result in fracture of the occipital bone. The possibility of such an occurrence cannot be doubted, when the head is forced against an unyielding surface; under such condition, the side which is weaker or on which the force applied is more circumscribed or concentrated, would most readily yield. But, that fracture should result in the way described, without the existence of the condition mentioned, is opposed to sound reasoning, applied upon mechanical principles. The proposition that such might be the case, would probably assume the following form. As a consequence of force sharply applied to the side of a suspended hollow sphere, the *vis inertia* is overcome at the point struck, and some change of form is the consequence, converting momentarily the circle into an ellipse, or the sphere into a spheroid; the vibrations are, at the same time, propagated in all directions away from the point struck, and would proceed around the sphere, until they met in a kind of focus at the point exactly opposite, where they would neutralise each other. The result would be the conversion of a state of active vibration into one of rest; and, as a consequence of this sudden change, disruption of the vibrating body at a point diametrically opposite to that which received the impact of the force. Whether such a consequence would be likely to ensue, where the sphere or circle acted on is of highly elastic and homogeneous material, such as glass, I must leave to physicists to determine. But I would submit that it seems impossible that such an effect could be produced in the skin-clad skull, irregular as it is in form, made up of many segments, varying in density, and presenting anatomical characteristics specially designed to break up and neutralise such physical force as I have supposed to be in operation. Under these circumstances it cannot be credited that vibrations could be propagated with sufficient regularity to permit of any focus of neutralisation being found; and I cannot suppose any other hypothesis upon which the occurrence of such fracture can be founded. But, it may be remarked, the sphere is filled. Yet, if it is difficult to conceive that fracture could be produced in the way I have described, the supposition that fracture could occur as a consequence of the transmission of vibrations through the soft and inelastic brain-substance is still less tenable. If such fractures have ever been observed, they

were probably produced under conditions unknown to the investigator.

It is true, as I have witnessed in several instances, that blood may be extravasated into, or on the surface of, the brain, at a distance from, or even precisely opposite to, that point on which a blow has been received. This is, no doubt, due to the vibration transmitted across and through the substance of the brain. When this vibration is suddenly arrested by the rigid skull, the adjacent portion of the brain and its membranes is subjected to a considerable instantaneous pressure, and the vessels give way. A similar effect is produced as the vibrations travel across from side to side: numerous small extravasations or blood-points are by no means infrequently met with in fatal concussion; and this condition was especially remarkable in a case, which I shall presently mention, of extravasation between the dura mater and skull, at a distance removed from the point of impact of the head against the ground. When the extravasation is distant from the point struck, in the course of the meningeal artery, and between the dura mater and skull, probably the rupture of this vessel is influenced, if not determined, by the vibrations of the skull; but the texture of the meningeal arteries is very thin and delicate; and they would yield much more readily, even to pressure, than arteries in other parts.

Whenever I have noticed a fracture or fissure of the skull, not directly communicating with the seat of injury, I have always found a ready explanation in the relative strength of the different bones subjected to pressure.

Thus, the frontal bone as low as the superciliary ridges, the occipital as low as the transverse sinuses, and the entire parietal bones, are denser and stronger than the roof of the orbit, the cerebellar portion of the occipital region, and the squamous plate of the temporal. Yet, all these parts of the skull are immovably fixed in their position; and pressure applied to the vault, therefore, more readily fractures the weaker part to which the force is transmitted. Indeed, in some instances of fracture of the skull, the extent of injury to the base is so great as compared with that of the vault, as to indicate that the fissures in the latter must have spread from the base upwards, and not from the vertex towards the base.

I think that the explanation I have suggested is sufficient to account for the phenomena which we meet with in complicated injuries of the skull, including laceration of the brain-substance; at least they are not inconsistent with the results of experiments on the dead body, nor with the consequences of physical force applied under analogous circumstances. If such be the case, we may discard as a fiction the assertion that fracture of one side of the skull may result from a blow received on the other, unless the head be forced against some resisting body. I have never met with such an instance; and I have failed to learn that other surgeons of extended experience, with whom I have conversed on the subject, have ever seen a case of this kind.

It is well known that a fall or blow on the vertex may be attended by fracture of the vertex, of the base, or of both. It may be interesting to examine how far the character of the injury may be inferred from the nature of the accident. I believe that the conclusions to which we should be led by a consideration of the mechanical conditions under which such fractures occur, are consistent with those which we realise in practice. Thus, if the injury be inflicted by the fall of a hard and heavy body on the vertex, this part would be fractured; and if the weight were not very great, the mischief might end there, as the resistance offered by the head may so far exhaust the momentum of the falling body, that the force would not be transmitted in sufficient amount to cause fracture of the base. But if the weight and momentum of the falling body were in excess of the expenditure of force in causing fracture of the vertex, the impulse would drive the head down upon the summit of the spinal column; and fracture of the base would result: in that case, mechanically viewed, the lower fracture would be successive to the upper. But, if the falling weight which struck the vertex were of a yielding material, fracture, if any, would be in the base, and not of the vertex, because the *vis inertiae* of the skull would be overcome, and it would be driven down upon the spine, without the application of circumscribed force to the vault. The same reasoning applies when fracture of either the vault or base, or of both together, is the effect of a fall on the vertex. If the fall be on a hard and resisting surface, the fracture of the vault would precede that of the base; but if upon a yielding body, there would probably be fracture of the base, without fracture of the vertex.

When fracture encircles the skull, vertically, it will generally be found to occur as the consequence of a perpendicular fall on the vertex, the head being jammed between the point of impact and the summit of the vertebral column. Sometimes, as in a case I am about to mention, the upper fracture is starred. Under these circumstances, the two lines of fracture usually, but not necessarily, intersect or run into each other.

Whenever fracture of the base occurs, and fissures extend from it towards the vertex, but do not reach the point of impact which is indicated by bruising or laceration of the scalp, it may be assumed that the fracture has proceeded from below upwards. But when fracture extends entirely from the vertex to the base, the origin of the fracture may be determined, *post mortem*, by its relative severity, and the amount of displacement at the vault and base. Thus, when the base is fractured, and the vertical extremity of the fracture exhibits a simple fissure, which is gradually lost as it extends upwards, it may be concluded that the fracture originated in the base. [See Figs. 1, 2, 3, 4, 5, 6, 7.]

1. Lea.—Starred fracture of vertex and fracture of base. A beam, weighing 20lbs., fell thirty feet on the vertex.

2. Dorrell.—Double fracture, but not uniting above or below. Fell against a gate, striking the occiput on each side, probably between the bars.

3. Bird.—Fracture of base only, on both sides. Fell forty feet on the vertex.

I have met with several instances which, like the following, seem to admit of but one explanation; viz., that fracture of the vertex and of the base simultaneously occurred as the result of a blow received on the former, and of irresistible compression of the latter against the summit of the spinal column.

A bargeman, aged 51, was admitted under my care at the close of last year. A heavy beam of wood had fallen perpendicularly, thirty feet, on his head. He was insensible and in a state of collapse, but without the usual symptoms of compression, making an effort to sit up, though

4. *Dodd*.—Fracture in anterior fossa. Was thrown from a cart, and struck the frontal eminence of the same side.

5. *Fearn*.—Fell from the top of an omnibus, and struck the left parietal eminence. Fracture across the posterior fossa, including the body of the sphenoid, and extending from left to right.

6. *Taylor*.—Circular fracture, extending from the posterior fossa round to the anterior. Nature of the accident unknown.

7. *Garnham*.—Fracture from a blow with a stone in a handkerchief. Recovery, after exfoliation of outer table.

apparently unconscious when spoken to. In less than half an hour his pupils became inactive, stertor supervened, the surface of the eye became insensible, the pulse was 42, and the temperature sank to 95 deg. At the same time, puffiness over the parietal bone, which had before been observed, became more apparent. Reactionary hæmorrhage had occurred. He survived twenty-six hours, the face being flushed, the pulse rising to 128, the respirations to 40, and the temperature to 104.8, two hours

before his death. Both vertex and base were found fractured. The upper fracture commenced as a fissure, just behind the coronal suture, and was crossed at its commencement, at right angles, by another fissure, constituting, in fact, a starred fracture. On the right side, this fissure extended downwards across the anterior half of the right parietal bone, and the squamous plate of the temporal bone; then backwards and inwards across the petrous bone, and partially through the basilar process of the occipital. The fissure on the left side took a similar course, but terminated at the middle lacerated foramen. Blood was extravasated on each side, between the dura mater and skull, opposite the squamous suture; there was also blood effused into the arachnoid and over the surface of the brain in considerable quantity. The under and outer part of each middle cerebral lobe was lacerated.

This typical case exemplifies many points of interest, associated with the diagnosis of such injuries, and to which I shall have occasion to refer in my next Lecture.

The question of recovery after fracture of the base of the skull is necessarily one which rarely admits of demonstrative solution. Yet, the circumstantial evidence, based upon diagnostic characteristics which we are enabled to identify with these injuries, and upon analogy, amounts to proof little short of demonstration, that recovery from fracture of the base of the skull is by no means an infrequent occurrence. A simple fissure extending across the central compartment of the base of the skull—the most frequently fractured—is not liable to disturbance; and if the patient survive the first effects of the injury, there is no apparent obstacle to the cementing of the broken surfaces thus kept in close relation.

A. indicates the line of fracture, as described in the text.

Moreover, we know that such reparation does occur in fracture, as exemplified in the specimen I have here before me, in which a fissure had extended through the great wing of the sphenoid bone, and across the squamous portion of the temporal bone; thence passing backwards from the anterior inferior angle of the parietal, through that bone, to the coronal suture. The line of fracture is very distinctly marked on the exterior of the skull, but is scarcely perceptible in the interior.

THE NEW LAW ON IMPROVED DWELLINGS FOR THE WORKING-CLASSES.—The last Act of Parliament passed in the late session enacts that premises can now be represented by four or more householders, and officers of health are to report, and, when required, the owners are to improve the dwellings, or to demolish the same.

PENNSYLVANIA HOSPITAL.—A new and commodious Hall for the purposes of Clinical Instruction is now in course of erection at the Pennsylvania Hospital. The ground floor is subdivided into a number of rooms, and a carriage-way runs through its centre. The hall or lecture-room is above, on the first floor. The structure is octagon in shape, each side having a length of thirty feet. The face and corners are neatly dressed with gray stone. The height of the building, which is to be surmounted by a small dome, is about fifty feet. The lecture-room is to be arranged in amphitheatre style, the seats circling it, save where the operating-table occupies the space, and gradually rising one above the other.