

or irresistible impulses, with intervals of calm in which the patient may sleep; with moderate pyrexia, accumulation of sticky and frothy mucus about the mouth and throat, the diagnosis of *hydrophobia* may be made. In some cases small or large vesicles have been found around the *frænum linguæ*, but their significance is doubtful. If the patient do not die in the acute stage from respiratory or cardiac spasm, he passes into a stage of gradually increasing palsy, in which the mind becomes clear only to be again clouded by the increasing *asthenia* just before death. The signs by which *hydrophobia* can be distinguished from tetanus have been already given (page 73), but it must be carefully distinguished from what is called *false hydrophobia*, which may be a wilful or an unintentional close imitation of the real disease, and when ending fatally presenting great difficulty of diagnosis; chief reliance must be placed on discovering whether the patient have been concentrating his thoughts and attention upon the disease, constantly reading and talking about it, or dreading its onset, and on noting the occurrence of exaggeration of the symptoms, such as barking noises, snapping of the jaws, running about on all-fours, and so on, which are all popular delusions concerning the disease, and noting other departures from the usual course of the disease. Where recovery follows, the diagnosis of false *hydrophobia* becomes extremely probable, some would even say certain. Whenever possible, care should be taken to ascertain whether the animal suspected of inoculating the patient undoubtedly suffered from *hydrophobia*.

CHAPTER V.

THE DIAGNOSIS OF INJURIES OF THE HEAD.

Few cases are of more interest or importance from a diagnostic point of view than those of injury to the head. With the exception of the scalp, the condition of which can be thoroughly explored, it may in some cases be quite impossible to determine whether serious injury has or has not been inflicted upon various parts of the head. The skull may be extensively fractured or bruised without causing any signs by which it may be recognised, and serious and various lesions of the cerebral membranes, or of the brain itself, may exist without symptoms enabling the surgeon to discriminate between them, or even to predicate their existence. It follows from this, that the utmost care must be expended upon every case of head injury, as those apparently trivial may really be most grave. While availing himself of all evidence which can enable him to make a positive diagnosis, the surgeon must never accept the absence of such positive evidence as sufficient to warrant the conclusion that lesions other than those clearly recognisable are not present. In other words, while symptoms may enable the surgeon to prove a positive, they do not warrant him in asserting a negative diagnosis.

Diagnosis being beset with so much difficulty, it becomes especially important that the examination of the patient should be made in the most thorough and painstaking way; and the mode of procedure, which is at the same time the simplest and the best, is, first, to search for signs of injury to the *scalp and pericranium*; then for those of *fracture of the bone*; and,

finally, for those indicating *lesion of the contents of the cranium*; the affections of each of these three groups of tissues must further be divided up into *primary*, those produced more or less directly by the injury, and presented by the patients immediately, or within a few hours; and the *secondary*, those which indirectly result from the injury, and which manifest themselves only after an interval of days or even months; these are mainly inflammatory in nature.

A. Injuries of the scalp.—From falls or blows the scalp may be *bruised* or *wounded*; in the case of wounds, it must be determined to what depth they extend; if merely into the scalp there will not be gaping of the edges; if simply through the scalp (the most common form) the edges gape, but bare bone is not exposed; should the bone appear bare and smooth at the bottom of the wound, it shows that the pericranium has been wounded; the edge of the cut or torn pericranium may be felt as a thin, sharp edge. *Scalp wounds* may be *incised*, *contused*, or *flaps* of various extent may be stripped off the skull. The effects of *contusion* are not so apparent in the scalp as elsewhere, and in many cases the surgeon has to rely upon a knowledge of the nature of the injury inflicting the wound to guide him in this diagnosis. In some cases large portions or even the whole of the scalp may be completely torn away.

If a swelling form over the vault of the skull within a few hours after a blow or squeeze, it is either a collection of blood (*cephal hæmatoma*) or an *escape of cerebro-spinal fluid*. The latter is a very rare condition. (See page 82.) That the swelling is due to blood will be certain if it fluctuate in part only or indistinctly, or if there be a firm edge to the swelling, caused by coagulation of some of the blood, or if the scalp be discoloured or the swelling be opaque. Of *cephal hæmatoma* there are several varieties described,

which can sometimes be distinguished one from another.

(1) If the swelling be firm, more or less flat and distinctly movable over the subjacent bone, it is a *hæmatoma in the scalp*; this may be small and *circumscribed*, or larger and *diffuse*.

(2) If the swelling be soft or fluctuating, giving in places a soft, crackling sensation to the fingers, and be not distinctly movable over the bone, it is a *circumscribed subaponeurotic hæmatoma*.

(3) If, however, the swelling be quite soft and fluctuating, and easily movable over the bone and under the scalp, being capable, perhaps, of passing from the occipital protuberance to the supraorbital arch, and from zygoma to zygoma, the whole scalp, indeed, being detached from the pericranium, it is a *diffused subaponeurotic hæmatoma*.

(4) If the swelling be absolutely fixed to the bone, while the scalp is movable over it, and especially if it correspond in outline to one of the cranial bones, being soft and fluctuating throughout, or presenting a firm edge, it is a *subpericranial hæmatoma*. This form is not unfrequently met with over the parietal bone in children at birth, being caused by the pressure of the pelvic bones or the forceps. When the margin of the swelling is firm, either from coagulation of the blood or effusion and more or less complete organisation of lymph, while the centre remains soft, it may be mistaken for a depressed fracture. The distinction can, however, readily be made by noticing that the firm edge of the swelling is compressible, and when indented by pressure the bone may be felt passing in an unbroken curve from beyond it into the centre of the swelling, and also by noticing that the firm edge rises gradually, and is itself raised above the bone outside it; in a case of depressed fracture the hard edge is not raised above the bone beyond it

nor is it compressible, while the bone within is felt to be distinctly below the proper level.

(5) If the swelling pulsate synchronously with the arterial pulse, and if the pulsation be lost when the superficial temporal occipital or supraorbital artery is compressed, or when all these vessels together are compressed, while coughing and straining does not cause the tumour to swell out, and especially if the pulsating swelling be movable over the skull, the tumour is a *pulsating hæmatoma*, due to the communication of a large artery with the effusion of blood.

Cephalhæmatomata usually undergo absorption, but the blood may remain fluid for a long time, leaving a fluctuating swelling, which will then be distinguished from every other similar swelling by the history of its formation. Occasionally they become inflamed and suppurate, and if a swelling, which by its history and characters is recognised as a hæmatoma, become more tense, hot, painful, very tender, with œdema around it, the skin over it being red, while the temperature is high, with quickened pulse, and especially if the patient have a chill or distinct rigor, it may be diagnosed as a *suppurating hæmatoma*.

In the diagnosis of the late consequences of injuries to the head, the recognition of a *scar* in the scalp may be of great importance, both as corroborating a history of a particular injury, and still more as localising it with precision. The development of a soft puffy swelling in the scalp was referred to by Pott as a valuable sign of subcranial abscess; but this has been only very rarely seen by other surgeons.

The **secondary complications of wounds of the scalp** are :

- Abscess.
- Cutaneous erysipelas.
- Diffuse cellulitis.

(1) If the edges of the wound have adhered, but the scalp be boggy, œdematous and tender, and the patient complain of constant pain of a tensive and throbbing character, retention of *pus under the scalp* may be diagnosed, and this may be demonstrated by separating the edge of the wound, when the pus will at once escape.

(2) If with symptoms like the above a distinct fluctuating swelling be detected, it is an *abscess*. These abscesses are not unfrequent as sequelæ of erysipelas.

(3) If the skin of the scalp be found swelled, of a bright-red colour, hot, painful and very tender, the redness and tenderness extending over a wide area, considerably beyond the wound, and presenting a sharply defined raised edge, and if reaching over the forehead it be attended with œdema of the eyelids, and the patient be febrile, with rapid pulse, furred tongue, malaise, anorexia, headache, and gives the history of a sudden or acute onset of these symptoms, with a shiver or rigor, nausea or vomiting and severe headache, the disease is *cutaneous erysipelas of the scalp*.

(4) If with signs of severe constitutional disturbance, initiated possibly with a rigor, followed by high fever, rapid pulse, great weakness, headache or delirium, the scalp or the greater part of it be found greatly swollen and boggy, painful and tender, with œdema of the eyelids or ears, which may reach down even on to the face and neck, while a little turbid serous fluid oozes from the wound, it is to be recognised as *diffuse cellulitis of the scalp*. This condition must be carefully distinguished on the one hand from *cutaneous erysipelas* by the much greater swelling of the scalp and greater severity of the general disturbance; and on the other hand from a simple local *cellulitis or bagging of matter* under the scalp where the swelling is quite local, the general disturbance

much less, and where by opening up the recently or partially healed wound pus is freely evacuated with immediate subsidence of all the symptoms.

B. Injuries of the skull.—First examine the vault by passing the fingers gently over it, to note any *irregularity* of the surface, particularly any *depression* or *sharp edge* of bone. The cerebro-spinal fluid may escape under the scalp, and form a translucent tumour there. If there be a wound of the scalp, it should be examined for splinters of bone and for portions of brain matter, and then the finger should be passed in and the bone explored, any depression of the surface being carefully examined to determine its depth and extent and the direction of any fissures running from it, as well as the presence of detached fragments of bone; on holding back the edges of the wound a fracture may be seen, the broken edge of bone having a dark-red colour and an uneven surface. Very severe injury may be inflicted on the bones of the skull without producing any symptoms by which it may be certainly recognised, and surgeons often have to infer a contusion or fracture of bone from the nature of the violence inflicted, being quite unable to demonstrate its actual existence.

The **primary effects of injuries** inflicted upon the bones of the skull are :

Contusion.
Infraction.
Fracture.

(1) There are no positive signs whereby a *contusion* of bone can be recognised; it is only known or suspected to have occurred when certain *inflammatory sequelæ* or *necrosis* occur; it may be inferred in all cases of severe injury to the skull, especially when not attended with fracture.

(2) If in an infant at birth, or a young child in

whom the vault of the skull is still soft, a shallow smooth depression in the bone is felt, with rounded edge, it may be diagnosed as a depression or dent in the bone or *infraction*; such a depression without fracture is only possible in quite early life. The surgeon must not mistake for an infraction the yielding of an unclosed *fontanelle*, or of a softened spot of bone in *craniotabes*; in the latter there is no permanent depression, only a yielding of the bone under the pressure of the finger. (See page 384.)

(3) If an abrupt depression of the vault of the skull, with a sharp, perhaps irregular edge and uneven surface, can be felt through the scalp, the sharp edge being not raised above the bone outside it, and being quite incompressible, it is a *simple depressed fracture* of the vault of the skull.

(4) If on passing the fingers over the skull a sharp irregular edge of bone can be felt, it indicates a *simple fissured fracture* of the vault of the skull; if the fissure take the line of one of the sutures, it is a *separation of a suture*. In some of these cases mobility and crepitus may be detected along the line of fracture. Effusion of blood in or under the scalp may partially or completely obscure these simple fractures. The surgeon must not mistake for fractures the *normal sutures*, which may be felt as slightly raised ridges on the bones, and are always smooth and somewhat rounded; nor the slight smooth irregularities of the surface, which may be natural irregularities of the bone or the bossy elevations produced by *congenital syphilis*; the distinguishing features of all these are the facts of elevation above the surface, not depression, and their smooth rounded outline. It is often impossible to diagnose a *simple fissure* of the vault if there be no displacement of the bones.

(5) If, after a blow upon the forehead, or behind the ear, a soft puffy swelling gradually form and

increase, and it yield a distinct dry crepitus on manipulation, and if extensive gives a hollow percussion-note, it indicates *fracture into the frontal sinus or the mastoid cells, with emphysema.*

(6) If, after an injury to the vault of the skull, a tumour form over the part struck, and gradually increase in size for days, the swelling being translucent and fluctuating in every part, and becoming tender and fuller when the child cries, being without any sign of inflammation in the scalp or of induration around the margin, it is a collection of *arachnoid or cerebro-spinal fluid beneath the scalp*, and is proof of the existence of a *fracture of the vault.* The swelling may begin to form at once after the injury, or not be noticed for several days; in cases where the communication with the interior of the skull is very free, the swelling pulsates synchronously with the brain.

(7) Where there is a wound in the scalp leading down to the bone, it is easier to determine with certainty the existence of a fracture, and for this we rely upon sight and touch. If at the bottom of a wound an irregular red line be seen, from which, if the pericranium be torn, blood issues or may be squeezed, and especially if by pressure slight movement along this line can be detected, or if the finger-nail or the probe can be inserted into the line and detect a sharp edge of bone, a *compound fissured fracture of the vault* of the skull is to be recognised. This fissure must not be confounded with a *suture* exposed in the wound, which is not a red bleeding line, nor is the edge of the *torn pericranium or temporal fascia* to be mistaken by the finger for the edge of bone; the edge of the dense fibrous membrane can in either case be recognised by its slight yielding to pressure, by its smoothness, and by its not grating under the finger-nail; the mistake, however, has been made. If such a fissure be placed exactly in the line of a cranial

suture, it may be distinguished as a *separation of a suture.*

(8) The finger in the wound will readily distinguish those varieties of fracture known as *compound depressed, comminuted, punctured, and saucer fractures.* If the bone be fissured, and there be slight depression as seen and felt, it may be a *fracture of the outer table* of the bone only, and similarly there may be an entire outer table and a *fracture of the inner table* only; neither of these conditions can be with certainty diagnosed. Where, however, from an injury inflicted on the outer surface of the bone, there is depression and splintering of the outer table, it may be inferred that there is still greater injury of the inner table, and the more nearly any fracture approaches to the form of a punctured fracture, the greater becomes this probability. If a probe can be passed into a fissure and under the bone laterally, and still feel firm bone beneath it, it indicates a *separation of the two tables* of the bone, with depression of the inner plate.

The signs of **fracture of the base of the skull** are (a) *hæmorrhage*, (b) *escape of cranial contents*, (c) *injury to cranial nerves.* The *hæmorrhage* may take place into the orbit, the nose, the pharynx, the ear, or under the deep muscles below the occiput. It is characterised by its long continuance, often going on for twenty-four or even forty-eight hours. In the orbit and in the neck this leads to the formation of a continuously-increasing ecchymotic swelling. In very severe lesions *brain matter* may be forced into the nose or pharynx. More frequently, *cerebro-spinal fluid* trickles from the nose or the ear; it is known by being limpid, of very light sp. gr., yielding only a slight precipitate on boiling and the addition of nitric acid, or, if it escape from the nose, giving but a faint precipitate with acetic acid (mucin), and yielding a slight reddish-yellow precipitate of cupric

oxide when boiled with Fehling's solution (glucose). Injury to the cranial nerves is shown by motor or sensory paralysis.

(9) If after an injury to the head or upper part of the face, there follow an effusion of blood under the ocular conjunctiva, which may or may not spread subsequently to the eyelids (usually reaching the lower before the upper lid), and, if extreme, causing protrusion of the eye-ball, it indicates a *fracture of the roof of the orbit*. Hæmorrhage into the eyelids may be caused by a simple contusion (black-eye), or by a fracture of the malar or upper jaw-bone, in which cases the subconjunctival hæmorrhage is absent, or much less marked than the effusion into the lids. In some fractures of the roof of the orbit and of the orbital arch, in which the periosteum lining the orbital cavity is not torn, the blood does not get under the conjunctiva, but only into the lids, and in such a case a diagnosis could only be made if it was certain that there had been no direct injury of these parts.

(10) If, after an injury to the head or nose, there be hæmorrhage from the nose continuing for some hours, or even a day or more, or if succeeding the flow of blood there be a copious discharge of cerebro-spinal fluid from one or both nostrils, there is a *fracture of the base of the skull*. If the injury have been received upon the bridge of the nose or the anterior part of the skull, or have been inflicted from the nasal cavity, the fracture will be in the *roof of the nose*; but if the injury have been inflicted upon the vertex or the middle of the side of the head, the fracture is probably *into the tympanum*, the blood escaping into the nose through the eustachian tube. Should the patient be conscious, unwonted deafness on the same side would confirm this diagnosis.

(11) If after an injury to the middle zone of the vault of the skull, or a heavy fall upon the feet or the

buttocks, there be bleeding from the ear continuing for many hours, or if after hæmorrhage of shorter duration there be a copious flow of cerebro-spinal fluid, and especially if the hæmorrhage be accompanied with deafness, or facial palsy, and if an examination of the ear show the meatus to be intact and the membrana tympani ruptured, there is a *fracture of the middle fossa of the base of the skull*; and if the cerebro-spinal fluid escape, it proves further the laceration of the tube of arachnoid membrane around the seventh cranial nerve. Transient hæmorrhage may be caused by lacerations of the meatus or of the membrana tympani; a slight flow of watery fluid might possibly be an escape of liquor Cotunnii from the inner ear; and if the fluid were richly albuminous it would indicate that it was blood serum or inflammatory exudation.

(12) If a patient who is known to have received an injury to the head, or may have received such an injury, after an interval vomit some dark slightly altered blood, it becomes highly probable, in the absence of evidence to the contrary, that the blood has flowed into the pharynx from a fracture of the base of the skull, and been swallowed. The lips, mouth, and tongue should be carefully examined to exclude hæmorrhage from that source. If there be bleeding from the nose at the same time, or signs of such immediately after the accident and before the patient assumed the horizontal position, and if the patient be conscious of swallowing blood, or, when unconscious, if the movements of deglutition are seen to occur spontaneously from time to time, and especially if on inspection, or on passing the finger to the back of the mouth, blood be found in the pharynx, the diagnosis of *fracture of the base of the skull* is assured. In the absence of other evidence it will be impossible to determine which fossa is injured, as the blood may

flow into the pharynx from the nose, or the ear, or from a fissure in the vault of the pharynx.

(13) If after an injury to the posterior part of the skull, or a fall upon the feet or the buttocks, a puffy swelling appear around the mastoid process, or on the side of the neck, or below the occiput, and be followed by staining of the skin over it with blood, especially if the swelling be not over the part struck, and do not come on for some few hours after the accident, and then go on increasing for some hours, it indicates a *fracture of the posterior fossa of the base of the skull*.

The **secondary effects upon the bones** of the skull of injuries inflicted upon them are :

Necrosis.
Osteo-myelitis, and
Osteo-phlebitis.

(1) If a scalp wound do not heal, but, on the contrary, the soft parts retract from the bone, and this is seen to be dry, bare, and of a dull white colour, there is *necrosis*. It will not be possible to tell to what depth the necrosis extends until the sequestrum separates or is removed; but so long as there are no signs of intracranial inflammation, there is no indication that the inner table of the bone is involved. Necrosis of the bone may occur from contusion without a wound in the scalp. It will then be indicated by a puffy swelling of the scalp, which when cut into exposes bare, dry, dull white bone.

(2) There are no positive signs whereby *osteomyelitis* and *osteophlebitis* may be recognised with certainty before they have led on to their more serious sequelæ, *necrosis*, *pyæmia*, and *thrombosis* of the *sinuses*. But if, two or three weeks after an injury to the head, there be pain in the head, fever, and tenderness of the skull when pressed upon through the scalp,

or slight deep swelling of the scalp, *osteomyelitis* may be suspected. When extensive it may lead to the death and separation of large portions of the calvaria.

C. **Lesions of the cranial contents** cause either *irritation* or *paralysis* of the nervous apparatus, motor, sensory or reflex. Irritation of motor structures is shown by *muscular twitchings* or *spasms*; irritation of sensory parts causes *pain* and *hyperæsthesia*; irritation of reflex nerve centres leads to *increased reflex action*. *Motor palsy* is estimated by noticing the position of the limbs, the absence of all resistance to passive movements, and stertorous breathing, or flapping of the lips and cheeks with respiration. *Sensory palsy* is recognised by the insensibility of the patient to all external impressions, such as sound, light, pinching, pricking. *Reflex palsy* is specially indicated by a fixed condition of the pupils, and the failure of contact with the conjunctiva to cause contraction of the orbicularis palpebrarum. From these symptoms the surgeon must attempt to *define the position and the nature of the lesion*.

(1) **The position of a lesion.**—(a) Paralysis or irritation of a single nerve, or of nerves lying close together in the skull, is probably due to some lesion of the nerve trunk or trunks on the same side; e.g. paralysis of the fourth cranial nerve, or of the two parts of the seventh nerve. (b) When, however, the paralysis or the irritation affects nerves whose controlling cortical areas lie in close juxtaposition, it indicates a cortical lesion of the opposite side. (c) If the palsy affect a very wide extent of muscles, it points to a lesion of some part of the main strands of nerve fibres in the central nervous system passing from the cortical centres to the nerves of distribution; e.g. ordinary hemiplegia from hæmorrhage into the corpus striatum.

(d) **Electricity in diagnosis.**—Although elec-