On injuries of the head affecting the brain. And on some points connected with the anatomy and surgery of inguinal and femoral herniae / [G.J. Guthrie].

Contributors

Guthrie, G. J. 1785-1856.

Publication/Creation

London : J. Churchill & H. Renshaw, 1847.

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GUTHRIE

ON

INJURIES OF THE HEAD

AND ON

THE ANATOMY AND SURGERY

OF

HERNIA.

H. xxv. 9

——— Guthrie (G. I., *F.R.S.*) On Injuries of the Head affecting the Brain, and some points on Anatomy and Surgery of Inguinal and Femoral Hernia, *plts.*, large 4to, or. bds., 1847

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ON

INJURIES OF THE HEAD

AFFECTING THE BRAIN:

AND

ON SOME POINTS

CONNECTED WITH

THE ANATOMY AND SURGERY

OF

INGUINAL AND FEMORAL HERNIÆ.

With Explanatory Plates.

BY

G. J. GUTHRIE, F.R.S.

LONDON:
JOHN CHURCHILL, PRINCES STREET, SOHO;
AND
HENRY RENSHAW, 356, STRAND.
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2 Berkeley Street, August 22, 1833.

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INJURIES OF THE HEAD

AFFECTING

THE BRAIN,

BEING THE SUBSTANCE OF

THE LECTURES DELIVERED IN THE THEATRE OF THE

ROYAL COLLEGE OF SURGEONS

IN THE SPRING OF 1841,

AND A RECORD OF THE SURGERY OF THE BRITISH ARMY DURING THE WAR IN PORTUGAL, SPAIN, FRANCE AND THE NETHERLANDS, FROM 1808 TO 1815.

INJURIES of the head affecting the brain are difficult of distinction, doubtful in their character, treacherous in their course, and for the most part fatal in their results. The symptoms which appear especially to indicate one kind of accident are frequently prevalent in another. It may be even said that there is no one symptom which is presumed to demonstrate a particular lesion of the brain, which has not been shown to have taken place in another of a different kind. Examination after death has often proved the existence of a most serious injury, which had not been suspected; and death has not unfrequently ensued immediately, or shortly after the most marked and alarming symptoms, without any adequate cause for the event being discovered on dissection. Such are the deficiencies in our knowledge of the complicated functions of the brain, that although we think we can occasionally point out where the derangement of structure will be found, which has given rise to a particular symptom during life, the very next case may possibly show an apparently sound structure with the same derangement of function. One man shall lose a considerable portion of his brain without its being productive at the moment, or even after his restoration to health, of the slightest apparent functional inconvenience; whilst another shall

fall, and shortly die without an effort at recovery, in spite of any treatment which may be bestowed upon him, after a very much slighter injury inflicted apparently on the same part. During the second attack made by the French on the hill which constituted the left of the British position at the battle of Talavera, I found myself under the fire of a battery of twelve guns, and just at the distance at which the shot began to *ricochet* or bound like cricket-balls. The position was not desirable, and I tried to change it as quickly as possible by carefully guiding my horse between the shot. Whilst doing this a soldier of the 48th Regiment, whose corps was immediately in front, came running up to me, and begged I would look at his head, for one of these balls he declared, pointing to one that was passing by, had just alighted on it; saying this he raised his cap, and showed me portions of brain mixed with his hair, the left parietal bone being very much shattered. I told him to walk to the field hospital, which is marked on all the plans of the battle, and which I had established the evening before. This I saw him do, and his wound was dressed, but I could not find him a few days afterwards in the hospital in the town. I have, however, seen some few recover from a similar injury attended by the loss of a considerable portion of brain, without any apparent defect; whilst others have fallen, and never rallied, from a comparatively trifling injury of the same part; a fact which I do not attempt to explain, although I believe that the fatal issue then occurs from some further and unperceived mischief. The result of my experience on this point is, that brain is more rarely lost from the fore-part of the head with impunity, than from the middle part; and that a fracture of the skull, with even the lodgment of a foreign body, and a portion of the bone in the brain, may be sometimes borne without any great inconvenience in the back part. During the war with the United States in 1814, a soldier in Canada was struck by a ball which lodged in the posterior part of the side of the head; the wound healed, and the man returned to his duty. Twelve months afterwards, having got drunk, he fell down in the streets of Montreal, and died. The ball was found on the corpus callosum, where it had made a small hole or sac for itself. After the battle of Toulouse I had three cases, in each of which a piece of the occipital bone was driven in by a ball, which, striking directly upon it, made a hole no larger than the end of the finger: the absence of serious symptoms in these cases insured exemption from operative treatment. One case was, however, peculiar: the part injured was

so exactly the size of the ball, and the bone was so clearly to be felt deep in the posterior lobe of the brain, whilst the ball had probably gone beyond it, that I thought it right to recommend the man to have the bone removed. He declined, but begged to have more to eat, which I in turn refused. He had no bad symptoms, and the wound closed in, and had healed when I left him at Bordeaux about to embark for England. It was the recollection of these cases which induced me, after the battle of Waterloo, to recommend, in that of a soldier similarly wounded, that nothing should be done unless symptoms arose demanding the use of the trephine; as none appeared, and the wound healed, the man was sent home to Colchester, where he one day got drunk, and also fell down dead in the market-place. The ball was lodged deeply in the posterior lobe of the brain in a sort of cyst. I have never seen a person live with a foreign body lodged in the anterior lobe of the brain, although I have seen several recover with the loss of a portion of the brain at this part. My experience then leads me to believe, that an injury of apparently equal extent is more dangerous on the forehead than on the side or middle of the head, and much less so on the back part than on the side. A fracture of the vertex, is of infinitely less importance than one of the base of the cranium, which although not necessarily fatal, is always attended with the utmost danger. The treatment of these several injuries, although they may be at first sight apparently similar, cannot, and must not be alike in all; and this fact should always be borne in mind in their management. In civil life, both in hospitals and among private persons, injuries of the base of the cranium prevail, from the circumstance of their generally being the consequence of falls; whilst in military life injuries of the base of the skull are rare, and those of other parts are common. The practice of the military surgeon is therefore more successful, all things considered, than that of the surgeon in civil life, and particularly in a great metropolis; which may perhaps account for some of the discrepancies in opinion which have existed between them.

I have often thought with many other persons that I could distinguish the part of the brain injured from the symptoms which took place; and I sometimes think so still, although no great reliance can be placed on a diagnosis which has been too frequently placed in doubt, or even in error, by examination after death. There are some symptoms which do not admit of dispute as to their cause, but there are infinitely more which are not understood, or which are so mingled

with each other as not to be capable at the present moment of separation, or of being distinctly traced to their source.

The experiments of Flourens,* Mayo† and others have proved, that birds, small quadrupeds, fishes and reptiles, will live for some weeks and months after nearly all the contents of the skull have been removed.

Sensation and volition are destroyed by the removal of the cerebral hemispheres. Memory, judgment, sight, hearing, and all other sensations are lost, as well as volition.

The removal in addition of the corpora quadrigemina, destroys the mobility of the iris, which remains intact after the removal of the hemispheres.

If the cerebellum be now cut away, a bird can no longer fly, jump, walk or retain its natural position, but it can move, and live.

When the medulla oblongata, or medulla spinalis, or the nerves of these parts are divided, muscular contraction ceases, and all power of movement is lost. Life is destroyed because respiration ceases, when the medulla oblongata is divided at or immediately below the origin of the par vagum or eighth pair of nerves. The removal of any one of the nervous parts in animals only weakens the powers of those which remain. In man it destroys them, and life is extinguished.

Flourens says, page 170, "I cut away the cerebral hemispheres of a rabbit; he lost the faculty of willing and perceiving. I then removed the cerebellum; he lost in addition the faculty of moving with *order* and *regularity*. I then removed the corpora quadrigemina; the iris lost its mobility, all movement ceased. In spite, however, of all these mutilations the animal lived and breathed well. I then began to slice away the medulla oblongata from before backwards. After the first slice or two, respiration became laboured, and troubled, and increased as I continued slicing; half-way through the animal breathed, but with the greatest efforts imaginable; the last slices deprived him of life." When the medulla oblongata was not touched, a hen lived two days, and a pigeon three days, after the rest of the brain had been sliced away.

"Respiration consists of four movements:—1, the opening of the mouth and dilatation of the nostrils; 2, the opening of the glottis; 3, the elevation of the

* Flourens (P.), Recherches Expérimentales sur les Propriétés et les Fonctions du Système Nerveux. Paris, 1824, p. 170. Deuxième édition, 1842.

† Mayo (H.), Anatomical and Physiological Commentaries, p. 81, 1823.

ribs; 4, the contraction of the diaphragm. The division of the dorsal spinal marrow, below the origin of the phrenic nerve, paralysed the movement of the ribs; above the phrenic nerve it paralysed the diaphragm, and respiration ceased; the yawning or opening of the mouth and glottis alone remained. On dividing the point of origin of the par vagum, the movements of the glottis ceased. On taking another rabbit, and beginning to slice at the upper part of the medulla oblongata instead of the lower, from before backwards, the opening or yawning of the mouth ceased; another slice and the dilatations of the nose were arrested, and the inspiratory movements of the trunk alone remained."

Whilst the power of motion in each part seems thus to be dependent on an isolated point of the medulla oblongata and the medulla spinalis, an indirect or connecting influence is admitted to take place between them, and the remaining parts of the brain; and whatever may be its nature or extent in animals, there can be no doubt of its being so infinitely greater in man, as to be essentially different; for none of these experiments can be made either artificially or accidentally on any one of these parts in him, without being productive of the ultimate if not almost immediate death of the whole.

Dr. Marshall Hall*, in the comprehensive and luminous view he has taken of the nervous system, in which he has been supported by Müller†, supposes that each sentient and motor nerve of the spinal marrow is accompanied by an incident fibril for sensation, and a reflex one for motion. He calls these generally excito-motory nerves, and considers them to be connected with a part of the medulla spinalis, distinct from that portion which is strictly an appendage to the brain. *Incident* nerves arise from the skin and certain mucous membranes, and convey impressions from them to the spinal marrow. *Reflex* nerves convey back the nervous influence excited through the medium of the incident nerves, to the voluntary muscles in which they terminate; and Mr. Grainger‡ believes he has shown their origin, course and terminations in a satisfactory manner. Dr. Hall considers that these nerves, and the part he calls the true spinal cord, constitute the true spinal system which presides over ingestion and exclusion, retention and egestion; and consequently that its influence is exerted upon

* Marshall Hall, M.D., F.R.S., On the Diseases and Derangements of the Nervous System. London, 1841. Lectures on the Nervous System, &c.

† Müller (J.), Elements of Physiology, translated by William Baly, M.D. Part 3.

‡ Grainger (R. D.), Observations on the Structure and Functions of the Spinal Cord. London, 1837.

the muscles which belong to the entrances and outlets of the animal frame; or in other words, upon the sphincters, the muscles of deglutition and of respiration, and that the true spinal system maintains the tone of the whole muscular system. Stimulating an incident or excitor nerve of the extremities, by tickling or pricking the sole of the foot or the palm of the hand after sensation is apparently destroyed, causes a special muscular contraction or motion in the limb, if the excito-motory system be uninjured. Tickling or irritating the eyelashes induces contraction of the eyelids; and the irritation of one will sometimes cause contraction of both. Tickling the verge of the anus induces contraction of the sphincter muscle. Irritating the fauces and the root of the tongue, by pressing it down with the handle of a spoon, induces an action of deglutition. Respiration is excited by irritating or exciting the trifacial, or fifth pair of nerves, by throwing cold water on the face, and stimulating the nostrils; by influencing the spinal nerves by a similar use of cold water to the body and chest, and by tickling or stimulating the sides, soles of the feet, and verge of the anus. The pneumogastric nerves may be excited by artificially distending the lungs.

The great object or value of these facts and physiological experiments, is to enable us to conclude, as far as possible, what part, what great division of the brain is most seriously injured, and more particularly with respect to the prognosis than to the treatment. Great severity, and persistence of the symptoms lead to the belief that the part of the brain, or spinal cord on which they depend, is directly injured rather than indirectly affected, and that the result is more likely to be fatal. Permanent insensibility and loss of motion may depend on cerebral mischief only. The loss of the mobility of the iris implies an affection of the tubercula quadrigemina. Convulsions, vomiting, a drawing up of the limb not affected by paralysis, stertor, a difficulty in swallowing, strabismus and relaxed sphincters, show derangement of the spinal functions; which is well marked when tickling the eyelashes causes no closing of the lid, the verge of the anus no contraction of the sphincter, the sole of the foot no motion of the toes*.

In order to simplify the investigation of Injuries of the Head, they have been

* See Carpenter (Dr.), Inaugural Dissertation on the Physiological inferences to be deduced from the Structure of the Nervous System in the Invertebrated Classes of Animals; and Contributions to the Pathology of the Spinal Cord, by William Budd, M.D., in the 22nd volume of the Medico-Chirurgical Transactions for 1839, in support of these opinions; and the Articles "Irritability and Irritation," in the Dictionary of Practical Medicine, by Dr. James Copland, in opposition to them.

divided into two great classes, one denominated Injuries from Concussion, the other Injuries from Compression or Irritation, of the Brain. By the term Concussion of the Brain, a certain undefinable something, or cause of evil which cannot be demonstrated, is understood to have taken place; although the effect is often clearly proved by the almost instantaneous death of the individual, or by the succession of symptoms which quickly lead to his destruction. The term concussion is very aptly and forcibly illustrated by the homely but striking expression in use in our sister country, when a man has been suddenly killed by a fall on the head, "that the life has been shook out of him." Littre* was the first distinctly to draw attention to the fact, that on the dissection of the brain in a pure case of this kind, no trace of injury or even of derangement of any part of that organ could be perceived. Life was extinct, but the brain was intact. The immaterial, had been separated from the material part by an injury apparently inflicted on the very seat of life, with as little apparent derangement of its structure, as if death had occurred in a secondary manner from the abstraction of blood by a rupture of the heart itself. He states, that on examining the head of a criminal sentenced to be broken on the wheel, but who had killed himself on the spot by rushing across the dungeon, a distance of fifteen feet, and striking his head against the wall, no external mark of violence could be perceived, except a slight separation not exceeding the third of a line of the squamous portion of the temporal from the parietal bone. On removing the skull-cap his astonishment increased on finding the brain, and its membranes apparently sound. The brain did not, however, appear to fill the internal cavity of the cranium so closely as usual, and its substance as well as that of the cerebellum and medulla spinalis, were, both to the touch and sight, more close and compact than is commonly observable. He satisfied himself that the diminution of size of the brain was real, by replacing all the cut portions within the cavity of the skull, which cannot be done in an ordinary state of parts; and attributed this diminution of size to the violence of the shock, and the incapability of the brain to recover itself from its want of elasticity or spring, in consequence of which the distribution of nervous influence to all parts of the body failed in an instant; the heart lost its power, blood ceased to be circulated, and none could be extravasated.

* Histoire de l'Académie Royale des Sciences, Paris, 1706. Obs. xii. p. 54, Année 1705.

This case of Littre's has been alluded to by most writers since his time, and particularly by those of the French Academy of Surgery, and their successors*.

Morgagni refers also to the following one of Hænel†, as supporting Littre's opinions generally, but on searching for it according to the reference I find only the following case.

Extract from a letter from Dr. C. F. Hænel (Commer. Literar. Nor. An. 1741, Hebd. 14.), addressed to the celebrated Trew of Nurnberg.

"A certain metallurgist's apprentice having fallen (*in secturam ærariam*) into a copper-mine and lighted on his head, suffered such a *commotion* of the brain that in twelve hours he died, although he had been twice let blood, had had a stimulating glyster, and his head had been well fomented with a decoction of herbs in wine. He lay without sense or motion, buried as it were in a profound sleep. On the head being examined after death, not a vestige of a fracture could be found, nor of a drop of blood extravasated, either on the outer surface or within the substance of the brain. But the vessels were everywhere greatly distended, and in the right lateral sinus a mass of coagulum resembling a polypus was discovered. It is therefore very certain that the brain may be seriously affected though there be no fracture of the skull."

This case does not seem to bear actually on the subject; nevertheless most authors, even to the very last, have referred to it as affording evidence of concussion without apparent injury of the brain.

Sabatier‡, after noticing the case related by Littre, says, "I saw the same thing in a person who died suddenly from a blow on the head. The brain did not fill the cavity of the cranium, and a vacant space could be seen between the brain and the inside of the bones of the head."

Richerand§ and Delpech‖, who are said to have recorded similar cases, only refer generally to theobservations of those who have preceded them.

O'Halloran of Limerick¶ gives a more positive testimony on this point, and says, "the pericranium and skull were uninjured; the dura mater adhered to

* Valher, Thése, No. 57. Paris, 1827.

† In Alexander's translation he is called Hævelius; in the original Latin Hænel, or Hænelius.

‡ Médecine Opératoire, tome ii. p. 20. Nouvelle édit. Paris, 1822.

§ Nosographie Chir., tome ii. p. 62. ‖ Précis Elément, tome i. p. 328.

¶ O'Halloran (S.), Transactions of the Royal Irish Academy, vol. iv.

the latter; there was rarely any extravasation of blood, and this but slight, and out of the reach of any instrument. In a word, I could get no information, except that in those who died soon after the accident, I have *sometimes thought* the brain did not completely fill the cavity of the cranium."

Dupuytren* thinks that the brain may have less consistence, more or less disposition to diminish in size, and may be readily torn by the slightest effort.

Modern surgery has in fact added nothing to our information on the subject, perhaps from its peculiar difficulties, which may not admit of removal in the present state of our knowledge; although all writers seem to coincide in opinion that a sudden stoppage of the circulation of the blood is the more immediate cause of death. That the positive shock communicated to the brain from one side to the other, and the re-percussion which follows from its resiliency, are capable of giving rise to a direct and visible injury, is indisputable. It usually falls on what may be termed the edges of the hemispheres, which appear to be discoloured, bruised, and sometimes torn, so as to have caused the term laceration to be given to this kind of injury. This mischief, however, is most commonly found in the examination of those persons who have survived the accident for some days, and is therefore only a predisposing cause, whilst, as Sir B. Brodie has well observed, "if we consider that the ultimate structure of the brain is on so minute a scale that our senses are incapable of detecting it, it is evident that there may be changes and alterations of structure which our senses are incapable of detecting also†." Chopart‡ believed that Littre's case was much exaggerated, in which opinion I fully coincide, and place little or no reliance on the statement made by him, and so implicitly admitted since his time. I am not willing to believe that a diminution of the size of the brain, or its subsidence from the inside of the bones of the cranium, is more than an accidental circumstance, which may, or may not be dependent on the shock which takes place, although it be followed by immediate death. In thus expressing my dissent from a received opinion, I do so solely with the hope of stimulating future investigators to closer inquiry on this point of so much interest.

It is impossible to calculate upon what the extent and nature of the shock

* Dupuytren in Lancette Francaise, 1830. Leçons Orales. Paris, 1832, p. 496.

† Brodie on Injuries of the Brain, in Medico-Chirurgical Trans., vol. xiv. p. 337.

‡ Chopart, Prix de l'Académie Royale de Chirurgie de Paris, tome iv., and also published separately.

may be, which gives rise to a fatal concussion or rupture of the brain. Two men were brought to the Westminster Hospital apparently dead; one had fallen from the dome at the top of Buckingham Palace on the back and head of the other, who was walking unconcernedly below and who was killed on the spot, although no bones were apparently broken. The man who had fallen from the dome—perhaps the greatest height from which any one has fallen without injury, was quite well on the third day, felt only a little stiff, and left the hospital to return to his work. It is supposed that if the fall be from a sufficient height the brain will recede from the cranium, and a vacuum be formed, which may be of a longer or shorter duration, either causing immediate death, when the vacuum will be found on a *post mortem* examination; or the brain will resume its former volume in consequence of the circulation of the blood being restored; or the vacuum it is said may be filled by extravasated blood or by halitus, or gas emitted from it. What may be the sufficient height alluded to by philosophers to cause the necessary vacuum, has not yet been satisfactorily ascertained, and I suspect that something has been overlooked in the explanation, which I do not attempt to supply.

I once saw a girl of ten years of age fall thirty feet from the parapet of a house on the ground, which was rather soft; I ran to her, thinking she must be killed, but she got up, and ran away roaring and rubbing her bottom, which seemed for several days the only part inconvenienced by the fall. I have read in one of the older authors, however, of a young Dutch girl, who falling in this way, was so much shook by it and by the rebound, as to suffer afterwards from suppuration on the dura mater at the vertex, requiring the use of the trephine.

When the effect of the injury is not so immediately fatal, and life, although for a time in imminent danger, is not destroyed, yet fluctuates on the verge of destruction, gradually to be restored, again to fail, and at the end of several days to be eventually extinguished, the changes which take place in the functions of the brain during this period are accompanied by alterations which are observable in its appearance. The assemblage of phenomena which now occur constitute inflammation; and it is only by that vigorous treatment which subdues inflammatory action, that a person in whom they have occurred can be preserved. The immaterial part of man is so intimately connected with his material part, that they cannot be suddenly separated without the material part receiving an irrecoverable,

though often an unperceivable detriment; the bonds which unite them cannot be temporarily loosened without a derangement taking place, which appears to require for its recovery the aid of some of those processes of nature which are known to occur in inflammation of other parts. A moderate shock is often immediately followed by sickness, faintness, weakness, and in a few hours by a slight headache, from which the person quickly recovers without further inconvenience; or the headache may remain the sole symptom or sign of an injury having been sustained for several days; the slightest possible approach to that action which we call inflammation having sufficed to effect a cure. One step further, the headache continues, the stomach sympathises, there is little or no desire for food, the whole person feels more or less deranged, and the pulse quickens. A smart purgative will perhaps relieve all these manifestations of approaching evil, but the loss of a little blood will be more certainly efficacious.

A child ten years of age fell over the banisters into the passage, and struck its forehead. It was taken up apparently lifeless, but it soon appeared that it was only stunned; it breathed deeply, looked about vacantly, and could not speak; it then vomited, and gradually recovered its speech, and senses. A brisk purgative was all that was required to remove the slight headache which followed on the subsequent day.

In the more dangerous cases which ultimately prove fatal, a laceration of the brain, which is often observed to take place, complicates the mischief as well as the symptoms, and is perhaps the actual cause of death. I am not satisfied that a cicatrix, or mark indicative of the slow healing of such a bruised or lacerated wound, when it has occurred to any great extent, has been faithfully observed. It has however been demonstrated, and it may be readily conceived, that a slighter injury of the kind, giving rise to long-continued symptoms, need not necessarily be fatal; in which case it is supposed that the cure is effected by adhesion, and not by granulation and the secretion of purulent matter.

When a concussion of the brain has rendered the sufferer senseless and motionless, the countenance is deadly pale, the reverse of what takes place in sanguineous apoplexy; the pulse is not discoverable; the man does not appear to breathe. It is useless to open his veins, for they cannot bleed until he begins to recover, and then the loss of blood would probably kill him. It is as improper to put strong drinks into his mouth, for he cannot swallow; and if he should be

so far recovered as to make the attempt, they might possibly enter the larynx and destroy him*. If he should appear to breathe, and be made to inhale very strong stimulating salts, they will probably give rise to inflammation of the inside of his nose and throat, to his subsequent great distress. Mild stimulants and disagreeable smelling substances, together with partial as well as general friction with the warm hands, are the best means to be adopted, and should be continued until it be ascertained that life is extinct. If the patient should recover, some signs of breathing will be discoverable, followed by a distinct inspiration, repeated at so distant an interval as to render its recurrence uncertain. At last respiration is satisfactorily established, and the pulse which was doubtful at the commencement of the restoration to existence, becomes perceptible, although often irregular, and sometimes continues so until reaction has taken place. With this partial recovery of the natural functions of the body, vomiting is apt to supervene, and is one of the earliest and most satisfactory symptoms of returning sensibility. It was formerly supposed to be peculiar to cases of concussion, but it is often present in cases evidently of compression or irritation from external violence†. The breathing becomes in general quite free; and although it is occasionally laboured, it is rarely stertorous, which may be considered, when permanent, as a more distinct sign of continued irritation, or of compression and of extravasation, than of concussion. The sensibility of the surface is not fully established, the patient is not cognizant of any injury committed upon him, and if he should recover, has no recollection of what has passed. Mr. Abernethy believed that this first stage could not last

* It is said, however, by MM. Dupuytren and Tyrrell[1], that in all cases of coma the act of swallowing can be excited, provided the solid or liquid be placed in contact with the fauces; but the first insensibility of concussion, and that which may follow from coma, are different states. Mr. Andrews mentioned to me in support of this opinion, the case of a man who was brought to the London Hospital within these few days, who after drinking, had fallen down stairs, vomited and died. Nothing could be found of any importance on examination, save some meat in the pharynx, a portion of which had also slipped into the glottis during vomiting, and had suffocated him. I have seen a man killed by being made to vomit when lying on his back; and in all cases of insensibility the person should be raised when it is intended he should swallow, and a small quantity only, if anything, should be given at one time.

† Petit (J. Louis), truly called le grand Petit, relates the case of a man who suffered from continued vomiting for seven hours, when he died; an enormous quantity of blood being found in the ventricles of the brain. Traité des Maladies Chirurgicales. Nouvelle édition. Paris, 1790, p. 114.

[1] Lancette Française, 1830, and Grainger on the Spinal Cord, p. 85.

long, and that with the re-establishment of the functions of the lungs and of the heart, the second stage might be supposed to begin; and it may be considered as commencing from the time the circulation of the blood through the brain has been partially re-established, although retarded in its progress, or irregularly or insufficiently performed. The patient is still in a state of stupefaction, although now perhaps sensible to personal maltreatment, and may remain so for many days; he draws away or moves the part aggrieved; he may be able to answer in a monosyllable correctly or otherwise to questions loudly put, as if to rouse him from slumber; but if the answer should be longer it will generally be incoherent. The pupils are for the most part in a medium or in a contracted state*. Stimulants were formerly given at and up to this point, with a view of reviving and restoring the patient to greater activity, and to prevent a relapse into his former state. Dissection has however proved, that it is a state in which congestion is about to be followed by inflammation of the brain or of its membranes; that the stage succeeding to this is one of active inflammation, even if the patient should eventually recover; and if he should relapse into that state of stupefactive insensibility which precedes death, sufficient evidence to account for his decease will, I believe, be always found in the laceration of the substance of the brain, in small extravasations in various parts, or in other mischief which may not be perhaps expected. Previously to this stage of fatal termination the muscles are not relaxed and do not lose their tone, as in a similarly fatal case of compression of the brain; the urine does not flow involuntarily until after the spinal marrow has been some time seriously implicated, and death is at hand; which renders it necessary in all cases of injury of the head to attend to the state of the bladder, which may become distended, and thus render the use of the catheter necessary. The urine will be acid as long as the catheter is required, and will become alkaline as soon as it dribbles away involuntarily†. The bowels will at an early period be

* Dupuytren thought that in this stage or degree of concussion the pupils were dilated, and that in compression they were contracted, which is not consonant with my observations. Lancette Francaise, 1830. Leçons Orales, Climique Chirurgicale, 1832.

† A young gentleman applied to me four years ago on account of a hard swelling on the lower and fore part of the left thigh, which I pronounced to be malignant, and that amputation would be useless. The pain he felt in the limb was not equal to that which occurred from the startings and spasms in the other. These symptoms were shortly followed by loss of motion and sensation in both. The urine ceased to flow naturally, and was acid until it dribbled away involuntarily, when it became turbid and

confined, and more powerful doses of aperient medicines will be required than under more ordinary circumstances, although the sphincter ani may be relaxed, and the power of retention be lost from the first, provided the injury has been very severe. When the fæces pass involuntarily, it is presumed that the cerebro-spinal axis is seriously affected, and that the excito-motory system is greatly impaired, if not wholly destroyed. When a person is insensible, it is not always easy or convenient to ascertain whether the fæces pass involuntarily from loss of power of the sphincter ani, or are discharged from the ordinary action of the bowels, of which the patient cannot give notice. It may be inferred when the urine flows in a stream, although apparently in an involuntary manner, that the power of the detrusor muscle of the bladder is only impaired. In general, certain efforts are made to evacuate the bowels, although the person may be upon the whole unconscious of the act, which show that the defect is not essentially in the sphincter ani, but in the want of consciousness in the brain.

Vomiting should not be solicited, as it may do harm when in excess, but when slight it has appeared to be beneficial. The simpler the treatment during this the period of commencing reaction, the more likely is it to be ultimately successful. The period at which insensibility ceases, and the re-establishment of the natural functions of respiration and of the circulation begins, must always be uncertain.

The termination of the second and the commencement of the third or really inflammatory stage, or that tending to recovery, is marked on dissection, by the vessels of the brain and of its membranes being full of blood, and showing those appearances which are indicative of inflammation. If the patient is to recover, the stupefaction, or *assoupissement*, continues, although a greater degree of sensibility prevails ; the pulse now becomes regular if it were not so before ; the skin is hotter than natural ; the patient can often be induced to show his tongue, which is white, and to answer shortly, and tell where he feels pain, although he often answers incorrectly ; he can sometimes put out his hand and help himself, and occasionally even get out of bed. He usually turns to avoid the light, and

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alkaline. The fæces came away almost without his knowledge. On examination after death, the large tumour in the thigh was found to grow from the periosteum, the bone being bare and rough. Small ones of a similar character were found on each side of the spine between the bodies of all the lumbar and dorsal vertebræ, and had penetrated between the arches into the theca vertebralis.

the pupils are for the most part contracted; but no reliance can be placed on the state of the pupils at this period of the complaint; they are sometimes both dilated, or one is dilated and one contracted, sometimes dilating on the admission of light, sometimes contracting; and they may not be in the least changed until shortly before death. An alteration from the ordinary state of the pupils does not prove the absence or presence of any serious general injury, but only that a particular part of the brain has been more or less affected*. The breathing at

* Great stress has frequently been laid by writers on the mobility of the iris, as an indication of concussion, or of compression, or of irritation of the brain. I taught in my Lectures [1] as early as the year 1818, that the motions of the iris were influenced in three ways; one by the direct stimulus of light, the patient being quite blind; and two by sympathy or indirect influence; the first, with the retina of the same eye when sound; the second with the iris of the other eye, whether the retina was healthy or otherwise. The facts were stated from the observation of these parts in man whilst in health and under disease; and little or nothing has been added to our knowledge on the subject by experimental anatomy [2]. It has, on the contrary, tended to obscure it practically, although it may eventually be useful; for the surgeon would be led into error in the treatment of diseases of the eye, who attended to it alone.

The optic nerve is probably not a simple but a compound nerve [3], and possesses the incident and reflex fibres of Dr. Marshall Hall in addition to those for sensation; the former exerting an influence perhaps on the motions of the iris, which is more distinctly supplied with nerves from the lenticular ganglion. When the optic nerve is divided within the cranial cavity, the iris, it is said by Mayo and by Flourens, loses its contractile power, although it may be again excited, and the pupil be made to contract by irritating the root of the optic nerve still attached to the brain. A man may, however, be blind from a defect in the retina or in the optic nerve, and utterly incapable of distinguishing light from darkness; yet the pupils will contract and dilate under the proper influence of light, proving that it is not on the optic nerve, as one of sensation, that these changes depend. The division of the optic nerve within the head commits in all probability a greater and a different injury on the parts than that which takes place from disease. The part of the brain may not be sound in which perception takes place, whilst that part may be healthy to which other impressions are conveyed. Vision may be lost, yet the iris may be movable. The cerebrum may be injured, yet the cerebro-spinal column, and particularly the corpora quadrigemina or upper part, may be sound. An injury to the third nerve paralyses the iris. It is said that an injury to either of the corpora quadrigemina does the same. A certain kind of injury to the fifth nerve may deprive a person of sight, but it does not always at the same time affect the motions of the iris.

None of the changes which take place in the appearance of the iris can then be considered as distinguishing signs of concussion or compression, or of irritation of the brain; they merely imply that

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[1] Guthrie (G. J.), Lectures on the Operative Surgery of the Eye, 1823, p. 198.

[2] Mayo (H.), Anatomical and Physiological Commentaries, 1823, p. 81. Flourens (P.), Recherches Expérimentales sur les Propriétés et les Fonctions du Système Nerveux. Paris, 1824, p. 47. et 1842.

[3] Grainger (R. D.), on the Spinal Cord. London, 1837.

this period is free and never in the least noisy or stertorous, unless the concussion is complicated with irritation occurring from lesion of the brain or its membranes, or of the medulla oblongata. The patient may remain in this state without any sensible alteration for several days, or he may, which is more commonly the case when restoration to health is to follow, recover his speech as well as his general sensibility; nevertheless he frequently speaks more or less incoherently, mutters to himself as if thinking of something, and wanders at night, becoming even delirious, and requiring restraint to keep him in bed. Inflammation of the brain is now fully established and must be subdued. It is at or about this period that other symptoms occur, which are frequently enumerated as those indicative of concussion,—it should be added, of concussion in its latter stage. The pulse becomes quicker, perhaps full or hard, varying from 84 to 90, and even to a hundred; and Sir Astley Cooper* considered its rapid increase, on the patient being raised, as a certain sign of inflammation following concussion. "In such cases," he says, "an augmented pulsation of the carotids may be often observed, and is considered by some to be confirmative of the fact of concussion. Such a person will not be comatose but watchful, sleeps little or none, talks incoherently, or is often really delirious, refuses food if offered, drinks with avidity, has a hot skin and a white tongue. If other symptoms occur, such as spasms or convulsions, the absolute loss of any sense, or paralysis of any or the whole of a part, the case is complicated by laceration of the brain, compression, or other cause of

a derangement of a particular part has taken place within the head, which may not be perceptible on examination after death, or which may subside and be removed without leaving any permanent defect.

Dr. Auchinclose has related a case in the Glasgow Medical Journal, copied into the sixth volume of the Medical Gazette, in which, after an injury to the head, he found the left eye was blind, yet the iris acted freely, and the patient recovered.

Mr. Hancock, when House Surgeon of the Westminster Hospital, examined the head of a woman, a patient of mine, who died three weeks after the receipt of a blow which was considered to have caused only a concussion of the brain. The pupils contracted for several days before her death, separately and conjointly, although the levator muscle of the left eyelid was paralysed, and the eyelids appeared to be nearly closed. An abscess had formed in the base of the skull, implicating and destroying the third nerve of the left side at the point at which it leaves the crus cerebri, which led him to think that the mobility of the iris might continue after the motor oculi or third nerve was separated from the brain. The other muscles of the eye supplied by the third pair were also implicated, and the eye was fixed and the conjunctiva inflamed.

* Sir A. Cooper's Lectures, by Tyrrel, p. 284.

mischief, from the effects of which, if he cannot be relieved by bloodletting, he gradually sinks into a state of coma and dies."

The following case will show that great pulsation of the carotid arteries is not a more certain symptom of concussion than of compression. W. Andrews, two years old, fell from the second story of a house on his head; he was taken up in a state of complete insensibility, with loss of voluntary motion, and could not be roused. When brought to the Westminster Hospital the skin was cold and clammy; the breathing stertorous, with convulsive action of the diaphragm and abdominal muscles; the right pupil much dilated, the left contracted. The pulse at the wrist could not be felt, although it was distinguishable at the heart, and the carotids pulsated strongly; he bled from the mouth and nose, the lower jaw being fractured; there was partial relaxation of the sphincters. Spasmodic twitchings and movements of the limbs supervened, and they were forcibly drawn up from time to time as if by a great convulsive effort. He died in a few hours.

The deviations which take place from the usual and ordinary modes of breathing, are supposed to offer distinctive signs of the nature of the injury which has taken place. They are I fear equally uncertain signs; they mark the degree of injury, and perhaps the part injured, rather than anything else. Stertorous breathing has always been considered a sign of extravasation causing compression of the brain. I have, however, seen many cases of slight extravasation with partial loss of power of one half of the body, accompanied by great numbness, without any stertor in breathing; although I have never seen a well-marked case of large extravasation without it, or another peculiarity of breathing which is less thought of, although an equally characteristic and dangerous sign of such mischief having taken place when it is permanent; I allude to a peculiar whiff or puff from the corner of the mouth, as if the patient were smoking; and which, when observed among other urgent symptoms, is usually followed by death. Stertorous breathing and the whiff or puff at the corner of the mouth are presumed to indicate an injury to the cerebro-spinal axis as well as to the cerebrum; but whether the injury is direct or indirect is uncertain, although it is frequently accompanied by extravasation or laceration. When the breathing is only oppressed or laboured or heavy, neither extravasation nor lesion to any extent can in general be discovered after death. The surgeon will then practically be right in considering

the stertor or whiff in breathing to be accompanied by, if not directly dependent on, extravasation or lesion; the heavy or laboured breathing to be dependent generally on a derangement of function, which is not perceptible on examination. If there be truth in experimental anatomy, stertorous breathing ought to be dependent on a direct affection of the medulla oblongata*; nevertheless there can be no doubt that a temporary stertor or a puff at the corner of the mouth may exist without it, as a consequence of too great an abstraction of blood.

It is important to recollect that the stupefaction or insensibility of concussion is coeval with the injury, and that as few cases of compression of the brain do occur without some degree of concussion, the insensibility may in many instances depend on it. The stupefaction peculiar to compression, and demanding relief by blood-letting or by operation, is that which comes on some two or more hours after the accident, and is caused by congestion or by extravasation; and must be again distinguished from that which appears after several days, and is the consequence of inflammatory action and effusion. The pulse has been supposed to offer a diagnostic sign of the nature of the mischief which has taken place in the brain: pressure or extravasation, it is said, is attended by a slow and laboured action of the heart. This may be admitted as a general but by no means as a certain rule, for many of the largest extravasations I have seen, and many of the most diffused, have been accompanied throughout by a very quick pulse; and when the physiological doctrines of the circulation are duly considered, as well as the experiments on which they are founded†, it will be evident that the action of the heart may be influenced by other causes than those occurring from

* An officer exercising his regiment under a hot sun in Portugal, suddenly fell back on his horse and was carried home insensible and breathing stertorously; from which state he soon recovered, feeling weak in his lower limbs and incapable of influencing the sphincter ani, which was soon followed by an incontinence of urine. His intellectual faculties were never affected after the first insensibility; and on the third day he rode on a mule with care 20 miles, to Lisbon. Many months elapsed before he recovered the necessary command over the sphincter ani. Years have elapsed, and he cannot now always retain his urine. In this case the spinal marrow would seem to have been principally affected.

† Le Gallois, Expériences sur le principe de la vie. Paris, 1812.
Philip (Wilson), M.D., Experimental Inquiry into the Laws of the Vital Functions. London, 1817.
Hall (Marshall), M.D., A Critical and Experimental Essay on the Circulation of the Blood, 8vo. London, 1831.
Flourens (P.), Recherches, &c. Deuxième édition, chap. viii.
Müller (J.), Elements of Physiology, by Dr. Baly, part 1, page 190.

the part of the brain apparently injured. I am free, however, to declare that in all those cases, and they have been many, in which I have had occasion to make pressure on the brain or dura mater in man during life; it has been followed, when carried to too great an extent, by diminution of the frequency of the pulse, and even by syncope.

Mr. Abernethy*, who has done much towards a just understanding of the nature of concussion and its more immediate consequence, inflammation, has been, I apprehend, less fortunate in the examples and directions he has given to bring it to a successful issue. He says that large blood-letting, brisk purging, &c. ought to be employed at the very commencement of the inflammatory stage, "for if omitted then the disease will become established, and the powers of the body will be too much sunk to admit of the same active treatment at a later period." His ideas of large bleedings do not coincide however with those of later practitioners. In his seventeenth case, page 63, especially selected as one of concussion followed by inflammation, he says, H. S., twenty-three years of age, was bled before she was carried to the hospital (and probably when it ought not to have been done), but after she came under his care on Thursday, when the pulse is described as full and labouring, although intermitting every fourth or fifth stroke, eight ounces of blood were taken away; and on the Sunday, when her pulse was regular and harder, the girl restless, complaining of pain in her forehead, sitting up in bed and wishing to go home, six or eight ounces of blood *only* were ordered to be abstracted from her temples. In the eighteenth case, page 70, *ten* ounces were taken away, and subsequently *nine*, although the patient afterwards lost a large quantity by the arm bleeding at night in a fit of delirium, which saved his life†.

A labouring man, thirty years of age, enjoying robust health and of a sanguine temperament, was admitted into the Westminster Hospital on a Friday morning at ten o'clock, having fallen fifteen feet on the back of his head, a small puffy

* Abernethy, Essay on Injuries of the Head, contained in vol. ii. of his Surgical Works. London, 1815.

† Wiseman[1] relates a case of a somewhat similar kind, in which the patient was bled to ten ounces daily, or every second day, for sixteen days, and only recovered his senses on the seventeenth in consequence of his having bled him accidentally in a porringer which had a hole in it, and allowed more to run out than remained in.

[1] Wiseman (Richard), Eight Chirurgical Treatises, vol. ii. Second Edition, 1734, p. 129.

tumour being perceivable near the junction of the right parietal with the occipital bone. He was insensible and motionless, countenance deadly pale, circulation weak in the arms, but more marked in the carotids, respiration heavy and slow, pupils much dilated and fixed, no relaxation of the sphincters. Hot-water bottles were applied to the feet, and friction to the body generally. In the afternoon he became warmer, some reaction seemed to be taking place, accompanied by slight twitchings of the face, and shiverings. At four o'clock he was bled to sixteen ounces by the House Surgeon, in consequence of the pulse having become fuller, although soft and 96 in number in the minute. The surface was warm and moist, and he was so far sensible as to complain, on being pressed for an answer, of pain at the part of the head injured. The bleeding was arrested, in consequence of its bringing on *convulsive* movements ending in syncope; the pupils now contracted, the countenance became deadly white, and he breathed on the right side of his mouth for a few minutes with the whiff or puff so peculiar in cases of compression of the brain. On recovering from his swoon the pulse became regular and 85 in number, the skin warm and moist, the pupils more sensible to their proper stimulus. The bladder, which had been a little distended, acted voluntarily. The next day he was perfectly collected, and complained only of a little pain in the head. Pulse 84; was quiet, and slept during a part of the night. The bowels acted under the influence of the calomel and colocynth given the evening before, and a senna draught in the morning. He quickly recovered without any further bad symptoms.

The effects of a large abstraction of blood at too early a period are well shown in this case, especially by the convulsions and by the peculiar kind of breathing, although it proved ultimately so highly beneficial. Greater caution was exercised in the following case with equally good effect.

Frederick Paris, aged twenty-seven, a shoemaker, fell from a scaffold twenty-five feet high, and was admitted into the Westminster Hospital on the 3rd of August at eleven o'clock, two hours after the accident, apparently insensible, the skin clammy and cold, pupils contracted, pulse feeble and irregular, respiration quickened, no relaxation of the sphincters. The head was shaved in order to discover more readily any external injury, but none appeared of consequence, although the scalp could not bear to be touched without the patient showing some signs of uneasiness. The pulse rose to 100, became regular and fuller towards

the evening. He spoke incoherently from time to time. A cold lotion was applied to the head. Calomel and colocynth, salts and senna were administered, and in the evening he was bled to twelve ounces with the most beneficial effect; he slept, and awoke next morning quite collected, and from this time he gradually recovered, with only a slight giddiness occurring occasionally*.

There is then a time, when the stage of depression is slowly passing into that of excitement, in which it may be doubtful what quantity of blood, if any, should be taken away; but the loss of six, eight, or even of ten ounces can do no harm if they do no good, and their loss may enable the surgeon to form a more accurate judgment of the state or degree of the complaint than he could otherwise have done. When the period of excitement or of inflammation has begun, and the patient, although "disposed to coma, but when roused is still irrational and impatient," he is not to be left to await the effects of a blistering plaster or a dose of physic, as has been recommended in such cases, but ought to be bled sitting up in bed to whatever extent may be necessary to relieve the symptoms, or at least to cause a near approach to fainting, for nothing less can relieve such a person effectively, and give him a fair chance for life. The bleeding must be steadily

* Andral[1] says, a short-necked and tolerably fat old man labouring under disease of the heart, had suffered for some time from continual giddinesses, his right side feeling heavy and swollen, for which he was ordered to be bled from the foot. Whilst the blood was flowing he suddenly became senseless, the left side stiffened for a few seconds, and then lost all power of motion. The left commissure of the lips was drawn downwards, the mouth filled with froth, and the breathing became stertorous. At the end of an hour he recovered his sensations. The next morning the mouth was straight, the intellectual faculties entire; the left side remained paralytic for twelve days, during which time leeches to the neck, a blister and purgatives were made use of; he then began to recover from it also, and was soon discharged cured. He adds, there are certain rare cases in which not only no benefit is derived from bleeding but some evil, as it gives rise to so great a perturbation in the animal œconomy, that under its influence the simple signs of cerebral congestion are transformed into those which accompany an attack of apoplexy.

Mr. Andrews has related to me the following case which occurred in the neighbourhood of the London Hospital. A young gentleman struck his head against the ground by jumping out of a chaise, which slightly stunned him, but did not prevent his walking home, nearly a mile. He was bled to thirty ounces, but gradually becoming more stupefied, he was bled again to thirty ounces more. This was followed by convulsions, and an increase of the comatose symptoms, for which external stimuli were used with advantage. It was now thought necessary by another surgeon to open the temporal artery, but a small quantity of blood only was abstracted, when the patient died.

[1] Andral (G.), Clinique Médicale: Maladies de l'Encephale, tome v. page 295. Paris, 1833.

repeated as the symptoms recur until relief is obtained, or until it becomes evident that the powers of the patient cannot resist the inroads of the disease and of the efforts made for its cure. The quantity of blood lost in two or three days is sometimes enormous in powerful healthy men, amounting to 100, 150 and even 200 ounces with the happiest effect; the following case, which was one of inflammation tending to effusion, will show the extent to which it ought to be carried in an elderly person of a different habit of body.

A gentleman, sixty-seven years of age, had suffered three weeks from occasional attacks of gout in his right foot, which he had treated himself by simple means, taking the Pulvis Ipecacuanhæ Compositus at night to relieve pain. Once or twice his family had observed that his head was for a short time not so clear as usual; but no suspicion of further evil was entertained until he awoke one morning, evidently talking incoherently. As the gout had nearly disappeared from his feet, sinapisms were applied to both; purgatives and diaphoretics were freely administered, and he appeared to be relieved. On the third morning he became more loquacious, forgetful, and occasionally incoherent, and complained of a certain loss of power, and of numbness in his right side. Pulse 84, full and regular, tongue white, some confusion of idea was evident, with slight headache. He was cupped at ten in the morning to ten ounces, without advantage; and as all the symptoms appeared to be increasing at four in the afternoon, sixteen ounces of blood were taken from the arm, which produced a marked effect for some time. At ten at night the symptoms having rather returned, and the blood drawn being very much cupped and buffed, twelve ounces more were taken from the arm, when the pulse quickened, and began to intermit; he appeared to be about to faint, and the object seemed to be attained. Calomel and opium were now given every four hours until the mouth became affected, but the essential symptoms were already subdued, and the patient recovered, with a slight sensation of numbness and loss of power of the right side of the body and head.

The necessary effect was in this case produced by the loss of forty ounces of blood. In a younger and more vigorous man it might have required three or four times as much to have been taken away by repeated bleedings before the object could have been attained, of which the following case is a good instance.

Mr. B. having jumped out of a carriage, the horses of which were running

away at full gallop, fell on his face, and was found senseless and motionless. Some cold water having been poured upon him he gradually recovered, and afterwards ate a hearty dinner, drank a bottle of Port wine, and walked home, a distance of three miles. He thought himself quite well the next morning, and went to bathe; but on returning about noon he felt uneasy, lay down on a sofa, began to talk incoherently, and was soon quite delirious. At one o'clock he was bled, but the symptoms of inflammation were not completely subdued until after he had lost 84 ounces of blood, the last quantity being taken away at eleven at night. The vigorous treatment adopted in this case during the first ten hours in all probability saved the life of the patient.

It sometimes happens that congestion precedes inflammation to such an extent as to give rise to stupefaction and symptoms of compression.

A Portuguese soldier of General Harvey's brigade of the fourth division of infantry, was struck by a musket-ball at the first siege of Badajos, on the top and towards the back part of the head, which divided the soft parts, and grazed without fracturing the bone. He walked from the trenches to the rear, and said he was not much hurt. About five or six hours afterwards he was found apparently asleep, and could not be awakened, on which I was asked to see him; and finding the pulse at 60, regular and full, although compressible, I directed him to be raised and blooded until he fainted. When he had lost some twenty ounces of blood he opened his eyes, recovered his senses, and knew those about him. The next day he went to the rear free from all symptoms, and rejoined some time afterwards in apparent good health, although he complained more than was usual to him of the heat of the sun.

My colleague Mr. White was called, in the month of August 1836, to a child of eight years of age, who had been knocked down by a man on horseback, in the street, at mid-day. The boy was seen to get up and run forwards for several yards, when he fell prostrate as if dead, and was carried home. In the evening Mr. White found him insensible, with scarcely a pulse, deadly pale, and with a considerable-sized swelling of the scalp over the junction of the parietal with the occipital bone. Under these circumstances he made a free opening into the swelling, but could detect neither fissure, fracture, nor depression. The child showed some signs of pain on this examination being made, which induced Mr. White to open the temporal artery, when there at first oozed out a small

quantity of dark-coloured blood, which afterwards came in drops, and finally in a stream of a florid colour *per saltum*. When a saucer-full had flowed, the boy hastily sprung up and began to rub his feet rapidly and violently, mustard poultices having been applied to them, but of which he did not seem to be conscious until the brain had been relieved from its congestion by the abstraction of blood. A few more ounces of blood were taken away, and he shortly afterwards slept for several hours, and was quite free from complaint next day.

William Eady, aged four, was admitted into the Westminster Hospital on the 4th July, 1841, under the care of Mr. White, with a large puffy tumour on the top of the head, having fallen fourteen feet out of a first floor window, striking his head against the pavement. Pupils dilated and permanently fixed, countenance deadly pale, pulse weak and irregular, respiration considerably impeded, and accompanied by a little stertorous noise and a deep sigh about every third inspiration. He vomited; convulsive twitchings of the face and arms took place, and he passed his motions involuntarily. The head was shaved and cold was applied; and on the child appearing a little quieter, Mr. White directed the temporal artery to be opened, when a small quantity of blood oozed away, and was followed in a few seconds by a full stream until a tea-cup-full was abstracted, when the pupils began to contract, the child lost the stertorous snort, the spasmodic twitchings ceased, he fell into a quiet sleep, and was quite well next day.

In some less important cases of injury one bleeding will answer the purpose, cupping and leeches may also be resorted to with advantage; but in all very severe ones general blood-letting is the only trustworthy source of relief. It should always be done with effect, the finger examining the opposite pulse and regulating the amount to be taken away. At an early period of concussion the quantity should not be large: it should increase with the urgency for its abstraction, and diminish with the frequency of the repetition, being always, however, carefully regulated by the effect. The inability of blood-letting to overcome the disease will be shown by the increase in frequency of the pulse, its diminution in power under slight compression, its greater softness, together with the persistence of the other symptoms.

It is in these cases that repeated small bleedings, to the amount of six or eight ounces, ought to be resorted to, and when it is doubtful whether the loss of blood

can or cannot be borne; they may then be considered not as curative but as explorative measures, although they may sometimes prove very effective.

In all these and other more desperate cases, the effect of mercury, provided it have been early and rapidly administered, may yet be decisive. Calomel, combined with another and not less important remedy, opium, ought to be given every two or three hours until the effects of both are fairly induced.

Blisters should never be applied to the head until after the leading symptoms of inflammation have been overcome; and they will do more good at a later period when applied between the shoulders, or on the nape of the neck.

The hair should be cut close in ordinary cases, or shaved off in more serious ones. The head should be raised in bed and kept wet with a cold evaporating lotion, or with a small quantity of pounded ice and water in a large bladder *. Perfect quietude and nearly absolute starvation should be enforced.

The different points of practice which have been noticed, are well illustrated by the two following unfortunate cases, in which the symptoms of concussion were complicated by those which are commonly observed in compression of the brain.

An old man fell from some steps when cleaning windows, on his forehead, which he slightly cut and bruised, and divided the left temporal artery by another small cut, which bled profusely until arrested by a surgeon. He remained in a state of insensibility for nearly two hours, when he rallied, and answered questions, although imperfectly. Pulse quicker than natural, and intermitting. He shortly afterwards relapsed into a state of insensibility, with convulsions, stertorous breathing, puffing at the corner of the mouth, and complete loss of voluntary motion: the pulse could scarcely be felt. This convulsive fit lasted about ten minutes, when his respiration became natural, and his pulse was restored. The insensibility continued for an hour, when it was attempted to bleed him, but the pulse fell immediately, and it was not persisted in. He soon, however, became quite sensible, sat up in bed, and vomited some blood. In the afternoon he had another and slighter fit, from which he quickly recovered. On the third day I first

* Schmucker recommended a lotion for the wounded of the Prussian army, composed of two ounces of the nitrate of potass, one of the muriate of ammonia, one pint of vinegar and five pints of water. As the temperature of the water is greatly lowered by the solution of the salts, it should be made in small quantities, when used.—Schmucker, Chirurgische Wahrnehmungen. Berlin, 1759.

saw him. He was then free from all bad symptoms; and said, when asked, that he had only a very slight headache. The pulse occasionally intermitted. On the fourth day he declared he was starved, became snappish and irritable, complained of pain in the head, with a quick and irregular pulse. On Saturday the fifth day he got up and dressed himself, had another slight convulsive fit, and fell into a state of stupefaction, for which bleeding gave little relief, and in the evening he died. From the first period of his improving on Monday afternoon until his death, sensation and motion remained. On examination a starred fracture without depression was found corresponding to the wound on the forehead, continuing to the base of the frontal bone, across the ethmoid, over the body of the sphenoid bone, breaking off the posterior clinoid processes, and extending to the basilar process of the occipital bone, but not quite to the foramen magnum. The anterior lobe of the right hemisphere of the cerebrum was lacerated to the extent of one inch, which part was surrounded by the usual appearances of inflammation. Some blood was extravasated on the tentorium, beneath the posterior lobe of the brain, and lymph was effused over the whole of its surface, between the arachnoid membrane and the pia mater.

It is possible that the convulsive fits might depend either on the loss of blood, or on the laceration of the cerebrum, for they occur from either cause. On the third day he appeared to be almost free from complaint, and to have suffered from concussion of the brain only. On the night of the third, inflammation of the brain and of its membranes rapidly commenced, in consequence in all probability of the lacerated part not having united by the adhesive process, and of the deep internal fracture, both of which evils were beyond the curative efforts of nature. The trephine would only have added to the mischief.

Mr. S. was thrown from his carriage at Walham Green, at 8 o'clock at night on the 16th of April 1842, and was taken up senseless, motionless, without pulse, and black in the face from some handkerchiefs which were tied tightly round his neck. On his pulse becoming distinct, he was bled to 20 ounces and sent to London. A bruise only was found on the upper and back part of the right parietal bone. He was quite insensible, and remained so until his death. He was motionless as if dead, breathed regularly as if snoring, sometimes more, sometimes less loudly, as was his custom during sleep. Eyelids closed; pupils fixed, neither contracted nor dilated, but quite insensible to the light of a candle brought

close to them. On tickling the soles of his feet, the left toes moved a little, the right not at all. On pricking them with a pin, the right toes very slightly moved, the left toes did so very plainly. Tickling the palms of the hands induced a slight movement, and particularly in the left. Irritating or tickling the eyelids and cilia with a feather, caused a slight contractile motion of the left eyelid but none of the right. The eyes were always fixed in the central position; mouth closed, or nearly so, although a small spoon could be introduced with some force; pulse 78, moderately full. The head was shaved, and 24 ounces of blood were taken away at eleven o'clock, which relieved the breathing; the pulse rose to 88, and became softer. He could after this move the left arm and leg, and gradually recovered their use. When the right arm was drawn from the side, a slight effort was made to draw it inwards. The sphincters were not relaxed. Ten grains of calomel were placed on the back of the tongue. The head was kept raised and cold.

Monday, 17th. Breathed more easily during the night. Pulse 108, full and soft. Repeated the calomel, and passed the catheter, as he rubbed the lower part of his belly with the left hand as if suffering pain, and drew off 4 ounces of water. Ordered a stimulating enema; repeated the calomel at twelve o'clock, and took away 20 ounces more blood, which reduced the quickness of the pulse from 108 to 100. At four o'clock the use of the left arm and leg were apparently quite restored; breathing easier. The enema had been repeated, and the bowels had acted freely, and apparently involuntarily. Pulse 108. Was cupped to 12 ounces on the left temple, at the desire of his friends, who placed great reliance on it. Ten at night. Pulse 120, soft but good; breathing easy, but not quite natural; has swallowed a very little water with great difficulty when carried far back over the tongue, it otherwise runs out of his mouth; has half opened his eyes three or four times, and has endeavoured to move in bed, but cannot stir the right side. Repeat the calomel.

18th. Passed a better night; bowels well opened several times; urine free in a short stream; pulse 120, soft, smaller, and rather sharper. Insensibility continues; face flushed. V. S. ad ℥vj. on trial, and found to be buffed. Breathes much more freely.

19th. Slept and snored loudly, but when shaken ceases to snore; he slightly moved the right leg once. Pulse 100, soft. Continue the calomel. Evening.

Pulse 112, soft and compressible; more restless; tries to move; right foot insensible to tickling; slightly moved the great toe on pricking the sole; bowels often open.

20th. Passed a quiet night and was thought by his friends to be better: pulse had increased to 130. Empl. Lyttæ inter scapulas. Continue the calomel. Pupils contracted a little for the first time under a strong light. Died at half-past two.

On examination, no fracture could be discovered; the dura mater was found adhering to the calvarium on the right side, and was slightly ossified in the course of the superior longitudinal sinus. There was no extravasation of blood either between the calvarium and the dura mater, or between the latter and the arachnoid membrane. Slight extravasation beneath the arachnoid on the upper part of both hemispheres, with appearances of inflammation of the membrane. The vessels of the brain were more turgid than natural; with which exception the left hemisphere appeared quite healthy. The vessels of the right side were more congested than those on the left, and there was a little more extravasation. There was a small quantity of blood in the right ventricle, the roof of which was lacerated superficially to the extent of about an inch, and one point of purulent matter was observed in its middle. The corpora striata, the thalami optici, and optic nerves were in their natural state. No defect could be found in the corpora quadrigemina, the medulla oblongata, or the spinal marrow, although the examination was most carefully made by Mr. Hancock and Mr. C. Gardiner Guthrie.

The symptoms in this case were so distinctly such as might have been expected to accompany an extravasation of blood, either on or in the cerebrum, that I had little, indeed no doubt, of one being found on examination. It did not prove to be the case; and the whole of the symptoms which followed the injury must be attributed to the rupture of the roof of the ventricle of the *right* or the *same* side of the body as that which was affected by as great a loss of sensation and motion as is commonly seen in the most marked instances of extravasation into the cerebrum, or of lesion of the lower part of the spinal cord. That there might have been other mischief besides that which was actually observed, is probable; but it may be reasonably concluded that it was not discoverable in the present state of our knowledge, or was of so small extent as to have been accidentally overlooked.

Inebriation from spirituous liquors may complicate a case at its earliest period from the insensibility or stupefaction it occasions, but I have never seen one in

which the odour of the spirits was not demonstrative of the fact, and the stomach-pump in such cases is an admirable remedy. There was a man in the neighbourhood of the Westminster Hospital formerly, who frequently got drunk and as generally fell down apparently insensible, and was brought to the hospital. The first time there was some doubt about the case, but never afterwards; and he became so fearful of the pump as to take care that he got drunk only when at a distance from his home.

There is another kind of case of infinitely more importance; it is when mania supervenes on the injury, from the consequences of which it has often been undistinguished. It occurs only, I suspect, when the sufferer has an hereditary predisposition for insanity, and rarely unless he has shown some previous symptoms of such derangement. The first case I saw of the kind was in a soldier after the battle of Salamanca, who had suffered a slight injury of the head, and my suspicions as to the nature of the case induced me to examine the brain after death, when nothing could be found to account for it. The second occurred many years ago in the Old Westminster Hospital: the man had fallen from a moderate height, and suffered from the ordinary symptoms of concussion through the first and second stages, when they assumed those attendant on mental derangement. He sat up, talked irrationally as well as incoherently, required some restraint to keep him in bed, owned to no complaint, would eat as well as drink anything that was offered to him; the pulse never ranged above 88, and all the ordinary functions were regular. He died at the end of three weeks apparently exhausted, and nothing peculiar could be perceived in the brain. This man might possibly have recovered under the use of opium, which I have since found of great utility in several cases; the preparations I prefer are those of morphia, which seem to cause less headache and less confinement of the bowels, although they sometimes give rise to nausea and sickness, when the dose is too large.

Mr. Bromfield * having learned from a friend that an empiric had been very successful in the treatment of injuries of the head by opium, advocated its use in the form of the Pulv. Ipecac. Comp., or Dover's powder, or combined with antimony, and gives three successful cases in which the trephine was not resorted to, he believed in consequence of the use of this remedy; and one fatal one in which it was had recourse to, and the depressed portions removed; but

* Bromfield (Wm.), Chirurgical Observations, vol. i. London, 1773, p. 14.

the practice he recommended has not been generally followed, although it has been frequently referred to.

A gentleman's servant, aged thirty, fell from his master's carriage, being rather intoxicated, and cut and bruised the right side of his forehead. He was insensible for an hour, and then gradually recovered, complaining only of general uneasiness and headache; pulse quick. He was purged, had the head shaved and cold applied, and was the next day bled. His complaint continued with little variation for several days, the pulse becoming quicker, and himself more irritable and watchful. I now first saw him, and observing something peculiar in his look and manner, was induced to inquire into his previous state of health; learning that he was occasionally of a moody disposition and odd in manner, I directed him to be well purged, and then to take the Pulv. Ipecac. Comp. g. iv. in a saline draught every four hours: the exhibition of these remedies was soon followed by copious perspiration and sleep, and under this treatment he gradually improved, returned to his occupation, and remained well.

George Grey, aged 45, a stout man, was admitted into the Westminster Hospital on the 1st of November 1839, at half-past twelve P.M., having fallen from an omnibus on Westminster Bridge, and received a blow on the right parietal bone a little behind the coronal suture. He lies on his back in a state of stupefaction, although sensible when pinched, but is restless, and suffers from convulsive motions of the mouth and limbs; pupils fixed, the right being more dilated than the left; pulse 120; heat of skin natural, respiration deep and rapid without stertor; the sphincters not relaxed. A turpentine enema was given, and a pill of calomel was swallowed with great difficulty. The head was shaved, and a cold lotion applied; he soon afterwards became violent, and required the restraint of a tight jacket. The pulse fell in the afternoon to 84.

Nov. 2nd. Passed a restless night without sleep, and has a wild appearance: pulse 96, and regular. At twelve o'clock became sensible, and gave a confused account of the accident. At one Mr. Guthrie saw him, ordered him to be freely purged, and to have a quarter of a grain of the acetate of morphia every four hours afterwards, until he slept. The first dose was given at seven, the second at eleven, and the third at three in the morning.

Nov. 3rd. Has passed a quiet night, but with little sleep; the morphia has had a soothing effect; talks rationally, although a little confusedly, and recog-

nized his mother, who says he received a violent blow on the head three years ago, which has rendered him mad ever since whenever he drinks too much, and for which he was three weeks in St. Bartholomew's Hospital. Pulse 72. Bowels open, and is free from restraint. At seven in the evening he suddenly started up in bed, saying some one was going to murder him. Half a grain of the acetate of morphia quieted him; it was repeated at half-past twelve and at half-past four, and kept him tranquil, although he did not sleep.

Nov. 4th. He was collected, quiet, and free from restraint. Pulse 96, rather full: secretions natural. The morphia was continued in adequate doses for a few days, and he gradually recovered.

A tradesman was admitted under my care, in a state of insensibility, into the Westminster Hospital on the 15th of January, having been immediately before thrown from a gig against the edge of the pavement, and bruised on the right side of the head: there was bleeding from the right ear; the breathing was laboured; he had lost the power of moving the right arm and leg, which induced me to suspect an extravasation on the brain of the side opposite to that which was bruised. Pulse slow and weak, a little different in the two arms. Irritating the sole of the right foot caused the leg to be drawn up; not so the hand. Two hours after his admission he vomited, and his breathing was relieved, as well as the paralytic affection of the right arm and leg, which he was now able to move. The head was shaved, and a cold lotion applied. The next morning, the 16th, the pulse having risen to 88, although weak, he was bled cautiously to 10 ounces, and calomel and colocynth, senna and salts were administered until he was copiously purged, the fæces and urine coming away without his notice; after which he became a little more sensible, and answered questions and recognised his wife. On the 17th he was better, could answer distinctly, and complained of pain in the back of the head. Pulse 90, very compressible and weak. The cold lotion was continued. A blister was applied between the shoulders, and the calomel repeated. On the 18th the bowels not having acted since the day before, a large stimulating injection was administered with effect; and as blood-letting appeared to be inadmissible, the acetate of morphia was given in half-grain doses, with 30 minims of the Liquor. Antim. Tartar. in the Mistura Camphoræ every six hours, and four grains of calomel with colocynth at night. The morphia was repeated from time to time as he became restless, but the antimony was omitted. The calomel was continued, and he

gradually improved, being sometimes rational, sometimes wandering. On the night of the 24th he became very violent, so as to require the strait waistcoat; and on the 25th it evidently appeared to be more a case of mania than of low inflammation. A blister was applied to the nape of the neck, and the morphia was continued with purgatives, under which he gradually recovered, although he remained, his wife thought, odd in manner, and bad tempered. He was not sure that his family were not subject to some affection of the head. The injury in this case seems to have been caused by concussion principally of the spinal marrow, giving rise to low irritation of the brain and a state approaching to mania. The value of the treatment is entirely dependent on the substitution of opium or morphia, with a moderately nourishing diet, for blood-letting. I have not met with an instance in which it was necessary to give wine or other stimulants; but I can readily conceive that cases requiring them may occur in very irritable persons, or in such as I have alluded to, who have been in the habit of indulging in their use.

Concussion induces affections of the brain and of its membranes of an equally serious nature, at a more distant period of time when the stage of stupefaction and insensibility is wanting; and it is to guard against such an occurrence that persons who suffer from falls or severe blows on the head usually lose blood. A gentleman was thrown from his gig near Hounslow, and received a very severe shock and several bruises, without feeling much hurt, or being aware that his head had actually touched the ground. He came up to town, went to bed, and got up next morning suffering only from a slight headache, and stiff from his bruises, of which he thought nothing. On the second day I saw him in consequence of headache, throbbing in the temples, sickness, and general malaise or discomfort. Being a stout young man, thirty ounces of blood were taken from the arm in a sitting posture, until he nearly fainted, when he was relieved. In the evening the symptoms having all returned, pulse 88, and full, he was bled in the erect position until he fainted, forty ounces being taken away. The blood of the morning was buffed and cupped, and the bowels had acted freely. On the morning of the third day the pulse, which had become fuller, yielded to twenty-four ounces of blood, and in the afternoon, on its rising again, to sixteen more; after which the symptoms gradually subsided, and he appeared to be restored to health, with one interruption from irregularity in diet, which required the further loss of blood by cupping behind the ears, and some sharp purgation. His

cure was not however permanent; for having dined out a month afterwards, he became delirious during the night, and required to lose sixteen ounces of blood in the morning, which relieved but did not cure him. Some pain remained in his head, the pulse continued at 90, the tongue was white, with thirst, loss of appetite, and watchfulness. Calomel and opium were now administered until the mouth became affected, when he quickly got well; although a slight relapse or two afterwards convinced him that he could not drink or lead an irregular life with impunity*.

There are no cases of convalescence after disease or injury which require more care than those which follow injuries of the head. Relapses, from apparently trifling causes, are extremely frequent, and gradually but certainly undermine the health; they are in fact connected with chronic derangement of the brain, or its membranes, and unless successfully met, generally end, after the lapse of a few weeks or months, in irritative fever and death. In many instances, and particularly among poor people subject to privations and of irregular habits, in whom an injury of the head has not originally been of any apparent importance, such a state of irritation, combined with debility, is very difficult to manage, and requires a combination of local as well as of general means for its cure. A few leeches and blisters may be applied alternately over the part affected, with great advantage, and a mild nourishing diet with gentle alteratives and tonics will expedite the cure, especially when aided by perfect repose and a fresher atmosphere. In persons of a higher station, who rather suffer from casual irregularities, I have found an issue in the arm, which establishes a gentle but permanent drain, a most efficacious remedy; and I am in the habit of recommending its adoption in all cases of affection of the head among elderly persons, in which any material or long-continued inconvenience has been suffered.

The transition from the cases, which may be considered as dependent on concussion accompanied by laceration of the brain, to those in which extravasation has also taken place, complicating the symptoms and rendering it difficult to distinguish the state of Concussion from that of Compression, will include that

* Dupré de Lille recommends three ounces of the album græcum of fowls to be dissolved in one bottle of white wine, one small glassfull to be taken night and morning, as an infallible cure for the consequences of concussion; and he gives some remarkable instances of cure effected by this remedy!

class of accidents which in former days particularly occupied the attention of the continental, and especially of the French writers on these injuries, and which they designated "Plaies de tête par contre-coup." By this expression it was implied that the shock had given rise to mischief in the brain or its membranes on the opposite side to that on which the injury had been inflicted, although slighter extravasations might also occur in other parts.

Contre-coup is well illustrated by the accident, described by Paré*, which caused the death of Henry the Second of France. This case has been repeatedly quoted by authors; but the injury of which it is held to be a remarkable instance is so seldom observed in the present day, that the word contre-coup has almost become obsolete; and I am greatly inclined to regard the greater number of cases of this injury which are recorded, as cases in which mischief went on and matter formed in or on the brain in consequence of inefficient treatment.

Compression of the Brain means a diminution of the size of certain parts, resulting from the pressure of an extraneous body, whether it be fluid or solid, in consequence of which particular symptoms are generally known to ensue. When they occur, it is said that the sufferer is labouring under symptoms of compression of the brain, and apoplexy from the rupture of a blood vessel may be considered as the truest form of the complaint. These symptoms sometimes take place from the presence of a foreign substance, such as a point or piece of bone, which from the smallness of its size can hardly compress, although it may displace; and it is then said, that the symptoms arise from irritation of the brain. Many of them have also been found to occur from loss of blood, or the absence of pressure, or from insufficient pressure arising from changes in the circulation; and several different opinions have been entertained on all the points connected with these

* Paré[1] says, "Henry the Second, king of France, received a severe blow on the body at the tournament of the field of cloth of gold, from a lance which broke, but did not unhorse him. A splinter was driven by the shock under the visor which it raised, and struck him over the right eyebrow, penetrating the eye itself, but without fracturing any of the bones of the orbit. He died on the eleventh day after the accident. On examination, a quantity of blood was found extravasated between the dura and pia mater under the occipital bone directly opposite to the part struck by the splinters of the lance, and the brain underneath, for the extent of an inch, was of a yellow colour, and in a commencing state of putrefaction." Contemporary writers affirm that the king did not fall from, but was lifted off, his horse, and did not therefore receive any other injury than from the single stroke of the lance.

[1] Paré (Ambroise), Œuvres de, Lyon, 1641, 10ème édit. folio, chap. viii. page 255.

subjects. It has been argued, that as the brain is incompressible no compression can take place. There is no proof however of the fact of its being incompressible, although it has been stoutly maintained by Monro secundus *, Sir C. Bell and others, when its intimate structure was less known than at present.

The smallest nerve can be separated into fibres, and these into others, until they are reduced to about the diameter of the blood-disc, when they present a definite character, and were first distinctly recognised and described by Fontana†, under the name of "Cylindres nerveux primitifs." That the cerebral tissue is likewise composed of minute fibres, was discovered by Coiter‡ as early as 1573, who called them "fibræ capillares." This discovery was confirmed by Leeuwenhoek, and the course of the bundles of these fibres has been traced by Varolius (1578), by Willis (1674), by Vieussens, and many modern anatomists.

Ehrenberg§ has devoted much attention to this subject. The chief result of his researches is, that the primitive fibres of the brain, spinal cord, and nerves of the senses are more minute than those of the ordinary nerves; and that their sheath is so delicate that it is ruptured by the slightest pressure, even by that of a thin plate of mica; and the fibres then assume a knotted or varicose appearance. This Ehrenberg believed to be natural. The primitive fibre of ordinary nerve, which is twice the size of the preceding, only assumes the varicose structure under very strong pressure, but naturally presents the form of a band with a double outline or cylinder, from which a mixed pulpy and granular matter may be expressed.

Müller‖ doubted that a fibre with a diameter equal or superior to that of the blood-disc could be a simple cylinder with structureless contents. The analogy of the compound structure of the primitive striated muscular fibre made more obvious the necessity for further and more careful investigation of the primitive nerve-fibre or cylinder.

Treviranus¶ described more minute filaments in the primitive nerve-fibre of Fontana and Ehrenberg.

* See Kellie (Dr. George) on Congestions of Blood in the Brain, parts 1 and 2 of the Transactions of the Medical and Chirurgical Society of Edinburgh for 1824.

† Sur le Vénin de la Vipère, 1781. tom. ii. 206.

‡ Observationes Anatomicæ, p. 107.

§ Poggendorff, Annalen der Physik, 1833.

‖ Elements of Physiology, Baly's Translation, part 3, p. 597.

¶ Beiträge zur Aufklärung des organischen Lebens. Band ii.

Schwann * discovered that the double outline, which is the most obvious character of the primitive nerve-fibre, included a white substance, forming the parietes of the supposed cylinder; and he likewise saw more minute filaments escaping from the primitive cylinder in the mesentery of a frog.

Remak † observed that the contents of the cylinder were organized, and naturally formed a flat or band-like axis.

Purkinje and Rosenthal ‡ confirm and add to the preceding observations. They perceived longitudinal and sometimes transverse fibres in Schwann's white substance, which they term the external case. They say that Remak's organized axis is not band-like, but cylindrical. They recognize transverse folds or sinuosities in the subtransparent sheath.

Dr. Barry § finds that the central axis and peripheral white substance are both composed of filaments, which are developed from the centre to the circumference; and being more compacted at the exterior part of the primitive nerve-fibre, there constitute Schwann's white substance, and give rise to the double outline constantly figured by Ehrenberg. Dr. Barry is further of opinion, that *each filament*, in both the white substance and band-like axis, as seen in the spinal cord, is a *compound body*, having a structure like that of the filament which he has detected in the blood-disc. "This filament is not only flat, but deeply grooved on both surfaces, and consequently thinner in the middle than at the edges, which are rounded; so that the filament, when seen edgewise, appears at first sight to consist of segments. The line separating the apparent segments from one another is, however, not directly transverse but oblique."

By gradually tracing the fibre or filament above mentioned into similar objects of larger size, Dr. Barry endeavours to show that it is not possible to draw a line of separation between the minutest filament and an object being to all appearance composed of two spirals running in opposite directions, and interlacing at certain regular intervals, an arrangement which produces in the entire object a flattened form, and gives it a grooved appearance. It is in fact, the structure, which, for want of a better term, he has called a *flat filament*. The

* Quoted by Müller, *loc. cit.*, p. 563.

† Observationes Anatomicæ et Microscopicæ de Systematis Nervosi Structurâ. 1838.

‡ De Formatione Granulosâ in Nervis, &c. 8vo, 1840, p. 15.

§ Proceedings of the Royal Society, January 1842, pp. 363, 364; and Annals and Mag. of Nat. Hist., March 1842, p. 545.

edge of this filament presents what at first sight seem like segments, but which, in reality, are the consecutive curves of a spiral thread.

The brain, composed of the peculiar structure thus described, is surrounded by membranes, capable of secreting a halitus or a fluid whenever it may be necessary to fill up space; it is intersected by partitions apparently for the prevention of jar and pressure, and is permeated in every part by vessels of various sizes, both venous and arterial. It has been presumed that the brain contains at all times the same quantity, or nearly the same quantity of blood, in consequence of its freedom from atmospheric pressure, through the intervention of the bones of the skull. If this conjecture be correct the quantity cannot be materially increased, unless something is displaced to make room for the addition, nor can it be essentially diminished without something being added to supply its place. The question turns however very much on the words "materially increased or diminished;" for a very small quantity in addition may be the cause of serious mischief, and the subtraction of even less may give rise to great cerebral disturbance; but I have no doubt that the actual quantity contained in the head is less at one time than at another; and I am of opinion that the deficiency is usually on the side of the arteries, and that when congestion takes place it is for the most part venous. When a person is about to faint on the first passage of a catheter through the urethra, the blood deserts his face, he feels sick, his pulse nearly ceases, and he would faint if he were allowed to remain in the erect position. Let his head now be bent down between his knees for a minute, his face fills with blood; I believe his brain does the same, and he recovers almost immediately. Dr. Kellie * made some valuable

* Dr. Kellie of Leith, bled animals to death under various circumstances; and he found that though all the other organs of the body were blanched and emptied of their blood, the *brain* in these cases presented its ordinary appearance; or even seemed to contain more blood in its superficial vessels than usual. In one instance, he describes the sinuses as being loaded with dark blood, and the vessels of the pia mater as being delicately filled with florid blood. In another, the sinuses were charged with blood, the veins of the pia mater were filled, and the choroid plexus remarkably turgid. In a very few cases only did he remark that the vessels of the brain contained sensibly less red blood than in others; and in all of these few, some serous effusion was observed. Having satisfied himself, by repeated trials, upon these points, he varied the experiment. He first made a small opening in the skull by means of the trephine, and *then* he bled the animals until they died; and in *all these* cases he found that the brain was as completely drained of red blood as any other part of the body.[1]

[1] Dr. Kellie, *loco citato*, and Dr. Watson's Epitome in the Medical Gazette for 1840–41, No. 21, p. 741; and Dr. Haworth in Medical Gazette for 1841–42, No. 23.

experiments on this subject, which deserve great attention. They have been further elucidated by those that have been instituted by others for the purpose of determining the nature and causes of the motions observable in the brain, which were anciently supposed to depend on the vessels of the dura mater. Schlichting * first established the fact, that the brain rose during expiration and fell during inspiration, but he doubted whether it arose from the blood or from air. Haller † simply stated the fact, in a letter to Sauvages, that it depended on the flux and reflux of venous blood. De la Mure ‡ (page 555) thought it depended on the blood in the jugular and vertebral veins, although he could not entirely account for a certain degree of motion which took place under strong suffering on the part of the unfortunate animal when the jugular and vertebral veins were divided. Richerand § supposed the motion of the brain to depend on the systole and diastole of the arteries situated at its base, and that respiration had no influence upon it. Blumenbach ‖, on the contrary, states it to be dependent principally on respiration, and gives the observations he had the opportunity of making on a young man who had recovered from the loss of a considerable portion of the frontal bone. "The hiatus thus formed, covered by a soft cicatrix, formed a hollow, very deep during sleep, less so when he was awake, and varying according to the state of respiration, *i. e.* very deep if he retained his breath; much more shallow, and even converted into a swelling, by a long continued expiration;" he adds, "at the bottom of the hollow I observed a pulsation synchronous with the pulsation of the arterial system, such as deceived Petrioli, Vandelli, and others, at one time the adversaries of Haller, who all foolishly confounded it with that other remarkable motion which depends upon respiration." Magendie ¶ supports the opinion of Blumenbach, of the double motion of the

* Schlichting (M.), De Motu Cerebri, premier volume des Mémoires présentés à l'Académie par divers Savans, p. 113.

† Haller, Mémoire sur les parties sensibles et irritables du corps animal, tome 4.

‡ M. de la Mure, in a Memoir read on the 12th August, 1752, 'Sur la Cause des Mouvemens du Cerveau qui paroissent dans l'Homme et dans les Animaux trépannés.' Printed for the year 1749, but published in 1753, in 'Histoire de l'Académie Royale des Sciences.'

§ Richerand, Nouveaux Elémens de Physiologie. Paris, tome 1.

‖ Blumenbach, by Elliotson, Elements of Physiology. London, 4th edition, 1828, page 191.

¶ Magendie (F.), Compendium of Physiology, translated by Dr. Milligan, 2nd edition. Edinburgh, 1826, page 107.

brain. Flourens * denies that the motion derived from the pulsations of the arteries can be distinctly seen, and declares that the ordinary movements of the brain depend entirely (*pour tout*) on respiration. He endeavours to demonstrate by various experiments, that its rising and falling is *principally* caused by the dilatation, proportionally small as it may be, of the sinuses on which it rests, which are filled by the regurgitation of blood from the vertebral sinuses during expiration. The last act of life being one of expiration, fills the sinuses and veins of the base of the brain with blood, which accounts for these vessels being always more or less distended. This consequence of expiration explains why in approaching syncope the arteries only may be partly empty, and why bending down the head retards the return of blood by the veins, and aids its progress to the head by the arteries. Mr. Stanley † made the following observations on this subject on a boy who was suffering from protrusion of the brain. When he rose the tumour instantly sank to a certain degree, probably from the blood being then returned more freely from the head than when he was in the horizontal position. When he was desired to hold his breath, the nostrils being at the same time closed, no alteration in the tumour was produced. In the inspiration preceding the act of coughing, the brain sank; but in the instant of the strong expiration it was again driven upwards with great force.

The motions of the brain covered by the dura mater are but little observable under ordinary circumstances when a circular portion of bone is removed by the trephine; the surface of the dura mater remains in general perfectly LEVEL; it is of a reddish silvery colour, and is firmly attached to the cut edge of the bone. The surface is raised however on a full expiration, and it falls on a deep inspiration. Fluid secreted or placed upon it is seen to move synchronously with the pulse; but the dura mater never rises up into the hole made by the removal of the bone, unless some fluid is retained beneath it. If the quantity of fluid extravasated or collected under it is large, it rises immediately on the removal of the bone; but the protrusion of this membrane does not always take place for some hours afterwards, if the fluid should be more diffused. The motions of the brain, when the dura mater is thus protruded into the opening, become very

* Flourens (P.), Recherches Expérimentales, &c. Paris, 1842, deuxième édition, page 340.

† Stanley (E.), Cases of Hernia Cerebri in the 8th volume of the Medico-Chirurgical Transactions, page 31.

indistinct, if they can even be perceived ; and these two points, viz. the protrusion into the opening and the absence of pulsation, are great practical facts, to be borne in mind in connexion with the physiological observations.

If we take into consideration that we can often see the natural and ordinary size of the brain diminished under pressure, and that certain symptoms, such as insensibility, syncope, convulsions, paralysis, are consequent on this state, and are relieved by the removal of the pressure and the restoration of the compressed brain to its ordinary state, we may safely conclude that some derangement takes place in its integral parts, which may be best understood by the word Compression. If we further consider that compression can rarely exist without irritation, and that sometimes of a formidable nature, there does not appear to be so much difficulty in the subject as is frequently represented, although the physiological explanation may not be so simple. Sir C. Bell* says, what is termed compression of the brain is a diminution of the vessels within the cranium, a diminution of the quantity of blood actually circulating, and the consequence a diminution of all the cerebral functions,—insensibility or profound sleep, an immovable and dilated pupil, the pulse labouring, the breathing heavy and stertorous ; nevertheless, if one vessel is emptied another must be irregularly filled, or the blood must be removed from the brain. In the present state of our knowledge, we apprehend that in many cases approaching to apoplexy, and in which the symptoms are similar to those arising from compression, all, or nearly all the vessels, as far as we can ascertain, are actually full of blood, instead of being partially empty and containing less than the natural quantity. When we see a patient, lying in a state of insensibility with a fracture of the cranium, immediately recover his senses after the application of the trephine and the removal of a large coagulum of blood, we are apt to conclude that the coagulum of blood and the insensibility stand in the relation to each other of cause and effect. It is not unreasonable to conclude that the pressure of the extravasated blood confined by the bone had occasioned the insensibility, and that this did not depend alone upon some few vessels containing less blood than usual ; for the brain, I apprehend, must be considered as a whole in all these investigations, and that reference may not be made to its vascular structures only, in explanation of the cause of its derangements.

* Sir C. Bell, Institutes of Surgery, vol. i. page 168.

Velpeau*, following Flourens†, considers "the brain as existing under the influence of four powers.—1st, The force of expansion, or its elasticity. 2nd, and this partly influences the first: The circulation in the capillary vessels of the substance of the brain, or pia mater. 3rd. The influence communicated from the large vessels at the base of the brain. 4th. The resistance offered by the bones of the skull.

"These four different powers, in reacting on each other beyond certain limits, necessarily give rise to compression. An enlargement of the superficial vessels compresses the brain on itself. The congestion of its substance presses it against the dura mater; an extravasation between the membranes compresses it from the periphery to the centre. Its density or elasticity prevents liquids or soft bodies, such as a sponge placed upon its surface, from compressing it sufficiently to interfere with its functions. A solid body would not compress it, if it had not a certain weight to enable it to cause a manifest compression; the weight of the body must be greater than the resistance of the three powers first alluded to, which does not usually occur in compression of the brain.

"If foreign bodies, whether they are liquid or solid, do not compress the brain by their weight, they can act only by the intervention of another power, and the pressure they make is indirect and not immediate. The other power is the fourth I have alluded to; viz. the resistance of the inside of the skull.

"The first object of the operation for removing a portion of bone in a state of compression of the brain, is not then to permit of the removal of a foreign body alone, whether solid or fluid, but also to obtain the immense advantage of taking off the compressing power which had overcome the resistance offered by the expansive and elastic force of the brain."

The experiments of M. Flourens appear to elucidate a difficult point which occurs in connexion with compression of the brain from extravasation of blood. He showed that when an artery was opened, such as the anterior cerebral artery, and the blood rapidly poured out was retained within the skull, loss of sense and motion followed as it spread itself from before backwards on the cerebral lobes; but as soon as the blood was allowed to escape from within the

* Velpeau, De l'Opération du Trépan, &c. Paris, 1834.

† Flourens, Considérations sur l'Opération du Trépan, &c. Paris, 1830.

skull, the animal recovered its faculties in the order in which it had lost them, and that sometimes almost instantaneously.

M. Serres, on the contrary, opened the longitudinal sinus, and showed that a large quantity of blood might be allowed to spread itself slowly over the surface of the brain without causing either a loss of sense or of motion. This has been attributed to the blood from the veins or sinuses of the head flowing more slowly and being more fluid and less coagulable than that from the arteries, and to the capability of the brain to bear a pressure which is slowly and equably spread over it; whilst it is not able to resist a pressure that is more direct and more rapidly effected. It must also be borne in mind, that a single point of injury from a fractured portion of bone is often capable of giving rise to the same symptoms, and that an ounce of lead may lie quietly in the brain without causing any. It is from the consideration of these and other circumstances that Serres, Gama*, and others of the French physiologists, have come to the same conclusion as Sir C. Bell, that the symptoms hitherto supposed to be dependent on compression of the brain, are more strictly caused by irritation.

When compression of the brain is caused by the extravasation of blood, the patient is senseless, breathes slowly, loudly, and in a heavy laboured manner, or with stertor, and cannot be awakened, although the noisy breathing may be for a time suspended. The breath is sometimes emitted from the corner of the mouth, like a whiff or puff of smoke, and with something of a similar noise, which, when permanent, is a more dangerous symptom than the common snoring or stertorous breathing. He sometimes froths at the mouth, and occasionally appears convulsed, but neither hears nor sees, nor takes the least notice of those about him. The countenance is generally flushed if the shock or blow has been slight, pale or livid if it should have been great. The pulse is usually slower than natural, sometimes irregular or intermitting, occasionally quick, even from the receipt of the injury. The pupils of the eyes may be contracted or dilated, being dependent for their condition more perhaps on the part of the brain affected than on the degree of injury. They are generally more contracted in the first instance than dilated; they may afterwards pass into a medium or doubtful state; one may be even dilated, and the other not. In general, as the mischief is continued and augmented, they become dilated and immovable. The eyes

* Gama, J. P., Traité des Plaies de Tête. Paris, 1835.

may be turned upwards, or may be fixed in the centre, or be drawn irregularly outwards or inwards, causing strabismus, which is however a more rare occurrence. If the eyelids should be partially open, tickling the cilia or the conjunctiva of the ball with a straw or a feather, will cause them to close if the spinal cord be sound. The mouth and lips are more or less compressed, and fluids run out at the corners, unless placed on the very back of the tongue by a long narrow spoon, when they are swallowed with difficulty. Paralysis of one side of the face and hemiplegia are common, paraplegia is more rare. In both kinds of palsy, one part in one limb may be more completely affected than another, in which convulsive twitchings are sometimes present, as well as a frequent drawing up of the limb of the unaffected side. Tickling the soles of the feet or the palms of the hands will sometimes cause retraction of the toes or fingers, when the limbs are apparently motionless; pricking them gently with a pin will often give rise to convulsive startings and tremblings of all the muscles of the extremity when tickling fails, showing that the capability to move the part remains, although the will to do so is wanting. The leg or arm is sometimes drawn towards the body when separated from it; it more often falls from the hand as if it belonged to the body of a dead person; the muscles are occasionally more stiff and rigid, and some power of motion remains, although little of sensation; sometimes sensation is perfect when motion is lost, and sensation may be lost on one side and motion on the other. The urine at first retained, may ultimately pass as well as the fæces, involuntarily; nevertheless, irritating the verge of the anus will excite motion and contraction in the sphincter ani, if the functions of the spinal cord are not destroyed. The action of the involuntary muscles is little impaired in general, the secretions are but slightly affected; and when it is otherwise, the injury must have extended to the ganglionic system, and the whole of the nervous centres must be materially implicated.

The loss of motion, or of the power of moving parts of the body, is either perfect or imperfect according to the degree of injury which has been inflicted, varying from a sense of feebleness to an almost utter incapability of moving the part. It is accompanied in general by defective sensation, or numbness, or by the complete loss of sensation, and of the power of resisting heat and cold: the whole side, or one extremity, or a part only of an extremity, may be affected, and not the whole. The case of the late Admiral Sir P. Broke, which I have related in my work 'On Gun-shot Wounds, and on Injuries of Nerves,' &c., is perhaps the most

extraordinary on record; and particularly with reference to the incapability of resisting cold when sensation was not destroyed, and of the partial paralysis of a distant part from an injury of the brain. The mischief which gives rise to the loss of motion usually occurs on the side of the brain opposite to that part of the body which is paralytic. This was known and stated by Hippocrates, and was generally assented to by the earlier writers, who supposed with Cassius and Aretæus, who lived in the first century, that the nerves proceeding from the brain interlaced at their origins, and crossed in such a way, that those which came from the right side passed to the left, and those from the left to the right. Pourfour du Petit of Namur, in 1710 published in three letters his 'Nouveau Système du Cerveau,' in which he clearly demonstrated the decussation of the fibres of the upper part of the spinal marrow; and Louis has preserved, in the second volume of his 'Recueil d'Observations d'Anatomie et de Chirurgie, Paris, 1788,' these letters, as well as the observations which they drew forth from Valsalva, Morgagni, Santorini, Winslow, Molinelli and Mistichelli. The labours of Haller*, of Lorry †, and of Zinn‡, tended to the elucidation of this important point. In modern times the subject has been pursued to the most complete anatomical demonstration by Gall and Spurzheim§, Sir C. Bell‖, Messrs. Mayo¶, Magendie**, Solly††, Grainger‡‡, Reid§§, and others‖‖.

* Haller, Mémoires sur la Nature sensible et irritable des Parties du Corps Animal, tome i.

† Lorry, Académie des Sciences. Mémoires des Savans étrangers, tome iii.

‡ Zinn, Mémoire sur la Nature irritable, &c., &c., tome ii.

§ Gall et Spurzheim, Anatomie et Physiologie du Système Nerveux en général et du Cerveau en particulier, 4 Tomes avec Atlas in fol., Paris 1810–19. Spurzheim, The Anatomy of the Brain, &c. 8vo. Lond. 1826.

‖ Bell (Sir C.), An Exposition of the Natural System of the Nerves of the Human Body. 4to. London, 1824.—The Nervous System of the Human Body. 4to. London, 1830. (Third Edit., ib. 1836.)

¶ Mayo (Herb.), Anatomical and Physiological Commentaries, Parts 1 and 2. 8vo. Lond. 1822–23. —A Series of Engravings, intended to illustrate the Structure of the Brain and Spinal Cord in Man. fol. Lond. 1827.

** Magendie (F.), Journ. de Physiologie, Expérimentale et Pathologie, 9 tomes, 8vo. Paris 1821–29.

†† Solly (Sam.), The Human Brain, its Configuration, Structure, Development, and Physiology. 8vo. Lond. 1836.

‡‡ Grainger (R. D.), Observations on the Structure and Functions of the Spinal Cord. 8vo. Lond. 1837.

§§ Reid (J.), Edinburgh Medical and Surgical Journal for 1841.

‖‖ The experimental proofs of most value have been made by Flourens, who has shown (page 256),

The pathological proofs have been not less complete. Desault and Bichat* were by no means satisfied that the paralysis which followed an injury always took place on the opposite side, and some pathologists since their time, in admitting the fact, have proved that there may be exceptions. It is acknowledged, although it is not clearly and satisfactorily accounted for as to the face, that an extravasation of blood into one hemisphere of the cerebrum, or even of the cerebellum, can cause paralysis of the complete half of the body of the opposite side. It has been demonstrated, that the right side of the body and the left side of the face may be paralytic at the same time and from the same injury of the left side of the head, the mischief which caused the paralysis of the right side being found in by far the greater number of instances on the left side of the brain, and that which gave rise to the paralysis of the left side of the face to have been caused by an injury in the course of the portio dura of the seventh pair of nerves after it had left the brain.

Burdach† found in 268 cases of lesion of one side of the brain, that ten presented paralysis on both sides of the body, two hundred and fifty of one side, and of these, in fifteen the paralysis was on the same side as the injury. The convulsions were in twenty-five cases on the same side as the disease; in three cases on the opposite side. In cases of lesion of one corpus striatum, there were in thirty-six instances paralysis of the opposite side, and six with convulsions of the same side, and in no instance convulsions of the opposite side. In twenty-eight cases of cerebral lesion of one side the muscles of the opposite side of the

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that each part of the brain of an animal can produce its own peculiar effect, and that each also, when injured, exercises a depressing power on every other. He is therefore disposed to believe that the word paralysis is improperly used to express not only a partial, but a total loss of power; that the partial loss of motion and sensation, for instance, of one side in animals, may depend on derangement of the opposite hemisphere of the brain; but that the total loss of motion and sensation must depend on the destruction of a part of the medulla oblongata or spinalis. Life he thinks in *animals* depends on the integrity of the medulla oblongata, or that part which extends from the corpora quadrigemina above to the origin of the par vagum or eighth pair of nerves below inclusive. Hertwig has repeated the experiments of Flourens, and confirmed all the deductions made from them, with the exception of the occurrence of convulsions as a consequence of wounds of the corpora quadrigemina.—Hertwig, Exper. de effect. læsion. in partibus encephali. Berol. 1826.

* Desault (P. J.), par Bichat. Œuvres Chirurgicales, tome ii. p. 53. Paris, 1813.

† Burdach, Vom Bau und Leben des Gehirns, p. 372. Müller (J.), Elements of Physiology, by Baly, Part 3. p. 842 *et seq.*

face were paralysed, in ten cases those of the same side*. Paralysis of the eyelid was in six cases on the same side, in five on the opposite side. Paralysis of the muscles of the eyeball occurred in eight cases on the same side, in four on the opposite. Paralysis of the iris in five cases on the same side, and five on the opposite ; the tongue being generally drawn towards the paralysed side of the face.

MM. Serres†, Foville and Pinel Grandchamp‡ are of opinion that paralysis of the lower extremities is caused by lesion of the corpora striata ; and paralysis of the upper extremities by injury of the thalami optici. They are, however, merely coincidences when they occur. M. Bouillaud supported Gall in the idea, that the anterior lobes of the brain preside over the organs of speech, and are the seat of memory. Cruveilhier§, Andral‖, and other French pathologists have disputed and successfully controverted this opinion. It has been contended by MM. Delaye¶, Foville and Pinel Grandchamp**, that disturbance of intelligence depends upon lesion of the grey substance, disorder of locomotion on implication of the medullary matter, and that lesion of the grey substance is more frequently accompanied by spasms and convulsions.

Valsalva††, Morgagni, Gall, Larrey, Serres and others, consider the sexual organs and the lower extremities to be influenced by injuries of the cerebellum : Cruveilbier, Andral, Flourens and others, do not admit it‡‡. La Peyronie believed he had established the fact by pathological proof, that life essentially depended in man on the integrity of the corpus callosum.

* Forestus (Pet.) Observat., tom. i. lib. x. Obs. 11. p. 419. In a boy of eleven years of age who was paralytic on the *right* side, the brain after death was found corrupt and fœtid on the same side ; the opposite or left being sound.

† Serres (C. R. A.), Anatomie comparée du Cerveau, &c., trois parties, en 8vo., et Atlas en 4to. Paris, 1824–26.

‡ Foville et Pinel Grandchamp, Recherches sur le Siège spécial des différentes fonctions du Système Nerveux. 8vo. Paris 1823. Conjoint mémoir.

§ Nouv. Biblioth. de Médecine, 1826.

‖ Andral (G.), Clinique Médicale, tome v., page 382.

¶ Delaye (J. B.), Paralysie de Plusieurs Parties de l'arrière Bouche (in Nouv. Jour. de Médecine, tome vii., 1820, p. 189.), et M. Foville, Considérations sur les Causes de la Folie, suivies de Recherches sur la Nature et le Siège spéciale de cette Maladie (Nouv. Journ. de Med., tome xii., 1821, page 110.)

** Nouv. Journal de Médecine, 1821.

†† Valsalva (A. M.), De Aure Humana, cap. v.

‡‡ See Dictionary of Practical Medicine, by James Copland, M.D., Article 'Apoplexy,' London 1832 ; and Dictionaire de Médecine et de Chirurgie, 'Apoplexie,' by J. Cruveilhier. Paris, 1829.

The following case is illustrative of many of the observations made in the preceding pages.

A man fell down stairs in Broad Street, Golden Square, many years ago, and received an injury on the head from the fall, which rendered him nearly insensible at the moment. When I saw him there were no signs or appearances on the outside of the head indicative of any serious mischief, nor were any found on examination after death. The pulse was quick, and rose to 140; the left side was paralytic; the breathing not stertorous, but accompanied by a little puff on the right side of the mouth, the pupils somewhat dilated; he could not speak, convulsions supervened, and he died the day after I saw him. On dissection, the peculiar flatness of the convolutions of the brain on the right side was so remarkable, when compared with those of the left, as to leave little doubt of its being occasioned by something which had pressed them against the inside of the cranium; and on slicing off a portion of the brain, a larger coagulum of blood was found below than I have ever observed to exist without the almost immediate death of the patient. I have seen the same thing so distinctly marked in two other instances, that I am satisfied those convolutions of the brain, which were situated between the coagulum and the cranium, did undergo a considerable degree of compression. It is worthy of remark, that the pulse of this person was always regular and remarkably quick from the first examination after the receipt of the injury, until the period of his death*.

Convulsive actions of the muscles, or positive convulsive fits, are always im-

* The brain is believed to be capable of undergoing an augmentation in its size without enlargement of its bony case, when it is said to be hypertrophied, the nervous molecules having increased in number if not in size. Laennec pointed out this fact, which he attributed to excess of nutrition, rendering the brain too large for its envelopes, and giving rise to a peculiar flatness of its convolutions, from the pressure it sustained against the inside of the cranium, whilst the intervals between them were for the same reason greatly diminished, if not entirely wanting; the brain itself being firmer than usual, containing little blood, and when cut away in slices, showing a remarkable dryness of their surfaces.

Laennec, in the Journal de Corvisart, tome ii. p. 669. Paris.

Dance, Observations pour servir à l'histoire de l'hypertrophie du cerveau, dans le Répertoire d'Anatomie, tome v. Par Breschet. Paris, 1828.

Andral (G.), Précis d'Anatomie Pathologique, tome ii. p. 775. Paris, 1829.

Bouillaud, Traité de l'Encéphalité.

Scoutetten, Archives générales de Médecine, tome vii. p. 3.

portant symptoms; yet they seem in some persons to be dependent on idiosyncracy, particularly when they appear early, and after the loss of blood, in which cases they are less dangerous. They occur at different periods after the receipt of the injury, and have been supposed to depend in general upon laceration of the substance of the brain, although experiments on animals would seem to show that they may be caused directly by irritation of the cerebro-spinal axis within the skull, when the patients are more likely to recover*. They have been observed to accompany these injuries from the earliest antiquity, and to appear particularly on the side opposite to that which was paralytic, so as to give rise to the idea that paralysis was dependent on injury of one side of the cerebrum, and convulsions of the other. When the effect of injury is so great as to prevent the transmission of sensibility along the nerves to the muscles, the paralysis is complete, and, I suspect, convulsive twitches do not then take place, although they frequently precede and may in many cases be considered as premonitory signs, whilst the evil which gives rise to the paralysis, is gradually accumulating. When the paralysis is not complete, I have frequently seen that side affected by slight convulsive twitches, whilst the other suffered from well-marked spasms; leading to the belief, that whilst paralysis is an affection of only one half of the brain of the opposite side, or of half of the spinal marrow of the same side, convulsions are the effect of a more general irritation, capable however of being con-

* A Portuguese labourer, in the hospital at Belem near Lisbon, fell from a height on his head, in January 1813, and was taken up insensible, nearly motionless, and bleeding from the side of his head and right ear; the pulse 84 and very small; the pupils natural in size and contracting on the admission of light; respiration easy, and without noise; extremities cold, face very pale. The patient was put to bed and well covered over with blankets. In the evening, some reaction having taken place, he was bled to twelve ounces, and five grains of calomel were placed on his tongue, and repeated in the night. On the second day he was better, could be roused so as to give an answer, and could get out of bed; pulse 90, and small. Sixteen ounces of blood were taken away with advantage, and he could swallow but with difficulty. The calomel was repeated. On the third day, when apparently improving, he suffered from a convulsive fit, which was followed by insensibility and stertorous breathing; the pulse rose to 120, and became fuller; he was bled to twenty ounces, which gave immediate relief. The calomel was repeated, and his bowels were well opened. The convulsive fits returned at intervals during the day and night, of a less serious and more epileptic character, for the next four days; more blood was drawn as the pulse seemed to indicate it, and a small quantity of opium was added to the calomel, which last was soon omitted, as his mouth became tender. He still complained of some pain in his head, which was relieved by purging, after which he gradually although slowly recovered, with deafness of the right ear and great debility, which continued for a considerable time.

fined to a part; for partial convulsive motions do very frequently occur without any paralysis accompanying them on the opposite side, and I have not seen these convulsive actions occur, as far as I can recollect, where both sides have been paralytic from injury of the head, although spasms and twitches are symptoms of daily occurrence in paraplegia from disease of the spine. I have met with several cases in which the convulsions have ceased and the patients recovered after the removal of a portion of bone which was irritating the brain; but convulsions have generally been the forerunners of death when the seat of injury was unknown and this assistance could not be given. When they occur in cases apparently of pure concussion, accompanied by inflammation of the brain or its membranes, and the patient recovers after many days of the strictest antiphlogistic treatment, it is possible that the brain may have been lacerated and the cure have been effected by adhesion. Convulsions, it must be remarked, are among the most common symptoms of inflammation of the membranes of the brain, without any such lesion of its substance, although they are frequently wanting. They may be expected to take place about and after the fifth day in injuries of the head, when inflammation of the brain or its membranes is about to extend to or become continuous with the neighbouring parts, and may be more or less severe, varying from a state of partial trembling of a limb to that of general agitation and restlessness of the body generally; from a slight irregular movement of the eyelids, or muscles of the face, to the more marked spasmodic startings of the whole of one side, grinding of the teeth, and contraction of the limbs. Sir B. Brodie* has well shown in his memoir, that they may exist at a late period independently of inflammation, "being aggravated by any additional abstraction of blood, and subsiding on the patient being allowed to take some more substantial nourishment than that which had been allowed him previously." They would seem in these cases to be dependent on the same or similar causes to those which gave rise to them after the loss of too great a quantity of blood in the first instance, and to be relieved or removed in a similar manner. It is far different with those convulsive movements which, at a late period, became nearly permanent or rigid spasms, resembling tetanus, in which the body is drawn in different directions forwards, backwards, or to one side. They are for the most part the forerunners of death;

* Brodie in vol. xiv. of Med. and Chir. Transactions, p. 423.

fortunately they are seldom present except in very hot weather*, and are not even then of frequent occurrence. Examination after death in such cases has shown nothing discoverable beyond inflammation of the pia mater, and an effusion of fluid, generally purulent, on the surface of the brain or in its ventricles, or between the pia mater and tunica arachnoides.

The three following cases are intended to show the different forms of paralysis which ensue after injuries accompanied by compression or irritation of the brain.

Charles Murray, private in the 2nd battalion of 1st Foot Guards, aged thirty-three, was wounded on the 18th of June at Waterloo by a piece of shell which struck him on the superior part of the *left* parietal bone. He remained insensible about half an hour, and on recovering from that state was affected with nausea and some bleeding from the left ear, and found himself unable to move his *right* arm and *right* leg, which hung dead and had lost their feeling. Admitted into the Minime General Hospital at Antwerp on the 20th; he suffered much from pain in his head, which was relieved by being twice bled. The paralytic affection having remained without change from the moment he was wounded, a piece of the parietal bone about three-fourths of an inch long, and several smaller fragments, were extracted four days after admission into the hospital, two perforations of the trephine having been necessary. Immediately after the removal of the bone he recovered the use of his right arm and leg, so far as to be able to move them and to be sensible of their being touched. He gradually recovered by the 14th of August, so as to be sent to the General Hospital at Yarmouth, never having had a bad symptom; the only defect remaining on the right side being an inability to grasp anything in his hand with force. The pulsation of the brain was still visible at the bottom of the wound for about the space of half the circumference of the head of a trephine. September 16, 1815. The wound has filled up with healthy granulations, and has nearly cicatrized. A small sinus remains at the superior part, through which the edge of the bone is felt. His health has been invariably good, although he has suffered a good deal of pain twice previously to the coming away of little pieces of bone, but towards evening he has been generally subject to slight vertigo; this however is not so much the case as it has been, and appears to be almost daily decreasing. Discharged cured.

* The most remarkable cases I have seen, occurred after the battle of Salamanca, when the weather was very hot and the hospitals for the most part were crowded.

William Mitchel of the Royals, aged forty, was wounded by a musket-ball on the 18th of June at Waterloo, which struck the side of the head near the vertex, and passing across fractured and depressed *both* parietal bones through the sagittal suture. When he recovered his senses he suffered great pain in the part, and found that he had lost the use of BOTH his legs, and was benumbed even from the loins and lower part of the chest; he was often sick, and felt low and ill. He remained in this state until the 27th, when he was brought to the Minime General Hospital at Antwerp, and on the 28th, ten days after the battle, the trephine was applied in two places, and the whole of the detached and depressed portions of bone were removed. The sickness, lowness of spirits and general illness immediately subsided, and the loss of power in the lower extremities gradually began to diminish, but he was not able to walk without assistance until the first week in August. On the 10th he arrived at Yarmouth, never having had a bad symptom after the depressed bone had been removed; and in the end of September he was discharged, able to walk well with the assistance of a stick.

During the delivery of the Lectures last summer in the theatre of the College, Mr. Keate invited me to see a case in St. George's Hospital, in which the injury, and the paralysis were apparently on the same, or right side. The paralysis although positive, was not so complete as to render the patient quite incapable of moving the arm, and leg, which were frequently convulsed, although the convulsions which were observable in both were more marked on the opposite or left side. If this man had recovered, it might fairly have been noticed as a case, in which the injury, and the paralysis had been on the same side; but an opportunity occurred by his death of ascertaining the facts*. The most serious injury was a fracture of the right parietal and temporal bones, extending to the petrous portion of the latter, and beyond it, which with the rather large extravasation of blood under and in the course of the fracture, appeared to be sufficient not only to destroy life, but to have caused paralysis of the left side, which it did not do. Another extravasation, rather less in quantity, had however taken place under the upper and anterior portion of the left parietal bone, which enabled him fully to account for the paralysis which took place on the right side, and which nothing but a *post mortem* examination could have made known.

* See the case of Mr. S., page 26.

According to the surgery of the French academicians of the beginning of the eighteenth century, this man would have been trephined or trepanned on the left side of the head in search of an extravasation, but accident or chance alone could have led to the right spot, as it was by no means opposed to that of the other side. If the paralysis had been more complete on the left side, the convulsions would not, I presume, have been so observable; but why an apparently greater injury on the right side of the head should only have given rise to convulsions, and not to paralysis, is inexplicable in the present state of our knowledge.

The history of the treatment of compression of the brain, when connected with fracture of the skull, may be divided into three periods. From Hippocrates to Le Dran and Petit. From Le Dran, who published his opinions in 1731, to Schmucker, Dease, Pott, Desault, and Abernethy; and from Abernethy to the present time. The opinions of our great predecessors may be gathered on most points from the quotations, and references made from their works; it would be unjust, however, not to mention Le Dran and the great Petit with the praise they have so well merited. What they begun, by more accurately distinguishing the symptoms, and effects of concussion from those of compression, Mr. Abernethy on many points completed, and it is left for those who follow, to give to their labours that additional degree of perfection which the complexity of the subject will permit.

A simple fissure or fracture of the skull is of no more importance than a fracture of any other bone in the body, unless it implicates the brain, and should be managed according to the same principles of surgery. These, however, involve a treatment diametrically opposite to that practised by many of our predecessors almost unto the present day. Mr. Abernethy was the first to declare in this country, that a simple fracture of the skull should always be left to the efforts of nature, unless urgent symptoms were present requiring relief. Sir A. Cooper was the first to insist, in modern times, that if the scalp or integuments of the head were undivided down to the bone, they should not be interfered with; and that although a fracture might be suspected, its existence should not be ascertained, unless symptoms rendered it necessary.

Velpeau * has published on this point some observations made by F. Martel

* Velpeau (A. M. L.), De l'Opération du Trépan dans les Plaies de Tête. Paris, 1834.

of Lyons in 1601, which deserve to be recorded, as they show that the light of truth did break in on our predecessors when it might not have been expected. Martel says, "A wound in the integuments ought not to be made to expose the bone on the suspicion of its being fractured; for I say, that a simple fracture of the head may be cured without its being seen, and the less wounds of the head are exposed to the air the better. I repeat, that a simple fissure, without a wound in the integuments, gets well by the aid of nature alone, and that if the bone does not press on the dura mater there is no use in exposing it; and when the bone is deprived of its integuments the sooner it is covered over the better." He recommends for dressing only water or oil.

If the integuments or scalp should be divided, and the bone fissured, the same principle should be carried out, by endeavouring to procure the union of the divided parts, as was done during the war in all such injuries from sabre cuts as did not quite penetrate the skull,—a practice that was found to be eminently successful even when union did not take place. The general treatment should be similar to that I have insisted on in Concussion, of which the following may perhaps be considered a sufficient example.

A soldier, partly in liquor, received a blow from a spade in Lisbon in the beginning of 1813, which cut the upper part of the head across the sagittal suture, and rendered him senseless. He soon recovered, and a slight fissure or fracture without depression was discovered on his being brought to the Estrella hospital. As there were no symptoms indicative of mischief, I desired that his head might be shaved and the divided parts brought together by sticking-plaster; that the head should be kept raised, wet and cold; that he should be bled to twenty-four ounces, purged, starved, and kept quiet in a dark room. The next day he said he had slept well, but that his head felt painful, as if something tight was tied around it. Pulse 96, small and hard; bowels not open. Blood was taken from the arm to the amount of forty ounces, when he appeared ready to faint. Calomel and jalap, followed by Infus. Sennæ cum Magnes. Sulphate, were given, and acted well, and he was greatly relieved. The calomel was continued every six hours. In the evening however the pain and tightness of the head returned, with a pulse of 110, hard and full, and were again removed by the loss of twenty-four ounces of blood. He remained easy until the evening of the next or third day, when the pulse quickened to 120, became small and hard, and he complained of

severe pain in the head. It was evident that inflammation of the brain or its membranes had commenced, and that it must be subdued; he was therefore bled until he fainted, forty ounces being taken away. This entirely relieved him, and calomel, jalap, senna and salts were again administered, with great effect. On the fourth day he was easy, the pulse 94, soft and full, the mouth being tender from the mercury. The wound did not heal by adhesion, but by granulation; and under the continuance of the starving and purging system he gradually got well without any more bad symptoms, having been saved by the loss of 128 ounces of blood in three days.

The wound in the scalp, and the certainty that the bone was fractured, made no difference in the treatment; nor if the scalp had been sound and the knowledge of the fracture wanting, should I have sought to ascertain the fact of the bone being injured, unless I had been prepared, on finding a fracture, to apply the trephine, which it has been shown by the result would have been unnecessary. The vigorous, and decided abstractions of blood saved the man, and, with the mercury, in all probability prevented the occurrence of those evils which our predecessors sought to obviate by removing a portion of bone. They believed the bone could not be fractured without an extravasation taking place beneath; and some took credit to themselves for placing wedges between the broken edges, in order to allow of the escape of the blood or matter which might be formed below it. That blood may be effused, and matter may be formed is indisputable, even under the most active treatment; but that an operation by the trephine will anticipate and prevent these evils, cannot be conceded in the present state of our knowledge; and the rule of practice is at present decided, that no such operation should be done until symptoms supervene distinctly announcing that inflammation, compression or irritation of the brain have taken place. It is argued that when these symptoms do occur it will be too late to have recourse to the operation with success; which may be true, as such cases must always be very dangerous; but it does not follow, and it has never been, nor indeed can it be shown, that the same mischief would not have taken place, if the operation had been performed early. The records of operations done, and the histories of recovery under these circumstances which have been left by our predecessors, are not very numerous, and do not lead to this belief; they have been transmitted to us in most instances rather as curious facts which have occurred,

than as records of the success of the practice they inculcated. I do not find in the older authors frequent notice of the comparative result of the success or ill success which followed these operations, except perhaps in Morgagni, who declares that all who were operated upon in the hospitals in Italy died; in Dease of Dublin, and in Desault, who abandoned at last, in the Hotel Dieu of Paris, the operation of trepanning for the same reason,—a proceeding which his no less distinguished successors MM. Dupuytren* and Roux† have thought it necessary to modify. The best commentary on the practice of Desault, as stated by Bichat, is that of Giraud‡, a contemporary of the latter, who published the histories and the results of thirty cases of fracture of the skull of different kinds treated in the Hotel Dieu. Six of the most desperate cases were trepanned, and five died. Of the remaining twenty-four, some of which had no serious symptoms, eighteen died §.

When a simple fracture, which in its slightest form is called a capillary fissure,

* Dupuytren, Gazette Médicale, 1830, p. 13.

† Roux (Philibert Joseph), in the Journal de Médecine, Chirurgie, Pharmacie, &c. Sept. 1821; and in Considérations Cliniques sur les Blessés du 27, 28 et 29 Juillet. Paris, 1830. In the first he relates a remarkable cure in a lad of 18, whom he trephined four years after a common accident, which had given rise to a fistulous opening through the upper part of the parietal bone. He found an opening as large as the end of the finger in the dura mater, leading into the sac of an abscess formed by the arachnoid membrane, capable of containing at least four ounces of pus, the depressed brain being seen at the bottom. This young man perfectly recovered, having never suffered more than great apathy and tendency to sleep, and general derangement of health and weakness.

‡ Giraud (B.), Considérations et Observations sur les Plaies de Tête, tom. ii. and Mémoires de la Société d'Emulation. Paris, l'An. 6 de la République, par. 315.

§ Saviard, one of the predecessors of Desault in the Hotel Dieu, says, alluding to a woman who had recovered, "for nothing is more rare than to see a person recover in the Hotel Dieu after being trepanned;" and admits that the ill success of the operation depended much on the bad air of the hospital. Saviard, Nouveau Recueil d'Observations Chirurgicales. Paris, 1702, p. 139.

Palfin[1] says that surgeons before his time were of opinion that as many fractures were cured without the trepan as with it, and cites the works of the authors who preceded him. Rouhault[2] does the same, and Creutzenfeld[3] even more.

[1] Palfin, Anatomie, edition ii. page 326.

[2] Rouhault, Traité des Playes de Tête. Paris, p. 45 and 52.

[3] Creutzenfeld von S. H. de Vigil Vindobonæ, 1781, vol. ii., in his 'Bibliotheca Chirurgica,' gives all the writers on Injuries of the Head in succession, from Hippocrates to Dease, with the principal points they have noticed.

takes place, the dura mater must be separated from it, at that part, to a certain extent, and some small vessels must be torn through. It does not follow, however, that blood must necessarily be poured out in such quantity that it will not be absorbed. Dissection has, on the contrary, established the fact, that it will be absorbed even in cases of fracture of greater extent, where it has been seen that a larger quantity has been extravasated. As the effusion of a larger, or of so large a quantity of blood as to prove eventually mischievous does not *usually* take place except under other circumstances than a simple fracture, the ordinary practice ought not to be to seek for that which is not likely to be found. The dura mater is rarely separated beyond the limits of a simple fracture, and it is more likely to recover without any further exposure or interference, than with it. The dura mater may be, and often is, separated to a considerable extent from the bone, and a quantity of blood is often extravasated upon it; but when this does occur, the commotion or shock which occasioned the fracture, the separation of the dura mater, and the extravasation, will generally have caused other more important, although less perceptible derangements*. These show themselves after the lapse of a few days, by giving rise to inflammation of the brain or of its membranes, of which such patients more usually die, than of the separation of the dura mater, or of the extravasation. The case is no longer one of simple fissure or fracture of the cranium, and the nature and severity of the symptoms which have supervened must regulate the practice to be pursued.

After the receipt of a severe blow or a gun-shot fracture of the head, which has not even stunned the person at the moment, he may walk to the surgeon, and be dressed, and converse with his fellows as if nothing had happened; yet in a short time he becomes heavy, stupid, drowsy, unwilling to move, with a slow pulse and a pallid countenance. Inflammation has not yet had time to set in, and extravasation has not always taken place. If the loss of a moderate quantity of blood should relieve such a person, it shows that congestion had

* Mr. Keate, who has had great opportunities for observation in St. George's Hospital, has invariably remarked that the symptoms dependent on extravasation have been less severe in the first instance, in proportion as the separation of the edges of the fracture has been greater one from the other, or when the sutures have yielded to the shock and have been separated. It has been stated from the earliest antiquity, that the greater the fracture, the less the concussion of the brain.

occurred, perhaps on the surface of the brain under the injured spot; recovering from which by the unassisted efforts of nature, he would still be liable to inflammation*. I have repeatedly seen a sharp bleeding from an incision made to allow a complete examination of the part in such a case, cause the restoration of the patient to his natural state. A return of untoward symptoms during

* See the cases on this point, page 23. Mr. Rutherford Alcock, who was formerly House Surgeon of the Westminster Hospital, and who served with great credit with the British troops in Spain under the command of Sir de Lacy Evans, has given me the following case, the symptoms of which he considers to depend on weakness of the cerebral fibre, and not as I have supposed in similar cases on congestion in the blood-vessels.

Philip Thorne, aged twenty-four, was struck on the 16th of March 1837 by a musket-ball on the frontal bone, which it fractured, but did not penetrate. He walked into the ward from the field of battle, distant some two miles, and conversed intelligently for some time after he came in to his comrades. Much hemorrhage had taken place. Towards evening he became quite comatose. Pulse slow and weak; surface pale and cold. Head ordered to be shaved, and cold applied.

℞ Hyd. Chlorid. gr. v. Pulv. Jalapæ, gr. xxv. Pulv. Ipecac. gr. iii. fls. Pulv. sts.

9 P.M. A small arterial branch has bled very freely, by which the symptoms of coma have been relieved. 17th. Much improved; no urgent or bad symptom present. Pulv. Purg.; spoon diet. 18th. Pain in the head; pulse slow and laboured; tongue clean and moist; bowels open. The wound still bleeds a little. 19th. Says he is light-headed occasionally; no pain however in the head, except near the wound, which is very tender. 21st. He has been proceeding favourably, but today is very sluggish and languid. Pulse 56. Horridines xx. Capiti. Cold lotion to the head. ℞. Magn. Sulph. ℥ss. Liq. Ant. Tart. mxx. Aquæ ℥iss. m fl. haust sts. 22nd. Sore continues sloughy and unhealthy; in other respects he feels relieved. Pulse 52, sluggish. 30. The pulse has continued unvaried in number and character. Bowels open; free from head symptoms; wound granulating and healing. April 2. Pulse regular, 70; wound contracting and filling up; tongue clean; no pain. The case proceeded without any symptoms worthy of note to the cure, and on July 13 he was sent to England. The wound was healed, but he complained of giddiness when exposed to the sun, or when he stoops. He states himself in all other respects to be well, and the same as before the wound.

Le Dran in his 16th observation, relates the case of a young surgeon, who having received a blow on the back part of the left parietal bone, fell down in the street; but recovering himself walked home. In the night he suffered from great pain in his head, became stupefied, delirious and convulsed, for which he was bled and taken to the Charité. Le Dran, desirous of knowing what was the state of the bone, made a crucial incision through the scalp and detached the pericranium, causing the loss of a good deal of blood. An hour afterwards the patient became sensible, was bled from the arm and foot next day, and the day after, these bleedings were repeated. On the fifth day, as the feverish symptoms were not abated, he was trepanned, and nothing was found under the bone. The dura mater appearing to be on the stretch it was opened, and a little serous fluid escaped. After this the fever and the bad symptoms increased, and the patient died on the eighth day in convulsions. Nothing was found beyond several small spots of coagulated blood in different parts of the brain, on the oppo-

the progress of the case does not always indicate essential mischief, and will be removed, if of a temporary nature, by a further moderate bleeding, by purgatives, and by greater restriction in diet, through irregularities in which, these secondary attacks most usually occur. If the loss of blood should not relieve the symptoms, the case is probably complicated by an extravasation having taken place between the dura mater and the bone, or even in, or on the surface of the brain.

When a fracture takes place at the anterior inferior angle of the parietal bone, or in any part of the course of the middle meningeal artery, it often gives rise to a more serious injury, which nothing but an operation can remove. The artery is always in a groove, and is often even imbedded in the bone at its lower part, and may be torn at the moment of fracture. A gradual extravasation of blood on the surface of the brain can be borne to a considerable extent without causing any particular symptoms; a sudden effusion causes immediate insensibility. When the extravasation is gradual the patient walks away after the accident, converses freely, becomes more slowly oppressed, and in the end insensible, as the last drops of blood which are effused render the compression effective. When these symptoms occur after a wound in this particular part, attended by fracture, the bone should be immediately examined; and if there should be no obvious fracture, and relief cannot be obtained by the abstraction of blood, the trephine must be resorted to as a last resource; for if there be truth in the statements so confidently made of fracture of the inner table of the bone from concussion of the outer without fracture, it is here especially that we may be permitted to look for it. The hemorrhage in the greater number of these cases takes place slowly, and the blood effused, depresses the brain by separating the dura mater from the neighbouring bone; a process, however, which can hardly occur unless the injury has been so violent as to rupture its attachments to the bone; for the brain yields in general rather than the attachments of the dura mater, and is depressed, the hollow or cavity thus formed being filled up by the coagulum, which becomes thicker and thicker until insensibility is induced.

site side to that on which the injury had been received, one of which was as large as a nut. The commentary which follows is admirable. "When the periosteum adheres to the bone, it is almost certain that the bone is not injured, and the trepan should not be had recourse to, the bad symptoms being dependent on concussion, which may give rise to extravasation in the substance of the brain." Le Dran, Observations de Chirurgie, p. 113.

Blood effused between the dura mater and the bone readily fills up in the first instance all the space formed by the disruption of the membrane; for the force with which the blood is poured out from the artery overcomes the resistance offered by the brain, which gradually yields and sinks unto that point, at which its natural functions can be no longer carried on. If the attachments of the dura mater be strong, and the separation which has taken place between it, and the bone, be small, the blood effused is compressed by the bone on one side, on which it can exert no influence, and is resisted by the dura mater, which will recede no further on the other. The wounded artery in such case is soon compressed by its own coagulum, and the effusion is comparatively trifling, giving rise, according to its nature, either to the primary symptoms of compression from extravasation, or to the secondary ones, dependent in all probability on inflammation and suppuration of the part, and of irritation and compression of the brain beneath. If on the contrary the separation of the dura mater from the bone should be extensive, the quantity of extravasated blood may be considerable, and the brain will be greatly depressed. It is impossible to say to what extent this depression may or may not be compatible with the continuance of life. Experience has demonstrated, that persons have recovered after large coagula have been removed; but in all these cases the brain had not lost its resiliency, and had been seen to regain its natural level on the removal of the depressing cause. I have several times seen the depressed brain gradually recover its natural position, and the person open his eyes, and recognize and speak to those about him; but I never saw the symptoms mitigated, or the persons in any way relieved, when the brain remained depressed after the blood had been removed. The empty vessels were there, and the blood to fill them was traversing the neighbouring parts. It probably did not enter them on account of the derangement the ultimate structure of the brain had undergone in consequence of the great and continued displacement of its constituent parts.

A French artillery driver was knocked off his horse by a musket-ball, which struck him on the anterior, and inferior portion of the right parietal bone, in a charge made by General Brennier at the battle of Vimiera on the British infantry under the command of the late Sir Ronald Fergusson. The charge was as vigorously met, and the French guns were taken on the spot, two of the drivers lying dead by the sides of the horses. In this state I found them. A third was

struck on the head and also wounded in the leg, which prevented him from running away. He explained the nature of his case, the manner of the advance, &c., and I took him under my care, thinking from his freedom from symptoms, and the slightness of the fracture, that he would probably do well. The next morning I went into the village to look after some French officers *, and found my driver lying under the wall of the church, which had been turned into a hospital, apparently dying. I lost no time in procuring a trephine, and in raising a portion of bone, when a thick coagulum of blood appeared underneath, apparently extending in every direction. Three more pieces of bone were taken away, and the coagulum, which appeared to be an inch in thickness, was removed with the help of a feather with difficulty. The brain did not however regain its level, and the man shortly after died. The middle meningeal artery was torn across on the outside of the dura mater,—the wound did not pass through to the inside. After his death I opened the dura mater, but there was no blood beneath it; the convolutions of the brain were depressed and flattened by the pressure.

A soldier of the 29th regiment was struck on the right parietal bone in a similar manner, shortly after daylight, at the battle of Talavera, during the first attack on the hill, the key of the British position. He walked to me soon afterwards, to the place where the wounded of the evening before had been collected in the rear. Being otherwise employed, I heard his story but could not attend to him at the moment, and found him some time afterwards senseless, with a slow intermitting pulse, breathing loudly, and supposed to be dying. The fractured parts were sufficiently broken to admit of the introduction of two elevators, by means of which they were gradually removed, together with a large coagulum of blood which had depressed the brain. When this was removed the brain regained its level, the man opened his eyes, looked around, knew, and thanked me. The pulse and breathing became regular, he said he suffered only a little pain in the part, and should soon get well. He died however on the third day.

During the battle of Salamanca a soldier of the 27th regiment was brought to me, who had walked to the rear, and had fallen down insensible within a few yards of the hospital station. I found a considerable fracture, with depression

* Guthrie (G. J.), Clinical Lectures on Compound Fractures of the Extremities, on Excision of the Head of the Thigh Bone, &c. London, 1838.

at the inferior part of the parietal bone, before, and above the ear. The end of the elevator being introduced, a small piece of bone was first raised, then another, and a third, when a thick coagulum was exposed and removed. The dura mater was not separated from the bone around to any extent, and the coagulum, although thick, was not large. The brain, which had been depressed, regained its level immediately, and the man recovered his senses. He was sent to Lisbon cured of his wound, but unfit for service. The artery did not bleed after it was exposed.

I had a nearly similar case in a soldier of the third division of infantry at the siege of Ciudad Rodrigo, and another at the siege of Badajos belonging to the fourth, both of which recovered; and I have had others on subsequent occasions, where the brain had been also wounded, in which the result was not always so fortunate. The case the most remarkable for its severity, and for the recovery of the patient, with which I am acquainted, is the fifth related by Mr. Hill*. Those of Mr. Abernethy are equally valuable†.

The rule in surgery, to remove the bone in such cases, appears to me to be absolute.

Fractures of the skull are stated, from almost the earliest records of surgery, to occur on one *side* of the head in consequence of blows received on the *other*; and the facts which ancient authors have collected and related on this point are so numerous and so well attested, that it must appear like scepticism to doubt their accuracy. Celsus writes of a fracture on one side of the head taking place from a blow on the other side, or on another part, as an accident likely to happen, and gives nearly the same directions as a surgeon would do in the present day. "If bad symptoms follow the injury, and no fracture is perceived at the part, the head should be examined, and if another part shall be found soft, and swelled, it ought to be opened, and the fracture will be often discovered‡." This point, however, Galen disputed; but Amatus Lusitanus§, who transcribes the argument, gives the case of a boy nine years of age, who received a blow on the right temple apparently of little consequence; on the third day he was trephined (ad cerebrum usque rosario scalpro cranium rasimus); and on the symptoms returning, and the child complaining of pain on the

* Hill (James), of Dumfries, Cases in Surgery. Edinburgh, 1762.

† Abernethy (J.), Surgical Works, vol. ii. 1815.

‡ Celsus (A. C.), liber octavus, cap. iv. Lugduni, 1785.

§ Amatus Lusitanus. Basiliæ, 1566, p. 257.

opposite side of the head, an incision was made over the part and the skull removed in a similar manner, when a quantity of well-formed pus was evacuated: the boy was cured in thirty-five days. It is not stated whether the bone was or was not fractured.

Bonetus*, in his first book, 'Tit. de Paralysi,' relates a more marked case from Bartholin, of a German who became paralytic after receiving a slight blow on the head, and in whom an abscess was found after death on the opposite side. He also relates from Losius† the case of a man sixty years of age, who fell from his horse on his forehead without injuring the bone, and whose os occipitis was found to be fractured after death.

Nicholas Fontanus‡ says, "A lad fifteen years old fell from a wall and struck his left temple against the ground, but did not believe that he was hurt. At night he became feverish, then delirious, for which various means were adopted. A tumour appearing over the left temporal muscle, an incision was made through it, when several fissures were seen in the temporal bone: recourse was had to the trepan, but the patient died, and on opening the head two triangular fractures were found on the opposite side, and the dura mater was distended like a drum-head by a quantity of matter underneath."

Paré relates the history of a man whose body he examined after death, who had died on the twenty-first day after a blow on the head, under the care of M. Thierry de Hery, in whom the right side of the head which was struck was sound, but the bone of the left was fractured, and a quantity of blood and matter were found under the dura mater and even in the brain.

Job. a Meckren§ says, that "Frederick Hermannides, a drunken shoemaker, was struck in a brawl by a spear on the right side of the head, above the ear at the edge of the frontal bone (*ad aurem ubi os bregmatis se exhibet*). He fell, sunk into a state of coma, was hemiplegic, and died in the course of twelve hours. The body being examined by order of the magistrate, a slight bruise was found on the right side where the blow from the spear had been received; the peri-cranium was somewhat bloody, but in the bone there was neither chink, fissure,

* Bonetus (Theophil.), Sepulcretum sive Anatomia Practica. Lugduni, 1700. De Vulneribus, lib. iv. § 3. Obs. 16, 52.

† Losius (Frederic.), Observ. Medic., 1. lib. i.

‡ Fontanus (Nicholas), Annotat. in cap. Vesalii.

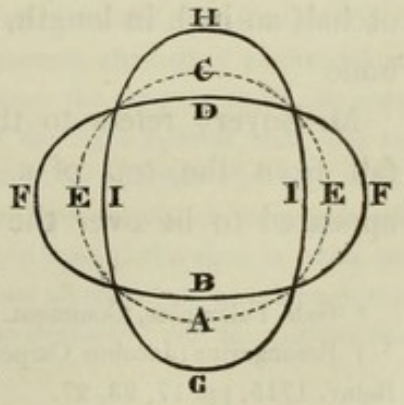
§ Job. a Meckren in Manget. Biblioth. Chirurg., vol. i. p. 579. col. 2.

nor fracture; neither was there any blood found here between the skull and the membranes, or in the substance of the brain; *but in the opposite left side*, about the lower edge of the os frontis near the temporal bone, not only was there found a notable quantity of blood, and injury of the meninges, *but a double fissure in the cranium itself.*"

Dupré de Lille * relates the case of a ship-carpenter who fell in the year 1756 from a height on the left side of his head, which appeared to be only bruised. On the eleventh day, having gradually got worse, Dupré examined the head carefully, and found the opposite or right side swelled, which made many suspect a counter fissure. The patient died shortly afterwards, and on examination after death a fracture was found at the part swollen, with a considerable fetid effusion beneath, accompanied by inflammation of both cerebrum and cerebellum.

Chopart† goes so far as to give the following statement and diagram explanatory of the way in which this counter fracture or fissure takes place; and Grima, Quesnay, Saucerotte and Sabouret, with all the surgeons of the best days of the French Academy of Surgery, appear to be fully satisfied on this point; in spite of the doubts of its accuracy expressed by Falloppius, who collected the opinions of those authors who had preceded him, and were opposed to it. Morgagni has also expressly referred to his own experience and to the works of Berengarius, Carcanus and Diemerbroeck, who, whilst they admitted the apparent existence of such an accident, which could not indeed be disputed, were disposed to believe that it occurred, not as a consequence of the one more immediately known to have taken place, but of another which the patient had received in falling or otherwise.

"If we suppose a spherical and elastic body to be struck at the point A, this point instantly flies to B, and the point C to D, and the other parts, E, come to F. The two first approach the centre, the others fly from it, and the body thus becomes elliptical. In the second moment, from its elastic property, and the force of percussion, the parts B and D are carried to G and H, and the part F to I, which makes the body elliptic



* Dupré de Lille. Paris, 1770, p. 45.

† Chopart, tome iv. Prix de l'Académie de Chirurgie de Paris.

in two ways. It is an experiment of Mariotte's which has led to this geometrical demonstration. Leibnitz and other natural philosophers have also shown it in their works."

Berengarius relates a case from Nicolas Florentinus* of a man under his care who was struck by a key on the right temple, and a portion of the cranium was removed without any fracture being perceived. On the twentieth day shivering supervened, followed by fever, and swelling on the opposite temple, the integuments of which being removed on the twenty-second day, a fracture was found underneath, and the patient died.

He also† refers to Haly, Rhases, Avicenna, and to Albucasis particularly, and to the Arabian authors generally, as acknowledging under the term Marusis a fracture of the inner table without any of the outer; and under that of Hæsena a folding, or bending of the inner table at the moment the blow is received, much in the same manner *as the bones of children* are known to bend instead of break, and again to resume their form. The surgeons of that day, he says, were more willing to believe with Paulus of Ægina, Gentilis, Dinus, Guido and himself, that these fractures depend upon there having been more than one injury sustained at the same moment. "Et hoc ego in actu practico pluries ac pluries feci et prænarrata vidi, ideo concurro in hoc cum Dino ad expositionem literæ Avicennæ." Diemerbroeck, in two hundred cases of injury of the head, says he never once saw such an accident.

The following case from Bohn‡, or Bohnius, has been particularly insisted upon as one of the best cases in point: he says, "that called in 1669 to a man who had received a blow from a stick on the right eyebrow, he found the bone was not broken at the part, but that in the right orbit a counter fissure existed of half an inch in length, on the side, or near the sella turcica, of the sphenoid bone."

M. Boyer§ refers to this case of Bohnius, and relates another of a severe fall from the top of a house on the forehead, in which, whilst the injury appeared to be over the left eyebrow (without fracture), the orbitary plate

* Gab. Falloppius, Comment. in lib. Hippoc. de cap. vulner. cap. 14.

† Berengarius (Jacobus Carpensis), De Fractura Cranii. Liber aureus editio Broutesteyn. Lugduni Batav. 1715, pp. 17, 23, 27.

‡ Bohn (Joan.), De Renunciatione Vulnerum. Lipsiæ, 1711, p. 142.

§ In the Journal des Découvertes; rédigé par M. Fourcroy. Paris, 1792.

was broken into splinters*, the patient dying of pus in the lungs, and in the diaphragm.

In spite of these great authorities, modern surgeons seem to have repudiated the idea of a counter fracture or fissure, of one parietal or temporal bone, caused by a blow on the opposite one; and whatever may have happened formerly, there is so little proof of such an occurrence having taken place in later years, that the accident is in general altogether unnoticed by writers on injuries of the head. It is not so, however, with respect to a fracture of the base of the cranium from a blow on the vertex, or on the back part of the head; a kind of accident which occurs more frequently perhaps than any other in civil life, from the circumstance of persons who suffer from fractures of the skull, doing so more generally by falling from a height, or being pitched on their heads, than by blows or other injuries.

The late Mr. Earle supposed that a fracture of the base of the cranium depended on the occiput being forcibly impelled against the atlas. Sir Charles Bell has maintained the same opinion, and given a scientific account of the manner in which the mischief takes place. It appears to me that this accident principally depends on the superincumbent weight of the body, pressing on the unsupported flat, and thin base of the skull, and is but little connected with the unyielding nature of the spine; for it occurs to as great an extent in consequence of falls from a short distance without any impetus, as from falls from a great height. Some of the worst cases I have seen have taken place by the

* Mr. Adams of the London Hospital has related the history of a case somewhat similar, with the exception of there being also a fracture of the base of the cranium, in the twenty-second volume of the Medical Gazette, page 564.

Nolleson[1], a surgeon-major in the French army, says a young man received a blow on the right parietal bone, which wounded the integuments without causing a fracture, although it rendered him insensible, and nearly deprived him of the power of motion: he bled from the ears, the eyes[2], the nose and the mouth. He thought it right to trepan him on the centre of the right parietal bone, and to open the dura mater, which allowed some blood to escape, which relieved the patient. Five days afterwards he complained of a girding pain on the left or opposite parietal bone, which was soon followed by fever and delirium. He decided on making an incision down to the bone at this spot, in which he found a fissure or fracture, which induced him to apply the trepan, and afterwards to cut through the dura mater, from under which a glassfull of dark red fetid matter was evacuated, and the patient recovered.

[1] Journal de Médecine, Août 1766, Paris.

[2] Probably an exaggeration or a mistake.

sufferer having been thrown from the back of a horse by the sudden starting of the animal without any running away; and although in these cases a fissure might often be traced to the foramen magnum, the great fracture was essentially distinct, extending from the petrous portions of the temporal bones on each side, across, and between the sphenoid bone, and the os frontis, and even separating the edges of the coronal suture nearly to the opposite side. It is said that a heavy blow on the vertex will fracture the base of the cranium as readily as a fall upon the crown of the head, but my observations lead me to doubt the statement.

A noted gambler, riding home from Epsom after the races, was thrown from his horse and pitched on the top of his head at the door of the Old Westminster Hospital late at night; he was taken up insensible, and died shortly afterwards. The skull was fractured quite round from the vertex to the base, and from side to side, so that the fore, and back parts might have been easily separated into halves if the soft parts had been removed. Sir A. Cooper notices a similar case; but injuries of the kind are rarely so complete as in these instances, the fractures being confined to the sides, and base; I have, however, met with several in which a fissure has crossed over the vertex from the sides. Fractures of the base of the cranium are generally fatal, but they are not always so; for some persons live a considerable time afterwards, and appear to die from other causes; and that partial, if not perfect recovery is possible, I shall show by the history of the following case, which I obtained from Mr. W. J. Lee. The subject of it having been killed by a second accident on the Great Western Railway, the fractured portion of temporal bone was removed, and presented by Mr. Lee to the Museum of the Royal College of Surgeons.

H. Cochrane, 45 years of age, on the 1st of April, 1839, fell from an elevated platform a distance of twenty feet upon his head; he was taken up apparently lifeless, bleeding largely from the ears, nose and mouth, but more particularly from the ears. He was seen within half an hour of the accident, when he remained quite insensible, the surface of the body cold, pulse about 68, and very feeble; in three hours after the accident he was bled to sixteen ounces, when his pulse rose to 76, and the breathing, which before was rather oppressed, became more free: he was ordered six grains of calomel, followed by moderate doses of senna, till the bowels should be relieved.

2nd. 7 A.M. Pulse small and quick, varying from 90 to 100; head hot; pupils dilated and quite insensible to light: the patient remains quite insensible, but not altogether without the power of motion, which sometimes takes place, though not excitable by any external stimulus; no evacuation of fæces or urine. A pint and a half of urine was drawn off, and a dose of castor-oil administered without any resistance; twelve leeches to the head. 12. Pulse indistinct and difficult to be counted; no action of bowels; bleeding repeated to sixteen ounces; pulse became distinct during the operation, from 80 to 90; lotion continued; Vespere: still insensible to all external impressions; no relief of bowels. Rep. Cal. gr. 6; Cont. H. Purg. 3^{tiis} horis. Enema quam primum: pulse 68 to 72, feeble and indistinct.

3rd. Bowels feebly relieved towards morning; has passed urine; still quite insensible to external impressions, but upon intimating some uneasiness he was put upon a night stool, when he had a copious evacuation. Pulse between 130 and 140; breathing quick; skin hot and dry; is reported to have lain in a sound sleep during the night without stertor. Empl. lyttæ nuchæ. Vespere: could be sufficiently roused to answer questions, which he appeared to do with great reluctance, and rather as a matter of habit than of deliberation,—merely yes and no: made an ineffectual attempt to put out his tongue.

4th. Pulse 100; head hot; pupils continue insensible to light; rolls about in bed, but does not appear to feel when pinched. Rep. Haust. Sennæ; Nocte, Potass. Sulph. gr. xii.; Pulv. Antimon. gr. ii. 6^{tis} horis. 5th. More sensibility. Pulse continues quick; patient swallows everything that is presented him indiscriminately. Ten leeches to the head. 6th. Bowels acted very freely. 7th. Answers questions more freely, and takes food eagerly; slight sensibility of the limbs returning. 9th. More sensible. Can now see; pupils contract to light; skin continues hot and dry. Pulse 90 to 100. The radius of the left arm is found to be fractured. 11th. Restless, uneasy and irritable. Twelve leeches to the head; lotion continued. 12th. Blister at the back of the neck. 16th. Has become much more sensible; pupils act freely; heat of skin abated. Pulse still continues frequent.

30th. Has continued progressively mending from day to day since the last report, but still appears in a state of stupidity accompanied by extreme listlessness. He answers questions sullenly, and frequently rests upon the broken arm

without appearing conscious of pain; the mouth is now drawn to the left side, to which there has been a slight tendency for the last few days; the tongue not at all affected.

He continued under treatment till the 20th of May, soon after which he was permitted to resume his employment, the mouth being still drawn in some degree to the left side. When he returned to his duty, which was that of a porter on the Great Western Railway, his habits became silent and solitary, but he performed his task with the greatest exactness. He was occasionally subject to a vertigo, particularly in hot weather, after any violent exertion or taking a small quantity of beer; a pint of ale would render him stupid or insensible. On the 7th of November, in the same year, he was found dead, lying in a ditch by the side of an elevated portion of the railway, into which he appeared to have been precipitated by violence.

Sectio Cadaveris.—The nasal bones were fractured by a blow which had made a transverse incision in the upper part of the face. The femur was found fractured upon the right side, and the scalp puffy and ecchymosed on the left. On removing the skull-cap the dura mater appeared perfectly healthy, without any sign of extravasated blood upon the surface. Beneath the pia mater on the left side, the sulci of the brain were filled with black blood, apparently very recently effused. The brain was removed without the least violence, when a lesion was found upon its inferior surface, corresponding to the petrous portion of the right temporal bone. The dura mater in this situation was externally of its natural structure, and adhered with its usual degree of firmness to the bone beneath. The arachnoid and pia mater were here deficient; the lesion consisted of a cavity about fifteen lines in length, nine in breadth, and three in depth, coated with a light yellow lining, which also adhered to the corresponding portion of the inner surface of the dura mater, which completed the walls of the cavity inferiorly: the cavity contained a turbid serum, in which were seen floating numerous exceedingly minute white globules. The portion of the brain in this situation did not appear to have been disturbed by the recent violence, except that from the upper part of the cavity a probe was admitted without any resistance into the descending horn of the right lateral ventricle, which, together with the one on the opposite side, was filled with a large quantity of bloody serum, none of which had however escaped into the cavity beneath. The brain generally appeared per-

fectly healthy, and not more vascular than usual. Even within a line of the yellow deposit above mentioned there appeared not the slightest change of structure. On removing the dura mater from the base of the skull indications of a former fracture were discovered, leading vertically down through the squamous portion of temporal bone, from whence it appeared to have been continued along the anterior part of the petrous portion into the vidian canal (the edges of this fracture both internally and externally had been rounded by absorption): this fracture was met at right angles by another which ran across the base of the petrous portion of the temporal bone. The direction of this last fracture was marked by numerous small rough particles of bone, which adhered so slightly to the rest that they were removed by maceration. The transverse ligament of the second vertebra was ruptured, and the atlas forced forward. The connection between the articular processes of the second and third cervical vertebræ on the right side had also been separated by the fall which had caused death.

Mr. Keate has communicated to me the following particulars of a case somewhat of a similar nature which came under his care. A young gentleman, eleven years old, fell down a flight of kitchen-stairs on a stone pavement on his face in September 1839; his nose bled considerably, and appeared to be flattened and a little out of shape: he complained only of the pain of his nose, which in a few days quite left him. Three weeks afterwards an abscess formed behind the left ear of the size of a small hen's egg, which was opened and healed. He then went into Devonshire, and remained some months apparently in perfect health, when, without any cause which his friends could assign, he every night suffered from retching without actually vomiting, which gradually subsided, and he afterwards passed a good night. In December 1840 he died after a short illness, his death being preceded by all the symptoms of hydrocephalus, and Mr. Norton furnished Mr. Keate with the following report of the *post mortem* examination. The width of the head from ear to ear was greater than usual in a child of his age; the pericranium was easily separated from the left parietal bone, which appeared discoloured; the dura mater appeared more vascular than usual; the sinuses were full of blood; there was considerable effusion between the dura mater and arachnoid membrane, and some coagulated lymph around the tract of the optic nerves, which were soft, and readily torn across; a quantity of serous fluid escaped from the ventricles, of which six ounces were preserved. On removing the brain a small abscess was discovered upon the sella turcica,

and the bone in front was very rough. A fracture or fissure was also perceived running across from the temporal and between the sphenoid and ethmoid bones, and which no doubt was occasioned by the fall he had received fifteen months before.

Wm. Clayton, forty-four years of age, was admitted on the 31st of July 1841, into the Westminster Hospital, having received a blow on the RIGHT side of his head from the handle of a windlass, which fractured his skull. The fracture extended downwards from the parietal bone across the temporal bone, and in all probability through its petrous portion, as blood flowed freely from the ear for the first six hours; he was stunned for a few minutes at first, but became sensible by the time he was brought to the hospital. The bleeding from the ear was followed by the discharge of a fluid resembling water, which is usually a very dangerous symptom, as it flows from the sac of the arachnoid membrane, and afterwards at intervals by a discharge of blood and matter, particularly he said on coughing; he was also quite deaf, with a little pain on the right side of the head. The bowels were well opened, and he lost sixteen ounces of blood. On the evening of the 3rd of August, four days after the accident, paralysis of the muscles of the RIGHT side of the face supplied by the portio dura came on, or was first observed. Pulse 80. He was well purged, but lost no blood, as he was apparently weak and the pulse soft; it fell next day to 72. Mercury was now administered twice a day until the mouth became sore. On the 18th of September he was discharged, cured of the paralysis, the wound on the head being open, and a piece of bone bare and likely to exfoliate. October 8. Re-admitted in consequence of great headache after drunkenness, with numbness of the toes and fingers; he was well purged, and felt relieved. He remained in the hospital for a month, his mouth being again slightly affected, occasionally drinking in spite of all remonstrances; he then returned to his work on the piers of Westminster Bridge. He is now, June the 8th, again in the hospital, several small pieces of bone having come away; and the wound is nearly healed. The course of the fracture can be traced, in consequence of the scalp having adhered to the bone, causing a slight depression and hardness, which can be felt by the finger, extending down to the ear.

An ostler was thrown from a horse, and pitched on his head, which was slightly bruised on the back part, and was carried to the Old Westminster Hospital late at night in a state of stupefaction; no other injury could be discovered. The

next morning he could answer questions although not always correctly; complained of pain in his head, had bled from the ears all night, and had vomited some blood two or three times. Pupils dilated, but they contract on bringing a lighted candle near them; the left eyelid more open than the right; pulse 52; very restless, and constantly turning in bed. V.S. ad ℥xxiv. Calomel and colocynth. Salts and senna. Cold to the head. The pulse rose to 60 after the loss of blood. 2nd day. Is delirious; bleeding from the ears but trifling; complains of pain in the head; bowels open; passes his urine freely; pulse 54, a little irregular. V. S. ad ℥xvj., which gave relief. Continue calomel and senna and salts. 3rd day. Restless all night; headache and thirst; bowels open. V.S. ad ℥xiv., which relieved the pain in the head. Pulse 56. 4th day. Restless and delirious at night; pulse 60, regular; bowels open; headache. V. S. ad ℥xiv. No discharge from ears. 6th day. Slightly paralytic on the left side of the face, tongue drawn to that side; headache, restless, delirious; fæces, and urine passed unconsciously; pulse 80. V.S. ad uncias 20. Pulse rose to 100, and weaker. Calomel gr. iii. every six hours. 7th day. Pulse 88, compressible; restless at all times, delirious at night; bowels open, but he is more conscious of everything. 8th day. Pulse 80, small, intermitting; occasionally slept a little, and is generally better; bowels well purged; paralysis of the face continues. Has taken a little farinaceous food. Continue calomel and Inf. Sennæ. 10th day. Improved; slept tolerably well. 12th day. Continues to improve. Omit the calomel, but continue the Infus. Sennæ. 16th day. Is better. Paralysis less. Recollects he was thrown from a horse, but nothing else. Is free from pain; but very weak. Mouth a little sore.

After this time he gradually recovered, but was for a long time unable to work, or to undergo any exposure. A very little more mischief, and he would have gradually sunk, and died after the seventh day, instead of slowly recovering.

A lad, fourteen years of age, was admitted on the 13th of July into the Westminster Hospital, having been thrown from a horse on his head, which rendered him insensible at the moment; he soon recovered, however, and complained of great pain in the right side of the head. Pulse regular, and full; blood flowed from right ear; pupils dilated and fixed. After admission he vomited, became stupefied, although he could be roused; breathing free; the pulse weak and fluttering. The head was shaved, and a cold lotion applied.

14th. Is sensible, and answers any question put to him; refers to the side of his head and forehead as the seat of pain; has passed no urine, neither have the bowels been open; discharges a quantity of watery fluid slightly coloured from the ear, which on testing did not contain albumen*; pulse irregular, ranging between 55 and 85. Calomel and Colocynth. Infusio Sennæ, and an enema. 15th. Is quiet and sensible; has had the necessary evacuation; watery discharge continues; pulse irregular in frequency and strength; twelve leeches to the spot above the ear, where some swelling is perceived. 16th. Appears to be slowly improving. 17th. Pulse regular in frequency at 80. Breathing quick but regular; pupils act readily; bowels open; no pain; skin natural; watery discharge continues from the ear. 8 at night. Discharge ceased to flow. Complains of great throbbing pain in the side of the head, and is suffering from a violent rigor, with subsultus, which was followed by an epileptic fit, ending in coma, and death early next morning.

After death a fracture was found of the temporal bone, extending across the petrous portion forwards to the sphenoid bone, and backwards to the foramen magnum; and there was a large coagulum and about an ounce of fluid blood between the dura mater and the skull. The right ventricle contained from two to three ounces of clear fluid.

Mr. Banner of Liverpool, in his paper inserted in the ninth volume of the Provincial Medical and Surgical Association, p. 252, has related more than one case, in which, I suspect, the patient recovered after a fracture of the petrous portion of the temporal bone, and in all probability of the basis of the cranium. The more general result is death, from the third to the eighth day, under any mode of treatment which may be adopted; and I am not aware of any advantage which can be derived from the art of surgery beyond that which a well-directed and scientific general treatment enjoins.

Surgeons were in the habit formerly of trepanning in these cases from above the mastoid process, in the course of the occipital bone, and as near as they could to the foramen magnum. Mr. Hunter† even spoke in his Lectures about separating

* This watery discharge has been observed in other cases to contain albumen and cerumenous matter, and is always a very dangerous symptom, as it shows that a communication exists with the sac of the arachnoid membrane.

† Hunter (J.), Manuscript Lectures in the possession of the Author, taken by Dr. Cheston.

the attachments of the muscles of the neck, with this object. It is now however known, that the principal fracture in these cases is not in the direction of the foramen magnum, but in that of the petrous portion of the temporal, and towards the body of the sphenoid bone; and that although the extravasation of blood may take place from a rupture of the lateral sinus, it is as frequently found under the middle, or one of the other lobes of the brain, accompanied by laceration of its substance. I have even seen the fracture pass across the canal in the temporal bone for the passage of the carotid artery and the extravasation caused by its rupture; a fact which has been noticed also by Bohn. I have in my possession a calvarium in which the fracture extended from the base upwards, separating widely the edges of the coronal suture *.

A fracture of the inner or vitreous table of the skull, as it has been termed, from its peculiar brittleness, as opposed to the greater toughness of the outer, is a very rare occurrence without some signs of depression or fracture of the outer table. Ancient writers supposed this accident to be dependent also on a species of contre coup, said to have been called by Hippocrates ξυμφουν, and by Paulus of Ægina, and Vidus Vidius Απηχημα; by their successors, 'Resonitus' 'Infortunium,' or 'Calamitas;' but even they considered a fracture of the inner table alone, or of the opposite bone by contre coup, more as a remarkable, than as an ordinary occurrence. It was known to Celsus †. Bonetus ‡ has collected the facts related by several who preceded him. Grima § has closely investigated these points. Quesnay ‖ alludes to them in his Memoir, 'Du trépan dans les cas douteux,' and particularly to Arcæus, Valleriola, Tulpius and Borel, and relates a case communicated to him by Soulier of a soldier struck by a stone on the parietal bone, who died. On examination, matter

* Mr. Davies of Hertford has published in the Lancet for 1839–1840, page 161, a very interesting case of fracture of the base of the skull, by which the portio dura of the seventh pair of nerves of the left side was injured, causing deafness and paralysis of the muscles of the face supplied by it. The man cut his throat five months after the accident in a fit of insanity, caused by family affairs, having partly recovered from the deafness of the left ear, and having lost the hearing of the right. The fractured particles of bone were not united, and readily separated.

† Celsus (A. C.), lib. viii. cap. 4. p. 516.

‡ Bonetus (Theoph.), Sepulchretum, lib. iv. sectio 3. observatio x.

§ Mémoire sur les Contres Coups, &c., tome 4. Prix de l'Académie Royale de Chirurgie, 1778.

‖ Mémoires de l'Académie de Chir., tome i. p. 210.

was found underneath the internal table, which was fractured in an angular manner without any injury having been done to the external table. On referring to the works of Arcæus and Valleriola, I cannot find the cases in support of this opinion, and conclude that the quotation was at first an error in memory which has been repeated without inquiry; the reference itself to the Bibliotheca of Bonetus instead of the Sepulchretum being also a mistake. Arcæus * merely alludes to such a thing as a known fact, but does not give a case in support of it. Valleriola† relates two cases in his third book, which however are not cases of fracture of the inner table, but of the formation of matter beneath it: the first in a boy named Arduymus Ferreius, who died on the eleventh day after receiving a blow on the head, matter having formed between the dura mater and the bone, but without fracture either of the inner or the outer table. The second case is that of Claudius Aymargus, who received a blow from a stone on the left side of the head, and died on the thirteenth day after the injury, when matter was found between the dura mater and the skull, but without fracture or fissure of the bone.

Tulpius ‡ says, "Jacobus Bexius being struck by a musket-ball on the occiput fell upon his face, apparently little hurt; but fever and convulsions having supervened, we trepanned him, although there was no fissure externally, and thus were enabled to remove a small quantity of blood effused on the membranes of the brain. He nevertheless died on the sixth day, and several cracks were found in the inner table of the skull, the membranes and the brain itself being affected beneath. Whilst trepanning the patient, the blood," he says, "started up by the side of the instrument, and fell like dew upon the parts around, showing the extreme vascularity of the diploe." It is as possible that the fissures or cracks in the inner table were made by the surgeon as by the accident, but of that Tulpius does not seem to have had an idea.

Quesnay also quotes Borel as relating the case of a camp follower, the inner table of whose skull was broken without the outer having suffered; but on referring to Borel §, I find this also inaccurate. He says, "In the year 1651, a camp

* Arcæus (Franciscus), De recta curandorum Vulnerum ratione, cap. 3. p. 17. Amstelodami, 1658.

† Valleriola (Franciscus), Observationum Medicinalium lib. 6.

‡ Tulpius (Nicolas), Observationes Medicæ, lib. 1. cap. 2. edit. 5. Lugduni Bat. 1716.

§ Borel (Petrus), Historiarum et Observationum Centuriæ 2, observat. 20. Frankfort, 1676.

follower being struck by small shot on the head, died, with the skull broken into many pieces (cranio multis fracturis disrupto obiit). The head being opened by D. Faudryo, a piece of the inner table was found entirely separated from the outer and lying on the dura mater, without any other fracture being visible at this place, which," he says, "I imagine must have been produced by the counter-stroke."

Bonetus reports from Schenkius ex Petro Sphererio, that Cortesius had a skull in which the inner table was broken, without any sign of a fracture externally having ever taken place.

Scultetus* relates two cases nearly similar, in which the irritation arising from the broken inner table had caused suppuration and death.

Smethius† says, one Reutlingner, a student, died from a blow on the right temple on the fourth day after the accident. On opening the head he found a triangular fracture of the inner table without even the mark of a fissure externally. There was, however, matter under the dura mater.

Salmuthius‡ relates the case of a man who received a blow on the forehead above the nose, from which under good treatment he recovered. Nine weeks afterwards, having complained of severe pain in the part struck, he was suddenly seized with epilepsy, and died. On opening the head the inner table was found pressing on the brain, beneath which it was in a state of suppuration.

Paré, at an earlier period, had related two cases of a similar kind. One of a gentleman who received a blow from a cannon ball on his helmet at the siege of the castle of Hedin, which indented it, but without any apparent injury to the head. He died on the sixth day. The external table was whole, but the internal one was broken in several places below the spot on which the injury was received. The other nearly similar case occurred at Rouen.

Platner§ relates the case of a man who received a severe blow on his head when nine years of age. Being drowned, after leading a very irregular life, his head was examined. On the outside there was no sign of injury, but on raising the calvarium, a fissure was observed with very sharp pointed edges on the upper

* Scultetus (Job.), Armament. Chirurg., obs. 14 et 15, Lugduni, 1593, p. 226.

† Smethius, Miscellan., lib. x. p. 570.

‡ Salmuthius (Philip.), Observationum Medicarum Centuriæ tres. Brunsvijæ, 1648, p. 14.

§ Platner (Zachar.), Institutiones Chirurgiæ. Lipsiæ, 1751, §. 530.

part of the inner table of the right parietal bone, which had pierced the dura mater and injured the brain so as to give rise to ulceration.

Garengeot* relates from Hery, that being called to see a man who had received a wound on the middle of the left parietal bone, he found that it did not appear to have penetrated to the skull. The patient had bled from the nose, the eyes were bruised and inflamed, and he had considerable fever accompanied by convulsive movements. Hery made a crucial incision, and found the pericranium detached from the bone, which was of a vermilion red without any fracture. As the symptoms continued, he thought that the detachment of the pericranium without fracture assuredly indicated a fracture of the internal table, and he accordingly trepanned the patient, and found a fracture of the inner table running across the bone removed by the trepan, and consequently beyond it. A quantity of blood was removed from the surface of the dura mater. The patient recovered.

He also relates a case of his own, in which on inspection after death he found no fracture, but only a discoloration of the bone at the part injured, although there were two fissures lower down, but on examination of the inner table he found it considerably fractured opposite the external dark spot on which the blow had been received.

De la Motte† supposed that when the inner table was broken without the outer one, the patient might be aware of the fact, by the peculiarity of sound which followed the blow, resembling that given out by a broken pot when violently struck, and he relates a case in illustration of this idea.

Atthalen of Besançon, in relating the history of a very interesting case of injury of the head which happened in 1746, was only able to distinguish an external fissure after death, in consequence of the thinness of the skull, by sounding on the two parietal bones, when the injured one emitted the same kind of sound as a pot would have done which had been cracked, without the parts being apparently separated; and this may have happened in other instances, rendering the diagnosis of a fracture more than ordinarily difficult, and have given rise to the opinion that it did not exist.

The skull of Captain Gauntlett, of the 29th Regiment, who was killed by a

* Garengeot (Jacques Croissant René de), Traité des Opérations de Chirurgie. Paris, 1731.

† De la Motte, Observat. de Chirurgie, tome ii. p. 303.

musket-ball which struck him on the right side of the head above the ear at the battle of Talavera, was not thicker than Bristol board paper.

Mr. Pott* says he had seen two cases only in which the inner table was broken without the outer. In the first case, that of a young woman, the head after being shaved was found to be "absolutely free from all mark of violence." On trephining, in consequence of the bad symptoms continuing, the outer table came away in the crown of the trephine, whilst the inner receded from the finger, and when he pressed upon it and of course on the brain, the girl's whole frame was spasmodically agitated†. Several small trephines were applied all round this piece before it could be removed, and he had great hopes of recovery until matter formed between the dura mater and the skull, under which the patient died. In the second case, or that of a porter who was knocked down by an iron hook, the patient remained senseless for half an hour, but afterwards walked home. The next morning he lost his sight, and in the evening his speech and faculty of walking, and died at night. Upon examining his head a piece of the inner table of the right os parietale, of about an inch and a half in length and not quite so broad, was found detached from the outer table, having a quantity of blood both between them and on the surface of the dura mater‡.

Mr. C. Trye§ of Gloucester, relates a case of an injury of the internal table of the skull successfully treated in the year 1786. Nine weeks after the accident, the external table of the right parietal bone being evidently dead, the trephine was applied, and he found then that the greater part of the internal table had been removed by absorption, and that granulations were springing up from the

* Pott (Percivall), F.R.S., Observations on Injuries of the Head. London, 1771, Second edition, p. 273.

† Dionis[1], Turner[2], Sharp[3] and Hill[4], warn the surgeon against the incautious use of the trephine, lest this should happen.

‡ Dr. Batting, in his Chirurgical Facts relating to Injuries of the Head, mentions a case (the eighth) in which, after trepanning and the death of the patient, a piece of the inner table, about the size of a shilling, was found lying loose on the dura mater, about an inch and a half from the opening made by the instrument.

§ Medical Communications, vol. ii. 1790.

[1] Dionis (P.), Cours d'Opérations.

[2] Turner (Daniel), the Art of Surgery, vol. ii. 8vo. p. 211. London, 1732.

[3] Sharp (Samuel), Operations of Surgery, &c. 8th edition, p. 147. London, 1761.

[4] Hill, op. citat. p. 175.

parts beneath, but whether they were from the dura or pia mater or brain could not be accurately ascertained. The man recovered.

Mr. Pitt of Upton-on-Severn, informs me that he saw a case which he presumed to be one of fracture of the inner table of the right side of the frontal bone, without injury to the outer, and which did not cause any mischief to the individual for eight years afterwards, when he became subject to fits, in one of which he died. At the time he received the injury he was merely stunned and had slight symptoms of concussion, the side of the face corresponding to the injury being however paralytic. On examination after death there was not the slightest mark found on the bone where the blow had been received, but the inner table was separated and curled upon itself, the diploe having been removed, and the irritation from this was presumed to be the cause of death.

Audouillé* in 1748, called to an officer at the siege of Maestricht who had received a blow on the side of the head from a good-sized ball, found only a very small fissure at the side and back part of the right parietal bone; and although there were no symptoms present requiring any operation, he thought it right to prevent them by trepanning the patient. The crown of the instrument being removed on reaching the diploe, showed so considerable a portion of the inner table broken and detached, as to require a second application of the trepan for its removal. The officer recovered without any bad symptoms.

Mr. S. Cooper states in his Surgical Dictionary, article "Injuries of the Head," that he had seen cases in which fracture and depression of the internal table had taken place, the external one remaining unbroken. "One case," he adds, "of this kind, attended with urgent symptoms of compression, I trephined at Brussels. A large splinter of the inner table was driven more than an inch into the brain, and on its extraction the patient's senses and power of voluntary motion instantly returned. The part of the skull to which the trephine was applied, did not indicate externally any depression, and Dr. Hennen† says, 'Mr. Cooper had not sawn long before the external table came away in the hollow of the trephine, leaving the inner table behind, which was not only splintered but driven at one point more than half an inch into the membranes and substance of the brain.'"

* See Percy, p. 205. Manuel de Chirurgien d'Armée.

† Hennen (John), M.D., Principles of Military Surgery, p. 323. Second edition, 1820.

The records of eighteen centuries have produced but little information on this most interesting subject; and if the cases were collected which I have overlooked, as well as those which have been altogether omitted, I apprehend that very little more would be gained. I therefore think it safe and reasonable to come to the conclusion, that although these things have happened, they will rarely occur again. I have never, in the great number of broken heads I have had under my care on many different, and grand occasions, actually known the inner table to be separated from the outer, without positive marks of an injury having been inflicted on the bone or pericranium, however slight that injury may have been; and although it is not possible to doubt the fact of fracture of the inner table having occurred, it is very desirable in a practical point of view not to bear it in mind; for if a surgeon should be prepossessed with the idea that the inner table might be so readily fractured, and separated from the diploe placed between it, and the outer table, and thus cause irritation or pressure on the brain, few persons who had received a knock on the head, followed by any serious symptoms, without fracture or depression, would escape the trephine, and the worst practice would be again established. An operation should never then be performed under the expectation that such an accident may have happened, unless it is apparently required by the urgency of the symptoms indicating compression or irritation of the brain, which cannot be relieved by other means.

I by no means intend to imply by these remarks that a blow on the head will not frequently detach the dura mater from the inner table by rupturing its vessels, and thus give rise to compression or irritation of the brain from the effusion of blood or the formation of matter, or that the inner table may not from the same cause become diseased, and be the cause of ulterior mischief; but these are altogether different states of injury to that which I have just noticed, and require special consideration.

The object I have in view in the following observations, is to show, that severe effects do not always take place in similar cases in the course of the first treatment, but occur afterwards; or that unfavourable symptoms having never been entirely removed, increase so much at a later period as to render the aid of operative surgery necessary.

The case of Mr. Trye, above stated, is an excellent one, showing disease, and the subsequent death of the whole substance of the bone, requiring its removal. That

of Saucerotte* is not less valuable. He reports that Nouvelle, surgeon of Remiremont, showed him in 1760 the upper part of the skull of a young man who had received a blow on the middle part of the os frontis five months before his death, which took place after much suffering. The external part of the bone was sound, but the inner table was of a black colour and perforated by many small holes; the diploe was also diseased. Le Dran mentions a nearly similar case in his twenty-seventh observation.

Dr. Blake, late of the 7th Dragoon Guards, and of Nottingham, relates the case of a soldier (in the Med. and Phys. Journal, vol. lv.) who received a blow on the right parietal bone from a closed hand on the 4th of February 1824. The first symptoms passed away, but returned on the 29th; and on the 2nd of March he was seized with a fit of epileptic convulsions, which continued until a fatal result appeared likely to follow. This induced him to trephine the patient as a last resource. Nothing was observed on removing the bone, but the paroxysms were gradually mitigated and ceased in a few hours. The patient gradually recovered.

Peter de Marchettis†, in his seventh observation, relates a nearly similar and successful case cured in thirty days after the operation.

Rhodius‡ says a noble young lady of Pavia suffered upwards of a year from a pain in the head, of a perforating, and fixed character. The medical man, who suspected that something was pressing on the brain, in a lucky moment thought of trying the cranium with a small trepan. On its being opened a drop of fetid matter scarce equal to a grain of millet-seed escaped, and she was never troubled again with that pain.

He gives another case of a somewhat similar character in a Venetian nobleman, who was cured by the operation after several years of great suffering from a blow on the head.

Scultetus reports, in his twelfth observation, that in the year 1635 he trepanned an officer who had become apoplectic six weeks after the receipt of a blow on the vertex, which had fractured and depressed the skull. He recovered, but died suddenly three months afterwards, the head not being allowed to be ex-

* Saucerotte, Mélanges de Chirurgie, p. 309. Paris. Edit. 1801.

† Peter de Marchettis, Observationum Medico-Chirurgicarum Rariorum Sylloge. Amstelodami, 1665.

‡ Rhodius (Johannes), Centuriæ tres Observationum Medicinalium. Obs. 69, 70. Francofurti, 1626.

amined. He says, in his thirteenth observation, that an officer received a blow on the head in the month of September 1829, at Milan, which was cured in fourteen days. Six months afterwards, when at Ulm, he suffered from great pain in the head, vertigo, defective vision, and paralysis of the right arm, which induced him to divide the scalp, when he found a fissure in the skull, and applied the trepan twice at each end, cutting out the intervening piece; some matter was discharged, and the patient perfectly recovered his health in one month.

M. Bouchery* relates the case of a carpenter whom he trepanned three times, in consequence of a dull pain in a certain part of the head, and hemiplegia of the right side, which followed some blows inflicted on the head ten months before. Fifty-six days after the operation the patient was quite cured.

Dease† trephined a young man nine months after he had received a blow on the upper part of the os frontis, which caused him great pain in the head, rendering him in general incoherent in his speech, and infirm in his limbs. The wound was not quite cicatrized. On examination Dease found a depressed fracture larger than the breadth of a sixpence, which he removed with a large crown of a trephine. The three subsequent days he extracted ten pieces of the inner table, which had been driven into the brain. The man left the hospital in about three months in perfect health.

Sir A. Cooper, in his Lectures by Mr. Tyrrell, notices the case of a gentleman who suffered from epileptic fits after a blow on the superior part of the frontal bone, and was cured by the trephine twelve months after the accident; and another from Mr. Cline, of a sailor who had a depressed portion of bone near the superior edge of the left parietal bone, and had lived for a year unconscious of his existence; being in a great degree destitute of sensation, and voluntary motion, and having lost his memory and speech. Mr. Cline removed the depressed portion of bone, after which the man gradually recovered, and was discharged from the hospital cured in two months.

During the siege of Badajos, Colonel F. applied to me on account of a pain he felt in his head on the slightest effort of any kind, which had followed a wound on the posterior part of the parietal bone. It was so distressing to him that he

* Bouchery (M.) de Maubeuge in the Recueil Périodique de la Société de Médecine de Paris, tome viii. p. 334.

† Dease (Wm.), Observations on Wounds of the Head. 1776.

willingly agreed to submit to the trephine with the hope of obtaining a cure at the end of the campaign, but another wound at the battle of Vittoria in nearly the same place killed him.

Marechal* cured one case by the trephine in which epilepsy had supervened after several years of suffering. Morel of Besançon cured two by the same means, one after six months, the other after more than twelve months of suffering, no disease being found. Vacher, however, lost a patient who had not received a previous injury, whom he trepanned.

Severinus trephined a Spanish nobleman on account of the most horrible pains in the head which induced him to submit to the operation. A fungus was found beneath, the destruction of which allowed a cure to be effected†.

Sir E. Home‡ says he operated with the trephine on the head of a person who had long suffered much from pain after a blow. On cutting down to the part he perceived a crack about half an inch long, and not wider than a hair: the inner table was however depressed for about the size and thickness of a shilling. The patient got quite well.

Hildanus§ relates the case of a man cured, on the contrary, of a continued pain in the head, by having his skull fractured, and many fragments of bone removed; his cure being perfect during the remaining nine years of his life.

M. Walther has gone a step beyond his predecessors on this point, as the following case will show:—A man 36 years old received a blow from a stone on the left parietal bone, from which he thought he had recovered on the sixth day: it was however followed by such frequent, and violent attacks of pain as to render him unable to work; and after all other means had been tried in vain, he was trephined. Nothing abnormal being found, Walther thought he would replace the circular piece of bone he had removed, which he did, and the replacement was not followed by any severe symptoms. At the end of three months, during which time the pain in the head went away, he saw a loose piece of bone at the bottom of the wound, which had not healed, and on removing

* M. Quesnay, Mémoires de l'Académie de Chirurgie, tome 1.

† Severinus (Marc. Aurelius), De Medicina Efficaci, lib. i. part 2. Chir. quæ ad ossa pertinet, cap. iii.

‡ Home in Twelve MS. Lectures.

§ Hildanus (G. F.), Opera. Observat. Curationum Medico-Chirurg. Frankfort, 1682. Centuriæ 2, observat. 8, pag. 85.

this he found it was a part of the external table of the replaced bone. The wound soon healed after this, and the patient recovered (in defiance of the doctor).

Klein* relates the following very interesting case:—A woman 35 years of age received a blow on the head, and from that time suffered almost insupportable pains, which extended from a point in the forehead she could cover with her finger, all over the head. Having suffered this evil for three years and eight months without obtaining any relief, Klein trephined her on the painful spot over the longitudinal sinus, and found underneath one of the external Pacheionian glands so much enlarged as to have caused a hollow in the portion of bone removed, of half its thickness. The pain ceased on the removal of the bone, but returned with the cicatrization of the wound, beginning however half an inch behind the place where the trephine had been applied. These pains increased in severity, the pupils became dilated and very little sensible to light. One year after the first operation he thought it right to apply another, but larger crown of the trephine, after which the cure was complete, and was so seven years afterwards when he wrote his book. In two other cases of a nearly similar kind the operation was not attended with success.

Dr. Dudley†, of Lexington in the United States, gives the history of a person wounded in the head by a musket-ball, which fractured the skull, several small portions of which were removed, together with some of the substance of the brain. The wound was dressed simply, and in two months the man was cured, with the exception of a small fistulous opening, from which a little matter was discharged daily. Some months afterwards his health became much decayed, and he suffered from epileptic fits. In this state he applied to Dr. Dudley, who finding the bone diseased at the bottom of the wound, trephined the part in the direction of the original fracture; and found several isolated pieces of bone lying in a hollow of the dura mater, supposed to have been formed by the absorption of the brain beneath. Three of these pieces, about the size of a finger nail, were removed, together with a morbid excrescence which had developed itself on the dura mater. All the bad symptoms under which the patient laboured subsided at the end of a week after the operation‡.

* Klein, Journal de Chirurgie et d'Ophthalmologie, vol. iii. page 219.

† Dudley (Dr.), Transylvanian Journal of Medical Science.

‡ He has given three other cases, of even greater interest, in the second volume of the American

I have in my possession a frontal bone, and a portion of a parietal bone, in both of which there is a sufficient projection of the inside of these bones to have caused a pressure on the brain, which might have given rise to any of the symptoms alluded to, and which would have been removed by one application of the trephine, provided the spot where the mischief existed could have been ascertained.

It was in consideration of the facts thus recorded that I operated in the following case, the particulars of which have been given to me by Dr. Bird, who was then clinical assistant at the Westminster Hospital.

"M. A. Farnham, aged twenty-three, a stout healthy-looking girl, received a blow, two years ago, from a stone falling from a door-way under which she was passing, which struck her upon the left side of the head at a spot an inch anterior to the parietal prominence, the weight of the stone, and the space through which it fell, making the estimated force with which it struck the head equal to sixteen pounds. The immediate effect of the blow was insensibility, followed by acute fixed pain in the head, which has ever since continued to mark the seat of injury. A week after the receipt of the blow she began to lose the power of moving of the right arm, there being however no loss of sensation or any disturbance of the cerebral functions.

"During the following twelve months her symptoms remained unchanged, and this period was spent in Guy's, St. Thomas's, Westminster, and St. George's Hospitals; but having derived no relief whilst in any of these institutions, she became an out-patient under the care of Dr. Roe.

"After the lapse of a few weeks the paralysis of the arm suddenly increased, sensation still being unaffected, and she experienced no further change in her condition until after eleven months, when she was again admitted into the hospital, her symptoms then being the following:—the arm and leg of the right side quite paralytic, the former, which had previously been flaccid, having now

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Journal of the Medical Sciences for 1828, p. 489, in which the trephine was applied for the cure of epilepsy and loss of memory with perfect success, many years after the accidents had happened which gave rise to the depressions in the skull. In two, large processes of bone dipped down into the brain, and on their removal in one case a large quantity of blood was lost, followed by the discharge of two gallons of a colourless serum in three days.

Dr. Warren of Boston, Dr. Guild[1] and Unger[2], of Chateau du Loire, have been not less successful.

[1] Guild (Dr.), Revue Médicale, 1829, vol. iv. p. 301.

[2] Encylopédie des Sciences Médicales, 1838, p. 171.

become remarkably rigid, and its temperature being below that of the opposite side; vision, particularly of the left eye, imperfect, the pupils however acting naturally; hearing on that side also affected; memory bad; respiration frequently slow and almost stertorous; the countenance assumed a dull heavy expression, and she manifested an unusual tendency to sleep. All the ordinary remedies having failed to relieve these symptoms, Mr. Guthrie was requested to see her, and the operation of trephining was eventually agreed upon.

"*April* 1*st*, 1841.—Mr. Guthrie this day removed a disc of bone from the exact point in the parietal region to which she referred the pain. The portion of bone presented no evidence of disease; its thickness varied from two and a half to four lines, the latter measurement corresponding to the part most distant from the sagittal suture; the vessels of the diploe bled freely, the dura mater was quite healthy, and without any very evident motion.

"On visiting her *an hour* after the operation, she raised the previously paralytic arm several inches from the bed, and was able to bend, and extend the fingers. The pain in the head was considerably less, and her countenance, before dull and heavy, was now remarkably animated. Sensation had returned in the arm, and partially in the leg. Her pulse was calm, and skin cool.

"Ten hours after the operation she was attacked with rigors, followed by pyrexia and all the symptoms of commencing inflammation of the brain. By the immediate abstraction of blood, which was three times repeated during the succeeding twelve hours whenever the pain in the head or the force of the circulation increased, every bad symptom was removed. In the course of three days the paralysis had completely disappeared, sight and hearing again became perfect, and after passing through a speedy convalescence, she quitted the hospital completely recovered."

She has since had some relapses of pain, and uneasiness in the head, but is altogether a different person, although of a very hysterical temperament. The cicatrix on the head is firm, and she considers herself to have been cured by the operation, although I find it difficult to say in what manner it was effected, or why the removal of the bone, which was in a perfectly natural state, should have given relief.

The inner table is sometimes broken in a peculiar manner, and to which I believe attention has only been drawn by myself in my lectures, since trepanning

has ceased to be the rule of practice in all cases of fractures. It occurs from the blow of a sword, hatchet, or other clean cutting instrument, which strikes the head perpendicularly, and makes one clean cut through the scalp and skull into the brain. This kind of cut is usually considered as a mere solution of continuity, and not as a fracture; the bone being apparently only divided, with scarcely any crack or fissure extending beyond the part actually penetrated by the instrument. When the outer table alone is divided, the wound in the scalp should be treated as a simple incised one, and united as quickly as possible, a practice of which I have seen several successful instances. When the instrument even penetrates to the diploe the same course should be pursued; for although the external wound may not unite by the adhesive process, and some small exfoliations may occur; it is not common for serious consequences to ensue under that strictly antiphlogistic plan of treatment to which all persons with such injuries should be subjected.

When the sword or axe has penetrated as far as, or through the inner table, the case is of a much more serious nature; for this part will be broken almost always to a greater extent than the outer table; and will be separated from it, and driven into the membranes, if not into the substance of the brain itself; the surface of the bone showing merely a separation of the edges of the cut made into it. These cases should all be examined carefully. The length of the wound on the top, or side, or any part of the head which is curved and not flat, will readily show to what depth the sword or axe has penetrated. A blunt or flat-ended probe should in such cases be carefully passed into the wound, and being gently pressed against one of the cut edges of the bone, its thickness may be measured, and the presence or absence of the inner table may thus be ascertained. If it should be separated from the diploe, the continued but careful insertion of the probe will detect it deeper in the wound; a further careful investigation will show the extent in length of this separation, although not in width; and will in all probability satisfy the surgeon that those portions of bone which have thus been broken and driven in, are sticking in or irritating the brain. In many such cases there has not been more than a momentary stunning felt by the patient; he says he is free from symptoms, that he is not much hurt, and is satisfied he shall be well in a few days.

An officer was struck on the head in Halifax, Nova Scotia, by a drunken workman with a tomahawk, or small Indian hatchet, which made a perpendicular

cut into his left parietal bone, and knocked him down. As he soon recovered from the blow and suffered nothing but the ordinary symptoms of a common wound of the head with fracture, it was considered to be a favourable case, and was treated simply, although with sufficient precaution. He sat up, and shaved himself until the fourteenth day, when he observed that the corner of his mouth on the opposite side to that on which he had been wounded was fixed, and the other drawn aside; and that he had not the free use of the right arm so as to enable him to shave. He was bled largely, but the symptoms increased until he lost the use of the right side, became comatose and died. On examination, the inner table was found broken, separated from the diploe, and driven through the membranes into the brain, which was at that part soft, yellow, and in a state of suppuration.

Mr. B., of the 29th regiment, when in Halifax, Nova Scotia, was struck in a drunken frolic on the anterior part of the left parietal bone by his own sword, which was a straight heavy one; and a wound about two inches long, was made in the side of his head through the bone. His little finger was much cut at the same time, and it was not until the finger was dressed that I was asked to look at the head, which he declared had nothing the matter with it. I had him vomited, and purged, and the next morning bled, and as symptoms of inflammation of the membranes of the brain came on, or increased, the bleedings were repeated, the quantity taken at each time being gradually diminished. He lost 250 ounces of blood in five days, after which he gradually, although slowly recovered, some small spiculæ of bone coming away during the cure. Returning to England, the vessel was taken off the Scilly Islands, and he was sent to Verdun, where he remained several years, until liberated by the peace of 1814, when he rejoined his regiment, which had served in the Peninsula, and had returned to North America. It was soon found that he became outrageous on drinking a very little wine, and was odd in his manner, and had a great propensity to set out walking for hours without apparently knowing what he was about, or where he was going. When his regiment came immediately in front of the enemy, he was found going over to their lines, without being aware of what he was doing; and he was at last obliged to be sent to England, having become evidently deranged. Mr. Cline being consulted by me on the express point of the propriety of removing a portion of bone, would not advise it, as he anticipated from the length of the wound the application of more than one trephine. This gentleman has been ever since confined

in a private mad-house. His brother offered lately to allow me to remove the bone if I pleased; but after thirty years of derangement I could not hope for a recovery. The impression on my mind is, that if I had made the examination I have since learned to be proper in such cases, I should have found the inner table of the bone broken and depressed; and that if I had removed it, he might now have been in health, both of body and mind.

I first discovered the exact nature of the particular injury I am considering, at the battle of Talavera, in a soldier who, from urgent symptoms, I was obliged to trephine; the removal of the pieces of bone, which had pierced the dura mater, relieved him in a remarkable degree, but he died in a few days afterwards from inflammation and suppuration of the brain, the operation having been done perhaps too late.

M. le Capitaine N—— was brought into the village of Valverde the second day after the battle of Albuera with a wound from a musket-ball in the spine, which had deprived him of sensation and motion in the lower half of the body, and another from a sword on the head, which had penetrated the skull on the right side, near the vertex, without depressing the bone. On examining this, I clearly ascertained that the inner table was driven into the brain; but as death was certain from the other wound, and he suffered little from the head, I was not disposed to trephine him uselessly. Finding his case was hopeless, he begged to have as much opium given to him as would put him out of his misery, he did not fear death, and even wished to save me the trouble I took with him, which he said might be so much better bestowed on others. He died three days afterwards; but I had only time to ascertain that the splinters of bone were buried in the brain*.

I removed, in Lisbon, in the hospital appropriated to the wounded French prisoners in 1812, a portion of bone by the trephine, which had been fractured by a sword some months before: the wound was not healed, and some pieces of bone were depressed. I found one piece, in particular, of the inner table detached, and irritating the dura mater, and in all probability the immediate cause of the fits from which the patient had been suffering. He recovered.

A British soldier received a wound at the affair of El Boden, in front of

* No one had so much to do with the wounded officers, and soldiers of the French army as I had during the Peninsular war; and I bear most willing testimony to their self-devotion and courage on all occasions.

Ciudad Rodrigo, from a sword on the top of the head, and accompanied me to Sabugal, on the retreat of the army. The bone was apparently only cut through, yet the inner table was depressed, and felt rugged when examined with the probe. The symptoms of inflammation increasing on the fourth day, and not being relieved by copious bleeding, I removed a central portion of the cut bone by one large crown of the trephine, and took away several small pieces which were sticking into the dura mater, after which all the symptoms gradually subsided*.

The whole of the French wounded, who remained on the ground or were taken prisoners after the battle of Salamanca, were under my care, and among them there were several severely wounded by sword cuts received in the charges of heavy cavalry made by Generals Le Merchant, and Bock. The cerebellum was laid bare in two cases without any immediate bad effect. I have seen the same thing on other occasions; in one particular case, after the battle of Waterloo, which recovered, the brain was seen pulsating for several weeks; and the statements made to me by the different officers at Brussels and Antwerp, and afterwards at Yarmouth and Colchester, entirely confirm the observations I had made, and the recommendations I have inculcated on these points as resulting from the practice of the Peninsular war.

Sir P. Crampton† relates the case of James Fagan, a patient of Mr. Cusack in Stevens's Hospital, which bears strongly on this subject. He received a cut five inches long from a convex-edged sword over the right parietal bone, at twelve at night on the 17th of March, which cut through it, the membranes, and into the brain itself, some of which appeared on the edges of the wound. He had been drinking when he received the injury. On the 24th, seven days after the receipt of the wound, the state of the man having gradually deteriorated, he having been attacked by violent convulsions followed by stupor, it was

* Wepfer says that a countryman of Doggenburg, unable to endure a continual and violent pain in the head, insisted on having his head trepanned by the farrier, who was in the habit of performing this operation on horses subject to attacks of giddiness. On this occasion he borrowed a borer from a cabinet-maker, with which he pierced the bone, and allowed a quantity of fluid to escape, after which he recovered.

Wepfer further states, that he had found tumours, bony concretions, and pus and blood extravasated, after death, under the bones of the head of persons who had long suffered great pain at a fixed point. Wepfer (Joh. Jacob.), Observat. Medico-Practic. de Affectibus Capitis, obs. 48, pag. 119.

† Crampton (P.), Dublin Journal of Medical and Chemical Science, vol. ii. p. 36.

thought right to examine it with a probe, when it appeared that the inner table was in all probability separated from the outer and driven in upon the brain. A slip of bone about a quarter of an inch broad, and three inches long was removed from the upper edge of the divided bone (which implies that there was a depressed under edge), by means of a straight saw about four inches in length, by Mr. Cusack, in a very few minutes with great ease. The inner table was then found to be detached, so as to form an acute angle with the outer table. The patient was relieved by the operation, and everything went on well until the 27th of March, when a small red pulsating tumour, about the size of a pea, appeared in the centre of the wound, and gradually, although slowly, enlarged until the 16th of April, when it began to decline rapidly in size; on the 20th it disappeared, and on the 1st of May the wound healed. On the 15th he was discharged the hospital in good health, but his memory was much impaired as to *words* but not *things*. He was readmitted on the 24th of August, complaining of severe pain in the wound, the cicatrix of which was raised above the scalp in the centre, and of defect of power and sensation in the right arm and leg. On the 4th of September a small opening was made in the prominent part of the cicatrix, when two drachms of healthy pus were discharged; the symptoms, and particularly the convulsive attacks from which he suffered, were all relieved. On the 9th of October he is reported in perfect bodily health, memory defective, power of the right arm and leg weak, some slight confusion of sight.

Sir P. Crampton, in his observations on this case, thinks it probable, "that had the portion of depressed bone been removed in this case in the first instance, namely, on the 17th of March, the result would not have been so favourable. The operation, in the first instance, would have been an additional violence to parts already severely irritated, and consequently an additional source of inflammation. It would besides have removed all support from the wounded brain, a great part of which would (it is probable) have escaped through the opened dura mater. If the patient escaped these first dangers, then came the danger of hernia, or rather fungus cerebri—one of the most frequent and dangerous consequences of wounds of the dura mater*."

* Mr. O'Halloran objects to any operation after a wound from a clean-cutting instrument, and says, "What pretence can we offer for trepanning in wounds of the cranium inflicted with incisive instruments? I know of none that can justify so violent an outrage to nature, except symptoms (page 157)

This opinion of O'Halloran and of Sir P. Crampton is in direct opposition to the principles I have laid down for the management of wounds of a similar nature, and is deserving of the greatest respect and attention, as everything must be which they have suggested.

A piper received a wound on the top of the head from a sabre, which cut perpendicularly through the whole length of the left parietal bone. A year afterwards he was able to resume his duties, and served sixteen years apparently quite well. He then had fits, and soon died. On examination, it was found that the cut in the bone had never been filled up by osseous matter, and that a firm cicatrix extended into the brain as far as the lateral ventricle, marking the wound made by the sabre. The ventricle contained serum, and lymph was effused on the surface of the brain *.

Sir B. Brodie †, in the case of William Myddleton, who was struck by an axe on the vertex, causing an incised, and depressed fracture into which the little finger could be introduced for half an inch, trephined the part, and elevated the depressed portion of bone, the internal table being found to be more extensively fractured than the outer. The man was cured.

It appears to me that too much stress is laid upon a difference which is supposed to exist in the danger of trephining a man on the first or on the seventh day after an accident, and that an error may be committed in believing that the trephine is a more dangerous instrument on the first day than on the seventh. The question here is not whether the man is to be trephined or not? but which will be the best and safest day or time to do the operation? I do not hesitate to say the first day. I believe the violence to be greater when done on parts already in

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of extravasation appear, which I believe very seldom happens where the skull itself is injured." Nevertheless, he committed a greater outrage by trepanning a child (page 159) seven years of age, on account of a depression which might contain a very small egg, she being quite composed, and sensible at the time; but she escaped from the accident, and the doctor. Let us, however, do O'Halloran justice by transcribing the following passage:—" The depression may be uniform, so as no point of the fracture may press on the brain. In such an instance, no doubt, things may come about without trepanning; but have we any symptoms to determine this point? None that I know of. Numbers I have seen perish by neglecting the operation, because they found themselves free from pain and fever at the beginning."

* Schmucker (J. Leberecht), Vermischte Schriften, 2nd edition, p. 247, Berlin, 1785, relates the case from Engel, surgeon to the Prussian Guards; but the treatment is not clearly expressed.

† Medical Gazette, vol. ii. p. 219.

a state of inflammation than when they are sound. I am quite satisfied, that when the inner table is sticking through the membranes and into the brain itself, the individual will in most cases ultimately die miserably of the accident if not relieved by art; and that it is less safe to let him designedly run the certain risk of cerebral irritation, which when once excited is often indomitable, than to remove the cause, and so endeavour to prevent the evil. If the cerebral irritation only manifested its effects on the surface of the dura mater by causing suppuration there, I might yield my opinion, but as I know that it often gives rise under these circumstances to the formation of matter on the surface of the brain, and under its membranes, where it is generally deadly, I cannot assent to that which may be called "la chirurgie expectante." Lastly, I do not think that there is more danger of a hernia cerebri when the operation is done early than when it is done at a later period; on the contrary, I think the patient has a much better chance of escape from hernia cerebri, and from all other evil, when the local and the general treatment are alike immediately decided, and efficient.

Sir P. Crampton in the same paper relates the case of Mr. Brougham, whose gun went off accidentally and fractured the upper part of the os frontis in small pieces, and drove the greater number of them deep into the substance of the brain. On attempting to remove one large fragment on the second day which was buried in the brain, the whole body was shaken by a convulsive movement, and the patient moaned deeply. Sir P. Crampton desisted from all further attempts to extract the splinters, and as even washing the part gave rise to a sensation which the patient described as dreadful, he desisted from that also. The discharge contained a large proportion of softened brain mixed with blood, but the wound itself was not so much as washed for twenty-two days, and even then nothing more was done than to lift off the small fragments of bone as they became detached by the process of nature. This gentleman recovered, and Sir P. Crampton supports the practice he adopted by quoting the opinion of Mr. Colles*, which I transcribe at length:—"In very small depressed fractures (such as may deserve the name of punctures of the bone), where a depressed bit of bone is sunk into the brain, it will perhaps be prudent to postpone the operation for a few days. For if the operation be performed immediately after the re-

* Colles (A. C.), Practical Precepts on Injuries of the Head. Dublin, 1814.

ceipt of the injury, and if we attempt to seize the depressed fragment, the first touch of the forceps sinks it more deeply into the brain; portions of the brain, from the softness of its texture, rise up and conceal the bone both from our sight and touch, whereas, if we defer the operation for a few days, we give time for the adhesive inflammation to take place; this circumscribes the depressed piece, hardens this spot of the brain, and thus enables us more easily and certainly to lay hold of the fragment of bone." The result of the case just quoted, and the opinions of Mr. Colles, must not be allowed to bear on the point previously discussed. They are only exceptions to the general rule, and not the rule itself.

It is necessary to recollect that the brain appears to be insensible, or nearly so, when first exposed; and it has rarely occurred to me to see a serious convulsion or anything beyond vomiting take place on the removal of a piece of bone from the brain; nor do I suspect any difficulty will be found in removing such small fragments as can be seen, with a pair of forceps duly adapted for the purpose. It is impossible to say at what period of time the brain becomes irritable, and no longer admits of being touched without convulsive movements ensuing; but whenever this state of irritation has commenced, and its existence is proclaimed by the excitement which takes place on touching the fragment of bone, the surgeon should at once desist from all attempts to remove the foreign body. The brain under ordinary circumstances is, I conceive, much more likely to recover from an injury, all foreign or irritating matters being removed, than when also suffering from their presence. Should I be mistaken on this point, the opinion generally entertained of the propriety of removing extraneous bodies from wounds in general, must I imagine be erroneous. It is very inconvenient to remove a granule of iron which has been implanted in the cornea when the eye is irritable, and particularly when the surgeon has not a sharp-pointed instrument to lift it out with; it will doubtless be more easily removed when suppuration has taken place, but the cornea will be in a much worse state. There is in fact no comparison between the two modes of proceeding; and I suspect it will be found to be much the same with the brain as with the cornea.

The establishment of the principles which ought to regulate the practice of surgery in cases of fracture and depression of the inner table of the skull is of the greatest importance, and it is on this account that I have quoted so many

authorities on the subject. The principle being laid down that it is right and proper to examine all such wounds with a blunt flat probe, in order to ascertain if possible whether the inner table is depressed and broken; the question necessarily arises, what is to be done when such depression and breaking down of the inner table is ascertained to have taken place? There can be no hesitation in answering; that in all such cases the trephine should be applied, although no symptoms should exist, with the view of anticipating them. The old doctrine, it may be said, in regard to fractures generally, is revived in these cases, but on a principle with which our predecessors were not sufficiently acquainted. A patient very often survives a mere depression of the skull; he may, and occasionally does survive, a greater depression of the inner than of the outer table; but I do not believe that he ever does survive and remain in tolerable health, after a depression with fracture of the inner table, when portions of it have been driven into the dura mater. If cases could be advanced of complete recovery after such injuries, I should not consider them as superseding the practice recommended, unless they were so numerous as to establish the fact, that wounds of the dura mater, and brain by pieces of bone are not extremely dangerous. I have referred purposely to many cases in which a cure was effected after a lapse of time, by the bone being removed; but they rather support than invalidate the principle I have inculcated. There are great objections I admit to the trephine being applied in ordinary cases of fracture, which are not attended by symptoms of further mischief; but the nature of the cases which I have particularly referred to, having been ascertained, I maintain that the practice should be prompt and decisive in every instance in which the surgeon is satisfied that there is not merely a slight depression or separation of the inner table, but that several points of it are driven into the dura mater. If one trephine will suffice, the central point being applied close to the edge of the middle of the wound in the bone, it should be applied there; but if the cut be longer, and the spiculæ of bone extend upwards and downwards in its length, a small trephine should be applied as near each end as may be judged advisable, and one edge of the cut bone should be removed by the straight saw, of which Paré and Scultetus made such use in ancient times, and which Mr. Hey of Leeds revived in modern surgery; or the small straight saw may be used alone, if the object of removing a portion can be attained without the trephine. By these means sufficient room will be

obtained to remove the broken portions of bone which are irritating the dura mater, and brain. I am satisfied that the danger resulting from the application of the trephine in such cases, bears no proportion to the risk incurred, by leaving the broken portions of bone as a constant cause of irritation *.

Fractures of the skull from sharp cutting, weighty instruments, impelled in a horizontal direction, do not always cause the peculiar derangement and fracture of the inner table which has just been noticed, and the practice recommended does not apply to them. The nature of the injury in such cases can be more readily perceived, and the broken portions of bone removed; so that although one of Hey's saws may be a very necessary implement, the trephine will rarely be required. This kind of wound should be treated in the simplest manner.

When a portion of bone is as it were sliced off with the scalp, and adheres to it firmly, the scalp and bone should be reapplied; and the cure will often be effected without difficulty. When the portion of bone cut off, and hanging to the scalp which is turned down, has but little adherence, it had better be removed.

Lombard† relates three very interesting cases of recovery from horizontal sword cuts in the head through the bone. In the first, the wound was on the right parietal bone, nearly four inches long, the edges at the centre being so far separated as to admit the extremity of the finger even to touch the brain. The patient was cured without even an exfoliation. In the second, the horizontal wound was on the left parietal bone, laying bare the dura mater, the pulsations of which could be seen. This man was also cured without exfoliation, a firm cicatrix covering the opening between the edges of the bone. In the third case the horizontal cut, which was long and deep, was on the upper part of the occipital bone, and had injured the brain; the cure was however complete‡.

* The osteotome invented by D. Heine of Wurtzburg for removing pieces of bone of straight, oval, elliptical, and indeed of all shapes, will, I am of opinion, be found of great use in such cases. The complication of its machinery renders it however too expensive and complicated for general use.

† Lombard, Père, Remarques sur les Lésions de la Tête. Strasbourg, 1796.

‡ Le Dran relates, from M. Leaulté, who had charge of the wounded at the battle of Malplaquet, the case of a soldier who was wounded by a sabre at the upper and middle part of the occipital bone, which cut through the scalp and bone, forming a flap, which exposed the dura mater without injuring it. The flap, with the bone adhering to it, having been replaced the day after in its natural position, united in twenty-five days. He died a year afterwards; and, on examining the head, Le Dran found the piece of bone which had been cut off had united very smoothly on the inside of the skull, but with some irregularity on the outside. Le Dran (H. F.), Observations de Chirurgie, tome i. page 156. Paris, 1731.

A German dragoon was brought to me at Madrid, who had received a slicing cut of this kind on the top and side of the head, which caused a portion of the scalp, and parietal bone to be turned down over the ear, and uncovering the dura mater; replaced and retained in its situation, the flap and bone appeared to adhere, and the man recovered. In the case of a Portuguese soldier, cut down by the French cavalry in a sortie during the second investment of Badajos, a portion of bone cut off with a flap was quite loose, and was removed. The patient did equally well.

I saw a soldier at Brussels, after the battle of Waterloo, in whom a portion of the occipital bone, and dura mater had been separated with the scalp, and turned downwards by a slanting cut with a sabre; Dr. Thomson*, who alludes to this case, says, "a tendency to protrusion of the brain took place during an attack of inflammation, a slight degree of stupor with loss of memory occurred; but on the inflammatory state having been subdued, the brain sunk to its former level, the stupor went off, and the memory returned."

In the museum of the Royal College of Surgeons there are ten skulls which have suffered from very severe slicing cuts. They appear to have been collected from the burial-place of some establishment for invalid soldiers in Germany. The portions of bone thus sliced, and they are large pieces, were once detached, and afterwards reunited a little out of their proper places, so that the points of union and of separation can be distinctly seen. These fissures are all in a certain state of progress towards being filled up by bone, and the patients must have lived some months, if not years, after the receipt of their respective injuries; for bone is deposited apparently with difficulty, and most carefully in all such cases, so as not to irritate the membranes of the brain. The opening in the first instance is filled up by granulations, over which a thin skin is formed, this afterwards became firmer and harder, being in some cases, where the trephine has been used, a thin but strong membranous expansion extending from one edge of bone to the other. In others it is thicker and more solid, and in a few instances osseous matter is deposited in its circumference so as in part to fill up the opening; the edges of the bony circle made by the trephine becoming gradually thinner as they appear to grow inwards. It is rare that an exfoliation does not take place

* Thomson (John), M.D., Observations made in the British Military Hospitals in Belgium after the battle of Waterloo. Edinburgh, 1816.

from the edges of the cut bone, or from the circle made by the trephine. It has been occasionally observed after death, that the circular cut edge of the bone does not become thin in the manner described, but that a sort of ridge forms around and within it, which was thought to be the cause of death in some persons who died suddenly, and in whom no other derangement of structure could be perceived.

When the scalp is torn down without being bruised, and a large flap extending from the occiput to the forehead falls down on the shoulder, covered with blood or dirt, the flap should be cleaned and restored to its place. When it is large two or three sutures may be necessary to keep it in its proper situation; but they are not to be had recourse to when they can be avoided, the retention of the flap being generally best effected by adhesive plaster, compress and bandage. The flap may not entirely adhere under any management, but it will do so in parts, and care should be taken to evacuate at an early period any matter which may form, by small but sufficient incisions made where required, and which will be in general above, and about the ear. The French surgeons during the war bathed the scalp in wine, when they could get it, and dressed the flap separately, allowing granulations to form from both it and the pericranium before they placed them in apposition; which is a much longer process, and generally causes a larger cicatrix from the ultimate shrinking of the integuments. I have tried both ways of proceeding, and prefer in all scalp wounds to procure by the former plan as much adhesion as possible. When the flap is much bruised, the attempt at adhesion by close apposition will be useless until after suppuration has taken place, when a well-regulated pressure will do much towards expediting the cure.

A blow or bruise on the head often gives rise to a swelling or tumour, occurring from the rupture of the small vessels passing into the cellular membrane between the scalp and the pericranium; the tumour in these cases appears *immediately* after the receipt of the injury as a soft swelling, and is usually found to contain blood, which in most instances is removed by absorption in the course of from fourteen days to three weeks. In some cases inflammation supervenes, and one part becomes tender and appears to point; into this a small incision should be made to allow the blood and matter to escape, when gentle compression should be resorted to, in order to induce the parts to unite. I have lately seen two swellings of this kind in new-born infants, occurring from press-

ure during delivery, which might readily have been mistaken for deficiencies of the occipital and parietal bones, if it had not been for the absence of all motion, which under such circumstances would have been communicated to them from the brain. The blood effused in the cellular membrane raises the border of the swelling, which becomes harder than the neighbouring parts, whilst the centre remains soft and yielding, giving the sensation to the finger as if the bone beneath were wanting, and after a blow, the idea that the bone beneath had been depressed. If such a swelling be unfortunately opened, considerable inflammation and suppuration will often follow, to the great inconvenience of the patient, which will in general be avoided by the use of a moderately stimulating cold lotion.

Erysipelas sometimes supervenes on wounds of the head, and usually occurs in one of two forms,—1st, when the skin has the ordinary redness characteristic of the complaint ; and, 2ndly, when the colour of the skin is not altered, or is whiter than natural, but puffed, tense, and shining, in which case the inflammation is seated beneath the tendinous expansion of the occipito-frontalis muscle, or under the fascia of the temporal muscle.

The general treatment in both forms should be regulated by those principles, referring to the powers of the patient and the state of the constitution, which I have inculcated in my work on ' Inflammation and on Gun-shot Wounds,' &c. p. 99, Third Edition.

The local treatment of the first form essentially depends on puncturing the red and inflamed skin all over with the point of a lancet, after the manner recommended by Sir. R. Dobson, assisting the flow of blood by warm fomentations. The punctures should be repeated if the inflammation continue, or should extend to other parts. It is an excellent means of cure. The second form is to be treated by incision, in the manner I have recommended, p. 109 of my work above quoted. Of this treatment the appended case * affords the first re-

* Thomas Key, aged 40, a hard drinker, admitted into the Westminster Hospital on October the 21st, 1823, at night, in consequence of falling, and striking his left arm against a stool four days previously, which had given rise to erysipelatous inflammation. He was smartly purged with calomel and jalap, and took small doses of the antimonium tartarizatum and sulphate of magnesia, so as to cause both vomiting and purging. In the evening he lost twenty-five ounces of blood from the temporal artery. The arm was very much swelled, the skin of an erysipelatous redness, very tense, elastic, springy, and yielding a sensation of fluctuation, the inflammation being evidently deep seated;

corded instance, and proves what I have stated in my work, that this improvement in practice is really due to the surgery of the Peninsular war, and is one of the benefits resulting to science and humanity from that arduous contest.

John Burkett, aged 45, was admitted into the Westminster Hospital, October the 11th, 1828, in consequence of a wall having fallen upon him, lacerating his scalp, fracturing the sternum, the left clavicle in two places, five ribs on the right side and three on the left: those on the right side were, in addition, separated from their cartilages near the sternum. The right ulna was broken in two places, the olecranon was laid bare, and so was the external condyle of the humerus. Four days after admission he became restless, incoherent, and in fact delirious. The scalp was in a state of general puffiness, causing the head to look considerably larger than usual, but without a shade of redness, and retained the impression of the finger; pulse 98 and wiry. Mr. Guthrie, on examining the head, said the case was one of diffused inflammation of the cellular texture, both above and below the occipito-frontalis tendon, constituting a very rare example of dis-

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pulse 120, strong; tongue dry and furred; great thirst; skin hot; is very restless, unruly, and wandering. After the bleeding he became quiet; a profuse perspiration broke out over the whole body; he appeared relieved and comparatively tranquil. Fomentation and poultices were applied every three hours to the arm.

On the 30th, his state not being improved, a consultation was held to determine on the propriety of making incisions into the inflamed part, but this was considered improper by the parties consulted, and saline medicines with small doses of tinct. opii were substituted.

October 31. Pulse 130; he is weaker and more irritable; was delirious all night, and in a state of great restlessness; countenance sunk; skin dry and hot; tongue furred, and altogether in a state of extreme danger. The arm greatly swelled, of a darker colour, and giving to the touch a strong fluctuating boggy feel. I made two incisions forthwith into the fore-arm; one on the back part eight inches in length, the other five inches long on the under edge in the line of the ulna down to the fascia, which was in part divided, and one vessel bled freely. There was not any matter beneath it, but a considerable quantity of serum and matter of a gelatinous appearance was discharged, mixed with venous blood, but no pus. The incisions did not give much pain.

November 1. Pulse 90, and steady; tongue furred, but rather moist; heat of the skin moderate; slept occasionally during the night, and was much quieter; says himself he had a good night. The arm is less swelled; the cellular membrane is evidently sloughing, and this state extends beyond the extremities of the incision on the back of the arm, which was therefore augmented to the extent of eleven inches. Ordered to continue the saline mixture, four grains of calomel and four of extract of colocynth, and the infus. of senna and salts to be given afterwards, and repeated till a due effect is produced.

From this time he gradually recovered; the incisions were made, however, too late to prevent the loss of a considerable quantity of cellular membrane and skin.

ease, and being in fact the same as that which in other parts was frequently called erysipelas phlegmonodes; the erysipelatous blush being alone wanting, and therefore showing that it was not an essential sign of the complaint. The only practice which could save the patient's life was, he said, by incision, so as to relieve the internal and external parts at the same time, by which the general disturbance and irritation would be removed. He made two incisions in the scalp on each side of the sagittal suture, one six inches long, the other four, united them by a cross cut, and added another from the ear upwards. The scalp was upwards of an inch in thickness, and filled with a fluid partly serous, partly purulent, which was readily squeezed out in all directions. Several arteries bled freely, and were allowed to do so until the man was presumed to have lost about thirty ounces of blood, when the hemorrhage was stopped by pressure. The head was directed to be fomented.

16th. The patient is greatly relieved, and there is a manifest improvement in the scalp; pulse 84 and small. Mr. Guthrie said the imminent danger was past as regarded the scalp, for he believed the man would not have survived this day if any other mode of treatment had been adopted.

On the 20th another incision was made in the back of the head; after which the patient gradually, although slowly, recovered from all his injuries, and was discharged cured *.

The essential points are, first, to take off tension; the second, to allow of the free discharge of any fluid which may be secreted. I have in the Westminster Hospital at this moment (June 1842) the servant of Sir F. Trench, who falling from behind his master's cabriolet, suffered a compound dislocation of the right ankle, which was followed by an inflammation of this kind up to the groin, neither leg nor thigh showing any redness, although each was of double the natural size. Several incisions, from one to two, three, and even four inches in extent, were made in different places, and even through the gastrocnemius and soleus muscles, down to the deep fascia of the leg, in order to give him a chance for life, which has been by these means almost miraculously preserved.

The following case, for the notes of which I am indebted to Mr. Avery of the Charing Cross Hospital, is one of great interest in all points.

Mr. F. B., 64 years old, was knocked down by a horse in the Strand on Mon-

* Medico-Chirurgical Journal for 1841, by Dr. Johnson.

day afternoon, and taken to the Charing Cross Hospital, where I was desired to see him with Sir B. Brodie, Mr. Skey, and Mr. Rowe, in consultation with the surgeons of the institution, Messrs. Hancock and Avery. He was in a state of stupor, but could be roused by speaking sharply; breathing slowly and silently; pulse 46 and feeble, skin cold, pupils dilated. There was a lacerated wound over the right parietal protuberance, and bleeding from the right ear; he vomited and brought up some blood. A cold lotion was applied to the head: at night he was sick again and brought up some more blood. Hydr. Chloridi gr. iii., Ext. Coloc. C. gr. v.

Tuesday, June 22nd. Haustus Sennæ cum Magnes. Sulphate. Half-past two. Skin warmer; complains of pain in the head; pulse 68 and firmer. V. S. ad ℥xiv. Enema Catharticum. 1 P.M. Restless, drowsy, wandering at intervals, gives a short answer correctly, but appears to forget what he is saying when he attempts a longer one; bowels freely open; bleeding from the ear has ceased; pulse 84, rather hard; he complains of pain in the head. V. S. ad ℥xii, which made him sick; the bleeding was therefore stopped. Haustus Catharticus tertiis horis. 4 o'clock. Still complains of pain in his head, and does not answer any question correctly, and wanders; the pulse has been gradually rising, and is now 100 and hard. V. S. ad ℥xxiv. Pulse became soft; pain in the head relieved. A saline draught with antimony every three hours.

Wednesday, June 23rd. Bowels open three times during the night; still restless and wandering; tongue white and moist; pulse 96; the scalp about the wound swollen and puffy. At 12. Pulse 102, much the same. Empl. Cantharidis inter scapulas. At 4. Six ounces of blood were taken away on trial, but as the pulse became smaller and softer the bleeding was arrested. Pulv. Ipecacuanhæ gr. xx., Ant. Tart. gr. i., which was repeated, the first not having acted. He had a slight sort of fit, which lasted two minutes, and a copious perspiration followed. Calomel gr. ii. secundis horis.

Thursday, 24th, eight in the morning. Restless; respiration noisy, sighing, but he appears more sensible; bowels have acted freely, and a quarter of a grain of opium was added to the calomel; has slept a little; pulse 88. Four P.M. Swelling of the scalp is extending; the right eye is quite closed; pulse 74; an incision was made by Mr. Avery above and anterior to the right ear. 25th. Continued the calomel, being much the same. 26th. Has slept; says he is freer

from headache, and is generally rather better; wound discharging well; bowels very free. 27th. Much the same; pulse 64, soft; quite sensible; another incision was made in consequence of a retention of matter above the right ear; he sat up in bed and was allowed an ounce of sherry in water. 28th. A short incision was made, which arrested the mischief entirely in the scalp, and from this time he gradually improved until his final recovery.

The incisions in this case were attended with the most marked advantage.

Erysipelatous inflammation is more apt to follow punctured wounds in persons who live, or have lived irregularly; and the moment the parts around the cut or puncture have become puffy, the surface of the wound changing from a red to a yellowish colour, with a thin discharge instead of good pus, an incision should be made through them, and repeated in different places as often as may be found necessary. It relieves the tension, and prevents the quickened pulse, the irritative fever, the delirium which would follow, and which neither bleeding, purging, nor the other constitutional remedies which the state of fever may indicate, will remove. If it should be neglected, suppuration and sloughing will extend under the tendon of the occipito-frontalis, or the fascia of the temporal muscle, as the case may be, and the greatest danger will be incurred. Mr. Pott, and many of the older surgeons, were, it is but just to say, aware of the value of incisions in such cases; and Desault derived the greatest advantage from emetics and purgatives, the use of which is deserving of the greatest attention.

There is an essential difference between a depression of the skull in a CHILD and in an ADULT. In the child the inner table is not brittle, it bends equally and does not break; it very often does little mischief when depressed, and gradually recovers its level. The brain in young persons is softer and less consistent, and can accommodate itself more readily to pressure for a limited time without ultimate mischief than the brain of an adult, so that a continuance of the most urgent symptoms can alone authorize the application of the trephine in children, and young persons under fifteen or sixteen years of age. If the records of surgery for the last twenty years be carefully examined, it will be found, that the greater number of successful cases of recovery from depression, or from fracture and depression of the skull, which were not trephined, were in young persons; a fact which is deserving of the most serious attention.

Twenty years ago a small child fell over the banisters of the second floor in a

public-house at the top of the Haymarket. I saw it as soon as possible afterwards, lying on the bed, motionless, senseless, breathless, with a hollow in the parietal bone that would have held half of a small orange, and I thought it was dead. In a short time it gave a gasp, another followed at an interval so long as to excite surprise, and a third shortly afterwards led to some hope. The motions of the heart and the pulse, which were only now to be felt, being equally irregular and defective. It gradually recovered, and the next day breathed regularly, could speak, and answer shortly, although apparently otherwise stupid and restless. Pulse 90, and regular. Cold lotions were applied to the head. The loss of a little blood by leeches with some smart purgatives gradually removed the unfavourable symptoms, and the child began to walk about, with a hollow in the side of the head which exceeded anything I had seen before, and it was several weeks before the skull regained its level. The same thing then takes place in the bending of the flat bones of the skull in young children, which is so often observed in the long ones at the same period of life*.

The propriety of dividing the scalp in an adult in order to examine the state of the bone beneath, which is evidently depressed, and thus rendering a simple although comminuted fracture a compound one, is a matter of much greater importance, the decision of which rests upon the still more essential point, viz. whether a depressed portion of bone ought, or ought not to be removed? And this again must depend upon the nature and extent of the depression, for many persons who have suffered from such a misfortune have recovered without the depressed portion being raised. It is a question of degree or extent, upon which every surgeon must form his judgment from his own observation and experience.

The difference between a simple and a compound fracture of the leg is often considerable, it is more often dependent on degree; and when the fracture is nearly transverse, and the skin cleanly divided, the difference between it, and a simple fracture of the same part, is little more than one of time. I suspect this to be the case with an injury of the head, and my experience induces me to believe that the difference between the two states in fractures of the skull has been much exaggerated; so much so, that I place no reliance on the supposition that

* Avellan says that a girl of fourteen had a depression of the right parietal bone from a blow, which gave rise to mental derangement, amounting almost to imbecility, for three months; at the end of which time the depressed bone gradually resumed its level, and the girl completely recovered. In Quesnay, Mémoires de l'Académie de Chirurgie de Paris, tome i.

there is more real danger in a case of fracture with depression, in which the scalp has been divided, than when it has been only bruised, and not divided; and I apprehend that in all cases in which a fracture with marked depression is known to have occurred in an ADULT, it is the best practice to divide the scalp, and ascertain the nature and extent of the depression.

If the result of a great number of comparative trials should prove in favour of never, under any circumstances, raising a depressed portion of bone in an adult, but of leaving it to the efforts of nature, an incision in order to ascertain the state of parts below ought not to be made; but as such result is not likely to be obtained, according to my observation and experience, the practice recommended appears to be the best.

The scalp should be divided, in such cases as may require the operation, by a straight, crucial, or such other shaped incision, as may be found most convenient to the surgeon; but no part should be removed which can be preserved with the hope of maintaining its life *. Heliodorus †, who followed Celsus but preceded Galen, had much more proper ideas on the subject than many of his successors of a much later age. He says in a fissure, a simple incision is proper, or that form of double one which by two transverse lines gives the figure of a cross—a recommendation which our countrymen Banester ‡ and Lowe § enforced; Woodall ‖ and Wiseman ¶ recommending in addition the form of a Roman T. It was only a little before the time of Sharp** that scalping, or the removal of a circular piece, came into fashion; a piece of barbarity which is however no longer in use.

The cranium, together with the fracture and depression, being exposed, the question whether the trephine should be applied or not, is now to be determined. If the operation by the trephine, or that of sawing a piece of bone out of the head, was not in itself dangerous, there could be no hesitation about its use; but

* See Mynors (Robert) of Birmingham. An Historical Sketch of the practice of laying bare the Skull, and containing the opinions of the various authors who wrote from the time of Hippocrates to Benjamin Bell. 1785.

† Heliodorus de Fracturis, ex Nicetana collectione per Cocchium, p. 91. Florentiæ, 1754.

‡ Banester (John), The Works of that famous Chyrurgeon, in five books. London, 1632, p. 205.

§ Lowe (Peter), Scottishman, The whole Art of Chyrurgery. London, 4th edit., 1654, p. 313.

‖ Woodall (J.), Military and Domestique Surgery. London, 1639, p. 3.

¶ Wiseman (Richard), Eight Chirurgical Treatises, vol. ii. edit. 1734.

** Sharp (S.), Treatise on the Operations of Surgery, edit. 5. London, 1749, page 238.

it is a dangerous operation, especially in crowded hospitals, and ought not to be resorted to when it can be avoided. I am of opinion, that if any ten healthy persons were trephined in an hospital, one would in all probability die from the effects of the operation; and that three or four more might have a narrow escape from the inflammation of the brain and its membranes, or the other consequences, which would probably ensue. It is not the admission of air, which has been even lately supposed to do mischief, that is to be dreaded in these cases, but the same kind of irritation which often follows the abstraction of a piece of bone under other and more ordinary circumstances at a later period of time. It does not necessarily follow that the same unfavourable consequences should take place under happier circumstances, when the operation of trepanning may be fairly considered as less formidable.

The following cases are illustrative of many important points.

William Rogers, aged 19, of the 32nd regiment, was wounded on the 16th of June by a musket-ball, which entered at the inferior angle of the left parietal bone; it knocked him down, and for a few minutes rendered him senseless. On recovering his mental powers, which he soon did, he found that he was unable to speak, not so much (as he says himself) from the want of power to form words, as from the incapacity of giving them sound. He was conscious of everything passing around him, and reasoned correctly: he retired out of the reach of shot, and then lay down for the night. On the following morning, finding the picquets retreating, he fell back himself on Brussels, where he was examined and dressed. On the morning of the 18th he reached Antwerp on horseback, very giddy, and overwhelmed with fatigue, fasting and watching; he was admitted into the Minime General Hospital, and put to bed, when he soon fell into a sound sleep, which with some tea refreshed him much.

June 19th. On examining the wound, the ball was found to have passed obliquely upward and backward at least two inches, and could be distinctly felt with a probe. It gave more the idea of having raised the outer table than that of having depressed the inner; both tables must however have been displaced. The defect in speech was in some measure restored, and this with giddiness were the only symptoms of compression. A poultice was placed over the wound, a sharp purgative given, and spoon diet ordered.

20th. The pain and giddiness having increased, with annoyance from noise

and exposure to light, twenty-six ounces of blood were taken from the arm. The following day the purgative was repeated, and the patient was much relieved: a faltering in the speech continued for many days. Everything went on well, the wound was nearly healed, and he was considered almost fit to be discharged, when, on the 16th of July, the wound began to open; on the 18th it was dilated and a portion of the cranium removed by the forceps, which was soon followed by symptoms of inflammation of the brain, and twenty ounces of blood were taken immediately from the arm; purgatives and diaphoretics were ordered, and the strictest abstinence enjoined. 23rd. Venesection was repeated, as well as the other means usually adopted to reduce high action. 24th. Completely relieved. Saline mixture continued; a little meat soup allowed. 26th. Another portion of the cranium removed, the dura mater being fully exposed; the general health in the best state.

August 3rd. Doing remarkably well; the wound healthy; the pulsation of the brain evident; the power of speech perfectly restored. The ball yet remains in, according to the opinion of the patient (who is a fine intelligent lad), and he thinks has gradually descended towards the petrous portion of the left temporal bone. Sent to England at the end of the month well.

When I saw this man at Antwerp I gave my opinion without hesitation, that the bone and the ball ought to have been removed in the first instance, when he would have had a better chance for perfect recovery. The operation when afterwards performed for the removal of the loose pieces of bone placed his life in great jeopardy. He was discharged the service with the ball lodged, and it is more than probable that he did not long survive, which he might have done if the ball had been removed when it was first felt within the skull.

The following case from the Baron Larrey may be advantageously read in connexion with the one just related.

An officer was wounded on the right side of the forehead by the point of a lance, which passed upwards, making a deep groove in the frontal bone. On the tenth day he was attacked by tetanic symptoms, with loss of sight of the right eye, and convulsive movements of the lid. The external parts were all now divided with the greatest benefit, the tetanic symptoms subsiding within twenty-four hours. On the twenty-fifth day, symptoms of inflammation and of effusion on the brain supervened, and he died on the twenty-seventh day after the receipt

of the wound. On opening the head a portion of the inner table was found detached, and the anterior lobe of the brain in a state of suppuration. Larrey adds, "I had in this case to regret that I did not apply the trephine. Occasio præceps, judicium difficile."

In the appended case of O'Brien the ball could not perhaps have been removed in the first instance with propriety; it might however have been lying on the dura mater, or near it, within reach, and the actual state of things ought to have been ascertained; the surgeon afterwards deciding whether in such a case any further operation was proper or necessary *.

The case of Clutterbuck † may be properly contrasted with that of O'Brien which

* Thomas O'Brien, 28th regiment, aged twenty-three, was wounded by a musket-ball on the 16th of June at Quatrebras; the bullet penetrated the occipital bone below and to the right of the junction of the lambdoidal and sagittal sutures. On his arrival at Colchester, the wound was healthy in appearance and healing rapidly. It appeared from his own account that for some hours after the injury he was totally deprived of sight; since that time he has been constantly more or less affected with headaches, for which he has been prescribed occasional cathartics and low diet. He has been also affected with pain and weakness in both eyes, but more particularly in the right. While at Brussels and during his progress to Ostend he lived very irregularly, and was frequently intoxicated; the external wound was entirely healed on the 20th of July, and no suspicion existed that the ball was lodged in the brain. On the 25th matter was perceived under the scalp, and was yesterday evacuated. Today, the 27th, he complains of increase of headache; pulse small and quick. V. S. ad ℥vj. Haust. Cathart. statim. 28th. In the course of this day his symptoms have become very urgent; he is restless, with a very quick pulse; an extensive crucial incision was made in the site of the original wound, and now for the first time it was discovered that the ball had penetrated the brain; several loose pieces of bone were extracted; a considerable quantity of arterial blood was suffered to flow from the small vessels divided in the incision. His bowels had been well opened by the cathartic. The most vigorous treatment was continued, but the symptoms notwithstanding increased, and he died on the morning of the 29th of July.

The ball was found lodged near two inches deep in the substance of the right posterior lobe of the brain; a considerable quantity of pus surrounded it; some inflammation of the brain and its membranes was observed, but it was much less than might have been expected.

† A. Clutterbuck, 61st regiment, aged twenty-five, was wounded in the back of the head by a musket-ball at the battle of Toulouse, on the 10th of April, 1814. He felt little inconvenience from the wound the first two days. On the 14th he complained of severe pain in the head, giddiness, and dimness of sight; the face was flushed, pulse hard and frequent. Twenty ounces of blood were taken from the arm, and the wound enlarged to expose the cranium. The upper part of the os occipitis was found fractured by the ball, and a circular portion of it, about the size of a shilling, was depressed and fractured. 15th. Pain in the head much abated; no giddiness, dimness of sight, or any unfavourable symptom; pulse still hard. V. S. ad ℥xx. To be well purged. 19th. He was bled again this day to the extent of twelve ounces, as a matter of precaution. 23rd. Continues free from any bad symptom. May 8th. The wound is now much contracted. He has been out of bed for some time past,

precedes it, as showing by the result the difference between an uninjured and an injured brain. If the fractured and depressed bone had not been at the back part of the head, it is probable the depressed portion would have been removed in the first instance, as it certainly would have been after the 15th, if the unfavourable symptoms had not yielded to the general treatment; but the bone would then have been removed under much more unfavourable circumstances than at first.

Lawrence Moore, æt. 27, was knocked down on the night of the 6th of April, 1816, by a blow of a stone, which fractured the upper and left edge of the frontal bone, the depression being about an inch and a half square. Fluat sanguis ad ℥xxv. Took out the detached pieces of bone and dressed the wound simply; he lost about 20 oz. of blood during the operation.

7th. Had a pretty good night; pulse small and very hard; head feels to himself full, and gives the sensation as if it were bound with an iron hoop (his own words); eyes very suffused. Fluat sanguis ad ℥L. Valdè melius se habet post V.S. Hora 8va P.M., pulse up, hard and full. Iterumque fluat sanguis ad ℥xxv. Much relieved. Habeat Electuarii Scammonii scrupulos duos.

8th. Awoke after having passed a good night, pain in the head gone, pulse small, medicine operating well. At nine o'clock the pulse had risen to 130, hard and small; has a severe throbbing sensation in the head over the seat of the injury; tongue white and dry. Fluat sanguis ad ℥40. Valdè melius se habet æger post sanguinis detractionem, habeatque cras primo mane si opus sit, Electuarii Scammonii scrupulos duos. Bibat ad libitum aquæ hordei $\bar{c}$ super tart. potassæ. 9th. Repeated the purgative medicines.

10th. Has been well purged; tongue clean, pulse more natural, eyes much depressed, the redness has left them, the fulness of head is also gone, and on the whole he is doing well. The discharge of a sanious nature, the wound externally like ochre. In the afternoon the pulse rose, but was not so hard as to indicate the use of the lancet; has pain and fulness over the injury. Rept. Infus. Sennæ uncias octo, duabus vicibus sumend., et nisi plene responderit alvus, vespere habeat, Electuarii Scammonii scrupulos duos.

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and feels no inconvenience. A small portion of the bone still feels bare to the probe, but the greater portion of the depressed piece is covered with healthy granulations. No exfoliation has taken place. May 24th. The wound is nearly healed; he is in good health and spirits, and without inconvenience. Discharged to Bordeaux.

11th. Was purged eight or nine times during the night from the infusion and electuary; pulse good; feels more comfortable in every respect; had some sleep during the night and this morning, which has refreshed him. Water gruel *ad libitum*. Vespere; multo melius; pulse 84; habeat mane primo cras, Electuarii Scammonii ℈ij.

12th. Pulse good, being almost natural; feels quite easy, and has no complaint except of weakness; the medicine operated well. 13th. Pulse 72, and soft; head easy, wounds healing, discharge very small in proportion; tongue rather white, but not loaded; diet confined to thin water gruel. 14th. Is doing well in every respect; very little discharge; pulse 84. Electuarii Scammonii ℈ij. 15th. Pulse *natural*; wounds healing; discharge good; in every respect doing well; and continued to improve until the 23rd of June, when he was discharged cured.

This case shows the advantage to be obtained by removing such fractured and depressed portions of bone as might irritate the dura mater and brain if allowed to remain, and also demonstrates the very great extent to which blood may be drawn in strong and healthy persons, in a short period (160 oz. in three days). When the symptoms were not so immediately urgent as to demand the use of the lancet, the free exhibition of drastic purgatives was attended by the best effect*.

The following case supports the former, as to the extent to which blood-letting ought to be carried to preserve the life of the patient. There having been no reason to believe that the symptoms depended on fractured and depressed bone, the scalp was not divided; and as the symptoms were coeval with, and not consecutive on, the injury, they were therefore supposed to depend on concussion rather than on compression of the brain. If the trephine had been applied on the fourth day because the insensibility continued, the additional injury would in all probability have proved fatal. If the depletion of all kinds had been less effective, the inflammation of the brain, or of its membranes, would certainly

* Certain diseases give a peculiar tone to the circulatory system, enabling it *to bear*, and causing it *to require*, great loss of blood in their treatment: they are inflammations of the serous membranes and parenchymatous substance of organs. Other diseases induce this effect in a much slighter degree; such are the inflammations of the mucous membranes. Lastly, other diseases render the system unduly susceptible to the effects of loss of blood: these are the class of irritations, as gastric and intestinal disorders and irritations. Dr. Marshall Hall in the Gulstonian Lectures for 1842.

have terminated in the effusion of lymph or the formation of matter, which the trephine would not have prevented nor removed.

George Mills, an artillery driver, aged twenty-eight, was admitted into the Depôt de Mendicité Hospital, Toulouse, May 29, 1814, in consequence of having been thrown from his horse on his head against the ground. He had fallen on the right side of the os frontis, immediately above the eye, where the surface of the skin appeared to be scratched and bruised, but the bone was not depressed: he was bled freely, but remained insensible. The next morning he was again bled to twenty ounces, which operation was repeated in the evening. On the 29th the temporal artery was opened, and a vein in his arm at the same time; the breathing being strong and sonorous, he lay quite insensible, the eyes being closely shut; the pulse before the bleeding was quick and small; after he had lost about eight ounces of arterial and eight ounces of venous blood it became fuller, and the breathing was somewhat relieved; the slightest touch gave him pain, and he shrunk from pressure made directly above the eye. The temporal artery was again opened in the evening, and ten ounces of blood were taken away. A purgative and a stimulating enema were ordered, and cold was constantly applied to the head.

30th. He was freely purged, and appears more collected; the pulse is still quick and small; breathing very free; the irritability continues, and he complains of pain on pressing the head. The purgative and enema were repeated, and ten ounces of blood were drawn from the temporal artery; after which he attempted to speak. 31st. Passed a good night; the pulse is quick and small; pain in the head still great; was again bled to twelve ounces, and the purgative was repeated. June 1st. Pulse quick; there is not so much pain in the injured part, and he appears more sensible; was bled to twenty-four ounces, and the purgative was repeated. 3rd. Was again bled to ten ounces. From this time until the 20th he gradually improved, and was then discharged cured.

Captain R., aide-de-camp to General Sir L. Cole, received a wound from a musket-ball at the battle of Albuhera on the anterior and middle part of the left parietal bone at its junction with the frontal, which fractured it, causing some slight depression. He was rendered insensible at the moment, and was brought in the evening to the village of Valverde, where the insensibility was shortly followed by symptoms of inflammation, which were subdued by repeated bleed-

ings, under which he gradually recovered, and remained well until killed at Pampeluna. The division of the scalp gave rise to no additional symptoms.

The treatment in these two last cases was the same, although in one there was no fracture, and in the other there was fracture and depression. The broken portions of bone did not on examination appear to press unequally on the dura mater, and it was presumed that the moderate degree of pressure which ensued from the depression might be borne with impunity, as it did not seem likely to be accompanied by the projection inwards of any pointed pieces which might irritate the brain. The result confirmed the supposition, and justified the treatment. If the examination of the depressed part had led to the apprehension that such points of bone did exist and were sticking into and irritating the dura mater or brain, I should have removed them, under the belief that although they might not at the moment have given rise to any other symptoms than those which depended on the blow, the time would come when they would scarcely fail to cause those which usually accompany the formation of matter within the skull; or if this danger should also have been avoided, that the evils which have been noticed from p. 79 to 84 as occurring at a later period, and which ultimately require the same operation for the relief of the patient after months of acute suffering, might be encountered; the cases at the pages indicated were referred to solely for the purpose of showing that although a person might temporarily recover from an injury in which a portion of bone was allowed to remain an irritating substance to the brain, it did not follow that such recovery should be permanent*. If there be a doubt on the mind of the surgeon whether there are or are not any portions depressed and irritating the brain or its membranes, he should wait; and in this it is that the real difference between modern surgery and that of the olden time exists with respect to adults †.

When a fracture is accompanied by depression, and the broken portion or portions of bone would seem to be driven into the dura mater or the brain, or to press

* Sharp (William) of Bradford, Practical Observations on Injuries of the Head. London, 1841, page 153.

† Warner (Joseph), in his Cases in Surgery, Third Edition, London, 1760, has related an excellent one bearing on this point, in a boy thirteen years of age, a part of whose sagittal suture was driven into the longitudinal sinus and into the brain on the 16th of November, 1749. A fungus was pared off, the trepan was applied in two different places, the dura mater was incised, and matter was evacuated from beneath it, but a piece of bone remained sticking into and irritating the brain for three months. The boy at last died, and as Warner believed from this cause.

so unequally upon them that as much mischief is likely to ensue from leaving, as from removing them, and especially in an adult or middle-aged man, less harm will in general follow from ascertaining the fact, by dividing the scalp, and removing the broken pieces, than by doing nothing, more particularly when the presence of a foreign body is ascertained. If there be no symptoms indicative of mischief below the fractured part, the surgeon must then decide, after the best estimate he is able to make of the probable evil which will occur from allowing the broken or depressed portions of bone to remain. I have already stated, page 104, that according to my experience an incision through the scalp renders the dura mater very little more liable to suppuration than it is without this; nevertheless that trifling degree of liability should not be incurred without an absolute necessity. I have now under my observation a child four years old who fell out of a window and has driven or bent in a portion of the frontal and parietal bones of the top of the head. The depression and fracture can be distinctly felt, but as there are no symptoms indicating any immediate mischief, there can be no reason for interference.

I have said, page 102, that in young persons the brain will bear a greater degree of pressure and of irritation with impunity than it will in persons of mature age, that by far the greater number of cases in which recovery has taken place after fracture and depression of the skull with injury of the brain, and even loss of its substance, have occurred in children or in persons under the adult age; greater reliance may therefore be placed on the powers of nature in them, and less frequent recourse may be had to the aid of operative surgery in order to prevent mischief than in adults, even when the bone is fractured as well as depressed*.

* Mr. Roberts of Bangor, has recorded an excellent case in a little boy (page 398 of the Lancet for 1836–37), in which he allowed a large piece of bone to remain depressed and forced perpendicularly into the brain, and which appeared to him to be too firmly imbedded in it to admit of extraction. Several portions of brain were lost or removed, the child suffered from convulsions, became paralytic on the opposite side to the injury, yet gradually recovered, three pieces of bone coming away in less than ten weeks. He strongly recommends the use of cold as a substitute in many cases for venesection. In the same volume, page 144, there is also recorded a case by Mr. Liston, of a boy eleven years of age, who had been thrown out of a cart eleven weeks before, and had his head cut in two places by a stone bottle. The wound on the anterior superior part of the head was the most serious, and from this an angular piece of the bottle was removed. He was insensible for one week after the accident, but gradually recovered, and could walk at the end of a month. A few weeks afterwards he lost the power of speech for three days, which he recovered on a profuse discharge of matter taking

Cases of recovery are occasionally recorded in which the broken portions of bone have or have not been removed; but little notice is taken of those in which either practice has been unsuccessful; for few are disposed to offer an unsuccessful case for observation in which the post mortem examination proves either that something has been overlooked, or that the injury was beyond remedy by the ordinary means at present known, and from the relation of which case no addition was likely to be made to our knowledge.

The opinions of those surgeons of hospitals of most repute in London to whom I have not already referred as having written on this particular subject, will be found in their various Clinical Lectures* which have been published in different journals, or in the accounts of cases which have been recorded for them. Mr. Lawrence, of St. Bartholomew's Hospital, appears to be the most earnest supporter of the opinion of Desault, of the Hôtel Dieu, and I have therefore thought it right to transcribe his Clinical Lecture on this important point without abridgment†. It is followed by the particulars of a case nearly simi-

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place from the wound, together with vomiting. Three days after his admission into the University College Hospital, Mr. Liston examined the bone, and finding a fissure with some little depression, he applied the trephine, when two angular pieces of the inner table were found projecting much inwards on each side of the fissure, and were removed. The child recovered.—Liston (R.), Practical Surgery, p. 42.

These two cases, both of them in children, may be advantageously contrasted. In the first there was opening sufficient to allow of a free discharge of matter as it was secreted, and for the removal of all irregular-shaped pieces of bone. In the second the opening was not sufficient, and the irregular-shaped pieces of bone could not be removed. In the first case the trephine was unnecessary; in the second its use was imperatively called for, and it was successful.

* Medical Gazette, vol. i. Clinical Lectures by Mr. Travers; vi. and xxi. Mr. Lawrence; xiii. Sir C. Bell; xxii. Mr. Adams; xxvii. Mr. S. Cooper and Mr. Hall; xxviii. Mr. A. Shaw and Mr. C. Hawkins.

Lancet, 1832–33, 1835–36, Clinical Lectures by Sir B. Brodie; 1836–37, Mr. Liston; 1838–39, Mr. H. Thomson; 1841–42, Mr. Fergusson and Mr. Arnott.

Provincial Medical and Surgical Journal, vol. i., by Mr. B. Cooper.

† The case to which I now direct your attention is a severe injury of the head, a comminuted fracture of the cranium, with bone beaten in on the brain, and portions of the latter forced out through the wound. An important practical question arises in the treatment of such injuries at two periods of their progress, namely, whether the injured bone should be exposed and elevated, or removed, at the time of the accident; and whether, if this has not been done, the measure ought to be resorted to at a subsequent period, if serious symptoms, such as convulsions and paralysis, should supervene.

Thomas Bennett, thirteen years of age, was thrown from a horse which had run away with him,

lar to that which he relates and which was treated by Messrs. Lawrence, Camac,

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and was only stopped by a waggon, against which it came with such force, and received so great an injury as to die half an hour afterwards. The boy was thrown violently forwards, and his head came in contact with a piece of timber. He was insensible from the shock of the injury, but could move his limbs; he was breathing naturally, and his pulse was not materially affected; he had thrown up the contents of his stomach. The upper and right part of the head was covered by a large mass of clotted blood, which I removed with my hand, and found, on turning it over, that it contained portions of brain, which might have been about sufficient to fill a dessert spoon. This had escaped through a wound of the scalp, about one-third of an inch in length, just over the coronal suture. There was a fracture of the right parietal, which could be traced under the integuments from the back of the bone to the situation of the wound, at which there was a considerable and irregular depression. He was conveyed in a coach to the hospital; and a further escape of cerebral substance, to a small amount, was found to have taken place when he arrived. At the end of two hours he manifested sensibility on being pinched; he moved his limbs readily; the circulation, respiration, temperature, and colour of the skin, were natural.

As the bone was here evidently and considerably depressed, and as it was also probably driven in upon the brain, it would, I believe, have accorded with principles of treatment generally admitted, to have performed an operation for the purpose of elevating and removing depressed and detached portions of the bone. The considerations which determined me not to do this were, the favourable state of the patient generally, and in particular the absence of all symptoms indicating compression of the brain; the specimens, in pathological collections, of very extensive injuries of the skull repaired by a natural process; the smallness of the external wound, which brought this case nearly into the state of simple fracture; the extensive incision of the integuments, and exposure of the bone, dura mater, and brain, which an operation would have involved; and the almost invariably fatal termination of such proceedings, within my own experience, in hospital practice. In the latter respect, the chances are less unfavourable in a young than in an older subject; on the other hand, the powers of natural restoration are more vigorous in the former than in the latter. On the whole, I consider the dangers attendant on such an injury as that which befel this poor lad, to be much less than those belonging to the operation which would have been required in this case.

A strict antiphlogistic treatment was adopted, comprising perfect quiet, opening medicines and clysters, and tea diet. The head was shaved, and kept cool by the repeated application of cold cloths; and the wound was kept open, that blood or effused liquids might escape readily. In thirty-six hours after the accident, the external senses and the mental powers were completely recovered, and speech was restored. When questioned, he complained of pain in his head, which continued more or less for about ten days, and was the principal symptom referable to the accident. On the 9th the neighbourhood of the wound was red, hot and painful, and there was restlessness. The application of six leeches removed these symptoms.

The entirely favourable progress of the case seemed to justify the course which had been adopted; but new and alarming symptoms appeared on the 14th. There was some increase of temperature in the head and general feverishness. Convulsions came on in the face and right limbs, while the left arm and leg were completely paralysed. The question of operation was again considered. I did not refer these symptoms to pressure of the displaced bone, believing that if any effect had been produced

and Furner of Brighton, in a diametrically opposite but equally successful manner*.

A French grenadier was brought to the field hospital the second day after the battle of Salamanca, who had received a blow on the left side of the head, probably from a piece of a shell, which had caused a contusion and swelling on the left

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by that cause, it would have followed the accident immediately; and I thought the present symptoms must be ascribed to the inflammation of the brain, which might be expected after such an injury. The external wound was opened and probed, and gave issue to some bloody matter. Four leeches were applied in the neighbourhood, and were followed by bread and water poultices. Four grains of the hydrargyrum cum cretâ were given every four hours. A blister was applied to the nape, and the vesicated surface, after removal of the cuticle, was dressed with strong mercurial ointment. The mischief was speedily and effectually arrested by these means. The convulsions, which had come on in paroxysms, did not return after the bleeding. The left arm and leg remained totally powerless for forty-eight hours, and he recovered slowly, but completely. The mercury quickly affected the mouth, and lowered the pulse, which became slow and feeble, with considerable sense of weakness. It was therefore necessary to give it up entirely at the end of a week, and to allow some improvement of diet. The strength and health soon returned, and the patient became quite well, except that discharge of matter continued from the original wound, and from another small opening, which had been made a little lower down. The integuments had remained detached from the bone to a considerable extent from the time of the injury, and matter had accumulated under the loosened portion of the scalp; a counter opening had been made to allow a dependent discharge.

Matter can still (June 3) be pressed out from both apertures, and a rough portion of the bone can be felt with the probe introduced at the original wound. In all other respects, this patient, who has for some time left his bed, is in perfect health: there is not a trace of imperfection in the senses, mental faculties, or the power of moving the limbs which had been paralysed.

T. Bennett remained some time longer in the hospital, in the expectation that a portion of the bone would come away, and because a quiet mode of living, with strict attention to diet, was thought necessary until the part had become sound. No exfoliation however took place, and he left the hospital with the opening in the integuments still occasionally discharging. He came occasionally, that we might watch the progress of the case. In about a month the wounds had firmly cicatrised, and no evidence of the injury remained, except a considerable indentation of the skull where the bone had been broken.—Lawrence (W.), Clinical Lecture in the Medical Gazette, vol. xxi. page 345.

Petit (J. L.), after relating the history of two remarkable cases of injury of the head, in each of which a depressed portion of bone was not elevated, and a portion of the inner table was separated and found adherent to the dura mater ten years afterwards, says, "Two or three of such wounds out of a thousand will get well without operation, but the remainder will die without it."—Petit (J. L.), Traité des Maladies Chirurgicales. Paris, 1790, page 79.

* Late in the evening of the 25th of April Mr. Lawrence of Brighton was summoned by Mr. Camac of Seaford to meet him upon a case of fractured skull. He arrived about 12 o'clock at night. The patient, William Coombs, 16 years of age, about six hours before our arrival had been thrown from a horse on a hard road, and struck by the horse's feet on the left side of the head. He was taken up in a state

parietal bone, with a graze of the scalp, but without any opening communicating with the bone. This swelling on examination was so soft, and the feeling of depressed bone beneath so distinct, combined with the fact of the continued lethargic state of the patient, that I did not hesitate to lay it open, when the bone beneath was found broken in several small pieces. On clearing away the blood with

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of insensibility and removed to his father's house, where Mr. Camac found him, perfectly insensible, with a very feeble pulse and dilated pupils. Upon examining the head there was discovered an extensive laceration of the scalp, with fracture and depression of the temporal and parietal bones to a very considerable extent, involving the squamous suture. Mr. Camac, after removing two small loose pieces of fractured bone, requested that Mr. Lawrence might be sent for, the case being one of extreme danger. Mr. Lawrence, having enlarged the wound of the scalp, removed five pieces more of depressed bone by the elevator, some of which, from being driven into the brain, had forced out a considerable quantity of cerebral substance, leaving a cavity into which the finger could be passed to the depth of an inch or more: during the operation the patient cried out lustily, but became more sensible after it was completed, and soon fell into a natural sleep. The wound was carefully dressed by Mr. Camac, who has favoured me with the subsequent report of the case, and on whose skilful management the successful result must have greatly depended.

April 26, nine o'clock A.M. The patient is sensible and complains of pain in the head; reaction has taken place; pulse 100; skin hot; bowels have not been opened; eight leeches to be applied to the forehead, to take four grains of calomel directly, and an ounce of castor oil after an hour, with a dose of a mixture (containing a solution of Epsom salts) every four hours; cold lotion to be constantly applied to the head; low diet. Five o'clock P.M. Bowels freely moved, with a slight improvement in all the other symptoms.

27th. Has passed a good night, and is decidedly better today; pain in the head partially relieved; pulse 96; skin cooler, the wound looking favourably; to have six leeches to the forehead, and continue the mixture and lotion as yesterday. The above treatment was continued with but slight alteration up to the 3rd of May, the patient gradually improving.

May 3rd. The symptoms today have assumed a more unfavourable character, from the lad not being kept sufficiently quiet. He complains of darting pains in the head; skin hot and dry; pulse 100; the bowels open, with a healthy discharge from the wound. To be bled in the arm to six ounces, to take four grains of calomel directly, and continue the mixture, with the addition of fifteen minims of antimonial wine to each dose every four hours. The head to be shaved and the cold lotion applied.

4th. Passed a good night, and all the symptoms decidedly relieved; bowels freely moved, pain in the head much abated, pulse 94, and soft; skin more comfortable; a small blister to be applied to the nape of the neck, and continue the mixture every six hours.

From this time he continued to improve; the wound was daily dressed with spermaceti ointment, the hair being kept closely cut. The granulations rapidly formed, and after a few weeks dressings were discontinued for straps of adhesive plaster, and the occasional application of the nitrate of silver, the cold lotion being continued. The pain in the head having subsided, and the appetite returned to its natural standard, a more generous diet was allowed, with the moderate use of exercise in the open air.—Medical Gazette, vol. xxvii. reported by Mr. Furner.

This lad, July 12, 1842, was in perfect health.

which the tumour was filled, two of the pieces which were loose were readily raised and removed by the elevator and forceps, and egress given to an ounce or two of blood, which was extravasated beneath, apparently from the rupture of the vessels passing between the dura mater and the bone. The patient regained his senses in the course of the night and morning of the third day, and under a strictly antiphlogistic regimen gradually recovered, some other small pieces of bone coming away; and one or two others apparently re-uniting to the uninjured parts, showing that it is not always necessary to remove every portion of bone which may be broken, provided any bond of union remains, and principally that which exists between it and the dura mater.

These different cases stand out in bold relief as opposed to each other. The success which attended their treatment renders it almost impossible to declare which were and which were not conducted according to the most approved principles of surgery. They tend to show that no general rule can be formed which does not admit of so many and such important exceptions as almost to invalidate the rule itself; and they prove that experience, aided by sound and correct observation, is essentially necessary for the formation of a scientific surgeon.

The result of my experience has rendered it imperative in my mind to remove at once all portions of bone or foreign substances which may have or may be supposed to have penetrated the dura mater in adults, although no symptoms of compression should be observed; and generally in children, whenever it can be done without difficulty, and especially when symptoms of compression are present. If the wound in the dura mater should not be sufficiently large to allow the offending body to be extracted through it, the opening must be increased to enable it to be withdrawn without further laceration; and all substances which are irritating, or are likely to irritate the brain, should be removed in the first instance, as I have already suggested, page 92, unless the attempt should be forbidden by the occurrence of convulsions, by the inability of the surgeon to seize the extraneous body, or by the evidence of the great suffering which it occasions; and all blood which may be extravasated should be carefully and lightly removed.

I have shown by the case of the soldier, p. 50, by that of Clayton, p. 70, of Capt. R., p. 111, and by others, that every depressed portion of bone accompanied by fracture, and especially on the back part of the head, need not neces-

sarily be removed. When the fractured and depressed bone is accompanied by symptoms of compression in an adult, which continue after the usual antiphlogistic means and remedies have been employed in vain, and appear to increase rather than to diminish, the broken and depressed portion should be raised; for although the brain will bear and accommodate itself to pressure in many persons in a manner which could not be either foreseen or expected, it will not do so in all; and the removal of the bone offers the best chance for relief, whether the mischief has arisen from the pressure made by it, or occurs from the extravasation of blood beneath. I have on several occasions found the principal symptom of compression to be a fixed pain in the part; and although the state of the fracture and depression would not alone have rendered the removal of the bone positively necessary, I did not hesitate about removing it when this symptom was present; and I have generally seen the pain subside after the operation. The case related by Mr. S. Cooper, to which I have referred, p. 78, is most useful, from the fact which followed the removal of the bone, viz. that the patient, who was before in nearly a lifeless state, instantly sat up in bed, looked around, and spoke rationally *. There was scarcely one of those great battles or sieges in the Peninsula at which I was present, where a nearly analogous case did not occur.

The greatest discrimination is required in cases where the extent of the injury is not so manifest, and in which there is more room for doubt. In most cases in which a slight or moderate degree of fracture and depression of the skull has taken place, the symptoms of concussion are present as well as those of compression. The symptoms of concussion are however coeval with the injury; and although those of compression may take place almost instantaneously, they more usually occur at a later period of time. The symptoms of concussion may nevertheless continue for days, and more particularly the insensibility, or that state which is approaching to it, complicating the case and embarrassing the practitioner. In a child or young person the symptoms of compression or irritation, when they appear even at a secondary period, may pass away under further moderate depletion; but in an adult any undue delay in giving the necessary relief by the removal of the depressed portion of bone, will in general be destructive to the patient. It is the irritation caused by the depressed bone on

* Cooper (S.), Dictionary of Practical Surgery, Article Trephine.

the dura mater, and communicated to the brain, which gives rise to the unfavourable symptoms, and to the formation of matter which follows them.

A gentleman received a blow on the side of the head, which knocked him down and deprived him of his senses, from which state he partially recovered, and vomited: some stupefaction however remained, although he could be made to answer by a little importunity. Pulse 62, irregular, breathing slow, the pupils contracting under the influence of light; the integuments where the blow was received were soft and swollen, in all probability from an extravasation of blood beneath. The next day the pulse was full and regular, the pupils were dilated, vomiting had taken place several times, and the patient answered correctly on being sharply questioned. He was now bled largely, purgatives were administered, and cold was steadily applied to the head. He was bled the next day, and on the third the left arm became paralytic, the pupils continued dilated, and on the fifth day paralysis implicated the left leg as well as the arm. There could now be no doubt that the brain was suffering from compression, but as the nerves of the excito-motory system were unaffected, and the functions of ingestion and egestion were satisfactorily accomplished, it was thought advisable to trust to the efforts of nature. The swelling of the scalp was painful.

A week afterwards the general symptoms were the same, or only slightly augmented by fever; but as the swelling of the scalp was more painful, it was opened, and a quantity of matter was evacuated, the bone beneath being fractured and depressed. As this operation gave some relief, it was thought advisable to wait, with the hope that the benefit thus obtained might prove permanent. The patient did not however improve; and as the symptoms of fever increased, and were accompanied at last by rigors and great pain in the head, the depressed portions of bone were removed, and about half an ounce of purulent matter escaped from between the dura mater and the bone. The relief given this time was effective, and the patient perfectly recovered. "La chirurgie expectante" placed this man's life in the greatest jeopardy. It was only saved at the last moment by the aid of that surgery which ought not to have been withheld when the paralysis, by affecting the leg as well as the arm, demonstrated the extension of the mischief within the head. In this instance the operation was successful, but it is not in general so serviceable when delayed to so late a period. It is in cases of this nature often a means rather of prevention than of cure.

When a very severe blow, accompanied by a shock, as from a fall, has been received on the head, and the skull is so thick and strong as to be able to resist the violence thus offered without being broken, or is only slightly fractured, the vibration or *tremoussement* * is directly communicated to the brain, giving rise to laceration or bruising of its structure in various situations, to the rupture and separation of the vessels of the dura mater from the bone to which they are attached, and to derangement of other parts, which will in all probability be followed by inflammation, and may even terminate in the formation of matter under the dura mater as well as above it, and even in the brain itself. This is said to take place by "contre coup" when it takes place in any other part of the head than that which is struck, of which Mr. Shaw† gives two cases; and of instances of which the older French authors are so profuse both in the explanation and in the fact. The cases related by Mr. Shaw are truly cases of laceration, the accompaniment and the consequence of concussion of the brain, and were not relievable by the art of surgery; but they are not exactly what the older surgeons particularly distinguished as injuries by "contre coup," where the blow was on one side, and a fracture took place or matter was formed in a circumscribed spot on the other, which cases did sometimes, although rarely, admit of relief by operative surgery. I have not had the good or the bad fortune to meet with one of them unaccompanied by fracture, as they do not appear to take place under the improved method of treatment by larger depletion, by antimony, and by the early use of mercury; I can only therefore allude to the records of preceding writers, and several cases illustrative of the fact are referred to from pages 61 to 64, and particularly in the note, page 65‡. In the event however of such cases again occurring, there is no surgeon of the present day who would attempt an operation of exploration, although it might accidentally be attended with success.

When the periosteum covering the bone is bruised, or the bone is deprived of this membrane, it does not follow that the bone should die or exfoliate. In many

* Le Dran (H. F.), Observations de Chirurgie, p. 176.

† Shaw (A.), Medical Gazette, vol. xxviii. p. 67.

‡ O'Halloran states distinctly, with respect to this species of injury, in which a deposit or matter forms in the membranes of the brain or on its surface, "In the course of many years' practice and painful observation, I cannot give myself credit for a single cure I ever performed in this way when the symptoms of deposit were formed; and whether the patient was or was not trepanned the scene closed with death."

instances the wound will gradually close up and heal as if no such accident had happened; and in most cases this termination will only be delayed by the separation of a scale of bone from its outer surface. If the bone should be bruised in addition, or slightly fractured or depressed, without a wound of the integuments, and the general treatment has not been strictly attended to, the case may terminate in one of those secondary tumours of the scalp which Messrs. Dease and Pott have so admirably described, and which may be considered as a complaint fraught with the utmost danger.

Mr. Pott says*, "Whenever the dura mater is separated from its attachment to the inner surface of the cranium, the pericranium covering the outer part of the same bone is generally detached also. When this separation is produced by the formation of matter, in consequence of inflammation, the tumefaction of the scalp, which denotes this effect, appears some days after the violence has been received, and is always accompanied with a symptomatic fever.

"In such cases the patient goes on well for eight or nine days, at the end of which time they complain of headache, giddiness, nausea, restlessness, thirst, and generally of fever. A few days more, frequently from the thirteenth to the fifteenth day, rigors, sometimes severe, are superadded, and a swelling if not observed before is now perceived on the spot where the injury had been received if the integuments had not been divided; or if there should be a wound, it loses its healthy red appearance and assumes a yellowish unhealthy one, which is accompanied by a thinner and more acrid discharge. From this time the symptoms gradually increase, the patients become delirious, convulsed, comatose, and die, and matter is found between the skull and the dura mater, or on the substance of the brain. If this secondary swelling be divided and the fluid evacuated, which is not good pus, the pericranium will be found detached and the bone bare."

Mr. Abernethy† believed that a bone so circumstanced would not be found to bleed on being scraped, and that by attending to the want of hemorrhage from the outside of the cranium, the extent of the evil might be ascertained, and that so long as a denuded discoloured bone will bleed on being scraped, it may be considered that the dura mater is attached below, and that no operation should be performed.

* Pott (P.), On Injuries of the Head, 1771, p. 245.

† Abernethy on Injuries of the Head, vol. ii. p. 47, 1815.

When the primary swelling which I have noticed, page 97, proceeds to suppuration, the formation of matter is accompanied by febrile symptoms, which are generally relieved by the evacuation of the matter, as in the case of any other ordinary abscess, although the pericranium may have been detached and the bone may be bare. The essential difference between the primary and the secondary swelling is to be found in this circumstance, that although the bone may be exposed, and even in some degree have changed its colour in the primary swelling when matter has formed, the febrile symptoms will subside after its evacuation, healthy granulations will spring up, and little or no exfoliation will take place; whilst in the secondary swelling none of these favourable symptoms or appearances will take place, for the bone is incapable of maintaining its life, it must separate or be removed in part if the outer table only be diseased, and by the operations of nature; but this must be done by the trephine, if there be reason to believe that matter has collected beneath; which must, I am of opinion, certainly take place, unless there should be a fissure or fracture through which it may escape.

Inflammation of the dura mater proceeding to suppuration or the formation of matter between it and the bone, appears to have been a much more common consequence of injuries of the head in the time of Dease and Pott than at present. I have rarely seen a case of the secondary tumour they have described, and on inquiring of the surgeons of the different hospitals in London who are on the Council of the College of Surgeons, consisting of what may be called from their standing and position the *élite* of the surgery of London, I find it is almost equally unknown to them.

As blows on the head, and the structure and functions of the brain are much the same at present as when Pott and Abernethy wrote, the difference in regard to such cases can only depend on the difference of treatment. It is in fact infinitely more depletory now, and therefore less operative. Blood is taken away in larger quantity, and the tartrate of antimony, and mercury are by most surgeons administered at an early period. The case appended in a note from Mr. Dease*, is highly instructive on some of these points. And I imagine that

* William Bead, a strong middle-aged man, came to the hospital, having received a wound on the superior and posterior part of the left parietal, which laid the skull bare, ten days before. He on the eighth day sickened and became hot and restless, and complained of a pain in his head; his pulse was quick and low; he had a continual puking on him, and shivered from time to time. The wound

there are few, if any, who will doubt that a good early antiphlogistic treatment might have prevented the suppuration which occurred in it; that the trephine was improperly applied; that the separation of the pericranium does not necessarily imply a corresponding detachment of the dura mater; and that bone may be bare without being dead. If it had been scraped, which would not have interfered with the necessary exfoliation, it would in all probability have bled in sufficient quantity to prove that it was still alive, and that the trephine could do no good if it did no harm.

Suppuration, or the formation of pus on the surface of the dura mater, is not, then, under the strictly antiphlogistic system of the present day, a common occurrence; and sufficient attention is not therefore paid to the evil which frequently accompanied it in former times, viz. suppuration on the surface and in the substance of the brain itself—the more usual cause of death in all these cases of fracture and depression which are left to the "chirurgie expectante," or that which has been too long delayed. On referring to the records of surgery from the earliest times unto the present moment, I find that the greater part of those who have died with fracture and depression of the skull, and whose cases are recorded, suffered from alteration of the structure or substance of the brain, and the formation of matter within it or upon its surface. I have seen and read of many cases of injury of the head without depression in which this termination ensued, as it might have done and has done from idiopathic inflammation without injury; but I firmly believe that it would not have taken place in a large proportion of those cases in which it occurred, if the present system of treatment had been pursued; or if the depressed bone had been raised to its level, and the irritation arising from undue or unequal pressure had been avoided. It must be admitted, however, that an internal part of the brain may receive such shock at the moment of injury, as well as an external part, that no treatment can arrest its

looked dry and gluey, with a spontaneous detachment of the pericranium all around. Having no doubt of matter under the skull, it was agreed in consultation to apply the trepan, which was instantly performed. We found the dura mater firmly attached and in a natural state: a clyster was ordered in an hour after. He raved much in the night and shivered twice, and became quite delirious; his pulse began to fail. Next day he was speechless and apparently dying, and died the succeeding morning. On opening the head the dura mater showed not the least sign of inflammation or disease, but a suppuration covered very near the whole surface of the left hemisphere of the brain.—Dease (Wm.), Observations on Wounds of the Head, 1776, Dublin, p. 124.

progress towards evil, although the mischief may be delayed; and when the patient dies after four, five, or more weeks of alternate hope and of suffering, matter is found in some part of the brain where an injury was not suspected.

Purulent matter may be formed beneath the dura mater in a confined spot, or it may be diffused generally over the surface of the brain, in which case the sufferer has no chance of relief. There is some hope when the formation of matter is circumscribed and the brain is otherwise but little affected.

The operation of incising the dura mater to admit of the discharge of blood or matter from beneath, and even of puncturing the brain, is much more commonly performed in France * than in Great Britain, where it is very rarely had

* See the cases of La Peyronie, Bellair, Petit and Manteville in Quesnay's Remarques sur les Plaies du Cerveau, tome i. de l'Académie de Chirurgie. The following case by M. Roux is equally instructive, and of a more modern date. It is to be found in the sixth volume of the Medical Times, p. 144.

The patient having a fracture with depression of the posterior edge of the right parietal bone, without any particular symptoms of injury of the brain, walked to the hospital to be dressed every morning for six days, living as usual. On the seventh he became unwell, and on the eighth was received into the hospital. As the symptoms had become urgent by the time of his admission, the wound was examined and the trephine applied. The dura mater was found ruptured underneath, and on incising it a little blood escaped. The cerebral substance at this part was softened and disorganized, resembling pap of a dirty yellow colour. The man died twelve hours afterwards. At the autopsy, no effusion was found on the brain, either of blood, serosity, or pus. The brain was greatly injected on its surface, but its substance was of a normal consistence; on a level with the fracture it was torn and greyish, and became detached in small lumps; around this disorganized portion the cerebral substance was of the colour of wine-lees for about one-third of an inch, but beyond this areola it possessed its natural whiteness and consistence.

In this case the dura mater was torn by a piece of the depressed bone, which also appears to have injured the brain, and to have led to the death of the patient. The careless manner in which the patient lived does not appear to have hastened the occurrence of the mischief, which might reasonably have been expected to take place from the continued irritation of a piece of bone sticking in the substance of the brain. The great Petit or Le Dran would have divided the scalp and removed the depressed portion of bone irritating the brain in the first instance, and they could not have been less fortunate than their distinguished successor. That a surgeon may err in the estimate he may make of a piece of bone being so much depressed as to injure the brain, is shown by the twenty-third case mentioned by Le Dran of a man thirty-five years old, in whom a small portion of the os frontis was felt by the probe to be loose. As the man had no bad symptoms he refused to submit to the trepan, and left the hospital. He returned however two months afterwards to show himself, quite content that he had escaped the operation.

Hill of Dumfries opened the dura mater in six cases out of eight that he had trepanned, and in five with a successful result. He noticed in one of them, the absence of movement in the dura mater until after the incision was made.

recourse to, and which may be an error. The records of surgery supply many cases where it might possibly have been done with advantage, and many where it was done with the greatest benefit to the patient. It is not however an operation which ought to be done idly, or without signs sufficiently demonstrative of the necessity for doing it.

Petit* says a grenadier, struck on the side of the head by a splinter of a shell, was knocked down on the glacis, but on being carried away soon recovered his senses. He had scarcely arrived at the hospital when he fell into a state of stupefaction. He was again bled, and a tumour, which had formed over the temporal muscle, was laid open; the bone beneath was not fractured, nor was the periosteum detached. As the symptoms of compression continued, the trepan was applied, but no extravasation was discovered underneath. Five or six hours after the operation he spoke and answered some questions, took some nourishment, but relapsed shortly afterwards into a similar state of stupefaction. On removing the first dressing the cause of evil was made manifest, the dura mater had risen up into the opening made by the trepan, and was above the level of the bone, which had given some relief to the compressed parts, and had probably been the cause of the temporary amelioration which had taken place. The dura mater was opened by a crucial incision, and two table spoonfuls of blood, half fluid, half coagulated, were evacuated. His stupefaction ceased two hours afterwards, and he recovered so as to be removed with the other wounded who were nearly cured.

I have seen, on the removal of a portion of bone by the trephine, the dura mater rapidly rise up into the opening, so as to attain nearly the level of the surface of the skull, totally devoid, however, of that pulsatory motion which usually marks its healthy state; and an opening into it, under these circumstances, has allowed a quantity of purulent matter to escape, proving that the unnatural elevation of the dura mater was caused by the resiliency of the brain when the opposing pressure of the cranium was removed. I consider this tense elevation and the absence of pulsation to be positive signs of there being a fluid beneath, requiring an incision into the dura mater for its evacuation. It is a point scarcely, if at all noticed in English surgery, although much insisted upon in France. It was not in the slightest degree understood at the commencement of the war in

* Petit (J. L.), Des Plaies de la Tête, page 91, in Traité des Maladies Chirurgicales. Paris, 1730.

the Peninsula, and was one of those points which particularly attracted my attention.

A. Monro, of the 42nd regiment, was wounded on the 10th of April at Toulouse by a musket-ball, which fractured the left parietal bone in the slightest manner without depressing any part of it. No symptoms followed requiring more than the ordinary attention until the 23rd, during which time he had been kept on low diet, for the most part in bed, and had been bled and purged. On the evening of that day he became feverish and hasty and odd in manner, and the pulse quickened; he declared himself however to be quite well, and submitted to be bled and physicked with great reluctance; calomel combined with opium being afterwards given him at short intervals. On the 24th he complained of pain in the head, which he said was very slight, and that upon the whole he was quite well, and would not be bled, nor have anything done. He was bled largely by force, which lowered the strength of the pulse, but did not relieve any of the symptoms of irritation of the brain. On the 25th he was evidently worse, although he declared himself to be quite well; he talked a little incoherently, the pupils were dilated; the pulse quick but regular, the countenance was changed; he was sensible apparently upon all points except that of being much worse, which he resolutely denied, saying he was better and would soon be well. Satisfied that matter was forming or had formed in or on his brain, I desired that the trephine might be applied on the fractured part, and the bone removed. This however he would not permit the officers in charge to do, and they awaited my return in the afternoon, when, finding him much worse, I directed it to be done by force, three of his own regiment with others attending to assist the surgeons. He called upon these men by name not to allow him to be murdered in cold blood, declared he was getting well, and would get well if let alone, and prayed them to avenge his death on the doctors if they meddled with him. The surgeons were dismayed, and left the operation, which as they said required great care, to be performed by me; I therefore removed the bone myself, and the moment it was taken away the dura mater rose up into the opening nearly to the level of the surrounding bone, and remained without any pulsatory motion. I had no doubt of matter being beneath, and that from his general state he would die. I did not therefore think it prudent under all circumstances to do more than warn his comrades that when dead they would see the whole brain beneath in a state of suppuration. He died that night, and the next day the whole of the left hemisphere

was found soft, yellow, and in a state of what would formerly have been called putrefaction.

Absalom Lorimer, of the 42nd regiment, was wounded by a musket-ball on the 10th of April 1814, at the battle of Toulouse, which carried away a small portion of the scalp just above the right temple, fracturing the bone slightly, but without any depression. No symptoms occurred demanding more than the ordinary attention for the first fortnight, during which period he had been bled once, purged, and kept on low diet. On the 25th he complained of pain in his head around the wound, and shooting to the back part; pulse 60, pupils dilated. An incision being made to the bone, the pericranium was found detached, the bone fractured, but without any obvious depression. V. S. ad ℥xx. calomel and colocynth; and as the pain continued the bleeding was repeated in the evening. 26th. Pain in the head greatly relieved; pulse 60; bowels torpid. Ten ounces of blood were taken from the temporal artery, the calomel and colocynth, salts and senna were repeated. On the morning of the 29th, the symptoms of compression having increased, the trephine was had recourse to, and the fractured portion of bone was removed; a layer of coagulated blood was found on the dura mater which puffed up into the opening. In the evening he became convulsed, the pulse intermitted, and he died. On examination, a large abscess was found on the right hemisphere of the brain having the ventricle for its base with some matter on the surface of the brain and between the dura mater and the bone at the base of the cranium.

On the morning of the day that I performed this operation I had done another of the same kind at the Hospital des Minimes; the dura mater rose up into the opening made by the removal of the circular piece of bone by the trephine, in a similar manner, and without pulsation; and on my puncturing it a considerable quantity of pus oozed out. The opening was enlarged, and the flow of matter was daily encouraged, until it gradually diminished, and ceased with the formation of granulations and the drawing in and cicatrization of the part.

Sir Astley Cooper entertained the opinion of Mr. Hunter, that a wound through the dura mater was particularly dangerous, in consequence of the tunica arachnoides which lines it being a serous membrane; and that, if the inflammation which ensued did not cease at the adhesive stage, by the consolidation of the surface which covered the pia mater with that which lined the dura mater, a diffused inflammation would necessarily follow, which might spread over its whole extent.

This theoretical opinion is fairly deduced from the state of analogous membranes, such as the pleura and peritoneum when wounded. I do not apprehend however that practically the diffused inflammation is found to occur in cases of injury of the head, so often as it might be expected; in consequence probably of the more equal pressure that is kept up within the skull than in the chest or abdomen; but if wounding the dura mater be a danger that ought to be avoided, if possible, as one of great magnitude, the risk run by doing so cannot be put in comparison with that which accompanies the continuous irritation depending on the presence of a spicula of bone, which has passed through the dura mater and is also irritating the brain beneath. Sir A. Cooper supposed that the danger would be diminished if the pia mater were wounded also, as the brain would project and fill the wound; but I am not satisfied of the accuracy of this opinion; and if I had opened the dura mater through error or design, I should not think I had lessened the evil by adding to it a wound of the pia mater, and perhaps also of the brain.

To those who have been accustomed to the terrible injuries which occur in military warfare, in which large portions of the brain are often exposed, and even lost, without much inconvenience following; the exposure of, or the opening into the dura mater, is not considered of so much importance, as it is by those who have had no opportunities of seeing such awful cases; whilst the formation and retention of matter below the bones of the cranium is, on the other hand, more dreaded by those who have often seen their ill effects, than by those who have had fewer occasions for observing them, and by whom they are often considered, when they do take place, to be irremediable by art.

The records of surgery are so rich in cases of recovery after division or puncture of the dura mater with injury of the brain, that I might fill a book with the relation of them. Yonge* has collected the facts to be found on wounds of the brain in most of the authors who preceded him. I shall notice only three from the works of those who succeeded.

La Peyronie† says a young man sixteen years old received a blow from a stone on the upper and forepart of the left parietal bone, which appeared to be

* Yonge (James), Wounds of the Brain proved Curable. London, 1682. He gives in this a collection of the opinions of sundry good authors concerning wounds of the brain, wherein no less than sixty affirm them curable, and confirm it by above a hundred observations.

† La Peyronie, sur la partie du cerveau ou l'ame exerce ses fonctions, dans l'Histoire de l'Académie Royale des Sciences, 1744, page 199.

contused but not fractured. No bad symptoms took place until the 25th day, when he began to feel his right eye heavy and painful, particularly on pressure, and in three days more he lost the sight of it, together with his senses generally, and fell into a state of stupefaction. On cutting down to the bone, a very slight fissure was perceived; three trepans were applied, and some splinters of the inner table were removed from the surface of the dura mater, the bluish colour of which, and its great softness, caused him to make an incision into it, when near three ounces of matter of a bad quality were evacuated, containing some portions of the brain. The abscess was supposed to be about the size of a hen's egg, and from the depth to which a flat, blunt and bulbous-ended probe penetrated (a meningophylax), it was presumed that when held lightly it rested upon the corpus callosum, near the falx. The moment the matter was evacuated, the patient recovered from his stupefaction, his sight and senses were restored. All these defects began to return as the cavity of the abscess filled, and again disappeared as the matter was discharged. Injecting a fluid into the cavity gave rise to the same effects, which he could renew or remove with the syringe at pleasure; depriving him of his sensation and his reason, when the cavity was filled, and restoring them when the injection was drawn out. At the end of two months he was perfectly cured, and free from the slightest inconvenience, although he had lost a considerable portion of his brain.

Schenkius* goes further. He says, a man being wounded on the head by an iron-pointed instrument, which penetrated perpendicularly, suffered from an abscess on the upper part of the brain. As the matter could not discharge itself through the opening, he was attacked by epilepsy and rigidity of the limbs, followed by shaking. To relieve these evils he was suspended for some time by the heels, the head being downwards, which allowed the matter to run out, and the patient recovered. La Peyronie observes that this manner of emptying an abscess is not so convenient as by the syringe†.

* Schenkius, Observat. 4, page 19.

† Dupuytren[1] relates the case of a young man who had received a wound on the head from a knife, which healed in the usual way, leaving only a little pain, which occurred occasionally around the cicatrix. Some years after he was brought to the Hotel Dieu in a state of stupefaction, with which he had been suddenly seized. An incision having been made through the cicatrix, the point of a knife

[1] Dupuytren (Baron), Lancette Francaise, Jeudi, 14 Octobre, 1830.

Gun-shot wounds of the skull are attended by certain peculiarities, which require some little variety of treatment. In ordinary circumstances there is usually a fracture more or less comminuted with depression, and an external wound, which should almost always be enlarged by a simple incision, so as to show the extent of the depression or the size of the broken and depressed portions of bone. When the bone is scarcely injured, and the periosteum is only bruised, or when the bone is even deprived of this covering, as I have before remarked, it does not follow that it should die or even exfoliate. In many instances the wound will gradually close in and heal, as if no such evil had occurred; and in those which do not terminate so favourably, the cure will only be delayed by the exfoliation of a layer or scale of bone from its outer surface, unless the mischief should have penetrated deeper, affecting the whole substance of the bone, or even the parts beneath.

A musket-ball striking directly against a bone sometimes makes a hole not larger than itself with or without any radiating fracture; and one trephine, if properly applied, will often embrace the whole of the mischief, and admit of the removal of the broken pieces. The trephine should be of a large size, and as a centre pin cannot be used, it may be made to turn very well in most cases in a flat but thick bar of iron, having a hole in the middle, of such size only as will admit the outside of the polished trephine to turn in it. Sufficient support for the instrument will be obtained by this means until it has made a groove in the bone for itself, when the operation may be continued as it would be in an ordinary case after the removal of the centre pin. Botal* and Percy† both allude to contrivances of this kind as eminently useful, and I have myself found it very advantageous.

When a musket-ball ranges along the side or top of the head, it may break the outer and depress and fracture the inner table to a considerable extent, for the space even of three or more inches, of which the case related, page 105, is an

was seen sticking in the bone, the removal of which gave no relief. The trephine was then applied, without any result. The paralysis continuing on the opposite side to that on which the wound had been received, it was thought right to open the dura mater, and then to plunge the knife into the brain, when a large quantity of pus escaped. The paralysis ceased that night, he recovered his speech, became sensible, and entirely, although gradually, recovered.

* Botallus (Leonardus), Op. Omnia de Vulner. Sclop. 1582.

† Percy (Baron), Manuel de Chirurgien d'Armée.

example. I have almost always removed the broken portions of bone by means of good forceps and a straight saw, and have perhaps been as often successful as the reverse. I can see no reason for delaying the operation unless the case be doubtful, when it may be as well to wait for symptoms, as in the case above noticed. It sometimes although rarely occurs that a ball sticks so firmly in the bone that it cannot be extracted by working round it in any ordinary way, with a pointed instrument. The difficulty usually arises from the ball having half buried itself in the diploe, and so little of it being exposed, as not to admit of a firm hold being taken of it. The large trephine, used in the way I have just pointed out, has enabled me several times to overcome the difficulty. I have even found the removal of the outer table to be sufficient where the inner one has not been driven into the dura mater ; but where any doubt is entertained on this point the two should be removed. Dr. Hennen* has given the history of a case of the kind I saw at Brussels with him and Dr. Lindsey, which is highly interesting on account of the loss of speech that followed the injury, and the manner in which it was recovered.

A ball or other foreign substance may penetrate the brain directly or obliquely. When the ball penetrates the brain directly, it is not often that it can be removed, and the sufferer rarely survives beyond two or three days. It has often appeared strange to me that many should live so long. The principal officers who were wounded at the battle of Salamanca, and who in the evening occupied my tent, the only one on that field, will never forget a sergeant of the 27th regiment, who was shot directly in the centre of the frontal bone: my finger went in readily as far as it could go, and any one could see for more than an inch into his head. His moans distressed many, and he did not die until the third morning. I have never had under my own care a case in which the patient recovered after the removal of a ball which had been driven thus directly deep into the anterior part of the substance of the brain, although I have seen and mentioned several who recovered, where the injury had occurred towards the back part of the head, and the ball had been allowed to remain. I believe it will be better in all such cases to allow the ball to remain unmolested, which it will often do for many days, until circumstances render it necessary to endeavour to find it. When it can be felt immediately under the surface, it ought to be removed

* Hennen (J.), Principles of Military Surgery. Edinburgh, Second Edition, 1820, p. 305.

as a foreign substance, provided this can be done with little apparent inconvenience*.

Dr. Rogers† relates the history of an excellent case, in which a young man of nineteen received a wound on the frontal bone just above the centre of the left superciliary ridge from the bursting of a gun on the 10th of July. It was not until the 4th of August that he discovered a piece of iron lodged within the head in the bottom of the wound, (from which a considerable quantity of brain had come away,) and which he extracted the next day. It proved to be the breech-pin of the gun, three inches in length and three ounces in weight. On the 10th of December he was perfectly cured.

In the case detailed by Gooch‡ of a gentleman wounded in a similar manner by the bursting of a gun thirty years previously, he trepanned twice, removed several small pieces of bone, and one in particular of the inner table of the skull as large as a shilling; the patient after this recovered his senses, but some portions of brain were discharged daily for nineteen days, when he died.

A successful case of the same kind is related in the Edinburgh Medical and Surgical Journal§, and these and others, some favourable, others the reverse, have led

* Cases of the kind are mentioned by La Martiniere, Preussius, Veslingius, Zacutus, Sala, Majault, and are collected by Quesnay. In the Philosophical Transactions for 1709, No. 316, art. 6. By Fabricius, Cent. Obs. 2, and by others of the older authors in different places.

Marechal mentions the case of a soldier in whom the ball was found a year afterwards two fingers breadth deep in the anterior lobe of the brain; and Anel, in the Bibliotheca Chirurg. of Mangetus, speaks of a ball which had lodged on the pineal gland for several years. The sufferer having died suddenly, the ball was found covered with blood, lately extravasated, which had probably caused his death.

Ramdohr gives the case of a hussar, wounded above the left eye at the corner of the frontal sinus, by a musket-ball which penetrated the brain. He got quite well, and remained so for four months, when he became stupefied, had convulsions, and died. The ball was found a quarter of an inch above the left ventricle.—In Schmucker (J. Leberecht), Vermischte Schriften, 2nd edit., Berlin, 1785, p. 227.

D. Zartmann of Bonn relates the history of a case in which the brain was injured through the right side of the frontal bone by a portion of a gun-barrel, which with the splinters of bone having been removed, the patient perfectly recovered in the course of a month, under a strictly antiphlogistic and mercurial treatment, having lost it is supposed three ounces of brain.—In the London and Edinburgh Monthly Journal of Medical Science for July 1842.

† In the thirteenth volume of the Medico-Chirurgical Transactions, 1827, Second Part.

‡ Gooch (Benjamin), Cases, &c. London, 1758.

§ Sir G. Ballingall has recorded the case of an injury of the same description, in which the breech-pin partly came out through the palate, and was removed seven years after the injury, on the death of the patient.—In the New Series of the same Journal for January 1842.

to the belief that injuries of the anterior part of the brain are less dangerous than those of the back part, an inference which does not accord with my experience.

When a ball strikes the head obliquely, it may enter and pass out or lodge. Nearly all of these cases die, but one occasionally escapes, and none should be allowed to die without assistance. When the entrance and exit of the ball are obvious, and not far distant from each other, the splinters of bone should be removed; and if the little bridge between the openings should be injured, the whole should be taken away by the straight saw; an operation which cannot however be necessary in the first instance, if the portion of bone should be apparently sound.

Hildanus* relates the case of one Clerget, who received a wound from a musket-ball in the attack of the camp of La Cluse on the forehead, with a great fracture of the bone. Carried half dead to Geneva, and carefully treated, the wound healed, and he lived six months in health. Dying shortly afterwards of an acute disease, the head was opened and the ball found near the vertex lying between the bone and the dura mater, which was uninjured.

Baron Larrey† says, "a soldier of the 18th demi-brigade was wounded during the first revolt at Cairo by a musket-ball, which pierced the middle of the frontal bone near the longitudinal sinus, without injuring the dura mater, and passed backward between it and the bone as far as the occipital suture. The accident was followed by the usual symptoms of compression, the soldier, however, always complaining of pain at the back part of the head at a spot opposite to the entrance of the ball. I introduced a gum-elastic sound through the hole in the frontal bone along the track which the ball had made, until I discovered it by the resistance it offered to the further passage of the sound, and by the inequalities of its surface. Having thus ascertained the distance at which it was situated, I applied a large trephine immediately over the part by measurement; a quantity of pus was immediately evacuated, and I easily extracted the ball, which was depressing the dura mater and brain." The man after this recovered.

At the battle of Talavera a soldier of the 48th regiment was brought to me in a state of insensibility, who had received a musket-ball on the upper part of the right side of the frontal bone, which had entered and had evidently passed backwards, and could be followed by the probe rubbing against the bone for near four inches. The scalp over this point was soft, as if blood was effused below;

* Hildanus, Centuria 2. Observat. 2, p. 77.

† Larrey (D. J.), Mémoires de Chirurgie Militaire et Campagnes. Paris, 1812, vol. ii. p. 139.

and on dividing it, a fracture was seen rather buiging outwards. The trephine was applied forthwith, and the bone removed, together with the ball, which only wanted a little more impetus to have come through. The brain was injured in front, and the man died two days afterwards.

A French grenadier was wounded at the battle of Salamanca by a musket-ball, which struck him on the right side of the head, penetrated the temporal muscle, and lodged in the bone beneath. He was brought to me two days after, labouring under symptoms of compression of the brain. On dividing the parts down to the bone, I found that the ball had fractured and driven in a part of the temporal bone, one portion of the ball being above the other below the broken bone. The upper half of the ball was readily removed, but several small portions of bone were raised by the elevator and forceps before the remaining portion of the ball could be got away from under the bone, which was not depressed; the ball having been cut in two by its edge. Some blood which had been extravasated was cleared away, the dura mater being only bruised, but not torn through. The wound suppurated freely; several pieces of bone exfoliated, and the patient was ultimately discharged in progress towards a cure.

I had a case of a similar kind after the battle of Toulouse in the Minime Hospital, in which the ball had actually come through the bone and had lodged under the scalp, which it could not penetrate. The brain was however injured at both openings, and the man ultimately died.

A small ball sometimes becomes so flattened by striking against the skull as to remain undiscovered when care is not taken in the examination. A soldier was wounded at the storming of San Sebastian by a ball on the side of the head, which was not supposed to have lodged. The wound did not heal, a small opening remaining, although no exfoliation took place, and the bone did not seem to be bare. On dividing the scalp to ascertain the cause of the delay in healing, I found a small ball, quite flat, which had sunk down a little below the hole left for the discharge to which by its irritation it had given rise *.

When a larger ball or a piece of a shell strikes the head, the fracture is usually extensive, and portions of bone, or a piece of the shell itself, are often lodged in the substance of the brain. There is nothing peculiar in the management of

* Muzell found a ball at the end of four years lying flat against the parietal bone, which had not been discovered, and had kept up an ulceration at that part with caries of the bone. Muzell (F.) of Berlin, Medical and Chirurgical Observations, translated. London, 1758.

these cases: they are for the most part unfortunate, although I have seen some excellent cases of recovery.

It is well known that when a violent shock has been received on the head, particularly by a fall on the vertex, the sutures are often separated to a considerable extent; these cases usually terminate fatally. A suture may be separated by a musket-ball, which impinges with a moderate degree of force directly upon it, with less danger. It can only however happen in young persons in whom the sutures are not obliterated as they are in elderly ones, and in general takes place when the ball happens to lodge as it were between the bones concerned in the formation of the suture. The first case of the kind which came under my observation occurred at the taking of Oporto. I met with a second at Albuhera, a third at Salamanca, and a fourth in a slighter degree at Orthez.

A heavy dragoon was wounded at the battle of Salamanca by a musket-ball in the body, which caused him to fall from his horse, and injured the top of his head. Little attention was paid to him until mischief was suspected from the lethargic state into which he fell, and which could only be attributed to the blow on the head, where a tumour was observable. This, on being divided, showed a separation of the edges of the sagittal suture, from which some blood flowed. Two crowns of the trephine were applied on the twelfth day, in order to admit of the free discharge of some blood which had been extravasated from a wound in the longitudinal sinus, after which the symptoms subsided and the patient gradually recovered.

A ball may pass apparently through the fore part of the head from side to side without doing much mischief beyond depriving the sufferer of sight. It does not in these cases injure the brain, but passes immediately below it and through the back part of both orbits. I have seen at least four such cases, in which the recovery was rapid, although the blindness was irremediable.

The danger of injuries to the frontal sinuses has been greatly exaggerated, and vanishes in a great degree, when attention is paid to their structure. The uncertainty of the depth of the cavity between the tables of the bone and the irregularity of the exposed surface of the inner table, which may through carelessness be mistaken for depression, should be remembered. Larrey relates the history of two cases of fracture from musket-balls which he treated with success in the campaign in Egypt and Syria without leaving any aërial fistula, by the application of a large crown of the trephine on the exterior table, so as to expose

the inside of the frontal sinus, when a smaller instrument was readily applied, so as to enable him to raise the depressed or broken portions of the inner table; a practice which ought to be imitated in all such cases which require the operation of the trephine.

A soldier of the 29th regiment was wounded at the battle of Talavera by a ball, which struck him on the lower part of the right side of the forehead, fracturing the external wall of the frontal sinus. On examination, the ball could be felt lodged in the sinus, from whence it was readily removed by enlarging the opening, and the man recovered without any bad symptoms*.

At the storming of Badajos a soldier of one of the regiments engaged at the little breach was struck by a small ball about the size of a swan-shot, which penetrated the frontal sinus of the right side and stuck in the inner table, the outer being considerably injured and splintered by the blow. The splinters being removed, the small ball could be seen sticking in the inner table of the bone, from whence it was easily extracted, leaving the dura mater bare beneath. He was sent to Elvas, and recovered with a good and firm cicatrix†.

Höog‡ relates the case of a soldier struck at Dresden on the left frontal sinus by a musket-ball, which he could not extract in consequence of the smallness of the opening. He afterwards refrained from attempting extraction, because no symptoms appeared to render it necessary, and the man recovered, the ball remaining in. The Baron Percy, in referring to this case, says the ball could not be removed on account of the convulsions which supervened; but this is not in the original. La Martiniere noticed a similar case.

Baron Dupuytren and Sir Astley Cooper both say they each saw a case of injury to the frontal sinus, in which, after the wound was healed, the air raised up the integuments of the temple into an elastic crepitating swelling whenever the patient blew his nose, so that a compress and bandage were required on the

* Le Dran (H. F.), Consultations, &c., Paris, 1765, page 126, gives a case from Marechal, in which a ball having entered in this way, was found a year afterwards lodged in the brain by the side of the sella turcica.

† The French used a cylinder of wood, about two inches in length, as a projectile from the musket, in which half-a-dozen or more of these shot were imbedded, which went like a patent small-shot cartridge of late invention, and when it struck it was supposed these small balls flew off in different directions. Sir Charles Broke Vere, the present member of parliament for Suffolk, was badly wounded in the right shoulder by one of them on the occasion above mentioned.

‡ Höog (Antonius), Observationes Medico-Chirurgicæ, in Sandifort's Thesaurus, vol. iii. p. 91.

part for its relief. These cases must, however, be rare, as I have never happened to see one, among the many injuries which have come under my observation, in which the air did more than raise the cicatrix, although I have often had great difficulty in closing the external opening.

Wounds of the bony parts within the orbit are often attended by the most serious consequences. A boy, nine years of age, was brought to the Ophthalmic Hospital struck by his playfellow with the end of a thick iron wire on the right eye, which blackened it. There was no external wound; but as there was some bloody chemosis at the upper part and inside, there was a probability of the wire having penetrated deeply, although the opening could not be discovered by the probe. The accident had happened two days before, and the boy had vomited shortly afterwards, and had eaten little since, although he did not think himself ill. He was well purged, and cold water was desired to be applied externally. Two days after he returned, complaining of sickness, headache, and some pain over the brow, and looked ill. It was now suspected that the instrument had penetrated into the brain, although the ecchymosis was in a great measure gone and the eye was unaffected. He was bled freely from the temple of that side by leeches, and calomel and jalap were given him so as to act fully. He did not attend the next or fifth day, but on the sixth his mother came to say he had been very ill, and delirious and restless all night. On going to visit him, he was found stupefied, answering with difficulty and incoherently; pulse very quick, skin hot and dry, with some convulsive twitches of the face and arms; pupils slightly obeying the influence of a strong light, but not dilated. He was again bled freely from the temple, but his breathing became more difficult, he fell into a comatose state, and died in the night. On examining the head, the stiff iron wire was found to have passed under the upper eyelid between it and the eye, through the posterior part of the orbitar plate of the frontal bone and into the anterior lobe of the brain, which was softened at that part, and bedewed with a little matter.

The second case I have seen of the kind was in a woman, who had been struck by her husband on the left eye with a tobacco-pipe, whilst preparing her frying-pan for cooking; the blow she returned by knocking him down with the pan, and rupturing his right eye, which was lost. She then, she said, pulled a piece of the pipe out, which was sticking in the orbit, the eye being itself uninjured, the wound being under the lid, between it and the upper and inside of the eye, in which direction a probe could be passed for some distance. She complained of

little but the redness of the eye and the bruise, and rather brought her husband than herself for advice. She was, however, bled and purged, and did not complain of anything for several days, indeed she did not attend for a week, when she said she had been very ill all night, with nausea, headache and shivering, with hot and dry skin, pulse very quick, the upper eyelid paralytic, and she was altogether looking very ill. She was bled largely and purged freely, but became delirious at night, and died in two days after the first complaint of serious illness. On examination, half an inch of the red waxed end of the tobacco-pipe was found to have gone through the sphenoid bone, by the side of the sella turcica, and to have lodged in the brain, from whence it was removed bedewed with pus, the brain being yellow and softened around it. I have seen two other cases in children of a nearly similar nature and terminating in the same way.

A wound of the longitudinal or lateral sinuses, which allows a free discharge of the blood poured out, is of little comparative consequence. It is, on the contrary, a very fatal injury when the blood is permitted to accumulate; of each of these kinds of cases I have seen several instances*. The ancient opinions on the subject have been collected by Lassus †.

A protrusion of the brain, often improperly called a fungus cerebri, was known to take place by the earliest writers on surgery, and was noticed by Celsus ‡. It is of two kinds, and occurs at different periods of time. The first kind is principally composed of coagulated blood, usually appears immediately after, or within two days after the injury, and is generally fatal. The second takes place at a later period, although I have seen it occur on the third and fourth day, and is formed for the most part of brain. They rarely or never take place when a considerable portion of the skull has been lost or removed, the brain being able to expand to such

* Sarah Randall, four years old, was struck by a rake, one of the teeth of which penetrated the skull and longitudinal sinus near the anterior fontanelle, from which blood jetted out with a pulsatory motion to the amount of three or four ounces. It was arrested by a compress and cold water; a slight hemiplegia was shortly after observed at the left side, which subsided in seven or eight days under purgatives and the application of a few leeches. The child did not however recover its strength, and appeared to have a tendency to low inflammation of the brain, or the effusion of fluid, which was relieved by purgatives and diuretics.

† Lassus (J.), Sur les Plaies du Sinus Longitudinaire Supérieur, in the fifth volume of the Mémoires de l'Académie de Chirurgie de Paris, 1774.

‡ Quod si membrana per inflammationem intumuerit, infundenda erit rosa tepida. Si usque eo tumebit, ut super ossa quoque emineat, coercebit eam bene trita lenticula, vel folia vitis contrita, et cum recenti vel butyro vel adipe anserino mista. A. Corn. Cels. Medic., cap. iv. p. 520.

extent as the inflammatory impulse from within may render necessary. When the opening, on the contrary, is small, and the dura mater has not been injured, they have been seldom observed. It is then principally when the opening in the skull has been of greater extent than the size of one piece of bone removed by the trephine, the dura mater having yielded either in consequence of the injury or by ulceration, that this evil takes place; it is by no means, under proper treatment, a fatal, although it is always an extremely dangerous occurrence.

In the first kind of protrusion the dura mater must necessarily be torn to some extent, and the tumour which comes through it is of a dark brown colour, glazed and covered in general by the pia mater. These protrusions were accompanied, in every case I have seen, by delirium and other symptoms of inflammation of the brain and of its membranes, and not by coma, until near the fatal termination of the disease. I have seen them torn off by the patients themselves during life*, or have found that they have been torn off before death, and was able to satisfy myself that they all arose from hemorrhage into the substance of the brain, probably immediately below its surface, which became augmented in size as the inflammation proceeded, and was gradually protruded at the part where there was the least opposition. When the tumour was torn off little hemorrhage ensued, but a dark brown bloody cavity was seen in the substance of the brain; or when cut off and examined, the protruded part seemed to be covered by the pia mater, with or without a layer of cerebral matter, and was made up generally of coagulated blood. I never saw a case of this kind recover†.

* Lambert of Marseilles relates a case in which he cut off portions of the fungus daily, until at last the patient, in a fit of drunkenness, tore off the remainder and recovered.—Comment. sur la Carie, chap. i.

† These patients all died by the fifth day, generally at an early period; and the labour of the medical officers was always so greatly beyond their strength, until perhaps the last campaign in the Pyrenees and in France, that it would have been dishonest, if not highly improper, to have devoted even half an hour for the purpose of an examination after death. I can only plead in excuse for the omission, that on several occasions, under my superintendence, the labour was so disproportioned to the bodily strength of many of the medical men, that they have said openly, their only hope for safety was, that I should kill myself before I killed them. I regret to add, that the treatment many of these gentlemen have since met with is highly discreditable to the country. If I were to permit myself to say more, I should, in stating only the truth, excite many painful and perhaps angry feelings. I will therefore refrain, with the hope that the strong sense of right and wrong possessed by the officer who at present holds the military purse-strings of the country, will induce him to relieve the medical officers of the army from the degrading state of humiliation to which they have been reduced by his

The case which Mr. Abernethy* has related, in which the protrusion took place on the tenth day after the operation for the removal of a portion of bone, seems to have been one of this nature; and I am disposed to recommend that all such bloody tumours should be cut off on a line with the surface of the skull as soon as they appear above it, or that they be removed altogether, so as to allow of a free discharge of blood or of any fluid which may be collected under the dura mater. Blood cannot be drawn under these circumstances in any other way so well as from the surface or the substance of the brain itself, and a free discharge for any matters which may be collected beneath the bone is essential to the safety of the patient. I have already said that all persons so afflicted labour under inflammation of the brain, of which the hernia ought to be considered as a symptom and a consequence, although it may assist in keeping up the original irritation from which its existence was in all probability deduced. The general treatment should be conducted on the same principles as those recommended for inflammation of the brain under other circumstances†.

In the second kind of protrusion, or that which usually although not necessarily takes place when the first or active inflammatory symptoms are on the decline, the tumour is formed by the substance of the brain. If the histories of cases which have been related on this subject should not be sufficient to prove the fact, I may add that I feel satisfied of its accuracy from my own observation. It has been supposed, however, "that in whatever manner a case of hernia cerebri may arrive at a favourable termination, there must inevitably be a loss of brain proportionate to the extent of the protrusion;" a conclusion which my experience does not confirm, and which I have no doubt will be hereafter modified, inasmuch as it may lead to the establishment of an erroneous practice for the early removal of the protrusion, grounded on the necessity supposed to exist for the loss of all that part which may spring up above the level of the skull. The

predecessors, and to give to science and to learning that support and protection which ought always to be characteristic of a great and civilized country like Great Britain.

* Abernethy (J.), Surgical Works, vol. ii. 1815, page 51.

† There is a case I believe of this kind reported from the Norwich Hospital, in the Lancet for 1835–36, in which symptoms of compression of the brain, and a protrusion of it followed shortly after the removal of the breech-pin of a gun which had been driven into the forehead, and injured the longitudinal sinus; the vessel was apparently prevented from pouring out its blood until the breech-pin was removed, when the protrusion took place, which appeared to consist partly of coagulated blood and partly of brain, and the extravasation of blood led to the fatal symptoms which destroyed the patient.

loss of a portion of one of the hemispheres of the brain is now known to have occasioned little or no inconvenience in many instances, either in the intellectual or corporeal faculties; nevertheless, as the precise quantity which a person may lose with impunity has not been ascertained, it may be as well to deprive a patient of none, provided its removal can be dispensed with; and that it may be so dispensed with I have had positive proof in several instances by the protruded part being gradually withdrawn within the skull, the wound having afterwards healed by the ordinary processes of nature.

There were three cases of recovery from a protrusion of the brain after the battle of Toulouse, the histories of two of which are annexed*. They were the

* Bernard Duffy, 40th Regiment, aged twenty-four, was wounded on the 10th of April at the battle of Toulouse, and admitted into the Caserne de Calvete Hospital on the 13th with fracture and depression of the upper part of the os frontis. Some portions of detached bone were removed; he was largely bled and purged.

On the 14th he complained of severe pain in his head, giddiness, dimness of sight, and drowsiness. The pupils were much dilated; pulse 60, and full. An incision was made down to the bone, and the divided arteries were allowed to bleed freely. One perforation was made by the trephine, and the whole of the detached and depressed pieces of bone, which were of considerable size, were removed, one of them having penetrated the dura mater. 15th. Has less pain in his head; pulse full and slow; pupils dilated; has a tendency to coma, but is sensible when spoken to. V. S. ad ℥xxiv. Continue the purgatives. 18th. Is less drowsy; pupils more contracted. The surface of the dura mater is sloughy, and a small dark-coloured excrescence is rising up through the opening in the cranium. 22nd. The fungus cerebri has considerably increased in size the last few days; in other respects doing well. 24th. The wound looks clean; the discharge is healthy. The fungus increases in size, and is rather above the edges of the wound; some sloughs have separated from it, and it has now a red and tolerably clean appearance. 26th. The wound granulates regularly, the excrescence seems to enlarge rather at the base than the upper part; it was touched slightly with lunar caustic without any pain or unpleasant symptom being produced. 30th. Continues doing well. The pupils are still somewhat dilated, but contract readily on the admission of light; appetite good; bowels regular; and the patient says he has no complaint. Discharge from the wound healthy, the fungus is prevented from increasing by a slight application of the Argentum nitratum every second day. He has required no medicine for some time past.

May 6th. The wound has closed around the fungus, which is a little above its edges; it is touched slightly every day with lunar caustic or the cuprum vitriolatum. The pulsation of the brain elevating and depressing the fungus is perfectly distinct: no constitutional derangement. The man can sit up, and walks about. Discharged cured to Bordeaux.

William Donaldson was admitted on the 13th of April 1814, into the Depôt de Mendicité Hospital, having received a gun-shot wound in the head on the 10th of April, which fractured the right parietal bone to a considerable extent. The brain protrudes, and the wound discharges a thin sanies. Pulse quick and small; bowels open. V. S. ad ℥xvi. 14th. The pulsation of the brain is evident, and the

subjects of those observations I have alluded to, page 19, the favourable issue resulting from graduated pressure on the brain.

The pressure was graduated according to the feeling of the individuals; when made too firmly it gave rise to swimmings and pain in the head, retardation of the pulse, a sense of sickness and fainting, and even in one instance to syncope. Pressure could only be borne when very lightly applied whilst the protrusion was increasing, but could be gradually augmented when it became stationary, and during its diminution and secession. The pressure was continued until after the wound had healed.

I had occasion at Santander to remove a portion of bone, including the upper part of the lambdoidal suture of the right side, from the head of a soldier of the Light division, wounded by a musket-ball on the heights of Vera, which had fractured and depressed the skull at that part some weeks before, in consequence of symptoms of irritation having come on after an irregularity in drinking. A piece of bone was depressed, and had irritated the dura mater at the part; the membrane had some matter upon its surface, and was evidently abraded. The operation gave relief, but a tumour soon sprang up evidently composed of brain. The patient was again bled, purged and starved; calomel and opium were given in moderate doses, and the protrusion ceased to increase; about the same time it changed colour, became yellow, fetid, softer, and slowly wasted away, pieces of dead matter separating at each dressing, until it sunk within the level of the

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protrusion increases; he complains of no particular pain; the discharge is profuse, and of a thin black watery quality. Pulse at 90; bowels freely open. V. S. ad ℥xvi. Continue the purgatives. 15th. The pulse and bowels natural, the protrusion has scarcely increased; discharge profuse, and still gleety; a small compress was laid over the dressings, and a bandage was lightly applied. 16th. Pulse and secretions natural; the wound looks more healthy; the discharge something better in appearance; the fungus does not increase. 19th. Is doing well, and complains of no manner of pain; functions natural. The protrusion somewhat less; discharge good. A small quantity of cloth has come away. 21st. Discharge improved. Continue the purgatives. 26th. The protrusion evidently diminishes, and begins to heal at the edges. 30th. The hernia cerebri has considerably diminished; secretions natural; a small quantity of bone has come away; discharge diminished.

May 4th. The wound is healing rapidly; the patient is now permitted to get out of bed, and has half diet. Another very small piece of bone has come away. 10th. The wound is now nearly healed. Between the 15th and the 25th several small pieces of bone came away. On the 26th, on introducing the probe, a small piece of bone followed it; and on further examination a large piece was felt quite loose, which was removed by incision. Discharged cured to Bordeaux.

skull; after which healthy granulations sprung up, and the wound healed. I have seen several others follow the course as stated more minutely in the following case by Mr. Taylor, now surgeon of the 29th regiment, then House Surgeon of the Westminster Hospital*. Paralysis accompanied by stupor and other symptoms of compression of the brain invariably supervened before death in all.

* Thomas Welsh, aged 27, a stout muscular man, was brought to the Old Westminster Hospital on the 12th July, having fallen from a scaffold at Buckingham palace sixty feet high. He was quite sensible, roared loudly on being moved, and complained chiefly of his head, which was bleeding freely from a small wound behind and above the left ear. The skull was fractured, and a portion of bone depressed. He was bled to forty ounces. 13th. The breathing is quite natural, and he has perfect command of all his faculties; pulse 50, and oppressed. Forty ounces of blood were again abstracted, when the pulse quickened and lost its strength, perspiration succeeded, and shortly afterwards the bowels acted freely; the pulse having become slower and oppressed in the evening, and some convulsive fits having supervened. Thirty ounces of blood were immediately taken from the arm, after which he expressed himself much relieved. 14th. Mr. Guthrie finding that there was a portion of bone depressed and rather loose, enlarged the wound, and removed several small pieces of bone, one of which at the upper part had evidently perforated the dura mater, as on moving it some whitish matter like brain escaped. 15th. Pulse 74, and soft; skin cool; bowels open. He complains now of pain at the top of his head; two dozen leeches were applied as near the wound as the dressings would admit. 16th. The leeches were repeated to the scalp. 17th. Pain in his head has increased this morning, and he cannot bear any pressure on the scalp near the wound; was cupped to fourteen ounces. Calomel gr. v. Ext. Color. C. gr. v. statim. 18th. Pulse 72, firm and rather sharp. There was constant twitching of the muscles of the face, but the pupils were natural and acted freely. Twenty ounces of blood were taken from his arm, after which the pulse became quick and soft. Fifteen grains of Dover's powder were then given to him, and soon afterwards he fell asleep. 19th. Restless during the night, but slept at intervals. Two motions have passed from him involuntarily. Pulse 74, small and weak. There is a small granular prominence at the bottom of the wound, to which the motions of the brain are communicated. Pulv. Ipecacuanha Comp. gr. xv. h. s. Oleum Ricini ℥i. primo mane. 20th. The protrusion of the brain is a good deal enlarged, so that it is on a level now with the skin; no motion observed in it. To be cupped to twelve ounces. 21st. He complains of great weakness, and of pain in his head. Pulse 72, full and very soft; bowels open. The protrusion of the brain is very much enlarged, rising considerably above the level of the skin, and separating the edges of the wound; it is of a dark purple colour, and bleeds from several little points: its pulsations are very distinct, and synchronous with the pulse at the wrist; the discharge is thicker and more fetid, and the least touch of the sponge gives pain. Compress and bandage applied, making gentle pressure on the tumour. 26th. During the last four days the tumour has been gradually increasing in size and assuming a sloughy character, with a very offensive odour. On removing the dressings a large portion of the tumour was found to be nearly detached, and only held by a small neck of strong fibrous matter, which was divided with the scissors without giving the patient any pain. The cut surface was of a dark purple colour, very hard, and did not bleed. The edges of the wound are now more healthy, having lost their former dirty yellow colour, and presenting small red granu-

The preceding cases prove that persons may recover after having had a protrusion of the brain, without, as well as with the loss of a portion of its substance, the difference in all probability between the cases being dependent on the degree of mischief which gave rise to them. In all those which I had an opportunity of examining after death, and the injury in all was on the top or upper part of the sides and back of the head, the protrusion was manifestly a part of the substance of the brain, and firmer than the hemisphere beneath, which was soft, pulpy, and of a yellow and sometimes of a reddish colour, the lateral ventricle being filled with a sero-purulent matter, pus itself being spread over the surface and intermingled with the pulpy structure, into which the brain had been changed. That the protrusion was the consequence of low inflammation of the brain, there could be no doubt; and that greater caution had been necessary during the progress of the mischief than had been enforced, was in all probability the fact. It was the observation of this and of other circumstances not less important which led me to enjoin that rigid system of management which I have insisted upon in all cases of injury of the head. There can be no doubt of the formation of many of these protrusions being aided by the opening which has been made in the dura mater, which would have restrained their growth if it had been sound. The dura mater should never therefore be opened if it can be avoided, and the protrusions thus formed are the most likely to be withdrawn as the irritation which gave rise to them subsides.

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lations. He says that he feels pretty well; suffers very little pain in his head. Pulse 80, small and soft; tongue white, but not loaded; bowels open. The urine and fæces have come away involuntarily ever since the 19th, but the paralysis has not increased.

From this day the hernial tumour gradually became smaller, sloughing away in small pieces till the evening of Sunday, July 29th, when he became worse, and on the Monday morning a fresh portion of brain was found protruded, and little altered from its natural appearance. He now lost his voice, and the right side of his face was paralysed; he still, however, was sensible; his pupils acted freely, and he could move his limbs. The pulse is 72, full and easily compressed, although *the carotid arteries are observed to be pulsating very violently*. The skin is hot and dry, and the bowels open. Eighteen ounces of blood were taken from the left temple. From this period the hernial tumour again diminished, and by the 14th of August it was merely a small granulating prominence, and the wound seemed to be healing. He had, however, during this time been gradually losing the use of the right side, and had become quite paralytic. On the 15th another relapse took place; the hernial tumour again enlarged, and continued increasing till the 18th, when he died comatose. An examination of the head was not permitted.

It has been proposed to destroy protrusions of the brain with escharotics, a practice which even Hildanus condemned; and more faith has sometimes been placed in the knife for their early removal than in the more deferred operations of nature. De Gorter*, Le Dran†, and Mr. Hill‡ of Dumfries advocated the use of the knife, which was successful in their hands. Mr. Stanley§, among others, has related three cases in which he tried excision; two of these were fatal, and he has referred to seven others, in some of which the protrusion was removed by the knife, in others by ligature. I am not disposed to recommend either means if it can be avoided, but to suggest in all such cases a reliance on the efforts of nature, assisted by a methodical treatment of the low inflammatory state of the brain, and by such pressure at a later period as can be borne with comfort, and persisted in with propriety‖.

Dr. J. Thomson¶ has alluded to substances or growths forming on the surface of the brain, immediately under the place where the cranium had received a contusion, in cases in which the trepan had not been applied, or any portion of the cranium removed; and he inquires, "whether in these cases the removal of a portion of the cranium, by admitting of the protrusion of the fungi, might not have produced an alleviation of the symptoms of compression which occurred before death." The answer is a very simple one. "That where an injury has been inflicted on the skull by gun-shot, which is followed by symptoms of compression of the brain after an interval of some days or even weeks, and which symptoms are not relievable by ordinary means, recourse should be had to the trephine." I am of opinion, from what I saw, and from the reports I have received of the wounded after the battle of Waterloo, that the growths to which he alludes were

* De Gorter (Joh.), Chirurgia repurgata. Lugduni, 1742, p. 66.

† Le Dran records, from M. Bailleron of Beziers, the case of a young woman wounded by shot of different sizes, fired from a pistol at a very short distance, on the 17th of February, 1721, and which went in and came out in part like a ball, leaving a small bridge of bone between the opening. Between the 26th of February and the 4th of March he was obliged to cut off three times a portion of brain as large as a walnut. After this eight shot were discharged, and after many narrow escapes the young woman ultimately recovered.—Le Dran, page 166.

‡ Hill (J.) of Dumfries.

§ Stanley (E.), in 8th vol. of Medico-Chirurgical Transactions.

‖ Wilmer, Cases and Remarks in Surgery, Coventry, 1779, page 42, relates two remarkable cases in which protrusions of the brain took place, and were restrained and cured by dry lint, assisted by moderate pressure.

¶ Thomson (J.), M.D., Report of Observations after Waterloo, &c., p. 57. Edinburgh, 1818.

not observable in many cases; and I apprehend they were either dependent on softening of the brain from low inflammation, or owed their origin to disease of the dura mater.

Louis * drew the attention of the profession to the subject of fungous growths from the dura mater, in his excellent memoir 'Sur les tumeurs fongueuses de la Dure Mere.' He relates one case only of his own, but he collected and transcribed the histories of twenty-three which had occurred in the practice of other persons. Most of them terminated fatally; but some of them, and particularly one related by Sand † of Königsberg, is deserving of attention, being confirmative of the practice he was desirous of establishing, viz. that in all these cases the cranium around the diseased and protruding part should be removed, so as to allow of the abstraction of the tumour, which he shows most commonly arises between the layers of the dura mater. It is remarkable, that the greater number of these fungi followed blows or injuries on the head, and that similar tumours have been rarely observed since his time; a difference which in all probability may be ascribed to the greater care which has since been bestowed on such cases, and also affords additional proof of the strict attention which injuries of the head demand, long after the immediate symptoms have entirely disappeared.

The appended case is peculiar in many points, and therefore deserving of record‡.

* Louis (M.), Mémoires de l'Académie Royale de Chirurgie, tome v. Paris, 1774.

† De Fungo Cerebri. Halleri Disput. Chirurg. Select., tome i. p. 169.

‡ William Godfrey, 1st battalion 43rd regiment, aged forty, had never eaten meat or fish in his life, but had lived entirely on bread and vegetables, and was able to perform his duties with ease to himself until the 6th of April, 1814, when he was attacked with headache and other symptoms of fever, and about the same time discovered a small tumour behind his ear, which gradually increased in size until the 25th of May, when he was transferred to another hospital. On his admission, the constant, violent and distressing pain complained of, was striking. He had no febrile symptoms, and was treated by the physician in attendance for rheumatism, with bark, æther and frequent blisters. On dressing one of the blisters, the tumour was perceived above the mastoid process of the temporal bone, about the size of a hen's egg, having an elastic feel, with an extremely hard edge, as if surrounded by a bony ridge, and giving much pain on pressure. The pupils of the eyes were dilated; pulse natural; bowels regular; the pain in the head dreadfully severe, lancinating, and arising he thought from beneath the tumour. On the 31st, his bowels being confined, cathartic medicines were given to him in quantity, the pulse being quick and small, the pain in the head violent, with numbness of the left side and a difficulty in swallowing, the tonsils being somewhat inflamed, the pupils dilated, and the patient anxious for some relief. On the 1st of June, the tumour being considered as connected with the pain in the head, which was become intolerable, was removed. It adhered firmly to the

It has been supposed that abscess of the liver followed injuries of the head in a more peculiar manner than injuries of other parts of the body; an opinion upon which I am not disposed to place reliance. Bertrandi of Turin considers the opinions of Baillon and Molinella of Bologna, whether an abscess commonly forms on the convex or concave surface of the liver, and comes to the conclusion that they are generally perceived in the middle or centre of the viscus, and are likely to be caused by drawing blood from the feet, which retarded, he supposed, the course of the blood in the cava ascendens, and thus aided the mischief about to take place in the liver, an opinion in which he was supported by Andouillé, in a paper published in the same or third volume of the Mémoires of the Royal Academy of Surgery of Paris.

Boudon is said by Quesnay not to have trepanned in a case of fracture from a fall, in consequence of the great separation of the edges of the fracture, which allowed the blood extravasated beneath to ooze out until the fourteenth day, when rigors, fever and stupefaction indicating mischief having supervened, the trepan was twice applied, the dura mater was incised, and a tablespoonful of

bone, which in the centre seemed a little rough, but by no means to be concerned in the manner that was suspected. The root, or a process of the tumour, extended under the posterior edge of the sterno-cleido maostoideus muscle, and some blood-vessels were divided in its removal. The pain was much easier after the operation, but the numbness greater, particularly of the face; the soreness of the throat as before. 3rd. Passed a restless night, but appears better; the difficulty of swallowing continues; skin moist; bowels open; pulse more regular; the distressing pain of the head had left him. In the night, the pain of the head returned with great violence on turning in bed; the difficulty in swallowing increased. 4th. Cold water applied to the head gradually diminished the pain, and the most distressing symptom was the difficulty of swallowing. From the 5th to the 10th he gradually improved; on that day, however, the pain in the head became worse, the deglutition more impeded; tongue foul; pulse 110, and small, the wound looking well and discharging good pus. On the 11th he was better, and took some jelly; pulse regular; heat of skin natural. 13th. Pulse 120; skin hot; tongue foul; bowels confined, and had retention of urine, requiring the catheter. 14th. His bowels having been opened, he appeared more free from pain and uneasiness, but much weaker. On the 16th, the pupils, which for the last five days had much contracted, again dilated. On the 19th he died, apparently exhausted. On examining the head, a small excrescence was observed in the course of the meningeal artery, which had nearly obliterated its middle branch, the dura mater being whiter than natural. The blood-vessels of the cerebrum were filled with blood; the lateral and the third ventricles contained about three ounces of fluid.

A tumour, resembling in appearance the external one that had been removed, was discovered resting on the base of the cranium, originating in the cerebellum, adhering to the dura mater in the course of the lateral sinus of the left side, and forming a lodgment for itself on the petrous portion of the temporal bone. The bone between the internal and the external tumour was nearly absorbed, and there was a small quantity of matter between it and the internal tumour.

blood was evacuated from beneath. The patient however died, and an abscess was found in his liver.

Richerand * supposed that in cases of this nature the shock which injured the brain took effect at the same time on the viscera of the abdomen, and principally on the liver. Larrey † believed that when abscess occurred in the liver after an injury of the head, it took place rarely from the cause which Richerand had assigned, and agreed with Desault in opinion that it was a consequence of the sympathetic irritation of the liver, with the inflammation of the fibrous membranes of the head. My experience has induced me to think that unless the liver is really injured by a fall or blow which has been received, it only becomes affected in a secondary manner, in a similar way to the lungs or other viscera, or to the joints or other parts. The new disease in these cases is always insidious in its nature and progress, and for the most part fatal in its result, as I have explained at length when treating of "inflammation attacking internal parts in an insidious manner, as a consequence of secondary amputation ‡." It has been further commented upon and explained by Mr. Rose §, Mr. Arnott ‖, and others.

* Richerand (A.), Nosographie Chirurgicale, 1815, 4th edition.

† Larrey (Baron), Mémoires et Campagnes, tome iv. p. 238.

‡ Page 256 in my work on Gun-Shot Wounds, &c., 3rd edition.

§ Rose (Thomas), on Depositions of Pus and Lymph after Injuries of different parts of the Body, in the 14th volume of the Medico-Chirurgical Transactions, page 276.

Sir B. Brodie has stated, from notes made by Mr. Rose whilst serving with the Coldstream Guards in the Peninsula, and Mr. Samuel Cooper has referred to the statement in his Surgical Dictionary, that during the retreat of the British army from Talavera (to Deleytosa, in the convent of which place the first general hospital was formed), and which occupied sixteen days, "Twelve or fourteen with wounds in the head, accompanied with injuries of the bone, at least four or five of whom had both tables of the skull fractured, and two of them, along with fracture of the os frontis, had each the globe of one eye totally destroyed, followed the regiment. In none of them had the trephine been applied, nor had any attempt been made to remove splinters of bone," and that all recovered.

The fact stands, and is valuable as far as it goes, but I cannot confirm it with respect either to injuries of the head with fracture which were a little more serious, nor to the fractures of other bones; very many limbs and lives having been lost in the hospital of Deleytosa, in consequence of the irregularities and sufferings experienced in that retreat, which under happier circumstances would have been preserved. It was here I first publicly expressed my opinion to the surgeons of the different regiments assembled, on the impropriety of amputating the arm for a gun-shot fracture of the humerus, and prevented its being done in several persons who having followed the army, had partaken of its privations, and had suffered severely in consequence.

‖ Arnott (James M.), Pathological Inquiry into the Secondary Effects of Inflammation of the Veins, in the 15th volume of the Medico-Chirurgical Transactions, page 1, 1829.

When a person has received a serious blow on the head, which has given rise to an exfoliation of the bone, or to a very slight depression of the skull, he is rarely restored to his previous healthy and natural state. The scalp adheres firmly to the bone beneath instead of sliding loosely over it, and a deep hollow is formed, which would imply that greater mischief had been done and a greater loss of bone had been sustained than actually took place; and this is the more remarkable when pieces of bone have been removed. I have now under my care, for disease in other parts, Major D. of the Indian army, who was wounded on the left side of the forehead at its upper part by a musket-ball at the assault of Mahidpoore. Several pieces of bone were removed, and the pulsation of the brain was evident in the discharge. I can push the point of my little finger into the hole left by the cicatrization of the wound, to an extent I should not have suspected if I had not been aware of the fact. This officer suffers from headaches, augmented or brought on by any exertion of body or mind. He cannot bear exposure to the heat of the sun. He can scarcely drink three glasses of wine without feeling its effect. In all these cases, and I could relate many, of persons of education, they can bear no great exertion of any kind. They fall down under exposure to heat. They are easily inebriated, rendered furious by a small quantity of liquor, and often become stupefied, comatose, or even die suddenly. In addition to these evils, which may be avoided by care, many are subjected to fits, which are apparently epileptic; and others suffer from such intolerable pain in the part injured, as well as in the head generally, as to be rendered miserable and desirous of seeking relief at any risk.

These injuries are often accompanied during their progress by mental defects which time does not always remove. The memory is very often much impaired. It is frequently defective as to things as well as to persons. The sight of one or both eyes may be impaired, or even lost. Ptosis, or a falling of the upper lid, is not an uncommon although a more curable defect. Speech is not only difficult, but the power of uttering certain words is often lost; a language is occasionally for a time forgotten, and a sort of conventional one has even been adopted, in the manner mentioned by Sir A. Cooper, the Baron Larrey, Sir B. Brodie, and in the case related by Dr. Hennen, which was under my own observation. The more serious evils which befall these unfortunate sufferers are aberrations of mind, rendering some degree of restraint necessary, or a state

of fatuity, which is not less distressing. These intellectual defects are often accompanied by various states of lameness and debility, from which there is but little hope of recovery*.

It is an interesting fact, that a person who has been shot in the head, or ha

* Mr. Keate has favoured me with the following case:—A gentleman received a severe blow on the right side of the head from a loaded stick, which stunned and knocked him down. He partially recovered from this, walked with support to the sea-shore, and was taken on board his yacht. He soon became again insensible, and remained so for nearly three days. Whilst thus deprived apparently of sense and motion, and supposed to be dying, he distinctly remembers hearing a discussion between a relation and the sailing master, whether they should buy a coffin for him at the port where they were anchored, or take him to England as he lay in his cot; and he was conscious of his utter inability to make any movement indicating that he was alive and understood this conversation. After four days an incision was made through the temporal muscle down to the bone which was not fractured. He soon afterwards became delirious, and remained so more or less for a fortnight, when he suddenly recovered his senses. He was bled once during this time from the arm. About a month after the accident he came to London; the right side of the head and face was much thickened and enlarged, and hard to the touch, particularly over the temporal muscle. He cannot articulate distinctly, nor command his words so as to describe his case, nor his present feelings. Both pupils are much dilated, and the iris is hardly sensible of the stimulus of light. He cannot see to read nor to write, letters being mistaken and confused: has had no headache that he recollects, but was troubled by occasional sickness for the first few days, and feels himself gradually getting better. Pulse 72: tongue moist and clear. Perfect quietude was enjoined, and calomel and opium were administered in the dose of two grains of calomel three times a day, and the quantity was gradually increased between the 16th of September and the 16th of October, when it was omitted, the patient being much better, although the mouth was not made sore. Blisters were applied to the neck and to the forehead, the head was shaved and slightly irritated; and sarsaparilla and iodine were given until the beginning of December, when he was free from complaint, and has remained so unto the present time.

I have seen, whilst this sheet was passing through the press, a gentleman who had been thrown from his horse on his head, to which little apparent mischief was done. The accident happened at five o'clock in the evening, and during the time he was carried home he spoke two or three words, but became quite insensible, cold, clammy, and very restless. I saw him at eight o'clock the next morning, when reaction had taken place to a certain extent; the pulse, which had been irregular, was 112, sufficient in volume, but deficient in power; the skin natural in temperature, but covered with a profuse perspiration, which at this period is always an unfavourable symptom; the pupils were perhaps a very little dilated, the iris slightly sensible in the left eye. The breathing free from stertor, but short. The restlessness had passed away; the lower limbs were quiescent even under irritation; the upper were slightly convulsed. The eyelids scarcely contracted on irritating the eyelashes; the urine had passed, perhaps involuntarily. I desired a small quantity of blood to be drawn for examination at eleven o'clock on his face becoming flushed, but it did not improve his condition, and he gradually sunk, and died at four o'clock in the afternoon. The head was not examined, but the case illustrates the observations made pp. 20 to 25.—G.

fallen from the top of a house, so as to become insensible, has no knowledge of the circumstance, and when, after several days or weeks, he regains his senses, he has no recollection of the injury, or of receiving the wound; or if he should have fallen from a height, he only remembers that he was aware he was about to fall, but of the actual descent or the injury he knows nothing.

The continental surgeons generally use the trepan which works like a carpenter's wimble, and of course acts equally on a part of unequal thickness, and is therefore very likely to injure the dura mater; and although I do not dread a wound of this membrane so much as many surgeons, it is certainly very advisable to avoid such an evil if possible. The trephine, which is worked by turning the hand, and makes therefore only a half turn, necessarily saws unequally; but the operator has the advantage of being able to press with it on any particular part as the sawing of the bone draws to a close, and can thus cut any portion of the bone which is thicker than the rest without wounding the dura mater. The division and yielding of the last layer of bone is very sensibly felt by the hand, and when sawing, the surgeon can use the trephine as a slight lever with great effect, by pressing on a particular part, or from side to side, and the inner layer of the vitreous table is in this manner as much broken as sawn through. The piece to be removed should never be brought away in the crown of the trephine, but should be raised by the forceps and lever; and whenever a rough edge of the inner table remains, it should be carefully rounded off with the lenticular, or blunt-ended instrument commonly used for this purpose.

Whenever there has been a loss of the integuments or scalp, so that this part cannot be brought over the opening made by the removal of the bone, some fine soft cotton should be laid in on the dura mater, so that a slight degree of support may be given to that membrane, and more particularly when it is thought that it may not be necessary to examine it for two or three days. When circumstances appear to render a daily inspection necessary, I have usually brought the cut portions of scalp over the opening, and retained them by a slight compress and bandage kept constantly wet and cold. The dura mater usually changes colour, becomes more red, a layer of lymph is seen adhering to it when occasionally examined, from which granulations arise and spring up until they touch the scalp, to which they unite, or cicatrization takes place. When the patient dies early from other causes and the calvarium is removed,

the discoloured spot on the dura mater marks the place from over which the bone was removed. I have seen this in a state of slough, and the only apparent discoverable mark of disease.

One of the improvements in modern surgery is to be found in the restriction which has gradually been placed on the repeated use of the trephine on the same person, and on the removal of large portions of the skull. Cases are not, however, wanting in the older authors which would appear to justify the proceeding, although it may perhaps be said that they only show how great an extent of injury may sometimes be committed with impunity.

Saviard* trepanned one person twenty times. Russ Martel and Le Gendre†, surgeons to the king of Navarre, say that in the year 1686 they took away nearly both parietal bones, and the patient recovered and lived for thirty years afterwards, half his body being however paralysed. Marechal applied the trephine twelve times successfully, Gooch‡ thirteen times, Desportes§ twelve times. Saviard also says, page 386, that he had under his care a woman whose parietal bones, together with a great part of the occipital and frontal, separated at the end of two years after a blow, resembling a calvarium sawn off a dead person. No fungus or hernia took place, and she lived several years.

* Saviard, Nouveau Recueil d'Observations Chirurgicales, p. 139. Paris, 1702.

† See Loyseau, Observationes Med. Chirurg.

‡ Gooch (Benjamin), Cases and Practical Remarks in Surgery. London, 1758, page 1. He gives the case of a man 61 years of age on whom he trephined the parietal bone and part of the temporal thirteen times with success, and he gives a plate showing the position of the various crowns of the instrument. Six perforations at the upper part enabled him to remove all the depressed portions then in view; the dura mater being observed to be separated from the bone much beyond the perforations. He recovered his senses perfectly, under the usual treatment, in ten days, and the symptomatic fever abated. As the case proceeded matter was found to lodge at the depending part of the wound in the bone in greater quantity than a healthy surface should supply, and the dura mater was further separated from the bone; the pulse became quicker; the patient became more restless, and at last fell into a state of stupor. On removing more of the scalp in a circular form from above downwards, on the back part, a triangular sharp-pointed fragment of the cranium stuck into the dura mater, from whence the matter had issued for three or four days. Under these circumstances he thought it right to remove all the exposed bone by seven more perforations of the trephine, upon which he grew immediately better, and every bad symptom gradually vanished. He recovered so as to follow his ordinary employment several years afterwards.

§ Desportes, Plaies d'Armes à Feu, page 388.

Solingen says*, Philip of Nassau having been thrown from his horse fractured his skull in several places by striking his head against the stump of a tree; that he was trepanned twenty-seven times by a surgeon of Neomagen. He gave a certificate of this, signed by himself, and Solingen adds as a proof of his complete recovery that he afterwards drank three of his companions to death.

The following case, which was given to me by Dr. G. F. D. Evans, furnishes the instance of the largest trepanning I have heard of in the present day.

A young labourer in a coal-mine was struck by an iron chain, which had fallen on him from a height of nearly 200 feet. There was no external wound, but considerable tumefaction of the scalp; and as some hours afterwards he was labouring under symptoms of compression of the brain, it was deemed advisable to divide the scalp, to ascertain the state of parts underneath. This being done, the left parietal bone was found to be extensively fractured at its most protuberant part; two fissures extending nearly the length of the bone, joined by two others, inclosed an irregularly-shaped portion of bone, of about half an inch broad at its anterior, and an inch or more in breadth at its posterior margin; the inferior angle of this piece was considerably depressed. On applying the crown of a trephine, for the purpose of gaining room to raise the depression, it was discovered that the internal table was so much more extensively fractured than the external, that it required twelve applications of the instrument, and the consequent removal of a very considerable portion of the bone, before the broken edge of the internal table could be got at, or its extent ascertained. When this was at length effected, and an attempt made to elevate the fracture, the entire piece became detached, and was removed. The dura mater, thus exposed, was found distended by a quantity of blood extravasated underneath it. No abatement of the symptoms being perceived to follow the elevation of the bone, it was decided to endeavour to evacuate the blood by an incision through the membrane. This was accordingly made with a very sharp lancet, to the extent of about three quarters of an inch. Some blood flowed out, the symptoms of compression were immediately relieved, and shortly disappeared. The edges of the scalp were brought together over the wound, lightly retained *in situ*, and the wound covered with lint. Nothing unfavourable afterwards occurred, and the man got well.

* Solingen, Manuale Operatien der Chirurgie, &c., cap. vii. page 29.

The removal of a large portion of the skull may be necessary where the broken portions are deprived of their natural support and connexions, but under all circumstances as little should be taken away as possible. I have considered, from page 58 to 61, those accidents which are followed by extravasation of blood between the dura mater and the skull in consequence of a wound of the middle meningeal artery, which may render such removal necessary. Blood may however be extravasated between the dura mater and the bone, and beneath the dura mater from other causes, attended or not with fracture. When the loss of sense and motion are accompanied by fracture, and continue to increase rather than to diminish, after the necessary and usual means have been adopted for their relief, a piece of bone should be removed; and if blood should be found in any quantity on the dura mater, it may be necessary to take away more bone to admit of its free discharge, for although the gradual pressure of the brain from within will tend to expel it, this object may not be attained in sufficient time, and the patient may be lost. The older surgeons in these cases were anxious to ascertain how far or to what extent the dura mater was separated from the skull, and they often removed the bone accordingly, as in the case related by Gooch; and although I cannot advise that their practice should be implicitly followed, I am satisfied, from repeated observation, that modern surgeons have fallen too much into the opposite extreme of doing too little, which should be carefully avoided. When blood has been in this manner evacuated, the parts must pass from a state of inflammation into that of suppuration before the dura mater can again adhere to the superincumbent bone, and care must be taken that this matter shall have a free discharge; and if symptoms of fever, followed by those of commencing compression, should supervene from the granulations arising from the dura mater filling up the opening and preventing the exit of the matter, or from its having gravitated in a direction which does not admit of its being readily discharged, the opening in the skull should be increased so as to remove the impediment and thereby lessen the danger.

A layer of blood is often extravasated very thinly over the whole surface of the brain, and cannot be removed although it may be absorbed. It is on the other hand often collected in larger quantity on the basis of the cranium, from whence it will not be absorbed and cannot be removed. It may be extravasated without reference to the part on which the blow has been received, constituting a case

analogous to that of apoplexy, for relief of which no surgical operation can avail; but when a blow has been undoubtedly received on a part of the skull, and any sign of mischief can be perceived on or in that part, the removal of the bone is permissible. If in the case of Mr. S., page 26, I had applied the trephine, I should have committed an error, and yet it has been done in cases somewhat similar with the best effect.

The wind of a cannon-ball has been supposed to exert some influence on the brain, when passing close to the head; there is, however, no valid foundation for the opinion, for I have seen the skin injured in various parts of the head and neck by cannon-shot without any other inconvenience ensuing than that directly occasioned by the ball. An officer of the fifth division was struck by a cannon-shot at night, during the assault of Badajos, on the right side of the head and face. It carried away the right eye and the whole face, the left eye hanging in the orbit, the floor of which was destroyed. A part of the lower jaw remained on the left side, but a great part of the tongue was gone. He had lost a large quantity of blood, but was quite sensible. In the middle of the next day he suffered much from the want of water to moisten his throat, which could not be procured. After a distressing delay of three or four hours under a hot sun, a small quantity was obtained, the arrival of which he observed; and whilst I was giving directions relative to its distribution, I felt a gentle tap on my shoulder, and on turning round saw this unfortunate man standing behind me, a terrific object, holding out a small cup for water, not one drop of which he could swallow. Alone amongst strangers, he felt that every kindness in our power to offer was bestowed upon him, and he contrived to write his thanks with a pencil, which he gave me when he pressed my hand at parting at eleven at night. I was glad at sun-rise to find he had just expired.

THE END.

PRINTED BY RICHARD AND JOHN E. TAYLOR, RED LION COURT, FLEET STREET.

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ON

SOME POINTS

CONNECTED WITH

THE ANATOMY AND SURGERY

OF

INGUINAL AND FEMORAL HERNIÆ.

I HAD the honour of delivering the Lectures in the Theatre of the Royal College of Surgeons, in February 1831, on the Anatomy and Surgery of Inguinal and Femoral Herniæ; and I took the liberty on that occasion to demonstrate the anatomy of some of the parts concerned in these derangements in a manner which had not been commonly adopted, but which I trust will be found more satisfactory than the method which is usually followed. A difference of opinion in regard to the structure of a part of the body is not of much real importance, unless it involves some practical point; and it is under this impression I venture to hope that the dissections made on that occasion, and the elucidations and explanations which resulted from them, have enabled me to remove a discrepancy that existed between the anatomy and surgery of these parts, which I had always pointed out in my private lectures, but was unable previously to explain.

According to the prevailing opinion of modern surgeons, the parts through which an inguinal hernia passes or proceeds, have little or nothing to do with the causes of strangulation; which are supposed to depend upon certain circumstances connected with the state of the protruded parts themselves, rather than upon any positive contraction or diminution of the size of the aperture through which they pass. If it had been generally demonstrated or believed that the inner or superior opening of the inguinal canal was a muscular opening or split, through or between the fibres of which the protrusion took place, there would have been

little difficulty or hesitation in attributing the cause of strangulation to a sudden or irregular contraction of these fibres: but as such fibres were not believed to exist, or were supposed only to exist on the upper part, the impossibility of any circular contraction was necessarily inferred; and other causes of strangulation were sought for in the ingenuity of those individuals whose attention was devoted to the subject. I am quite aware, that these individuals have been and are among the number of the most celebrated anatomists and surgeons in Europe; that any effort to add to their labours may be considered an act of supererogation; and that any attempt to differ in opinion from them will be thought, perhaps, a matter of vanity. Facts have, however, forced themselves upon me so strongly, that I could not help acknowledging their influence; and it will be for those who doubt, to investigate this subject by their aid, and, by a similar patient inquiry, to confirm or confute the opinions I have founded upon them; viz. that the inner or superior opening of the inguinal canal is a muscular opening, or rather split, capable of a great degree of contraction, which is usually the cause of strangulation in cases of recent herniæ, and is by no means an infrequent one even in older ones. Before I was enabled to demonstrate the muscular structure of these parts, I had had the opportunity of examining the bodies of two persons who had died from strangulated herniæ, in both of whom the stricture on the intestine had been so great, that a common silver probe could not be easily passed in the canal of the gut. The last case was that of a person who had been operated upon, and died shortly afterwards; the intestine had been returned into the cavity of the abdomen, and was found lying behind the inner ring, with a narrow but deep indentation around it, marking the place at which the stricture had existed, and through which a probe could only be passed by dilating the contraction. I showed the preparation at my Lecture, and declared, what I believe to be true, that this could only have taken place from some direct muscular pressure from without, and not from any congestion or dilatation from within or below the stricture. I also acknowledged that I could not show, by dissection, in what manner this contraction had taken place, or by what parts it was effected. I have always, however, continued to impress upon the minds of the gentlemen attending my Lectures for the last ten years, that the principal cause of strangulation in recent hernia was a contraction of the superior or internal opening of the inguinal canal, the cause and nature of which I could

not satisfactorily explain; that it was, therefore, a point in anatomy deserving investigation, for a discrepancy of this kind could not exist in nature; and that there must be something defective in our knowledge of the subject.

That it may not be considered I am combating a shadow, I shall first show what are the opinions of some of the ablest anatomists who have written on these points, and then proceed to develope my own.

Mr. Samuel Cooper, whose Surgical Dictionary may be justly consulted as a summary of the opinions of the principal surgeons of Europe, has given, in the last edition of this Work (of 1830), page 653, the following account of the anatomy of the parts concerned in inguinal hernia, compiled with especial reference to the Works of Sir Astley Cooper, Messrs. Lawrence, Scarpa, Hesselbach, Cloquet, and Langenbeck.

"The tendinous fibres of the aponeurosis of the external oblique muscle, as they run downwards and forwards towards the pubes, separate from each other, so as to leave a triangular opening, called the abdominal ring, which is usually more capacious in the male than the female subject. The upper and inner pillar (as it is termed,) of this aperture is inserted into the symphysis of the pubes, and is the weakest of the two; the lower and outer one, which is the strongest, is chiefly a continuation of Poupart's ligament (Hesselbach, *Über den Ursprung, &c. der Leisten-und-Schenkelbrüche*, p. 4.), and is fixed into the angle and crista of the same bone. Some tendinous fibres cross the upper and outer angle of the ring, so as to diminish the triangular appearance of the whole aperture: these are said to be very strong in old herniæ. The anterior and thicker layer of the aponeurosis of the internal oblique muscle joins the tendon of the external oblique; the posterior and thinner one joins that of the transversalis; but the lower portion of this tendon, together with the corresponding part of the transversalis, goes wholly in front of the rectus muscle. Thus, the inferior border of the obliquus internus and transversalis, which originates from the upper part of Poupart's ligament, lies behind the outer pillar of the abdominal ring. Sir Astley Cooper first noticed, that a thin fascia proceeds from the inner edge of Poupart's ligament, and spreads over the posterior surface of the transversalis. This fascia forms the only partition between the peritoneum and the outer opening of the abdominal ring; and were it not for its existence, inguinal herniæ would probably be much more frequent. The partition in question, however, is said by

Scarpa to be formed by the aponeurosis of the internal oblique and transverse muscles; while Hesselbach, who has named the small smooth point, situated directly behind the outer opening of the abdominal ring, its crural surface, distinctly states that it is formed by delicate fleshy and tendinous fibres of the internal oblique muscle (*Über den Ursprung, &c. der Leisten-und-Schenkelbrüche*, p. 4.); and that behind them is the weakest part of what he names the internal inguinal ligament, in the rear of which is the peritoneum, with the intervention of a very loose cellular substance (*Op. cit.*, p. 26.). The internal inguinal ligament of Hesselbach is, therefore, clearly the same thing as the above fascia, first pointed out by Sir Astley Cooper. This point of the abdomen is one of the three weak places on the inside of the inguinal region, where herniæ are liable to occur; yet, weak as it appears to be, it is not the most common situation for such tumours. A computation has been made, that in a hundred cases of inguinal hernia, not ten occur at the point here specified (H. J. Brünninghausen, *Unterricht über die Brüche, &c.* Wurzb. 1811.). Mr. Lawrence observes, that if we trace the fascia transversalis from the crural arch upwards, we shall find it divided immediately into two portions, an internal and external, which leave between them a considerable interval, just in the middle of the crural arch. The former of these, which is the strongest and most decidedly fibrous, is connected by its inner edge to the outer margin of the rectus, and to the inferior margin of the tendon of the obliquus internus and transversus; and both are gradually lost above, between the peritoneum and transversus (*On Ruptures*, ed. 4. p. 179.)."—Mr. S. Cooper then proceeds to give the following explanation of the parts as they appear on dissection (p. 658.). "The removal of the integuments exposes the exterior investment of the hernial tumour, continuous with the margins of the ring, and formed of tendinous fibres from the aponeurosis, the cremaster muscle, &c. This is connected by cellular substance with the proper hernial sac, formed of the peritoneum. This production of the peritoneum passes within the ring of the external oblique, and then goes upwards and outwards. Behind and above the ring, the inferior margin of the obliquus internus and transversalis crosses the neck of the sac. When these muscles are reflected towards the linea alba, the fascia, ascending from Poupart's ligament, and forming the upper opening of the ring, is exposed, and the epigastric artery is discovered emerging from the inner side of the neck of the hernial sac (Camperi

Icones, tab. x. 6. M.), which, at this precise point, becomes continuous with the peritoneum lining the abdomen. The removal of the hernial sac will disclose the course of the spermatic cord in its descent towards the testicle; and when this is also elevated, the first part of the course of the epigastric artery, and its origin from the iliac trunk, are exposed. (Lawrence *On Ruptures*, edit. 4. p. 203.)"

The following is Cloquet's description of these parts :—

"The inferior fibres of the internal oblique muscle have a direction nearly transverse. They are usually intimately intermingled with those of the transversalis muscle, which is placed behind it. They are inserted externally into Poupart's ligament, internally into the pubes, between its spine and angle. The inferior edge of the internal oblique is then parallel with the crural arch (Poupart's ligament). In some persons it is separated, and very distinct from the transversalis muscle; in others it is so intimately connected with it, that they cannot be separated. A number of dissections, carefully made, appear to show, that the inferior edge of the transversalis muscle, composed of very pale fine fibres, passes in a transverse direction across the spermatic cord, at the spot where it enters the inguinal canal; that is, on a level with the superior opening of the canal. It is inserted internally in the inferior part of the linea alba, and slightly to the pubes by uniting with the aponeurosis of the internal oblique, the inferior edge of which muscle, arising, as I have said, from the crural arch (Poupart's ligament), descends parallel to it, covering the spermatic cord in the inguinal canal, and is attached internally to the pubes. The internal oblique crosses over the spermatic cord just at the point where it passes out from the superior opening of the inguinal canal. The fibres, which go to form the cremaster muscle, change their direction and form; those which were straight and nearly horizontal, become curved and vertical. They pass through and descend below the ring, forming successively, in front of the spermatic cord, several nooses or arches, with their concavities turned upwards, and which may be traced to the bottom of the scrotum. These fibres are situated upon the anterior face of the spermatic cord and tunica vaginalis.

"The inferior fibres of the transversalis muscle are very thin, run transversely, and give rise to an aponeurosis, which passes inwards, and soon unites with the internal oblique muscle, which lies exterior to it and goes to be inserted with it in

the linea alba, passing in front of the rectus muscle, and into the superior part of the pubes, behind the internal pillar of the ring and the pyramidalis muscle. The spermatic cord does nothing more than slide under the inferior border of the transversalis muscle, on a level with the superior opening of the canal.

"The *Fascia transversalis*," he says, (page 27.) after describing it minutely, "is an aponeurosis, the thickness of which varies: it springs from the posterior edge of the crural arch (Poupart's ligament), from the aponeurosis of the iliac muscle, from the external border of the rectus muscle, and is continued upwards with the cellular tissue on the internal surface of the abdominal muscles: below and towards the middle of the crural arch this aponeurosis gives rise to a membranous canal, commencing by a wide opening directed backwards and outwards, the internal edge of which is thicker than the outer. This canal descends around the spermatic vessels, forming their proper sheath. The fascia transversalis supports the peritoneum, which is behind it, the epigastric artery passing between them. Before, it corresponds to the transversalis muscle, with the aponeurosis of which it is often so closely united that it can only be distinguished from it by the different direction of its fibres.

"Finally," he says, (page 32.) "the passage of the spermatic cord through the abdominal parietes does not take place through a simple ring, but through a truly oblique canal. This is the *Inguinal canal.* The aponeurosis of the external oblique muscle is reflected, as I have already said, backwards, and then upwards to give origin to the fascia transversalis. By thus passing backwards and then upwards it forms a straight but deep groove, the convexity of which is turned downwards towards the crural canal, and rests partly on the psoas and iliacus muscles, the concavity being of course turned upwards, and corresponding to the inguinal canal. This groove (*gouttière*) extends from the pubes to the superior and anterior spine of the ilium, and gives attachment in nearly all its length to the fibres of the internal oblique and transversalis muscles; and, moreover, contains, in a part of its extent, the spermatic cord in man, and the round ligament of the uterus in the female. Its anterior wall is thick, and formed by the tendon of the external oblique muscle, having, posterior to it, the internal oblique; at the inner and under part, near the pubes, is the inguinal ring (the lower opening of the inguinal canal). The posterior wall of the canal is formed by the reflected portion of the aponeurosis of the external oblique (viz. the *fascia transversalis*),

which ascends behind and in connexion with the internal oblique and transversalis muscles. It is pierced by the superior opening of the inguinal canal, situated more outwardly and higher up than the inferior opening, from which it is about an inch and a half distant, being the length of the inguinal canal containing the spermatic cord. Between the superior orifice of the canal and the anterior superior spine of the ilium, the groove formed by the external oblique and Poupart's ligament is filled up by the internal oblique and transversalis muscles. Between the superior and inferior orifices, the groove constitutes the inguinal canal, containing these muscles and the spermatic cord. Lastly, the groove ends within the inguinal ring, at the pubes, by a small triangular space, bounded before by the internal pillar of the ring, behind by the tendon of the rectus and pyramidalis muscles, and often by a fasciculus of radiated tendinous fibres, which ascend in diverging from the external pillar of the ring, pass behind its internal pillar, and are affixed into the lowest part of the linea alba."

P. F. Blandin, the latest French writer on this subject, says, in his *Traité d'Anatomie Topographique*, Paris 1826, page 330:—

" The inguinal canal, or inguinal passage, is flattened from the front backwards, is about an inch and a half in length, is directed obliquely forwards and downwards; it occupies the abdominal wall in that triangular interval which I have already mentioned,—an interval bounded within by the rectus muscle, below by the crural arch, above by the conjoined inferior edge of the internal oblique and transversalis muscles; a point of the abdominal wall which would be very weak, as these two last muscles do not descend to it, if a special aponeurosis, the fascia transversalis, was not fortunately superadded. The inguinal canal offers a middle and two extremities or openings; the middle part has four walls; of the two openings, one is superior, the other inferior.

" 1st. The anterior wall of this passage is formed by the aponeurosis of the great oblique muscle, covered by the fascia superficialis, the external vessels, and by the skin.

" 2nd. The posterior wall is formed by the fascia transversalis, lined posteriorly by the peritoneum, and having behind it the epigastric artery.

" 3rd. The inferior wall is formed by the hollow of reflection upwards from Poupart's ligament of the fascia transversalis.

" 4th. The superior wall, less strongly marked, is traced by the lower edge

of the internal oblique and transversalis muscles. The interior of this passage is lined by the hollowed-out prolongation of the fascia transversalis."

Velpeau is to the same effect, *Traité d'Anatomie Chirurgicale, ou Anatomie des Régions*, Paris 1826, tome ii. page 78.

Sir Astley Cooper, in his book on the Structure and Diseases of the Testis, (1830,) gives the following description of the anatomy of the inguinal canal, and which is a revision of, and improvement upon that to be found in his first Work on this subject.

" This canal is bounded at the lower part by the external abdominal ring, formed by the tendon of the external oblique muscle; at its upper part, by the internal ring, formed by the fascia transversalis. In dissecting it, after removing the integuments, the superficial fascia of the tendon of the external oblique muscle is laid bare. An incision is to be made through the tendon of the external oblique, beginning above the abdominal ring, and extending near to the anterior and superior spinous process of the ilium. The edges of the divided tendon being then turned down, the inguinal canal is brought into view. At the lower part of the canal, just above the abdominal ring, the spermatic cord appears in the centre, the cremaster muscle between it and Poupart's ligament; above it the tendinous insertion of the internal oblique muscle, which passes behind the upper part of the abdominal ring to the sheath of the rectus muscle. At the upper part of the canal, in this first view, the internal oblique is seen arising from Poupart's ligament, and crossing over the cord and part of the cremaster muscle in the form of an arch: some of its muscular fibres blend with those of the cremaster.

" Upon raising the lower edge of the internal oblique from Poupart's ligament, and turning it upwards, the transversalis abdominis appears. It arises from Poupart's ligament, under the internal oblique, and also blends with some of the fibres of the cremaster. It forms an arch over the spermatic cord, and is inserted, with the tendon of the internal oblique muscle, into the tendinous covering of the rectus. But the lower edge of the transversalis has a very peculiar insertion, which I have hinted at in my work on Hernia. It begins to be fixed in Poupart's ligament, almost immediately below the commencement of the internal ring, and it continues to be inserted behind the spermatic cord into Poupart's ligament, as far as the attachment of the rectus. Thus the inguinal canal is endowed with

muscular contraction, which, under the action of the abdominal muscles, serves to close it, to lessen the propensity to hernia. Sometimes a portion of muscle descends from the tendon of the transversalis in the course of the linea semilunaris, to be inserted into the fascia transversalis, behind the cord, and into Poupart's ligament. It is this circular insertion of the transversalis which is the cause of stricture in inguinal hernia, in the course of the canal, and nearly at the upper ring.

"Behind this insertion of the transversalis, the internal portion of the fascia transversalis appears, adhering strongly to the tendon of that muscle at the back of the inguinal canal. Thus the inguinal canal is, at its anterior part, formed by the tendon of the external oblique; in its posterior, by the tendon of the transversalis, and by its folded muscular fibres; behind which is the fascia transversalis, into which those fibres are also inserted. It contains the spermatic cord and the internal oblique muscle. Its lower part is bounded by the external abdominal ring, formed by the separation of the tendons of the external oblique muscle; and at its upper extremity are placed the two portions of the fascia transversalis, forming, with the tendon of the transversalis, the internal ring; the anterior continued from the edge of Poupart's ligament to the outer side of the spermatic cord; the posterior, or internal, descending behind Poupart's ligament, to form the crural sheath, and ascending behind the spermatic cord and tendon of the transversalis. Between the two layers passes the spermatic cord. From the edge of the two portions of fascia, a layer of membrane extends in a funnel shape, uniting itself with the spermatic cord: thus the cord becomes united to each aperture through which it passes; at the external ring, by the fascia superficialis; at the upper part of the canal, by membranous processes from the fascia transversalis, which descend upon and envelope the spermatic cord. The epigastric artery, arising from the external iliac at Poupart's ligament, curves inwards and upwards, behind the inguinal canal, to the rectus muscle, giving an artery to the cremaster in its course."

The reader cannot fail to be surprised at the great difference which exists between these different versions of the same thing, and that a plain matter of fact, and not of imagination; and a student in anatomy and surgery, on trying to reconcile them by an actual examination of the parts, will find considerable difficulty in making his dissection correspond with any one of the descriptions which have been quoted; and he will be led to conclude, either that the descrip-

tions are not sufficiently clear and distinct, if not in some respects faulty, or that there is so great a variety in the formation of these parts, as to render any one account of them inapplicable to the greater number. No student can look at the four engravings No. 1. of Plate I., and No. 1. 2. 3. of Plate II., appended to this paper, and believe that they are intended to represent the same parts in the same stage of dissection, without drawing very much on his imagination; yet they are really intended for that purpose.

I hardly dare venture to give the reason which in my mind has led to the great apparent discrepancy of opinion which exists between so many able men on so plain a matter of fact. It is possible that it may have arisen from the great minuteness with which it has been attempted to describe parts that scarcely deserve it, especially the fascia transversalis, and from the great variety which exists in the formation of several of the principal parts.

Sir Astley Cooper first gave to the fascia the name of fascia transversalis, and drew attention to it in so marked a manner as to attract that of other anatomists. Jules Cloquet made it an object of particular study, and Blandin and Velpeau consider it to have been more accurately investigated by him, on which account I have transcribed his account of it, page 5. Cloquet says, that he had not seen Sir Astley Cooper's Work, but had formed his ideas of it from that of Mr. Lawrence; and it appears to me that he, Blandin, and Velpeau, have fallen into a misapprehension on the subject, common to many of our own countrymen, who have described that to be fascia transversalis alone, which is in reality the tendon or aponeurosis of the transversalis muscle implanted upon it; for without such misapprehension it is impossible to say that the spermatic cord always lies on the fascia transversalis in any part of its course after it has passed the superior opening of the inguinal canal, and has emerged from under the fleshy fibres of the transversalis muscle; nevertheless this is said to be the case. The statement made by Cloquet, Blandin, and Velpeau, that the fascia transversalis arises from the inner edge of Poupart's ligament by a reflection upwards of that part, whilst Sir Astley Cooper describes it as passing beneath to form the sheath of the femoral vessels is another cause, I suspect, of the misunderstanding which has taken place. Cloquet, who wrote from very laborious observation, says, in a note at page 26 of his Work, and in addition to the observations I have quoted, page 6, "that very often the fascia transversalis is evi-

dently formed of two aponeurotic layers, which are united on a level with the top of the crural arch. Of these the anterior comes from the arch itself (Poupart's ligament), the posterior being only a continuation of the fascia iliaca, which quits the iliac muscle to ascend upon the anterior wall of the abdomen. These two layers thus reunited proceed back to back between the transversalis muscle and the peritoneum. It is easy to separate them on the outside of the superior opening of the inguinal canal, but on the inside and around it they are intimately united. When this formation is met with, the posterior layer passes usually behind the rectus muscle in its way to the linea alba, whilst the anterior one is continuous with the edge of the tendon of the rectus. The epigastric artery is sometimes posterior, sometimes anterior, and sometimes even between these two layers." This description, which Cloquet gives as of an accidental occurrence, is, in my opinion, that which most frequently takes place; and if the fascia transversalis be said to be composed of two layers, the anterior being fibrous, the posterior cellular, much confusion will be avoided.

The division which is made of the fascia transversalis into two parts, where it lines the wall of the abdomen, one being called external, the other internal, or anterior and posterior by Sir Astley Cooper, (but which are not the anterior and posterior layers of Cloquet,) the spermatic cord passing between them through an opening, which is named the superior opening of the inguinal canal; is also a fertile source of inconvenience to the student, who will seek in vain for any such opening. If he is taught to consider the fascia transversalis as a sheet of condensed cellular membrane divisible in some parts into two layers, passing upwards from Poupart's ligament to fortify the peritoneum, he will readily understand it; and if he is shown that at a certain spot it becomes much thinner and allows the spermatic cord to pass through, he cannot fall into any misapprehension. This part is not however an opening; it is merely the thin portion of the fascia which, as the testis escaped from the abdomen, was carried forward by that gland, and is now seen attaching itself to the spermatic cord. If this cord be drawn down and an incision be made around it close to where it is attached to the peritoneum, a sort of ring is formed, and if the finger be introduced, the thin part can be stretched or torn, until the firm internal edge of the denser anterior layer of fascia transversalis can be distinctly seen, having the epigastric artery a little to its inner side. The outer side of the ring is not so

well marked, and the hole thus made by the finger is usually so large, and its outer edge so weak, as to occasion little fear of any great constriction being made by it on any portion of the contents of the abdomen which may be protruded through it. It is therefore not the part which constitutes the stricture at what is called the inner ring.

When the peritoneum is carefully removed from the inside of the wall of the abdomen, by tearing through the cellular membrane which attaches the one to the other; the fibrous or anterior layer of fascia transversalis is not the part next brought into view, but a distinct layer of cellular structure resembling fascia, although oftentimes loaded with fat, which can be readily dissected off in a complete sheet, carrying with it the epigastric vessels which adhere rather to it than to the fibrous texture in front. This cellular layer I take to be the same thing as the posterior layer of Cloquet; but whether it is or not, it passes behind the rectus to meet its fellow from the opposite side, covers the iliac vessels below and passes under Poupart's ligament, forming their cellular and adipose sheath and the septum which passes between them. When this cellular layer is turned down, (as in Plate III. fig. 1.) the fibrous fascia transversalis is brought into view. If an attempt is made to turn the latter down from the transversalis muscle two inches above Poupart's ligament, it is often found to adhere very firmly to it, and to its aponeurosis. When muscular at this part, many of the fibres seem to be implanted on it, although both muscle and aponeurosis are sometimes wanting, in which case only can the spermatic cord lie upon the fascia transversalis. When the tendons of the internal oblique and transversalis muscles are complete and well marked, and they and the fascia transversalis are traced inwards to the rectus muscle, the two tendons are seen to pass in front of it very distinctly; the fibrous layer of the fascia transversalis on the contrary divides, the anterior and thickest part is attached to the anterior edge of the rectus; the other, which is very thin, passes behind the rectus to meet its fellow from the opposite side; but at the lower part close to the pubes, a portion of the fascia transversalis becomes very strong, and resembles, more than any thing else, a round white tendon going to be inserted into the pubes near its symphysis, and behind the rectus. The interspace formed by the recedence of the two insertions is very distinct, the rectus filling it up. The fascia transversalis passing externally from this sort of tendinous insertion, is attached to the inside of Gimbernat's

ligament, of which it forms the internal layer, and is then continuous with the pelvic fascia. Passing from the upper edge of Gimbernat's ligament, or the third insertion of the external oblique muscle, to the inner edge of Poupart's ligament, or the second insertion of the same muscle, the fascia transversalis seems to adhere so strongly as to appear to be a reflection upwards from it, which is the view taken of it by the French anatomists: but if care be taken in making the dissection, it can with some difficulty be separated from it, and be shown to pass under the ligament to form the septum crurale, and the anterior part of the sheath of the femoral vessels. Exterior to the femoral artery the fascia transversalis is firmly attached to Poupart's ligament, and is continuous with the iliac fascia.

The transversalis muscle lies immediately upon the fascia transversalis. Its inferior edge is said to pass over the spermatic cord at the inner or superior opening of the ring, in order to form, with the internal oblique, the sheath of the rectus. This I believe to be in many instances an incorrect description. In the demonstration of these parts in the Theatre of the Royal College of Surgeons, I had the opportunity of showing (see Plate I.) the transversalis muscle advancing fleshy or muscular, until it reached the spermatic cord; a portion of it then took the usual course above and over it, whilst another portion passed below it, the terminating muscular fibres of which were inserted along the inner edge of Poupart's ligament up to the pubes. The muscularity of this insertion was admitted by the various teachers of anatomy, and other competent judges who were present. The lower part of the abdomen was thus shown to be defended by a layer of muscular and tendinous fibres, lying upon the fibrous layer of the fascia transversalis; and the spermatic cord passed, not, as it is usually stated, under the inferior edge of the transversalis muscle, but through a split in it originally formed for the purpose of giving passage to the testis. This split or opening was rounded on its under part where the spermatic cord rested upon it, and formed a small opening essentially muscular in every direction, and much less in size than that which is described as the opening of the fascia transversalis, which adheres to the internal surface of the muscle.

It is this part therefore, and not the fascia transversalis alone, which constitutes the inner or superior opening of the inguinal canal for all surgical purposes. The transversalis muscle does not, however, in the generality of instances, send

its inferior portion forwards and beneath the spermatic cord in so marked a manner. This part of the muscle more frequently becomes tendinous and aponeurotic; but its fibres, although tendinous, are distinctly marked, running transversely in continuity with the fleshy fibres of the muscle, and are inseparably united to Poupart's ligament. In some instances the muscular fibres of the transversalis do not take so oblique a direction from without inwards and downwards, but crossing more horizontally, send down a narrow tendon, on forming with the internal oblique the sheath of the rectus, which descends almost perpendicularly for some distance, to be inserted into the tuberosity or spine of the os pubis. The inferior or aponeurotic part of the transversalis may be equally present, forming the inferior edge of the inner opening of the inguinal canal; but this formation cannot take place if the spermatic cord passes immediately over Poupart's ligament, in which case, this ligament forms the under part of the inner opening of the inguinal canal, the lower edge of the transversalis muscle the upper, and the fascia transversalis the sides. The epigastric artery runs within a few lines of distance from the internal edge of this part or opening; and between this vessel, on the outside, the edge of the rectus on the other, and Poupart's ligament below as the base, the triangular space of Hesselbach is formed, through which that sort of hernia takes place, which is called *internal* by him, but *direct* by Sir Astley Cooper, to distinguish it from the more common one which, passing through the inner or superior opening of the ring, is called *external* by Hesselbach, and *oblique inguinal* hernia by Sir Astley Cooper.

When the transversalis muscle is inserted broadly into Poupart's ligament by its superior fibres only, the anterior ones pass on to form the sheath of the rectus, and to be inserted into the tuberosity of the os pubis; but a layer of fibres internal to these (the folded fibres of Sir Astley Cooper,) are implanted on the fibrous external layer of the fascia transversalis, and curve downwards to be inserted into Poupart's ligament, or proceed, according to Breschet, to form what he calls the pretended ligament of Gimbernat, and which he will not admit to be a third insertion of the external oblique muscle. These fibres are depicted by Cloquet (Plate I. fig. 3.) as belonging to the fascia transversalis, and by Breschet (Plate III. fig. 1.), in his *Considérations et Observations Anatomiques et Pathologiques sur la Hernie Fémorale*, Paris 1819, as essentially going to form the internal layer of Gimbernat's ligament, of which the fascia lata of the thigh

supplies the outer. They are very distinctly shown in Plate III. fig. 1., and certain other fibres running in a less curved and more vertical direction, belonging to the anterior or fibrous layer of the fascia transversalis, are equally well marked. These fortify this part in an especial manner, and something like the way in which the outer angle of the external ring is strengthened by fibres crossing in a similar manner.

It may appear that I am laying claim to the discovery of the muscularity of the superior opening of the inguinal canal, after such a structure had been previously described by Sir Astley Cooper. I had not, however, seen his Work at the time; and it was in consequence of my mentioning my ideas to him, that he made the dissection with Mr. Owen and myself, engraved in Plate II. fig. 1, to show us his view of the subject. The opinion, that this opening is in many instances a muscular one, was I believe first advanced by myself, having always maintained that point since the year 1816, although I had not been able to give a demonstrative proof of it until the delivery of my lecture on the subject in the Theatre of the College of Surgeons. There is, however, a difference between us, as to the manner in which the muscularity is effected. Sir Astley Cooper considers it to be accomplished by what he calls the folded fibres of the transversalis, that is, the internal layer of the fibres of the muscle which turn down inside the ring to be inserted into Poupart's ligament, according to Breschet as tendon of the transversalis going on to form the internal layer of Gimbernat's ligament, or according to Cloquet being inserted into his anterior layer of the fascia transversalis, as a part of which he has depicted them. According to my view of the matter, the ring, opening, or split, cannot be rendered a complete muscular circle, by any muscular fibres, which merely pass over and curve round to one side for insertion; one half, or at most two thirds only of a circle can be effected by such disposition of fibres; but if an inferior portion of transversalis muscle be admitted, and in the manner I have demonstrated it, then the circle is completed, and its muscularity is established, in all cases in which such a disposition of fibres exists. If I might venture to try to reconcile these views, I would do it by saying, that the circular structure can only take place when the opening or ring is formed by a split in the muscle, or in it and its aponeurosis, and can only be shown advantageously as a circle when the part has suffered a certain degree of distention, which brings

it to that form; but even in that case there are no perfectly circular fibres, each apparently circular one being of necessity formed of two parts, one from the upper, and one from the under edge of the transversalis.

From the misapprehension which has taken place with reference to the inferior portion of the transversalis muscle, the coverings which a hernia of direct descent receives at this part has been a matter of doubt. Mr. S. Cooper gives (page 660 of his Dictionary,) the opinions upon this point of Messrs. Hesselbach, A. Cooper, Cloquet, Lawrence, and Stanley, leaving it, however, undecided whether the covering or investment is or is not formed as, he says, Sir Astley Cooper is reported to have described it in his lectures, viz. one half by the tendon of the transversalis, and the other half by the fascia transversalis. According to my version of the anatomy, it appears to me quite clear that there are two investments, one formed of the two layers of the fascia transversalis, and another external to that formed by the tendon or aponeurosis of the transversalis. The statement said to be made by Sir Astley Cooper can only be correct when there is no inferior portion of muscular fibre or of aponeurosis to the transversalis muscle, and which is sometimes wanting, although rather as an exception to the general rule, than as the general rule itself, or when the insertion of the superior fibres of the transversalis is effected by a narrow tendon. In the hernia of direct descent, or the internal inguinal hernia of Hesselbach, the coverings, when enumerated from within, are, the peritoneum, fascia transversalis, tendon of the transversalis, and tendon of the internal oblique more or less conjoined, the intercolumnar fascia, the superficial fascia and integuments. As this hernia passes to the inside, and rather underneath the spermatic cord, it does not receive a covering from the cremaster. The external inguinal hernia, or of oblique descent, lies upon or above and to the outside of the spermatic cord; the internal inguinal hernia, or of direct descent, lies to the inside of, or below and underneath the cord, constituting the principal features of diagnosis, especially in old herniæ. In the latter species, or of direct descent, the internal oblique muscle may not always be inserted low enough down towards the pubes, so as to give a covering to the hernia, which then only protrudes, or carries before it the transversalis. This fact will not however be discovered in operating; for the pressure on the parts causes such a consolidation of them, that the two tendinous expansions when they exist, become so closely united as to form but

one covering. When enumerated from without, the coverings are the integuments, superficial fascia, intercolumnar fascia, the tendinous expansions of the internal oblique and transversalis muscles when they exist, the fascia transversalis, and peritoneum.

The internal oblique muscle would in the male form a layer of muscular and tendinous fibres external to the transversalis, and a complete support or covering to this part of the abdomen, if it were not for the opening to admit of the descent of the testis and the passage of the spermatic cord. The *gubernaculum* testis, a part of original formation, is supposed to possess the power of drawing down the testis through this opening, which I very much doubt. I believe that the testis descends or ascends, as the case may be, at the proper period, for the same reason that a child is usually born at nine months in preference to any other period of utero-gestation, which is, as Avicenna says, by the will of God. The office of the gubernaculum appears to be to keep a passage open which might otherwise be closed, if it were not occupied in this manner, rather than to operate on the testis by any contraction of its substance. As the testis passes through the transversalis muscle it may bring down with it any fibres which lie in its way; and when this occurs, the transversalis is found to be united at this part to the internal oblique, and the fibres thus brought down assist in forming the cremaster muscle, which is nothing more than a certain portion of the lower edge of the internal oblique caught by the testis and carried before it. The fibres caught on the centre of the testis are carried down with it into the scrotum, by a gradual elongation, so that they form a sort of sling around the testis, which supports and can raise it towards the abdominal ring, whilst those fibres which are only entangled on its anterior and posterior surfaces, form arches, which descend before or behind according to the situation of the points of entanglement. The cremaster muscle is then a portion of the under edges of the transversalis and of the internal oblique muscles, arising also from Poupart's ligament by its under edge, until it is carried away by the descent of the testis; but the point of insertion of these fibres remains the same, viz. into Poupart's ligament near the pubes, after forming the sling and the arches above described, and which point of insertion was considered by Scarpa and others until the time of Cloquet, to be another or second origin, which is evidently an error. When the testis is detained in the abdomen, it is not for the

want of an opening in the transversalis or internal oblique muscles, but for some reason which has not yet been sufficiently explained, as the person commonly suffers from a hernial protrusion, the consequence of the part being less defended than usual by the natural structures.

The anatomy of the inguinal canal from without inwards is as follows. The tendon or aponeurosis of the external oblique muscle being turned down upon the thigh, the spermatic cord is seen lying in the inguinal canal, embraced by the cremaster muscle, which passes down upon it. The lower edge of the internal oblique separating from the cremaster which is a part of it, passes on to form its share of the sheath of the rectus. The cremaster being cut across and turned upwards, the spermatic cord is seen passing from under the fleshy edge or through the split of the transversalis muscle, and having beneath it another fleshy or aponeurotic portion of the same muscle descending to be inserted into Poupart's ligament. It is on this part that the cord lies, and it forms of course the posterior wall of the inguinal canal, having behind it more or less closely attached the fascia transversalis. If the internal layer of fibres of the transversalis curve downwards to be inserted into Poupart's ligament after passing over the cord, this part lies more decidedly upon them, and not on the fascia transversalis. See Plate III. fig. 1.

When, according to this view of the anatomy, an oblique hernia, or one of indirect descent, takes place, the peritoneum is protruded against and carries before it the thin portion of the fascia transversalis, which is nearly opposite to the opening in the transversalis muscle, through which the spermatic cord passes. The bend or elbow, which the cord makes in ascending to pass over the superior edge of the lower or aponeurotic part of this muscle, or the fascia attached to it, opposes an insuperable obstacle to a protrusion at this part, and the hernia necessarily passes above the cord and between it and the lower or fleshy edge of the superior part of the transversalis. The peritoneum covered by the thin part of the fascia transversalis having passed through the opening in the transversalis muscle, meets with the cremaster, from which it receives a covering. If the hernia is *incomplete*, by which is understood that it remains within the inguinal canal, it has no other covering; but if it is complete, or passes through the external ring as it is called, or the triangular opening of the external oblique muscle, it gains two additional layers; one from the thin fascia which runs from one column or

pillar of the external ring to the other, thereby closing the part, and is called, with great propriety, the intercolumnar fascia; the other from the superficial fascia lying under the integuments. The different coverings of an oblique inguinal hernia enumerated from without inwards, are, therefore, the integuments, superficial fascia, intercolumnar fascia, cremaster muscle, fascia (sometimes called also canalis,) transversalis, and the peritoneum. When an oblique inguinal hernia takes place, the opening, or what may be truly called the inner opening of the ring, is by this protrusion gradually stretched or dilated: but if this be too suddenly done, the irritation caused by it gives rise to spasmodic contraction, followed by inflammation in the muscular fibres passing over it; and the hernia becomes incarcerated or strangulated. If the split or opening in the transversalis is muscular above and below, the contraction upon the protruded parts will be considerable; if the upper portion only is muscular and the lower aponeurotic, the pressure will not be so great.

If the hernia is of long standing, two great changes take place in the situation and even in the structure of the parts. The opening in the transversalis muscle becomes dilated and rounded. This change takes place principally in the superior fibres of the muscle, which instead of running obliquely downwards and inwards become more curved, the convexity being upwards and inwards, and are of course brought so much nearer to the median line of the body, and to the pubes, which gives to the insertion of the muscle itself a peculiar curvature; which is rather the effect of derangement, than a natural appearance of the part. If the under edge of the opening be muscular, it will of course yield in a similar manner; and circular fibres will then be seen, which are not I believe observable in the part in its normal state. The fibres of the transversalis which come from above and below, and meet a little beyond the lower part of the opening, which is itself rounded to allow the spermatic cord to lie uninjured upon it even under pressure, represent rather the truncated apex of a triangle or split than a ring. As this opening is more used and increases in size, it becomes rounder, approaches nearer to the pubes, and the second change takes place, viz. the edges lose their sharpness, become less defined, harder and more tendinous; so that in very old herniæ the muscle loses all power over them, and the ring or opening remains unaffected by its contraction.

This view of the nature of the parts and the changes which they undergo,

appears to me to account in a satisfactory manner for all the circumstances and differences which take place between recent and old herniæ. It does more; it enables us to account for the great difference which exists in the treatment of these two conditions of hernia. It also reconciles and removes the discrepancy observable between the anatomy as hitherto described, and the surgery as hitherto taught. It removes the difficulty which students had in comprehending why some surgeons recommend one mode of treatment, and some another: why for instance bleeding has been recommended by Sharp, Pott, B. Bell, Sabatier, Richter, Callisen, Scarpa, and Sir Astley Cooper,—names which can never be surpassed in respectability; whilst Wilmer, Alanson, and others, have published against the practice.

In order to understand these points, it is necessary to consider the changes which have been stated to occur in the relative situation and structure of the parts, and to make a very marked difference between herniæ which are of recent origin and those of very long standing. In a RECENT HERNIA, or one which has taken place but a short time before it became incarcerated or strangulated, the parts through which it passes are comparatively but little altered from their natural state; and from the view which has been taken of their anatomy, the inner opening of the ring is a muscular structure capable of exercising great compression on the protruded parts, and often in a complete circle; so that when these fibres are spasmodically excited, the compression may be so great as to prevent all circulation in the hernia, giving rise to a state of strangulation; or it may be only to that extent which compresses and retains the protruded parts without entirely preventing circulation, and which is a state of incarceration. In either case inflammation will soon follow, (unless the pressure is removed,) in consequence of the sharpness of the edges of the compressing parts, and the force with which they contract on those that are protruded, whilst the secretion of fluids and of air into them adds to the mischief. The first and greatest object to be attained in a recent hernia which has become strangulated, is to take off the spasmodic and inflammatory contraction of the transversalis muscle forming the inner ring, which is best done by producing syncope; and there are three great and common means for effecting this object; viz. bleeding, the warm bath, and the tobacco enema. When blood is drawn in a recent hernia which has become strangulated, it should be done or continued, the patient sitting in an erect position,

until he faints. When the warm bath is used, it should be at a temperature not less than 100°, or even as hot as the patient can bear it, and he should be kept in it until he is in the act of fainting. If the tobacco enema be had recourse to, nearly the same effect should be produced by administering repeated small doses, or no good will result from its use. When the patient is in this state of syncope, or just approaching to it, an attempt should be made to restore the protruded parts by a well directed pressure, technically termed the *taxis*, provided they are capable of bearing it. On this point there is a marked difference between recent and old herniæ when strangulated; there is also no less difference in regard to the situation of the pain. In recent herniæ which have become strangulated in young and healthy persons, inflammation soon commences in the protruded intestine and in the part which is above the stricture; and if relief is not obtained, the intestine below mortifies, or ulceration takes place, or would take place if time were given, immediately at or directly above the part pressed on by the edge of the transversalis or stricture. The patient therefore in a recent hernia dies of acute inflammation followed by mortification, rather than of congestion followed by low inflammation and perhaps, although not always, by mortification; which is the state of parts to be found usually in old herniæ which have become strangulated. The symptoms correspond with the appearances found after death. In recent herniæ when strangulated, there is pain in two distinct places: at the umbilicus and extending from it to the pit of the stomach, and in the herniary tumour; and both may be equally acute to the touch as well as to the sense of the patient. In old herniæ the pain is felt at first, and often for a long time, at the umbilicus alone; the swelling shows little sign of derangement, and admits of considerable pressure being made upon it for several hours and even days after the incarceration and supposed strangulation are complete. It is a peculiarity in inflammation of the intestines, that the pain is referred to the umbilicus, whatever part of the intestines may be inflamed; be it the jejunum or the rectum, the fact is the same; and the acute pain there, and in the tumour in recent herniæ, only marks the higher degree of inflammation. I have twice seen patients in whom bougies have been forced through the upper part of the rectum: I have seen an ulcer eat its way from the rectum into the cavity of the abdomen, allowing the contents of the gut to escape: and in all these the principal and essential pain was felt at the umbilicus and upwards to the pit

of the stomach; and the same thing takes place in wounds. I have already stated the reason why the inflammation is more acute in recent herniæ, and it only therefore remains to show why certain remedies are more proper in one case than in another;—why bleeding, for instance, which is a sheet-anchor in recent herniæ that have become strangulated, is comparatively useless in old ones. In recent herniæ, the part forming the stricture is positively contracted from spasm and inflammation, and the pressure is direct. In old herniæ, the rounded smooth ring through which the protruded parts pass, does not admit of being diminished in size by any spasmodic action of the surrounding structures, or only in a comparatively trifling degree, and the pressure is therefore not direct; the ring is passive. The parts forced into it by any sudden exertion, suffer from their own distention, from whatever cause it may arise; and from the evils which must invariably follow from soft parts being made to press unduly against others of a much firmer nature. In old herniæ which have become strangulated, the first evil is from congestion and distention: the first stage is that of incarceration, followed ultimately by inflammation, first shown by pain at the umbilicus, and after a greater or less lapse of time by pain in the part, but which is never so acute as in the recent cases. It is, then, in recent cases of herniæ only which have become strangulated, that bleeding is of so much importance, aided by the warm bath, and followed by the use of the tobacco enema in young and healthy persons, previously to the performance of an operation. The application of cold to the tumour is in my mind always secondary to that of the hot bath, and should only be had recourse to in recent herniæ which have become strangulated, when it cannot be procured. On the same principle, however, cold when used must be efficient. In large towns, and in winter, a mixture of salt and pounded ice can at all times be obtained, and applied in a half-filled bladder, or the freezing mixture of Sir Astley Cooper, composed of two ounces and a half of nitrate of potash, with the same quantity of muriate of ammonia and ten ounces of water, which in cases of old hernia will often be found very efficient.

Tartar emetic is often talked of as a remedy in strangulated hernia; but as its effects cannot be controlled, and great nausea and vomiting are often produced, it is obvious that the efforts made in vomiting may be more detrimental than the debilitating nature of the remedy can be beneficial. Purgatives are always

injurious as such, being merely irritants; although calomel combined with opium in a soft state may be administered with advantage, as allaying irritation of the stomach and procuring ease. Injections of hot gruel, with salt and oils of various kinds, are useful, inasmuch as they clear the rectum, and may also reach the great intestines, if the tube of the syringe be long and introduced to its full length, which it always should be in every case of constipation, so that it may reach the sigmoid flexure of the colon: but an error must not be committed in such cases, by supposing that the discharges are from above the stricture unless all the symptoms subside, even if the protruded part is not returned.

The application of pressure or the taxis, is limited by the state of the part. In recent herniæ which have become strangulated, it must entirely depend on the pain felt by the patient. If the tumour is so painful when touched that the person cannot bear it, the operation ought not to be delayed; and more particularly if the swelling is hard and tense like a ball, or if any discoloration of the skin has taken place. In these cases, delay is not admissible; and the operation should be done without reference to the time the part has been supposed to have been strangulated; it being immaterial whether it has taken twelve or only two hours to arrive at this state. In a young and healthy person, an attempt may be made at once to return the protruded part by a well directed and steadily supported pressure in the direction of the swelling in the inguinal canal, the parts being relaxed by position. But if there be any pain in the tumour, and this is increased by the pressure, it will be advisable to bleed to fainting in the erect position, before further efforts be made at reduction. I have frequently reduced an incarcerated hernia after bleeding which was irreducible before, and much more frequently after the patient had been again brought to a state of syncope from the effects of the hot bath. The best time to make the attempt at reduction, is a few minutes after the patient has been taken out of bed and laid between the blankets. If it fails after a steady well supported application for at least fifteen minutes, the patient should be returned to the bath, and a second attempt be made in the course of an hour, provided always that delay is warranted by the non-painful state of the part, and the absence of severe general symptoms.

If a patient is presented with a strangulated hernia, even one of recent for-

mation, in whom the general symptoms are very severe, and evidently from that cause; the operation (that is, the obtaining of complete relief,) should not be delayed, although the tumour itself may be comparatively but little painful. These general symptoms are the pain at the umbilicus, the irritability of stomach, the anxiety of countenance, and the failing state of the pulse. These symptoms of inflammation of the intestines accompany each other; and when they are well marked, the danger is imminent, and the decision must be prompt. The two most important symptoms, are the anxiety of countenance, and the failing of the pulse; they mark the severity of the inflammation and its tendency to gangrene, whilst the pain and irritability of stomach only indicate its existence. They are, in fact, symptoms which must always be judged of by comparison; some people suffering more apparently than others, with less real cause: but the anxiety of countenance to which I allude, and which, when complete in a more advanced stage, is called the facies hippocratica, cannot be mistaken; neither can the pulse, the almost extinction of which more distinctly marks the great degree of inflammation. The state of the pulse in inflammation of the viscera of the abdomen is remarkable, from being small, hard, quick, and vibrating like a cord in the generality of cases; but when the inflammation sets in with great intensity, the pulse often alters its character, becoming smaller, and sometimes so indistinct as scarcely to be felt, rendering the abstraction of blood imperative; and the quantity to be drawn must be regulated by the pain, as ascertained by pressure on the umbilicus. The presence of pain on pressure, and the diminution or absence of pulse, are only signs of great inflammation. The absence of both pain and of pulse, are signs that gangrene has taken place; but then the anxiety of countenance will be so marked, the face so pale and so bedewed with large drops of perspiration, that an error cannot be committed as to what has occurred. In acute inflammation of the liver as well as of the intestines, the pulse will often become indistinct, and the countenance very anxious; the pain will be constant, and increased on pressure. As blood is drawn, the pulse rises, the anxiety of countenance and pain diminish, and the patient after the loss of from fourteen to twenty ounces feels more at ease. In all these cases of abdominal inflammation the pain is constant; it is often increased by paroxysms, but is never absent: there are moments of relief, but it is never complete: it is always augmented by pressure, whilst in colic, there

is in all cases an occasional positive absence of pain, and pressure gives relief. Let us suppose a young and healthy man to be brought to an hospital with an inguinal hernia of recent formation, presumed to have been strangulated only four or six hours. On examination, the swelling is found to be painful, and very tense when touched. The nausea and sickness are frequent; the pain at the umbilicus severe and increased on pressure; the pulse small and hard; the countenance distressed. What should be done? The answer is positive. 1. The operation with the least possible delay. 2. The exhibition of from four to six grains of calomel with a grain and a half of soft opium. 3. The abstraction of blood. 4. Stimulating injections per anum: and lastly, Gentle purgatives if the bowels do not act of themselves satisfactorily. If on the other hand a young and healthy man is brought to an hospital, with a similar hernia which has been strangulated from four to six hours, the part being but little painful, the umbilicus only tender on pressure, but not acutely sensible, the operation may be delayed until the effect of bleeding unto syncope in combination with the hot bath have been ascertained; but no time must be lost in the trial, and it is quite useless to make it if the herniary swelling will not admit of considerable pressure without much suffering. It is a difficult thing to decide when incarceration ends and strangulation begins, and it is consequently almost impossible to compute the length of time a part has been in that state; frequent observation has, however, taught us, that a hernia of recent formation cannot remain in a state of incarceration ending in strangulation for a longer period than ten hours, without placing the patient's life in great jeopardy, and that the operation is always less dangerous than the continuation of repeated and ineffectual trials at reduction. An operation, on the other hand, is not to be had recourse to until its necessity is evident; inasmuch as a person may die from it and not from the disease: and I have often been enabled to restore the protruded parts by a well directed treatment, almost at the moment when the failure to do so would have been followed by the operation.

I should regret, however, very much to be misunderstood on this point; for I am quite satisfied the general result of cases of recent herniæ has shown that it is better to operate even half an hour before it is absolutely necessary to do it, than to delay for ten minutes after the necessity for an operation has become obvious. The French surgeons, who operate at an earlier period than we gene-

rally do in this country, are certainly not less successful than ourselves; and of two extremes, theirs is assuredly the safest.

The practice of surgery with reference to recent herniæ is infinitely more clear and precise than it is with regard to old herniæ, and for the reasons I have assigned, viz. The symptoms are so much more marked and decided in their course and termination. It is not often that an error is committed in cases of recently strangulated herniæ; it is not uncommon in cases of old herniæ which have become incarcerated or strangulated.

In old herniæ which have become strangulated, the state of parts as well as the nature of the symptoms are essentially different. From the alteration which has taken place in the form, situation and structure of the openings through which the parts are protruded, they are not likely to suffer any diminution of size from muscular contraction; the herniæ are therefore incarcerated or detained, and the bowel is obstructed, rather than it is compressed and strangulated, and the symptoms are consequently more of obstruction than of inflammation. One of the purest cases of this kind I am acquainted with, I had the opportunity of seeing with Mr. Chinnock of Brompton. It was an old gentleman, who had an incarcerated inguinal hernia of three days' duration. The swelling was large and very hard; but as the integuments were thin, and the part not painful, it admitted of accurate examination. The hardness appeared to be dependent on a collection of solid fæcal matter, and after some trials a portion of it at the upper part was broken, and pressed through the external ring. This was followed by a second, and so on in succession until the whole was pushed into the abdomen, with the intestine which had contained it. The symptoms immediately subsided, and a dose of purgative medicine completed the cure. The openings in the abdomen through which the parts protruded were in this case entirely passive.

In some instances it has been proved by operation and consequent exposure of the parts, that the symptoms induced depended entirely on mere detention without compression, which had given rise to obstruction; the intestine in the sac showing little or no signs of inflammation, and the openings being sufficiently large to admit the fore finger in addition without any previous enlargement. The symptoms in these cases were caused by the obstruction, whether dependent on a peculiar apposition of different parts of the intestine, competent to produce such effect, or by adhesions between them and the sac, or from other causes.

In every case, however, the operation is required for the relief of the patient, if it cannot be obtained by other means.

In all these old and well-marked cases of the passive state of the abdominal opening, the symptoms on incarceration differ much from those that take place in recent herniæ which have become strangulated. The patient is uncomfortable, the rupture is not reducible, the bowels are confined, he suffers from eructations, followed by pains referred to the umbilicus and to the pit of the stomach, which become permanent, and gradually although slowly increase in intensity. The abdomen becomes sore, and the tenderness and pain are increased on pressure, although the rupture itself is scarcely painful, and admits of very great pressure being made upon it. These symptoms are soon accompanied by general ones; the pulse quickens and is smaller, perhaps a little harder than usual, the skin becomes hot and dry, the tongue foul, the stomach irritable, nausea is succeeded by vomiting, the countenance assumes a yellowish unhealthy appearance; and gradually deteriorating from this state, at the end of four, five or more days, the patient dies, worn out by the continuance of the constitutional irritation, but not suffering much pain in the herniary swelling. On examination after death, the intestines above the detained or strictured part appear to have suffered from low inflammation, rarely proceeding to gangrene. It is this kind of case which is described in books as being caused by inflammation coming on independently of the incarcerated hernia, but which I believe to be an error; and in all instances in which the symptoms do not yield to the usual means, the operation should be had recourse to, and the protruded parts returned if they will admit of its being done. The patient must die if it is not done; and if it is done without advantage, he has still had the chance of recovery, which good surgery entitles him to. I am, however, of opinion, that the operation will succeed in a great majority of cases if it be done in time, that is, before the constitution is so much affected as to be unable to recover itself after it has been done.

In these cases the treatment should differ materially from that recommended in the foregoing pages on recent herniæ. Bleeding to syncope will only weaken the patient and do little good. The warm bath will not be very effective, and tobacco enemata with elderly persons are sometimes dangerous. The three principal remedies in recent herniæ which have become strangulated are here of

little use, save as they act generally in reducing inflammation, because there is no muscular contraction to subdue; whilst on the other hand cold steadily applied may be of great service, when combined with such mechanical pressure as may be found advisable. In these cases stimulating injections are of great use, and if they be applied, as Mr. O'Beirne of Dublin advises, by means of a tube ten inches long, with a hole at the end of it, and introduced into the sigmoid flexure of the colon, the happiest results will I think follow in a much greater proportion than at present. It draws off the flatus as well as the watery contents of the bowels, whilst the cold acting on the tumour condenses the air contained in the incarcerated intestine, and tends to cause it to pass more readily into the abdomen.

In those cases which are of a mixed character, being neither of recent nor of old formation, the proper course to be pursued must depend on the judgment of the surgeon, in adopting an intermediate course, and in a proper selection of these different remedies.

The use of purgatives after the operation, which has been equally lauded and decried, without sufficient reason being given, admits of strict regulation on sound principles. In recent herniæ which have been operated upon, none but the most gentle aperients should be given; the object being to persuade the bowels to act, and not to force them by irritation. They have been, if they are not actually in a state of inflammation, and an irritating purgative may induce its return, and counteract the effect for which it has been given. If on the contrary it acts violently, the intestine, weakened by the congestion and inflammation which it has suffered, may not be able to sustain this superadded irritation. I have known an intestine returned to the cavity of the abdomen in a doubtful state, (which is the proper course to pursue,) give way under severe purging, and allow the fæces to escape by the wound; the patient recovered, but I have little doubt that mischief has been often done in a similar way. In old herniæ when the incarceration has continued some days, and probably arose from obstruction in the first instance, the happiest effects have often followed the exhibition of active purgatives after the restoration of the protruded parts, whether by the taxis or by operation, and it appears to me that it is in these cases only they are to be recommended.

With regard to the manner of performing the operation itself, I have nothing

to add worthy of remark. The sac should be cautiously opened on its anterior and lower part, where some fluid will usually be found, and then slit up as high as the external ring. If the stricture should not be situated there, but at the inner or superior opening being formed by the edge of the transversalis muscle, the method of proceeding depends on whether it is a recent or an old hernia. If a recent oblique one and the inguinal canal is little altered from its natural state, the aponeurosis of the external oblique muscle forming its outer wall, should be divided in an oblique direction outwards, so as to expose the swelling near its neck. This may now be drawn down, whilst the more external parts are drawn up so as to bring the stricture into view, when it and the neck of the sac should be divided together directly upwards. It has been recommended not to divide the anterior wall of the inguinal canal, but to introduce a cutting instrument on its flat side in an oblique direction outwards, for the distance of an inch and a half, and then to turn its edge, and cut in the dark directly upwards, which appears to me almost impossible to do, to say nothing of its being very dangerous. I therefore always advise that the aponeurosis of the external oblique be slit up to that extent, which will enable the surgeon, by drawing down the sac, to see whereabouts his knife is to cut and the direction it is to take. I am an advocate for dividing the neck of the sac with the stricture, rather than for leaving an inch of it uncut below the stricture. It was supposed that this would prevent an inflammation of the peritoneum; but the experience of the Peninsular war proved, that a cut of half an inch in length was as dangerous as one of an inch, and that the admission of air into the cavity of the abdomen did no mischief.

In old herniæ, and in those of direct descent, the openings are nearly opposed to each other, and this difficulty does not occur. The incision in all cases should be made directly upwards, because it more certainly obviates danger from the epigastric artery in case of an error as to the kind of hernia; but the division of this artery is after all but an anatomical bugbear. I am ready to admit that if a surgeon pokes a knife the length of an inch and a half in the inguinal canal, and then cuts with the end of it, he knows not what nor where, and in this manner divides a large artery, his patient's case may be hopeless; but if he has proceeded in the manner I have mentioned, he will have very little difficulty in placing a ligature on the artery as soon as he has cut it, and the danger to his patient will be but little increased.

If the symptoms denoting the presence of inflammation continue after the stricture has been completely removed, the means necessary to be employed for their removal must be had recourse to as in other cases of inflammation; for there is no axiom so much to be doubted in medicine, as that which leads to the belief that the removal of the cause will certainly lead to the subsidence of the effect.

In femoral hernia, the parts through which the protrusion takes place being entirely tendinous or aponeurotic, no positive contraction can occur in them, and the symptoms of incarceration and strangulation must depend on obstruction and distention of the contents of the hernia; these will be regulated of course very much by the extent to which the distention is carried, and the sharpness of the edges against which they press. The distinction between a recent and an old femoral hernia will not be quite so marked as between a recent and an old inguinal hernia; and it is usually believed that there is less prospect of returning a strangulated femoral hernia by the taxis, or without an operation, than a strangulated inguinal hernia.

The points of anatomy on which I wish to remark with reference to femoral hernia are few; and on referring to Mr. S. Cooper's Dictionary for the existing state of opinions on them, I find the accounts as given by Hesselbach, Langenbeck, &c. so prolix, and so minute as to be almost unintelligible to a person not already well acquainted with the subject. I shall therefore refrain from quoting them, and only notice those which are more commonly received, or remain a matter of doubt. Poupart's ligament from its origin at the superior spinous process of the ilium to its insertion at the pubes is extended over a space more or less filled up; and constitutes what is called the crural arch. From the ilium to the outside of the femoral artery, it is admitted that there is no possibility of a protrusion taking place. From this part the arch begins to spring, and terminates at the insertion of the ligament into the pubes. The outer portion of the arch is occupied by the femoral artery and vein which pass underneath it inclosed in a sheath formed by the two layers of fascia transversalis described at page 13. A septum separates the artery from the vein, whilst another septum confines the vein on its inside, and separates it from the absorbents generally, and from anything there may be in that situation, constituting all that I consider to be the true sheath of the vessels. There is however a space exceeding an inch,

extending from the septum on the inside of the vein to the pubes where Poupart's ligament is inserted by its lower pillar, and by what is called its third insertion, or Gimbernat's ligament. This is occupied by a continuation of the fascia forming a barrier nearly at a right angle with the septum or sheath on the inside of the vein, and is perforated for the passage of the absorbents. This is called by Cloquet septum crurale, being the barrier between the abdomen and the thigh, and when weakened and forced to descend before a hernia, it is called fascia propria by Sir Astley Cooper. This same part is also called the inner and superior opening of the crural canal by the German and French anatomists; the opening through the fascia lata of the thigh which gives passage to the vena saphena to join the femoral vein, being called the inferior and exterior opening of the same canal.

The French anatomists do not describe the anterior portion of the sheath of the vessels as formed by the fibrous layer of fascia transversalis which passes under Poupart's ligament, the crural arch, or arcade crurale for this purpose; but consider this sheath to arise from the ligament or arch, at its lower edge, and not in the manner I have noticed it; and although they describe very accurately the barrier which exists between the inside of the femoral vein and the pubes, they do not look upon it as a part of the sheath of the vessels.

The septum crurale, as Cloquet calls it, and which I think the best name for this barrier, is not a straight partition, but a curved one, being concave upwards or inwards towards the abdomen, and convex towards the thigh, so that by a little management in dissection it may be made to assume a funnel-like shape on the thigh, and to lead to the conclusion that anything passing into it from within must follow the inclination which such a formation naturally gives, and of course be projected against the vein, by the side of which it would pass out at the lower opening of what the French anatomists call the crural canal; this does not however occur when a femoral hernia takes place. The inside of the septum crurale, or that part which is next the abdomen, is concave, and the oval hollow formed by it is partly filled up by an absorbent gland, which is separated from the peritoneum by the cellular layer of fascia transversalis extended across from the edges of the hollow. It is into this concave septum, oval from side to side, that the hernial sac first passes; and it is this fact has made Sir Astley Cooper say, that a hernia is protruded into the sheath of the

femoral vessels; but this manner of expressing it leads to the same misapprehension, in my opinion, as the French mode of describing it as protruding into the superior opening of the crural canal. They both imply or admit of its being supposed that the hernial or peritoneal sac passes down by the side of and in direct contact with the femoral vein, which is demonstrably an error in those who so understand it.

In all the dissections of femoral herniæ I have had an opportunity of making, the septum crurale of Cloquet, or the fascia propria of Sir Astley Cooper, formed a distinct sac, separated from the septum on the inside of the femoral vein by a mass of condensed cellular structure, sometimes more than half an inch in thickness; the septum had been elongated into an outer sac for the hernia, and had grown down by the side of the sheath of the vein. The hernial sac or peritoneum is not then projected into the sheath of the femoral vessels, but into a separate sac, which it forms for itself by the side of them. When the French anatomists say that the hernial sac is protruded into the superior opening of the crural canal, takes the course of that canal, and re-appears at its lower opening, or where the vena saphena joins the femoral vein, it is only intelligible by understanding that the hernial sac lies in contact with the femoral vein, whereas it passes by the side of it, separated from it by two portions of sheath, viz. one formed by the septum on the inside of the vein, the other by the elongated part of the septum crurale, or fascia propria, which forms the outer sac. This lies on the pubic portion of the fascia lata of the thigh, and if it descends far enough, is found outside the opening for the passage of the vena saphena, but does not come through it from the inside.

The hernial sac having descended below Poupart's ligament, carries before it the septum, or fascia propria, and now has above it Poupart's ligament, behind it the pubic portion of the fascia lata; to the pubic or in-side, Gimbernat's ligament, to the outside the sheath of the femoral vein. Breschet considers Gimbernat's ligament to be erroneously described as a third insertion of the external oblique muscle, or as a part of Poupart's ligament; and supposes it to be formed behind by the transversalis tendon, and before by the fascia lata. The manner in which the transversalis sends down its fibres to form the posterior part, is shown in Plate III. fig. 1.; but the part which the fascia lata has in forming the anterior part, does not appear to me to be sufficiently appreciated. The

falciform process which lies over the femoral artery, and passes inwards to attach itself to Poupart's ligament, and to form the anterior part of Gimbernat's ligament, does more than this; it passes on, and is inserted also into the pubes, on a plane lower than the insertion of the inferior pillar of Poupart's ligament, so that, in fact, it forms an arch exterior to the septum crurale, which, when it is forced to descend, is compelled to pass under it; and it is this, and not Poupart's ligament, which causes the greatest compression on the hernia, and is the seat of external stricture. This portion of the fascia lata forms an arch in reality when a hernia is protruded underneath it; but in its natural state it is not the case; the absorbent vessels pass underneath it and through the septum near the sheath of the femoral vein; but as the falciform process of the iliac fascia lata passes on to its insertion in the pubes, it rests on, and is attached to, the pubic portion of the fascia lata. This attachment, although not a very intimate one, is sufficient to confine the part, but sometimes it is so strong just at the pubes, and forms so firm and complete a union, that drawing on one part evidently influences the other, and renders the arch a circle, through which the hernia is protruded. The anterior part, or the iliac portion of the fascia lata attached to Poupart's ligament, being tendinous, and firmly stretched across from point to point, can yield but little; the inside, or Gimbernat's ligament, can hardly yield at all; indeed it appears to retain its sharpness unimpaired. The sheath of the femoral vessels is scarcely displaced, and the under part, or the pubic portion of the fascia lata covering the pectinalis muscle, seems to be the only part which can easily make room for the hernia to be protruded. This it does by the separation of the attachment between it and the falciform process of the iliac fascia lata, and by the muscle beneath yielding to the pressure.

The structure thus described is of great importance, in giving rise to stricture when any additional matter is forced into the hernial sac, and is much more frequently the cause of strangulation than has, I think, been hitherto supposed.

When a femoral hernia has passed this point, it would descend on the inside of the thigh towards the knee, like a psoas abscess, if it were not prevented by the vessels passing from the femoral artery to the superficial fascia, which bound it below; and from the turn which it takes upwards, from the natural and almost constant bending of the thigh. The herniary swelling, small as it is on passing under Poupart's ligament, expands after it has passed it, turns upwards and

widens, so that as it increases it passes above the sheath of the vessels, above the fascia lata, and even sometimes above Poupart's ligament. In doing this the swelling changes its shape as well as direction, and becomes an oval tumour, having its axis directed from the ilium to the pubes, and in fat elderly people so much resembles an inguinal hernia, as to have been mistaken for it. I suspect that it has been herniæ of this form and shape, which have been supposed to come out immediately in front of the femoral vessels, in which situation a hernia is certainly of rare occurrence.

When a hernia commences, the peritoneum pushes some loose cellular or fatty membrane before it, until it reaches the more condensed cellular structure or fascia, which covers the oval hollow or concavity of the septum crurale; this it presses against the gland contained in the hollow, and usually causes it to be removed by absorption. The continued pressure now acts on the septum, it begins to yield, is elongated, and forms a sac, which, like the peritoneum itself, is thickened as it descends, and increases by a regular growth; its outer surface being rough and adherent to the surrounding parts, the inner being a smooth secreting surface, moistened apparently by a serous fluid, which keeps it distinct from the peritoneal sac inclosed within it; a quantity of fat is sometimes found between them, rendering the detection of the herniary sac more difficult. This sac is usually very thin, and contains little or no fluid, in which respect it is unlike the same investment in inguinal hernia, and renders the operation on this part more difficult. From without inwards the coverings are the skin, fat, superficial fascia, absorbent glands in various states of enlargement, the fascia propria, and on opening that a second sac, viz. the herniary or peritoneal one, and within this the omentum, intestine, &c. as the case may be.

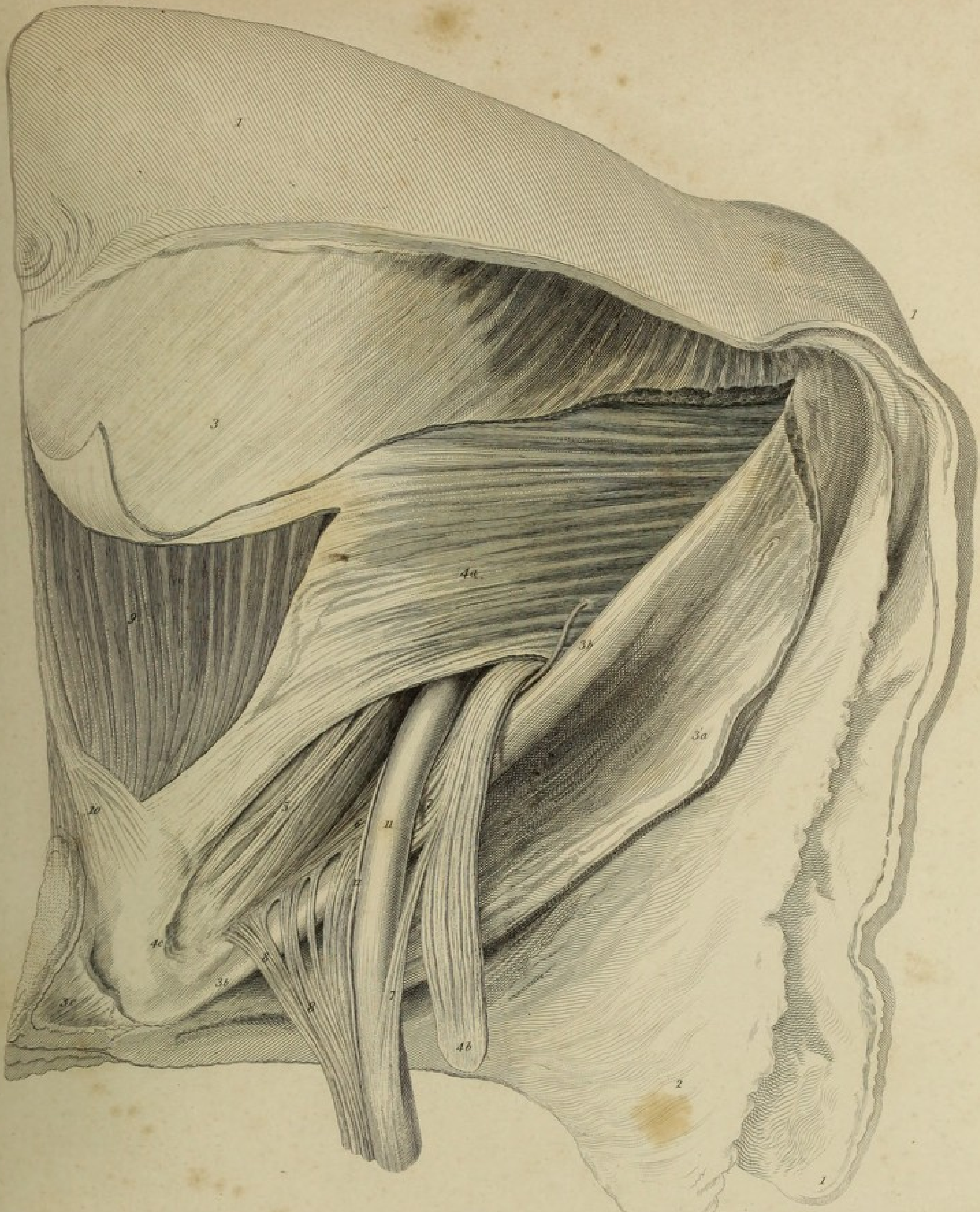
It was the want of knowledge of the fascia propria as a distinct or external sac that made many surgeons suppose that they had met with something extraordinary, when they found one sac within another. But the more accurate knowledge we at present possess on this subject must also be modified by the fact, that it is possible for the peritoneal sac to adhere so intimately to the fascia propria as to be divided with it; and then if the surgeon does not accurately distinguish the next part to be intestine when it presents itself, he may open it, believing that it must be sac, and place his patient in the greatest danger. I understand that one of the most distinguished surgeons in France states, that

he once fell into this error. I have seen it once committed in England, the intestine being opened for the peritoneal sac; and Mr. Vincent informs me, whilst this sheet is passing through the press, that he has lately operated in a case, in which no fascia propria existed. After the sac formed by the fascia propria has been opened, the surgeon must proceed with the greatest attention; and when a second sac, or something like it, is brought into view, he must increase his caution. If he can raise this, or take a small pinch of it up with his finger and thumb, so as to satisfy himself that there is something separate from it within, he may be sure it is the peritoneal sac which presents itself, and may proceed to open it accordingly. But if he cannot do this, and the appearance of the part exposed leads to the belief that it may be intestine, he must not open it, but trace it upwards to Poupart's ligament, and where the firm compression appears to be made upon it, there proceed to divide the stricture until he can satisfy himself whether the part adheres or not. If it be intestine, it will not be adherent, and on the division of the stricture will be readily drawn down or reduced. If it be sac, its adherence to Poupart's ligament will prove its nature, when it should be opened and its contents exposed, if the division of the ligament does not admit of the perfect reduction of its contents.

The manner of dividing the stricture has been, and is still, a subject of discussion, some surgeons recommending that it should be done upwards and rather outwards, others directing that it should be done horizontally by a division of Gimbernat's ligament, according to the opinions they severally entertain of the seat of stricture. It is admitted that the stricture may be situated externally or internally, by the anterior border of Poupart's ligament, (according to my views it is formed by the fascia lata,) or by the edge of Gimbernat's ligament; but I am not aware of any proportion ever having been stated in which they occur. In the absence of this information I am disposed to believe that it happens much more frequently anteriorly than posteriorly, and which will of course regulate the operative process. Practical surgeons know that a very slight touch of the knife is often sufficient to give the requisite relief; and the distended part yields with a sound resembling that which would be heard on dividing a piece of parchment tightly stretched between two points. The stricture thus cut, readily yields to a little pressure with the nail or point of the fore-finger, and the part becomes sufficiently dilated to allow of the return of the contents of the herniary sac into

the abdomen. In by far the greater number of cases this mode of proceeding will be found as effectual as it is safe ; but if it should not be sufficient, and a further division of deeper-seated parts is necessary, in what manner should it be done ? By continuing the incision upwards, or by making a new one in connexion with it, but horizontally ? There are objections to both. It is urged against the operation upwards, that the spermatic cord may be divided by it ; but as the operation is usually performed on women, this objection has not so much weight, for this part may be easily avoided, and if necessary even drawn out of the way, but which I do not however think will be necessary. The division of the edge of Gimbernat's ligament by a horizontal incision is dangerous for two reasons : first the depth of the parts and the greater chance of cutting the intestine, which if protruded in any quantity can only with great difficulty be kept out of the way of the knife ; and secondly the danger of wounding the obturatrix artery when it happens to surround the neck of the sac. I know that if the end of the bistoury be just carried beyond the edge of Gimbernat's ligament and no further, it may be cut without injuring this vessel, which in these cases runs close to it ; but I have been made aware of more than one accident of this nature having occurred in operations performed by some of the best anatomists and surgeons in London, and the patients subsequently bled at intervals until they died from hemorrhage. It does not appear, then, that the ablest and best informed men can avoid such a misfortune, and I am therefore disposed to recommend that the operation should never be done in this way until the one directly upwards has been tried in vain ; and if attention is paid to the division of that portion of the fascia lata which is attached to Gimbernat's ligament and to the pubes as well as of the fascia propria, I suspect sufficient room will be obtained without cutting horizontally inwards. If this should be insufficient, of which I have great doubts, the horizontal incision may then be made with more ease and advantage, but to a far less extent. The obturatrix artery is something of an anatomical bugbear in this operation also ; it has very rarely been injured, although the case I have adduced shows that it may be cut, but then it may be tied, and ought to be tied in every case in which it has been divided. The operation is very simple. In the male a transverse incision should be made in the line of Poupart's ligament, the aponeurosis or tendon of the external oblique muscle is then to be divided and the spermatic cord exposed ; this is to be drawn upwards and kept in that

situation by a bent probe; Poupart's ligament is to be then cut through, until the first incision for dividing the stricture is met by that just made. The blood will now easily lead to the artery, which must be secured by ligature; and to render this easy of execution, sufficient space and a blunt knife only can be wanted, in addition to the forceps and ligature. In the female the operation is more simple, as the round ligament requires little attention being paid to it. It is surprising to see men who place a ligature on the external iliac or on the common iliac, as a matter almost of course, hesitate at tying the obturatrix artery, and even allow a patient to die in the mean time of hemorrhage.



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EXPLANATION OF THE PLATES.

PLATE I.

The parts concerned in Inguinal Hernia on the left side.

1. 1. 1. Integument.
2. Fascia superficialis.
3. External oblique muscle.
3. *a*. Its aponeurosis turned down on the thigh.
3. *b*. Poupart's ligament.
3. *c*. The insertion of the external oblique into the os pubis.
4. *a*. The internal oblique muscle passing across the abdomen to assist in forming the sheath of the rectus.
4. *b*. A portion or slip of this muscle separated from its attachment, and hanging down outside the spermatic cord.
5. The superior fibres of the transversalis muscle passing above the cord to their insertion into the pubis.
6. The inferior fibres of the transversalis muscle passing below the cord, forming the lower edge of the internal or superior opening of the inguinal canal, and inserted into Poupart's ligament up to the pubes.

   The fibres marked 6 are all muscular; in some instances they are tendinous and aponeurotic; in others they are either wanting or so indistinct as scarcely to be distinguished from the fascia transversalis.
7. The cremaster muscle given off from the internal oblique, and partly from the transversalis muscles seen lying upon the cord at 7, and passing under it from 7 to 8.
8. The portion of the cremaster usually considered as a second origin, but which is in fact its insertion after its fibres have proceeded the whole length of the spermatic cord and testis, forming in this way a sling partly muscular, partly tendinous, whereby it may be drawn up towards the abdomen.

9. The rectus muscle, its sheath having been turned up.
10. The pyramidalis muscle.
11. The spermatic cord.
12. The cremasteric artery, a branch of the epigastric.

The preparation from which this engraving is taken, was made by Mr. Owen, and is deposited in the Museum of the Royal College of Surgeons, as well as that which shows the continuation of the cremaster muscle on the spermatic cord and testis.—The drawing was made by Mr. Clift.

PLATE II.

FIG. 1. The right side of the same individual whose left side is shown in Plate I. The drawing from which the engraving was taken was made by Mr. Clift. Sir Astley Cooper dissected the internal parts to show how far they accorded with the view of them given in his Work, and which is fig. 3.

A. Poupart's ligament.

B. The tendon of the external oblique, turned towards the linea alba.

C. The spermatic cord.

D. The cremaster muscle.

E. E. The internal oblique muscle; at the upper part its anterior surface is shown, at the under part it is separated from the transversalis, a little raised and turned upwards and inwards, so as to show the under surface of the muscular fibres at E.

F. The transversalis muscle partly exposed and raised in a similar manner; the under surface is shown by the line extending from F.; the outer surface of the same muscle is shown by the line extending from I., and which corresponds with No. 3. and 4. *c.* of Plate I.; and lower down with No. 6., or the fibres passing under the cord.

G. Fascia transversalis, outer division.

H. Peritoneum.

I. The inferior fibres of the transversalis.

PL. II.

FIG. 1.

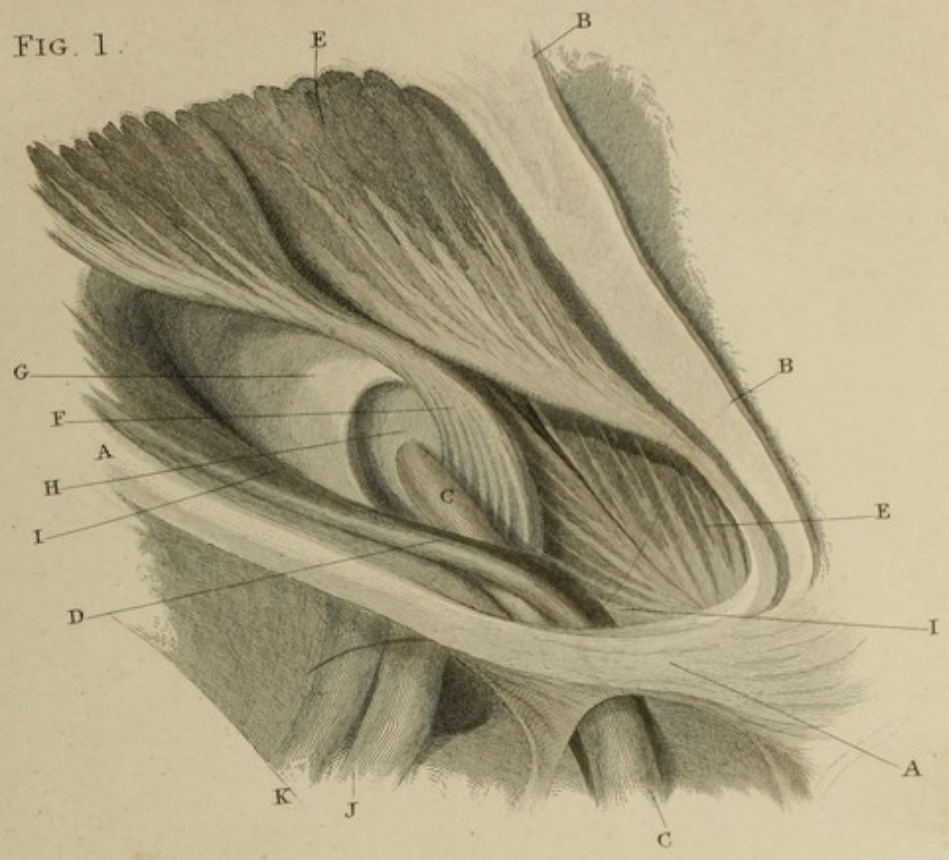


FIG. 2.

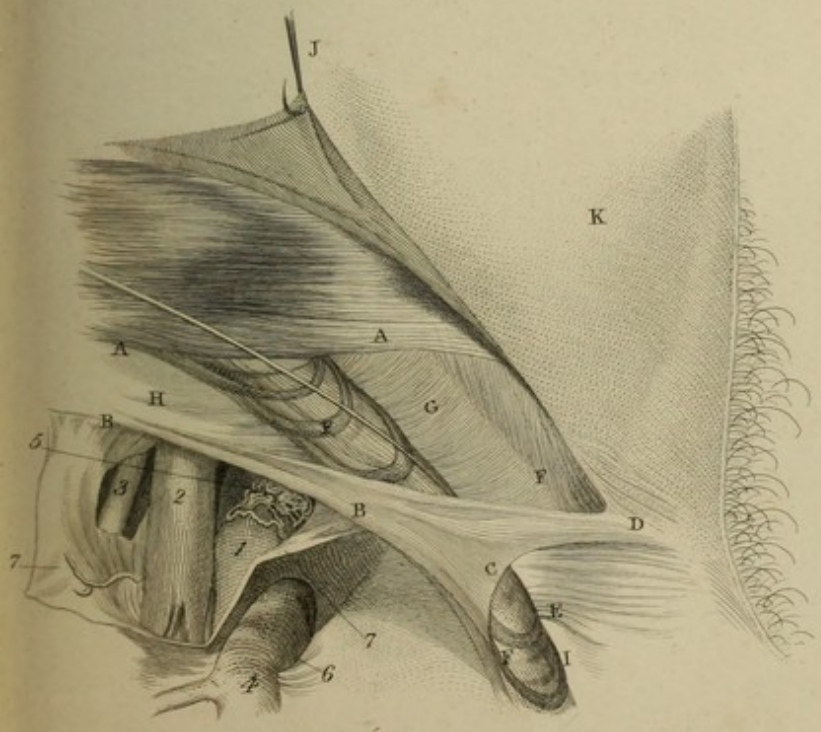
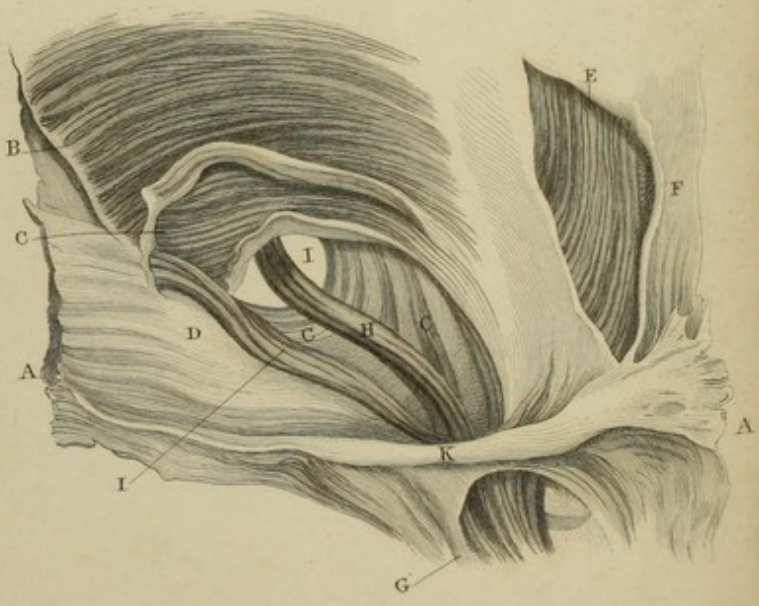


FIG. 3.



J. F. Wedgwood. Sculpt.

J. The femoral vein.

K. The femoral artery.

FIG. 2. Is taken from Plate VI. of P. F. Blandin, *Traité d'Anatomie Topographique*, and which is supposed by him to be in accordance with the opinions entertained by those French anatomists who preceded him to 1826.

A. The inferior and united edges of the internal oblique and transversalis muscles, horizontally directed across the abdomen to the linea alba.

B. The crural arch, or Poupart's ligament.

C. Fibrous expansion detached from around the inguinal ring, *i. e.* the ring exposed by the removal of the intercolumnar fascia.

D. The internal or superior pillar of the ring.

E. The external or inferior pillar of the ring.

F. Muscular nooses or arches formed by the cremaster muscle on the spermatic cord, and derived from the inferior border of the internal oblique and transversalis muscles.

G. This is S. in the original, and is described as the aponeurotic fascia transversalis, which forms the posterior wall of the inguinal canal in a spot where, of the three muscles of the abdomen, only one is found, viz. the external oblique. This is internal to the cord.

H. This is also S. in the original, and represents the same thing, but external or to the outside of the cord.

I. The spermatic cord.

1. The femoral vein situated on the inside of

2. The femoral artery.

3. An opening made in the external part of the crural canal (sheath of the vessel), to show the anterior crural nerve situated immediately on the outside of it, and lying on the cellular structure covering the psoas muscle.

4. Saphena major vein.

5. A lymphatic gland and vessels.

6. Falciform or semilunar fibres situated at the junction of the vena saphena with the femoral vein.

7. The anterior wall of the crural canal or sheath of the vessels, opened and turned outwards and inwards to show the canal.

FIG. 3. Is a copy reversed of Figure 1. of Plate V. from Sir Astley Cooper's book on the Structure and Diseases of the Testis, showing the inguinal canal and course of the spermatic cord.

A. A. Poupart's ligament.

B. Internal oblique muscle.

C. C. Transversalis muscle arising from Poupart's ligament, and passing around the spermatic cord at the internal ring, so that the fibres of this muscle appear behind as well as before the spermatic cord, and thus the inguinal canal is rendered a muscular canal: this is a most important provision in preventing hernia; and when hernia exists, it is often the cause and seat of stricture.

D. The cremaster muscle arising from Poupart's ligament between the internal oblique and transverse muscles, and receiving fibres from the transversalis behind the cord.

E. The rectus muscle.

F. Its sheath from the internal oblique and transverse muscles.

G. Superficial fascia of the cord.

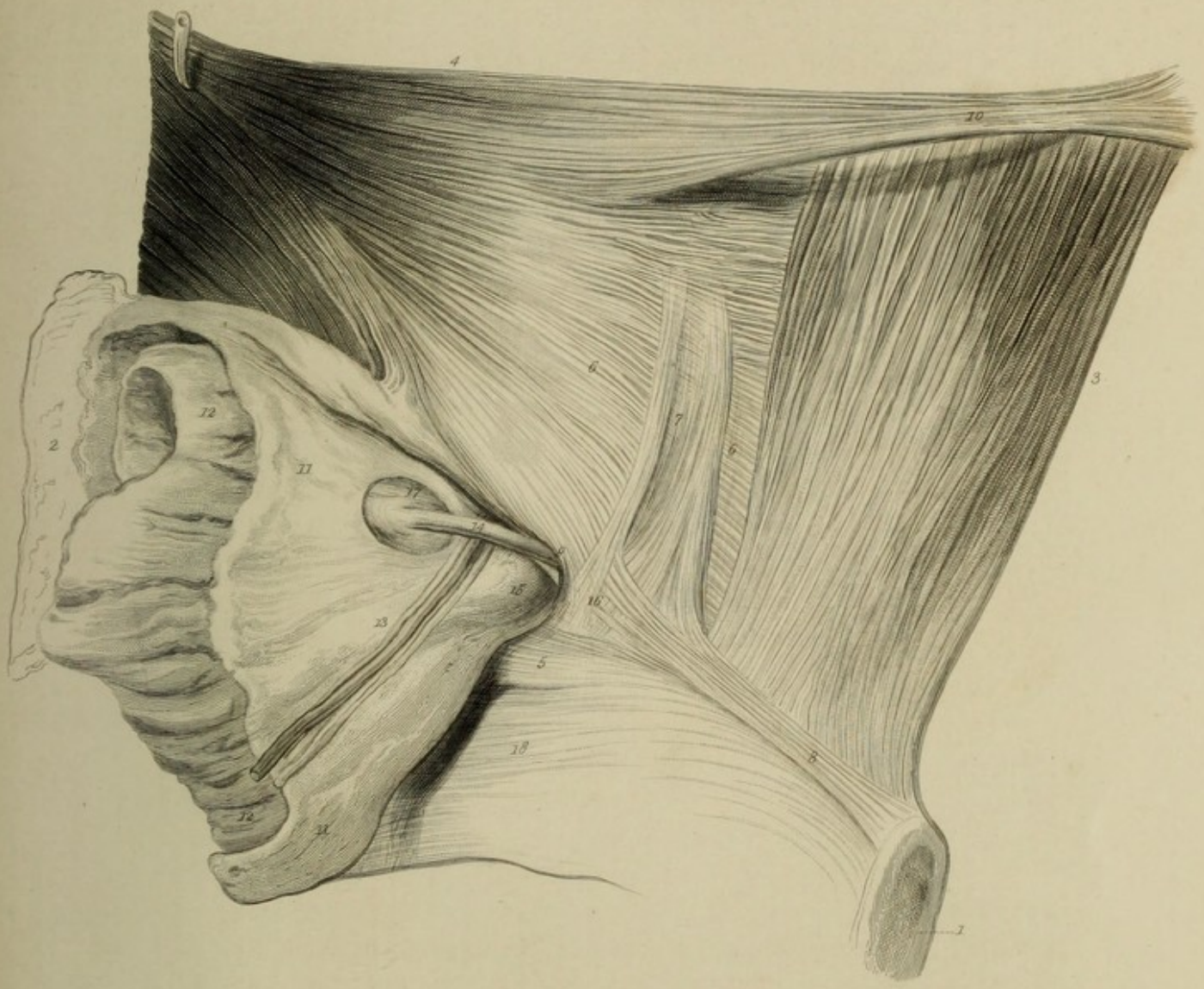
H. Spermatic cord.

I. I. The internal ring. By an oversight the line running from I. rather appears to stop at the cremaster muscle at D., than to go on to the inner ring.

K. The external ring.

N.B. The difference between F. and G. of fig. 2. when compared with F. and I. of fig. 1. is remarkable; it is no less so when compared with C. C. of fig. 3. of the same Plate, or with No. 5. and 6. of Plate I.

The French anatomists generally appear to consider that formation of the transversalis muscle to be the more natural one, in which it runs across to the linea alba, without being inserted into Poupart's ligament, when the spermatic cord will be found lying on the fibrous layer of the fascia transversalis, as in fig. 2. Plate II. at G.; and in order to show the loops or nooses formed of the



W. F. Cliff. del.

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cremaster by the testis in its descent into the scrotum, they sacrifice the insertion of those fibres which do not take this appearance, as seen in Plate I. No. 8. Anatomists only can judge which description is most correct, and which formation is most commonly met with.

PLATE III.

An internal view of the left half of the pelvis and parts concerned in Inguinal and Femoral Herniæ.

1. The symphysis pubis.
2. The ilium, sawn across.
3. The rectus muscle, the inner layer of the fibrous fascia transversalis being removed.
4. The transversalis muscle.
5. Gimbernat's ligament.
6. The posterior or fibrous layer of fascia transversalis lying on or lining the transversalis muscle, the transverse fibres of which are seen passing on to the edge of the rectus.
7. Additional strengthening fibres to the fascia.
8. A particular tendinous insertion of it running behind the rectus to be inserted into the pubis at its symphysis.
9. The falciform edge of the fascia at the inner opening of the inguinal canal.
10. The lunated edge of the posterior part of the conjoined tendons forming the sheath of the rectus.
11. The internal or cellular layer of fascia transversalis turned down and lying upon the peritoneum which is seen underneath it.
12. The peritoneum.
13. The epigastric artery with its two veins turned down with the cellular layer of fascia transversalis.
14. The round ligament passing into the inguinal canal.
15. A femoral hernia covered by the cellular layer of fascia transversalis protruding through the crural canal or ring.
16. The fibrous layer of fascia transversalis, passing under Poupart's ligament,

and by the edge of Gimbernat's ligament, to form the septum crurale, and in this case of hernia the fascia propria of the hernial sac.

17. The part of the internal or cellular layer of fascia transversalis, which corresponds to the commencement of the inguinal canal; the inner edge of this has a very strong falciform appearance when the part is replaced in its proper situation.

18. Pelvic fascia.

This preparation was made by Mr. Owen, to illustrate the lectures delivered in the Theatre of the College of Surgeons. It is also preserved in the Museum. —The drawing was made by Mr. Clift.

THE END.

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RED LION COURT, FLEET STREET.