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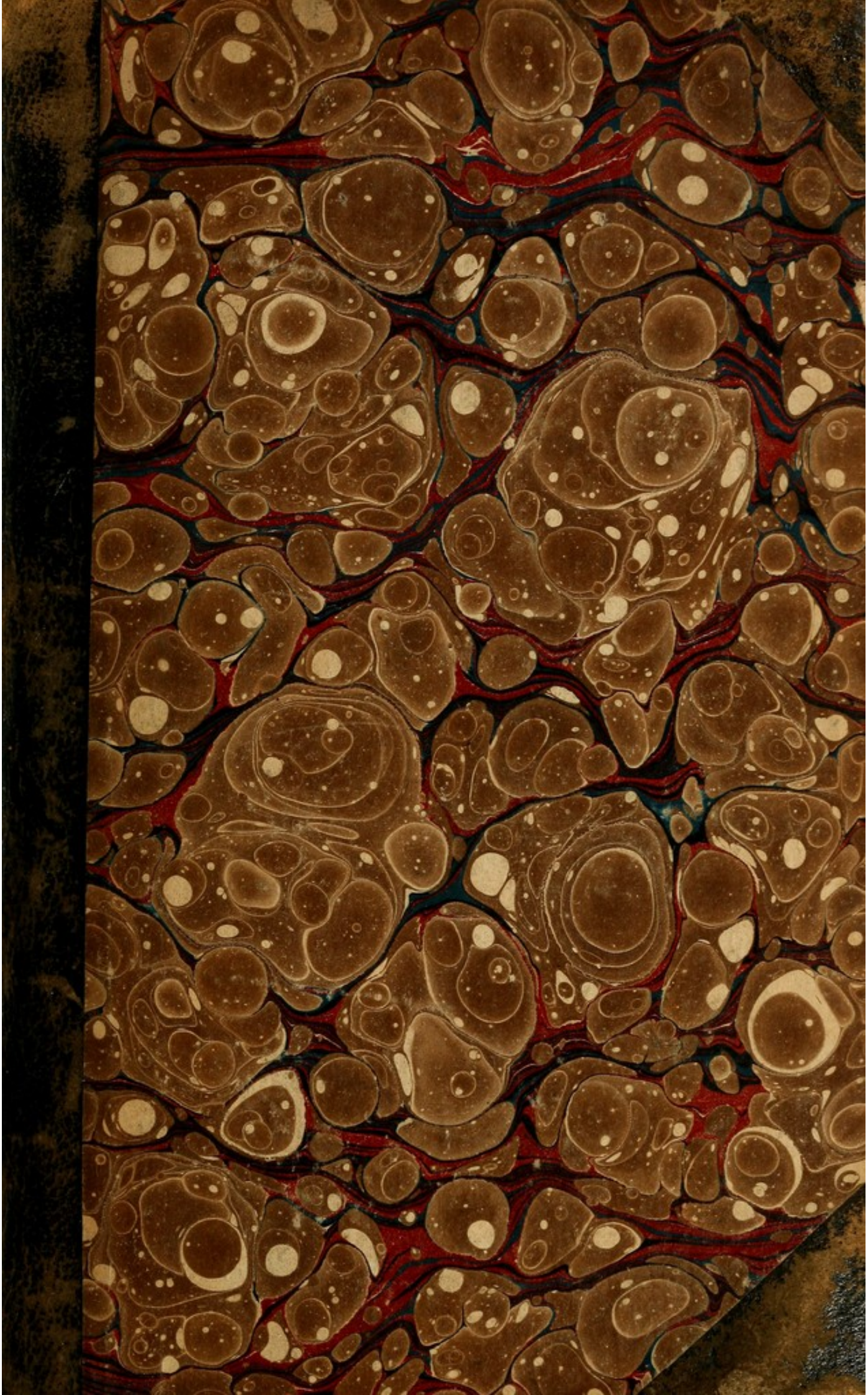

THE

LECTURES

OF

BOYER

UPON

DISEASES OF THE BONES.

VOL. I.

S. Gosnell, Printer,
Little Queen Street, Holborn.

THE

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OF

BOYER

UPON

DISEASES OF THE BONES:

ARRANGED INTO A

SYSTEMATIC TREATISE

BY A. RICHERAND,

PROFESSOR OF ANATOMY AND PHILOSOPHY, AND PRINCIPAL SURGEON TO THE NORTHERN HOSPITAL AT PARIS.

TRANSLATED FROM THE FRENCH

BY M. FARRELL, M. D.

IN TWO VOLUMES.

VOL. I.

LONDON:

PRINTED FOR JOHN MURRAY, 32, FLEET STREET;
BELL AND BRADFUTE, EDINBURGH; AND
GILBERT AND HODGES, DUBLIN.

1804.

TRANSLATOR's PREFACE.

THE celebrity of the authors of this Treatise entitles it to a considerable share of attention. Boyer, a distinguished professor of surgical pathology, and an eminent practitioner of surgery, who is the principal author, would have contented himself with delivering the substance of it in his public Lectures, had not some of his pupils attempted to publish from their notes a spurious edition of the work. These copyists presented Boyer's doctrine in so mutilated a form, that it was found necessary to give a genuine edition of the Lectures to the public. Richerand, professor of anatomy and physiology, and practitioner of surgery, in which department he has

distinguished himself by his writings *, at the request of his friend Boyer, and immediately, under his inspection, undertook this task: but he has not confined himself to the duty of a compiler; he has enriched the work by many of his own observations.

The want of a complete treatise in English, on the diseases of the bones, must have been felt by students in surgery. The present work, it is presumed, will not only fill up this deficiency, but facilitate the study of surgery, and expedite the progress of those who devote themselves to that branch of medical knowledge.

A scrupulous attention has been paid to preserve the precise meaning of the authors.

* See Professor RICHERAND's Elements of Physiology, translated from the French by R. KERRISON, 8vo.; printed for J. Murray, 32, Fleet Street.

Their

Their ideas have been rendered in plain and intelligible language; and it is hoped that the work, as it is now presented to the public, will answer the same purposes to the English reader, that the original does to the French.

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A TREATISE,

A

TREATISE,

&c.

INTRODUCTION.

Bones are subject to the same diseases as the soft parts. This assertion may at first appear to be made at random, but its truth will be proved by the explanation into which we are about to enter. Hardness, which is their distinctive quality, does not belong to them in every stage of their existence; their soft and gelatinous state in the embryo is changed in a more advanced stage of life to that of cartilage, which finally hardens by the deposition of a neutralized combination of lime and phosphoric acid, in its parenchymatous structure. To this saline inorganized substance is to be ascribed whatever difference is found between the bones and soft parts. When deprived of this substance, whether artificially, by immersion in an acid, or by the

operation of the disease called rachitis, they become soft and flexible, and are reducible, by long maceration, to a cellular structure, in which vessels of every species are seen to ramify.

The existence, however, of the phosphate, and of a small quantity of carbonate of lime in bones, has a great influence on their diseases: the circulation is in some degree obstructed by the presence of this inorganized matter, and all the vital properties are thereby rendered more obscure. Thus all the diseases of the bones, which depend on a greater or less excitement of these properties, are slow in their progress, and of the chronic kind, although similar affections of the soft parts would produce acute diseases. A solution of continuity, for instance, or a simple wound of the soft parts, heals and reunites in two or three days, if the parts be brought into immediate contact; but a wound or fracture of a bone requires twenty days at least, not unfrequently forty or fifty, and even several months in some cases; and in general it may be said, that the cure will be slow in proportion to the person's age; because, as years increase, the proportion of the saline part of the bones increases also.

How

How much greater is the duration of exostosis than of phlegmon, or any other swelling of the soft parts? Is not necrosis, which is the true gangrene of the bony substance, equally slow? Is not the separation of the living from the mortified part slower than in the gangrene of soft parts? This long duration of these diseases, and the tardy succession of their symptoms, will be greater or less in proportion to the greater or less relative quantity of saline matter in the bones; whence it follows, that their progress will be quicker in the infant than in the adult, and, *cæteris paribus*, that they will be slower in old age than at any other period.

The best and most ancient division of the diseases of the bones is that which distributes them into two orders; the first of which comprehends whatever affects each bone singly, in its substance or continuity; the second comprehends their diseases in the joints, and in their points of contact one with another. But it is to be observed, that the diseases of this second order may affect also the substance of the bones, as frequently, in cases of white or lymphatic swellings of the joints, caries of the extremities of the bones accompanies the morbid affection of the surrounding soft parts.

The first order of the diseases of the bones comprehends their fractures, wounds, exostosis, necrosis, and caries, the ricketty softening of the bones, their friability, and that morbid state known by the name of spina ventosa, or osteosarcoma.

The second order embraces sprains, luxations, dropsy of the articulations, the diseases arising from preternatural substances generated in the articulations, white or lymphatic swellings, and anchylosis.

It shall be shewn in the sequel, that the assistance of art is indispensable, and efficacious, in the greater number of these diseases. Whatever relates to fractures shall first be considered: of all the diseases of the bones, they are the most frequent; to none is a strict attention more necessary; in the treatment of none is the utility of the surgical art more evident.

CHAPTER I.

OF FRACTURES IN GENERAL.

FRACTURE is defined a solution of continuity of one or of several bones, resulting from a force of extension disproportionate to, and exceeding their natural extensibility. We shall not, in imitation of the greater part of authors, add, "produced by some external cause;" for though the most usual cause of fractures be some external force, yet muscular force is sometimes the sole cause. It is this alone that always occasions the fracture of the patella, olecranon, and calcaneum. This definition might be applied to a solution of continuity produced by a cutting instrument, and therefore very different from fracture properly so called; but a rigorous precision of language is not to be expected, particularly in medical subjects.

SECTION I.

Of the different Species of Fracture.

FRACTURES differ from one another in five respects; 1st, as to the bone affected; 2d, as to

the part of the bone; 3d, as to the direction of the fracture; 4th, as to the relative position of the fractured portions; 5thly, and finally, as to the attending circumstances by which the fracture may be either simple, or variously complicated. We proceed to consider them successively in these respects. The fractured bone may be broad, such as the scapula, or bones of the pelvis; or short, as the calcaneum and astragalus; or belong to the class of long bones, as is most frequently the case. The situation and use of the broad bones do not expose them much to be fractured, with the exception, however, of those of the cranium; in which case, the fracture is less to be attended to than the affection of the brain, which it almost necessarily occasions.

The fracture of short bones is still less frequent, on account of the equality of the three dimensions; and, if not produced by an external force or weight, which crushes, or rather grinds the part, is almost always produced by muscular contraction, which is by much the most frequent cause of the fracture of the patella, of the olecranon, and calcaneum. The long bones, whether they serve as pillars, as levers, or as arch-ending points of support and resistance, are much exposed to fracture, and are more frequently fractured than

than any other class of bones; therefore, all that is to be said of fractures in general, is principally applicable to them.

These bones may be fractured in different points of their length, and that happens most frequently in the point of bisection; in which case, the fracture is produced, like that of a stick bent beyond its natural extensibility, by a force applied at each extremity. These bones may, however, be fractured more or less near their extremities; sometimes even it happens in their extreme points, as shall be explained in treating of the fractures of the neck of the femur and humerus. Sometimes, too, the same bone is fractured in different points, whether it be caused by a weight falling on a fragment of a single fracture, or whether a cause of that nature alone, and exclusively of any pre-existing fracture, break the bone into several distinct splinters. This last species of fracture, which the ancients termed "nut-like," in allusion to the breaking of a nut by a hammer, is distinguished by the descriptive name of *comminutive* fracture.

The differences relative to the part of the bone fractured, establish a distinction of great importance, and not purely scholastic, as is imagined

by some; for these differences influence the treatment and prognosis, as shall be proved. Thus, in a fracture of the middle part of a bone, though, on account of the bone being less thick in that part, and the contiguous surfaces therefore less extensive, the fractured portions are more easily and more widely separable one from the other, yet this kind of fracture is the least dangerous; because, in such cases, the cause is seldom applied to the part fractured, and for that reason the surrounding soft parts are injured equally seldom. Another reason of this difference is, that a less force suffices to break the bone in the middle than in any other part; besides, the means usually employed to keep the fractured portions in just contact are more effectual, because they are longer. Add to all this, that inflammation, stiffness, and anchylosis of the joint, are less likely to happen than when the bone is fractured near the articulation.

With respect to the direction of the fracture, there are several distinctions to be made. It is called transverse when its direction is perpendicular to the axis of the bone; oblique, when it deviates from the perpendicular. In this respect also, the comminutive fracture is to be considered as of a particular species. This fracture of

the

the bone into several pieces of different directions, is always attended with contusion of the surrounding soft parts. Another species of fracture of a longitudinal direction has been admitted by *Duverney*, of which he quotes two cases, and compares it to the cracks which sudden drying causes in a board that had been impregnated with humidity. *J. L. Petit* has, with reason, denied the possibility of this species of fracture; arguing, that the cause which could fracture a bone longitudinally would fracture it more easily transversely, and must necessarily have done so. The cases of these pretended fractures related by Duverney are by no means satisfactory; for it is very difficult to ascertain the existence of such a fracture through the skin, periosteum, and intermediate parts. *Heister* admits its possibility however, and even asserts, that the panaris is for the most part owing to the longitudinal fracture of the finger-bones; but this erroneous opinion has been amply refuted by *Louis* at the conclusion of his discourse on *Petit*'s Treatise on the Diseases of the Bones. We adopt the opinion of this latter author, and reject as impossible, the longitudinal fracture, unless that name be applied to longitudinal splinters of comminutive fracture, as is most likely to happen when the fracture is occasioned by a gun-shot.

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The most important distinction of fractures is that resulting from the different situations of the fractured portions; the knowledge of their derangements is of the greatest importance, because the principal object in the treatment of fractures is to prevent or remedy these derangements. The separation of the fractured parts is not, however, essential to the disease, for it often happens that the leg is fractured without any change in the form of the limb; and this is particularly the case when the tibia alone is fractured at its superior extremity, because its diameter is considerable in that part, and the extensive surfaces in contact cannot separate without difficulty: the fibula also contributes to retain the fractured portions in their natural situation. But when both bones of the fore-arm or leg are fractured, it rarely happens that the derangement of the parts is not the distinctive sign and proof of the accident. This derangement attends, almost without exception, the fracture of the thigh and arm, these members being each formed of a single bone, and surrounded by very powerful muscles. The causes of this derangement, and its varieties, shall next be considered.

It may happen in the direction of the diameter of the bone, be parallel to, or form an angle

angle with the axis, or merely affect the circumference.

When a bone is fractured transversely, the contiguous surfaces may remain in partial contact, or be totally separated. In a fracture of the tibia, for instance, the inferior portion of the bone may be pushed inward, and totally separated from the superior; or the external part of the former may be placed in contact with the internal of the latter. This incomplete derangement in the direction of the diameter of the bone, does not produce any shortening of the limb; but when this derangement is complete, then follows that parallel to the axis of the bone. The derangement in the direction of the diameter happens when the fractured bone is of a considerable size, as the tibia, for instance, and the fracture transverse; and when the proper means of keeping the parts in their natural situation have been too long neglected. But if the fracture be oblique, the surfaces not extensive, and the accident neglected, the derangement in the direction of the axis takes place, and the limb is shortened. In this last-mentioned might be included the fracture of the patella, olecranon, and calcaneum; with this difference, however, that in the latter cases the fractured ends recede

one

one from the other, and are always found separated by a greater or less distance, instead of passing one by the other, as in the former case.

The third species, viz. that in which two fragments form an angle one with the other, has not been mentioned by authors, and takes place principally in cases of comminutive fracture. It might happen, however, in a simple fracture of the leg, as may easily be conceived by supposing the foot placed on an inclined plane; in which case the angle formed would be salient anteriorly, if the heel were lower than the fore part of the foot, posteriorly if the contrary.

The fourth species, or that affecting the circumference, is produced by the rotation of the inferior fractured portion on the superior, in such a manner as that the part which was anterior becomes internal or external. We have an instance of this species of derangement in the fracture of the neck of the femur; when the foot being ill supported by the apparatus, and obeying its weight, aided by that of the leg and by the contraction of the muscles, turns outward, and carries the inferior fragment in the same direction; in which case, the anterior part of the body of the bone corresponds

sponds no longer to the anterior part of the neck.

The bones being but passive instruments of loco-motion, possess not, in their own organization, any cause of the change of situation which takes place, but yield to exterior causes, to the weight of the member, and to muscular contraction; whence it appears, that the causes of this change of situation may be very various. The cause of the fracture may also be the cause of the derangement of the fractured portions; as when the thigh, for instance, is fractured by a fall from some height: if the weight of the body, pressing on the inferior extremity which bears on the ground, bends the femur forward, the force will not be entirely spent in producing the fracture, but will, in addition, produce a greater or less derangement of the fractured portions.

The celebrated *Ambrose Paré* has offered, in his own case, a fracture and separation of the bones produced by the same cause. This eminent surgeon received a kick from a horse on the leg, with such force, that the lower fractured portion abandoned entirely the upper, which, impelled by the weight of the body, pierced the flesh, inte-

integuments, stocking, and gaitre, and drove its pointed extremity even into the earth.

The weight of the limb suffices alone to produce the angular derangement, or that affecting the circumference, as has been already explained, when treating particularly on that subject. Another cause is, the impulse frequently communicated to the limb, by the assistants, during the dressing: but of all these causes, the most powerful is the contraction of the muscles.

Of the muscles which surround a fractured bone, some are attached to that bone in a great part of its length, and therefore in many cases to both portions of the fractured bone. Others extend from the bone which is superior to that fractured, to that which articulates with the lower portion, or to the lower fragment itself; there are still others which terminate in the upper fragment, the other extremity of which may be more or less distant. The muscles of the thigh offer examples of these three different dispositions. The triceps is attached to the whole length of the femur; the biceps, semi-tendinosus, and semi-membranosus, descend from the pelvis to the leg, to which the lower part of the femur is articulated, and all the movements

of

of which it obeys; the great adductor muscle has its insertion in the lower part of the femur itself: finally, the psoas, iliacus, pectineus, &c. &c. descend from the loins and the pelvis, and have their insertion near the superior extremity of the femur.

The muscles which are attached to both portions of the fractured bone, contribute very little to their change of situation; but may, however, draw them both to the side on which they are inserted, and thus change the direction of the limb. The triceps, and more particularly its middle part, acts thus on the fractured femur, and renders the thigh convex anteriorly. The brachialis anterior tends to produce the same effect, when the humerus is fractured below its middle part. But the change from the natural situation is principally owing to the muscles which are inserted into the lower portion of the fractured bone, or the limb with which it articulates. Let us suppose the fracture of the humerus between its superior extremity and the insertion of the great pectoral muscle; this muscle, aided by the latissimus dorsi and teres major, draws the inferior portion inward and upward, and causes it to ascend on the interior side of the superior, which rests motionless on account of its shortness, and because the muscles, which are inserted into it, are

not

not acted on by any cause that excites them to action. In the fracture of the neck of the femur, the superior portion of the fractured bone has no muscle inserted into it, and remains motionless in the articulating cavity. Those muscles which, on the contrary, are attached to the lower portion, draw it upward and backward, and render its being displaced in that direction inevitable.

The lower portion being acted on by the limb to which it is articulated, follows all its motions, and is liable to be displaced by the action of the muscles which are inserted into it. Thus, in fractures of the body of the femur, the biceps, semitendinosus, and other muscles, draw the leg, and with it the inferior portion, upward, inward, and backward, and cause it to ascend on the internal, and a little on the posterior side of the superior portion, the inferior extremity of which projects, in that case, on the anterior and external side.

In the fractures of the leg, the gastrocnemii muscles, &c. draw the inferior portion upward and backward, with the foot; for in this, as in every similar case, the stronger muscles displace the lower portion of the fractured bone, and draw it in their direction: hence it is, that in this case the

portion

portion is drawn backward as well as upward, because the muscles are more numerous and larger on the back part of the leg than on any other. Therefore, when a fracture takes place in any part of a bone, it is easy to determine, from a knowledge of the muscles, what species of derangement will follow, if there be no counteracting cause. Finally, the muscles which have their insertion in a superior fragment, may produce its separation from the inferior. When the femur is fractured immediately below the small trochanter, the iliac and psoas muscles draw forward the inferior extremity of the superior fragment, which raises the skin and projects more or less. It is to be observed, however, that the displacing of this fragment is very rare, whilst the inferior fragment is displaced in almost every case.

Hitherto we have considered the derangements of fractures as simple, but they may be complicated; as, for example, when in a simple fracture of the femur, the lower fragment has ascended upward and inward, and the foot being ill supported inclines externally at the same time. The derangement in this case will be composed of the four species already described.

There are other differences still, which depend on the fractures being simple or compound. A simple fracture is that in which the soft parts have received no other injury than that necessarily produced by the fracture; for it is easy to conceive, that a fracture cannot take place without lacerating more or less the periosteum, the small blood-vessels, and the muscular fibres contiguous to the fracture; some degree of contusion and of swelling follows necessarily, and the skin of the part becomes livid and yellow in two or three days. A fracture is compound when it is accompanied by circumstances which require particular modes of treatment; such are a much greater degree of contusion than ordinary; a solution of continuity of the surrounding soft parts, whether that be immediately produced by the fracturing cause, or by the fragments penetrating through the skin, after having lacerated the intermediate soft parts: this happens when the fracture is very oblique and the fragments pointed. This compound fracture may be rendered still more complex, by the rupture of a large blood-vessel, whether an artery or vein, and by the effusion of blood in the cellular texture, which would be its necessary consequence.

Fractures are but rarely accompanied with luxation; in which case the luxation must necessarily precede the fracture; for the fracture once effected, the fragments are not susceptible of luxation: any motion which may be communicated to them can only impel them into the surrounding soft parts, producing more or less laceration.

Finally, fractures may be accompanied with other morbid affections, whether pre-existing to the fracture, succeeding that accident, or operating as its predisposing cause. Thus persons affected with a fracture, are also often affected at the same time with a vitiated state of the solids and humours; such are, for instance, the scurvy, scrofula, the venereal disease, or cancer. Add to all this, that the irritation caused by a fracture may be the occasion of an acute fever, which generally changes to the reigning epidemic.

We shall not treat here of the distinction of fractures into complete and incomplete; because these denominations appear to us unfounded, and fit only to lead into error. By complete fractures, authors mean those in which both bones of a limb are at the same time fractured; as those of

the leg or fore-arm: incomplete, those in which only one of these bones is fractured, the other not being injured; but it is evident that in this case the fracture is complete; for to the term incomplete, we can only attach the idea of a bone partially fractured, an occurrence utterly impossible.

SECTION II.

Of the Causes of Fractures.

The causes of fractures are as various as the means by which that effect may be produced; and, like the causes of other diseases, may be divided into predisposing, and remote. In the first class of causes are ranged the situation and functions of the bones, the age of the individuals, and their diseases, if affected by any. Superficial bones are more easily fractured than those which are covered by a considerable depth of soft parts. The functions of some bones render them more liable to be fractured than others: thus the radius, which supports the hand, and serves in some respect as a handle to it, is more liable to be fractured than the cubitus. The clavicula, which preserves the shoulder and sternum in their proper position, and supports on its arched

arched extremity all the motions of the superior extremity, is on that account frequently fractured. The gradual accumulation of phosphate of lime in the cellular structure of the bones, renders them brittle in proportion as we advance in life. In old age the proportion of the inorganized to the organized part is so great, that the bones are then fractured by the slightest cause. In childhood, on the contrary, the fibrous and organized part prevails, and communicates its properties to the bone, which is then flexible and elastic. An advanced period of life is, then, to be reckoned as one of the predisposing causes of fractures. Certain acrimonies affect the osseous system, by attacking its organized part, and reducing it to the same state as in old age, and render it even still more brittle. Thus, women affected with old and ulcerated cancers, have been known to fracture their bones, in performing the natural and ordinary motions of the body, or merely in changing their position in bed; instances of which are recorded by Louis and Saviard. In cases of this nature, all the bones of the body being equally affected, several fractures happen at the same time, and reduce the sufferer to the lowest state of wretchedness. The principal indication

in such cases is not that of the fracture, as it is only a symptom of a more dangerous disease, the cure of which ought principally to be attended to. A certain degree of cold has been numbered among the predisposing causes of fracture; but if this accident be more frequent in winter than in summer, it is because persons are then more liable to accidents from falling.

Every efficient cause acts in overcoming the natural cohesion of the osseous particles, by separating these particles, and lengthening the bone beyond its natural extensibility; the force thus acting, may have been applied on the part fractured immediately, or on some distant part. When the cause of the fracture is applied to both ends of a bone, the bone is curved by the approximation of its extremities: thus it is, that, by falling on the shoulder, the clavicle, forcibly pressed against the sternum, is curved and fractured, as if by what the French term *contre-coup*. In falling on the knees, the femur, pressed between the weight of the body and the ground, bends about its middle part, and the fracture takes place there. In these and similar cases, the natural curvature of the bones contributes, with the force applied, to determine

determine the fracture in a certain part; and in such cases the contusion is less considerable than if the fracture had been produced by a force immediately applied to the fractured part; for the action of the fractured extremities on the surrounding soft parts is then the only cause of laceration or irritation. But a force which fractures a bone exactly on the part which it strikes, bends it to the opposite side, and wounds or lacerates the soft parts. Thus, a blow of a stick on the middle part of the clavicle, where the fleshy parts give it but a trifling support, bends it downward and backward, and fractures it, but never without producing a greater or less contusion, and sometimes a contused wound. If the fracturing force strike a bone equally supported in all its parts, the fracture will be of the comminutive species, that is, in several fragments: the contusion is always great in such cases.

SECTION III.

Of the Signs of Fractures.

The signs or symptoms of fractures drawn from circumstances, and established by reasoning, are never conclusive. The pain, for instance, how-

ever intense, and the impossibility of moving the limb, may be occasioned by a simple contusion, a luxation, and a variety of other causes. The immediate signs (the natural evidence of which precludes reasoning), generally called sensible signs, such, for instance, as an alteration in the form of the limb, its being shortened, and the crepitation produced by the fractured surfaces in rubbing one against the other, can alone give any certainty of the existence of a fracture.

When the limb affected is found shorter than the other, it is necessary, before pronouncing on the existence of a fracture, to be certain that no luxation has taken place, that it is not naturally so, nor in consequence of a former fracture ill set. In comparing the length of the lower extremities, the body should be placed, so as that the anterior and superior processes of the ossa ilia may be in a line parallel to the horizon; for if one of them be lower than the other, the member of that side will appear longer than the other.

Whoever has acquired a precise knowledge of the natural east and conformation of our members, he more especially who has accurately studied the relative situation of the processes on the extremities of the bones, will quickly perceive

perceive any change induced by a fracture. Whenever, in consequence of a blow or a fall, a member becomes concave in a part where it is naturally convex or straight, and *vice versa*; this change of form and direction must be attributed to a fracture, with derangement of the fragments. The internal side of the great toe, when the foot bears on an horizontal plane, ought to be in the same perpendicular line with the inside of the patella: nothing but a fracture of both bones of the leg can change this relative position of these parts. The relative position of the condyles of the humerus, and of the apophyses of the olecranon, indicate in like manner the luxation or fracture of the humerus. The derangement of the fragments may sometimes be perceived by moving the fingers on the parts of the bone which are least covered by the integuments. This sign is easily detected in the fractures of bones which are not surrounded by much flesh, but which lie almost immediately under the skin: such, for example, are those of the lower jaw and the clavicles.

But of all the symptoms, crepitation is the most general and distinctive; and can never be confounded by an experienced practitioner with the noise produced by emphysema, by an aqueous effusion,

effusion, or the defect of synovia. In order to know if this symptom exists, the operator, in some cases, seizes the member between both his hands, and presses it in different points of its length; it is thus that the fractures of the radius are ascertained, by pressing that bone from the external side to the internal. In other cases the operator takes a fragment in each hand, and by turning their extremities in opposite directions, produces the crepitation, if the fracture really exists: if the volume of the member requires it, the operator causes the superior fragment to be held by an assistant, whilst he moves the inferior on it, if the fracture really exists, as is supposed by the trial, for which reason we have used the term fragments, as if it really did exist.

Although in the greater number of cases it be easy to ascertain the existence, or non-existence, of a fracture, by the foregoing signs; yet there are cases in which certainty is very difficult to be obtained. This difficulty may depend on several causes.

In some cases the bone affected is surrounded by such a depth of fleshy parts, that the solution of continuity is almost impossible to be ascertained,

tained, and the crepitation is very indistinct. If in a case of this nature, such, for instance, as in some fractures of the neck of the femur, the separation of the fragments one from the other be inconsiderable, the fracture may easily remain undiscovered. The fracture of one of the bones of the fore-arm or leg is often difficult to be perceived, because the other bone remaining whole, preserves the form of the member, by preventing any considerable separation of the fragments.

Finally, if the surgeon be not called in, until a compound fracture has been still further complicated by an inflammatory swelling, it will be extremely difficult to ascertain with certainty the existence of the fracture; and though that knowledge should be obtained, yet will it be prudent to await the abatement of the symptoms, before any attempt be made to set the fracture.

When every possible trial has failed, and doubts still remain on the existence of a fracture, it will be prudent to apply the ordinary apparatus imbibed with some resolvent liquid; after the lapse of a few days, the apparatus should be taken off, and discontinued if it be found that

no fracture exists, or re-applied, in the contrary event: at all events, no inconvenience can arise from its first application.

SECTION IV.

The Prognosis of Fractures

Is different according to the bone fractured, the part of the bone where the fracture has happened, the direction of it, and the circumstances which attend it.

The fracture of bones which are superficial, and but thinly covered, is, *cæteris paribus*, less dangerous than the fracture of bones surrounded by many and strong muscles. Fractures of the superior extremities are always less dangerous than those of the inferior extremities. The fracture of the middle part of a bone is less dangerous than that of its extremities; because in the former case it happens frequently, that the cause has not acted immediately; that the soft parts are not much contused, and the inflammatory swelling is less to be apprehended. Fractures of the extremities of bones may produce a false anchylosis of the neighbouring articulation. It is thus thatin the fracture of the femur,

a little

a little above the condyles, the congestion extends to the knee, and occasions a stiffness, which it is difficult to remove: if the inflammation extend to the articulation, the consequence is still worse. Finally, the splints acting only on one of the fragments, render their disjunction very easy. Therefore the fracture of the neck of the femur is more dangerous than that of the body of the same bone. With respect to the direction of the fracture, those which are transverse are less dangerous than the oblique; and the greater the obliquity, the greater the danger, as the disjunction is on that account more easy; for which reason, a very oblique fracture of the body of the femur is esteemed fully as dangerous as that of its neck.

The accidents which attend a fracture add more or less to its danger. In a case of extreme contusion, attendant on a comminutive fracture, and in which some of the splinters have lacerated the part to an excessive degree, the inflammation may be so violent, as that mortification will ensue, and extend from the member to the trunk, and kill the patient in a very few days. In general, fractures complicated with contusion and wound, are more dangerous in the inferior, than in the superior extremities.

Finally,

Finally, the prognosis will be more or less unfavourable, according to the health and age of the individual. In a debilitated old man, a fracture is more dangerous, than in a person in the flower of youth and health. There are certain dispositions of the body, which influence very much the prognosis. Scurvy, for instance, retards to such a degree the formation of the callus, that, joined with old age, it may prevent it entirely. The state of pregnancy, notwithstanding what authors have said of it, does not retard the consolidation of a fracture, at least not to any sensible degree.

SECTION V.

Of the Treatment of Fractures.

The first and principal indication in a fracture, without derangement of the fragments, is to retain the fragments in their natural situation, to prevent the bad symptoms which generally follow, or combat them if they have already taken place; but if there be derangement, as most generally happens, it will be necessary, in the first place, to set the bone, that is, to restore the fragments to their natural situation.

The manner of setting a fractured bone varies, according to the nature and species of the fracture; and the precept is not perfectly correct, which says, that in every fracture, extension, counter-extension, and coaptation are necessary; because in several cases the extension and counter-extension are perfectly useless; as, for instance, in the fractures of the patella and olecranon, in which the fragments separate in opposite directions. It is merely necessary for their reduction to push the fragments one towards the other, having first extended the leg or fore-arm, in order to relax the muscles which have their insertion in the part affected. In the derangement in the direction of the diameter of the bone, only a very slight degree of extension will be necessary, in order to diminish the friction of the fractured surfaces, which move in contrary directions. Extension and counter-extension are still useless, when the displaced fragments form an angle one with the other; for it will suffice to place the member on an horizontal plane, in order to reduce the member to its natural direction. The derangement of the circumference is alike easily reduced by a rotatory motion given to the lower fragment, in the direction contrary to that which it took in quitting its natural situation.

Extension

Extension and counter-extension are not therefore of any very evident utility, except in the derangement in the direction of the axis of the bone, in which both fragments mutually pass one another.

Extension is the force exerted on the lower fragment, in order to bring its superior extremity lower than the inferior extremity of the superior fractured portion: counter-extension is a resisting force, which prevents the whole limb, or even the body, from obeying the force of extension. The hands of intelligent assistants are always best for both these purposes; it is but very seldom that any advantage can be derived from the use of more powerful means, which by their excessive force extend too violently the muscles and soft parts, occasion much pain, and produce spasmodic contraction of the muscles, which resist always in proportion to the force of extension, and on that account render it most frequently of no effect.

The practice was formerly to apply the force of extension on the inferior fragment, and that of the counter-extension on the superior; but exclusive of the difficulty of seizing the two fragments, which difficulty is in some cases insurmountable, as in the fracture of the neck of the femur,

femur; there is, besides, a great disadvantage attending it when practicable, namely, the spasmodic contraction of the muscles which surround the fracture, caused by the irritation and violence which they suffer.

It is therefore better to make the extension on the lower part of the limb, or on the bone which articulates with the inferior fragment, and the counter-extension on that which articulates with the superior. In a fracture of the leg, for instance, the extending force should act on the foot, and the counter-extending on the thigh; whilst in that of the thigh, these opposing forces should be applied to the leg and pelvis. There is nothing to be said as to the degree of force to be employed, because that must vary according to the extent of the derangement, and the number and strength of the muscles which have produced it. The direction in which these forces ought to act, is that which the inferior fragment pursued in taking its unnatural position; but this applies alone to the force of extension, because the opposing force is a mere resistance. Thus, if, in a fracture of the thigh, the lower fragment has ascended on the internal side of the superior, the foot and knee will be turned a little externally; and the extension ought therefore to be directed at first downward, and

outwards: afterwards, in proportion as the limb recovers its proper direction, the fragment ought to be drawn into its natural position. The assistants employed in this operation should be very intelligent, because, when extension is well made, coaptation becomes very easy. It is much easier to set a fracture, than to keep the bones in their place; in which it differs from luxation, which is difficult to be reduced, but easily prevented from relapsing. The means commonly in use to maintain the portions of a fractured bone in exact contact, and the member perfectly motionless during the time necessary for the formation of the callus, are reducible to a proper position, repose, bandages, and other kinds of apparatus, such as *fanons*, *faux-fanons*, compresses, stuffing, splints, machines of various constructions, and the means of effecting perpetual extension. We shall consider each of these in detail, successively.

In the first place, a situation is to be given to the limb, in which it may continue as long as the affection lasts; for that purpose it ought to be placed on a horizontal plane, so disposed, that the intervals between it and certain parts of the limb shall be filled up, in order that every part of it may be equally supported. This horizontal

zontal support ought to be capable of making a considerable resistance; without, however, being hard enough to give any uneasiness or pain. For this purpose a mattress of hair seems preferable to any other; because one of wool or feathers yields too much to the weight of the limb and apparatus.

Surgeons were for some time divided in their opinions on the best position. Pott has advised the limb to be kept half bent; which position, he says, has the advantage of giving to the muscles which surround an articulation, an equal and moderate degree of tension; whereas, if the member be placed straight, some of these muscles will be much extended, whilst others are as much relaxed. The latter position, however, is that which is generally preferred.

Demi-flexion is the most natural position; it is that which our limbs spontaneously assume during sleep, and has for that reason been recommended both by Galen and Hippocrates: but a limb half bent, is not solidly fixed, and changes frequently its situation, by numerous involuntary motions, which may be occasioned by dreams or pain. This position has, besides, this great incon-

inconvenience, that during the treatment the length of the fractured limb cannot be compared with that of the opposite side, nor can it therefore be known if the fracture be well set, and the apparatus well applied; and in truth, demi-flexion becomes at length as painful as the extension at full length. The advantages of the former have therefore been a little exaggerated by Pott, as well as the disadvantages of the latter, which alone is now used in France, and generally adopted in foreign countries.

In whatever position the limb is placed, most perfect repose is absolutely necessary, particularly in the commencement; for if the fractured pieces be moved one upon the other, nature cannot effect their reunion, which would therefore be retarded or totally prevented, if the friction of the surfaces were frequent, and suffered to continue long; in which case an articulation would be formed in the situation of the fracture, and consequently the patient remain disabled for ever after.

It is necessary to apply proper bandages and other apparatus, without which the position given to the member, however good, would be insufficient; because, without these, the involuntary motions which are inevitable, those which

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are produced by pain, and those again which are rendered necessary by our natural wants, would certainly, without that precaution, disturb more or less the just relative position of the fractured pieces, which even the depressions and inequality of the bed would affect, if not guarded against.

Bandages had been for a long time considered as the most effectual means of retaining the fragments in just contact; but it is easy to prove, that bandages, however contrived, can have but little, or absolutely no effect for this purpose. We shall examine successively, those which have been in use, viz. the roller, eighteen-tailed bandage, and that of Scultet, composed of separate pieces.

The first ought to be long enough to cover the whole limb, three inches broad, and rolled up in one. It is applied, by drawing first three folds of it over the fractured parts; it is then made to descend to the extremity of the limb, in such a manner, as that each roll shall cover a part of the preceding; it is made to ascend again in like manner to the situation of the fracture, when three folds more of it are applied; after which the superior part of the limb is

covered, in the same manner as the inferior; and if the bandage be long enough, it may be again rolled on downwards. Let us suppose this bandage applied to a fracture of the middle part of the femur, or humerus: it is plain that those parts of it which are applied on one of the fragments alone, are absolutely of no effect, and that that part of it only which comprehends both fragments, can contribute to keep them in contact. But in order to understand how extremely trifling its effect must be, it is sufficient to remark, that, as it is but three inches broad, it can include only an inch and a half of each fractured portion; and that this very trifling power is still farther diminished, by the greater or less quantity of soft parts which intercept its action.

In this respect, the eighteen-tailed bandage is preferable to the former. It is composed of three pieces of linen, equal in length to the member, and broad enough to pass once and a half round the limb. These pieces are sewed together by a seam, which runs from one extremity to the other; and afterwards cut each into three; so that the whole is composed of eighteen pieces, nine at each end. The bandage thus composed, being moistened, is extended under the limb, and the middle piece on each side

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is first applied on the situation of the fracture, then the superior ones, and afterwards the inferior, and so successively with the middle and inferior pieces. The six middle pieces of this bandage act with more efficacy on the fracture, than the folds of the former bandage; because, being much broader, they encompass a greater part of it. It has this other advantage over the former bandage, that its application is easier, and does not require that the limb should be kept raised, nor exposed to many motions, which are always hurtful.

Scultet's bandage is composed of as many pieces of three inches broad each, as are necessary to cover the whole length of the member, in lapping two thirds over one another. It is composed of a piece of linen, of three times the length of the limb, and broad enough to pass once and a half round the limb; it is to be cut according to its breadth, in pieces of three inches broad each: this done, the pieces are extended under the member, one covering three parts of the other in proceeding from the inferior part. This bandage, like the two former, acts only by the pieces which encompass at once the contiguous parts of the two fragments; it is preferable, however, in the following respects.

It contributes as much as the others to maintain the fragments in their just position; it compresses sufficiently the member, and prevents any œdema; it is in this respect preferable to the eighteen-tailed bandage, the parts of which not passing one on the other, do not compress all the parts equally; whence it happens, that those parts which correspond to the edges of the pieces become œdematous.

This bandage can be taken off, and reapplied, without moving the limb, in which it is far preferable to the first-mentioned bandage, the disadvantage of which in that respect has been already pointed out. The eighteen-tailed bandage cannot be so conveniently renewed as that of Scultet, because, when any part of it is soiled by purulent matter, or any other cause, it is necessary to remove it entirely, and apply another; whereas any particular piece of that of Scultet may be changed, and a new one applied in its place, which may be done without moving the member, by fastening the new one to the extremity of the old, and drawing it into its proper situation at the same time that this latter is taken away. It ought, therefore, to be preferred to the two former, except in cases of simple fracture of the superior extremities.

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Although bandages may be of no great use for keeping the broken pieces in their proper position, yet they are useful for supporting topical applications, and preventing œdema of the limb; they are still further useful in benumbing the muscles, and in preventing their contraction.

The *faux-fanon* is a cloth rolled on itself, and differs from the *fanon* in this, that in the latter there is enclosed a piece of wood. They are applied on the internal and external sides of the limb; but our limbs, like the *fanons*, being nearly round, these latter come in contact with the limb but by a very narrow surface, so that in tightening the strings by which they are secured, they are liable to slide forward or backward; in which cases their action is frustrated, no effect produced, and the fractured portions separate without any difficulty.

Splints are much surer means; they may be formed of different substances, and their shape and length accommodated to those of the limb in which the fracture has taken place.

Splints made of pasteboard were formerly in use, which being wet were easily adapted to the form

form of the member, and in drying were moulded to it. They have been also made of the bark of trees, but the brittleness of these caused them to be laid aside. At present, wood or tin are the only materials of which splints are made: they are usually thin and narrow, and rounded at their extremities: their length must be determined by circumstances. Those of tin are extremely proper for simple fractures of the superior extremities; their flexibility admitting them to be adapted exactly to the form of the member. In case of not having them, their want may be supplied by thin laths of flexible wood, susceptible of being moulded into the shape of a trough. In general, splints for the superior extremities ought to equal the fractured bone in length. In fractures of the arm, the splint which is placed on the fore part, ought to be a little shortened, and not to descend to the bend of the arm, in order that its demi-flexion may not be prevented.

The splints designed for the inferior extremities ought to be strong, thick, and flexible, and longer than the member. For a fracture of the thigh, the external splint ought to extend from the superior part of the os ilium, to a little lower than

than the sole of the foot; the internal should equally descend from the upper and internal part of the thigh to a little below the foot, and the anterior from the groin to the superior part of the leg. In fractures of the leg, the internal and external splints ought to ascend above the knee, and descend below the foot.

In order to understand how the splints act, it is necessary to recollect what has already been said of the derangement of fragments; it is clear they prevent that in the direction of the diameter of the bone, by being in opposition one to the other, on every side of the bone, and by resisting therefore any force which might tend to move either fragment internally or externally, forward or backward. In fractures of the inferior extremity, no posterior splint is necessary, because its place is supplied by the plane on which the member rests.

Splints prevent also the angular derangement of the fragments, by supporting each of them in the whole length of the member. They prevent also the derangement in the circumference; but in order to do so, they must act on that part of the limb which is articulated with the lower fragment. For in a fracture of the femur, for instance, if

the splints do not descend below the thigh, there is nothing to prevent the weight of the foot or leg, or that of the bed-clothes, from turning them either inward or outward, and with them the lower fragment.

The derangement in these three last-mentioned directions is more easily prevented by splints, than that in the direction of the axis, or by *chevauchement*. If the fracture be transverse, the splints prevent even this latter kind of derangement, because they obviate that in the direction of the diameter of the bone, which must necessarily precede it. But, if the fracture be oblique, that is, with sloped surfaces, the fragments do not then oppose a sufficient mutual resistance, but slide on one another with a facility proportional to the obliquity of the fracture.

In such a case, the splints can oppose the derangement only by the degree of compression which they make on the whole length of each fractured portion; but if the fracture be very oblique, the surfaces smooth, and the part surrounded by strong muscles, this derangement will probably take place. Thus it is found by experience to be almost impossible to maintain properly adjusted, an oblique fracture of the body of the femur, by

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the aid of splints alone. It is equally difficult to remedy by their means oblique fractures of the clavicle; because they cannot be applied on every side of that bone.

The impossibility of obtaining, in certain cases, a cure exempt from all deformity, by ordinary means, has made surgeons recur to another apparatus, which, by drawing continually the two pieces in opposite directions, prevents them from repassing one on the other, and keeps the fractured surfaces in just contact all the time necessary for their consolidation: this method has been termed perpetual extension.

This apparatus should not be applied before the irritation and spasm of the muscles are completely removed. It prevents the muscular fibres from being too forcibly stretched or elongated beyond their natural extensibility; it supplies the place of the bone, which, before the fracture, regulated the contraction of the muscles. Its application may be submitted to some general rules, which I shall copy here from a work on that subject *.

* Anatomico-surgical Dissertation on Fractures of the Neck of the Femur, by A. Richerand, octavo, Paris, year 7.

RULE

RULE I.

To apply the extending Force on the Parts of the Members inferior and superior to the fractured Bone.

The extending and counter-extending forces ought not to be applied immediately on the fractured bone, but on that which articulates with the inferior fragment, for the extension; and for counter-extension, on that which articulates with the superior. Continued extension not differing from simple extension and counter-extension, except in its being continued, the same reasoning applies to both cases.

RULE II.

To act on as great a Superficies as possible.

In order to fulfil this condition, the bandages and other pieces of the apparatus, ought to be as broad as possible. The effect which external causes have on our bodies, is small in proportion to the extent of the surfaces on which they act; because the action is then supported by a greater number of parts. A thin and narrow bandage of linen folds on itself quickly, and becomes a hard cord, which causes a distention

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of the vessels of the inferior part of the member, by obstructing the return of the lymph and venous blood.

RULE III.

To give to the extending Power a Direction parallel to the Axis of the Bone.

The science of mechanics teaches us that the action of a force on a lever is decomposed, if its direction be oblique to the lever, one part of it acting in that direction, and the other in that of the lever; that is, in geometrical terms, the force acting on the lever will be to the whole force as the angle, formed by its direction with the lever, is to a right angle. It is easy to perceive that the part of this force which is not employed to effect the desired purpose, must counteract the proposed end, by causing pain, and uselessly compressing the parts.

RULE IV.

The Extension ought to be as gradual as possible, operating slowly, and by degrees.

Animal parts which yield to long-continued and insensible action of exterior causes, resist any violent and sudden effort, and revolt against it, as it were, with all their force: thus the slower

slower and the less rapid the extension, the more easily do the parts of our body yield.

Continued extension does not exclude the ordinary apparatus, but is additional to it.

As every part of the surface of our limbs does not lie in the same plane, that is, as our limbs are prominent in some parts, and depressed in others, and therefore liable to be hurt and bruised by hard, straight, and inflexible splints, even to the degree of producing gangrene, some means of remedying these disadvantages, and preventing these bad effects, were naturally recurred to. For this purpose, the different depressions of the limb are filled with lint, rags of old linen, compresses, or, what is still better, with little bags of the chaff of oats; the facility, which these latter offer, of moving the chaff from one part to another, as well as their soft and equable pressure, give them an evident advantage: by these means the pressure becomes equal on every part of the length of the member. Finally, it is not superfluous to remark, that tape ought to be preferred to strips of linen, which knot with difficulty, particularly when wet, for the purpose of binding externally the whole apparatus. The num-

ber of these tape strings must be proportioned to the length of the member; as must the length of the bags of chaff to that of the splints, the action of which they are intended to moderate.

We shall in the next place examine what is required by the third indication of fracture; that is, to prevent the complications which may succeed to it, and to remedy them when they have really taken place.

In every fracture, with the exception of those of the superior extremities, which are simple, the patient ought to be confined to a low regimen for the first four or five days: more or less blood should be drawn, if it be not contra-indicated by extreme old age, or great debility. No greasy irritating plasters, of which quacks make so much use, such, for instance, as the plaster of Cyroane, are to be employed; but in their stead, it will be sufficient merely to cover the limb with several folds of compresses soaked in camphorated spirit, or a solution of the acetate of lead, or any other repellent liquid, with which also the other parts of the bandage should be moistened. A solution of common salt is to be avoided, because that salt would quickly crystallize, hardening thereby the different pieces of

the bandage, and giving them a stiffness unpleasant to the patient. The bowels should be kept open by gentle laxatives; such as veal broth, whey acidulated with tamarinds, &c. When the lapse of a few days renders this regimen no longer necessary, the patient should be allowed a moderate quantity of very nutritive and easily digestible food; for it would be not only useless, but dangerous, to prolong the low regimen, in the case of a simple fracture, which does not sensibly disturb the functions, and which requires for its consolidation, a degree of vital energy in the solids, which a too sparing diet would enfeeble.

We shall not here amuse our readers with the different means recommended to increase the viscidity of the blood, in order thereby to accelerate the consolidation of the fracture; but proceed to consider the treatment adapted to compound fractures: this treatment must vary according to the nature of the complication.

Under this head, we have to consider, in the first place, the very difficult, but also very rare case of fracture accompanied by luxation. When this takes place, the luxation must have preceded the fracture; for a bone once fractured, is no longer capable of luxation. The principal question

question is, to which of the accidents shall we in the first place direct our attention? Some are of opinion, that the dislocated fragment should be first replaced in its natural articulation: others, on the contrary, recommend to await the consolidation of the fracture, before any attempt be made to remedy the luxation: but we adopt, most decidedly, the first opinion; for during the treatment of the fracture, the soft parts acquire a stiffness, and become so habituated, if the expression may be allowed, to their new situation, that the dislocation cannot, without great difficulty, be remedied; but if, in order to effect it, violent efforts and straining are unavoidable, it will in that case be better to set the fracture first; and as soon as the consolidation is a little advanced, habituate the member to certain gentle motions, in order to preserve the suppleness of the ligaments, which will facilitate the cure of the dislocation, when the complete consolidation of the fracture allows it to be attempted.

When the soft parts of a fractured limb are violently contused, but without external wound, the apparatus should not be too much braced; and Scultet's bandage should in such cases be always used, even though the fracture be in the

superior extremity. A large portion of blood should be immediately drawn, and the blood-letting repeated, except the patient has the stomach full, as is generally the case in hospitals; for the common people are usually brought there in a state of intoxication. The bandages must be taken off on the following day: this rule is without exception; the neglect of it has caused a mortification of the limb, which takes place by the bandages becoming too tight, in consequence of the swelling which ensues, and by the consequent stoppage of the circulation. On this first removal of the bandages, the member is generally found hard, tumefied, tense, and the patient complains of great pain. In which case the fractured part is to be covered with emollient poultices, over which the proper bandage may be applied, and the splints moderately braced. In cases of extreme contusion, without a wound of the integuments, the tension and inflammatory swelling may become so intense, as to cause the cuticle to rise in little blister-like vesicles filled with a limpid serum, very different from that blackish serum which fills the vesicles attendant on mortification. These vesicles should be opened without detaching the cuticle, and the small openings covered with linen on which some cerate has been spread. By these simple means the surgeon

geon has the satisfaction of seeing the inflammation, and all its menacing consequences, subside in a few days, leaving merely a slight degree of ecchymosis, which disappears in a short time. The poultices are then discontinued, the patient is allowed a nourishing diet, the splints are braced to the ordinary degree, and the treatment is afterwards the same as that of a simple fracture.

If a vessel of a certain magnitude is opened by a fracture, and the cellular texture of the limb becomes distended by the effused blood, which may be perceived by the tumefaction, and black or livid colour of the member, the surgeon ought, without hesitation, to make an incision in the part over the artery, and apply on it two ligatures, one above the other, below the wounded part. J. L. Petit relates a case of a false primitive aneurism, produced by the laceration of the anterior tibial artery in a fracture of the leg. It is possible too, that the laceration of a vein may occasion an effusion of blood, easy to be mistaken for a false primitive aneurism. Such, probably, was the case of the female of Gros Caillou, who fractured her leg with a wound by falling from her cart. In three or four days after entering the hospital *De la Charité*, the leg swelled enormously,

mously, the skin became of a violet colour, and of a marbled appearance; and there issued from the wound but a small quantity of blood. The lesion of the anterior tibial artery was suspected; the taking of it up was not, however, attempted: the patient was bled, emollient poultices were applied, and by these simple means the tension quickly diminished, and the effusion and distention vanished; a considerable degree of ecchymosis, however, remained, which gradually disappeared.

The wounds which render a fracture compound may be owing to the cause of the fracture, or may be occasioned by the penetration of the point of one of the fragments through the integuments. In the latter case, the wound should be enlarged by a bold incision, and the projecting fragment pushed into its proper situation. But if the projecting part be of a considerable length; if the muscles contract spasmodically, and much exertion and straining be necessary to reduce it, it would be better, in such a case, to cut off a portion of the projecting bone, which would facilitate its reduction, and prevent an excessive laceration of the parts. A young man having the thigh fractured, with a projection of two inches of the superior fragment

stripped

stripped of its periosteum, was well for two days after the forced reduction of this portion, without having any part of it cut off; but on the third day the limb became violently inflamed, the tension and tumefaction extreme, mortification quickly followed, gained rapidly on the trunk, and put an end to the patient's existence. When the fracture has been reduced, as has been directed, without too violent exertions, the wound is generally treated as a simple division of the integuments. Copious and repeated blood-letting obviates the inflammatory symptoms so much to be apprehended.

When the wound is produced by the same cause as the fracture, such, for instance, as the wheel of a very heavy carriage, which causes much contusion, the nature and method of the treatment must vary according to the circumstances of the case. If the lesion be excessive, the soft parts torn, enormously contused, and almost totally disorganized, the able and experienced practitioner sees at the first glance if the member be inevitably lost, or if mortification be certain: in which case he resolves instantly on amputating, and prevents by this conduct, the mischief which might ensue from the gangrene, the extent of which might prove fatal. It is

true, that in many cases in which the loss of the member was deemed inevitable, patients have preserved it by their own obstinacy. We ought not, however, on that account, to follow the example of Van Swieten, who, drawing a general rule from a single fact, establishes it as a maxim, that amputation should never be immediately performed after a fracture. In support of this doctrine, he cites a case of comminutive fracture, in which, amputation was decided on, but the patient was deterred, or would not submit to it. La Motte treated the patient as in less extraordinary cases; he extracted several splinters, opened some abscesses, and succeeded finally in effecting a recovery, without the loss of the limb; but not, however, without having experienced a great number of disagreeable occurrences, of which this surgeon has given the particulars. It is impossible to establish any general rule for cases of this kind. The surgeon must be directed by his own talents and sagacity in each particular case.

In most cases, if the injury be not very great, the fracture may be set, and the splinters, which are entirely separated from the bone and from the soft parts, may be extracted; the wound is then gently dressed, the bandage of Scultet

is applied, and the splints are but very slightly braced. The patient is restricted to the severest regimen, and copiously bled: a degree of inflammation equal to the extent of the evil is to be expected. If, on the third or fourth day, the tension become extreme, the part cold and livid, with vesicles arising on it, gangrene is certain. It is then necessary to wait until the progress of the gangrene is arrested, which, however, may be anticipated by the antiphlogistic regimen, and by making incisions to favour the separation. As soon as the mortification is stopped, and a red inflamed circle marks the boundary between the sound parts and those mortified, it is necessary to amputate; for if the putrid sanies be absorbed into the system, it will produce slow fever and death.

If the inflammatory swelling terminate by suppuration, as most generally happens, it is apt to be very abundant. When suppuration has commenced, the emollient poultices are discontinued. The dressings are repeated as often as may be necessary, to prevent the pus from retarding the consolidation by stagnating on the surfaces of the broken portions. The strength of the patient should be supported by the most nourishing

nourishing diet, and by tonic medicines, such as the extract of bark, &c.

By this treatment it generally happens that in about a month the suppuration diminishes, the lips of the wound begin to close, and the consolidation of the fracture advances; but a greater or less deformity is inevitable, from the impossibility of bracing sufficiently the apparatus. In some cases, the suppuration continues, and the fragments, always immersed in pus, cannot reunite; the pus is absorbed, and the patient dies of marasmus, to which diarrhœa and colliquative sweats reduce him. In order to prevent this fatal termination, it is necessary to amputate as soon as it is perceived that the suppuration cannot be stopped. Delay in this case would be very dangerous.

It appears, therefore, from the principles which we have established, that comminutive fracture, always attended with much disorder of the parts, offers three distinct cases in which amputation is necessary:

First, When the disorder and disorganization is such as to render gangrene inevitable.

Secondly,

Secondly, When gangrene takes place in opposition to the well-directed use of antiphlogistic remedies.

Thirdly, When the too abundant suppuration prevents the consolidation of the fracture, and induces debility and hectic fever.

SECTION VI.

Of the Formation of Callus.

All that art can do in any fracture, is to maintain the fragments in contact; their reunion and identification is the work of nature alone: the different opinions on the mode in which this is effected, are as follow:

The ancients attributed it to the effusion of what they called the osseous juice, a fluid capable of growing hard, and contracting strong adhesions with each of the fragments, by which means it was supposed to join them together, as two pieces of wood are united by glue. The moderns, who have adopted this opinion of the ancients, have said that this ossifiable humour was furnished by the vessels of the bone and surrounding parts, these vessels being developed

by the inflammatory state*. An English surgeon† has compared this secretion to that of pus in the inflammation of soft parts. But in allowing the existence of this osseous juice or humour, which, by the by, is mere supposition (for the ancients did not understand by it either the gluten extracted from bones by means of ebullition in Papin's digester, nor the phosphate of lime, which fills the cells formed by this gelatinous matter); yet would it remain to be proved how the thickening or concretion of this fluid could constitute solid organized matter. By being effused between the fragments, this inorganized fluid should naturally intercept or dam up the medullary canal; but that does not take place, as any one may be convinced, by splitting a bone which had been fractured and re-consolidated. Finally, this osseous humour should naturally, by its effusion, create tumours of greater or less magnitude in the neighbourhood of the fracture.

And, in fact, the deformity which attends a great number of fractures treated without me-

* See the Memoirs of Haller and Bordenave, collected by Faugeroux.

† Essays on Fractures and Luxations, by John Aitkin.—London, 1790.

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thod, has been attributed to the defective or superabundant effusion of this matter. Thus, say the advocates of this opinion, the fracture of the clavicle is always attended with more or less deformity, because the particular position of that bone does not admit the application of a bandage, which, as in other cases, might prevent a redundant effusion of the osseous juice. The opinion of Duverney was different: he thought that the irregular formation of the callus was owing not to any want or defect of bandage, but to the bone's being stripped of its periosteum, and wanting, therefore, the means of giving to the callus its just conformation. But at present it is known beyond all doubt, that this irregularity of form is to be ascribed to the ill setting of the fracture.

When the phenomena of the production of callus were observed with more care, a more natural explanation of this operation was attempted.

Duhamel attributed it to the periosteum, which he considered also as the organ of ossification. When a bone is fractured (says that great naturalist), the periosteum of the two fragments unites

unites first; afterwards this membrane swells, and forms a kind of hoop around the fracture. The periosteum thus tumefied, imbibes the humours, softens, and becomes a kind of gelly, which passes quickly to the state of cartilage. Vessels are formed in this cartilaginous substance; and nuclei of bone originate in several points, and gradually unite; and when the part of the periosteum adjoining the fracture is thus united, it has the appearance of a ring, which comprehends each of the fragments, and keeps them united. It was immediately objected to Duhamel, that in splitting a bone lengthwise, both fragments were found united, and not in simple contact, like two pieces of wood held together by a ring, agreeably to his theory. In order to answer this objection, he supposes that the periosteum extends itself from the circumference to the centre of the bone, and that this elongated part of it underwent a process similar to that of the parts contiguous to the fracture, and thus identified the two pieces.

The intimate adhesion of the periosteum to the bone, and its inextensibility, caused some doubts on this elongation; besides, did it really take place, the medullary canal would in consequence be obstructed. This theory has, for

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these reasons, been almost universally abandoned, and has at present but few partizans.

When there happens a solution of continuity of the soft parts of our bodies, if the lips of the wound be not brought into immediate contact, the veseels become turgid, the vascular tissue extends forwards, and gives rise to those small red conical tumours known by the name of granulations. This augmentation in the calibre of the vessels, and a certain degree of inflammation in the granulations which arise from them, are means which nature employs to effect the reunion of divided parts. But it is not known, whether or not, in this case, the fibres of one side become continuations of those of the other; if the vessels identify in like manner by anastomosing; or if an humour of a certain nature be effused between the divided parts, which it agglutinates together. The only thing certainly known on this subject is, that the *cicatrix* is organized, as has been proved by incontestable experiments.

There is a strict analogy between what takes places in the solution of continuity of soft and osseous parts. The irritation caused by the fracture produces the extension and turgescence of the

the vessels of the periosteum, of those of the bone itself, and of those of the medullary membrane; and then the only condition necessary to consolidation is that the fractured surfaces be placed in just contact. But this operation of nature, by which an organized substance is produced, is slower in bones than in soft parts, which are furnished with numerous vessels, and in which the vital properties are not impeded, as in the bones, by the deposition of a saline inorganized matter. In examining a bone having a consolidated fracture, the place of the consolidation is marked merely by a line; and if the bone be split, the medullary canal is found narrowed at that part, and in some cases totally obstructed.

The production of granulations on the membrane which lines the bone, accounts for this narrowing or obstruction of the medullary canal, one or other of which takes place, according to the greater or less activity of the vessels of that part. This theory, suggested by the striking analogy between the fleshy and osseous parts, supported by observation of the phenomena of the generation of callus in animals, has this further advantage over all the others, that it stands uncontroverted by any fact:

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on the contrary, it is confirmed by all the facts hitherto observed. Thus it offers a very natural and easy explanation of the difference of time required for the formation of callus in youth and old age, by the different proportions of the phosphate of lime which the bones contain at these periods.

The generation of callus is then an operation perfectly analogous to the cicatrization of wounded soft parts: its being more tardy is owing to the difference in the activity of the vital principle in these, and in bony parts. During a few days immediately subsequent to a fracture, the inflammation exists only in the neighbouring soft parts, and the bone seems perfectly inert; but its texture is soon after perceived to soften in that part, and the fractured surfaces become covered with granulations produced by the enlargement of the blood-vessels. This growth takes place without any secretion of pus, and the consolidation is effected by a process as little understood as that of cicatrization. Instead of pus, the enlarged vessels secrete and deposit a calcareous phosphate, which gives a solidity equal to that of the rest of the bone.

But leaving to physiologists the task of explaining the formation of callus, let us consider what more particularly interests us, that is, the means of accelerating, retarding, or totally preventing it. These means or causes are either general or local: we shall proceed to consider both the one and the other in detail.

The callus is formed, *cæteris paribus*, with more promptitude and facility in infancy and youth than in the adult or in old age. The younger the individual, the greater the proportion of the gelatinous to the calcareous part of the bones, and the more rapid on that account is the organization.

When the individual is extremely old, the vital principle becomes extinct, as it were, by the accumulation of calcareous phosphate, the enlargement of the vessels cannot take place, and consequently the consolidation, particularly if to old age be joined a vitiated state of the fluids, such as the scurvy, cancer, &c. cannot be effected: these diseases alone suffice in many cases to produce the same effect. A strong robust man of the sanguine temperament, recovers much more rapidly from a fracture than a weak

a weak person, or one affected with a cachexy. The difference of sex causes no difference in the generation of callus. At the period, however, of the cessation of the menses in our climate, that is, from the forty-fifth to the fiftieth year, its generation is slower, and the cure of fractures of women of that age is subject to the same irregularities as their other diseases.

The state of pregnancy does not perceptibly retard the generation of callus, though *Fabrice de Hilden* wishes to form a conclusion to the contrary from the observation of a few facts.

However favourable the general disposition may be to the quick consolidation of a fracture, different local circumstances may retard it. If one of the fractured portions does not receive a sufficient quantity of blood to nourish it, and to maintain in it the necessary vital force, the vessels will not be enlarged, nor, of consequence, the fracture consolidated. An instance of this is seen in fractures of the neck of the femur, in which the head of that bone is completely separated from its body, and the ligament which performed the functions of periosteum, and which envelopped the neck, is torn; so that the only vessels that enter the part of the bone thus detached,

are those that pass to it by the round ligament; which cannot in old age, when these vessels are nearly obliterated, furnish a sufficient quantity of blood for the generation of callus. It is necessary, then, that both fractured portions be endued with a certain vital energy, without which it would be as useless to attempt their union, as that of a gun-shot wound before the parts disorganized by the violent contusion, be separated from the sound parts by suppuration.

Another local condition favourable to the formation of callus is, that the surfaces of the fractured portions be brought precisely into contact. Let us suppose, for example, a transverse fracture of the femur, and that the fragments, after sliding one upon the other, have fallen into the derangement in the length of the bone, the fractured portions cannot, in this case, touch one another without the periosteum intervening. Inflammation will be extremely slow; and even at the end of two months the progress in the formation of callus will be scarcely perceptible. To effect, in this case, a complete cure, even with a shortening of the member, will be extremely difficult. It is therefore absolutely necessary to maintain the fractured portions in the position in which they have been set, as already prescribed.

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The perfect immobility of the fractured portions is not less essential to their union, than their proper contact and vitality. If the fragments were moved every day, no progress towards a union could be made; or were there fleshy ganulations already formed, they would be quickly obliterated by the friction, and the surfaces would become smooth and polished. The periosteum and cellular texture, distended and thickened, would form a kind of orbicular ligament round the ends of the fractured portions, and an unnatural articulation would be formed, which would render the member absolutely useless.

When the usual period of consolidation is past, the apparatus ought to be taken off, and the limb examined, to see if the fractured portions have continued in the situation in which they were placed, and if the whole limb constitute but one piece. The time necessary for reunion depends on several circumstances, of which the principal are, the age of the patient, and the kind of bone fractured. In general, fractures of the bones of the superior extremities are consolidated in a shorter time than those of the inferior. Thus we frequently see a fracture of the clavicle in adults consolidated in thirty days, and that of the radius and cubitus

in nearly the same interval; that of the humerus in from about thirty-five to forty days; whereas those of the leg and thigh require generally from forty to fifty days. A vulgar prejudice exists on this subject among the lower order of persons, who are those usually brought into hospitals: they think that every fracture ought to be consolidated in forty days exactly. But it is impossible to predict what time may be necessary for this purpose. In an infant, consolidation will take place six or eight days sooner than in an adult; and in an old man eight or ten days later.

If, on raising the apparatus, the limb be swelled, or a tumour be observed in the situation of the fracture, in consequence of the ends of the fractured portions having passed one another; and if, at the same time, the member, more or less shortened, be moveable in that part, it will be evident that the fracture is not consolidated, and that the apparatus has not had its due effect, whether from being badly applied, or not sufficiently examined from time to time.

If, instead of this swelling, the pieces be found moveable one on the other, and separated by a small interval, and the member has not diminished in length, the want of consolidation

solidation proceeds, in this case, either from the patient's advanced age, a vicious state of the fluids and solids, or from some imprudent motions of the limb during the treatment. In this latter case, if the fracture has already been of some months standing, the contiguous extremities of the fragments are worn into a rounded form by the friction, and surrounded by a species of ligament formed of condensed cellular membrane, so that an unnatural articulation is formed at this place.

Finally, it is possible, that, on taking off the apparatus, the fracture may be found not to have consolidated, but with a shortening and deformity of the limb. In this case it will be requisite to adopt the following proceedings.

If the ends of the fractured portions pass one another, or if the fractured surfaces are partially in contact, or totally separated, it will be necessary to reset the fracture, and to employ continued extension, if the ordinary means be insufficient for maintaining the fragments in their just relative situation. The duration of this second treatment is at least as long as that of the first; for if the natural period of consolidation be once past, the fractured surfaces are no longer equally disposed to unite.

If the fractured portions continue very moveable one on the other, notwithstanding the just position has been preserved, and if the cause of this be the advanced age of the patient, the same apparatus should be reapplied, and the vigour of the patient increased by the well-directed use of wine and nourishing diet. By persevering in these means a cure is at length effected in the space of five or six months. But if some constitutional disease, such as cancer, scurvy, &c. be suspected of being the cause of non-consolidation, these diseases must be combatted by appropriate remedies, the mechanical means persevered in, and every kind of motion of the limb abstained from.

But whether the fractured portions have passed one another, or whether an articulation has been formed between the fractured surfaces, if the fracture has been already of several months duration, the action of the fractured surfaces ought to be revived by rubbing them forcibly one against the other, in order to excite the degree of inflammation necessary for the generation of callus. The fractured ends of the bones having by these means acquired a disposition favourable to their agglutination, the apparatus should be reapplied, the extension

continued,

continued, if necessary, and the treatment prolonged until the cure be complete.

If, notwithstanding these means, the pieces do not unite, there remains another and last resource, the cutting off of their extremities. This operation is painful, terrifying, and of dubious event; its success has, however, been frequent enough to warrant the trial. It would be impracticable in fractures of the leg and fore-arm, on account of the difficulty of separating from the integuments the two bones of which each of these parts is formed, and on account of the numerous nerves and arteries which would be in danger of being wounded by the large incisions necessary for this operation. It is therefore praticable only in the femur and humerus, especially the latter.

This operation is performed by making a longitudinal incision over the fracture, on that side of the limb where the bone is most prominent and least covered: the nerves and vessels are to be avoided with the utmost care; each end of the fractured portions is nicely laid bare, and made to project beyond the soft parts, which may be protected by compresses, or by a thin plate of lead or pasteboard, from the action of the

saw

saw with which a sufficient quantity of each fragment is to be taken off. This part of the operation being performed, the extremities of the fractured portions are restored to the position which they ought to have, and the wound dressed with soft lint; in short, the subsequent treatment is the same as that already prescribed in the case of compound fracture; that is, Scultet's bandage is to be applied moderately tight, as well as the splints and other parts of the apparatus; for beyond all doubt a violent inflammation and copious suppuration will succeed. An abundant formation of purulent matter is disadvantageous, on account of the pus stagnating in the bottom of the wound, lubricating the fractured surfaces, and preventing their agglutination.

Citizen Boyer has performed this operation but once; and although he was not successful, I think it my duty to mention the case.

A man, aged thirty-six, had his right arm fractured, and nothing was done to adjust the fractured bone. The solution of continuity took place above the middle part of the humerus: this arm had been for so long a time useless to the patient, that he was determined to undergo any trial

trial for effecting a cure, but would not listen to any proposal of amputation. This operation was then resolved on: an incision was made over the fracture on the external side of the arm, a little above the place where the radial nerve winds on the humerus, for the purpose of saving this nerve, and thus preserving from paralysis the posterior muscles of the fore-arm: this incision being made, he exposed the end of the inferior fragment, and caused it to project by raising the elbow and pushing it inward.

The soft parts were protected by means of a plate of wood, and the conical or rounded part of the ends of the bone was then sawed off. The part of the operation for the superior portions was more difficult; for the conical part was longer and the point sharper: one of the collateral arteries was opened, on which a ligature was applied. The end being sawed off, as in the former case, and with the same precautions, and both fractured portions being restored to their natural direction, it was found that they were separated one from the other by an interval of two inches and an half. In order to bring them into contact, the elbow was raised by means of two casts of a bandage, drawn from

from the fore-arm bent to the shoulder of the opposite side. For the two first days immediately after the operation, no bad symptom took place. The inflammatory swelling and tension, as well as the fever, were such as might be expected from the extent of the wound. But on the third day the fever became more violent; a redness, and quickly after an erysipelas, appeared on the arm of the opposite side; the inflammation extended to the shoulder, and afterwards to the fractured arm. The tension was extreme: instead of pus there flowed from the wound a bloody sanies; gangrene came on, and the patient died on the sixth day.

The cure obtained by this operation is necessarily attended with a shortening of the member; but this inconvenience is but slight with respect to the arm: in the thigh it is evident that more or less lameness is necessarily the consequence of it.

It cannot be denied but that this operation is one of the most difficult in surgery; but it ought not to be renounced for that reason, when any hope may be had of recovering by it the use of a disabled member, and when the patient wishes at all risks to make the experiment.

ment. But should the patient prefer amputation to this cruel and uncertain chance, that operation ought to be recurred to, when all the other resources of our art have been tried in vain.

The progress of the callus to perfect consolidation is, analogously to that of the osseous system in general, slow and gradual. The patient is not, therefore, to be allowed the free use of a fractured limb immediately after the reunion of the fracture. In fractures of the inferior extremities, crutches ought to be used for some time, and the limb which had been fractured charged with its share of the weight of the body, but by little and little. From not paying sufficient attention to this circumstance, the callus has been sometimes so much pressed, as that the limb was shortened, and consequently lameness induced. Besides, the slightest false step might cause a relapse of the fracture; for, notwithstanding what certain authors have said to the contrary, the consolidated part of a fractured bone is never stronger than the other parts, nor even equally strong, until after a considerable lapse of time.

To procure the reunion of the fragments without any shortening of the limb, is not the sole object

object to be attended to in the treatment of a fracture. During the time that the member is necessarily motionless, the muscles lose the habit of motion, and grow rigid, and a false anchylosis frequently follows. This consequence is particularly to be apprehended in fractures which take place near the articulations (as has been already mentioned), in those, for instance, of the patella, of the inferior extremity of the femur, of the olecranon, or of the condyles of the humerus. It most frequently takes place in the articulations of the knee, elbow, and instep. It may be prevented by gently moving the limb from time to time, as soon as the consolidation is so far advanced as that its progress cannot be retarded by these motions. Finally, a false anchylosis may be removed by general bathing, by the use of the shower-bath, by resolvent plasters, and by continued and gentle efforts, as shall be more fully detailed in treating of that affection.

As fractures of the skull are more important by the necessarily attendant affection of the brain than by the simple consideration of the fracture, we think it most methodical to refer them to wounds of the head. The same may be said of the greater part of the fractures

of

of the bones of the upper jaw, the parts of which being strongly united together, and to the bones of the skull, render them susceptible only of comminutive fracture, when the fractured part is that on which the cause has immediately acted.

Let us suppose that the wheel of a carriage rolls over a person's head (of which the examples are but too frequent), and that the zygomatic arch is thereby fractured; in such a case, the surgeon's duty would be merely to bleed the patient, and use other means to combat the inflammatory symptoms. It would not be prudent to make an incision into the depression of the temple, in order to raise the zygomatic arch, at the risk of opening the temporal superficial artery, and of causing much pain by the laceration of the nerves, except in the case that the fractured bone crushed into the crotaphyte muscle, should excite great pain and other bad consequences.

If in a fracture of the superior maxillary bones, there should be detached from the body of one of these bones, a part of the alveolar process with one or more teeth, as in the third case of Ledran's Surgical Observations, it would

be

be necessary to follow the example of this surgeon; viz. to fasten silk threads to the teeth of the broken portion, which adheres still by the gum, and by the internal membrane of the mouth; and then to attach these threads to the teeth of the adjacent sound part, the fragment being first placed in its natural situation. Dentists frequently employ this mean for the purpose of fastening artificial teeth; and its use has been advised in cases of fracture of the lower jaw. We shall give the details of the fractures of this last-mentioned bone, after having first treated of those of the bones of the nose; these being in this respect the only bones of the face which merit particular consideration.

CHAPTER II.

OF THE FRACTURES OF THE BONES OF THE NOSE.

These symmetrical bones, with the ascending processes of the maxillary bones by which they are supported, form a kind of arch. As they project in the middle of the face, and are but slightly covered by soft parts, they are much exposed to different kinds of fracture from different causes.

In all these cases the cause of the fracture is always applied to that part immediately where the solution of continuity takes place, and the fracture may be oblique, longitudinal, or transverse, without derangement of the fragments; but it more frequently happens that the bones are splintered and crushed into the cavity of the nostril; that the nose loses its natural form, and that the neighbouring soft parts are much bruised by being crushed between the bones and the cause of the fracture, whether a body against

which the nose has been forcibly struck, or one which may have been strongly impelled against it.

If the soft parts have suffered no solution of continuity, and if the fragments have not been displaced, the fracture may not be discovered, because the form of the nose does not change. An oversight in this case is not dangerous, as the use of emollients and resolvents is all that is required. If the fracture be comminutive, not only the inflammatory symptoms ought to be combatted by blood-letting and other antiphlogistic means, but further, the fragments ought to be replaced, as they strain and irritate the soft parts, already contused, by their unnatural situation. For that purpose the operator takes a grooved sound, a female catheter, a ring-handled forceps, or any such instrument, introduces it into the nostrils, and by using it as a lever, pushes the fragments outward; at the same time with the index of the left hand applied to the ridge of the nose, he prevents them from being pushed out too far, and from lacerating the integuments. Sometimes the bones continue in the situation in which they have been thus placed; but it may happen, that, from being much fractured, and badly supported by the soft parts, they fall again inwards; in which case a

canula of elastic gum should be directed along the inferior surface of each nostril, which ought then to be stuffed with lint, and gently thrust in, lest the pituitary membrane should be hurt.

In cases of comminutive fracture, with depression of the splinters, it would be imprudent to wait the disappearance of the inflammatory symptoms, before making an attempt to raise and adjust the fragments; because, during the interval, the portions of bone might reunite in an unnatural situation, and produce deformity of the nose.

Fracture of the nasal bones is sometimes attended with very dangerous symptoms, whether produced by a violent commotion given to the head by the cause of the fracture, or by a coexisting fracture of the bones of the skull; or, as some authors think, by the concussion communicated to the perpendicular part of the ethmoidal bone, and thence to its cribriform part, which would, in that case, be fractured, on account of its great tenuity. The laceration of the dura mater and its vessels, caused by the fracture of the cribriform lamella of the ethmoidal bone, would produce effusion, and thus give rise to all the symptoms. It is certain that cases have occurred where blows on the root of

the nose have produced coma, convulsions, and death; particularly when the nasal bones were not fractured. How such an injury may take place may be easily conceived by the consideration of the effect of *contre-coup*, commotion, and other consequences which may ensue, if a great part of the percussive force be not consumed in producing the fracture.

This etiology is, however, applicable but to persons advanced in age, because in youth the perpendicular part of the ethmoidal bone articulates with only a very small part of the nasal bones; the rest of these bones being then supported by the cartilage which separates the nostrils, and with which that part of the ethmoidal bone is connected. At this last-mentioned period, the nasal processes of the os frontis are their principal support, and ought therefore to receive the principal part of the concussion.

CHAPTER III.

OF THE FRACTURES OF THE LOWER JAW.

The great mobility of this bone is the reason of its being seldom fractured. A violent blow may however fracture it, and wound at the same time, more or less, the neighbouring soft parts. It may also be fractured by the passage of the wheel of a carriage across it. An impelled force which fractures this bone tends first to increase the elliptic curve which is its natural form, and that in proportion as it acts nearer to, or farther from the angle of that bone; so that if a succession can be admitted in the rupture of the fibres, the rupture ought to commence in those which are external. When, on the contrary, the solution of continuity is the effect of a force immediately and directly applied on the part that breaks, there is no tendency to increase the natural curve, but that part is pushed inward, and the solution of continuity commences on the inside.

These fractures vary, first, as to the part of the bone fractured. That sometimes takes place near the chin, but seldom so as to produce the division of the symphysis of that part, though it be not impossible. At other times the fracture takes place more or less near the angle of the bone. Two fractures may occur in it at the same time, by which it would be divided into three pieces, of which, that corresponding to the chin is extremely difficult to manage; because many of the muscles which draw the lower jaw downwards, are attached to that part.

The lower jaw is subject to be fractured, not only near the symphysis, but also near the processes which terminate its branches; that is, near the condyles and the coronoid processes. Of these two parts, the condyle is that which is the more frequently fractured, it being covered merely by the parotid gland; the coronoid process being, on the contrary, protected by the temporal muscle, by the masseter, and by the zygomatic process.

The fractures of the lower jaw may vary infinitely in their directions; be perpendicular to its basis, oblique, or longitudinal: of this latter, examples have been seen, in which a portion

portion of the alveolar part, with the teeth implanted in it, was detached from the rest of the bone.

These fractures are seldom simple, particularly if the fracturing cause has been directly applied. The soft parts are always more or less contused or wounded. J. L. Petit mentions an instance of the complete denudation of the coronoid process, in a case of fracture by a kick from a horse.

In order to form a clear idea of the different ways in which the fractured portions of the lower jaw may be deranged, it is necessary to take a brief view of the muscles by which that bone is moved. The temporal muscle having its convergent fibres collected into one parcel, descends from the temporal to the zygomatic fossa, and embraces with its inferior angle the coronoid process of the lower jaw, of which it is the principal elevator. The masseter descends from the zygomatic arch to the external side of the branch of the lower jaw. The pterygoideus internus descends obliquely backward to the internal side of the same angle: this muscle serves not only to raise the lower jaw, but also to move it a little forward. This last motion is,

however, especially performed by the pterygoideus externus, which, passing obliquely outward and backward, embraces the neck, or narrowed part which supports the condyle.

The muscles which draw down the lower jaw, are attached to the body of that bone, and especially to the process at the chin. The greater part of these muscles come from the os hyoides. Those attached to it are the platysma myoides, the digastrici, the mylo-hyoidei, the genio-hyoidei, and the genio-glossi.

Let us see in the next place, how these different muscles contribute to produce the derangement of the fractured portions. If the fracture be near the symphysis, on which is the processus innominatus, that side to which this process belongs, is drawn downward and backward by the submaxillary muscles, and even by those which extend from the clavicle and sternum, to the os hyoides, while the other fragment is supported by the levator muscles; if the fracture be more backward toward the branches, the derangement takes place in the same manner, but with a little more difficulty. In the double fractures, the middle portion is perpetually drawn downward and backward by the

muscles

muscles which are attached to the process at the chin, whilst the two lateral are supported by the levator-muscles.

If the branch be the part fractured, any considerable degree of derangement is prevented by the masseter which is attached to each of the fractured portions. If the neck of the condyle be the part fractured, the condyle will be drawn forward by the action of the pterygoideus externus.

All these different derangements, except the last, take place in the same line as that which passes from the teeth to the basis of the bone. The fractured portions are never deranged so as that one passes on the other, or in the direction of their length; for the action of none of the muscles of the lower jaw is parallel to the axis of that bone: besides, its extremities are retained in the glenoidal cavities of the temporal bones.

When a blow is received on the lower jaw, or the bone is injured by a fall on that part, or by the pressure of some heavy body, and at the same time an acute pain is felt in the part; and when, with these circumstances, an inequality

inequality is found at the basis of that bone by moving the fingers along it; when some of the teeth, corresponding to that inequality, are found to have lost their level, one being lower than the other; and when, besides, by seizing these apparently deranged parts, one in each hand, and impelling them in opposite directions, a mobility and crepitation are perceived, there can be no doubt as to the existence of a fracture; although there be no denudation of the bone by wound, nor any laceration of the gums; circumstances, however, which would render the fracture still more evident.

The fractures of the branches and condyles are not so easily distinguished as those of the body of the bone. Yet the acute pain which the patient feels in the region of the ear, especially when he moves the jaw, the crepitation produced by these motions, or by pressure on the condyle, are sufficient evidence of its existence; if an inflammatory swelling has not taken place before the surgeon has been called in. In that case, the diagnosis cannot be established, until, by the lapse of a few days, by bleeding, poultices, and regimen, the tumour has been dissipated.

Fracture

Fracture of the lower jaw is in general not very dangerous. When simple, it would get well spontaneously; but there would be, it is true, some deformity, which it is the surgeon's duty to prevent.

Compound fractures of the lower jaw are more dangerous; and if the nerve which goes to the teeth, be torn, which rarely happens, because the greater part of these fractures take place between the symphysis and the foramen by which this nerve comes out from the conduit through which it runs in the substance of the bone, the square and triangular muscles of the chin are paralysed. The skin of that part and the internal membrane of the under lip preserve their sensibility, which it appears they owe to some threads of the portio dura of the seventh pair; but the paralysis of these muscles does not prove of itself that the jaw is fractured.

In order to set a fracture simple or double of the lower jaw, it suffices to push the deranged part upward, and a little forward, and afterwards, by pressing on the basis of the bone, to bring it exactly on a level with the portion which has preserved its natural position; which

may

may be done by bringing all the teeth of the lower jaw into close contact with those of the upper. But the facility of setting this fracture is more than counterbalanced by the difficulty of maintaining it set. Different means of accomplishing this purpose have been proposed; but those alone act efficaciously which keep both jaws together, by supporting the lower jaw, and keeping it applied to the superior or upper jaw.

All other means would be useless, if the jaw were not kept perfectly motionless. And this immobility is extremely difficult to be obtained, on account of the motions induced by mastication, deglutition, and speech; but which ought to be suspended for a time. For the two or three first days the patient should be restrained to a very small quantity of food, and nourished afterwards with broths, which may be given by introducing a small spoon between the teeth a little separated. If he should happen to want a tooth, that will be a fortunate circumstance on this occasion, because broths may be given through the opening by means of a canula, without causing the least motion to the fractured bone. If the patient be unmanageable, and insist on eating or speaking, in opposition to the

the surgeon's advice, the formation of the callus will be slow, and the cure difficult, and inevitably attended with deformity. An opening might also be preserved by introducing two pieces of cork, one on each side, between the teeth.

It has been proposed to tie the two pieces together, by means of a gold or silver wire, passed from some of the teeth on one side of the fracture, to those adjacent on the other side. But exclusively of this being very difficult, and even impossible in persons who have the teeth very close set, the wire could only prevent the longitudinal derangement. But we have already shewn, that the fractured portions have no tendency to derangement in that direction, and, consequently, that this expedient could be of use only in case of a part of the alveolar process being detached from the rest of the bone.

Some practitioners have made use of a pasteboard mould, composed of a semicircular piece, excavated for the purpose of receiving the neck. This piece is placed horizontally, with its convex edge projecting a little beyond the basis of the lower jaw. Another piece, of about an inch in breadth, is placed so as to extend from one

angle

angle of the jaw-bone to the other, having its under edge corresponding to the outer edge of the other, and its upper edge on a level with the under lip. Both these pieces are moistened with a resolvent liquid, which renders them flexible and more easily adapted to the form of the jaw. On these pieces are placed compresses, also moistened with a resolvent liquid, and a chin bandage is applied over all. Although the paste-board, on being dry, constitutes a kind of mould, in which the lower jaw is contained, yet, as it acts on the fracture only as it is acted on by the bandages, and as it injures by its hardness the soft parts on which it presses, it has been abandoned.

If the fracture be simple, the operator will commence by applying two bands externally, of three fingers breadth each: one of these is to be passed under the chin, and fastened on the top of the head to the patient's cap; the other is to be applied immediately to the chin and jaw, and fastened at the occiput; after which the chin bandage is applied: this bandage must be so long as that the two ends of it may cross on the top of the head, and broad enough to extend from the lip to the middle point between the chin and the neck. The extremities of this

bandage

bandage are split to near the middle part, in which a hole is made to receive the chin, and two ends are knotted on the top of the head, and the other two on the occiput. For greater security, two bandages of this construction might be applied; but if the patient be perverse, and the fracture double, it will be necessary to apply the double *chevestre*, which is more easily done than described.

Fracture of the condyles requires the following modification of the apparatus. As that process is incessantly drawn forward by the pterygoideus externus, it would be necessary to push it back; but being so short, and situated so deeply, it cannot be acted on but with great difficulty; for which reason the lower portion must, if possible, be pushed into contact with the condyle, which may be done by making the chevestre act on the angle, and aiding its action by means of a thick and graduated compress placed on that angle. It is almost needless to remark, that if both condyles be fractured, the double chevestre ought to be employed: in this case the parts are with difficulty kept in their situation; the apparatus ought therefore to be often examined, and reapplied frequently.

It is particularly important in fractures of the condyles to obtain a cure without deformity, because the motion of the bone would be affected by any deformity that would remain. If the patient insists on eating or speaking during the treatment, it is probable that there will be no reunion, that the condyle will exfoliate, and be cast out through a fistulous opening. Thus a carter, who quitted the hospital *De la Charité*, after being three months a patient in it, but without being perfectly cured of a double fracture of the lower jaw, one near the middle part, the other near the right condyle, returned after an absence of seven or eight months to Citizen Boyer, who extracted from a fistula, in the external conduit of the ear, a bony mass, which had evidently the form of the condyle.

When, at the end of fifteen or twenty days, the pieces begin to unite, soft food may be given to the patient, instead of broths; and according as the solidity augments, the consistence of the food may be increased. The cure will be complete between the thirtieth and thirty-fifth day, if nothing interrupts its natural progress.

After

After what we have already said on compound fractures, in treating of fractures in general, it is unnecessary to repeat here particularly what is there related, and which may be so easily applied to the fracture of the lower jaw, attended with violent contusion, or a division of the soft parts covering it. It may be remembered, however, that this bone frequently exfoliates, when the fracture is accompanied with a wound, and that the cure is on that account much more tedious.

CHAPTER IV.

OF THE FRACTURES OF THE VERTEBRÆ.

The bones which compose the spine are seldom fractured, because, like other short bones, they resist any violence that might be applied to them, by the equality of their three dimensions. If any great force be applied to the vertebral column, it is apter to lacerate the intervertebral cartilages, or to separate them from the vertebræ, than to fracture these bones: they may, however, be fractured in the very part against which the force has been immediately applied. The spinal processes which project from the body of the bones is the part most liable to be fractured, because it is that which is weakest and the most superficially situated. But it seldom happens that the fracture is limited to a single vertebra; several of them are generally fractured at once, and the spinal marrow suffers at the same time a commotion or contusion to a greater or less degree: and much less danger is to be apprehended from the fracture, than from the lesion of that substance. In fact, every cause that will fracture

the

the vertebræ, must give a commotion to the spinal marrow.

It is thus that this substance suffers from a fall on the back from an elevated situation, or from the action of a bullet, which strikes against the vertebræ after having penetrated through the soft parts: the displaced pieces of the fractured bones might in such cases press on that substance, or the fractured splinters might penetrate into it after having pierced the dura mater and its other tunics. The laceration of its vessels might also produce an effusion, which by its pressure would, as effectually as any other cause, produce a paralysis of the organs whose nerves proceed from the parts of the spinal marrow below the fracture.

The variety of causes which may give rise to symptoms analogous to those of fracture of the vertebræ, render it difficult to establish a diagnosis. Yet, when a person has fallen on his back from an elevated situation, or when a body very forcibly impelled, as a bullet discharged from a musket, has struck that part, if a fracture has taken place, some derangement of the spinal process of the fractured vertebra may be observed, by an attentive examination of the part affected. Much pain is caused by pressing on that

process; the inferior extremities are paralysed, as also the rectum and bladder; the patient is afflicted with a retention of urine and fæces, or with an involuntary discharge of the latter.

A sack of flour, weighing 300lbs. fell on the back of the neck of a porter of the corn-hall, in a moment that he was off his guard, and laid him prostrate. He complained of a very acute pain in the neck; and on being conveyed to *La Charité*, it was found that the spinal process of the seventh vertebra of the neck was more prominent than it naturally is. The superior and inferior extremities were paralytic, respiration became difficult, the bladder and rectum ceased to perform their functions, and the patient was suddenly cut off. On opening the body, a fracture of the seventh vertebra was found, with derangement of a fragment which compressed the spinal marrow.

The three following cases, of which the two first, like the foregoing, have been observed at *La Charité*, prove that the commotion or violent distention of the spine can produce the same symptoms as a fracture of the vertebræ.

A hosier

A hosier fell into a shallow ditch on his loins; the commotion was sufficient to produce a paralysis of the inferior extremities. After his death, which followed from the fall, no disorganization could be perceived, nor any effusion either in the cranium or vertebral canal.

A builder fell from a height of fourteen feet, and remained for some time senseless; and, on recovering from that situation, found that he had lost the use of his inferior extremities. He had at the same time a retention of urine, an involuntaty discharge of the fæces, and some disorder in the function of respiration. Death followed on the twelfth day after the accident; the body was opened, and the vertebral canal was found to contain a sanguineous serum, the quantity of which was sufficient to fill a little more than its lower half.

A man exercising himself at feats of activity, distended so much the intervertebral ligaments, that he was instantly seized with an acute pain in the part so distended, by the strained posture which he had assumed: the next day, the inferior extremities, the bladder, and rectum, were paralytic, and the patient died in a few weeks.

This paralysis of the inferior extremities, the necessary concomitant of fracture of the vertebræ, and of any lesion of the medulla spinalis, is not, in itself, a mortal affection; but the patient, losing the power of loco-motion, and being obliged to lie perpetually on his back, soon feels a troublesome itching in the region of the sacrum, on which the pressure of the body is principally concentrated; the skin of this part becomes inflamed, and gangrene ensues to a greater or less degree, because the pressure on that part intercepts the course of the humours. The bone is quickly denuded, the ulcer extends rapidly, and consumes the patient's strength; the dissolution is accelerated by the retention of the excrements from the paralysis of the rectum and bladder. The catheter, which must be introduced into this latter organ for the purpose of evacuating the urine, gives admission to the air; its mucous secretion becomes more abundant, and its substance thickened; a slimy matter flows out with the urine, and the penis and scrotum become œdematous, &c. A slow fever succeeds these symptoms; and the patient, however robust he may be, falls in a few weeks. We have known, however, a man of a very vigorous constitution, to have survived for six

months

months an accident of this nature. Examples of recovery are recorded, but they are extremely rare, and to be ascribed to the secret operations of nature, rather than to the efforts of art; and we repeat, that scarcely one in thirty recovers. Almost all die from the exhaustion of their strength, by slow fever, colliquative diarrhœa, &c.

Any attempt at setting these fractures, would be not only useless, but dangerous, by the straining which it would occasion. General treatment alone can be had recourse to; the inflammation and obstruction of the part affected may be moderated by cupping and scarification.

If the patient be affected with a flatulent distention of the abdomen, vomiting, hiccup, and other symptoms of that nature, the abdomen may be rubbed with a solution of two drachms of camphire, in a sufficient quantity of oil; purgative clysters may be also given, and antispasmodic medicines. A catheter should be allowed to remain in the bladder, with its external orifice corked, in order that the patient's bed may not be wet: the ulcerations of the sacrum are to be dressed simply with pieces of linen covered with cerate. If the gangrenous

eschar comes off, styrax ointment ought to be applied; and if the patient be fortunate enough to recover the use of the bladder, rectum, and inferior extremities, this return of the natural forces may be aided by frictions with tincture of cantharides, on the course of the nerves of the paralytic organs; and as soon as the patient is able to ride, or even walk with the aid of crutches, he will find it beneficial to drink the sulphureous waters of Bourbon or Barèges.

Such is the treatment in cases of fracture of the spine. Some authors recommend trepanning, or cutting out a portion of the fractured bone, when the compression of the spinal marrow by effused fluid, or its disorganization by the action of a splinter, is suspected; but exclusively of the difficulty of that operation, on account of the great depth of the intermediate soft parts, the indication is never sufficiently evident to authorize it.

If a fracture of the vertebræ, or an affection of the spinal marrow, take place in the neck, death follows rapidly. This effect is instantaneous, if the lesion be as high as the origin of the cervical nerves, which convey nervous energy to the diaphragm; for that organ being for the most part

part supplied by these nerves, is deprived of the power of motion, by any considerable lesion of them.

The lesion of the fourth and fifth cervical pair of nerves by fracture, supposes that accident to have taken place in the third vertebra; because the vertebral nerves originate a little higher than the hole by which they pass out of the vertebral canal.

CHAPTER V.

OF THE FRACTURES OF THE STERNUM.

The position of this bone, supported laterally by the flexible cartilages of the ribs, the great number of pieces of which it consists, unless in old age, its thickness, and spongy texture, co-operate in securing it against fractures. It may, however, be fractured, and in two different ways. The fracture takes place generally on the part where the force is immediately applied; but it may be occasioned by an extension, operating on both extremities of the bone.

David has cited (from a memoir on *contre-coups*, published under the name of Basile, among the prize-essays of the Academy) the case of a mason, who, in falling from a great height, struck against a cross-bar which intercepted his fall; and on which the trunk was so extended, that the sternum was ruptured transversely by the violent action of the abdominal and the sterno-cleido-mastoidei muscles. In cases of this nature, very rare it is true, the fracture must be simple,

simple, and without derangement of the fragments, or affection of the soft parts. But in those produced by the immediate action of an external cause, the soft parts are necessarily affected, and the fractured portions may be impelled into the mediastinum and cellular texture, so as to wound the pericardium, heart, or lungs.

Solutions of continuity of the sternum, like those of the cranium, are attended with a greater or less effusion of blood, mingled with a medullary substance, which is very abundant in the sternum; but the consequences of this effusion are very different in the two cases. The slightest effusion within the cranium, gives rise to the most alarming symptoms, and causes sometimes the death of the patient; but in this case, on the contrary, however abundant that effusion may be, it seldom occasions dangerous symptoms. The heart and lungs being composed of a substance less delicate and less compressible than the brain, suffer little or no inconvenience from this effusion: besides, the capacity of the thorax is variable, and may on that account accommodate itself to an unusual quantity of fluid.

A simple

A simple fracture is ascertained by the mobility of the pieces: that which is compounded with contusion, wound, effusion of blood, or by the splinters being thrust inward, is easily known by simple inspection of the part.

A simple fracture of the sternum requires no other treatment than the application of compresses, repose, and a proper position, that is, on the back, with the head and pelvis raised; so that the muscles already mentioned, which are attached to its extremities, may be in a relaxed state. But in cases (which are much more frequent) of fracture, with contusion, wound, or penetration of splinters into the mediastinum, the patient should be bled, and confined to a low regimen; poultices should be applied; and the necessary incisions made for extracting the splinters from the mediastinum, or for giving issue to the effused fluids. It is but very seldom necessary to trepan the sternum for either of these purposes; and that operation becomes necessary only when that part of the sternum which has been denuded, becomes affected with caries, the fistula proceeding from which would be incurable by any other means. Then a transverse or crucial incision should

be

be made on the part where the probe points out the course of the fistula. The part affected ought to be laid entirely bare, and completely removed, by a single or repeated application of the instrument, according as it happens to be more or less extensive. The instrument ought to be precisely the same as that used for the head, and applied with all possible care, lest, by pressing on it too much, it should be driven into the thorax, particularly as the sternum, naturally capable of making no great resistance, is then less so in consequence of the caries.

The appendix xyphoides is not susceptible of derangement backward; for, though violently struck and driven backward by a blow on what is vulgarly termed "the pit of the stomach," yet it restores itself by its own elasticity. It may be fractured in aged persons, as it is then ossified; but even in that case the remedies are resolvents and emollients, according to the degree of contusion. However, as the organs contained in the epigastric region may have suffered from the same cause that produces the fracture, it might be prudent to draw blood in proportion to the patient's strength, and to confine him for a few days to the antiphlogistic regimen.

CHAPTER VI.

OF FRACTURES OF THE RIBS.

The ribs are placed obliquely on each side of the thorax, and terminate in a cartilaginous substance, by means of which they articulate with the sternum. This oblique direction, and the cartilaginous termination, render them but little liable to fractures. Some, however, are more exposed to fractures than others: thus the first, or superior, being protected by the bones of the shoulder, and by the arm itself, when it hangs by the side, and the lower on account of their great flexibility, are less liable to be fractured than the middle ones.

Fractures of the ribs differ from one another by the part of the bone in which the fracture takes place, by the direction of the fracture, and by the cause, or its way of acting.

Fractures of the ribs happen generally near the middle of the bone; and this is the case, whether one or more of them be fractured at the same time. The fracture is sometimes transverse, at other times oblique; in which case the

fractured

fractured portions may penetrate the skin or pleura, according to the direction they take.

As the cause of fractures of the ribs may act either on their opposite extremities, or on their middle part, a distinction of them has been made into fractures inwards or outwards. In the latter, both extremities of the rib are at the same time bent towards one another, so that the convexity of the rib is increased, and the fracture is effected when its natural extensibility is exceeded. This fracture is not without some reason termed outward; for it may be easily conceived that the external fibres are the first ruptured, and that there is a succession from the external to the internal side, although the fracture be effected almost instantaneously. This species of fracture is sometimes observed from the body being violently pressed between a wall against which the back is supported, and a wheel of a carriage which presses on the anterior part of the breast.

The fracture inwards is caused by a body strongly impelled against the middle and convex part of the rib; or when, in falling, that part strikes against a hard unyielding body; in which case the fracturing cause tends to straighten the rib, and consequently the fracture commences internally.

In whatever manner the fracture is produced, it may be complicated with contusion or external wound. The sloped and pointed pieces of broken bone directed internally, may, by lacerating the pleura and substance of the lungs, give rise to emphysema.

Fractures of the ribs are indicated by an acute pain felt in breathing. However, the part should be carefully examined, by pressing the posterior part of the rib inward, and the anterior backward, and by thus ascertaining if there exists in that part any unnatural motion, or if any crepitation can be produced. In fractures of the ribs the derangement cannot take place either in the direction of the diameter of the bone, nor in that of its axis or length. The ribs being fixed posteriorly to the spine, and anteriorly to the sternum, cannot shorten, as the interval between these fixed extremities is invariable. Neither can the derangement take place by one of the broken pieces becoming higher or lower than the other, because the same muscles are attached to both fragments, and keep them at the same distance from the neighbouring ribs. The only derangement possible is the angular, which may be salient internally or externally, according as the fracture is in one or other of these directions.

Experi-

Experiments made on the dead subject, confirmed the reasoning used in this case.

Having taken off the muscles which cover the thorax, I fractured the true ribs by placing a great weight on the sternum, the body being laid on its back. This fracture was not attended with any derangement. If the weight on the sternum was increased, or the sides of the thorax pushed forcibly downward, the moveable pieces were not thereby displaced, but merely compelled to form with their contiguous extremities a salient angle externally. This angle was salient internally, in a subject the ribs of which were broken by a violent blow of a hammer on the middle part. Whether the projection was internal or external, it might be effaced by merely distending the cavity of the thorax as in inspiration *.

The derangement cannot then take place, unless the muscles be torn by the violence of the blow which caused the fracture, and a portion of the rib completely detached.

* Memoirs of the Society of Medical Emulation, vol. iii. page 159.

When one or more ribs are affected with simple fracture, it will be necessary merely to apply on the fractured part compresses moistened with a resolvent fluid; which compresses may be kept on by means of a bandage placed round the body, and drawn tight enough to impede the motion of the ribs, and to compel the patient to perform respiration chiefly by the descent and elevation of the diaphragm. When the fracture is outward, the compresses should be pretty thick, in order to repress the salient angle. When it is inward, they should be applied on the extremities of the rib or ribs, in order to force outward the fractured ends, which have a tendency to point inwards towards the lungs. The bandage round the body is prevented from falling downwards by means of a scapulary bandage.

When the apparatus does not confine the ribs sufficiently, and in consequence the fractured parts move and give pain in the act of respiration, the *quadriga* ought to be applied in its stead. This bandage commences by a stellated cross on the shoulder, and it is then made to descend on the thorax in folds; that is, each succeeding roll covering a part of the preceding. In order to render

render it more secure, it may be fastened with pins in different places. It is seldom necessary to raise the apparatus in order to view the state of the parts underneath, as the ecchymosis disappeared of itself in a very few days.

When the violence has been considerable, and the lungs have been contused or lacerated by the pieces of bone, the patient suffers much pain, has acute fever, thirst, and difficulty of breathing; in short, all the symptoms of an inflammation of the lungs. In this case the treatment ought to be the same as in pneumonia; among the remedies for which, copious and repeated bleedings hold the first rank.

With respect to the emphysema, which is the name given to a tumour formed by the admission of air into the cellular texture, it may be produced by a fracture of the ribs in the following manner. Let us suppose that a pointed piece of bone, impelled into the thorax, lacerates the pleura, and vesicular texture of the lungs, and that the air which escapes through the lungs in the act of inspiration is received between them and the pleura in the cavity of the thorax. In the succeeding expiration, the cavity of the thorax becomes diminished; the air contained in

it being compressed, endeavours to escape by the part where it finds least resistance, that is, by the wound of the pleura; but as there may exist no external wound in the thorax, or even, though there did, should it be narrow and sinuous, the air could not escape externally; it must, therefore, make its way into the neighbouring cellular texture, which it distends and tumefies. This effect of a single inspiration and expiration, is increased by a second, a third, &c. to the degree that the air may pervade the cellular texture of the whole body, except the palms of the hands and soles of the feet; because in these parts certain ligamentous processes unite the integuments so closely to the subjacent aponeurosis, that the interjacent cellular texture cannot admit the air. A case of emphysema has been observed, in which the whole body had acquired a most enormous volume: the anterior side of the thorax was eleven inches deep. If something be not done to stop the progress of the emphysema, the air, after having filled the cellular texture under the skin, makes its way along the vessels into the substance of the viscera, the forms and functions of which it deranges, and in a short time destroys life. Happily this accident rarely succeeds to a fracture of the ribs. Citizen Boyer has seen only one example of it, which was that of a labourer,

a labourer, who received his death from the explosion of the powder-mills of Grenelle in 1793. Ledran, in his 24th Surgical Observation, makes mention of the case of a coachman, in whom a fracture of the fifth true rib, in consequence of a kick from a horse, was followed by an emphysema, in which the integuments were inflated to the depth of four inches.

In cases of this nature, it is necessary to follow the example of that able practitioner; that is, to apply pyramidal compresses on the part where the emphysema commences: the compresses should be impregnated with some resolvent liquid, and braced according as the tumour collapses.

If the emphysema, already far advanced, be still making progress, it will be necessary to make an incision into that side of the thorax where the fracture of the ribs, with lesion of the pleura and lungs, was suspected: the air, finding free egress through this wound, will no longer pass into the cellular texture. The validity of this precept will be rendered evident, by considering that emphysema never follows large incised wounds of the thorax; and that, on the contrary, it is frequently complicated with narrow and oblique

wounds made by a pointed instrument, such as a small sword.

Whatever means be adopted for arresting the progress of the emphysema, the air which has already passed into the cellular texture, loses its elasticity ; its component parts combine with the fat and lymph contained in the cellular substance, and the tumefied parts return gradually to their former size. This termination of the disease may be accelerated a little by making incisions in different parts of the body, and applying resolvents over them.

The cartilages of the ribs cannot be broken before they are ossified. As long as they retain their cartilaginous structure, and remain supple and flexible, though they may be bent in towards the lungs, yet, being eminently elastic, they return to their natural shape as soon as the external force is removed. Nothing, then, can be more ridiculous, nothing more dangerous, than the absurd practice of bone-setters for raising what they call "depressed ribs." Their greasy and irritating plasters ought also to be proscribed ; for such topical applications can only irritate the skin, excite an erysipelatous inflammation, augment the pain which the contusion produces ; and, by inspiring a false

a false security, cause the consequences of the affection to be neglected. When the ossified cartilages are fractured in an old person, the treatment is the same as that for a fracture of any other part of the rib.

CHAPTER VII.

OF FRACTURES OF THE BONES OF THE PELVIS.

SECTION I.

Of Fractures of the Sacrum.

This bone is not much exposed to be fractured: it is thick and of a spongy texture, deeply situated, and covered by a great depth of soft parts, which deaden any force that tends to fracture it by acting on its great diameter, or transmit that force to the ossa innominata, between which it is fixed as a wedge. Some powerful cause, such as the fall of a very heavy body, or the passage of a carriage-wheel on the convex side of that bone, can alone fracture it: it may be also fractured by a fall on the same part from a great height. Thus we find that these fractures of it, which may have different directions, and exist in different parts, are always produced by a force which has crushed the bone. No muscle tends to derange by its contractions the position of the broken portions; and the fractures are, therefore, dangerous only by the contusion

tusion which the parts contained in the pelvis may suffer; and which, by producing effusion of blood, inflammation, and abscesses, may destroy the patient.

The treatment of these fractures consists simply in tying a napkin round the pelvis, an emollient poultice being previously applied on the fractured part. Inflammation, and its concomitants, are prevented by bleeding, low diet, and other means, of which mention shall be made in treating of fractures of the ossa innominata.

SECTION II.

Of Fractures of the Os Coccygis.

This little bone, though much slighter than the sacrum, is, however, not so often fractured, because it offers no point on which an external force can act with advantage; and because, by its mobility, it can yield to any impelled force, and return again to its natural position.

When it is fractured, as by a fall on the buttocks, the pain which ensues, and which augments by walking, indicates the existence of the fracture.

fracture. Some fibres of the glutæi are attached to this bone, and by moving the fragments one on the other, in the act of walking, produce the painful sensation: this sensation may, however, depend on the contusion, and cannot, therefore, be considered a proof of the existence of the fracture.

This kind of fracture does not require any apparatus for keeping the broken pieces in a just position; although the levatores ani may draw the anterior fragment a little forward. Resolvents, or emollient poultices, as the circumstances may require, ought to be applied: it may be also necessary to take away some blood; and the most perfect repose should be enjoined, in order that the action of the glutæi muscles may not interrupt the consolidation.

It is not amiss to remark here, that falls on the buttocks are frequently attended with bad consequences, when, from a foolish bashfulness, the patient conceals his sufferings, or refuses to submit to examination by a surgeon.

Thus, the sister of a celebrated actor, who refused to submit to examination, although she suffered much pain in the region of the coccyx, allowed

allowed an abscess to form in that part, on opening which, the os coccygis was found fractured, and affected with caries, as was also the inferior extremity of the sacrum.

SECTION III.

Of Fractures of the Ossa innominata.

Fractures of these bones are not frequent, but never take place without an attendant contusion of the external soft parts, and sometimes of the parts contained in the pelvis. Different parts of these bones may be fractured, and the fracture may run in different directions. The anterior and superior spinal process of the os ilium may be fractured, and with it the adjacent part of the ridge of that bone; of which we have seen an example in the case of a farrier, who received a kick from a horse on that part. The ossa pubis and ossa ischia, being protected by the inferior extremities, are less frequently fractured than the ilia. No derangement takes place in the fractured portions, whatever may be the direction of the fracture; not even in fractures of the ossa ilia, which is the more to be wondered at, as these bones are very thin: this immobility of the broken parts is to be ascribed to the thick

and

strong muscles, which are attached internally and externally to the broken portions.

But these fractures are rendered very dangerous by the extravasation of blood and medullary substance into the cellular texture of the pelvis, and by the contusion of the parts which are contained in it. When the pelvis has been fractured by the passage of a wheel, by the fall of a heavy body on it, or by a fall on the breech, the patient is entirely disabled from walking If the pelvis be pressed in opposite directions, the motion of the broken pieces on one another will be perceived, a crepitation will be heard, and some inequalities arising from the derangement of the bones may be clearly distinguished. The existence of the fracture being ascertained, the surgeon's first care will be to obviate the consequences of inflammation by copious and repeated blood-letting. If inflammation has already taken place, it must be combatted by the same means; at the same time topical remedies are to be applied. The pelvis ought to be surrounded with a napkin folded in the shape of a bandage for the trunk; and in cases where the contusion is excessive, the bones splintered and loose, and the neighbouring parts disorganized, as it would be impossible for the patient to move or go to

stool

stool without suffering the most excruciating pain, it will be necessary to pass a piece of strong girth web under the pelvis, the corners of which, collected into one, are to be fastened to a pully suspended from the top of the bed: by means of this pully, the patient may raise himself with a very little effort. Citizen Boyer invented this apparatus for a patient affected in the manner we have just described: he was able to raise himself with the greatest ease, and to such a degree as that a flat vessel might be placed under him. It is applicable to all cases of compound fracture of the inferior extremities, in which it may be necessary to raise the patient frequently.

However judicious the treatment, and well-directed the antiphlogistic remedies, the inflammatory symptoms will generally be so intense, that an excessive suppuration will be the consequence; and large abscesses will form, in which the pus will stagnate, in consequence of the great quantity of cellular texture in that part of the body.

Sometimes, however, the patient recovers, the effused blood is absorbed, and the inflammation ends in resolution. It may happen too, that

detached

detached splinters shall give rise to subsequent abcesses, as in a case related by *Maret*, in the Memoirs of the Academy of Dijon, of a woman who had had a fracture of the pubis, and from whom he extracted a large portion of that bone through an abscess formed in the labia pudendi.

Dessault, in giving an exit to a collection of urine which had taken place from a fracture of the pelvis, found a splinter which he extracted from the bottom of the wound.

If the bladder be perforated by a splinter, this should be extracted, and a catheter introduced into the bladder, in order to prevent the accumulation of urine, and its consequent effusion into the abdominal cavity. Chopart gives an example in Vol. II. of his Treatise on the Diseases of the Urinary Passages, which justifies this practice.

It may be said, that artificial means are but of small effect in fractures of the pelvis, that the treatment must be general, and that even this is not always efficacious, when (as most generally happens) the fracture is complicated with lesion of the external soft parts and contents of the pelvis.

CHAPTER VIII.

OF FRACTURES OF THE SCAPULA.

This bone is seldom fractured, because, being suspended on the superior lateral and posterior part of the trunk, and moveable in that situation, it yields easily to any force impelled against it. All its parts are not, however, equally secure from fracture. The acromion, which terminates externally its spinal process, and advances, like an arch, over the head of the humerus, forming thus a part of the shoulder, is easily fractured, because, being but thin, and lightly covered with soft parts, it yields easily to a force pressing it downward, where it is supported only by cellular texture. The inferior angle of the scapula is, after the acromion, that part of it which is most easily fractured. The coracoid process is too deeply seated to be fractured, except in the case of gun-shot wound: that is the only one in which J. L. Petit met an example of it. It has also been fractured by the fall of a heavy body on it: in this case, the soft parts were excessively contused, and the patient died.

Fractures

Fractures of the scapula, whether passing from its superior to its inferior edge, across the spinal process, or from its external to its internal edge, are always accompanied with considerable contusion, because the fracturing cause must have acted immediately on the part. The first-mentioned, or longitudinal fractures, are less frequent than the transverse. The vertical diameter being the greater, a greater force would of course be necessary to fracture the bone in that direction than in the other. Longitudinal fractures cause but very little derangement, because the muscles which are attached to the surface of the scapula, prevent the separation of the fractured portions. In transverse fractures, the derangement is not quite so trifling. The serratus anticus major draws forward the lower portion, to which it is principally attached. The rhomboides may also concur in producing this derangement, which is always great enough to be perceived by the fingers drawn along the base, or internal side, where the inequality will be produced. In fractures of the acromion and inferior angle, the derangement is much more considerable. The weight of the arm, and the contraction of the deltoid muscle, draw downward the acromion, at the same time that the trapezius and levator scapulæ draw the rest of the bone upward and backward.

backward. The serratus anticus major draws forward the lower angle, the rest of the scapula remaining in its natural situation; or if the angular portion be considerable, the teres major and some fibres of the latissimus dorsi contribute to its derangement forward and upward.

If the coracoid process is fractured, the pectoralis minor, the coraco-brachialis, and short portion of the biceps, concur in drawing it forward and downward.

These different fractures may be ascertained by the following signs: the longitudinal ones are, however, not easily distinguished. If much pain be felt in consequence of a blow or fall on the shoulder, the part should be examined; for by feeling the scapula, and pressing it in different directions, the motion of the broken pieces, and crepitation, may be perceived, particularly if the patient be not fat, and an inflammatory swelling has not as yet supervened. Transverse fractures are more easily distinguished by the inequality which they cause in the basis of the scapula, by the mobility of the pieces, which may be moved in opposite directions, by seizing in one hand the inferior angle,

and in the other the acromion and spinal process.

The derangement is so considerable in a fracture of the inferior angle, that it is impossible to be mistaken, or to overlook it: this part being quite detached, remains motionless, although the rest of the scapula should be moved.

The pain which always attends the fracture of the acromion, and which is increased by the motions of the arm, the alteration in the form of the shoulder, and the mobility of the acromion, which has descended, and which ascends when the elbow is raised close to the trunk, are the distinctive marks of this fracture. The small quantity of soft parts covering the acromion renders the discovery of it very easy.

The contusion which constantly attends fractures of the scapula, whatever may be the part fractured, is the most dangerous symptom. Abscesses have sometimes formed in the fossa subscapularis in consequence of fractures of the scapula, and effusions have taken place in the thorax, when the fracturing cause has acted with such

such violence as to extend the contusion to the parietes of that cavity.

When the scapula is fractured longitudinally, or transversely, near its spinal process, it is merely necessary to fix the arm to the side of the trunk by means of a bandage, which includes the arm and trunk, and which descends from the shoulder to the elbow. The steadiness of this bandage is still further increased by applying a roller which embraces the shoulder and the elbow. By binding the arm in this manner, the motions of the shoulder are prevented, because its motions are only concomitant to those of the arm. This apparatus, or that of Desault for the fracture of the scapula, with the omission of the cushion for the arm-pit, is by much preferable to that by which the hand of the side affected is placed on the shoulder of the opposite side—a situation which is unnatural and fatiguing, and which cannot be long persevered in.

As the inferior angle, when separated by fracture from the rest of the bone, is, like the condyloid process of the jaw, little susceptible of being acted on by any means in our power, it will be necessary to act on the scapula itself, to push it downward and forward toward

the inferior fragment, which the serratus anticus major has drawn in that direction.

In this case too, it is on the arm that it will be necessary to act, in order to move the scapula. The arm is to be pushed inward, downward, and forward, the fore-arm being half bent: it must be kept in this position by a circular bandage seven yards long. It will be proper at the same time to act on the angular detached portion by means of compresses, which may be pressed backward by some rounds of a bandage, and thus brought in contact with the rest of the bone. The arm may be supported by a sling knotted on the opposite shoulder.

The acromion, when fractured, is drawn downward and outward by the action of the deltoides, at the same time that the rest of the bone is drawn upward and backward by the trapezius and levator scapulæ. This fracture is set by raising the arm in such a manner as that the head of the humerus may push upward the acromion, which has descended, and which naturally covers it like an arched roof; at the same time an assistant pushes the scapula forward and downward in a direction opposed to that which is given the arm. In order that the

parts

parts may remain in this situation, it will be necessary that the action by which they have been placed in it be perpetuated by bandages; that is, that the arm be supported parallel to the trunk, and that the shoulder be pressed downward at the same time.

To effect this, a circular bandage is applied round the trunk and arm, and afterwards made to ascend from the elbow to the shoulder, and *vice versa*. In this last direction, the bandage has the advantage of securing on the shoulder the compresses, moistened with a repellent liquid, of raising the humerus against the acromion, of which it ought to be the support, while nature effects the consolidation, and of pressing down the scapula to the level of the acromion. This bandage, like all those of the thorax, is very liable to be displaced, on account of the motion of the thorax; it ought, therefore, to be frequently reapplied, never forgetting on these occasions to have the elbow raised, and the shoulder pressed down.

Although fractures of the scapula consolidate in the ordinary time of from thirty-five to forty days, yet in those of the acromion it will be necessary to continue the bandage a little longer;

not that the generation of callus is slower in that part of the bone than in any other, but because that process is acted on by two strong muscles, which might rupture the callus, if exposed to their action before it had acquired a great degree of solidity.

To these mechanical means general remedies may be added, such as blood-letting, &c. The consequences of these fractures are seldom dangerous. A case has been given, however, in which the cellular texture which unites the subscapularis muscle to the depression of that name, became inflamed, suppurated, and a deep-seated abscess was formed, for which it was found necessary to trepan the scapula. A person received a thrust of a sword in the shoulder; the weapon, after having penetrated the integuments and infraspinatus muscle, pierced also the scapula, and wounded the subscapularis muscle. The inflammatory symptoms were intense, and an abundant suppuration took place. In order to stop the suppuration, Maréchal enlarged the fistulous orifice by trepanning the scapula. The operation was attended with success, as we learn from the author of its eulogium, which is found at the commencement of the second volume of the Memoirs of the Academy of Surgery.

CHAPTER IX.

OF FRACTURES OF THE CLAVICLE.

MANY causes conspire to render the clavicle liable to fracture: it is long and slender, supported in its middle part only by cellular texture; and protected externally but by a very thin covering of soft parts. But its functions contribute much more than these circumstances to render the fracture of it frequent. It serves to keep the scapula at a proper distance from the sternum, and acts as a *point d'appui* to the humerus, every impulse of which it receives and transmits to the sternum.

A fracture of this bone may take place in any part of its length, but it most frequently happens near its middle, because its curvature is greatest at that part. Sometimes, but rarely, it takes place near the extremity, articulated with the scapula. Fractures of it may be transverse or oblique; simple, or complicated with contusion, wound, or detached splinters—differences which depend on the action of the fracturing cause. A blow on the shoulder, and of sufficient *momentum*, will, as it acts directly, fracture

the bone in that part on which it is inflicted, and will at the same time lacerate or contund the soft parts. A comminutive fracture may be produced by this means; and if the violence be sufficiently great, the subclavian vessels and nerves which lie between the clavicle and first rib may be torn; and a paralysis of the arm produced: this affection frequently follows the fall of a heavy body on the shoulder.

If the fracture be caused by *contre-coup*, in which case the fracturing force is immediately applied to the ends of the bone, it is not necessarily complicated with contusion. A fracture may be occasioned in this way by a fall on the point of the shoulder, or on the hands, the arms being extended. It may happen, however, in this case, that the clavicle, pressed very forcibly against the sternum, may be bent much beyond its natural curve, and fractured so obliquely, that the broken portions shall pierce through the integuments.

Fractures of the clavicle are generally attended with derangement of the broken portions, those, however, excepted, which take place near the extremity articulated with the scapula, and within the coraco-clavicular ligaments. Although

though the bone be very slender in this part, yet it is so strongly attached to the scapula by these fibrous productions, that the derangement is scarcely sufficient to indicate the existence of the fracture.

The mechanism of the derangement of the pieces is easily understood: the external portion is that which is always deranged, because the internal, retained in its articulation by the costo-clavicular ligaments, and drawn in opposite directions by the sterno-cleido-mastoideus, and pectoralis major, is immoveably fixed. The external fragment, on the contrary, being weighed down by the arm, and drawn in the same direction by the action of the deltoides, and being at the same time drawn forward and inward by the pectoralis major, is carried under the internal portion, which forms an eminence over it.

From the moment that the fracture of the clavicle allows the shoulder to approach the sternum, the arm falls on the fore part of the breast; and the patient resembles in that particular, an animal without a clavicle.

One of the principal signs of fracture of the clavicle, is the impossibility which the patient finds

finds of applying the hand of the side affected to his forehead, because that act requires a semicircular motion of the humerus, which cannot be performed if that bone has not a firm *point d'appui*. If the patient attempts this motion of the arm, it may be remarked that he merely bends the fore-arm and inclines his head, in order to bring the hand and forehead into contact. In addition to this sign, it will be observed that the shoulder and superior extremity are placed more anteriorly on the breast and nearer the sternum, than in their natural state, or than those of the opposite side. The patient leans to the fractured side; and if the part be examined before a swelling and inflammation has come on, the motion of the pieces on one another may be perceived, and the projection formed by the end, generally of the internal portion, will be evident. A crepitation may be produced by the motion of the shoulder, but not without causing great pain. These signs, independently of preceding circumstances, establish clearly the diagnosis of fractures of the clavicle.

If the soft parts have suffered no extraordinary contusion, a fracture of the clavicle is not dangerous; but if the fracture be comminutive, the soft parts lacerated, and the nerves of the brachial

chial plexus injured, much danger may result from it.

For no fracture have so many bandages and so much apparatus been invented, as for that of the clavicle. We shall examine them successively, and point out their defects and perfections. The ancients and many of the moderns have imagined, that, in order to set a fracture of this bone, it was necessary to have the shoulder drawn back, and fixed in that position: to effect this, it was ordered that the patient should be placed on a low stool, so that an assistant might place his knee between his shoulders, which he drew back at the same time with both his hands, whilst the surgeon applied the bandage, which was to keep the parts in this position. It is easy to perceive that in thus drawing the shoulders toward one another, the scapula is pushed toward the sternum, and with it the external portion of the clavicle, which passes under the internal. If this portion be sharp-pointed, and the shoulders drawn back with great force, it may lacerate and pierce the integuments. The bandage in form of the figure 8, with which it is attempted to keep the parts in this position, does not correct the defect in any degree. The manner of its application is as follows: While the assistant acts as above

above mentioned, the operator applies one end of a seven-yard bandage, rolled up in one, to the arm-pit of the side affected, and draws it obliquely to the opposite shoulder, round which it is made to pass, and from this to the other shoulder, about which it is to be rolled in the same manner, and crossed afterwards repeatedly before and behind. As this bandage acts obliquely, its force is decomposed; it is therefore necessary to draw it very tight, in order to keep the shoulders back. But this extreme constriction o fthe bandage excoriates the parts about the arm-pits, particularly in cases of women, and causes much distress, without producing any good; besides, the drawing back of the scapulæ forces the fractured portions to overlap, which is the very reverse of the desired effect; but luckily the obliquity of its action prevents it from acting so forcibly as to confine the shoulders; even though, as prescribed by J. L. Petit, they should be braced behind by a compress. The iron cross proposed by Heister, the corselet described by Brasdor in the Memoirs of the Academy, and the leather strap proposed by Brunninghaussen, are only modifications of the figure of 8 bandage, and have no advantage over it. All act obliquely on the shoulders, tend to effect a derangement of the fractured portions, by drawing the scapulæ toward

one

one another, excoriate the parts about the arm pits, and do not prevent the descent of the arm.

The general rules which we have given for setting fractures, are to be attended to in those of the clavicle. Extension is to be performed by means of the limb, which articulates with the fractured bone, and in the direction of this latter. This double purpose is answered by using the humerus as a lever of the first species, that is, by bringing its inferior extremity forward, inward, and upward, and pushing the shoulder backward, upward, and outward: the humerus may be converted into a lever of the first species, by placing a cushion in the arm-pit, which cushion will act as a fulcrum to the lever.

The Arabians, and Ambrose Paré, saw, though indistinctly, the necessity of this practice, and now and then had recourse to it; but it remained for Desault fully to develope it, and invent an appropriate apparatus.

The practice of this celebrated surgeon consisted in applying in the arm-pit a cushion, made of hair or flocks, five or six inches long, and three inches and a quarter thick at its base. To the corners of its base, placed upward, are fastened two strings,

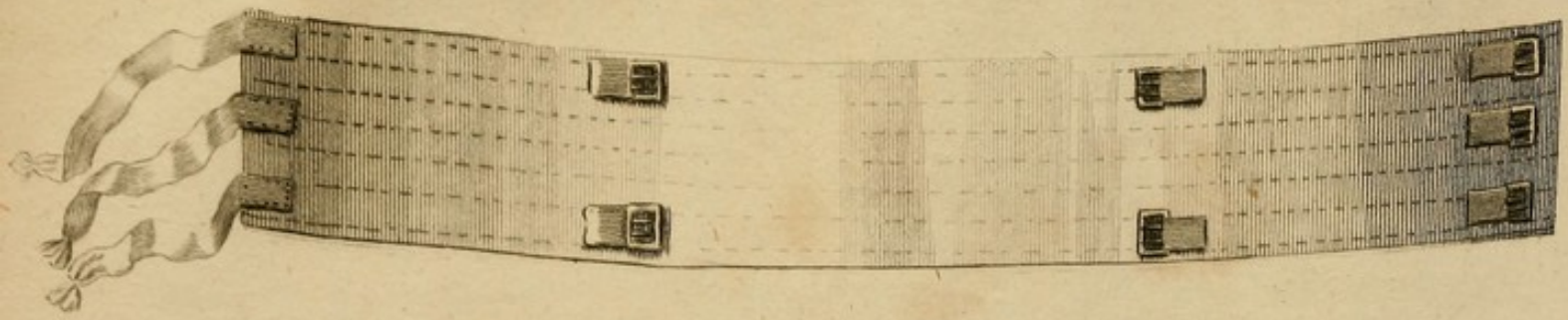
strings, which being passed across the back and breast, are to be tied on the opposite shoulder. The cushion being thus placed, the surgeon seizes the patient's elbow, the fore-arm being bent, and brings it forward, upward, and inward, pressing it with force against the breast. By this manœuvre the humerus carries the shoulder outward; the ends of the fractured portions are placed opposite one another, and the deformity disappears. All that is then necessary, is to fix the arm in that situation, and prevent it from moving all the time that nature requires for the consolidation of the fracture. For this purpose an assistant supports the arm in the position given to it by the surgeon; while he takes a bandage nine yards long, rolled up in one, and places one end of it in the arm-pit of the opposite side, and draws it from thence over the superior part of the arm, and across the back to the same part. This first cast of the bandage is exactly covered by another, which secures it, and the succeeding casts are made to overlap one another one third, until the arm is covered down to the elbow; taking care at the same time to draw the bandage tighter in proportion as it descends; because the bandage must be considered as the force which acts on the lever; for which reason it should operate particularly on its extremity. This

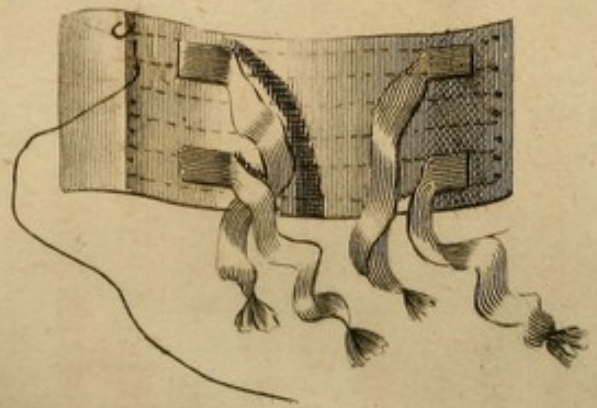
This first bandage being applied, compresses impregnated with camphorated spirit, or any other resolvent fluid, are placed along the fractured bone. Then another bandage as long as the former, is taken by the operator, and one end of it placed under the arm-pit of the opposite side, from whence it is drawn across the breast over the compresses and the fractured part, down behind the shoulder and arm, and upward on the breast, after having passed under the elbow; it is then brought across to the sound shoulder, under and round which it is passed, in order to secure the first cast; it is then drawn across the back, brought over the compresses, carried down before the shoulder and arm, under the elbow, and obliquely behind the back to the arm-pit, where the application commenced. The same process is repeated until the bandage is entirely applied. The principal use of this bandage is to support the arm; it admits therefore of some variety in its application. By means of these two bandages, the external broken portion is raised upward, and pushed outward, and therefore the two principal objects are attained. The whole apparatus may be still further fixed and secured, by pinning the bandage where it appears to have any effect. Finally, the hand is to be supported by means of a sling.

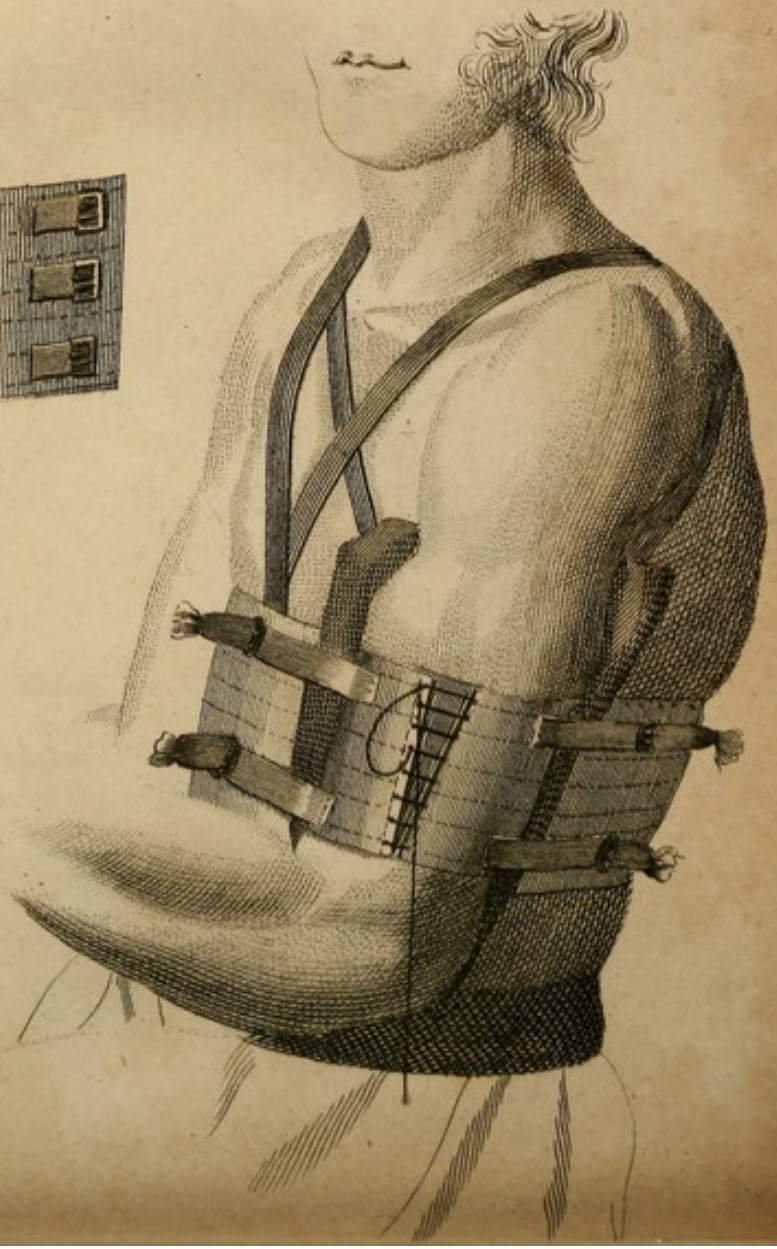
It has been recommended to make the cushion for the arm-pit of old linen, but hair or flocks are preferable for that purpose. A cushion made of them is soft, and will not benumb the arm by compressing the brachial plexus, or occasion an inflammation or gangrene of the parts.

It must be allowed that this bandage of Desault fulfils every indication of cure; but it has a disadvantage necessarily attendant on every such bandage, passed by a great number of casts round a part so bulky as the trunk: it is easily deranged. The dilatation of the thorax contributes much to this effect, particularly in women. It has a further disadvantage with respect to females, namely, its pressure on the mammæ, which must make it at least very troublesome. In both man and woman it renders respiration difficult. To these disadvantages may be added that arising from the difficulty of applying it, on account of the number of pieces of which it consisits, and the length of time requisite for its application. Every time that it becomes deranged, it will be necessary, in order to re-apply it, to raise the arm and move the shoulder more or less, which motion counteracts the consolidation of the fracture.

Convinced







Convinced by his own experience, of these disadvantages of Desault's apparatus, Citizen Boyer has invented the following one, more simple and less troublesome; by means of which he has effected a complete cure of a fracture of the clavicle, without deformity.

It consists of a girdle of linen cloth, quilted, and six inches broad, which passes round the trunk on a level with the elbow: it is fixed on by means of three straps, and as many buckles fastened to its extremities. At an equal distance from its extremities are placed externally on each side two buckles: that is, two anterior and two posterior to the arm. A bracelet of quilted linen cloth, five or six fingers broad, is placed on the lower part of the arm of the side affected, and laced on the outside of the arm; four straps fixed to this bracelet, that is, two before and two behind, correspond to the buckles on the outside of the girdle, already described, and answer the purpose of drawing the lower part of the arm close to the trunk; the more so, as the straps, by being two before and two behind, prevent the arm from moving either backward or forward. With this apparatus, as well as with the preceding, the cushion must be applied under the arm.

Nothing can be easier than the treatment of a simple fracture by means of this apparatus, the use and application of which may be more easily conceived by the assistance of the engraving at the end of this volume. The patient himself may tighten the straps and press the elbow to the trunk, whenever it is found necessary. He may quit his bed in a few days and walk about, having the hand and forearm supported in a sling. A fracture of the clavicle is frequently consolidated in thirty days, during which time the patient need not be confined to any very strict regimen.

These fractures, when compound, are treated as directed in Chapter I. In some cases it may be necessary to rub an irritating substance on the arm, when a paralytic affection of it remains. If the fracture be double or comminutive, it will be well to apply a flexible splint over the compresses moistened with a resolvent liquid, as already directed.

If Desault's bandage be employed, it will be necessary to renew it as often as it becomes slack; and we believe that its having been found unsuccessful by several practitioners, is to be ascribed to the neglect of this particclar circumstance.

CHAPTER X.

OF FRACTURES OF THE HUMERUS.

This bone may be fractured in any point of its length: in the middle, at either extremity, or above the insertion of the pectoralis major, latissimus dorsi, and teres major. The affection in this last-mentioned case is termed fracture of the neck of the humerus; but that denomination has not the merit of being strictly anatomical. It is possible, however, that what is strictly called the neck of the humerus may be fractured, particularly by a gun-shot wound. By neck of the humerus, we understand that circular narrowing which separates the tuberosities from the head.

The fractures of this bone may be transverse or oblique, simple or compound. In short, whatever has been said of the differences of fractures in general, is applicable to those in particular. The same may be said of the causes, whether acting on the extremities of the bone, or immediately on the part fractured.

The transverse fractures of the middle part under the insertion of the deltoid muscle, are

attended with but a trifling derangement. The anterior brachialis and triceps brachialis, attached posteriorly and anteriorly to both fractured portions, counteract one another, and admit only a slight angular derangement. When the fracture takes place above the insertion of the deltoid muscle, the inferior portion is first drawn outward, and then upward on the external side of the superior. Fractures of the humerus, near its lower end, such particularly as are transverse, are not subject to much derangement: an effect which is to be attributed to the breadth of the fractured surfaces; to their being covered posteriorly by the triceps brachialis, and anteriorly by the brachialis anterior, which admit only a slight angular derangement by the inferior portion being drawn a little forward.

The oblique fractures are always attended with derangement, whatever be the part fractured. The inferior portion being drawn upward by the action of the deltoides, biceps, coraco-brachialis, and long portion of the triceps, glides easily on the superior, and passes above its lower extremity. Finally, fractures of the neck of the humerus are always attended with derangement, which is produced by the action of the pectoralis major, latissimus dorsi, and teres major, which being

being attached to the lower portion near its superior extremity, draw it first inward and then upward, in which last direction it is powerfully aided by the biceps, coraco-brachialis, and long portion of the triceps. The superior portion itself is, in this case, directed a little outward by the action of the infraspinatus, supraspinatus, and teres minor, which make the head of the humerus perform a rotatory motion in the glenoidal cavity.

We proceed to examine the different marks by which these fractures may be ascertained.

The shortening and change in the direction of the limb, the crepitation, which may be very distinctly perceived by moving the broken pieces in opposite directions, the pain, and impossibility of moving the arm, &c. joined to the history of the preceding circumstances, render it easy to establish a diagnosis. It may happen, however, from ignorance or inattention, that a luxation of the cubitus may be mistaken for a fracture of the lower extremity of the humerus. In treating of luxation, we shall state how this mistake, which might be of the most dangerous consequence, may be avoided.

Fractures of the neck of the humerus are not so easily ascertained, and have been frequently, for want of attention, confounded with luxations of that bone. The diagnostic symptoms of these two affections are however very different.

When the neck of the humerus is fractured, a depression is observed at the superior extremity and external side of the arm, which is very different from that accompanying the luxation downward and inward of that bone. In the latter case, under the projection of the acromion, a deep depression is found in the part which the head of the humerus naturally occupies; whereas, in the fracture of the neck of that bone, the shoulder retains its natural form, the acromion does not project, and the depression is found below the point of the shoulder. Besides, in examining the arm-pit, instead of finding there a round tumour formed by the head of the humerus, the fractured and unequal extremity of that bone will be easily distinguished. The motion of the broken portions, and the crepitation which may be produced by moving them, serve still further to establish the diagnosis.

A simple fracture of the body of the humerus is not a very dangerous affection: in that near

the

the extremities, the danger is greater, because, as has already been mentioned, inflammation and false anchylosis are more to be apprehended, and the management of the fracture is more difficult.

Transverse or oblique fractures of the humerus are easily set. An assistant placed on the side not affected, and having his hands passed before and behind the thorax, fixes the shoulder, while another draws down the humerus by seizing the fore-arm, or even the condyloid processes of the humerus: the operator then places the fractured surfaces in proper contact. The criterion of the fracture being well set, is the arm having its proper length, form, and direction, so that the external condyloid process or tuberosity of the humerus may correspond with the most salient part of the shoulder. When the fracture is thus set, the surgeon takes a bandage eight yards long rolled up in one, and having placed some lint in the palm of the hand, commences the application of the bandage on that part, drawing by its means the fingers close together, after which it is rolled upward on the rest of the arm, each cast covering a part of the preceding. When it is brought as far as the elbow, the fore-arm is to be bent; and when carried as high as the de-

pression under the insertion of the deltoides, some lint is to be placed under it, in order that the compression may be as equal as possible; the whole arm is to be covered alike; but three folds, one over the other, are to be made on the situation of the fracture. When the bandage has reached the shoulder, four thin splints of wood, or, still better, of tin, slightly convex, are to be applied one opposite the other on the arm; or, if the arm be very slender, three splints may suffice. While an assistant holds these splints, they are fixed by turns of the bandage carried downwards, which cover one another partially as before. The bandage is brought up again in the same manner; and, if long enough, down again on the arm and fore-arm. The turns of the bandage which serve to fix the splints, ought not to be drawn so tight as to cause pain.

It is indispensably necessary to apply the bandage on the hand and fore-arm, as otherwise these parts would tumefy, on account of the circulation in the veins and lymphatics being obstructed. This obstruction, though not very painful, is at least troublesome. Besides, the articulation is rendered stiff by the swelling, and the stagnant fluid becoming thick, conduces very much to produce a false anchylosis. Should this precaution have

been omitted at first, the bandage should be applied even after the swelling has taken place. It is scarcely necessary to say, that every part of the bandage ought to be impregnated with some resolvent liquid: independently of the repellent effects of the liquid, the bandage can be better applied when wet than when dry.

If the patient keep his bed, a pillow should be placed under the arm; on the contrary, if he remain up, it will suffice to support the hand half prone in a sling. If the patient be very vigorous, it will be prudent to draw some blood, and to put him on a very low diet for some time. If no bad symptom come on after the application of the apparatus, it need not be taken off before the fifth day, and afterwards every eighth or tenth day, so that the consolidation will be found perfect at the fourth or fifth removal. It should be more frequently re-applied for a fracture of the lower extremity of the humerus. The articulations of the elbow and shoulder should be frequently moved, in order to prevent a false anchylosis; but the motion should not be attempted before the callus has acquired a certain degree of solidity.

If the fracture be complicated with violent contusion, and great inflammation be inevitable, or already established, the limb should be placed on a pillow, the fore-arm half bent, the hand prone, and a little raised, in order to facilitate the circulation in the veins and lymphatics. Scultet's bandage is first applied, its separate pieces being previously extended on a linen cloth as long as the humerus; the splints are rolled in this cloth, and applied over the bandage, care being taken to place little chaff bags where they may be necessary, as before directed. The strings or tapes with which the whole is to be bound externally, should not be drawn too tight. It will be necessary to apply emollient poultices on the arm, when the resolvent applications do not discuss the swelling. By accompanying these means with the general treatment in similar cases, such as bleedings, rigorous abstinence, diluent and cooling drinks, the inflammatory symptoms disappear in seven or eight days, and the rolled bandage, as last described, may be substituted for that of Scultet. If the fracture be comminutive, or complicated with wound, the treatment will vary as directed in Chapter I. on the General Treatment of Fractures.

It has been advised in fractures of the lower extremity of the humerus, to place the four splints in such a manner as that they should extend equally on the arm and fore-arm, care being taken to equalize the anterior and posterior sides, particularly the bend of the arm and olecranon, with the rest of the limb, by means of graduated compresses properly disposed. But this extension of the whole member would be painful, and might produce a false anchylosis of the elbow.

If the case require it, four splints may be so hinged in their middle part, as that the anterior and posterior ones should open or close up on their breadth, and the two lateral ones on their edges. Instead of these hinged splints, Citizen Boyer has successfully employed four simple splints for the humerus, and four more for the fore-arm.

The fracture of the neck of the humerus requires a mode of treatment which it is necessary to particularize. It has been proposed in this case to apply the spica, or the eighteen-tailed bandage, and other means equally insufficient. Moscati, a surgeon of Milan, sensible of the difficulty

difficulty of acting in these cases on the superior portion, invented a means by which this inconvenience was overcome. This consisted in filling the arm-pit, previously covered with a cloth fastened on the outside of the shoulder with tow soaked in a mixture of alum and the white of an egg beat up together. He covered the shoulder with a similar preparation, and over that applied the spica bandage. This mixture dried up rapidly, and formed a hard crust round the part. This mode of treatment (described by the author in the Memoirs of the Academy of Surgery) has a great disadvantage; it forces the patient to keep his arm at a distance from the trunk; and this strained and unnatural position is incompatible with the exact juxta-position of the broken portions, the situation of which cannot be known while covered by this substance.

Ledran thought of combining this invention of Moscati's with the means used by the ancients, which consisted in making the trunk serve as an internal splint, and binding the arm to the trunk by a circular bandage. This correction by Ledran led to the invention of the bandage for the clavicle, the application of which Desault extended

tended to fractures of the neck of the humerus. According to this method, the arm is enveloped by a bandage, and the elbow pressed toward the breast, a cushion being first placed in the arm-pit: another circular bandage is then passed round the arm and trunk, splints are applied to the anterior, posterior, and lateral parts of the arm, and some compresses wet with a resolvent liquid are applied on the shoulder.

By means of this apparatus, fractures of the neck of the humerus consolidate as easily, and sometimes in less time than those of its middle part.

It sometimes happens, that in young subjects the head of the humerus, being yet but an epiphysis, separates from the rest of the bone in consequence of a blow or fall; which affection, both as to the diagnostic symptoms and treatment, is analogous to a fracture of the same part in a more advanced age. It is, however, particularly necessary in this case, to fill the arm-pit so as to throw outward the lower portion of bone; because, if the parts be not exactly and fairly united, the motions of the arm will be impeded to a certain degree for ever after.

In compound fractures of the neck of the humerus, as well as in those of the body of that bone, no attempt is to be made to set the fracture till the inflammatory symptoms have subsided.

CHAPTER XI.

OF FRACTURES OF THE FORE-ARM.

Some authors have denominated complete, those fractures of the fore-arm in which both bones are fractured; and incomplete, those in which one only is fractured. We have already given it as our opinion that these denominations are fallacious, and we will substitute for them that of fracture of the fore-arm, when both the bones of which it is composed are fractured; and that of the radius or cubitus, where only one of these bones is fractured.

SECTION I.

Of Fractures of the Fore-arm.

They are almost always the consequence of a fall, or blow on the fore-arm, and take place in the part on which the cause has immediately acted. It is difficult to imagine, that, by a fall on the palm of the hand, both bones could be fractured at once, because the radius alone receives the impulse communicated by the hand: the cubitus

bitus having no immediate connexion with the hand, cannot be often fractured by this cause.

These bones may be fractured on the same level, as most frequently happens, or the fracture of one may be higher than that of the other. Fractures of these bones, whether transverse or oblique, are generally complicated with greater or less contusion, wound, detached splinters, and other concomitants of affections of this kind.

The connexion of the two bones of the fore-arm by the interosseous ligament which occupies the interval by which they are separated, and the manner in which the muscles which are attached to both, are inserted into them, render the derangement of the broken pieces in the longitudinal direction very difficult; and, in reality, a derangement in this direction has been seldom observed, and never to any considerable degree: when it does take place, it is to be ascribed to the cause of the fracture rather than to muscular contraction. The derangement in the direction of the diameter, on the contrary, always takes place in such a manner, as that the four pieces approach one another, and the interosseous interval diminishes, or is entirely obliterated at that part near the seat of the fracture; which approximation

proximation of the ends of the bones causes an evident deformity of the part.

To this derangement must be added the angular, which the fracturing cause always produces, either forward or backward, according to its direction.

The existence of these fractures is easily ascertained from the history of the circumstance, from the pain, which is rendered more acute by moving the hand, from the impossibility of performing pronation or supination of the hand, and from the noise produced by the friction of the fractured surfaces whenever these motions are attempted; finally, from the change in the form of the arm, the anterior and posterior sides of which appear tumefied by the protrusion of the muscles which the broken bones have displaced from the interosseous interval, the other sides being depressed, and from the mobility of the broken portions, and change in the direction of the arm.

When these bones are fractured near their inferior extremities, the inflammatory swelling might render a diagnosis less clear, and cause the fracture to be mistaken for a luxation of the hand. But the two cases may be distinguished

by simply moving the hand; by which motion, if there be luxation without fracture, the styloid processes of the radius and cubitus will not change their situation; but if a fracture do exist, these processes will follow the motion of the hand.

In order to adjust a fracture of these bones, the fore-arm is bent to a right angle with the arm, and the hand placed in a position between pronation and supination. The fore-arm and hand being thus placed, an assistant seizes the four fingers of the patient, and, by pulling, extends the fractured parts, while another assistant makes counter-extension by fixing the humerus with both his hands. By these means, the operator is enabled to restore the bones to their natural situation, and to push the soft parts into the interosseous space, by a gentle and graduated pressure on the anterior and posterior sides of the arm. Coaptation is very easy in fractures of these bones, as are indeed all the other parts of the operation, in which effort and violence are not at all required.

The fracture being thus set, the bones are kept in their place by applying first on the anterior and posterior sides of the fore-arm two longitudinal and graduated compresses, the base of which

which is to be in contact with the arm. The depth of these compresses should be proportioned to the thickness of the arm, increasing as the diameter of the arm diminishes. In the next place, the surgeon takes a bandage about six yards long rolled up in one, and makes three turns of it on the fractured part, descends then to the hand by casts partially superposed on one another, and envelopes the hand in passing the bandage between the thumb and index: the bandage is then carried upward in the same manner, and reverted wherever the inequality of the arm may render it necessary. The compresses and bandage being thus far applied, the surgeon lays on two splints, one anteriorly, the other posteriorly, and passes the part of the bandage that yet remains over them, in such a manner as entirely to cover them. It may not be unnecessary to remark, that the compresses and splints should be of the same length as the arm. It would be useless to employ lateral splints in this case, unless (what is scarcely ever to be expected or met with) a derangement should have taken place in that direction. It is evident, that lateral splints would counteract the compresses and two other splints, by increasing the radio-cubital diameter of the arm, and by concurring with the action of the pronatores to

move the pieces into the interosseous space. The surgeon's attention should be most particularly directed to preserve the interosseous space; for, if this be obliterated, the radius cannot rotate on the cubitus, nor the motion of pronation or supination be executed; and this object may be obtained with certainty by applying the compresses and splints in such a manner as that the fleshy parts may be forced into, and confined in, the interosseous space, and by renewing the bandage every seven or eight days.

Such is the treatment of a simple fracture of the fore-arm. If the contusion be excessive, with wound or comminutive fracture, the splinters should be extracted, the arm placed on a pillow, and dressed with the usual topical applications adapted to the degree of inflammation, the patient bled, and Scultet's bandage applied. If the inflammatory symptoms continue a certain length of time, the bones consolidate in a manner that deforms the arm, and renders it impossible to perform the movements of pronation and supination: this may be prevented, if the inflammatory symptoms disappear so much on the fifteenth or twentieth day as to admit the application of the apparatus for simple fractures.

If the fracture be simple, and the contusion inconsiderable, it will not be necessary to confine the patient to bed: he may be allowed to walk about and attend to his business, having the arm supported in a sling. The consolidation is generally perfect in thirty or forty days, no difference being perceivable in the time necessary for the generation of the callus in the case in which the two bones are fractured, and that in which only one is broken.

SECTION II.

Of Fractures of the Radius.

Of all fractures of the fore-arm, this is the most frequent: the radius being almost the sole support of the hand, of which it has been called the *manubrium*, and being in the same line with the humerus, is for both these reasons more exposed to fracture than the cubitus, which corresponds with the hand only by a very small surface, and which does not form a straight line with the humerus.

Fractures of this bone, whether transverse or oblique, near its middle part or extremities, may be caused by a fall or blow on the fore-arm, or, as happens in most cases, by a fall on the palm

of the hand. When the body is thrown off its centre of gravity, and falling appears inevitable, we are apt, from habit, to extend our arms, and let the hands come first to the ground; in which case, the radius, pressed between the hand which is supported on the ground, and the humerus, from which it receives the whole momentum of the body, is bent, and, if the fall be sufficiently violent, broken more or less near its middle part. When, after an accident of this kind, pain and a difficulty of performing the motions of pronation and supination supervene, the probability of a fracture of the radius is very strong. The truth is fully ascertained by drawing the hand along that bone on the external side of the fore-arm, with as great a degree of pressure as the pain excited will admit: besides, in endeavouring to perform supination or pronation of the hand, a crepitation will be heard, and the moving of the broken portions perceived, if the bone be in reality fractured; but it is not amiss to warn against mistaking the noise made by the tendons of the muscles of the thumb which wind on the inferior and exterior part of the radius, for a crepitation produced by the rubbing of the fractured surfaces. These tendons are thick and dry in labouring people, and cause a certain noise on being moved in their sheaths, in which there

is a scarcity of synovia. This noise is easily distinguished from crepitation by an experienced ear. When the fracture takes place near the head of the radius, the diagnosis is more difficult on account of the depth of soft parts over the bone in that part. In this case, the thumb is to be placed under the external condyle of the os humeri, and on the superior extremity of the radius, and at the same time the hand is to be brought to the prone and supine positions. If in these trials, always painful, the head of the bone rests motionless, there can be no doubt of its being fractured. The causes of derangement are here the same as in fractures of the fore-arm, and it can never take place but in the direction of the diameter of the bone, and is effected principally by the action of the pronating muscles. The cubitus serves as a splint in fractures of the radius; and the more effectually so, as these two bones are connected with one another in their whole length. Notwithstanding the evidence of the mechanism which prevents the longitudinal derangement, J. L. Petit has thought that derangement possible.

Extension and counter-extension are made in the same way as in fractures of both bones of the fore-arm, with this slight difference, that the as-

sistant who makes the extension should incline the hand to the cubital side of the fore-arm. Great care is to be taken, that, by means of graduated compresses placed on the anterior and posterior sides of the fore-arm, the natural shape be restored, the convexity produced by the fracture removed, and that the bandage may act principally on the extremities of the dorso-palmaris diameters, by which action the fleshy parts will be pressed in between the two bones, and therefore these bones kept separate, and the interosseous space preserved to the extent which is natural, and which is necessary for the pronation and supination of the hand.

It would be superfluous to repeat here what has been said in the preceding section on the mode of perfecting the cure, and combating the symptoms which might complicate the fracture: the treatment in this respect being absolutely the same in both cases.

SECTION III.

Of Fractures of the Cubitus.

FRACTURES of this bone, less frequent than those of the radius for the reasons already mentioned,

tioned, take place generally at its lower extremity, because it is smaller and less covered at that part than at any other; consequently we find, that a fracture of this bone is almost always the result of a force acting immediately on the part fractured; as, for instance, when one falls and strikes the internal side of the fore-arm against a hard resisting body. On applying the hand judiciously on the inside of the fore-arm, this fracture is easily ascertained by the depression in that part, from the inferior portion being drawn toward the radius by the action of the pronator radii quadratus. This derangement is in general less than that which takes place in fractures of the radius. The superior portion of the cubitus remains unmoved, as has been well observed by J. L. Petit.

In this case, the assistant who extends the parts, inclines the hand to the radial side of the fore-arm, the surgeon pushes the flesh between the two bones, and applies the apparatus last described. In all fractures of the bones of the fore-arm, and particularly in those which are near the head of the radius, a false anchylosis is to be apprehended, and should be guarded against by moving the elbow gently and frequently, when the consolidation is advanced to a certain degree.

gree. This precaution is more especially necessary in fractures of the olecranon.

SECTION IV.

Of Fractures of the Olecranon.

This curved process, by which the cubitus is terminated superiorly, its anterior surface being covered with cartilage, and its posterior having the tendon of the triceps brachialis inserted into it, is very analogous to the patella; and the resemblance would be perfect, if the latter, instead of being attached to the tibia by a strong ligament, were a continuation of its substance, as the olecranon is of that of the cubitus. This similitude is still stronger in the fractures of these two bones; so that what will be said on fractures of the patella, to which a long chapter shall be consigned, may be applied to those of the olecranon.

These last-mentioned, which almost always take place at the base, and seldom at the summit of the olecranon, may be oblique, but are more frequently transverse. They are occasioned sometimes by the contraction of the triceps brachialis, but more frequently by some external

force, as by a fall backward on the elbow. The fracture of the patella is, on the contrary, more frequently produced by muscular contraction than by an external cause.

When the olecranon is detached from the cubitus by any cause, it is always drawn upward by the contraction of the triceps brachialis, and the interval between it and the cubitus is perceptible to the touch or sight, and increases or diminishes by the flexion or extension of the forearm. The ascent of the separated olecranon along the lower extremity of the humerus, may be more or less considerable. in all cases, however, it ascends above the condyles, or lower tuberosities of the humerus. Finally, the olecranon may be pushed by the fingers to one side or other, without any motion being communicated to the cubitus.

Nothing can be easier than to distinguish by these marks a fracture of the olecranon, from a luxation of the cubitus backward, with which, however, it has been confounded. It is true, that when the fracture has been occasioned by an extremely violent cause, the contusion and inflammatory swelling may be so great as to render the diagnosis difficult, if not impossible.

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But this uncertainty should not influence the treatment, which must be directed first against the inflammation, whether the fracture exist or not. When the inflammation and its concomitant symptoms have been allayed by blood-letting, the use of emollients, and other such means, the discovery of the fracture will be easy; and if it be found to exist, it is to be treated in the following manner.

The divided parts are brought into contact, by extending the fore-arm, and pushing down the olecranon from the place to which it had been drawn by the contraction of the triceps. The principal object is to counteract the action of this muscle, which tends incessantly to separate the detached olecranon from the cubitus. To effect this purpose, a circular bandage, moderately broad, is passed on the fore-arm, fully extended; this being done, the olecranon is pushed down into contact with the cubitus, and the middle part of a long compress placed behind it, the extremities of which are brought downward, and crossed on the anterior part of the fore-arm; after which several turns of the bandage made so as to cross one another, are carried round the articulation of the elbow. The bandage should then be rolled up on the humerus,

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in order to diminish, by pressure, the irritability of the triceps brachialis, which is relaxed by the extension of the fore-arm. This bandage being applied, the bend of the fore-arm is filled with lint, and a long splint applied on it anteriorly, by which the flexion of the arm is prevented. This splint is fixed by the same bandage, rolled on downward from the shoulder to the wrist, and upward again if the bandage be long enough. The oblique casts of the bandage, which cross one another on the articulation, forming a kind of a figure of 8, ought to be nicely applied, and drawn very tight; because, if but slightly braced, their action, which is oblique, will not be sufficient to confine the olecranon to its situation. Previous to the application of these oblique casts, the skin of the olecranon should be drawn up by an assistant; for, if this precaution be not taken, it may sink between the divided portions, and prevent their contact.

Though the contact be exact immediately after the application of the bandage, yet if, as is apt to happen, the bandage become relaxed, or if the patient inadvertently contract the triceps, the olecranon ascends, because the bandage, acting perpendicularly to its direction, can but feebly

feebly oppose the ascent of this process. An interval will therefore exist between the cubitus and olecranon, which will be filled up by granulations, and by the thickening of the periosteum, or tendinous expansion of the triceps which covers that bone; and the reunion of the parts will be effected by means of an intermediate ligamentous substance, the length of which will depend on the careful application and frequent renewal of the bandage.

To this cause, as Camper supposed, is to be attributed the impossibility of obtaining an immediate reunion of the olecranon to the cubitus, and not to a defect of periosteum, or humectation of the parts by synovia, as some authors have thought.

We shall state the grounds of our opinion on this subject in treating of fractures of the neck of the humerus, and of the patella. In forty or forty-five days the ligamentous substance acquires its greatest consistence, but the articulation should not be kept motionless so long; gentle motion may be commenced on the twenty-fifth or thirtieth day. The object of these motions is to prevent a false anchylosis of the articulation, not, as David thought, by preventing

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the growth of inequalities or asperities on the callus, but by facilitating the absorption of the inspissated fluids accumulated about the part; by stimulating the secretion of synovia, and exciting the irritability of the muscles, benumbed by long inactivity.

In cases of recovery obtained by these means, the olecranon adheres to the cubitus firmly enough to transmit to it the action of the triceps muscle, and to moderate the extension of the fore-arm.

Compound fracture of the olecranon is an accident of the most grievous nature, on account of the great number of nerves which pass in the neighbourhood of that part; it should therefore be treated with the greatest care: the inflammatory symptoms are to be combated by copious and repeated bleedings; the arm is to be placed half bent on a pillow, and dressed with Scultet's bandage. In these cases the intermediate ligamentous substance is always longer than in simple fracture, and, consequently, the force of the arm is much diminished. If a false anchylosis be prevented by judiciously exercising the articulation as soon as the state of the parts will permit, the patient may think himself fortunate.

If the inflammatory swelling, &c. be not dissipated before the twenty-fifth or twenty-sixth day, the application of the apparatus we have described will be useless, because it will be necessary, at that time, to begin to exercise the articulation, the formation of the ligamentous substance being then considerably advanced.

CHAPTER XII.

OF FRACTURES OF THE BONES OF THE HAND.

SECTION I.

Of Fractures of the Bones of the Carpus.

The eight small bones which, placed in two rows, compose this part of the hand, are susceptible only of comminutive fracture. Their smallness, and spongy texture, do not admit of their being fractured but by a cause which acts on them immediately; and, in fact, fractures of them are always occasioned either by a gun-shot wound, or some very heavy body falling on the hand. It is obvious that in cases of this nature, more attention is to be paid to the state of the soft parts than to the fracture. It often happens, that fractures of these bones render amputation at the articulation of the wrist necessary, or even that of the fore-arm.

SECTION II.

Of Fractures of the Bones of the Metacarpus.

FRACTURES of these bones are rare, because any impulse received by the hand is divided between all these bones. That which supports the thumb, and which is unconnected with the others, would be frequently fractured, if its mobility did not secure it against that accident.

These fractures are always the result of a force immediately applied; for the length of the metacarpal bones, though ranged in the class of long bones, so little exceeds their other dimensions, that it can never happen that a force acting on their extremities can break them about their middle part. If the hand be very forcibly pressed between two bodies, or if a heavy body fall on it, comminutive fracture will be the result; and almost always several of these bones are fractured at once. The following case, however, furnishes an example of a fracture of one of them. An armourer proving some muskets, made use of an iron ram-rod for setting fire to the priming: the musket was forced back by the explosion, and the iron rod thrust into his

his hand, so as to project on the other side, and raise up the integuments. The rod was drawn out, and the wound dressed with lint and emollient poultices; and on the fourth day the patient complained of excessive pain, when he attempted to bend the fourth or ring finger. On examining the part with care, and pressing the fourth bone of the metacarpus, it was found by the crepitation and motion, that that bone was fractured. Two long compresses were applied, one to the palm and the other to the back of the hand, both corresponding to the fractured bone: over these were placed splints, which extended to the extremity of the finger. A bandage was then rolled round the hand and three last fingers. The suffering of the patient ceased immediately on the application of this bandage, and his recovery was complete in six weeks. Comminutive fracture of these bones, as well as that of the carpus, frequently renders amputation necessary.

SECTION III.

Of Fractures of the Phalanges of the Fingers.

FRACTURES of these bones being uniformly the effect of the immediate action of the cause, are

always attended with more or less contusion. The alteration in the form of the finger, the motion of the broken pieces, and the crepitation occasioned by it, leave no doubt as to the existence of the fracture.

The longitudinal derangement of a fractured phalanx is very difficult; and, in fact, that in the horizontal direction is almost the only one observed: it is effected by the flexor tendons, which draw the inferior portion to their side. The broken pieces may be brought into their proper situation, by pulling by the extremity of the finger, whilst the hand is fixed by an assistant. A circular bandage, moistened with a solution of acetate of lead, is then rolled round the finger, and over that are placed four splints of thin wood or pasteboard, which are fixed on by the same bandage: the whole dressing is completed by including the two adjacent fingers in the last turns of the bandage.

Fractures of these bones are generally united in twenty-five or thirty days, but the finger continues a little stiff for about two months, at the end of which time the stiffness entirely vanishes.

When a very heavy body has crushed the extremities of the fingers, or when they have been bruised by a folding door, the soft parts are generally lacerated, the nail torn off, and the last phalanx fractured and denudated. If in such cases the parts hold together by a shred of a certain thickness, and which contains vessels enough for the nourishment of the phalanx, the reunion of the parts should be attempted. The prospect of success, it is true, is not great in most cases; but if our endeavours to save the finger fail, amputation is still as much in our power as in the commencement.

If the last phalanx alone is crushed, it will be better to amputate at once, than attempt to save the joint. The cure would be tedious and difficult, on account of the exfoliation that would take place. Besides, the part being deformed, instead of being useful, would be troublesome. By amputating at the articulation with the second phalanx, a simple wound is substituted to the lacerated and ragged wound produced by the cause of the fracture. This will heal in a very short time, if care be taken to preserve a sufficiency of skin to cover the surface of the articulation.

CHAPTER XIII.

OF FRACTURES OF THE THIGH.

WHAT has been said of the treatment of fractures in general, in the first chapter of this work, is more especially applicable to those of this bone than to any other. The femur is much exposed to fracture from the nature of its functions, its length and direction; and, notwithstanding the great depth of soft parts by which it is covered, yet it is frequently fractured.

It may be fractured in any point of its length, near the middle or either extremity. We shall devote a particular chapter to fractures of its superior extremity, or neck: but besides these last-mentioned, there is another species of fracture, which consists in the separation of the great trochanter from the body of the femur. In the fractures of the lower extremity of the femur, not only one of the condyles may be separated longitudinally from the rest of the bone, but both condyles may, at the same time, be separated one from the other, and from the rest of the bone. All varieties of simple or compound

fracture

fracture may be observed in those of the femur. They may be produced in any part of it by a cause acting immediately on that part, or by a force acting on its extremities, which will probably produce a fracture of the middle part, where the bone is naturally bent: a fracture produced by any of these causes, may be transverse or oblique.

Derangement of the fractured portions is a uniform concomitant of fractures of the thigh; it may take place in any of the four directions already repeatedly mentioned, but that most frequently observed is the longitudinal derangement by which the limb is shortened. The numerous muscles of the thigh, by means of which derangement may be effected, are divisible into three classes, relative to the manner in which they tend or contribute to effect it. The three portions of the triceps femoris are attached to both pieces, and tend to produce the angular derangement by drawing the two fractured portions to a salient angle on the outside, where their fibres are the strongest and most numerous. The biceps femoris, semitendinosus, semimembranosus, sartorius, rectus internus, and third adductor, all those, in short, which extend

from the pelvis to the inferior portion, or to the leg with which it articulates, tend to draw the inferior portion upward, on the internal side of the superior, the extremity of which forms a tumour on the external side of the thigh. The inferior portion is that which is always displaced, except when the fracture takes place immediately under the small trochanter, to which process are attached, by a common insertion, the psoas and iliacus muscles; which muscles would, in such a case, draw the superior portion upward and forward, producing by that means a tumour in the groin.

When the femur is fractured immediately above the condyles, the inferior piece is drawn backward, and its superior surface turned downward by the action of the gastrocnemius externus, plantaris, and popliteus muscles. When the great trochanter is detached from the rest of the bone, it is drawn upward by the muscles which are inserted into it, but without producing any change in the direction or form of the thigh.

The angular derangement in which the foot inclines either inward or outward, is the effect of the weight of the foot, or of the bed-clothes, rather

rather than of muscular contraction. It shall be mentioned more particularly in treating of fractures of the neck of the femur.

Deformity and diminution of the length of the limb, a change in its direction, the tumour occasioned by the deranged portions of the broken bone, the impossibility of performing the ordinary motions, the acute pain and crepitation produced by the motion of the broken pieces one on the other, indicate a fracture of the femur in such a marked manner, that it is impossible to mistake it. Fractures of the thigh are, *cæteris paribus*, more dangerous than those of any other of our limbs, on account of the difficulty of keeping the pieces in a proper situation. The ancients considered a fracture of the femur difficult to be cured without a shortening of the limb; but at present the possibility of cure without any change or deformity is attested by numerous instances. It is to be remarked, however, that more unremitting care and attention is necessary in fractures of this bone, than in those of any other.

We shall point out, at some length, the objects to which the attention is to be particularly directed in the treatment of these fractures.

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The bed in which the patient is to lie should not exceed three feet in breadth; a broader bed would render the raising and reapplication of the apparatus very troublesome. It should have no foot-board, otherwise the assistant, whose duty it is to make the extension, could not conveniently draw the leg in the proper direction. Instead of a bed of down or feathers, a hair mattress should be used, which will not allow the limb, the weight of which is augmented by the apparatus, to sink. If mattresses of wool are the only bedding to be found, their solidity should be increased by placing between them thin elastic boards. The head of the patient should repose on a simple pillow, the horizontal position being one of the *desiderata*. When the head is too much raised by pillows, &c. the body tends to descend, and deformity of the limb will be the consequence, whatever attention may be paid in other respects.

These particulars relative to the bed being punctually attended to, an apparatus, as follows, is in the next place to be prepared: First, as many bandages, of three fingers breadth each, as will be sufficient to cover the leg and thigh, and which will form what has been already described under

the name of Scultet's bandage: secondly, a number of long compresses, wet with some resolvent liquid, which are placed on such parts of the limb as appear most inflamed: thirdly, a splint-cloth, or *fanon*, in which the two lateral splints are rolled: the splints should be long enough to extend externally, from the ridge of the os ilium, and internally, from the articulation of the femur, to a few inches beyond the sole of the foot; and anteriorly from the groin, or anterior side of the articulation of the femur with the bones of the pelvis, to the instep: fourthly, three bags of chaff, by means of which the sides of the thigh may be rendered parallel with the splints: fifthly, and finally, five strings or ribands, by which the rest of the apparatus are to be secured externally: two are to be placed on the thigh, two on the leg, and one is to be crossed on the instep and sole of the foot, and its ends made fast to the internal and external splints, in order to prevent the vacillation of the foot.

Some practitioners apply Scultet's bandage on the thigh only, and do not extend it to the leg, nor envelop the foot in long compresses, drawn moderately tight; in consequence of which neglect, the leg and foot are apt to swell, from the return

return of the fluids being impeded by the compression of the bandage on the thigh.

This apparatus should be extended on the bed on which the patient is to be laid, in the order of their application; that is, first, the strings or ribands; next, the *fanon* or splint-cloth; and over that Scultet's bandage, of which the different parts should partially cover one another; and last of all, the compresses. The patient, if dressed, is to be undressed very gently, and the fractured limb is to be moved as little as possible. In conveying the patient to the bed on which he is to lie during the treatment, the surgeon himself ought to support the fractured limb, and place it exactly on the middle of the apparatus. The setting is in the next place to be proceeded to; to effect which, the strongest of the assistants renders the pelvis immoveable, by pressing on the anterior and superior processes of the ossa ilia, whilst another assistant seizes the foot with both hands, the thumbs applied to the sole, and the fingers crossed on the upper part, and draws it with a gradual effort, first obliquely outward, and then quickly in its natural direction: the surgeon placed on the external side, performs the coaptation; but the great depth of integuments

renders

renders this part of the operation almost entirely useless.

The natural form and length of the limb being restored, the assistants continue the extension and counter-extension, while the surgeon applies the different parts of the apparatus in the order already described, rolling compresses on the thigh and leg, and commencing the application of Scultet's bandage from the lower extremity of the leg, and proceeding upward. The splints rolled up in the cloth, are placed perpendicularly on their edges, at a small distance from the leg, in which interval bags of chaff are to be placed, and, on the chaff being pushed into the different depressions, so as to equalize the surface of the limb, and provide for the equable pressure of the splints, these latter are pressed against the limb by the hands of an assistant, while the surgeon ties on the strings, by commencing with the one at the middle part of the thigh. The fillet crossed on the foot, and tied to the extremities of the lateral splints, is the last applied.

It may be necessary to bleed the patient once or twice, and to confine him to the antiphlogistic regimen for four or five days, at the end of which time

time no disagreeable consequences are to be apprehended. If the pain and suffering of the patient be not excessive, the apparatus need not be raised for the first three or four days, but this measure should not be deferred beyond that time; for, however well the fracture may have been set, and however well and permanently the apparatus may appear to have been applied, yet it is possible that the pieces of bone may have been displaced by the action of the muscles. By neglecting this precaution, and raising the apparatus only every eight days, the fractured portions have passed one another, and consolidated in that situation, and a lameness has been produced, which could never be remedied. At the end of about forty-five days, when, after having reapplied the apparatus eight or nine times, the callus is found so far formed as to bear the motion of the whole member, Scultet's bandage is to be taken off, and a simple roller substituted in its stead, capable of compressing the soft parts, and of preventing the œdematous swelling likely to take place.

The foregoing mode of treating fractures of the femur, and which is effectual when they are transverse, is of little or no effect in cases of oblique fracture, which was supposed by the ancients

cients to produce necessarily a shortening of the limb. In order to prevent this, continued extension, the mechanism of which shall be explained in the chapter on fractures of the neck of the femur, has been employed by the moderns.

If a very young child, as, for instance, one of two or three years, is to be treated for a fracture of the thigh, a roller of one piece may be employed instead of Scultet's bandage. Four elastic wooden splints should be applied on the opposite sides of the limb, and secured by the circular bandage, a part of which has been already applied. It is not necessary, in this case, that the splints should be longer than the limb, because the foot, at that age, bears a less proportion to the rest of the member, than at a more advanced period, and is not weighty enough to draw the limb to either side with it. The principal reason for preferring the circular bandage in the case of children, is the difficulty of reapplying the other apparatus every day, or as often as it may be soiled by the urine and fæces: it will be necessary, for the same reason, to roll up the whole limb, after the apparatus has been applied, in several folds of a strong linen cloth, which should be renewed every day. This is

the

the only case in which Scultet's bandage is not to be preferred to any other.

When the femur is fractured near the condyles, it will be necessary to stuff the hollow of the ham with lint, in order to prevent the lower fractured portion from being drawn back by the action of the muscles attached to it: if this derangement be not guarded against, the popliteal nerves and vessels may be wounded by the protrusion of the fractured end of the bone, and the worst consequences may ensue.

If the great trochanter be separated from the rest of the bone, the middle part of a long compress is to be applied on that process, and its extremities drawn downward and inward; over which compress a spica bandage for the groin is to be applied.

More time is necessary for the consolidation of fractures of the femur, than for those of any other long bone, on account of the great compactness of its texture, particularly near its middle part. For this reason it is in general necessary to continue the apparatus applied for fifty days, and sometimes for even a longer time.

If

If the consolidation be very tedious, a stiffness in the articulation of the knee will be a necessary consequence; and, if the fracture be so near the condyles as that the swelling and obstruction may extend to the articulation, this consequence will be inevitable, and very difficult to remove.

It would be superfluous to repeat here, respecting compound fractures of the femur, what has been already said on this subject in the first chapter, and frequently repeated by particular applications. We shall therefore, without further delay, proceed to consider the fractures of the neck of the femur.

CHAPTER XIV.

OF FRACTURES OF THE NECK OF THE FEMUR.

The neck of the femur may be fractured in any point of its extent. The fracture, however, most frequently takes place in its middle part, and more generally towards or at its base, than at its union with the head of the femur, although its base is its thickest part. These fractures exist, strictly speaking, within the articulation; the orbicular ligament of which adheres to the lower portion of the bone, the superior having no connexion with the rest of the body, but by the round ligament; except, however, the case in which the ligament reflected round the neck is not entirely ruptured. These fractures are almost always transverse; the reason of which is found in the spongy texture of the bone. In many cases the surfaces of the divided bone are very unequal, the one being marked with asperities or eminences, and the other with corresponding depressions.

There

There is another species or variety of this fracture which takes place outside the articulation, near the union of the bone with its trochanters, and sometimes between these two eminences, the greater of which adheres then to the superior portion. There have been so many instances of fractures of this nature, that all are now agreed as to the possibility of their taking place.

A member of the *ci-devant* Academy of Surgery fell on the great trochanter; the extremity of this side became shorter than that of the opposite, the foot and the knee inclined outward, and, in short, all the symptoms of fracture of the neck of the femur were manifest, and the existence of such a fracture was agreed on by a number of his brother surgeons. The fracture was treated in the ordinary way, and a cure was obtained, but not without a shortness of the limb. This person died shortly after from another disease; his body was opened, and the articulation of the thigh examined, when it was found that the fracture had taken place below the insertion of the orbicular ligament. I am indebted for this case to Citizen Lesne, a distinguished member of the Academy, and editor of the Posthumous Works of J. L. Petit. Citizen Boyer has met several cases of a similar kind.

I have seen a remarkable case of a shortened inferior extremity, in an old man, who died in the hospital of *La Charité*, in the year 7. A double fracture was found, one inside and one outside the orbicular ligament; the latter between the two trochanters, the larger of which was separated from the rest of the bone. Although the patient was eighty-three years of age, yet the consolidation had commenced.

Fracture of the neck of the femur, generally simple, is sometimes complicated with that of the great trochanter, very rarely with contusion, because the force which produces it does not act immediately on the part. Protected by a great depth of soft parts, and by the great trochanter, the neck of the femur is seldom fractured comminutively. That might however take place from a gun-shot wound; but as in that case the bones of the pelvis must also be fractured, and the parts contained in it injured: the fracture of the neck of the femur is but the slightest part of the affection.

Amongst the various fractures of the neck of the femur ought to be enumerated the decollation of the epiphysis, which, though rare, has

yet been observed. Paré * mentions the possibility of this decollation, allows that its diagnosis is extremely obscure, and assures us at the same time, that it has been often mistaken by very expert surgeons for a luxation. Young persons only are subject to this accident, because it cannot take place when the cartilage which unites the neck to the bone is ossified.

The superior extremity of the femur is entirely cartilaginous in the new-born infant; but soon after birth three points of ossification may be observed in it, one corresponding to the head of that bone, and the two others to the trochanters. These osseous points gradually spread, the cartilage diminishes, and at length entirely disappears; but the ossification of the head and neck is much slower than that of the trochanters; nor does the cartilage of these parts totally disappear before the eighteenth or twentieth year.

It is easy to conceive that an accident, which at a more advanced period of life would produce fracture of the neck of the femur, will with more facility separate the head before the age of eighteen or twenty. It may even happen that a

* Works of Ambrose Paré, lib. 15. chap. 21.

force which does not produce this decollation, shall, however, disorganize the cotyloid cavity, by impelling inward towards the pelvis the parts of the three bones of which that cavity is composed. Ludwig * has given a case of this kind. When the head and neck of the femur are completely united, their point of union is seldom the situation of a fracture; and, as Duverney remarks, decollation is then impossible †. The symptoms of decollation differ little from those of fracture: the dull crepitation which has been given as a sign by J. L. Petit ‡, is by his own acknowledgment very equivocal. But this difficulty in forming a diagnosis is of no great consequence, as the treatment does not differ from that of fracture of the neck of the femur; nor is the prognosis more unfavourable, notwithstanding what Colombus §, arguing from the difficulty of setting the divided portions with accuracy, says to the contrary.

Predisposing Causes.—Brittleness of the bones, as well as the vices of the constitution on which

* De Collo Femoris ejusque Fractura Programma. Lipsiæ.

† Traité des Maladies des Os, vol. i. chap. 8, art. 2.

‡ Ibid. vol. ii.

§ De Re Anatomica.

it

it depends, has been already given as a predisposing cause of fracture. Caries may be looked on as a predisposing cause of fracture of the neck of the femur, by its destroying a part of the substance of the femur; but as in this case artificial means can have no effect in producing a consolidation of the fracture, and as the caries will probably occasion the patient's death, unless nature effect the union of the carious bone with some part of the pelvis, it seems useless to give any further consideration to fractures, or division of the neck of the femur from this cause. Rickets, which some authors have mentioned as a predisposing cause of fracture, rather prevents it by rendering the bones flexible.

Duverney has given a case of a fracture of the neck of the femur, in which the venereal disease was evidently the predisposing cause. But in cases arising from an internal cause, the removal of that cause is the principal object.

Exciting Causes.—A fall on the great trochanter is the most frequent exciting cause; and fracture of the neck of the femur is so frequently a consequence of that accident, that when the one has taken place, the other is generally pre-

sumed. This observation made by Citizen Sabatier * has been confirmed by many particular cases treated in the principal hospitals in Paris. A fall on the feet or knees sometimes occasions a fracture of the neck of the femur, in which case the weight of the body must be thrown more on one side than on the other.

Let us examine the manner in which this fracture may be produced.

When a person falls on the great trochanter, the neck of the femur is acted on by that eminence which has a *point d'appui* on the ground, and by the body which acts immediately on the head of the femur. By this action and re-action, a force is exerted on the neck of the femur, which tends to make it parallel with the rest of the bone. By this tendency, that part of the bone is curved beyond its natural extensibility, and from the nature of the curve into which it is forced, its lower fibres break first, and so on successively to the superior, which break last; on the supposition that the rupture of these fibres was successive. In falling on the feet or knees, on the contrary the tendency of the

* Mem. de l' Acad. de Chirurgie.

fracturing

fracturing cause is to force the neck of the femur to form a right angle with the bone; and the rupture of the fibres must of course commence in the superior.

From this view of the mechanism of these fractures, it is evident that they are never direct, that is, produced by a cause acting immediately on the part; but that they are, on the contrary, always the effect of a force communicated to that part by *contre-coup*, or transmitted re-action, as has been observed by David *. The contusion, which in general is but trifling in indirect fractures, or those *par contre-coup*, may however be considerable in this case, when produced by a fall on the trochanter; for this reason, that, though the force be transmitted, yet, on account of the shortness of the neck of the femur, the fracture must take place near the part immediately affected; so that, with respect to contusion, fractures of this part may be considered as direct.

Fractures of the neck of the femur are always attended with derangement: it is possible, however, that this derangement may not take place

* Prize-questions of the Academy of Surgery, vol. iv.

for a few days after the fracture. There are in the Memoirs of the Academy of Surgery, the particulars of a case, in which a man, after having fractured the neck of the femur by a fall, was able to rise without any assistance, and walk home to his lodging. A similar case is found in Desault's Journal. Finally, a great number of cases collected by Louis, Duverney, Sabatier, and other authors of no less authority, and those observed by Citizen Boyer, leave no doubt on the possibility of a derangement ensuing several days after the fracture. And it is easy to conceive that in a fracture of what is properly called the neck of the femur, the orbicular ligament may oppose the derangement, and counteract the action of the powerful muscles, which pass from the pelvis to the lower fractured portion, into which, also, the orbicular ligament is inserted.

Another cause which must contribute to prevent derangement, is the projections and depressions of the surfaces of the pieces, which inequalities render lateral motion difficult. We have already remarked this circumstance, in treating of the direction of the fracture, which, accurately speaking, is neither oblique nor transverse.

The fractures within the articulation are never attended with a very considerable derangement. The orbicular ligament yields a little without being torn; the body and neck of the bone, instead of their oblique or angular position become rectilinear; from which change of direction, as well as from a slight derangement in the direction of the diameter, arises the shortening of the limb. Louis has asserted that the derangement may be considerable, but has not supported this assertion either by facts or reasoning. In fractures outside the articulation, or between the trochanters, the muscles which tend to produce the derangement act without any opposition, and draw the inferior fractured portion outward, upward, and a little backward toward the iliac depression. The great trochanter approaches the brim or ridge of the iliac bone, but never passes under the glutei muscles, which cover the surface of that bone.

The action of the muscles which are inserted into the inferior portion, and particularly that of the glutei, is not the sole cause of the derangement; that effect being in part produced by the weight of the body, which forces the pelvis downward, and with it the superior portion of the femur: muscular action is however the principal cause. Besides

Besides the longitudinal derangement, that in the circumference also takes place, in consequence of the rotation of the whole inferior extremity outward. This is effected by the weight of the part, rather than by the action of the rotatory muscles. If the rotation of the limb were produced by the contraction of these muscles, there would be more difficulty in bringing the foot to its natural position, or in inclining it inward, than in reality is found in bringing it in any of these directions. But in order to be fully convinced of the cause of this rotation, it is only necessary to observe the position which the inferior extremity assumes, when a person laid horizontally on his back abandons it to its own weight: in such a case the foot and knee incline constantly outward.

The derangement may take place internally, either by a particular disposition of the extremity, by the pressure of the bed-clothes, or some such cause. Paré and Petit describe the derangement as having taken place internally, in all the cases of this kind that occurred to them. Louis has endeavoured to give a favourable turn to the report of Paré. He says that Paré meant merely to state that the foot was separated from the opposite leg by a less interval than the knee of the

same

same side; which observation is true in a certain sense, even when both are turned outward. As to Petit, we must either suppose that a deference for the opinion of Paré led him into an error of fact or expression, or that the mistake originated with the copyist or printer. But since the publication of Louis's explanation in the Memoirs of the Academy, the possibility of derangement inwards has been ascertained by observation. Desault concluded from his experience that the rotatory derangement inward was to that outward as 1 : 4.

Diagnosis.—The resemblance between the symptoms of this fracture and luxation, has frequently occasioned these two affections to be confounded with one another. Thus we find that luxation of the femur was known to the ancients, and that fracture of the neck of that bone was unknown until described by Paré. He is, at least, the first author who has given any clear and positive information on that subject. Since his time, observations on the nature of this affection have been multiplied; but as yet authors are not agreed as to the symptoms by which it is distinguished.

Fracture

Fracture of the neck of the femur is so frequent a consequence of a fall on the great trochanter, that the former having taken place, renders the other highly probable: an acute pain felt in the articulation augments that probability. But the fall or pain, which may not exist even when the fracture has taken place, as in a case related by Duverney, are equivocal, or at best but corroborating circumstances. The sensible signs are those alone on which the diagnosis is to be founded: they are as follows:

It sometimes happens, that in the moment of falling the patient hears a crack in the articulation, and remains without the power of raising himself. Shortening of the limb is a consequence of this fracture; but as that does not always take place immediately, it cannot assist in forming the diagnosis in every case; but the uncertainty arising from the want of that sign is quickly removed, for the shortness supervenes in a few days. It may not be superfluous to remark, that in ascertaining the shortness of the limb, the patient should be laid supine on an horizontal plane, and the pelvis so placed as that its anterior and superior spinous processes may be in the same horizontal line.

The

The point of the foot is turned outward, as is the knee, and the leg bent so as that the heel is turned inward, and placed behind the ankle of the other foot, in the depression between the ankle and tendo Achillis.

It very rarely happens that the heel is placed above the ankle, except, however, when the fracture is outside the articulation, and the longitudinal derangement very considerable. In fractures of the part strictly called the neck, it would be necessary, in order that the ankle should be so placed, that the fracture had been produced by a fall on the feet or knees from a great height, and that the orbicular ligament had been entirely torn, of which no example has as yet been observed.

The limb may be brought to its natural length by means of extension and counter-extension, but it shortens again instantly if left to itself. The foot may, with great facility, be placed in its natural position, without causing in any degree the pain and suffering which Citizen Sabatier seems to have apprehended: he says, that the attempt is imprudent, and the motion difficult. The asperities of the broken pieces can seldom irri-

tate

tate or lacerate the soft parts, because the orbicular ligament is seldom entirely torn: to that cause, however, Citizen Sabatier attributes the pain and difficulty, which he considers as being so formidable.

In bringing the limb into its natural direction, the fractured surfaces are rubbed one against the other; and this friction, more or less considerable according to the asperity of the surfaces, produces a crepitation, which is one of the surest signs of fracture. It has been asserted by some writers, that the great depth of soft parts prevents the crepitation from being heard, which for that reason, say they, can be no sign of this fracture. But the clear and distinct perception of the noise is a better proof of its existence than any reasoning can be of its impossibility; and we assert, that it is possible in most cases to tear it. I have myself frequently heard it, by applying, it is true, a very attentive ear.

In turning the limb, in order to place the foot straight, or to incline it inward, the great trochanter will be found, by placing the hand on it, to move in a very small space, or, as it were, on itself pivot-like. But in the rotation of the thigh

thigh in its natural state, that eminence describes an arch of a circle, the radius of which is composed of the length of the neck and head of the femur; but after the fracture, the diameter of this circle is composed of the diameter of the bone and of that part of the neck which remains below the fracture. Whence we may conclude, that arches described by the great trochanter in cases of fracture of the neck of the femur, will be so much the greater, as the fracture takes place nearer the head, and that this arch will be at its maximum in the case of decollation of the epiphysis. In order to appreciate this sign, it will be necessary to compare the arches described by the trochanter of the fractured member with those described by that of the opposite side.

When the fracture is outside the articulation, the trochanter appears less, and is nearer the ridge of the ossa ilia than in the natural state. The buttock is also rounder than natural, on account of the relaxation of the muscles.

Another sign of which authors have made no mention, but which is constant, is the impossibility of raising the member all at once; that is, of

bending the thigh on the pelvis, the leg being extended on the thigh. It is necessary for the execution of this motion, that the limb have a *point d'appui* in the acetabulum: it may be compared to the circular motion with which the hand is raised to the forehead, and which is impracticable when the humerus has lost its *point d'appui* by a fracture of the clavicle. In attempting to raise the thigh, the patient first bends the leg analogously to the effort made to bring the hand to the forehead, by bending the fore-arm *.

According to Louis, much pain is produced by moving the fractured limb from that of the opposite, and none at all by the contrary motion: this difference he attributes to the action of the lower fractured portion on the soft parts of the external side, and considers the pain caused thereby as a distinctive sign of the fracture. We have already said, that a derangement as considerable as that supposed by Louis never takes place. If it really did, adduction and abduction

* It will always be easy to distinguish the impossibility of this motion resulting from pain, from that resulting from the want of a *point d'appui* for the femur. This impossibility remaining after the inflammatory symptoms have ceased, will always be a pathognomonic sign.

ought to be equally painful; and, in fact, every motion given the limb, no matter in what direction, causes more or less pain; but pain, however produced, is a very equivocal sign, as it belongs equally to all diseases of the articulation.

Of all affections, there is none so easily confounded with the fracture of which we are treating as the different species of luxation of which the thigh is susceptible. The luxation upward and outward is the most easily mistaken for fracture, notwithstanding the two affections have in common only the shortening of the member. The impossibility of restoring the limb to its natural length by a gentle effort, its permanence in the natural situation when once restored, and, before that is done, the impossibility of turning the foot outward, which has been carried inward, are signs by which that species of luxation can be easily distinguished from fracture of the neck of the femur.

In the luxation inward and upward, in which the head of the femur is propelled toward the pubis, the extremity is shortened, and the foot turned outward; neither of which circumstances

can be corrected without antecedently restoring the femur to its natural situation.

Luxations downward, whether inward or outward, can never be mistaken for this fracture, because in these the member is always lengthened.

The secondary, or spontaneous luxation of the femur, is always preceded by dull pains felt in the superior and inferior articulations of that bone; it is further characterized by a gradual elongation of the member, and then by a sudden shortening and a diminution in the interval which separates the great trochanter from the ridge of the iliac bone; by the inclination inward of the foot and knee; finally, by all the symptoms of luxation upward and outward, joined to the induration of the soft parts, the abscesses which form in these parts, and which terminate in fistulæ. All these signs leave no possibility of its being mistaken for a fracture of the neck of the femur, an affection with which it has nothing in common, except indeed that the spontaneous luxation is sometimes produced by the same cause as the fracture, namely, a fall on the foot, knee, or great trochanter,

chanter, by which the cartilages of the articulation are contused. The irritation caused by this contusion produces a turgescence and swelling of the cartilages and cellular texture that accompanies the round ligament. This tumefaction augments until the acetabulum is entirely filled, and the head of the femur expelled from that cavity.

It appears, then, that a strict comparison of the symptoms will enable the surgeon to distinguish a fracture of the neck of the femur from any affection of the hip joint. But we must acknowledge, on the other hand, that fractures of this part of the femur, which are without any, or with very little derangement, are not always very easy to be ascertained or distinguished. An old man fell on the great trochanter, and the length of the extremity of that side was found to have diminished half an inch in consequence of this fall; but there was no other symptom of fracture. Citizen Boyer pronounced the existence of a fracture of the neck of the femur, and a second surgeon confirmed this decision. A third practitioner was not clearly of the same opinion; but remarked, that the shortening might be owing to the contraction of the muscles; but as there was no symptom of that contraction which could not produce the

shortening of the limb without nearly obliterating at the same time the interarticular cartilages, the apparatus for fracture was applied, because, whichever opinion was the true one, no inconvenience or evil could result from its application. The patient died of ascites in five days. On dissecting the articulation of the thigh, a fracture of the neck of the femur was found, and consolidation had commenced, though it had advanced but very little.

We shall recapitulate in a few words what distinguishes this fracture: a fall on the great trochanter followed by pain in the articulation, with the impossibility of bending the thigh on the pelvis, the leg being extended on the thigh; shortness of the extremity, which is easily removed, but returns as soon as the extending force is discontinued; an inclination of the foot and knee outward, with great facility of moving these parts to their natural situation; crepitation produced in effecting different movements; and the smallness of the circle in which the great trochanter moves in a rotatory motion. We can seldom be mistaken as to the existence of this fracture, if we attend to all these circumstances.

When

When the want of any important symptom renders the case doubtful, the apparatus should however be applied, as no danger can result from its application, provided the inflammatory symptoms have disappeared. It generally happens that in a few days the shortening of the extremity removes any doubt that might have been entertained; and this shortening, as we have already mentioned, may be retarded by the mutual insertion of the fractured surfaces, or by the resistance of the orbicular ligament.

The prognosis of fractures of the neck of the femur is very difficult to establish. Some authors consider them as highly dangerous, always occasioning inflammation of the cartilages and surrounding soft parts. Morgagni * has made some observations, which tend to give weight to this unfavourable prognosis. Others, on the contrary, consider these disagreeable consequences as extremely rare, so much so as never to have met them in their practice. This we can say, that these fractures are never followed by secondary or spontaneous luxation of the femur, which proves that the contusion of the cartilages has not been excessive, and that probably the

* Morgagni *de Causis et Sedibus Morb.* Epist. 56.

whole force was spent in effecting the fracture.

The difference of opinion on the prognosis of this affection does not regard merely the inflammation and abscesses which it may occasion, and the fistulæ which result from these abscesses. Some authors are of opinion, that the shortening of the limb can by no means be guarded against; and others, that the consolidation of the fracture cannot be at all effected. There are some, however, who affirm that the consolidation is obtained in this case as in any other. As the treatment must be accommodated to whichever of these opinions is adopted, it is necessary to consider carefully the greater or less probability of each, how far any of them may be true, and the restrictions which they may require; and to consider, in short, in what particulars they may serve to direct the treatment. By recurring to what we have already advanced on the formation of callus, and on the different theories on that subject, we shall acquire at once a solution of the problem.

Thus those who have admitted the existence of an osseous humour from which the callus is formed, have argued, that fractures of the neck

of the femur cannot be cured, because this osseous humour is perpetually diluted by the synovia, with which the broken ends must always be moistened. The partisans of Duhamel's opinion have given as a reason for the supposed non-consolidation of this fracture, the want of the periosteum on that part. But, in fact, it is furnished with a periosteum by the fibrous duplicature of the orbicular ligament which is reflected round it, and which, provided itself with a very vascular texture, transmits to the bone the vessels that nourish it. But facts, which attest the possibility of consolidation, render it unnecessary to enter into any verbal refutation of assertions and theories. Numerous instances of recovery are related, and preparations which prove that consolidation had taken place, are to be met in many anatomical collections. The consolidation is, doubtless, slower and more difficult in this than in other parts, but the difference in the time necessary for cure may be easily accounted for by our theory of the formation of callus.

The possibility of the consolidation of a fracture supposes that each of the broken portions is endued with a certain degree of vitality: the splinters of bone which, in comminutive fracture, are totally detached, never reunite. In fracture

ture of the neck of the femur, the inferior portion is endued with all the conditions necessary to a prompt reunion; but the superior, on the contrary, enclosed entirely in the acetabulum, and in contact only with the cartilaginous surface of that cavity and with the orbicular ligament, has no connexion with the rest of the body but by means of the round ligament which conveys to it a few blood-vessels, but which are not sufficient for giving its vascular texture the degree of turgescence necessary for the generation of callus. In most cases, the duplicature of the orbicular ligament, which we have already described, is but partially torn, and a communication between the vessels of the head of the femur, and those of the other parts, is preserved, by means of which the consolidation is principally effected. To the complete rupture of the orbicular ligament * ought probably to be attributed the non-consolidation of some cases of fracture. Old age is, however, the most frequent cause of non-consolidation; and those who are of opinion that the fracture of the neck of the femur is incurable, endeavour to support that opinion by instances of

* The motion communicated to the limb, in order to produce crepitation, always obscure, may aid in completing the rupture; for which reason the trial ought not to be made without the greatest caution.

this

this kind in old persons. Ruisch cites many cases communicated to him by Gerard Borst, who was physician to an hospital of old women at Amsterdam, in which a recovery could not be effected. In these persons great age was an invincible obstacle to the formation of the callus, and was the sole reason why, after death, the head of the bone was found diminished, decayed, and converted into a kind of ligamentous cap.

I dare say too, that the great hospitals of Paris destined for the reception of aged persons, as *La Salpetriere* and the Hospital of Invalids, could furnish instances of the same kind sufficient to warrant the induction that this fracture is incurable beyond a certain age, if not sufficient to lead into error by too general an application of particular facts.

It is not in our power, however, to mark precisely the period beyond which a cure is not to be hoped for. To be able to settle this, it would be necessary that the effects of old age were uniform in every individual, and that the degree of senility were always commensurate with the number of years. Lesne shewed, at the Academy of Surgery, the femur of a woman aged eighty-nine, with marks of a consolidated fracture

ture of its neck. I have published the case of a man aged eighty-three, in whom the consolidation of a double fracture was considerably advanced. Numerous facts of this nature authorize and require the application of the apparatus in all cases, except where the patient, reduced to the last stage of decrepitude and debility, cannot support its weight, or is attacked by some mortal disease. But, at the same time, the surgeon should, for his sake, acquaint the patient and his friends with the uncertainty of the cure, in order to ward off any imputation that might be made in case of failure.

Authors who have considered the consolidation as impossible, have ascribed to that cause the shortening of the limb; whilst others, partisans of the opposite opinion, have however considered the shortening and lameness as uniformly arising from the improper position of the fractured pieces; the lower of which, say they, slides on the superior, obeying the contraction of the muscles which draw it upward, so that the fractured surfaces can no longer correspond exactly, and the member becomes necessarily shortened in proportion to the ascent of the inferior fractured portion, and diminution of the obtuse angle formed by the neck of the femur with the

body

body of that bone. Or it may happen that the fractured surfaces shall have no point of mutual contact; that the angle, from oblique, shall become right, or nearly so; and that the union shall be effected by means of a ligamento-cartilaginous substance: a case of this kind has probably given rise to the opinion that the reunion of these fractures was analogous to that of the patella and olecranon.

Fabrice de Hilden, Platner, Ludwig, &c. have positively asserted, that a recovery without shortening and lameness was impossible. Louis and Citizen Sabatier appear to have adopted the same opinion, which, however, is now known to be erroneous from the success obtained in various cases. Of this success, Desault's practice furnishes many instances: from that of Citizen Boyer, which has been equally extensive and successful, I shall content myself with citing one example.

A strong robust hackney-coachman fell from the box, and fractured the neck of the femur; the great trochanter having borne the reaction of the fall. The contusion was such as might be expected from the height of the fall and the person's weight. Four hours after the accident, when he

he was conveyed to *La Charité* on the 20th Prairial, 5th year, the swelling and tension were extreme. Emollient poultices were applied, bleeding and an antiphlogistic regimen were prescribed. The limb being but little shortened, afforded a ground of presuming that the fracture was within the articulation. On the subsiding of the inflammatory symptoms, the apparatus for making continued extension was applied, and reapplied, as often as its relaxation rendered it necessary. Gangrenous eschars were formed on the instep and tendo Achillis, although thick compresses were placed between these parts and the pieces of the apparatus: it is possible, however, that they might have been prevented, had the patient, a man of uncommon firmness and courage, complained of the pressure being too great. The reunion was complete on the fiftieth day, as was proved by the motion of the whole limb: on the sixtieth day the patient quitted his bed, and walked about with crutches; and, at the end of three months, left the hospital perfectly recovered, there being then no perceptible difference in the length of his two inferior extremities.

It is then established by what precedes, that a cure without lameness may be obtained, as well

as

as a perfect consolidation, but by means, it is true, unknown till lately. It is not surprising that surgeons, unacquainted with this means, supposed lameness an inevitable consequence of fractures of the neck of the femur.

The general causes which retard or prevent the formation of callus will affect fractures of the neck of the femur more than any other, because the formation of the callus is slower there than in any other part; for which reason every motion should be particularly avoided, as well as every other circumstance that might disturb the generation of callus. In this case more than in any other, a disposition to cancer, scurvy, &c. is unfavourable, and a state of general debility is also injurious; it should, therefore, be combated with extraordinary vigilance. Pregnancy, which we suppose to be in general of little or no effect, might, however, diminish the probability of a perfect consolidation of a fracture of the neck of the femur.

The particular objects to which, in treating these fractures, we are to direct our attention, are no other than those already mentioned in general, namely, to set the bone, keep the pieces in their place, and combat any unfavourable symptom

symptom that may arise. The means of effecting extension and counter-extension are the same as in other fractures of the femur, and for the same general reasons as mentioned in treating of the fracture of the body of that bone. If it be necessary to employ a great number of assistants, a cloth, on which each may pull, should be rolled on the inferior part of the leg, and two others round the pelvis; the extremities of one of which should be joined and held above the hip of the side affected, for the purpose of making counter-extension; whilst another should be brought in the opposite direction, and held by a sufficient number of assistants, in order to prevent the pelvis from being drawn to the fractured side. The joint action of these two last-mentioned means of counter-extension is necessary to render the pelvis immoveable. In most cases, however, this purpose is answered by simpler means.

Previous to any attempt to remedy the longitudinal derangement by means of extension and counter-extension, it will be necessary to correct that of the circumference, by giving the foot its natural direction. Coaptation is a part of the operation totally useless in setting a fracture of the neck of the femur, on account of the great depth

depth of soft parts, and the total impossibility of acting on the superior piece of bone.

If, on the first attempt to extend the limb, the muscles are found to contract powerfully, it will be useless to continue efforts painful and fruitless for the patient. The best practice to be adopted then, is to apply the apparatus for fractures of the body of the bone, draw some blood from the patient, put him on an antiphlogistic regimen, and wait the removal of the spasmodic state. This state is much less frequent in the fractures of the neck of the femur than in those of the body of that bone; because in the former the fractured ends are within the orbicular ligament, and cannot therefore irritate the soft parts. When it was customary to apply the extending force above the knee, and the counter-extending to the groin, the spasmodic state was much more frequent than since the present improved practice has been adopted.

The difficulty of keeping the pieces in their place in a fracture of the neck of the femur is inversely proportional to the facility with which the setting is effected; for which reason the inefficacy of the ordinary means has been long ago acknowledged in oblique fractures of the body

of that bone, as well as in fractures of its neck. Different expedients have been devised at different periods, to remedy this disadvantage. We shall compare their merits, after first considering the position in which the limb should be placed.

The half-bent state recommended by Pott for the inferior as well as superior extremity, is attended with a great number of inconveniencies, the mention of some of which will suffice for its rejection: the facility with which the limb changes from that position, the difficulty of applying the apparatus, the impossibility of comparing the length of the limb with that of the opposite side; finally, the pain produced by the continual pressure on the great trochanter, and the gangrene which ensues.

In fracture of the neck of the femur, as in all those of the inferior extremity, the leg should be extended on the thigh, and the thigh on the pelvis. This position must be secured by means of an apparatus, on the invention of which the imagination of practitioners and theorists has been very active. The expedients for effecting this are so numerous, that a description of them would lead us too far from our object. Studious to avoid any superfluous details, and equally so

any

any important omission, we shall range, in two classes, the different *apparatus:* in the first, those which do not effect any extension; in the second, those which do.

Several authors have recommended the spica bandage of the groin, composed of a piece of linen cloth, of a considerable breadth, and long enough to be rolled round the pelvis several times. This bandage being rolled up in one, is drawn three or four times round the pelvis, and then several times obliquely on the superior part of the thigh, by directing it towards the great trochanter, thence round the body, and so successively; but instead of fixing the fractured portions, it contributes to derange them. As much of it as is applied on the pelvis, is absolutely useless; and the oblique casts, upward and outward, can have no other effect than that of deranging the lower portion of bone; that is, of causing its ascent to the external iliac depression. Finally, the application of the spica requires that the limb be supported and raised up from the bed, which cannot be done without disturbing the generation of the callus. This objection is of the greatest importance, because the spica requires to be frequently renewed,

as it relaxes quickly, and is soon soiled with the patient's urine and fæces.

The eighteen-tailed bandage, and the *fanons* or *faux-fanons* with which it is assisted, act only on the inferior portion of bone, yield like it to the causes of derangement, and can therefore be of no utility. And even though this bandage should act on both the fractured portions, it is now well ascertained, that bandages, whatever may be their construction, can contribute but very little to the confining of pieces of a broken bone; and that, relatively to that object, the effect of this, as well as of the others, is absolutely null. As to the *fanons* or *faux-fanons*, their circular shape admits them to act only by single points, or a single line of contact; for which reason their effect can be but very trifling. Besides, if the bands by which they are secured be drawn tight, they will necessarily be displaced by sliding backward or forward.

Others have employed long splints, of which the external ascended on the ribs, and the anterior on the abdomen; both of which, and the internal splint, extended beyond the foot. The depressions were filled with some kind of stuffing,

ing, in order to procure an equable pressure; and the splints were kept applied to the limb by ribands or tape, and secured at their superior extremities by a roller passed round the trunk, the immobility of which, with respect to the limb, was one of the objects proposed. But this immobility of the body could not prevent the glutei muscles, as well as all the others, which extend from the pelvis to the femur or leg, from drawing the inferior portion of the femur upward and outward; for which reason this means has been abandoned, though it has, over the two preceding, the advantage of correcting the derangement in the circumference. Dalechamp hit on the expedient of fastening the leg to the foot of the bed; but as the body was not fixed, it slipped down, and rendered this precaution useless. To these may still be added, the tin trough, lined with fustian, invented by Fabrice de Hilden, and in which the outside of the thigh was placed, the oblique bandages, and all that assemblage of petty contrivances heaped on the limb by Duverney. All these expedients act only on the inferior portion of the femur, yield to all the causes that move it, and can in no manner oppose the shortening of the extremity.

There remains another method which demands a more particular notice. It was proposed by Foubert, adopted by Louis and Citizen Sabatier, and approved of by the Academy of Surgery. This method was for some time looked on as the most effectual for the treatment of fractures of the neck of the femur.

The fracture being set according to the rules prescribed, and compresses, impregnated with a resolvent liquid, applied to the articulation; the thigh and leg are fixed by means of *fanons*, and the foot by means of a slipper or sole. The inferior portion of the femur is in a very short time drawn outward and upward by the contraction of the muscles. This derangement, foreseen by the inventor of the method, is remedied by resetting the fracture every day, and reapplying the apparatus. From the fifteenth to the twentieth day, the derangement becomes less frequent, and the part less irritable; for which reason there is less muscular contraction. After the twenty-fifth, the resetting is no more necessary, the limb is allowed to rest, and the *fanons* are kept employed, tightening them as often as they relax, for three months and an half, at which time the apparatus may be totally removed.

moved. This invention, originally suggested by Ambrose Paré, does not merit all the encomiums which have been bestowed upon it. Nothing can more effectually retard, or even prevent the formation of the callus, than the motions communicated to the limb, at the very time that nature is most actively employed in generating it.

In order to keep, in fractures of the neck of the femur, the pieces in their proper situation, it is necessary that some cause counteracts that which tends to produce their derangement. This latter acts by drawing upward and outward the inferior portion, making it ascend on the external side of the superior, which is itself pushed downward by the weight of the pelvis and body. A further derangement is produced by the falling outward of the foot and knee: in order to prevent which, it has been proposed to tie the toes to those of the other foot. Brunninghausen used to fix the leg of the fractured side to that of the opposite, by means of a sort of stirrup, making, by this contrivance, the sound leg act as a splint: but these means serve merely to prevent the falling outward of the foot, but not at all the shortening of the limb. Besides, the position cannot be long persevered in, because fastening

both legs together, incommodes the patient very much.

A continued extension is the only means of keeping down the lower portion of the femur, of opposing the descent of the superior, of counteracting the irritability of the muscles, and of procuring a cure without lameness or deformity. We do not propose, as already remarked in the first chapter of this work, to overcome, by this means, the strong and involuntary contractions of the muscles which immediately succeed the fracture, and which should be opposed by a moderate and gradual extending force. The application of the apparatus for making continued extension is not prudent, until the spasmodic state be completely removed. It is not intended that this apparatus shall preternaturally extend the muscular fibre, by drawing its extremities in opposite directions, but merely that it shall supply the place of the bone, by opposing the contractile power naturally inherent in the fibre, and always tending to act.

Almost all those who have acknowledged the indispensable necessity of continued extension, have invented different means for putting it into execution. Their respective merits can be ap-

preciated by comparing their different ways of acting with the general rules already laid down for effecting this purpose.

The bed of Hippocrates, and the Glossocomon used by the ancients, engraved in the Works of Paré, have been abandoned on account of their complication: they had no other advantage than that of acting in the direction of the fractured bone. By acting immediately on the fractured thigh, in effecting extension and counter-extension, their action was limited to a small surface, and the limb lengthened abruptly.

The method used by Avicenna, adopted by Petit, Heister, and Duverney *, who have somewhat modified it, consisted in fastening to the head and foot of the bed, the bands with which the extension and counter-extension were to be effected. The superior were applied on the upper part of the thigh, and the inferior above the knee.

Petit advises to place two bands at the same time, one above the knee and another above the

* The greater part of authors recommend the use of the spica, in addition to the extension and counter-extension produced by this means.

ankle,

ankle, to act alternately, so that when one becomes troublesome it may be relaxed, and the other used.

Besides the unsteadiness of the band placed above the knee, and the irritation of the muscles occasioned by it; this method has still further the disadvantage of the thigh and pelvis not being so fixed by it as to constitute one piece; without which essential condition, the superior portion of the femur yields to all the motions of the pelvis, with which it is connected. The loosening of the bands, which is frequent in proportion to their length, is another objection which decides the absolute insufficiency of this method. In confirmation of this opinion, we may quote the testimony of the Arabians themselves, inventors of this method, who used it in every case of fracture of the femur, whatever might be its direction, but who acknowledge that the cure was seldom effected without a lameness.

Others have endeavoured to effect the extension, by means of a band applied above the ankle, and which, passed over a pully, had a weight suspended from the other extremity. The pully was so disposed, as that the weight

acted in the direction of the fractured bone, which, joined to the advantage of acting on the leg, produced a well-directed extension: this, however, was rendered useless on account of there being no counter-extension, to prevent the body from being drawn downwards.

The machine of Bellocq, described and engraved in the third volume of the Memoirs of the Academy of Surgery, is at present generally abandoned. By it, extension is made in the direction of the limb, on the lower part of the leg, and gradually; but the counter-extension acts immediately on the superior part of the thigh: besides, the great difficulty of applying this machine, justifies the oblivion into which it has fallen. Many other apparatus successively proposed after that of Bellocq, and of which they were but modifications, have, like their model, fallen into disuse.

The machine of Hook, perfected by Aitken, and described by Bell, acts in the direction of the limb, and produces a slow and gradual extension, by means of screws, but it has the disadvantage of acting immediately on the inferior part of the thigh, and on a small surface. Thus, while two precepts are observed, two

others

others not less important are neglected: besides, nothing opposes the falling outward of the foot and knee, nor the inclination of the hip to the same side.

Desault perceived all these imperfections and defects, and invented an apparatus by which the object proposed is more perfectly attained, and by means much simpler. It might be added perhaps, that, with a few modifications, it would comprise every advantage that can be expected from such an apparatus. His first attempts were directed only to correct the ancient methods. He attached the trunk to the head-board of the bed, by means of long bands fastened to a bandage passed under the arm-pits: he applied, in the next place, the middle of a band on some thick compresses placed on the back part of the leg, a little above the ankles; the extremities of this band crossed on the superior part of the foot, and, knotted on the sole, were then fastened to the foot of the bed. To this disposition was joined the ordinary means or apparatus. This method had a disadvantage of which we have already taken notice, namely, the facility with which the bands relax; besides which, the immobility of the body was very fatiguing, and the difficulty of breathing, on account of the

bandage

bandage round the trunk, was still more distressing. This last-mentioned disadvantage induced Desault, in a particular case *, to apply the bandage on the pelvis, to which it was fixed by bands passed under the thighs.

Desault ascertained by different experiments, that the object particularly to be aimed at, and which was essential, was such a disposition as that the foot, leg, thigh, and pelvis, should constitute but one whole; so that, though the different parts thereof should be drawn in different directions, yet they should still, with respect to one another, preserve the same mutual relation. Convinced of the justness of this conclusion, he invented the following apparatus to answer these purposes.

A strong splint, long enough to extend from the ridge of the os ilium to a certain length beyond the sole of the foot, is a principal part of this apparatus: this splint should be two inches and a quarter broad, and have each of its extremities pierced in shape of a mortice, and terminated by a semicircular niche. It is applied on the exterior side of the thigh, by means of

* Surgical Journal, vol. i.

two

two strong linen bands, each being more than a yard long.

The middle part of one of these bands is to be applied to the inside of the thigh, at its upper part; its ends are brought to the exterior side of the thigh, passed through the mortice, and knotted on the semicircular niche. Compresses are to be previously placed under the middle part of the band, in order to prevent any disagreeable pressure; as well as on the tuberosity of the ischium, which Desault considered as the principal point of action of this band. The inferior part of the leg is, in the next place, covered with compresses, on which the middle part of the second band is placed: the extremities of this band are crossed on the instep and upper part of the foot, then on the sole, after which they are conveyed outward, and one end passed through the mortice and knotted with the other on the niche, with such a degree of force as to pull the inferior portion of the femur downward, and to push the splint upward, and by this means the pelvis and superior fractured portion. On the internal side of the limb is placed a second splint, which extends from the superior part of the thigh, to a certain distance beyond the foot. A third is placed on the anterior

rior part, and extends from the abdomen to the knee. The superior extremities of the anterior and exterior splints are fixed by means of a bandage passed round the pelvis. A band, the middle part of which is placed under the sole of the foot, and the extremities crossed on its superior surface and fastened to the splints, prevents the motion of the foot, as does also to a considerable degree the action of the splints.

It may not be superfluous, perhaps, to remark, that, previous to the application of this apparatus, the whole limb should be covered with compresses, moistened with a solution of the acetate of lead, and that Scultet's bandage is to be applied on the thigh and leg over these compresses, and a roller to be passed round the foot: these parts of the apparatus should be moistened with a resolvent liquid. These have the double advantage of diminishing the irritability of the muscles, and preventing any stagnation of the fluids.

This apparatus of Desault's has, in the hands of that celebrated surgeon, produced a great number of cures; but it must at the same time be acknowledged that it has frequently failed: the causes of failure may be found in defects which it is easy to point out. The

The superior band has a triple disadvantage; first, that of forcing the inferior portion of the femur outward; secondly, of pushing the superior upward; thirdly, of rolling itself into a cord, compressing thereby painfully the adductor and rectus internus, the spasmodic contraction of which, in consequence of the pressure, tends still further to produce the ascent of the inferior portion of the femur. These disadvantages would be all removed, by giving the band a *point d'appui* on the tuberosity of the ischium.

The difficulty, however, of acting on a globular eminence of a small surface, and covered by a great depth of soft parts, is easily seen: the extension of the thigh on the pelvis increases this difficulty, by increasing the depth of the soft parts. This tuberosity would be more prominent for the inverse reason, if, according to Pott's method, the limb were placed in the half-bent position. The difficulty of acting on this tuberosity is much greater in women than in men, on account of the greater quantity of cellular substance about this part in females. Not only is it difficult to make the band act on that tuberosity, but other disadvantages result from it; for the great pressure of the band on these delicate parts, causes much pain, ulceration, and sometimes

times gangrene. To these circumstances Desault attributed the ill success which he sometimes met with.

The inferior band has nearly the same disadvantages as the superior: its direction is oblique downward and outward, and its action tends therefore to produce a derangement of the pieces of bone. This tendency is counteracted, it is true, by the band directed to be applied to the back part of the leg above the ankle, crossed on the superior and inferior surfaces of the foot, and fastened to the lower extremities of the internal and external splints. The compresses with which the inferior part of the leg is covered, do not always protect it from the extreme constriction of the lower band, which, being narrow, forms itself quickly into an hard cord, and causes pain by acting on a narrow surface. The gangrenous eschars, which are sometimes produced by the constriction of this bandage, are so considerable as to denude in many cases the tendo Achillis, and the tendons of the extensor muscles of the toes. These tendons, exposed to the contact of the air, are apt to exfoliate, and consequently the bones which they are destined to move will remain motionless. The oblique action of this band renders a great constriction necessary.

If, in order to appreciate exactly the merit of this method, we compare its manner of acting with the general rules already laid down for effecting perpetual extension, we shall find that some of these rules are transgressed, and others not completely observed. Thus, the extending force acts on that part of the limb which articulates with the inferior fractured portion; but the superior band acts on the superior fractured portion; and the bands being narrow and liable to roll up like a cord, do not act on large surfaces. Both the inferior and superior bands being oblique, they cannot act in the direction of the bone. Finally, their action cannot be gradually increased. The method of Citizen Boyer, which remains to be described, is strictly conformable to all these rules. By his apparatus and method, the extension is gradual and in the direction of the bone; and none of the muscles which surround the fractured bone are compressed.

The apparatus consists of a splint, a sole, or slipper, and a *sous-cuisse*. The splint should be four feet long, three fingers breadth wide, and about four or five lines in thickness, and made of hard and inflexible wood. A groove about half an inch wide, the extremity of which

is

is covered with iron, runs along this splint for about half its length. In this groove is placed a screw which occupies its whole length, one end of it being supported against the plate of iron with which the extremity of the groove is covered, the other being adapted to a key by which it is turned. To this screw is fastened, in the manner shewn in the plate, an apparatus to which the sole is fixed. The superior part of the splint is received into a pocket formed in the *sous-cuisse*. The sole is made of iron, and covered with shammy leather; towards the heel a large piece of soft leather is attached to it, which piece is divided into two, and serves to fix the sole to the foot. It is fixed to the part of the apparatus connected with the screw.

The *sous-cuisse* is composed of two parts, which meet at an acute angle. It is made of strong leather, covered with shammy and well stuffed with wool, like the girdle of a truss; one of the parts should be long enough to pass obliquely round the upper part of the thigh, its extremity terminating in a strap pierced with holes: the other should be only three inches long, and terminated by a buckle. At the place where both parts meet, a piece of leather is

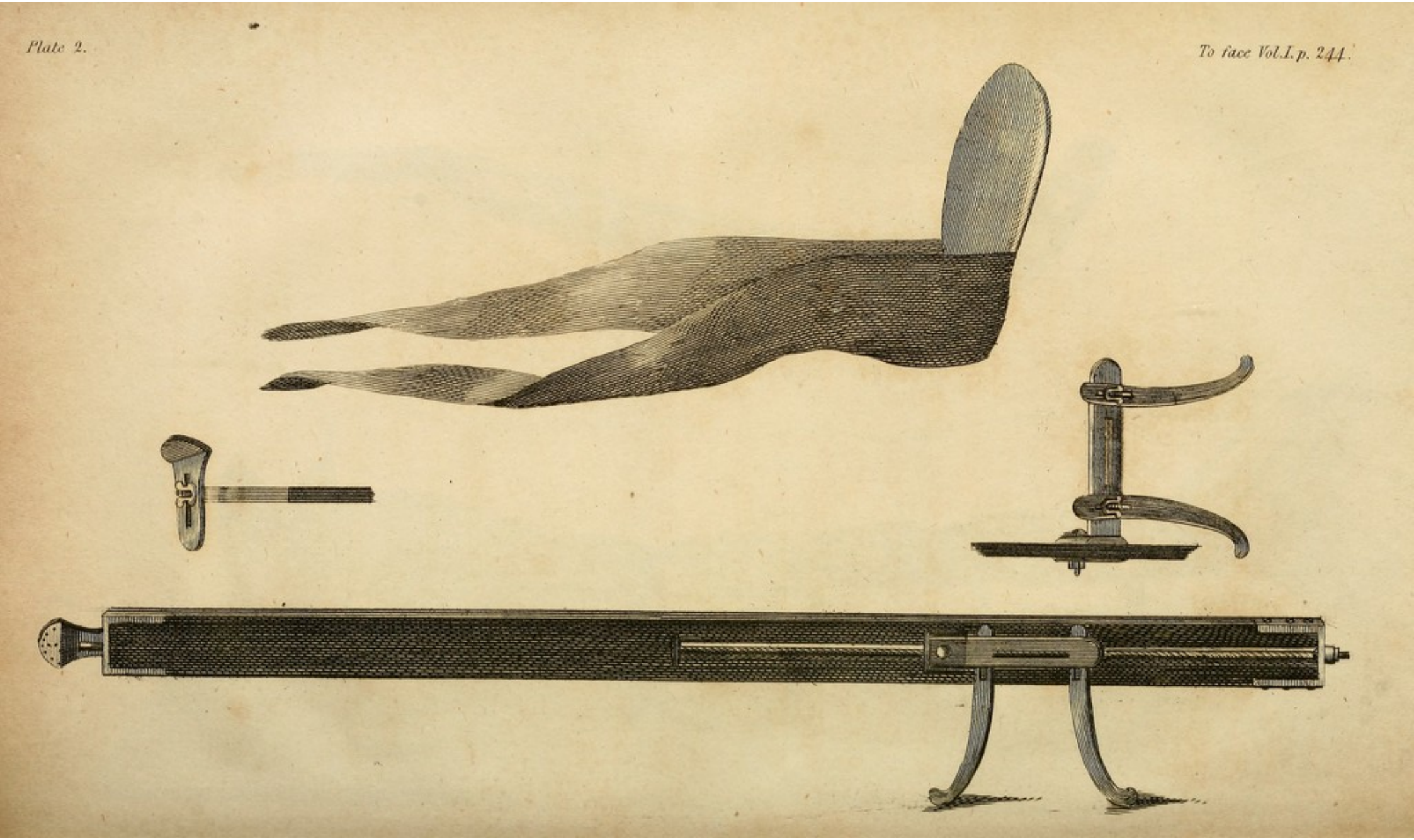
sewed in form of a pocket, into which the superior part of the splint is received.

It is difficult to give a satisfactory explanation of all the particular parts of which this apparatus is composed; but a sufficiently correct idea of it may be formed by taking a view of the plate No. 2.

The apparatus is applied in the following manner: after having surrounded the upper part of the thigh with a soft girdle of cotton three inches broad, the *sous-cuisse* is applied over it. Then the foot and lower part of the leg is surrounded with some soft matter, in order to secure against the effects of pressure, and the sole is applied to the foot. Next the superior part of the splint is introduced into the pocket of the *sous-cuisse*, and the sole is attached at the proper place to the remainder of the apparatus.

The application being thus far advanced, the necessary stuffing and two splints, one anteriorly, the other internally, are applied and secured in the ordinary manner. Every thing being thus disposed, the screw in the groove is turned by the key, and the sole descends and

To face Vol.I.p. 244.



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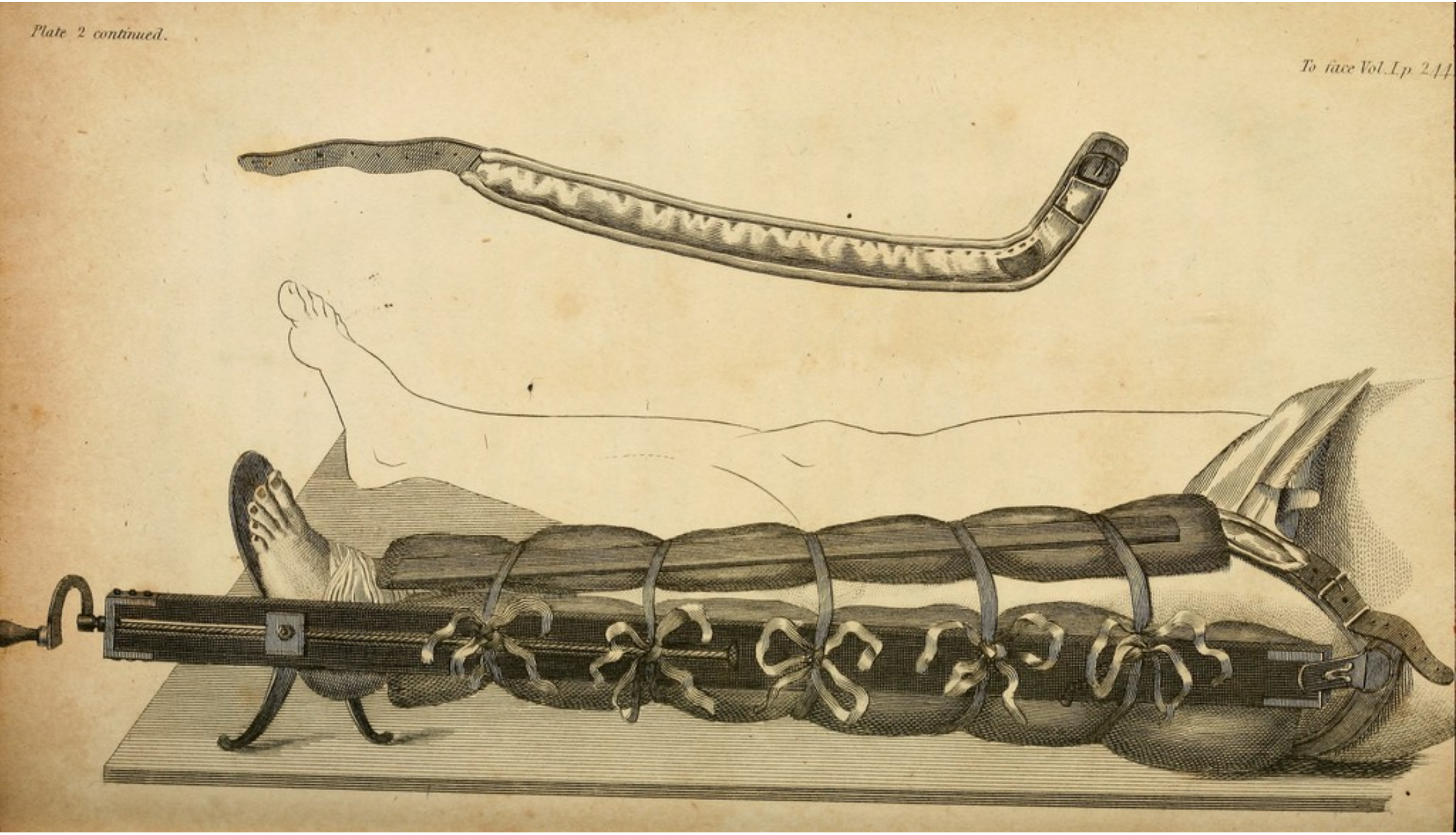

brings the foot with it, whilst the superior part of the splint is pushed upwards. In this way the limb may be extended gradually, and the extension increased as may be necessary.

Whichever apparatus is adopted, it will be necessary to examine it frequently, to tighten the bands, which are quickly relaxed in Desault's apparatus, and to give a few turns to the screw in that of Boyer; but for the latter, not near so much attention is necessary: the straps of skin by which the extension and counter-extension are made, though over-extended by any accidental cause, return again to the proper degree of constriction, on account of their elasticity; and though they should become relaxed, the means of bracing them are easy. When Desault's apparatus is used, it will be necessary to increase the thickness of the compresses on the back part of the leg, the tuberosity of the ischium, and inside of the thigh, as soon as these parts begin to excoriate.

Topical applications, except those necessary for combating the inflammatory symptoms, are absolutely useless. If there be contusion and violent inflammation, the removal of these must precede the application of any apparatus.

The bed on which the patient is laid, should not, as already mentioned, be too soft, but ought to be, on the contrary, firm enough to prevent his sinking into it. By adopting Desault's method, or that of Boyer, the patient may satisfy his natural wants without inconvenience.

The general rule of confining the patient to a low regimen should be modified in the present case; because in this, more than in any other, it is necessary to support and increase the vital action of the parts. A rigorous abstinence, which would in other cases only retard the formation of callus, might totally prevent it in this. Therefore, though the quantity of nourishment should be less than that used in a state of perfect health, because the exercise taken in that state renders reparation more necessary, yet any abstinence that might induce debility should be avoided.

Does the difficulty with which fractures of the neck of the femur consolidate, authorize the use of internal remedies, which might accelerate the consolidation?

The ancients were of opinion, that in a few days after a fracture the patient should be nourished

nourished with rich gelatinous food. André De la Croix *, and Fabricius of Aquapendente, prescribe formally, in imitation of Galen †, the use of farinaceous and young animal food, and that of inspissating medicines. Ambrose Paré ‡ has given the same directions, and observed them himself in the treatment of the fracture of his leg. Fabricius de Hilden § remarks with reason, that aliments of this kind are difficult of digestion, and must therefore be very unfit for a patient in a state of inactivity. But the same objection lies against the use of osteocolla, recommended by the same practitioner, and condemned by Van Swieten ||, on the same principle as the inspissating or viscid aliments of Galen. Osteocolla, so highly recommended by Fabricius, has been used by the greater number of surgeons. Some cases are found in the Philosophical Transactions ¶, in which the reproduction

* Dum substantia cartilaginea, compacta ac densa, quam Latini callum vocant, gignitur; eo tempore viscosum alimentum commendatur. Andreas a Cruce, vol. ii. lib. 1, cap. 6, de Cibo.

† De Methodo, lib. 6, cap. 5.

‡ Lib. 15, cap. 28.

§ Surgical Observations, Cent. 1. Obs. 92.

|| Comment. on Hermann Boërh. Aph.

¶ Abridgment of the Phil. Trans.—Med. and Surg.

of a part of the femur is attributed to the use of it; but Citizen Pinel, translator of this work, judiciously remarks, that it is difficult to conceive, how a stone of a calcareous nature, and of the melactite species, could aid the generation of callus. The use of gelatinous food, which came into use on the supposition of its being of a nature analogous to the supposed osseous fluid, has been discontinued; and the theory on which it was founded, has been abandoned. Spirituous liquors, recommended toward the end of the treatment, for the purpose of hardening the callus, have, in like manner, fallen into disuse.

Nourishment easy to digest, and the moderate use of spirituous drinks, particularly for old people, aid that expansion of the vascular texture, necessary for the generation of callus. A scrupulous attention should be paid to the manner of living, when the vital forces are found to languish from any cause whatever.

The time which nature employs for the consolidation of a fracture of the neck of the femur*, has been already mentioned.

* The consolidation was always effected from the forty-fifth to the fiftieth day, according to the cases related in the Surgical Journal.

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We repeat however, that the apparatus should not be finally removed before the sixtieth or seventieth day; and that three months must elapse from the day of the fracture to that on which the patient may be safely allowed to quit his bed, and walk even with the aid of crutches. The premature use of the limb has been more than once the occasion of its being shortened, after the formation of the callus had been considerably advanced, and a cure without blemish on the point of being effected. A shortening of the limb is particularly to be apprehended, if the pieces are united by means of a ligamento-cartilaginous substance. That the premature use of the limb may occasion this unfortunate accident may be easily conceived, by reflecting that the callus does not attain its ultimate degree of consistence until after the lapse of several months.

A stiffness in the articulation is not much to be apprehended, though some instances of it are related by authors: these examples would be more numerous, if the stiffness were produced by an effusion of osseous juice into the articulation, as some authors have thought. It is well known at present that this stiffness or false anchylosis

anchylosis is owing to the impeded circulation in the part, and to the muscles having lost the habit of motion by a long inactivity. Fractures of the patella and olecranon are more frequently than any others attended with this consequence.

To this description of the treatment of fractures of the neck of the femur, we have only to add, that cases occur in which the approved method cannot be adopted. I have often seen patients who could not support the pain produced by it. In which case, or in that of the patient's being old, the continued extension ought not to be persisted in: the apparatus for fractures of the body of the bone must be had recourse to, with the additional precaution of guarding against the rotatory derangement, by making the internal and external splints extend beyond the foot. A cure thus obtained, will be attended with a shortening of the limb.

If the patient were abandoned to nature, the continual motion which would take place, and the friction, would destroy the head of the bone, and often too what remains of the neck, as has been observed by Morgagni. The shortening is so great in that case, that the limb is nearly

nearly useless. Bœhmer has judiciously remarked, in his Osteologic Institutions, that the deficiency alone of a *point d'appui* would cause lameness, though the member should have lost no part of its length.

CHAPTER XV.

OF FRACTURES OF THE PATELLA.

These fractures may be transverse, or of different degrees of obliquity; but are seldom found longitudinal. The transverse fracture is frequently occasioned by a sudden and violent contraction of the extensor muscles of the leg, which act on the patella: this cause remained a long time unnoticed, and the fractures produced by it were ascribed to the fall which was the consequence of the fracture. It is at present generally acknowledged to be the immediate cause of the fracture, and by that means the cause of the fall.

It will be asked, perhaps, why the tendon of the extensors of the leg, and the inferior ligament of the patella, are not ruptured rather than the patella itself? To which it may be answered, that the extensibility of the tendinous and ligamentous parts renders them less liable to be ruptured than the patella, the hardness of which is more

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than compensated by its brittleness as an osseous substance.

Though fracture of the patella is the most frequent consequence of a violent contraction of the extensors, yet a rupture of their tendon and the inferior ligament is sometimes produced by the same cause. In both cases the symptoms, prognosis, and indications, are the same ; and the treatment is perfectly identical.

To form a correct idea of the manner in which fractures of the patella take place, it is necessary to recollect, that the erect posture is the firmest possible, when the centre of gravity is in a line perpendicular to the basis on which the body is supported ; that though the line passing through the centre of gravity may cease to be perpendicular, yet the body does not fall, but is kept erect by the action of muscles, which counteracts the deviation from the perpendicular direction: finally, that if this line fall on no part of the base, the body must necessarily fall towards that side to which the line inclines.

If the centre of gravity fall behind the base, so that the body tends backwards, the extensor muscles of the leg contract with great violence,

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in order to prevent the flexion of the thighs, at the same time that the superior part of the body is also drawn forward by the contraction of muscles, and the centre of gravity replaced on its natural support. If this contraction of the muscles be not sufficient to bring the body forward, the obliquity of the axis of the centre of gravity still increasing, the action of the muscles will increase in consequence; so that the patella, pushed forward by the inferior extremity of the femur, drawn with great force by the tendon of the triceps and rectus anterior, and retained in the opposite direction by its inferior ligament, is fractured transversely.

The effort made to resist falling, is not the only occasion on which the patella is violently acted on by an instantaneous contraction of the muscles inserted into it. It is exposed to the effects of a violent contraction of the muscles in leaping, which, as performed by the human species, consists principally in the sudden extension of the lower extremities, which are always bent to the leap: for which reason a fracture of the patella often occurs in dancers, and always takes place the instant of their quitting the ground. Another circumstance in which a transverse fracture of the

the patella may take place, is that in which the point of the foot is forcibly impelled forward; an instance of which is found in the case of a soldier, who made an attempt to kick his sergeant. In this case, the manner in which the fracture takes place, is analogous to that of the olecranon, produced by the action of throwing a stone. Another case of this fracture is that of a man brought to *La Charité*, in the month of Pluviose, 8th year. This person was a coachman: his horses took fright while he sat negligently on the box; on which occasion he extended suddenly the right leg, at the same moment that the point of the right foot slipped off the board on which it rested. He felt instantly a very acute pain in the knee, and heard very distinctly, at the same time, a loud crack; and, on applying his hand to the part, he found the patella fractured transversely, and divided into two pieces, which were separated an inch one from the other. These instances remove every doubt on the possibility of this fracture being effected by muscular action alone; and if any further evidence were necessary, it would be found in a case of a fracture of this nature, which took place by the violent contractions of the muscles of the thigh of a man in convulsions.

Falling

Falling on the knees is a no less frequent cause of transverse fracture of the patella: in this case it takes place easily when this bone, made to project by the flexion of the leg, strikes against some very hard, resisting body. When the leg is bent, the patella is supported only by its extremities on the superior end of the tibia, and the articular part of the femur, so that its middle part is without any support, and corresponds with the interval between the two last-mentioned bones: this space is occupied by the adipose cellular texture found behind the inferior ligament of the patella. In this situation of the parts, the patella is easily fractured, because the middle part of it, which is unsupported, is the thinnest, and because it is steadily fixed by the action of the tendon and ligament which are inserted into it. The direction of the fracture depends generally on the shape of the body against which the knee strikes. Should, for instance, its projecting part be transverse to the patella, the fracture will have the same direction; if longitudinal, the fracture will be longitudinal, &c. The same may be said of the violent impulsion of a body against the patella. In all cases this bone may be broken into several pieces, and the soft parts lacerated; or the fracture

ture may be complicated with a rupture of the capsular ligament, and an effusion of blood into the articulation.

Transverse fractures of the patella are always attended with a separation of the fractured portions. When the cause of fracture has been just sufficient to produce the solution of continuity of the bone, without disorganizing its fibrous covering, the derangement is at first scarcely perceptible; but this membrane stretches in a little time. The slightest motions of the leg are sufficient for elongating, or even totally rupturing this substance: in which case the separation becomes instantly considerable, and the articulation, from being no longer supported, bends under the weight of the body. The following case is a remarkable instance of a fracture, in which the separation of the pieces, and the fall which is the inevitable consequence of it, did not immediately follow the solution of continuity. The person, while dancing, heard a dull noise in the right knee, and felt a slight pain in the same part. Some minutes after, in walking about the room, he heard another crack in the same knee, and fell without the power of raising himself. On being brought to *La Charité*, the portions of the patella were found separated an inch and

three fourths, which, with the other signs, left no doubt on the existence of fracture. An uniting bandage, such as is generally made use of for simple incised wounds, was applied, and renewed as often as its relaxation rendered it necessary. On the thirtieth day of the treatment, the knee was gently moved, in order to prevent a false anchylosis, and the motion was afterwards continued every day until the patient quitted the hospital. An interval of about one line in breadth separated the two pieces, which was entirely filled up by a ligamentous substance, of a very inextensible nature.

Two causes concur to produce the separation of the fractured portions; one of which is, the contraction of the extensor muscles, which always takes place when their natural tendency to contract is not opposed, and by which the superior portion is drawn upward on the superior part of the thigh: the second cause is the flexion of the leg, the principal bone of which draws downward the inferior piece which is attached to it. The separation will be, then, great in proportion to the force of muscular contraction, the degree of flexion of the leg on the thigh, and the extension or laceration, more or less, of the tendinous expansion which covers the anterior

surface of the patella, and which is attached to the lateral parts of that bone, and adheres strongly, at the same time, to the capsular ligament.

Nothing can be easier than the diagnosis of fractures of the patella. If this bone be fractured transversely, by a forced extension of the leg, the patient falls, and remains without the power of rising. The fall may instantly succeed the fracture, or there may be some interval. The impossibility of rising exists also when the fracture is effected by a fall on the knee. If raised by the aid of others, the patient falls again if he attempts to advance; he can, however, move backward, by drawing the soles of his feet along on the ground, and by taking care not to bend the knee.

A boy fell on the ice the 11th Nivose, year 8, and fractured transversely the patella of the right side: his efforts to rise were to no purpose; he was therefore obliged to make his way on his back to a neighbouring house, sixty paces distant. He was there put on his feet, and, by leaning on another person, was able to walk backward three hundred paces, to the place of his destination, from which he was conveyed to

La Charité. On the 12th, a slight degree of swelling manifested itself about the articulation; to reduce which, and to calm the pain, which was very acute, emollient poultices were applied. The inflammatory symptoms entirely disappeared on the eighth day after the accident, at which time the usual apparatus was applied. Toward the conclusion of the treatment, the articulation was exercised gradually every day: the patient quitted the hospital in the beginning of Ventose, having the portions of the patella united by a ligamentous substance, half an inch broad. The great strength of this ligamentous substance rendered the joint of the knee sufficiently strong, though it was a little stiff on the patient's quitting the hospital.

Besides the signs resulting from the cause and circumstances of a fracture of the patella, there are others still equally easy to be ascertained, and not less conclusive. A depression is found on the anterior part of the knee, instead of the prominence naturally formed by the patella at that part: the two fractured portions, which are more or less separated one from the other, may be made to approach by extending the leg on the thigh, and bending the thigh on the pelvis; and they may be moved laterally in opposite directions:

rections: a crepitation may be very easily produced, on account of the slight covering of soft parts. A case may occur, however, in which the separation of the fractured portions cannot be distinguished, as when there is a great inflammatory swelling about the knee; but this uncertainty is of no importance, because, even were the fracture ascertained, nothing could be done to bring the divided portions together, until the inflammation had abated.

Is the consolidation of a fracture of the patella analogous to that of other bones? or is the process of nature different in this case from what it is in all others? Some authors have been of opinion that the fractured portions of this bone are susceptible of an immediate reunion, by being placed in contact; but the greater number question the possibility of such a reunion; and assert, on the contrary, that the pieces are always united by means of a ligamentous substance, which is long, thin, and very extensible, when the fracture has not been well treated; but which is, on the contrary, short, thick, and unyielding, when the treatment has been well directed.

Camper is the principal author of the latter theory, which he supports by a great number of

cases. The Academy of Surgery adopted it on the evidence of similar facts; and it is now brought forward in a Treatise on Surgery *, lately published in the north: we do not hesitate to subscribe to it.

Those who maintain that the consolidation of a fracture of the patella is analogous to that of fractures of other bones, appeal to experience, and cite numerous instances of an immediate reunion, which they attribute to a more perfect mode of treatment. But as this pretended immediate reunion has not been attested by dissection of the part after death, it is possible that a very close connexion, by means of a ligamentous substance, scarcely perceptible to the touch through the integuments, may have been taken for an immediate union. A postillion received a kick from a horse the 8th Messidor, year 6, which fractured the patella of the left knee, near its inferior angle: the fibrous expansion pre-

* "Patella fracta, haud uti alia corporis humani ossa, vero callo concrescit, sed fragmenta, solum mediante substantia firmiore, cellulosa, cartilaginosa, cum ligamento mucoso concurrente, conglutinantur, et firmiori cicatrisatione ligamentorum continentur, quod constans experientia, in vivis et cadaveribus, nos edocuit."—CALLISEN, Principia Systematis Chir. Hod. § 1288.

vented

vented the separation of the pieces for some time. The inflammatory symptoms not being intense, yielded quickly to the usual antiphlogistic treatment: the uniting bandage was applied, and the knee gradually moved as soon as the progress of the cure allowed it to be done with safety. The patient quitted the hospital on the 18th Thermidor, perfectly recovered; and so small was the interval between the two pieces, that, without a very attentive examination, it might be supposed that there was none. But had they who supported the theory of the union by a ligamentous substance, contented themselves with opposing their adversaries by facts, the question could not have remained long undecided. They attempted to explain the fact; and their adversaries, by being able easily to overthrow their reasoning, thought that they had thereby proved that the fact never occurred, as if a bad explanation could invalidate a well-attested fact.

We have already shewn that the explanation of the non-consolidation of fractures, founded on the want of a periosteum and lubrification of the fractured surfaces by the synovia, is vague.

Some authors, supposing that the patella was differently organized from other bones, have endeavoured

deavoured to explain, from this difference of structure, the peculiarities of the consolidation of its fractures. But it does not differ in its organization from the other small bones of the body, among which it is classed by the greater number of anatomists. Like them, it is composed principally of a spongy texture, covered by a very thin layer of compact substance. The fibres of the patella, when perfectly ossified, are visibly the continuation of those of the tendon, in the midst of which it is formed. This direction or continuation of fibres is easily demonstrated by the action of nitric acid on the patella, the calcareous part of which it dissolves. The consolidation of fractured bones is effected by the same process as the cicatrization of wounds of soft parts; that is, by a turgescence and expansion of the vascular texture of the part: hence, the less dense, and the more specifically light any bone is, the greater is the number of vessels which pass through it, and the less is the proportion of its saline parts to its volume; and further, the more intimate and multiplied are its points of contact with the neighbouring soft parts, so much the more energetic is its vital action, and the more rapid its consolidation when fractured. The fractured surfaces of the

patella,

patella, on which a great number of vessels are distributed, are, for the foregoing reasons, much disposed to the inflammatory turgescence, so necessary for the union of divided parts; and the consolidation would be very prompt if the granulations could be brought into immediate contact, and if mechanical causes did not counteract the consolidating process.

According to Callisen, the adipose cellular texture placed behind the inferior ligament of the patella, presses itself between the divided portions of that bone, and prevents their immediate reunion. When the leg is fully extended, the inferior ligament of the patella is also in a state of tension, and the cartilaginous trochlea of the condyles of the femur leaves no vaccum behind the patella: in which disposition of the parts, says Callisen, this cellular substance is forced upward and forward, and thrust between the pieces of bone, so as to prevent their contact and immediate reunion: but in no case is this cellular substance placed between the patella and anterior part of the condyles of the femur; and even though it should be placed there, and should insinuate itself between the fractured portions, yet it could not prevent their immediate reunion,

reunion, if it were possible to keep them in contact by a proper apparatus.

The impossibility of doing so is the sole obstacle to the immediate reunion of the fractured portions; and the cause of this impossibility is found in the contractility of the extensor muscles, which cannot be directly opposed by any bandage. For were it attempted to press down the superior portion, and confine it in its place by a bandage, it is plain that this means could only act perpendicularly to the muscles which tend to draw it upward, and cannot therefore be completely effectual; there remains, consequently, a greater or less interval between the two portions of bone, the fibrous covering of which becomes turgid and inflamed from the tension and irritation, and insinuates itself into the interval, so as to fill it up entirely. Such, in our opinion, is the cause and mode of formation of this ligamentous substance.

The strength, thickness, and inextensibility of this substance is in an inverse proportion with its length. When long, it is thin, weak, and extensible, and transmits but imperfectly the action of the extensor muscles to the leg. When short,

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on the contrary, it is thick, strong, and unyielding, and does not perceptibly diminish the action of the muscles, nor impede the motion of the articulation.

The diminution of muscular action is not the sole disadvantage resulting from the length of this ligamentous substance; the strength of the knee, the flexion of which is naturally graduated by the patella, is also diminished by it; for the lower extremity of the femur having no longer its natural support and resistance, the flexion is sudden and abrupt: hence persons so affected fall from the slightest cause. Galen * relates the case of a wrestler, whose patella ascended on the anterior part of the thigh, in consequence of the rupture of its inferior ligament. Every flexion of the knee put this person in the most imminent danger of falling. Descending a declivity was painful to him, and he was always obliged to use a stick on such occasions. Ambrose Paré † informs us, that those who have had the patella fractured have much difficulty in ascending a rising ground, but that they can walk with ease in an horizontal direction. Duverney ‡ mentions

* De Usu Partium, lib. iii. cap. 15.

† Œuvres d'Ambroise Paré, b. xv. cap. 22.

‡ Treatise on the Diseases of the Bones, vol. i.

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the case of a young man, whose patella was raised above the condyles of the femur, and fixed there, in consequence of the rupture of its inferior ligament. This person could not walk up stairs, but could readily come down. Morgagni * mentions a great number of similar facts. I might add several others, all concurring to prove, that, when the knee has lost the support of the patella, walking on rugged uneven ground is very difficult, and ascending a steep place almost impossible.

From what has preceded, it appears that the great object to be attended to in the treatment of fractures of the patella, is the diminution of the interval between the pieces, in order that the ligamentous substance, which is necessarily generated, may be as short and strong as possible. Previous to the application of the apparatus, means are to be used to prevent the accession of inflammation; or, if it has taken place, every effort is to be made to remove it. As inflammation does not instantly succeed the fracture, its approach may be sometimes entirely prevented. The most efficacious remedies in such case are fomentations with a solution of acetate of lead, and

* De Sedibus and Causis Morborum, Epist. 56, No. 27.

particularly

particularly cold applications, such as pounded ice, or very cold water. These remedies are particularly applicable before the accession of the inflammatory symptoms. When the inflammation supervenes, the afflux of humours to the part, which the irritation tends to produce, is to be opposed, and the return of these humours into the circulation favoured. Do we not find, that in plunging into a bath at the freezing point, any part which has been exposed to the action of an irritating cause, as, for instance, the immediate action of fire, or any injury which excites inflammation, is rendered in some degree torpid, or has its sensibility diminished? Which diminution of sensibility is a mark of a partial suspension of the vital property of the part, and is accompanied with a great diminution of the pain. The principle of irritability resides in the nerves, they being the sole organs of sensibility. By a momentary extinction of that property, or by a considerable diminution of it, do we not act against the cause of the evil, rather than against its effects? Whatever may be the value of this reasoning, experience teaches us, that in the case in question, and in all similar cases, the immersion of the part in cold water is useful, and should be continued for several hours, the water being frequently renewed, in order to keep up the cold.

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If the surgeon has not arrived in time to have recourse to this means, or if the contusion be so violent as to render inflammation inevitable, the general antiphlogistic treatment is to be pursued, and adapted to the age, strength, temperament, &c. of the patient. The pain is alleviated, and the tension diminished, by extending the leg. Bell recommends the application of a great number of leeches to the part, but it appears to us that this cannot be done with safety in the greater number of cases; for the irritation produced by their bites, added to that already existing, might bring on gangrene of the part, and the patient's death. In most cases, as when the fracture is a consequence of a fall on the knee, the inflammation is inconsiderable, and disappears in a few days: then compresses, wet with a solution of acetate of lead, may be placed on the part, and the apparatus may be applied over them.

If the contusion be excessive, and blood be effused into the articulation through its lacerated capsule, as well as into the cellular texture, the inflammatory symptoms will be violent, then an antiphlogistic regimen and copious blood-letting must be had recourse to; and should a suppuration take place, notwithstanding our endeavours,

vours, incisions should be made, in order to give a free issue to the purulent matter. This treatment is sometimes successful, but at other times, notwithstanding every precaution, the patient is cut off. Such was the fate of a mason, brought to *La Charité*, whose patella had been crushed rather than fractured by the fall of a large stone. If the contusion be not confined to the anterior part of the knee, the leg should not be fully extended, but placed rather half bent, that being the position in which all the soft parts are equally relaxed. This position produces, it is true, a separation of the divided portions of bone; but the treatment must be in the first instance directed against the inflammatory symptoms rather than against the fracture. If the inflammation be not subdued before the twentieth or twenty-fifth day, it will be useless to apply the apparatus; because the ligamentous substance is already formed, and has acquired a tolerable consistence: its length is much greater than it would be, were it possible to apply the apparatus, and the strength of the knee is considerably diminished. The patient is doomed to the disadvantage already mentioned, of not being able to walk on an uneven surface but with great difficulty, nor to ascend a rising place without some artificial support. When the inflammatory

symptoms

symptoms are subdued in this case, all that remains to be done is to guard against a false anchylosis, by gradually moving the leg from the moment that it can be done with safety, until the motion is free, and not attended with pain.

The conduct to be pursued when the inflammation has been overcome in time to admit of the application of the apparatus, or when it was originally trifling, has been already pointed out; we shall, however, recapitulate the particulars: the leg is to be extended on the thigh, and the thigh is to be bent on the pelvis. The limb is to be supported in this position by means of pillows, or some such bodies, placed under it from the buttock to the heel, and means are to be used to keep the fractured portions in contact.

Some authors have been of opinion that this position was alone sufficient, and that all apparatus for confining the pieces are useless. This is the opinion of Valentin and Citizen Sabatier, who relates, in the Memoirs of the Academy of Surgery, 1783, several cases of fractures of the patella cured by this position alone. But it must be observed, with all due deference to the opinion of these practitioners, that as no measure is taken to secure against the motion of the

limb

limb or the irritability of the muscles, which tend incessantly to draw the superior fractured portion upwards, there is every probability that the interval between the pieces of bone will be considerable. Besides, the ligament which fills up this interval will be still further lengthened, and therefore weakened, by the incautious motions of the limb; or it may be broken before it has acquired its full consistence. This will inevitably be the case if the patient, from any cause, bend the knee forcibly: such an accident would necessarily retard the cure, or totally prevent it, if frequently repeated.

The bandage in the form of the figure 8, and composed of a band rolled up from both ends, the two globes of which are made to cross one another alternately in the ham, and to embrace both sides of the patella, causes a congestion of the foot and leg, by not compressing the whole limb. Besides, the action of this bandage is oblique, and much of it is spent in merely compressing the neighbouring soft parts, which it irritates, and sometimes excoriates; neither is this inconvenience remedied by the pasteboard trough, and compresses proposed by Louis as an addition to this bandage. The part of its action which is employed on the fractured parts is

always insufficient to keep them in contact, if the constriction be not greater than the patient can bear for any length of time. If, in order to avoid this disadvantage, the bandage be not drawn sufficiently tight, its object will be entirely frustrated, and its application useless. These defects occasioned this bandage to be rejected, and led to the invention of another much less objectionable.

A bandage, which, instead of occasioning an œdematous swelling of the limb, obviates it by making an equable pressure on all its parts, which acts in direct opposition to the muscles, which tend to separate the portions of bone, and which, by acting on these muscles, diminishes their irritability and enfeebles their action, must concur powerfully with a good position to effect a favourable union of the divided portions of the patella. The uniting bandage used for transverse wounds possesses all these advantages, when modified as we shall presently mention. The relaxed state into which the parts are put by the extension of the leg on the thigh, and the flexion of the thigh on the pelvis, favours its action.

In applying this bandage, one assistant fixes the pelvis, while another raises and supports the whole

whole inferior extremity. The surgeon takes a strip of linen longer than the whole limb, and broader than the patella, extends it on the inferior part of the leg, and fixes it by several turns of a roller; he then turns up the inferior extremity of the piece of linen, over which he again winds the roller, which he continues to apply as far as the articulation of the knee. He then commits the roller to an assistant, while he himself extends the skin over the patella, lest it should sink or be thrust in between the pieces of bone, which he brings into as close contact as possible, and includes them in two long compresses passed obliquely round them, and crossed in the ham. In the next place he extends the longitudinal piece of linen first mentioned on the knee and thigh, as before on the leg, and again takes the roller, which he carries obliquely over the compresses, observing at the same time to let the folds cross one another in the ham. The application of this roller is continued upward on the thigh, and by its means the longitudinal piece of linen is fixed nearly as far up as the groin, from which its superior extremity is turned downward, having been previously drawn upward with much force. The roller is again carried downward over this double strip, and continued over the knee and leg until it is en-

tirely applied. Another roller is passed several times on the foot, and the whole completed by applying a long splint on the back part of the limb from the buttock to the heel. This splint is kept applied by means of several turns of a bandage passed round it, and the pressure made by it may be prevented from being inconvenient by placing a long cushion of chaff between it and the limb. By this means the patient is prevented from bending his leg, which, without this precaution, he would probably do, and thus frustrate all our efforts. The pain arising from the constriction and continued extension renders it impossible for the patient to keep the limb extended without the assistance of a splint.

This apparatus preserves the pieces of bone exactly in their place in the commencement; but as the circumference of the limb quickly diminishes, the rollers become relaxed; the muscles, which were acted on perpendicularly, are no longer sufficiently compressed; they therefore draw upwards the superior portion. But this separation will be very inconsiderable, if the patient be frequently visited, and the rollers tightened as often as they are found loose.

This chapter might be much extended, by drawing from the profound oblivion in which they are buried the numerous apparatus invented at different and distant times for the treatment of fractures of the patella. Some advantage might, however, be derived from the use of some of them, such as the pieces of metal, leather, or pasteboard, with an opening in the middle for the reception of the patella. Or for these appararus might be substituted two pieces of metal, covered so as to embrace the patella. The concave sides of these metallic pieces might be covered with hair, in order to diminish the pressure on the soft parts. This apparatus does not exclude the application of the splint and rollers, &c.

These general principles of treatment being once established, nothing can be easier than to apply them to particular cases.

We shall describe another apparatus, which appears to us very capable of keeping the leg extended, and the portions of bone in the greatest possible state of approximation. This consists of a trough, long enough to extend from the superior part of the thigh to the small of the leg, and wide enough to receive the thigh

and leg. Small buttons are fixed to the edges of this trough, to which may be attached two straps, that cross one another, and are fastened in the following manner. The trough being lined with carded cotton or soft linen rags, the limb is placed in it in such a manner as that the calf of the leg shall correspond to its middle part: it is then fixed in that situation by means of a circular bandage. One of the leather straps is then fixed to one of the inferior buttons, which rises vertically from the external edge or border of the trough, and conveyed upward and inward, and fastened to one of the superior buttons of the internal side. The other strap is fixed in the same way from the inside outward, so that they cross one another at their middle part, and embrace the superior fractured portion in their inferior angle. It will be necessary to extend the skin over the patella before the straps are tightened. Compresses soaked in a resolvent liquid are then applied, and a few turns of the remaining part of the roller are passed round the whole. The extremities of the straps should be made of leather, but the middle parts of buffalo-skin stuffed with hair like a bandage for a hernia, in order to guard against any excoriation of the parts on which they press. The simple mechanism of this apparatus may be more perfectly comprehended

Fig. 1.

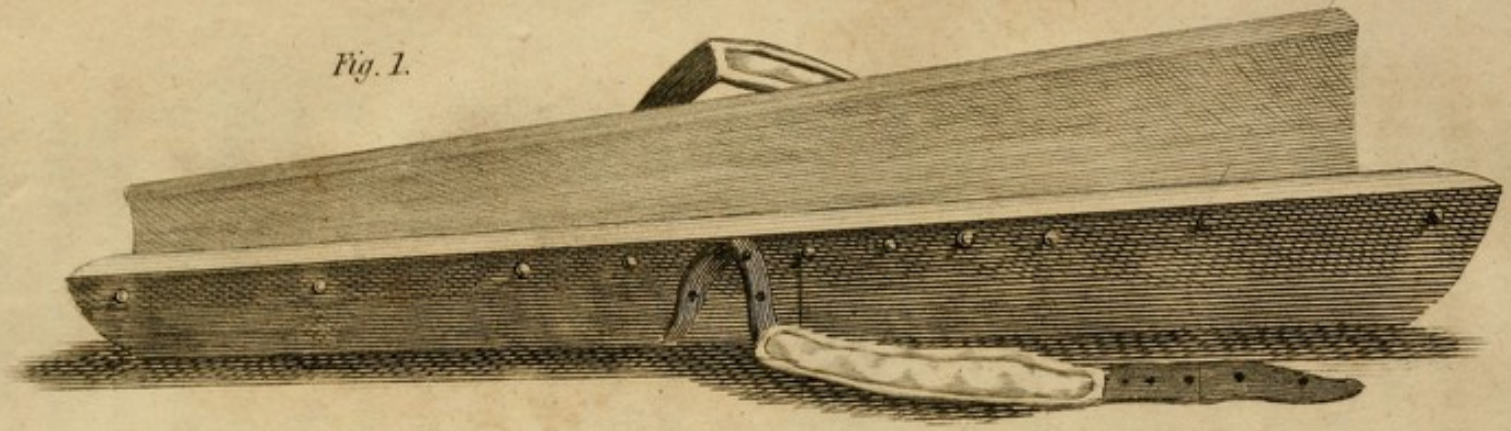
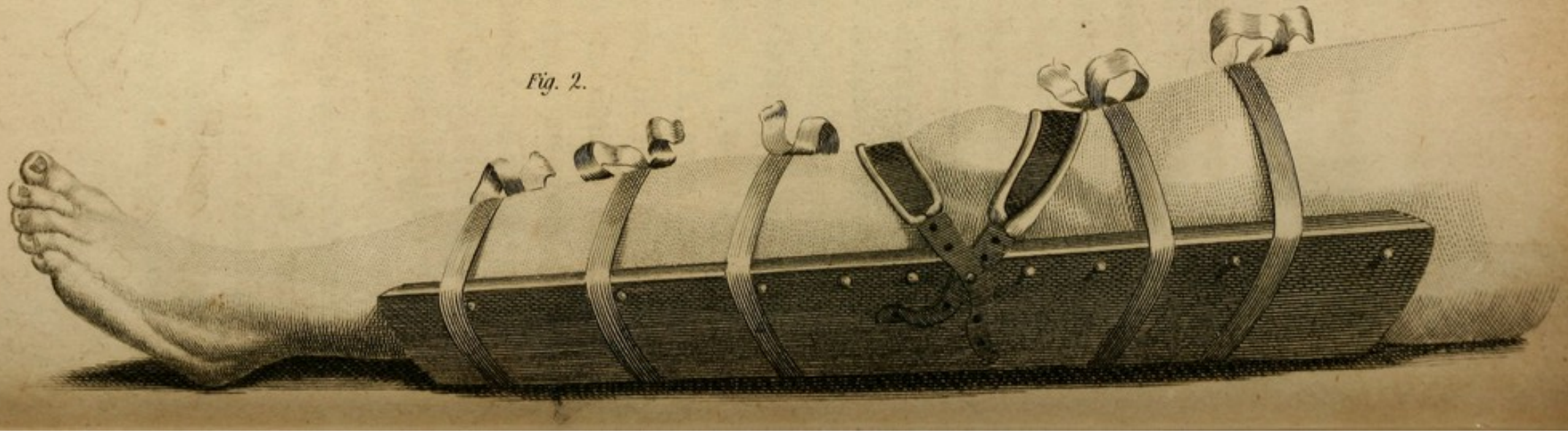


Fig. 2.



by means of the engraving, Plate 3, fig. 1 and 2.

Some authors have been of opinion that the separation of the fractured portions, so far from injuring the motions of the knee, was, on the contrary, favourable to these motions; and have, in consequence, proscribed every species of bandage which could prevent that separation. These authors content themselves with simply moving the limb after the disappearance of the inflammatory symptoms, in order to guard against a false anchylosis. They allow the limb to remain in the half-bent position. But a stiffness in the articulation of the knee is a consequence much less to be dreaded than the weakness and disability which necessarily result from the length of the intermediate ligamentous substance: for which reason this method has but very few partisans. It is applicable only in cases of a longitudinal fracture of the patella, which very seldom happens, and in which the pieces remain naturally in contact. An anchylosis may be always guarded against with certainty, by beginning to move the articulation about the twenty-fifth day. If the treatment has been judicious and regular, no danger can result from gentle

motion of the joint at that period; and the extent to which the motion is carried may be increased every day until flexion and extension can be performed freely and without pain.

CHAPTER

CHAPTER XVI.

OF FRACTURES OF THE BONES OF THE LEG.

SECTION I.

Of Fractures of the Leg.

THIS name is given to fractures of the leg when both the bones composing it are broken; and such fractures are much more frequent than those of the tibia or fibula singly. The middle part of these bones is that which is generally fractured; for the great thickness and strength of the superior part of the tibia render fractures at that part very rare; but the inferior, not being equally strong, is sometimes fractured, and with it the fibula. Both bones are generally fractured at the same height: this is a necessary consequence of the simultaneous action of the fracturing cause.

These fractures may be transverse or oblique, and are subject to every species of derangement.

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The longitudinal derangement is, however, much less common than the horizontal or angular. In the former case, the inferior pieces are almost always drawn outward and backward, whilst the superior project internally and forward. The angular derangement may be produced either by the action of the posterior muscles of the leg or the weight of the body, and in either case the angle will be salient anteriorly. The salient angle may take place posteriorly, if the heel be too much raised. The derangement in the circumference arises from the inclination of the foot inward or outward, but it most commonly falls in the latter direction. The longitudinal derangement is extremely rare, and cannot easily take place in transverse fractures, on account of the considerable extent of the fractured surfaces; but in oblique fractures the inferior pieces are almost always drawn upward by the action of the posterior muscles of the leg, in which position of the parts the lower ends of the superior portions project anteriorly, and may be felt by the hand. Sometimes, however, when the solution of continuity is obliquely downward and outward, the anterior projection will be produced by the lower pieces. In some cases the pointed ends of the bones tear and penetrate the integuments in both kinds of derangement.

Fracture

Fracture of the leg is accompanied by all the signs or symptoms mentioned in treating of fractures in general in the first chapter. Change of direction and shape of the limb, pain, and incapability of motion, mobility of the fractured pieces, and crepitation always distinct, &c.—all these circumstances render this fracture so evident, that it is impossible to be mistaken respecting its existence.

The prognosis, less unfavourable than in fractures of the thigh, varies according to the part of the bone fractured, the direction of the fracture, and many other circumstances. The fractures which take place near the knee are not much subject to derangement, on account of the thickness of the bone in that part; but are, however, more dangerous than those of the middle part, as being subject to be followed by a stiffness of the knee joint. Fractures of the inferior part are still more dangerous. Oblique fractures are very difficult to be managed; and when their derangement is upward and outward, the integuments are very apt to be torn by the projecting points of the superior portions of bone.

As

As to the treatment of a simple fracture of the leg, the patient is to be carefully undressed in the first place, and then laid on a hard and narrow bed, perfectly horizontal, and without any board at the end. Afterwards the apparatus are arranged in the following manner: 1. three pieces of tape, or linen; 2. a square piece of linen cloth longer than broad; 3. a sufficient number of short pieces of linen to cover the whole leg, or Scultet's bandage; 4. two quadrilateral compresses; 5. three cushions of oaten chaff, and three splints, two lateral, long enough to extend from the knee to a small distance beyond the sole of the foot, and a third anterior shorter than the leg. All the pieces of the apparatus being thus disposed, and the compresses and short bandages being wet with a resolvent liquid, an assistant takes hold of the knee with both his hands, and another seizes the foot, having both his thumbs applied to its sole: while both pull in opposite directions, the surgeon performs coaptation. The moment that the bones come into their right situation is easily known, on account of the thin covering of the tibia anteriorly. The square compresses are then laid over the leg, and on them Scultet's bandage, commencing always with the lowest pieces. The lateral splints, in the next place,

rolled

rolled up in the square linen cloth, are applied in such a manner as that they may rest perpendicularly on their edges, nearly in contact with the leg, between which and them a bag of chaff is placed on each side, by means of which the depressions of the leg are filled up. The remaining chaff-bag is placed on the anterior part of the leg for a similar purpose, and over it the third splint. An assistant holds fast with both his hands the different pieces thus placed, while the surgeon secures them more permanently by means of the three linen bands, which he knots over the external splint, commencing always with the middle one. The apparatus is completed by securing the foot by means of a small band to the lateral splints, in order to prevent it from falling to either side. But as the foot might be forced to either side by the weight of the bed-clothes, this inconvenience is guarded against by means of a hoop placed perpendicularly on its ends over the leg. If the patient's stomach be not full, he should be bled, and afterwards confined to a low regimen.

Not only is it useless to place compresses under the heel, as was practiced by the ancients, but it is attended with manifest disadvantages. The heel being raised by these compresses, supports the

the whole weight of the limb; and the pressure sometimes occasions gangrene to such a degree, that the os calcis is laid bare. Besides, by the elevation of the heel, the fractured part of the leg loses its support, and a salient angle is produced backward by the weight of the limb.

A roller cannot be substituted for Scultet's bandage, but in cases of children under two years of age.

If on the day after the application of the apparatus, the foot be neither painful nor swelled, and a slight degree of œdema be alone perceptible in that part, the apparatus need not be removed. It will be necessary to tighten the external bands every day, and to wet the whole with a repellent liquid; and at the end of eight days the apparatus should be re-applied. Some practitioners do not change the first dressing for eighteen or twenty days: but it frequently happens, that during this time the fractured portions become deranged in the direction of the diameter or axis of the bone, and that their consolidation has already advanced considerably in this vicious position. This derangement may be occasioned by some accidental or involuntary motions; some defect in the first application of the

the apparatus, or (what is of the greatest importance) by the bed not being perfectly horizontal. The practice of deferring for such a length of time the re-application of the apparatus, has probably originated from the use of the circular bandage or roller. The motion which should necessarily be given to the limb in re-applying that bandage, was certainly a sufficient justification of the practice. In adopting the improved method which we have described, the whole apparatus should be re-applied every seven days, and the external bands tightened whenever the relaxation may render it necessary.

On the fortieth or forty-fifth day, the progress of consolidation may be examined; and if the callus be found solid, the circular bandage or roller may be safely substituted for that which we have described, and the patient may be allowed to sit up and take any convenient posture, and in a very short time to walk about with the aid of crutches. The stiffness of the knee and instep arising from the long inactivity, will render walking difficult for some time.

For the three or four first days the patient should be allowed only broths, which may be gradually changed for more substantial food.

If he be costive during his confinement, clysters may be administered; and should other incidental symptoms occur, they are to be combated by appropriate remedies.

We shall not trouble our readers by treating particularly of compound fracture of the leg, because we could only repeat what we have already very minutely detailed.

When the leg is fractured very obliquely, continued extension ought to be employed, particularly when the points of the fractured portions penetrate through the integuments. In cases of this nature, in which there is some hope of preserving the limb, if the patient be strong and healthy, some blood should be taken from the arm, and the extending apparatus applied.

SECTION II.

Of Fractures of the Tibia.

This bone bears the whole weight of the body transmitted to it from the femur, and is fractured on that account more frequently than the fibula, though it is much thicker and stronger than

than the latter. But as fractures of it are almost always transverse, they are not very dangerous.

If the fracture take place near the inferior extremity, the great extent of the fractured surfaces prevents any considerable derangement of the fractured portions; and the fibula acting as a support on the external side, contributes also to this effect. Besides, there is no tendency to derangement from muscular action.

This circumstance renders a diagnosis of fractures of the tibia often very difficult, and the difficulty is further increased by the little pain and inconvenience produced by such a fracture; for persons have been known to walk, although the tibia was at the same time fractured.

Whenever there is reason to suspect this affection, in consequence of a blow or a fall on the leg, the part should be minutely examined. The fingers are to be moved along the anterior side of the tibia, the slightest inequality in which may be easily perceived, on account of its being covered only by the skin; and the motion of the pieces may be perceived, by seizing the opposite ends of the bone and pushing them in contrary directions. This motion, however, and

the crepitation which should accompany it, are very indistinct, on account of the fibula not allowing the fractured portions to be sufficiently moved on one another.

The patient complains of a constant pain in his leg, and particularly near the seat of the fracture. This pain continues for a much longer time than that which is the effect of a mere contusion, and it is increased by walking.

By means of these signs, the existence of this fracture may be ascertained; but little is to be done in the treatment of it. The slight derangement which has taken place, is to be corrected by moving the pieces in the direction opposite to that in which the derangement has taken place; but before giving them this motion, they should be drawn in opposite directions, in order to diminish the friction of the fractured surfaces. A long compress is then placed on the anterior part of the leg, and over that a roller or circular bandage; with which the leg being covered, three splints of pasteboard, or thin wood, are applied and bound on by the part of the roller which remained unapplied.

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The patient is to be confined to his bed, and not allowed to use the affected limb until the fracture is consolidated. In cases of aged or adult persons, it would perhaps be more prudent to use the ordinary apparatus for fractures of the leg, than the roller. Whichever mode is adopted, the bandage may be taken off on the fortieth or forty-fifth day, at which time the consolidation is complete. The articulations of the knee and foot are but little affected by this fracture, and the slight stiffness of them, arising from inactivity, is soon removed, and the patient is able to walk about in a few days.

SECTION III.

Of Fractures of the Fibula.

The fibula, though slenderer than the tibia, is less frequently fractured. It is not charged with the weight of the body, and its principal use seems to be that of preventing the dislocation of the foot outwards, in a forced abduction. Thus we see that it is placed externally, descends below the articulation of the tibia with the foot, and forms the external ankle. It is besides more flexible than the tibia, and can execute in its double articulation with this latter bone some

obscure motions, which consume a greater or less share of any force that might tend to fracture it.

Yet, from the very nature of its functions, the fibula is exposed to certain fractures, of which no author has taken particular notice. In every step that is made on an uneven ground, the foot presses against the inferior extremity of this bone. By this action of the foot on the external ankle, the fibula is pressed upward, and as the nature of its articulation with the tibia does not allow it to ascend in any perceptible degree, it is forced to bend more or less in proportion to the force applied. The elasticity of this bone enables it for some time to resume its natural direction, when the force is removed. But as the same force acts frequently, and is never intermitted but for very short intervals, the bone acquires insensibly a permanent bend, instead of being perfectly straight, as it is in the infant. This bend becomes more evident in proportion as age advances, and as the limb has been used.

Climbing animals, such as the squirrel, and others, whose feet are always in a very forced abduction, have the fibula stronger in proportion,

tion, and more convex externally, than it is in the human species. It has been observed by Citizens Cuvier and Dumeril, that, in the animal called the three-toed sloth, the inferior extremity of the fibula is inserted into a socket on the superior surface of the astragalus, in such a manner as that the foot must be considerably strengthened by it, and secured against dislocation by the extreme abduction which this animal is obliged to make, in grasping the trunks of the trees on which he climbs.

The motions of adduction and abduction, in which the sole of the foot is turned inwards or outwards, are very limited in the human species, and much less extensive than those of flexion and extension. It sometimes happens, however, that the foot, from missing its support, or being entangled by something, is turned forcibly inwards or outwards; in which case the ligaments of the articulation are always strained, and very frequently lacerated. It is in a case of this kind, when the foot is forcibly turned outwards, that the fibula is fractured by the pressure of the astragalus, the dislocation of which, outwards, it prevents, when the foot is forcibly turned in the same direction.

The action of the foot is always the immediate cause of fracture produced in this way. If the convexity of the fibula outwards were uniform, so that the whole length of the bone should form an arch of a circle; if it were of an equal thickness and strength in all its parts, and if its muscular and ligamentous connexions with the tibia were also of an equal strength in every part, the fracture would always take place in its centre; but none of these conditions exist, and the fracture takes place generally below its middle half. If the abduction of the foot has been very violent and sudden, the fibula may be fractured at about an inch above its lower extremity, by which the external ankle is separated from the body of the bone.

To the fractures produced by this cause are to be added those resulting from a fall, or a blow on the external side of the leg, in which the bone always yields in the part to which the force is immediately applied, and in a direction opposite to its natural curve.

Whatever be the manner in which a fracture of the fibula is produced, the pieces are not susceptible of the longitudinal derangement; but are in all cases drawn a little towards the tibia, by the muscles placed in the interval between

tween them. Hence a fracture of this bone will be best ascertained by pressing the fractured portions inward, as it is in that direction that their motion can be best perceived. This symptom, and crepitation, which is a consequence of it, may be also observed in the abduction and adduction of the foot. These signs are more evident when the fracture takes place near the inferior extremity, than when it happens near the superior, which is covered with thick muscles. But a fracture of the lower part may be very difficult to be ascertained, when the articulation of the foot has been at the same time violently strained, and the inflammation and swelling have arrived at a great height. In cases of this nature, some practitioners turn all their attention to the affection of the articulation, that is, to reduce the luxation of the astragalus, and combat the inflammatory symptoms, without doing any thing for the fracture.

But so imperfect a mode of treatment must be attended with the worst consequences. The peronei muscles, which extend the foot by raising its external edge, and turning its sole outward, act incessantly, and draw the foot gradually into that position. The fractured portions are deranged longitudinally, the infe-

rior being drawn upward along the internal side of the superior. The astragalus is carried under the internal ankle, and forms a considerable tense tumour there; the skin becomes inflamed and ulcerated at this part, and a fistula is formed, which communicates with the articulation of the foot. The patient cannot support himself on the affected limb, and in time the symptoms become more and more alarming, and may lead to the necessity of amputating the part. Fabre quotes two examples of the bad consequences resulting from neglecting a fracture of the fibula; they are to be found in his Researches on certain Points of Physiology and Pathology. I have myself seen the foot distorted, and the fracture not consolidated, in the case of an old man who died of a malignant fever, in one of the medical wards of *La Charité*.

It will therefore be prudent, in every case of a strained foot, to examine carefully the lower extremity of the fibula, and to apply an appropriate apparatus, if there be the slightest suspicion of a fracture. The first step of the treatment should be to cover the affected part with emollent poultices, and to take some blood from the arm; and if it be found that the bone is fractured, so soon as the swelling and inflammation are

abated, Scultet's bandage should be applied, and the distortion of the foot prevented by means of two splints, which descend from above the knee, to a short distance beyond the foot externally, and internally as low as the ankle. It is perhaps superfluous to repeat that the splints should be rolled in a splint-cloth, and tied on with bands, and that bags of chaff should be placed between them and the leg, in the depressed parts.

This apparatus should be continued for a month, and frequently removed, in order to renew the emollient applications. In this lapse of time, the fracture generally consolidates, but a stiffness remains in the joint, of which it will be prudent to warn the patient. This, however, will be removed in a few months by bathing and friction, but above all by exercise, the suspension of which was its principal cause.

If the fracture take place towards the middle part of the bone, the ordinary apparatus for fracture of the leg should be applied, and thick compresses placed on the anterior and posterior sides of the leg, by means of which the antero-posterior diameter being increased, the bandage

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can act in that direction, and press the fleshy parts into the interosseous interval, and thus prevent the fractured portions from obeying their tendency to approach the tibia. But preserving the interosseous interval is not so important here as in the fore-arm, because in the former it merely serves to lodge some muscles; the foot not having to execute any motions which require the rotation of the fibula on the tibia.

CHAPTER XVII.

OF FRACTURES OF THE BONES OF THE FOOT.

SECTION I.

Of the Fractures of the Os Calcis.

The solidity of this bone, the three dimensions of which are nearly equal, renders it but little liable to be fractured. The causes by which it may be fractured are muscular action and external violence, and in this respect it resembles the olecranon and patella. The violent and instantaneous contraction of the gastrocnemii muscles is sufficient to detach from the remainder of the bone that part of it called the tuberosity, into which the tendo Achillis is inserted, and which extends backward beyond the astragalus. Though the gastrocnemii muscles are at least as strong as the extensors of the arm or leg, yet fractures of the os calcis are, on account of its thickness, much less frequent than those of the patella or

olecranon. Fractures of it are also less frequent than the rupture of the tendo Achillis, the contrary to which takes place with respect to the tendons of the extensors of the arm and leg, which are stronger than the osseous parts to which they are attached.

Some rare examples of fracture of the os calcis from muscular action may be cited: that, for instance, of a woman detained against her will at *La Salpetriere*. She converted her sheets into a rope, and by means of them descended from her window; but the sheets not reaching to the ground, she let herself drop on her feet. On touching the ground, she heard a crack in one of her heels, and fell without the power of raising herself. On examination, the os calcis was found to be fractured.

The existence of this fracture is discovered by the circumstances of the case: a fall on the sole of the foot; a crack heard in the moment of the fall; pain, which is increased by the motion of the part; the almost absolute impossibility of standing or walking; a greater or less swelling of the heel; the mobility and elevation of that part of the os calcis into which the tendo Achillis is inserted; finally, the crepitation

and

and interval between the fractured portions—are all marks which separately or conjointly lead to the discovery of the fracture. It may be observed, however, that the separation of the fractured portions is not easily ascertained, on account of the thickness of the integuments.

In setting this fracture, it is necessary to extend the foot on the leg, and to bend the leg on the thigh. In this position the two portions of the os calcis can be very easily brought into contact, the superior of which is drawn upward by the gastrocnemii muscles.

The foot and leg are kept in this position all the time necessary for the consolidation, by means of the slipper invented by J. L. Petit for a rupture of the tendo Achillis.

The uniting bandage used for transverse wounds may be substituted for the slipper, when, from local circumstances, the latter cannot be had; but it must be modified as follows: the end of a bandage is placed on the superior surface of the foot, whence the bandage is reverted on the sole, and the end is made fast by circular casts round the foot: this bandage is

then drawn along the posterior side of the leg to the ham (the foot being previously extended), on which part it is fixed by other circular casts; it is thence brought downward forcibly, and the application of it terminated by rolling along the leg what remains. To this bandage might be added a long compress, the middle part of which should be applied above the posterior portion of the os calcis, and the extremities crossed on the superior surface of the foot, and turned under the sole. This compress may be fixed by a bandage rolled on the foot in the shape of the figure 8.

The union of this fracture is effected in thirty or forty days, at the end of which time the patient may be allowed to bend his foot. He must, however, for some days, avoid any forced flexion of the foot, as also an excessive extension by rising on his toes.

The other bones of the tarsus, as the astragalus, cuboides, scaphoides, and the three ossa cuneiformia, are susceptible only of comminutive fracture. The same may be said of the bones of the metatarsus, and the phalanges of the toes. On the treatment of fractures of these

these bones we have nothing to add to what has been already said in general on compound fractures, or in particular on fractures of the bones of the hand.

CHAPTER XVIII.

OF WOUNDS, AND DENUDATION OF BONES.

The bones may be stripped, not only of the integuments, muscles, &c. by which they are naturally covered, but also of the periosteum, which is their intimate and appropriate covering.

Cutting or contunding instruments may produce this denudation of the bone without injuring its substance, or they may cut or contuse its external fibres. These two cases must be carefully distinguished, as the contusion of the bone is attended with consequences much more serious than those of a simple denudation.

If the bone has been merely stripped of its periosteum and integuments, and these parts are immediately replaced, so as to exclude the contact of the air and bandages, the reunion of the periosteum is found to take place in a very short time. But if the external laminæ of the bone have been contused, or if its surface has been left a long time exposed to the action of the air,

air, or to the friction bandages, exfoliation becomes a necessary consequence. All the external laminæ must separate; and before this separation is effected, the cicatrization of the external wound would be rather injurious. Should the wound in the integuments be prematurely closed, purulent matter will continue to form underneath, the contused laminæ will exfoliate, an abscess will point externally and burst spontaneously, and the matter that escapes from them will contain small splinters of bone. Old age is unfavourable to the healing of wounds and contusion of the bones; because, as the cure can be effected only by means of the vascular texture of the bone and periosteum, the turgescence and expansion of this must be slow and difficult in proportion to the person's age. The treatment adapted to the different cases is as follows:

If the bone be simply laid bare, the integuments, if not completely separated, should be instantly replaced. This precept holds good in all cases, whatever may be the patient's age, if the bone has not been already a long time exposed to the contact of the air. At the same time it must be allowed that it is very difficult to know by mere inspection whether the bone be contused or not; but should that

be the case, and even should suppuration and exfoliation be inevitable, no bad consequence can result from the attempt to produce an immediate cicatrization; whereas, in the contrary event, the duration of the treatment will be much abridged. If it be impossible to unite the wound by the first intention, its lips are to be kept separate by lint interposed, and the whole is to be lightly covered. In a short time granulations appear, and the external laminæ of the bone exfoliate. Sometimes, however, and particularly in young persons, the bone becomes soft and red, and granulations arise from it, which bleed from the slightest cause. It has been said, that the bone exfoliates insensibly in this case; but this observation is not found to be true: the laminæ of the bone are not broken down, dissolved, and carried off by suppuration. The change consists of a softening of the bone, and conversion of it into a fleshy substance, which unites with the soft parts.

In this last-mentioned case the cure is much more prompt than when a real exfoliation takes place. The process of exfoliation resembles that of the separation of gangrenous eschars: the mode in which the separation is effected is equally unknown in both cases. In exfoliation,

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it is merely known that the subjacent vessels grow turgid, expand, and pullulate, and that a line of separation is observed between the contused laminæ and the sound part of the bone. The former are undermined, as it were, and their connexion shaken by the purulent matter formed under them, and at length are entirely detached, and may be easily removed by the fingers or a forceps. When the bottom of the wound is entirely freed, the granulations that arise from it unite with the soft parts, and in a short time the wound is cicatrized.

Various processes have been employed for expediting the exfoliation. Thus the ancients covered the bone with pledgits of lint impregnated with spirits, or with a tincture of myrrh and aloes; but it is found that these applications retard the exfoliation by opposing the expansion of the vessels; for which reason they have been laid aside, and oily relaxing applications have been substituted for them.

It has been proposed to perforate in different parts the laminæ which are to exfoliate, on the supposition that this practice facilitates the growth of the granulations. The perforations have certainly this effect, but the granulations, by shoot-

ing up through them, retain the laminæ rather than aid their exfoliation: each vessel spreading as it rises, and assuming in some respect the shape of a broad-headed nail. It will then be more prudent to limit the treatment to the use of unctuous or emollient applications. By means of these remedies, the texture of the part will be sufficiently relaxed, and the development of the vessels facilitated. But if the portion of bone to be exfoliated be very considerable and deep seated, these applications are nearly useless, at least their effect must be very trifling; then we must content ourselves with covering the part with lint, and trusting to time and nature for effecting the separation.

Though the exfoliation be complete, as may be known by the motion of the piece, it may still happen that the circumference of the detached portion may be encroached on by the growth of the soft parts, and thus prevented from separating. In this case it will be necessary to disengage it by making an incision in some point of the circumference of the wound, after which it may be drawn out by the fingers or a forceps. In general, there is but very little difficulty in removing it.

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The action of cutting instruments is not always limited to the mere denudation of the bone: they sometimes completely divide it: this, however, is but a rare occurrence. It sometimes happens that a part of the bone is cut off, of which there are numerous instances in wounds of the head, where a part of the parietal bone, with its pericranium, a portion of the occipito-frontalis muscle and hairy scalp, have been entirely separated by a blow of a sword.

When a wound of the soft parts is accompanied by a similar affection of the subjacent bone, an immediate reunion of the soft parts must not be attempted. Lint is to be gently introduced into the fissure, and the wound healed from the bottom; for a solid cicatrix of the soft parts cannot be expected until the wound in the bone is first cicatrized.

If the bone of one of our limbs be cut quite through, as in the cases mentioned by La Peyronie, Warner, and others; and if a piece of flesh remain undivided, which contains the principal vessels of the limb, it will be prudent to reunite the parts, and place the limb in the apparatus used in cases of fracture of the part.

The time necessary for the reunion of the parts in cases of this nature is full as long as that in those of fracture, and the consolidation is effected in the same manner as in the former case.

CHAPTER XIX.

OF NECROSIS.

That affection of bones by which a part of their substance is deprived of the vital principle, has been termed necrosis: the affected part of the bone, in this case, bears a strict analogy to that of soft parts in which a gangrene has taken place. This disease was not distinguished from caries by the ancients, and it has been termed "dry caries" by some of the moderns. Necrosis and caries are, however, essentially different.

Osseous parts attacked by necrosis are absolutely deprived of the vital principle: but this is not the case when they are simply carious; for caries is an affection exactly analogous to foul and corroding ulcers of the soft parts.

All the bones of the body are subject to necrosis, but some are more frequently attacked by it than others; the broad bones, for instance, and those which are but lightly covered with soft parts, such as the bones of the skull, the lower

jaw, the clavicle, the scapulæ, the humerus, femur, and tibia. The short bones are seldom attacked by it, but are much more subject to caries. The affection may be either partial, or it may extend to the entire bone. Thus we find a long bone affected in some part of its length, or entirely diseased from one end to the other, and broad bones affected only in their external laminæ, or in their entire substance.

The middle portion of long bones, or that part of them which is most compact, least porous, and consequently least endued with the vital principle, is that which necrosis most generally attacks: the extremities of these bones, and in general all spongy bones, are much less liable to it. This disease never extends to the articulations, even when the whole diameter of the middle part of the bone is affected by it: the extremities covered with cartilage separate from the dead part of the bone, and if this be removed by nature or art, they unite with the ossified periosteum, which occupies the place of the separated portion.

When the necrosis is superficial, the superior lamellæ are separated from the rest of the bone; but this separation is always preceded by a suppuration

puration produced by the irritation given to the surrounding soft parts by the dead portion of bone. It is to be observed, that no part of the substance of the dead portion of bone goes to the formation of this purulent matter; for it seems to be not only incapable of furnishing matter for the formation of pus, but is entirely without the sphere of vital action.

If a broad bone, as the os frontis, for instance, be attacked, the skin over the affected part tumefies, becomes inflamed, and assumes a brown or violet colour; it grows gradually thinner, bursts at length, and gives issue to the purulent matter contained under it. The necrosis of the bone is then ascertained by introducing a probe, which is found to pass on a rough and naked surface, if the affection of the bone really exist.

In a case of complete necrosis of a long bone, the limb swells at the part affected, and a hard and painful tumour is formed on it. Abcesses form at various points, they burst, and their openings degenerate into fistulæ. The discharge from these in the commencement is white and inodorous, but becomes serous and fetid in a short time. This matter is sometimes absorbed in such quantity

quantity as to produce marasmus, hectic fever, &c. In cases of necrosis, in which the whole bone is affected, the periosteum separates from the portion of diseased bone, its vessels seem to take on a new action, a calcareous phosphate is deposited in its texture, it acquires hardness, and in time forms a cylinder, in which the dead part of the bone is included. This new bone, which is in fact the periosteum ossified, is rough on its surface, and has but a distant resemblance to that which it replaces. Various holes are observed in it, through which the purulent matter and mouldering portions of bone escape, the fistulous openings in the soft parts being continuations of these holes, and the muscles of the limbs are inserted into it.

The dead part, completely separated from the sound, and enclosed by the indurated periosteum, is called *sequestra:* this separation is perfectly analogous to that of mortified soft parts.

The promptitude with which gangrened soft parts are separated, is much greater than that with which a dead portion of bone is detached; but this difference is to be entirely attributed to the state of the vital energy of the parts, which

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is much more considerable in one case than in the other.

The causes of necrosis may be divided into internal and external; the latter are blows, excessive pressure, imprudent applications of caustics; as happened in the case of a woman who had caustic potash applied to an exostosis on the internal side of the tibia. But necrosis is most frequently produced by an internal cause, such as scrofula, or syphilis. In persons thus constitutionally affected, a blow, or other external accident, may prove an exciting cause of the disease.

By whatever cause produced, the following symptoms characterize it: excruciating pains in the part affected, which no emollient nor sedative application can assuage. As there is no visible swelling in the commencement of the disease, these pains are frequently attributed to rheumatism. The pain which was felt at first but about the middle of the bone, extends towards its extremities, if the bone affected be a long one: the part swells, the skin becomes inflamed, and the tumour, which was hard at first, grows soft in different parts, or abscesses form in it, which burst, and whose openings degenerate

nerate into fistulæ. The surface of the bone, if not deep seated, as the tibia for instance, may be seen through this opening; in which case the nature of the disease may be ascertained beyond all doubt; but an equal certainty may be had when the bone is covered by a great depth of soft parts, by the insertion of a probe.

There is at first a copious discharge of purulent matter, but the quantity gradually diminishes, and splinters of dry bone, coloured, as if they had been buried a long time in the earth, come out with the pus. The disease may be said to be at its height at this period, for now the dead part is separated by the vital energy of the sound. By introducing a probe at this time, pieces of the bone are felt detached and loose. These symptoms of necrosis, evident enough in affections of the long bones covered with thick muscles, are still more so in cases of flat superficial bones, as those of the skull for instance: in affections of the latter, the skin becomes first thick, hard, and reddish; but it soon bursts, and an ulcer is formed in it.

The prognosis varies in this disease according to the bone affected, and the circumstances with which it may be complicated.

If

If the disease be confined to the surface of a flat bone, or though it should affect it quite through, it is not very dangerous, and nature alone effects the cure. If the assistance of art be necessary, it is only in combating the disease of the system. However, if there be a large surface affected, and if the introduction of instruments for the purpose of extracting the splinters be difficult, the prognosis becomes more unfavourable. Necrosis, when confined to the surface of the middle part of long bones, is equally free from danger as in the former case, and nature alone effects a cure. But the prognosis is far different when a large portion of the bone is affected, and when this portion is contained in the cavity of the cylinder formed by the ossified periosteum; for though nature has been able to separate it, yet the assistance of art is necessary to remove it from its osseous covering.

In cases of necrosis, in which the dead bone is entirely included in that newly formed, the prognosis may vary according to the state of the soft parts of the limb, the age and strength of the patient, and the form of the new osseous substance. The tumefaction of the limb may be excessive, the fistulæ numerous, the suppuration abundant, and the strength may be reduced

duced by colliquative diarrhœa and hectic fever. In such circumstances the danger is much greater than if the suppuration were trifling, the patient young and healthy: and the danger will be still less if the new bone be naturally perforated, so as that the old one may be drawn out.

The surgeon, whose art is so useful in most diseases of the bones, can, in cases of necrosis, be but a simple spectator of the operations of nature, which are frequently successful: it may be said with truth, that necrosis proves the efficacy of nature, and the insufficiency of art. Art can assist nature only in removing that part of the bone which the vital principle has abandoned; as has been amply shewn in the Memoirs of the Academy of Surgery, in David's Treatise on Necrosis, and more particularly in a Latin work on that disease, by M. Weidman. If the necrosis be superficial, or not very extensive, nature alone is sufficient to remove effectually the diseased part; but art assists in cases of deep-seated necrosis, in which the dead bone, after its complete separation, is enclosed in the new.

The treatment adapted to the necrosis of broad or flat bones, or that of long bones when the disease is confined to the surface of their middle

part, is very different from that which should be followed when the necrosis has seized the entire body of the latter. We shall therefore explain these different modes of treatment successively.

When one of the large bones of the skull is attacked by necrosis in any part of its surface, nothing is to be done until exfoliation takes place. The progress of this process is marked by an inflammatory circle round the part to be separated, by a fissure which succeeds, and marks the same circumference, and which grows wider and wider every day. If at this time the diseased portion be struck with a probe, a noise is heard which indicates an empty space under it: it becomes loose soon after, and may be very easily removed. The separation of it may be accelerated by stirring it every day, but it is useless to apply any instrument for the purpose of thinning it; for the exfoliating of a thick lamella is just as easy as that of a thin. The use of the trepan is equally inapplicable for this purpose, as it is impossible to know beforehand to what depth the exfoliation will take place, and if that depth be not entirely taken off, the slightest lamella which remains will be just as troublesome as if the whole remained: nature will require as much time to separate it, as if it had been much thicker.

thicker. We have already pointed out the inutility of perforating the affected part of the bone, with the intention of facilitating the exfoliation. We have also remarked, that unctuous and emollient bodies are better topical applications than spirituous irritating substances, such as tinctures of aloes and myrrh; or than caustic, which, by irritating the subjacent parts, often causes the disease to extend.

It is plain that the topical affection will continue to extend incessantly, when it depends on a constitutional disease; therefore, while nature tends to remove the former, it will be necessary to oppose appropriate remedies to the general disease, whether venereal, cancerous, scrofulous, or scorbutic.

If one of the bones of the cranium be affected with necrosis, and the brain be compressed by pus, it will be necessary to use the trepan, as advised by Quesnai, in order to remove the pus accumulated on the dura mater. The trepan is not applied in this case against the disease itself, but against a very dangerous consequence of it. In stirring the piece, in order to accelerate its separation, care must be taken not to break it, as the extraction of the remaining portion, gene-

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rally covered with soft parts, might be difficult. It is found necessary in many cases to make use of a spatula, or some such instrument, to disengage the splinter from the granulations which encroach on its surface, and take root as it were in its inequalities: this may take place to such a degree, that it may be sometimes necessary to make an incision into the soft parts, in order to extract more readily the portion of dead bone.

When the piece is extracted, the disease is reduced to the state of a simple wound. The granulations which arise from the diploe, or dura mater, when any of the bones of the skull has exfoliated, become the foundation of a solid cicatrix. The bone always remains thin in that part; and it has been found necessary to protect the part of the cranium, from which an exfoliation of this kind took place, with a piece of leather or pasteboard.

When the exterior lamellæ of a long bone are affected with necrosis, the treatment is precisely the same. If it be ascertained by the introduction of a probe through a fistulous opening, that an exfoliation of the bone has taken place, an incision must be made for the purpose of extract-

ing the exfoliated piece. But when this disease affects the whole of a cylindrical bone, and when the periosteum is ossified around the diseased bone, it will be necessary to acquire the greatest certainty of the complete separation of the decayed portion from the new one. In order to ascertain this, we attend to the duration of the disease, but principally to the motion that may be communicated to the decayed portion, by introducing a probe through one of the fistulous openings. It happens sometimes that, in moving the limb, a noise may be heard from the collision of the decayed bone against the parietes of the new one.

When nature has done her duty, the assistance of art must be called in to complete the cure; but the extraction of the dead bone is an operation of a painful and hazardous nature, and should not be undertaken without reflecting very seriously on its probable consequences, and on those of the disease if left to itself. The operation is extremely difficult when the diseased bone is covered with a great number of very thick muscles, as the femur for instance. In that case saving the patient's life alone, endangered by the excessive suppuration and absorption of the pus, is the only thing that can induce the

surgeon to perform the operation; the patient being at the same time firmly resolved to suffer any thing for the chance of saving his life. It will be necessary to try if the disease has extended as far as the articulations, in which case it would be better to amputate, than attempt to save the limb.

The operation being decided on, the following is the method to be followed. It is commenced by laying bare the affected bone on the side least covered with soft parts, and on which there will be the least danger of meeting principal nerves and blood-vessels. Thus the inferior and external part of the humerus is that in which the incision should be made when this bone is affected; when the disease is seated in the cubitus, the internal side of the fore-arm; and when in the radius, its external side; the lower part and external side of the thigh, when the femur is affected; and the anterior and internal side of the leg, which is covered by the skin only, when the tibia is the part diseased. This part of the operation does not consist of a simple incision, but of two semi-elliptic incisions, the parts between which are to be completely removed. This practice is by much preferable to the use of caustic, the action of which is tedious, and might extend to

the regenerated bone, and destroy its texture. If the patient be timid, caustic may be used, but the greatest care must be taken to confine its action to the soft parts. If the hemorrhage be great, and the patient's suffering intense, the wound may be washed, and filled with lint; and the rest of the operation deferred to the following day. After having laid the bone bare, two or three pieces are to be cut out from its inferior part by means of a trepan; the intervals which separate the holes are then forced out with a chisel and mallet; and a passage being thus opened, nothing remains but to extract through it the decayed bone, which is found to lie without any connexion in the inside. The deep wound produced by this operation is then filled with lint, and dressed in future like a simple wound, which is to be healed by suppuration; but the recovery is always slow. If the length of the decayed bone be inconsiderable, the perforation may be made in the middle part of the new one. But when that is not the case it will be advisable to trepan the inferior part of the bone, as a less opening will suffice there than in the middle part, and as the situation is more favourable for the evacuation of the pus.

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Notwithstanding the prodigious disorganization and suppuration necessarily attendant on this operation, it has however been followed with success in some instances related by David.

We are of opinion that few cases occur in which it is necessary to perform this operation; that the reasons for undertaking it are seldom conclusive; and that it should not be had recourse to without the maturest deliberation.

CHAPTER XX.

OF CARIES.

The more we advance in the study of diseases of the bones, the greater is the obscurity in which we find them involved; and if there be any of them, the nature of which may be said to be totally unknown, it is certainly that which is our present subject of consideration.

The clearest way in which we can convey an idea of caries, is, by comparing it to those ill-conditioned ulcers of soft parts, which are symptoms of a diseased state of the system. But the idea given by this comparison is not sufficiently comprehensive; we shall therefore endeavour to supply its deficiency by an exact detail of the appearances of bones affected with this disease.

Every part of the osseous system is liable to caries; but it has been observed, that spongy bones are oftener attacked by it than those that are compact; thus the vertebræ, astragalus, and

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other bones of the tarsus, those of the carpus, the sternum, and the extremities of long bones, are the most frequent seat of this disease. For a similar reason, the bones of young persons are more subject to it than those of persons advanced in life.

Very little information is to be acquired by reading the works of the authors who have treated of this disease. Almost all of them have confounded it with necrosis, which they termed dry caries; others have considered it to be the same as exostosis. For our part, we are of opinion that there is only one species of this disease, but that this is susceptible of several modifications. The substance of a bone affected by it becomes so soft, that the end of a blunt probe may be easily forced into it. The openings with which the bone is perforated, are filled with fungous flesh, which bleeds from the slightest cause: there is a discharge of a blackish serum from these perforations, which has at all times a disagreeable smell, but which is particularly fetid when exposed to the contact of the air. Necrosis and caries differ in this particular respect: in the former, the bone affected is entirely deprived of the vital principle; but in the latter this principle exists, and the disease consists of a

morbid action, by which the osseous texture is destroyed.

The causes of caries are distinguished into internal and external; the internal are the most frequent, because a contusion or external violence is apter to produce necrosis than caries. It may happen, however, that a blow on a spongy bone shall occasion a caries of it, by producing an extravasation of blood or medullary juice, which cannot be afterwards taken into the system by absorption.

Abscesses are said to occasion sometimes a caries of the bones, over which they take place; and we are told, that the existence of the morbid state of the bone may be ascertained by introducing a probe to the bottom of the abscess.

Conformably to this theory, it has been laid down as a rule, that abscesses situated over bones should be opened at an early period, in order to prevent any disorder of the bone or periosteum from the stagnation of the purulent matter. But if abscesses formed over certain bones, as, for instance, over the anterior face of the tibia, or mastoid process of the temporal bone, be frequently accompanied with caries, the lat-

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ter is the cause, and not a consequence, of the abscess. Pus, which is a bland, unctuous, and inodorous fluid, never attacks the soft parts with which it is in contact, until its qualities are changed by exposure to the air. When an abscess forms in the anterior part of the parietes of the abdomen, the peritoneum of that part, naturally a thin membrane, instead of being corroded, becomes thick and strong enough to resist the effusion of the pus into the cavity of the abdomen. The periosteum becomes thickened in similar circumstances, when the abscess is a consequence of an external injury.

We may conclude, then, that caries is seldom produced by an external cause; and that most frequently a blow or external injury, when followed by that disease, has acted only as an exciting cause, a disposition to it having pre-existed. There is every reason to believe that it may be ascribed in almost all cases to a disease of the system, such as scrofula, lues, scurvy, or even cancer.

Scurvy diminishes the energy of the contractile fibre, and diffuses a principle of dissolution in the solids and fluids. The blood, rendered more fluid by it than natural, oozes through the pores

of

of its small vessels: spots or ecchymoses manifest themselves, first in the parts in which the circulation is most languid, as on the hands and feet: the muscles become soft and painful; the gums swell, and separate from the alveolar process: the periosteum may become tumefied in like manner, and lose its connexion with the bone affected with caries.

Scrofula attacks the spongy part of bones and the lymphatic system. A caries from this cause is very frequent in the tarsus, carpus, elbow, and knee; but it is always preceded by a white swelling.

The venereal disease is sometimes a cause of caries, though its action on the osseous system more generally produces necrosis or exostosis. However, when it attacks the bones of the nose, it produces a caries of them, by which they are consumed, and the face sadly disfigured. The bones of the palate are sometimes destroyed in the same manner, and by the same cause.

In cancers of the mammæ, the sides of the sternum are often found carious; which proves that cancerous ulcers may, as well as the preceding

ing diseases, occasion a caries of the bones in their neighbourhood.

Nothing can be easier than to ascertain the existence of a superficial caries; and when the affected bone is deep-seated, it may be discovered by introducing a probe; for, if the bone be carious, the probe may be easily forced into its substance. But bones which we cannot readily come at may be carious, in which case the diagnosis is somewhat more difficult; however, if a fistula, from which a fetid blackish matter flows, be directed towards a bone, and if the surrounding soft parts be at the same time turgid and indurated, there is every reason to apprehend a caries. The black colour of the discharge is, however, equivocal; because, as remarked by Ambrose Paré, it may be occasioned by a bit of agaric or other foreign body introduced into the wound. It will be prudent, therefore, in dubious cases, to trust chiefly to the history of the disease.

If a person affected with a certain constitutional disease, feel deep-seated and acute pains in any of his bones; and if the pained part swell, and become the seat of an abscess, from which a purulent matter of a bad quality flows, there

there is every reason to believe that the bone affected with pain is carious. Inert abscesses are attended with nearly the same symptoms, with this difference, that they are not preceded by pain. Caries occasioned by syphilis affects most commonly the tibia, os frontis, ossa nasi, ossa palati, and sternum. Whenever, therefore, any of these bones becomes carious, whilst the person labours under syphilis, there is just ground for concluding that the caries is a symptom of the venereal affection.

A caries of the vertebræ is known by peculiar symptoms, among which a paralysis of the inferior extremities, and the formation of abscesses in the groin, verge of the anus, or lumbar region, are the most remarkable.

The prognosis is more unfavourable in cases of caries of spongy bones, than in those of a similar affection of compact ones; thus there is not so much to be apprehended when the bones of the cranium or the scapulæ are affected, as when the extremities of long bones are similarly diseased. Caries of the bones of the carpus and tarsus is also very dangerous. The evil, on account of these bones being in such close contact, extends from one to the other; and when one of them

them becomes carious, it is very difficult to stop the progress of the disease without amputating the limb.

This operation is often the only resource in our power against caries of short bones, or of the extremities of long ones; and we are even deprived of this when the bone affected with it is deep-seated: thus caries of the head of the femur, or of the cotyloid cavity, cannot be remedied by this operation. The same may be said of caries of the spine, also named gibbosity, in which, as well as in the preceding case, our treatment must be merely palliative.

Caries from an external cause is less dangerous as well as less frequent than that from an internal; and that resulting from an internal disposition is much more dangerous when it proceeds from a scrofulous or cancerous diathesis, than from a venereal or scorbutic; for some efficacious remedies against the latter are known; but cancer and scrofula resist all the remedies with which we are as yet acquainted. It is also more dangerous to old than to young persons, not that its progress is not more rapid in the latter, as already mentioned, but because nature is more capable of limiting its ravages

vages in youth than in old age. Finally, the prognosis is further influenced by the extent of the disease, the patient's strength, and state of the neighbouring soft parts.

There is, perhaps, no disease in which the indications of cure are more vague than in caries, and none in which the treatment is less regular. The ancients prescribed unctuous or relaxing applications, but they preferred acrid irritating substances, such as the powder of euphorbium, tincture of aloes and myrrh, oil of turpentine, mineral acids, caustic alkali, or even the actual cautery. Monro, Tenon, and, in imitation of them, some modern practitioners, have preferred the use of unctuous and emollient applications; but, in order to discover the preferable mode of treatment, it is necessary to take a close view of the evil against which it is to be directed. We must then consider, that a bone affected with caries is a prey to a morbid action of its own parts, and that this action creeps from one part to another, and pervades the whole with greater or less rapidity, if art does not come to the assistance of nature to arrest its progress.

If the caries be produced by some affection of the system, this should be ascertained and combated

bated with appropriate remedies. Thus the use of mercurial and sudorific medicines arrests the progress of caries proceeding from the venereal disease, and aids nature in separating the unsound from the sound part. The use of spirituous drinks, vegetable diet, and acids, removes at once scurvy and the caries, to which it had given rise, &c. &c. But if it has been occasioned by an external cause, or if it has remained after the internal one has been removed, so as to be reduced to the state of a mere topical affection, its progress may be arrested, and the separation of the diseased parts facilitated by the use of such substances as stimulate the parts, or such as absorb and neutralize the fluids which tend to propagate the morbid action. Thus the desiccation of a carious ulcer has been effected by the use of an absorbing powder and pledgets of lint that had been dipped in tincture of aloes and myrrh.

If these remedies be found ineffectual, recourse must be had to more active ones: a pledget of lint dipped in a solution of nitrate of silver, may be applied on the carious part, and renewed every day. This portion of the bone is by this means quickly dried up, and reduced to the state of a simple necrosis; the propagation of the morbid action is arrested, and nature effects

fects a separation of the diseased parts. It will not be amiss, however, to move frequently the dried piece, and it may be necessary to prevent the fungous flesh from spreading so as to impede the exfoliation. The ulcer heals after the exfoliation has taken place, and the cicatrix is more or less deep, and of a red colour, not blackish and livid, as a cicatrix formed over a diseased bone.

If the caries be very humid, that is, if a great quantity of sanies flow from it, these remedies, even the mercurial nitrate, will be of no effect. The sanies washes the pledget, and dilutes the caustic so much, that its action is considerably enfeebled. Caustic potash would be subject to the same inconvenience. In these cases, the actual cautery is a remedy to be preferred to all others: by its action the carious part is in an instant reduced to the state of an inorganic dry substance, and the caries thus converted into necrosis. This remedy is applicable to every case of humid caries where the surrounding soft parts have not a manifest tendency to cancer. Sometimes, however, the soft parts surrounding a carious bone have that tendency in so advanced a degree, that the actual cautery would necessarily occasion the development of that morbid state. The general rules to which the

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use of the actual cautery may be reduced are as follow:

In the first place, all the carious part of the bone must be laid bare, whether by cutting away the soft parts, or destroying them by caustic. The latter method being tedious, inconvenient, and uncertain, should not be used unless when the patient will not submit to the use of the knife. The bone being in this manner laid bare and scraped, the surgeon provides himself with several cauterizing irons of the same form, because the application of one is seldom sufficient. It will also be necessary to provide a number of canulæ when the cautery is to be applied on a bone from about which the soft parts cannot be completely raised, as, for instance, on the os coccygis, or sacrum: by means of these canulæ, the hot iron can be introduced without injuring the soft parts. In every case it will be necessary to protect the surrounding parts as much as possible from the action of the cautery.

The iron, whatever may be its size, should be heated white, as the hotter it is the more rapid and less painful is its action. On the instant of its application, a black thick smoke rises from the surface of the burning bone, the smell of

which resembles exactly that of burning horn: the great quantity of sanies quickly diminishes the heat; for which reason a second is to be immediately applied with the same precautions; and a third, if the two preceding have not burned deep enough. Care should be taken to extirpate the disease by burning every part that is affected; and if the use of the cautery has not always had the success expected from it, the failure of it is to be attributed to the timidity of the operator. A carious bone becomes worse by the application of the actual cautery, if the evil be not entirely rooted out; just as a cancerous tumour becomes irritated, and makes a more rapid progress, if imperfectly cauterized.

The actual cautery acts by evaporating the noxious fluids in which the carious bone was immersed; by changing the caries into necrosis, and by irritating the subjacent sound parts, and exciting that action of the vessels by which the dead part of the bone must be thrown off.

It is almost superfluous to remark here, that this operation cannot be undertaken with any hope of success, if the internal cause of the caries still exist.

Let us examine, in the next place, the modifications of this general treatment, which may be required for any particular bone.

The bones of the cranium are often affected with the venereal caries, of which pain and tumefaction of the part are the first symptoms. The tumour augments and becomes soft, and on bursting spontaneously, or being opened by an instrument, a thin, serous, purulent matter flows from it. If a probe be now introduced into the wound, the bone will be found to be carious. The first remedies must, in this case, be directed against the disease of the system. The use of caustics is entirely inadmissible; for should their action extend too far, the worst consequences might result from it, such as inflammation of the brain or its membranes. It is better to remove the diseased part of the bone by means of a trepan. In laying the bone bare, as much of the integuments should be preserved as will be sufficient to cover the wound, which precaution will accelerate the cure.

It is particularly in caries of the mastoid portion of the temporal bone that the use of the cautery is admissible. Abscesses are frequently formed in consequence of caries in that

part of the bone; these burst, and their openings degenerate into fistulæ. If a carious state of the bone be discovered by the introduction of a probe, the bone is to be laid bare, and the cautery applied, and repeated until the caries is completely destroyed. The mastoid portion of the temporal bone is spongy in its texture, and sufficiently thick to protect the brain and its membranes from the action of the cautery. Tenon and Chopart practised this operation with success.

The bones of the face, and those of the nose and palate, are very subject to the venereal caries; but this affection of them disappears by removing the general disease of the system. The parts, however, remain deformed in consequence of the loss of substance.

The collection of matter which frequently takes place in the antra maxillaria sometimes occasions a caries of the bones which form these cavities. In these cases, all that is necessary is to perforate into the cavity through the alveolar process; for as soon as the collected matter gets a free passage, the fistulæ, if any have been formed externally, dry up, the carious part of the bone

bone separates and comes away, and the wound in the soft parts heals at the same time.

The caries of the os unguis, which is sometimes complicated with fistula lachrymalis, is remedied by the different operations performed for giving a free passage to the tears. The scorbutic caries of the alveolar process is removed by the same remedies as the general disease.

As soon as the system is perfectly clear of the scorbutic diathesis, the bone exfoliates, and the gums acquire their natural firmness. Detersive gargles may be used to accelerate this termination.

Caries of the spine is attended with much worse consequences: the gibbosity and secondary abscesses of which it is the cause, generally prove fatal. When the anterior part of any of the vertebræ becomes affected with caries in consequence of a diseased state of the system *, the purulent matter that is formed makes its way into the cellular texture which lines the

* Masturbation is frequently a cause of this caries. Citizen Boyer's practice has furnished him with many examples of it.

anterior part of the spine, and descends by its own weight along the vessels to the superior part of the pelvis; whence it sometimes flows along the external iliac artery into the groin, where it forms a tumour. At other times it descends into the pelvis along the hypogastric vessels, and forms tumours about the anus; finally, it may penetrate through the fibres of the lumbar paries of the abdomen, and manifest itself at the posterior part of the pelvis. These accumulations of pus, or symptomatic abscesses, are always preceded for a longer or shorter time, by pain in some part of the spine; and the tumour forms without any antecedent or co-existing inflammation of the part. The abscess acquires insensibly an enormous volume, and the pus makes its way into the cellular texture of the limb of the affected side: its size may, however, be diminished by compression, and its contents seem to retreat into the abdomen. The integuments inflame at length, and burst in the most projecting point: a thin purulent matter flows from the opening: it is, at first, perfectly inodorous, but soon acquires a fetid smell, and changes colour. This alteration in the qualities of the pus seems to be owing to the contact of the air; but so great is its fetidness, that the patient's existence is loathsome to himself,

and

and insupportable to others: the absorption of this matter brings on slow fever, diarrhœa, colliquative sweats, and marasmus, and the patient is at length cut off. As the fatal event is distant in proportion to the retardation of the opening of the abscess, and to its protection, when opened, from the contact of the air, it is evident that it should not be opened as long as it can be avoided; and that, when it becomes absolutely necessary, the opening should be as small as possible, and the air carefully excluded. Both these purposes are answered by making the opening with a seton needle, and leaving the seton in the abscess; but as this is not the proper place to give a full account of the treatment of these abscesses, we shall proceed to the consideration of that affection of the spine which has been termed gibbosity.

This affection does not always depend on a caries of the vertebræ; and when it arises from that cause, the caries is then of a peculiar nature, being almost dry, and unattended with the formation of abscesses. The affected vertebra, filled with holes, and as if moth-eaten, yields to the incumbent weight; the body of that which is superior to it descends, while its spinous process ascends and projects under the integuments.

A never-failing symptom of this disease is a paralysis of the inferior extremities, rectum, and bladder. If the derangement take place in the vertebræ of the neck (which is very rare), the patient is soon destroyed in consequence of the paralysis of the muscles by which respiration is performed. When the derangement of the vertebra is gradual, the progress of the caries being slow, a numbness is first felt in the lower extremities, which is the precursor of paralysis: but the bladder, rectum, and inferior extremities, soon become paralytic, and the patient is confined to his bed until relieved by death. Gibbosity from this cause is fatal to adult persons. That observed in young children is different in its consequences, and seems to proceed from a different cause; that is, from a collapse of the vertebræ before they have acquired their full consistence, rather than from a carious affection. In cases of this kind, a perfect recovery has been effected by applying caustic to the sides of the tumour, by burning moxa, or rubbing irritating substances on the spine, and by joining to these means the use of the cold bath and a tonic regimen.

When

When the same person is at once affected with gibbosity and secondary abscesses, there is no chance of his recovery.

Enough has been said to shew the extreme danger of caries of the spine, and the insufficiency of art in the treatment of it.

The spongy texture of the sternum renders it very liable to be affected with caries, the progress of which is, for the same reason, more rapid in it than in any other bone. The soft parts which cover the carious portion of bone, become inflamed, and abscesses form, which burst in a little time. The state of the bone may now be discovered by introducing a probe through one of these openings; and very often, besides the caries, it is found that an effusion of pus has taken place into the anterior part of the mediastinum. In which cases the probe penetrates more or less into the cavity of the thorax, and the pus constantly flows in greater or less quantity through the fistula: it most frequently happens that the stagnation of the pus, the morbid changes which it undergoes, and the effects of its absorption in this state into the system, render it necessary to apply the trepan to the sternum. Among the bad consequences of caries of

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the sternum, may be reckoned the destruction of a part of the pleura, or even of the pericardium: although in the greater number of cases, the former of these membranes becomes thicker in the part corresponding to the abscess, and sometimes cartilaginous, or even bony. The pulsation of the heart becomes very manifest by the destruction of the pericardium. Harvey profited of a case of this nature to shew this phenomenon to the King of England, and several other persons. But whether the thickening of a part of the pleura, or the destruction of a portion of the pericardium, be the consequence of the abscess, the cavity of the thorax, properly so called, is not opened in either case.

The treatment of caries of the sternum varies according to the circumstances of the case; it may be remarked, however, that the particular structure of the bone renders a caries of it extremely dangerous. A spontaneous recovery is scarcely to be expected, although the following case furnishes an instance of it. A person convalescent from another disease, was suddenly seized with an acute pain behind the sternum; respiration became difficult, and a fever supervened. At length a tumour, with fluctuation, manifested itself a little lower than the middle

part

part of the bone. A small portion of caustic potash was applied to this tumour; and on dividing the crust formed by it, a great quantity of pus flowed out, and the patient felt much relieved. After opening the abscess, the suppuration gradually diminished, and the fistulous orifice was closed up in the space of a few months; during which time, however, the patient resided in the country, and used a nourishing diet and tonic medicines. It ought to be remarked, that it is possible that the abscess may not, in this case, have proceeded from a caries of the sternum; and that the pus collected in the anterior mediastinum may have made its way outward through the opening which is often found in this part of the sternum.

The treatment of caries of the sternum does not differ from that which has been already generally described. Particular care must be taken however, that, in applying caustics, their influence may not extend to the organs of respiration. But when, instead of caustics, cutting instruments are used, the part affected, however extensive, should be totally removed. This operation is not attended with great danger, because the internal mammary artery, if opened, can be easily taken up. After the bone has been removed,

moved, the pleura, corresponding to the empty space, will be found to thicken in that part, and to acquire a cartilaginous hardness, so as to replace, in some degree, the bone which has been destroyed. However, after the wound is completely healed, it will be prudent to cover the part with a piece of pasteboard or leather. If the carious part cannot be totally removed, it will be necessary to make two perforations in the lower part of the sternum, in order to give a free passage to the purulent matter. Though the disease will not be radically removed by this means, yet the sufferings of the patient will be considerably alleviated.

Caries of the ribs, or that of the bones of the pelvis, offers nothing particular: it is to be remarked, however, that when the posterior ends of the ribs, or the anterior face of the sacrum, are affected, secondary abscesses may take place as in similar affections of the vertebræ. Caries of the sacrum often succeeds a gangrene of the soft parts which cover its convex side: in which case it will be necessary to wait a spontaneous exfoliation; or if nature does not appear adequate to that operation, and if a great quantity of fungous flesh be found to grow up through the carious bone, it will be necessary to apply the

the actual cautery, according to the rules already laid down. Liquid caustics are improper in this case, because, by passing through the large cancelli, they might penetrate to the sound parts of the bone, and occasion a necrosis of it.

Caries of the different parts of the iliac bone, and particularly of the cotyloid cavity, shall be treated of in the article on secondary or spontaneous luxation of the femur.

Caries of the extremities of long bones, as it usually accompanies white swellings of the articulations, will be considered in treating of the latter affections.

CHAPTER XXI.

OF EXOSTOSIS.

A SWELLING may take place in bones as well as other parts, from a determination and accumulation of fluids; but there is a particular kind of tumour which forms on their surface, and which is denominated exostosis. This name, however, comprehends different species, which should be considered as distinct; thus, that affection which has been described under the name of *spina ventosa*, or *osteo-sarcoma*, is a distinct disease: there is also another species of exostosis different from all others, and which consists principally in a thickening and tumefaction of the periosteum: it may very properly be termed *periostosis*. Exostosis, properly so called, is rare, the reason of which is easily perceived from the consideration of the hardness and consistence of the texture of the bones, the small number of their vessels, and consequently the difficulty of a copious influx of humours into them.

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The tumefied portion of bone acquires in some cases such a hardness, that no remains of a fibrous structure can be distinguished in it, and it absolutely resembles ivory; in other cases it is spongy; and finally it may be composed of osseous and fleshy parts: this latter variety resembles very much spina ventosa.

The bones most frequently affected with exostosis are the broad bones of the head, the lower jaw, sternum, humerus, radius, cubitus, the bones of the carpus, the femur, and tibia. There is, however, no bone of the body which may not become the seat of this disease, and the affection may extend to a greater or less portion of it. It is not uncommon to find the broad bones of the cranium affected with exostosis in their whole extent; the ossa parietalia, for instance, sometimes acquire an inch in thickness from this morbid affection.

In most cases, however, the exostosis rises from the surface of the bone, and manifests itself as a hard round tumour. It sometimes appears towards the extremities of long bones, and at other times, more or less, near their middle part: and it is remarked that exostoses originating from a venereal cause are found principally on compact

pact bones, and such of these as are but lightly covered with soft parts, as those of the cranium and face, and the tibia at its internal side; whilst, on the contrary, those arising from a scrofulous diathesis appear on the spongy extremities of long bones, and on short ones of a similar texture. These two diseases are almost the sole causes of this topical affection of the bones. A cancerous or scorbutic diathesis seldom occasions it. They more commonly produce caries, by effecting a separation of the periosteum from the bone. It must be remarked, however, that exostosis and caries have the greatest affinity with one another; as is evident from the greater part of exostoses terminating in caries. J. L. Petit pointed out this analogy by a detailed comparison of the two diseases. The conversion of exostosis into caries takes place particularly in spongy bones, and in persons affected with scrofula. The ivory exostosis never terminates in caries.

Exostosis proceeds very rarely from an external cause, such as a contusion, though such a consequence is not impossible. In most cases it is produced by an internal disease, and principally by lues venerea, or scrofula, as already mentioned.

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An enlargement of the extremities of long bones, that of the whole substance of short ones, joined to a swelling of the glands of the neck, a delicacy and whiteness of the skin, a fulness of the face, and tumefaction of the point of the nose and upper lip, are marks of a scrofulous diathesis.

The osseous system is attacked by the venereal disease only in the advanced stages of that disorder. The formation of exostoses from this cause is generally preceded by dull pains, which appear to be deep-seated, and which are generally most severe during the night.

An exostosis is always hard, but varies in size, and may be indolent or painful. By these marks, and by its firm adhesion to the bone, it may be always distinguished from every other kind of tumour. But if, on the contrary, the enlargement take place in a short bone, and if its hardness, though considerable, be somewhat less than that just described, on which the finger can make no impression, it is probably a periostosis; which is by no means an uncommon symptom of the venereal disease. It is sometimes impossible to ascertain the existence of an exostosis before the patient's death; such was the case of an

individual whose parietal bone had been found, after death, to be three times thicker than natural. A similar case is related in the Memoirs of the Academy of Dijon. In this instance the person died from an exostosis on the internal side of the os pubis, which by pressing on the neck of the bladder prevented the passage of the urine, or the introduction of a catheter.

It is possible that the head of a luxated bone may be mistaken for an exostosis: this was the case with a young man whose clavicle was dislocated at that end of it attached to the sternum. The tumour formed by the end of the displaced bone, was mistaken for an exostosis, and was treated as such; but the inefficacy of the treatment induced the patient to apply to Desault, then head surgeon of *La Charité*. This practitioner recognised instantly the luxation outward of the clavicle. It is also possible that the enlargement of the ends of bones of ricketty persons may be mistaken for exostosis; but though this kind of enlargement does not constitute a real exostosis, yet it cannot be denied but that some analogy does exist between them. Another species of tumour which might be mistaken for an exostosis, is that formed by fungous excrescences growing from the dura mater, which,

which, after having destroyed a part of the bones of the cranium, protrude externally; but the real nature of these may be discovered by an attentive examination of their consistence and progress, and by attending to the pulsation of them, which is evident and synchronous with those of the heart.

The effects of exostosis may be divided into general and particular: thus the swelling is accompanied by a sense of weight; pain is produced by the morbid action, and the affected part is necessarily deformed.

Its particular effects arise from its situation: thus, should an exostosis take place in the orbit, the eye would necessarily be expelled from that cavity; and an expulsion of the eye from that cause has in fact been observed. Should a tumour of this nature arise from the clavicle or sternum internally, it might occasion death, by compressing the principal blood-vessels, arterial or venous. An exostosis of the pubis might, as already mentioned, occasion a retention of urine; or a similar tumour on any of the bones of the pelvis, internally, might render parturition in the natural way impossible.

The prognosis differs according to the nature of the primary disease from which the exostosis originates, and according to the particular change in the texture of the bone. Exostoses from an external cause are much more difficult to cure than those arising from an internal one; because the latter may be combated by appropriate medicines; but in the former, no internal remedy can have any effect, and the extirpation of the tumour is the only expedient. An exostosis produced by a scrofulous diathesis is much more difficult to cure than that arising from any other constitutional disease. Unfortunately, medicines have been as yet found ineffectual in scrofula, and the practitioner has generally the mortification of seeing exostosis from this cause mock his general remedies, and pass on to a caries, to which it has a particular tendency.

The ivory exostosis, if situated so as not to impede the action of any organ, is the least dangerous of all; for although it be impossible to procure the absorption of this tumour, in which no vessel, nor fibre, nor pore, can be discovered, and which appears a compact and homogeneous mass, yet after it has gradually acquired a certain volume, which is never very great, it becomes stationary, and causes

no inconvenience, but that arising from its weight.

Our complete ignorance of the pathology of exostosis, or of the manner in which it is formed, accounts for the imperfection of our treatment of it. The opinion of J. L. Petit, relative to it, is at present totally abandoned: that author attributed the greater part of the diseases of the bones to a defect of elasticity in the periosteum. We find nothing more probable in the opinion of a more modern author, who attributes exostosis to a diminution of the natural quantity of phosphoric acid.

We shall however endeavour to lay down some principles for the treatment of it. The first step to be taken, is to discover the primary disease, which when once ascertained, must be the principal object of treatment.

If the patient has formerly laboured under a venereal affection, which he has reason to think has not been totally eradicated, or if there are venereal symptoms present, the exostosis may be safely attributed to that disease. It may be observed here, that a venereal taint which has been but partially combated, is more difficult to remove than that for which no remedy has

been used. At all events, mercurial preparations are to be judiciously administered, and the use of them persevered in until all the venereal symptoms disappear.

This mode of treatment is certainly the most efficacious; but should the evil resist the use of the milder preparations of mercury, it must be given in small doses, in the state of corrosive sublimate, which may be advantageously dissolved in a decoction of sarsaparilla, or other sudorific article. If mercury in any form does not agree with the patient, sudorifics alone must be used: three glasses of a strong decoction of sarsaparilla and guaiacum, in which a few grains of alcali may be dissolved, are to be given daily; and the tumour is to be covered with a mercurial plaster. If the pain be very great, and prevent sleep, some opium may be added to the plaster. This latter application sometimes affords very considerable relief.

When the antivenereal treatment has been continued for two months or more, if the venereal symptoms disappear, and the exostoses diminish in size and become indolent, it would be useless or even pernicious to persevere in the use of the general remedies. It is not unfrequent to find

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an exostosis which was only a symptom of syphilis continue after the removal of the general disease, particularly when the infection has existed for a length of time in the system. The topical affection should in this case be left to nature, if its situation do not impede the action of some organ essential to life; under which circumstances, its removal by an operation becomes necessary.

In treating a venereal exostosis by mercurial remedies, it is of the utmost importance to regulate their use in such a manner as that the mouth may be but slightly affected, and a salivation avoided. Little reliance can be had on the topical applications, with which the tumour is generally covered; nor can it be reasonably expected that they should act effectually on the osseous system, through the integuments and soft parts. Hemlock plasters, and similar applications, only irritate the skin, and occasion erysipelas and excoriations, which add to the sufferings of the patient.

The scrofulous exostosis is opposed by the internal use of tonic medicines, by the application of discutients to the part, by sea-bathing, or by pumping on the part water in which some

alcali has been dissolved. But often all our endeavours are fruitless; the exostosis degenerates into caries; the soft parts which cover the diseased bone become inflamed, and abscesses are formed, the openings of which become fistulous. The slow fever which ensues from the absorption of the pus, and the copious discharge, exhaust the patient's strength, and the only resource that now remains is amputation; but this even is sometimes impracticable, from the situation or extent of the diseased part.

When, as is generally the case, the scrofulous exostosis terminates in caries, the treatment will be the same as if caries had supervened without being preceded by exostosis.

The scorbutic exostosis requires the same treatment as the disease of which it is a symptom. As to the cancerous exostosis, which is as rare as the scorbutic, its cure is as difficult as that of cancer itself. When the part cannot be extirpated, opiates and other palliative means are to be had recourse to.

If the disease has originated from an external cause, or if it be merely local, the pirmary

disease

disease of which it was a symptom being removed, it is best to leave it to nature. The use of caustics, or the actual cautery, occasions much pain, and, instead of doing good, adds to the evil. This is the case with an unfortunate woman, who had caustic applied to an exostosis of the internal side of the tibia; but which, instead of removing the exostosis, produced a necrosis, of which she is not yet well, though two years have elapsed since the application of the caustic. However, should the tumour, from its situation or size, press on, and derange some important organ, as the eye for instance, which it may turn to one side or the other, or totally expel from the orbit, it will be necessary to proceed to the following operation.

If the tumour rise from one of the broad bones of the skull, to which it is connected by a narrow neck, the integuments over it are divided by a crucial incision, and dissected from the bone. The periosteum is then to be cut round the neck of the tumour, which is finally removed by a thin sharp saw. This mode of operating is much to be preferred, even when the neck of the tumour is not very narrow, to that in which a chisel, and mallet of lead, are used; for the concussion given to the brain by the latter mode

may

may bring about the worst consequences. If the base of the tumour be so thick, that it cannot be sawed through by a small fine saw, it will be necessary to divide it into several parts by vertical sections, which parts may be easily sawed through in succession.

When the chisel and mallet are used, it will be necessary to fix immoveably the part to be acted on, and to direct the chisel obliquely, so that its action by cutting may be increased. If after having removed in this manner the greater part of the tumour, its base be found carious, it will be necessary to remove by the chisel, or even a scraper, as much as possible of the diseased part, and to destroy what remains by the actual cautery.

If the tumour to be removed by the chisel be very thick, it will be necessary to make holes in it in different points by a perforating instrument, by which means its basis will be diminished, and its removal facilitated. After the tumour has been removed, granulations sprout from the surface of the bone, and in a little time the wound is cicatrized. But I must remark, that cases rarely occur, in which it would be justifiable to perform this operation, and

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that in by far the greater number of instances the local affection is much less to be dreaded than the means used for removing it.

We have designedly omitted mentioning the lamellated exostosis, in which the internal part of the diseased bone is converted into flesh. This species of disease has been improperly confounded with exostosis, but it more properly belongs to those classed under the general name of osteo-sarcoma.

CHAPTER XXII.

OF OSTEO-SARCOMA.

We comprehend under this denomination all the osseous tumours to which authors have given the different names of spina ventosa, pœdarthrocace, and osteo-sarcoma; but in collecting them thus under one general name, we do not mean to say that these different denominations refer to a single disease, but merely that they have, notwithstanding their differences, certain points of resemblance which justify this classification. It is extremely difficult, says Marcus Aurelius Severin, to ascertain to what kind of organic lesion this affection is to be ascribed *. The bone affected is sometimes totally converted into a soft, lardy, homogeneous substance, resembling a cancerous gland. At other times it is filled with fungous flesh, which is covered exteriorly by a thin plate of compact substance, perforated by a great number of holes; finally, there are cases in which the bone becomes reduced into a soft gelatinous substance. We shall

* Non est sanè facile decerni quo sit genere censendus hic affectus. Mar. Aur. Sev. de Pœdarthrocace.

give

give a remarkable example of this species at the end of this chapter.

The first species or variety which we have mentioned is that which merits particularly the name of osteo-sarcoma, which signifies, in itself, the conversion of an osseous substance into flesh: it may be doubted, however, if the name of flesh be properly applied to this substance, which resembles rather a scirrhus of soft parts than flesh, and which presents no mark of organization. The soft parts which surround a bone thus affected participate in the disease, which is always announced by very acute pains, and which originates sometimes from an internal disease, and particularly from the cancerous virus; at other times, from an external cause, as a violent contusion: in many cases it can be traced to no cause.

The second species, named spina ventosa, or pœdarthrocace, consists in a swelling of the head or body of a long bone, in such a manner as that its cancelli become very much enlarged. The medullary membrane which lines these cancelli becomes thick, and granulations sprout from it, which destroy by their growth the substance of the bone, so that there only remains

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an external shell filled with small holes. To this species must be referred the swellings of the articulations of the phalanges, arising from scrofula, and which often lead to the necessity of amputating. This operation should not, however, be hastily recurred to, as nature sometimes effects a cure in which she may be aided by bathing the parts in a diluted solution of potash or soap-water. When a bone that has been thus diseased is macerated, the internal fleshy substance separates, and the dilated bone remains a mere empty and brittle shell.

In every species of this disease, the pains are at first dull and deep-seated, but in a short time they become more intense, and the volume of the bone increases, though the soft parts appear yet in their natural state. The latter, however, soon become red and inflamed, and abscesses form in them, which burst, and their openings degenerate into fistulæ.

The osteo-sarcoma, of whatever species, is in general a dangerous disease, and often requires the amputation of the part affected. When a tendency to this disease from a venereal cause is discovered early, its progress may be prevented; but if the disorganization of the bone has once taken place,

place, its structure can never be restored. The swellings of the extremities of the phalanges of the fingers and toes are the least alarming of all affections of this kind. They seldom render amputation necessary; in general, the wound in the integuments puts on a more healthy appearance, the fistulæ dry up and heal, and the patient recovers, but with the loss, it is true, of the motion of the joint.

When the structure of a large portion of bone is disorganized by osteo-sarcoma or spina ventosa, and the patient harassed by acute pain, and exhausted by slow fever, diarrhœa, and colliquative sweats, it will be necessary to amputate the part, if the operation be practicable. But should the extent or situation of the evil render amputation useless or impracticable, all that can then be done is to support the patient's strength by an invigorating diet and tonic medicines, and palliate his sufferings by means of opium.

Amputation is generally successful, except in case of real osteo-sarcoma, which, absolutely analogous to a carcinomatous affection of the soft parts, takes deep root, and may, like it, attack the bone again after this operation has been performed. This return is particularly to be

be apprehended when the lymphatic glands in the neighbourhood of the diseased part are swelled and indurated.

We have spoken of a particular disorganization of the bones, in which their substance, and that of the surrounding soft parts, become soft, and are converted into a gelatinous mass. The following case presents a remarkable instance of this species of osteo-sarcoma.

A priest, aged forty-seven, fell as he was running in the Rue de Barres, the 13th Vendemiaire, year 7, and received a contusion on the right shoulder, which was not, however, so considerable as to prevent him from attending to his usual occupations: both pain and contusion vanished in a short time. Four months after he felt intermittent pains in the right arm, which were relieved by extending the arm forcibly. A tumour as large as an egg manifested itself near the shoulder, the pain arising from which was assuaged by volatile liniment; but it soon became very acute, and the arm lost the power of motion. He was received in this state into the Hotel-Dieu, where he remained two months, during which time the shoulder was kept covered with emollient poultices. The

pain

pain diminished, but the tumour, which had been stationary, increased rapidly in size, and extended over the shoulder and into the armpit. After leaving the Hotel Dieu, he remained with his friends until the 2d Ventose, year 9, when he entered the hospital of St. Louis. The tumour, or rather the shoulder (for that part, though much increased in size, had not lost its natural shape), was moveable, though it appeared to be connected by some points to the side of the thorax: it was equally hard and elastic in every part, but little eminences were formed on its surface. The skin, though very much distended, had preserved its natural colour, and a considerable degree of pressure might be made on the tumour without increasing the pain. The right trapezius muscle, which supported principally the weight of the tumour, was much extended, and drawn into the shape of a cord visible through the skin. The pain appeared to be produced by the extension of the skin and compression of the axillary plexus of nerves: its violence was considerably diminished by emollient applications and by the use of opiates, the dose of which it was found necessary to augment when the atmosphere seemed overcharged with electricity; as the pain was then much increased, and seemed to dart in different directions through

the tumour with the rapidity of lightning. The great extent of the swelling of the lateral and superior parts of the thorax, our ignorance of its nature, and of the real state of the articulation, prevented us from amputating at the shoulder joint.

The tumour continued to augment, and the pains to become more intense; the emaciation and debility increased; opium could no more procure sleep or diminish pain; diarrhœa came on, and the patient died on the 2d Fructidor, five months after his entrance into the hospital of St. Louis. The tension of the skin of the tumour seemed to diminish, and the tumour itself to collapse, on the moment of the patient's death. Its circumference was still thirty-six inches, and its diameter sixteen: its weight, with that of the arm, was about thirty-three pounds, while that of the other arm was only about six, which left a difference of twenty-nine pounds. When the skin was thus relaxed, a fluctuation was perceptible, which could not be felt before, unless in the little eminences on the surface, which were liable to disappear and change their situation. A trocar was twice plunged into the tumour in different parts, yet no fluid escaped. I then opened it in presence

of Citizen Lassus, Thouret, and many other practitioners.

The skin was thinner than natural, and its texture decomposed: that is, the fibres and lamellæ of which it is composed were separated and distinct. The muscles, and particularly the deltoides, were extremely emaciated, and seemed to form a second fleshy covering not more than one line thick. A yellow gelatinous mass was found in the centre, and which resembled, in many respects, jelly in which some blood had been mixed. The humerus was nearly destroyed to its inferior extremity. The nerves and arteries, pressed against the integuments, did not seem to have been injured. The surface of the glenoid cavity was destroyed, and converted into a gelatinous substance. A chemical analysis of this substance proved it to be composed of a great proportion of gluten, a small quantity of albumen, and some salts. The clavicle was found in a healthy state, and no part of the scapula was affected but that which forms the glenoid cavity.

The diseased part has been preserved, and deposited in the Anatomical Gallery of the School of Medicine of Paris; where also may be seen a drawing

a drawing of the tumour in the last stages of the disease. An idea of it may be formed from an attentive examination of a drawing given by Marc Aur. Severin * of a Spaniard who died of a similar tumour.

There are other examples of similar tumours. Citizen Lassus has collected the particulars of a great number of cases of this kind, and has made them the subject of an Essay presented to the School of Medicine.

* De recondita Abscessium Natura, edit. de Leyd.

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