

CHAPTER VIII.

INCOMPLETE FRACTURES.

BENDING, PARTIAL FRACTURES, AND FISSURES OF THE LONG BONES.

§1. Bending of the Long Bones.

STRICTLY speaking, no bone can be much bent without being also more or less broken, and that whether it immediately or spontaneously resumes its position or not; for, if the bending and straightening of the bone be repeated a sufficient number of times, the yielding of the fibres will become apparent, and at length the separation will be complete. The first of this series of flexions was quite as much responsible for this result as the last, and, no doubt, performed its share in the production of the complete fracture.

There could be no impropriety, therefore, in speaking of a bending of the bones as a variety of incomplete fractures, as I have done in the first section of my "Report on Deformities after Fractures," made to the American Medical Association in 1855.¹

They have been called, not inappropriately, interperiosteal fractures, since in these cases the periosteum is not broken. M. Blandin thinks that the outer and semicartilaginous laminae of the bone also do not break, while the deeper laminae suffer an actual disruption.² But it is quite as probable that in a majority of cases the true pathological condition is a compression of the bony fibres upon one side, and a corresponding expansion upon the opposite side, with only a slight interstitial fracture, too trivial to be easily recognized even in the dissection. Sometimes, as I have several times observed in my experiments on the bones of chickens, when the bones are small, and the bending is near the centre of the shaft, the whole of the laminae on the side of the retiring angle produced by the bending are doubled in, or indented toward the hollow of the bone, so that the fibres on the side of the salient angle are not even stretched, and much less broken. In such cases the interstitial disruption, if it exist at all—and I think it does—first takes place in the deeper layers of the retiring angle.

I might, therefore, feel justified in continuing to call these cases partial fractures, or, perhaps, interstitial fractures; but I believe that the whole subject will be rendered more intelligible if I call them simply bending of the bones, as distinguished from those other and more palpably partial fractures of which I shall speak presently.

¹ Op. cit., pp. 421-422.

² Markham's Obs. on the Surg. Practice of Paris, London Med. Chir. Rev., vol. xxxiv. p. 473, 1841.

1. *Bending, with an immediate and spontaneous restoration of the bone to its original form.*—The possibility of this accident, to which, however, surgical writers have hitherto made no distinct allusion, is rendered certain by the following experiments:

Experiment 1.—July 16, 1857. I bent the tibia of a Shanghai chicken, four weeks old, at about the middle of the bone. It was bent to an angle of quite twenty-five degrees, but it was not felt or heard to break. It immediately and spontaneously resumed the straight position.

July 18, two days after the bending, I dissected the limb, and found no trace of the injury, either within or without the bone, unless I except a very minute blood-clot in the centre of the shaft.

Experiment 2.—I bent the leg of a chicken, four weeks old, at the same point and to the same degree. It immediately resumed the straight position.

Dissection after two days. Nothing abnormal except a small blood-clot in the centre of the bone, and a slight disorganization of the medulla.

Experiments 3 and 4.—Bent both legs of a chicken, four weeks old, at the same point and in the same manner. They immediately resumed their positions.

Dissection after two days. No lesions or morbid appearances which I could detect.

Experiments 5 and 6.—Bent both wings of a chicken four weeks old, bent the right wing to an angle of thirty-five degrees. I did not feel them break. Both resumed their positions spontaneously.

Dissection after two days. No lesions or other morbid appearances.

Experiment 7.—July 16, 1857, I bent the leg of a Shanghai chicken, five weeks old, below the knee and about the middle of the bone. It was bent to an angle of about twenty-five degrees, but the bone was not felt or heard to break. It immediately and spontaneously resumed the straight position.

July 20, four days after the bending, I dissected the leg, but could not discover any trace of the injury, except that there was a very minute ossific deposit in the centre of the bone at the point at which I suppose it to have been bent.

Experiment 8.—July 16, 1857, I bent the right leg of a Shanghai chicken, five weeks old, at the same point as in the first experiment, and to the same extent. The bone did not seem to break, but it immediately and spontaneously resumed the straight position.

Dissection after four days. Nothing appeared to indicate the seat of the bending, except a small clot of blood in the centre of the shaft.

Experiment 9.—Bent the leg of a chicken, six weeks old, in the same manner and to the same degree as in the other examples. It resumed its position spontaneously.

Dissection after ten days. No evidence of injury of any kind; the bone being sound and straight.

These experiments were made in connection with others to which more especial reference will hereafter be made. They are selected, and constitute the whole number of those in which I did not feel the bone break or crack under my fingers. In every instance the bone sprung back immediately and spontaneously to its natural form. In no instance could

I afterwards discover any trace of lesion or sign indicating the point at which the bone had been bent before dissection, nor did dissection itself disclose anything but the most inconsiderable marks, and that in but three examples.

I infer, therefore, not forgetting the caution with which the conclusions from all such experiments ought to be applied to similar accidents upon the human skeleton, that whenever the bones of healthy infants have been slightly bent and not broken, they will, probably, in most cases, unless prevented by causes foreign to the bones themselves, spontaneously and immediately resume their position, and that no sign will remain to indicate that a bending has occurred. The accident will not be recognized, and, as a further inference, this bending does not belong to that class of cases of which I shall next speak.

2. *Bending, without immediate and spontaneous restoration of the bone to its original form.*—“Dethleef, believing that he had broken the two bones of the legs of a dog, found the fibula bent without a fracture. Similar results were obtained by Duhamel upon a lamb; by Troja upon a pigeon; and I have myself twice succeeded in bending the fibula while breaking the tibia. The possibility of simple curvature is then not contestable” (the writer means to say that the possibility of a simple curvature remaining permanently bent is not contestable), “but we must observe that they have never been obtained except upon young animals, and that they have been unable to maintain themselves permanently except through the aid of a fracture and displacement of a neighboring bone; and there is a wide difference between these and those pretended curvatures which some believe they have seen in man, in which the curved bone maintains itself, and resists perfect reduction until the fracture is complete.”¹

In this single paragraph Malgaigne seems to have given a fair summary of the testimony upon this point. With the exception of these and a few other similar examples, some of which I think I have observed myself, where one of the bones of the forearm has been broken and the other bent, I know of no well-attested cases of a permanent bending; using the term bending in a sense distinguished from a partial fracture.

If, in numerous cases mentioned by surgical writers, there has seemed to be probable evidence that the permanent bending was unaccompanied with fracture, there has always been wanting, so far as I know, the positive evidence of dissection. The example of partial fracture mentioned by Fergusson, and represented by a drawing, is described as having also, “toward the lower extremity, a slight indentation and curve.”² This was the radius of a child; but how long the child survived the accident, and what was the condition of the ulna, we are not informed. The observations made by Jurine, of Geneva, in Switzerland,³ by Barton⁴ and Norris,⁵ of Philadelphia, all fail to furnish any such conclusive evidence of the correctness of their own views. Norris says that “Thierry, of Bordeaux, Martin, and Chevalier, had all met with and published

¹ *Traité des Frac.*, etc., par L. F. Malgaigne, tom. i. p. 48.

² *Practical Surgery*, by William Fergusson, 4th Am. ed., p. 208.

³ *Journ. de Corvisart et Boyer*, tom. xx. p. 278, etc.

⁴ *Phila. Med. Recorder*, 1821. ⁵ *Phila. Med. Journ.*, vol. xxix. p. 233, 1842.

cases of this kind prior to the appearance of Jurine's paper (in 1810), the former of whom asserts that Haller, in experimenting upon the subject, had been able satisfactorily to produce the same accident in young animals.” For myself, I cannot say how much confidence we ought to place in these assertions of Thierry, Martin, and Chevalier, having never seen the papers referred to; but since Dr. Norris has neglected to inform us whether any dissections were ever made, we shall not be expected to regard their testimony as conclusive.

With the qualifications now made, Gibson was more nearly right when he said, “Dupuytren and Dr. John Rhea Barton have each furnished accounts of bent bones. There are no such injuries, however, in my opinion; such cases being, in reality, partial fractures from which deformities result upon the same principle that a piece of tough wood, like oak or hickory, if broken half through, may be inclined to one side and shortened, although still held together by interlocking of fibres. Many specimens in my cabinet, and in the Wistar Museum, attest the accuracy of this assertion.”¹

In my own experiments upon the chicken, the bones uniformly resumed their original position as soon as the restraining force was removed, unless a fracture occurred, and this notwithstanding the bones were bent quite abruptly and to an angle of twenty-five degrees. Certainly, if the bones of children may be bent during life and be made to retain this position without a fracture, then the same thing might be done upon the bones of children recently dead, and, by successful experiments, this long-agitated question might be easily and forever put to rest.

It will be understood that our observations are confined to the long bones. That the flat bones, and especially the bones of the cranium, in childhood, may be indented by blows, and remain in this condition, is undeniable. Scultetus says he had seen “the skull pressed down in children, without a fracture, so that those who touch or look upon it can perceive a small pit,”² and it has been mentioned by many writers since, and perhaps before his day. I have myself published two examples of it in the second volume of the *Buffalo Medical Journal*,³ and since the date of that publication I have met with others.

§ 2. Partial Fracture of the Long Bones.

1. *Partial Fracture with immediate and spontaneous restoration of the bone to its original form.*—No writer seems to have given any special attention to the form of fracture now under consideration, although its existence appears to have been occasionally recognized. In the case reported by Camper, in 1765, of a partial fracture of the tibia, the bone

¹ *Institutes and Practice of Surgery*, by Wm. Gibson, Phila., 1831, vol. i. p. 254.

² *The Chirurgion's Storehouse*, by Johannes Scultetus, 1674, p. 126.

³ *Op. cit.*, p. 347, 1846, Cases 1 and 2.

FIG. 22.



Case mentioned by Fergusson.

had regained its natural form, but whether immediately after the accident occurred, or at a later period, I am not able to learn.¹ Jurine, Gulliver, and others, have noticed a gradual straightening of the bone after a partial fracture, so that its complete restoration has been accomplished after several weeks or months; but this, although partly due to the same cause which produces occasionally an immediate restoration, namely, its elasticity, is in part also due to other causes, and will be more properly considered under the next division of partial fractures.

Says Malgaigne: "Finally, at other times the fracture takes place without opening and without curvature; the only sign which one can recognize is a yielding of the bone under the pressure of the finger at the point of fracture; yet upon the living subject we may see the same symptom pertain to complete and simple fractures without displacement."²

In the following report of one of M. Blandin's clinics the accident is described a little more distinctly: "In some cases of fracture of the clavicle occurring about the middle of the bone in young subjects, displacement of the fragments does not immediately take place, thus giving rise to a risk of an error in diagnosis, by which the ultimate probability of a cure is diminished. A lad seventeen years of age was recently admitted into the Hôtel Dieu, under the care of M. Blandin, having, a few days previously, fallen upon one of his comrades while playing with him, when he instantly experienced pain and a cracking sensation about the middle of the left clavicle, where there soon formed a tumor, which, increasing, induced him to enter the hospital. On examination, the swelling was found to occupy the middle of the clavicle; it was about as large as half a hen's egg, ovoid in shape, well circumscribed, colorless, and hard, but sensible to pressure. There was not any deformity of the shoulder, nor any abnormal modification of the axis of the bone, to indicate the existence of a fracture; and although the different movements of the arm caused pain in the shoulder, yet they could be made without much difficulty.

"The symptoms in this case would lead to the belief that it was a case of simple periostitis, caused by external violence; but M. Blandin at once decided that there existed a fracture of the bone, having seen a similar case previously at the Hôpital Beaujon, where the tumor was treated as traumatic periostitis, the patient merely carrying his arm in a sling, until, by a sudden movement of the limb, displacement of the fragments was produced, and clearly demonstrated the existence of a fracture. A second case occurring soon afterward, M. Blandin profited by the experience gained from the preceding, and by moving the fragments of the broken clavicle on each other, obtained motion and crepitus. Still these indications were not so clear, that M. Marjolin could diagnose a fracture; he was of opinion that the case was one of exostosis, probably syphilitic, and the crepitus, he believed, depended on an erosion of the osseous surface. In consequence, the patient was left to himself, until a movement of the arm gave proof of the fracture by the displacement of the broken portions of the bones.

¹ Essays and Obs. Phys. and Lit. of Soc. of Edinburgh, vol. iii. p. 527.

² Op. cit., tom. i. p. 50.

"Two other cases occurring in young subjects have been admitted since in the Hôtel Dieu, under the care of M. Blandin, one of whom was purposely left without surgical assistance, while Desault's bandage was applied to the other. The former soon showed evidence of consecutive displacement; the latter was cured without any deformity following.

"The surgeon may diagnose a fracture, without displacement of the middle portion of the clavicle, when a circumscribed tumor forms in that part of young subjects, consecutive on a fall on the shoulder, and motion of the fragments, with crepitus, can be detected, there not being any syphilitic taint in the constitution."¹

The following examples, which have come under my own observation, will illustrate more completely the usual history and symptoms of these cases:

A. B., aged three years, fell from the sofa upon the floor, striking, it is thought, on her right shoulder. Two days after this, she fell again, and then for the first time Mr. B. noticed the deformity. She was brought to me three days after the second fall. There existed then a round, smooth projection at the outer end of the middle third of the clavicle. It felt hard, like bone. The line of the clavicle was not changed. I advised a handkerchief sling, simply to steady and support the arm. Seven months after the accident, she fell sick and died. The projection continued at the time of death, only slightly diminished.

H. S., aged six years, was thrown from a horse, partially breaking his left clavicle, near its middle. Dr. Sprague, of Buffalo, was employed. The projection in front was for several days very apparent, and was examined by myself at Dr. Sprague's request. The bone did not seem to be out of line. Five years after the accident, I examined the lad, and could not find any trace of the original injury.

September 25, 1855, Mrs. T. C. brought to me her infant child, then but two weeks old. Upon the left clavicle, at a point a little nearer the acromion process than the sternum, was an oblong swelling, three-quarters of an inch in length, smooth and hard like callus; the skin was not reddened, nor tender. There was no motion or crepitus, and the line of the axis of the bone was perfect. The mother, who had been put to bed by a midwife, thinks the injury occurred in the act of birth, although she did not notice the swelling until a week after.

October 20. Nearly one month later, I found no change in the condition of the bone; the hard lump remained, but it was still entirely free from tenderness. I have not seen the child since.

An infant boy, three years old, fell, August 12, 1857, from the hands of the nurse. The child cried, but the point of injury was not detected until the third or fourth day, although the mother examined the shoulders and neck carefully at the time. She is quite certain that if any swelling or discoloration had been present, she would have seen it then, or on the subsequent days, while washing and dressing the child. When first seen it was very distinct, but not so large as at present.

¹ Am. Journ. Med. Sci., vol. xxxi. p. 478, from Journ. de Méd. et Chirurg. Prat., July, 1842.

August 19. The child was brought to me. A little to the sternal side of the middle of the right clavicle there was an oblong node-like swelling, of the size of the half of a pigeon's egg, hard, smooth, and feeling like bone; there was no discoloration or swelling of the integuments; no crepitus or motion; the line of the clavicle seemed nearly or quite unchanged.

I have not noticed this variety of accident in any other bone except the clavicle, yet it is not improbable that it happens occasionally, and perhaps quite as often, in other long bones, but that its existence is not elsewhere so easily recognized. According to Poinsot, M. Demons has seen a similar case in the humerus of a newly born infant.

Of one hundred and fifty-seven fractures of the clavicle recorded by me, thirty-four were partial fractures; and of these at least eleven were spontaneously and immediately restored to their natural axes.

In explanation of the fact that hospital surgeons have not observed so large a proportion of partial fractures of the clavicle, it must be stated that most of these cases of partial fracture were drawn from private practice. Accidents of this class may be often met with in private practice and in dispensaries, but they are seldom found in hospitals.

Experiment.—In fourteen experiments upon the bones of chickens, a partial fracture, with immediate and spontaneous restoration, has occurred but once. In nine of these cases the bones were only bent, and in five they were partially broken; an immediate restoration has occurred, therefore, in one case out of five of partial fractures; while in my recorded examples of partial fracture of the clavicle it has been noticed about once in every four or five cases. The following is the experiment to which I have referred:

I produced a partial fracture of the tibia in a chicken six weeks old. The fracture was near the middle of the bone. It was felt to break under my finger; but, on removing the pressure, it immediately and spontaneously resumed the straight position.

The limb was dissected on the tenth day. The line of the axis of the bone was perfect, but on the fractured side was a node-like enlargement, sufficient to be distinctly felt and seen before the soft parts were removed.

Pathology.—In no case, except in my single experiment upon the bone of a chicken, has the actual condition been determined by dissection, and if any question has existed heretofore as to the possibility of an immediate and spontaneous restoration after a partial fracture, this experiment ought to decide it in the affirmative; but then the first nine experiments already quoted have shown that a mere bending with immediate restoration leaves no such traces or signs as have been described as following these accidents. We have, therefore, the negative argument that, since a bending with restoration leaves no signs, the examples, reported by myself and others as having occurred, and as having been followed by a node-like swelling, etc., must have been partial fractures. Moreover, in one of the cases of immediate restoration reported by Blandin, there was a feeble crepitus; and in another, the subsequent displacement proved the correctness of his diagnosis. The same has been noticed by myself in several examples.

We conclude, then, that these are examples of partial fracture, but that the number of bony fibres which have given way are too inconsiderable, as compared with those not broken, to affect materially the elasticity of the bone.

Diagnosis.—The diagnosis will depend somewhat upon the history of the accident as well as upon the present symptoms. In no instance, where I could ascertain the cause, have I known an incomplete fracture of this variety produced by any other than an indirect blow; and where the clavicle has been the seat of the fracture, the counter-blow has been received upon the end of the shoulder. The fact possesses, therefore, equal significance in its relation to either of the varieties of partial fracture; but in the case of a partial fracture with a permanent curvature, the diagnosis would be complete without the history, while in this case it might not be, and a knowledge of the manner in which the accident occurred would, therefore, be of great importance.

The signs, then, after a knowledge of the fact that a blow has been received upon the shoulder, are a node-like swelling upon the anterior or upper face of the clavicle, generally in its middle third, this swelling being hard, smooth, oblong; the skin only slightly or not at all swollen or tender, and in no way discolored, as it would have been had the swelling upon the bone been the result of a direct blow; and the line of the axis of the bone being unchanged. I have occasionally detected motion and crepitus at the point of injury, and we have seen that Blandin was able to detect both in one instance; but it has never occurred to me to see the swelling upon the bone until two or three days after the injury was received. We are not very likely, therefore, to recognize this accident immediately after its occurrence.

Treatment.—In the case of the clavicle, neither bandages, slings, compresses, nor lotions, can be of much service. Yet no harm can arise from employing a simple sling and roller to confine the arm; and it is always proper to enjoin some degree of care in using the arm of the injured side. The consolidation will be speedily accomplished, and after a time the ensheathing callus will wholly disappear.

If a similar accident should occur in any other of the long bones, as retentive and precautionary means, splints ought to be applied, at least for a few days.

2. *Partial Fracture, without immediate and spontaneous restoration of the bone to its natural form.*—The causes of this accident are the same as those which produce simple bending, or partial fracture with immediate and spontaneous restoration, from which latter they differ probably in the greater extent of the bony lesion. Perhaps, also, they differ sometimes in the peculiar form and degree of the denticulation at the seat of the fracture; in consequence of which an antagonism of the fibres takes place, preventing a restoration of the bone to its original form.

Very few surgeons have spoken of partial fracture in the clavicle, while Jurine, Syme, Liston, Miller, Norris, and many others, have declared that it is much more frequent in the bones of the forearm than elsewhere. This does not agree with my experience, according to which it occurs oftener in the clavicle than in the forearm; a discrepancy which

I cannot very well explain, except by supposing that, in the case of the clavicle, the accident has either been overlooked entirely or misapprehended. Blandin, who, we have seen, has reported five cases of partial fracture of the clavicle with immediate restoration, states distinctly that

FIG. 23.



Partial fracture without restoration of the bone to its natural form.

FIG. 24.



Partial fracture of the clavicle without spontaneous restoration. From nature; taken three weeks after the accident.

in two of these cases distinguished surgeons of the Hôpital Beaujon and Hôtel Dieu failed to recognize it.

Says Turner: "The next I shall descend to is that of the clavicle or collar-bone, which I have found the most frequently overlooked, I think, of any other, till it has been sometimes too late to remedy, especially among the children of poor people; for, though they find these little ones to

wince, scream, or cry, upon the taking off or putting on their clothes, yet, seeing that they suffer the handling of their wrists and arms, though it be with pain, they suspect only some sprain or wrench, that will go away of itself, without regarding anything further or looking out for help; whereas, this fracture discovers itself as easily as most others. For not only the eye, in examining or taking a view of the part, may plainly perceive a bunching out or protuberance of the bones when the neck is bared for that purpose, with a sinking down in the middle or on one side thereof, which will be still more obvious on comparing it with its fellow on the other side; but when it is more obscure, and the bone, as it were, cracked only—a *semi-fracture*, as we say—yet, by pressing hard upon the part, from one extremity to the other, you will find your patient crying out when you come upon the place; and by your fingers, so examining, sometimes perceive a sinking further down, with a crackling of the bone itself."¹

Erichsen, who regards all of these cases as mere bendings of the bones, remarks that it "most commonly occurs in the long bones, especially the

¹ Art of Surgery, by Daniel Turner, London, 1742, vol. ii. p. 255.

clavicle, the radius, and the femur."¹ He says, moreover, "Fracture of the clavicle in infants not unfrequently occurs, and is apt to be overlooked. The child cries and suffers pain whenever the arm is moved. On examination, an irregularity, with some protuberance, will be felt about the centre of the bone."² The reader will not fail to recognize in these symptoms the incomplete fracture of which we are now speaking, although Erichsen evidently believes them to be examples of complete fracture.

In addition to this testimony as to the frequency of these fractures in the clavicle, I will only mention that Johnson, in his review of Markham's *Observations on the Surgical Practice of Paris*, says that "many surgeons have noticed the incomplete fracture of the clavicle, as of other bones, which takes place in the young."³

Pathology.—The following experiment will assist in the elucidation of this part of our subject:

Experiment.—I bent the leg of a chicken five weeks old. It cracked under my fingers, and remained bent. Having waited a few seconds, and finding that it was not restored to position, I pressed upon it and made it straight. The chicken walked off without any limp.

On the fourth day, before dissection, the bone looked as if it was still bent; but, on removing the soft parts, the line of the axis of the bone was found to be straight. The areolar tissue under the skin was infiltrated with lymph, which was most abundant near the fracture, and gradually diminished toward each extremity of the limb. This effusion was confined almost entirely to the front of the limb, or to that side which had been broken, and constituted the greater part of the enlargement, which I had noticed before the dissection was commenced, and which then felt like bone.

On the front of the bone, also, underneath the periosteum, there was a loose, honeycomb deposit of ensheathing callus, about one line in thickness, and extending upwards and downwards about half an inch. This callus surrounded the bone in three-fourths of its circumference; but there was no callus on its posterior surface. It was also deficient exactly along the line of fracture, in front and on the sides, in consequence of which an oblique groove remained, indicating the seat of the fracture.

In three other experiments, the particulars of which are detailed in the earlier editions of this book, similar results were obtained.

So early as the year 1673, a dissection made by Glaser demonstrated incontestably the existence of partial fractures in the shaft, and in the direction of the diameter of long

FIG. 25.



Partial fracture; after union is consummated.

¹ Science and Art of Surgery. Phila. ed., 1854, p. 180.

² Op. cit., p. 205.

³ Lond. Med.-Chir. Rev., vol. xxxiv. p. 474, 1841.

bones.¹ Camper, in 1765, again described a specimen which he had seen;² and Bonn, in 1783, added a third positive observation.³

M. Gimelle is, therefore, in error when he ascribes to Campagnac the credit of having first proven by dissection their existence, in a paper communicated to the Academy of Medicine at Paris, in 1826. Campagnac, however, seems to have been the first who described very particularly the condition of this fracture. He has recorded the history and dissection of two cases, one of which occurred in the fibula, and one in the tibia. The first of these cases was a girl twelve years old, who survived the accident just eight weeks. The fracture had occurred near the middle of the bone, and upon the interior and internal side; in which direction, resting against the tibia, the bone was found inclined. "The bony fibres had been broken at different lengths, almost exactly like what takes place in the branch of a tree which has been partially broken; and, as we see sometimes in this latter case, the bundles of splintered bony fibres abutted upon themselves, and did not take their places when we endeavored to restore them; so the abnormal angle which the fibula represented could not be effaced, the ends of the divided fasciculi not restoring themselves to their respective places. This disposition might be especially seen toward the anterior part of the internal face, where a packet of fibres, coming from below, was braced against the upper lip of the division, which it thus held open. This opening at first made me think that the fragments could not have been well consolidated, but I assured myself that it was, and the fact was subsequently confirmed by the Academy of Medicine; all the points which were in contact were found intimately united."⁴

Diagnosis.—The diagnosis is not difficult. The distortion indicates sufficiently the existence of a fracture, while the complete absence of crepitus in nearly all cases, and of either overlapping or lateral displacement, must generally, especially where the accident has occurred in a child, sufficiently indicate that the fracture is incomplete. It will assist the diagnosis, also, to notice that these accidents are almost confined to the middle third of the long bones; and they are produced usually by a bending of the bones, the forces operating upon the extremities, and not directly upon the point which is broken.

In complete fractures, also, preternatural mobility is so constant a sign as to be regarded as diagnostic, while here there is almost always a great degree of immobility at the seat of fracture. The angle made by the projecting extremities is usually rather gentle and smooth; at other times it is abrupt, indicating a greater amount of fracture, or that the outer fibres are broken more irregularly. The power of using the limb is generally sensibly impaired, but not completely lost.

Treatment.—Jurine, Murat, Campagnac, Gulliver, Malgaigne, with some others, have noticed the fact that it is often difficult, and sometimes quite impossible, to restore these bones to position; a circumstance

¹ Malgaigne, *op. cit.*, p. 44, from Th. Boneti Sepulchretum, 1700, tom. iii. p. 424.

² Essays and Obs. Phys. and Lit. of Soc. of Edinburgh, 1771, vol. iii. p. 537.

³ Malgaigne, *op. cit.*, p. 44, from Descript. Thes. Ossium Morb. Hoviani, 1783.

⁴ Des Fractures Incompletes et des Fractures Longitudinales des Os des Membres; par J. A. J. Campagnac. Paris, 1829, pp. 9, 10.

which they have justly ascribed to that condition of the fragments described by Campagnac. The broken extremities of the fasciculi become braced against each other, and effectually resist all efforts to straighten the bone; unless, indeed, so much force is used as to render the fracture complete; a result which, if it should chance to happen, need not occasion any alarm, since, while it enables us at once to restore the bone to line, it does not much increase the danger of lateral displacement and overlapping. That the fracture has become complete we may know by a sudden sensation of cracking, by the increased mobility, and by the crepitus, which is now easily developed.

But we need not, on the other hand, be overanxious to straighten the bone completely, since experience has shown that after the lapse of a few weeks or months the natural form is usually restored spontaneously. I am not now speaking of those cases in which the restoration occurs immediately, in which it is probable that the splintered fibres offer no resistance to the restoration; but only of those in which the bone straightens so gradually as to induce a belief that the broken ends are the cause of the resistance. To this variety of accident belong cases one, five, six, seven, and eight, published in my Report on Deformities after Fractures;² in one of which the natural axis was resumed in less than four weeks. In a case mentioned by Gulliver, it required about the same time to render the bones of the forearm perfectly straight; and in one case mentioned by Jurine, at the end of six months it was "difficult to say which arm had been broken, and at the end of one year it was impossible."

Jurine attributes this restoration to "muscular action, or more especially to the reaction of the compressed bony plates;" but while it is easy to understand how the reaction of the compressed fibres may accomplish the gradual restoration, I am unable to understand in what manner muscular action contributes to this result, since most of the muscles attached to the long bones operate so much more energetically in the direction of their axes than in the direction of their diameters. Indeed, we have often seen these bones bent after complete fractures, and before the union was consummated, by muscular action alone.

I repeat, then, that the gradual restoration of these bones is due to the same circumstance which produces at other times an immediate restoration, namely, the elasticity of the unbroken fibres, but which elasticity, in this latter instance, is, for a time, effectually resisted by the bracing of the broken fibres. At length, however, in consequence of the gradual absorption of the broken ends, the resistance is removed, and the bone becomes straight. If this absorption refuses to take place, and the fibres continue pressed forcibly against each other, as in the case described by Campagnac, then the bone remains permanently bent.

Having straightened the bone as far as is practicable, it only remains to secure the fragments in place by suitable bandages or splints. If the restoration is incomplete, these means may assist the efforts of nature in accomplishing a gradual restoration.

It is scarcely necessary to say that extension and counter-extension avail nothing in partial fractures.

² Trans. Am. Med. Assoc., vol. viii., 1855, pp. 392-5.