

the cartilage of the internal condyle of the os femoris was chipped off, and the patella broken into a number of fragments."<sup>1</sup>

Lewitt, of Michigan, has related a case of fracture in a lad æt. 16, produced by striking his knee against a piece of timber, which resulted in suppuration of the knee-joint, but from which he finally recovered with the perfect use of the limb. The fracture of the patella was oblique, traversing only its upper and outer margin, and it was never much displaced.<sup>2</sup>

Dr. Levergood, of Pennsylvania, has reported a similar case, in which it became necessary to open the joint freely, yet it was followed by an excellent recovery, only a slight ankylosis remaining at the knee-joint.<sup>3</sup>

Dr. E. Mason has reported a case in which considerable ankylosis resulted from the plaster-of-Paris treatment. A refracture occurred, and although no blow was inflicted directly upon the knee, the adhesions which had ensued upon the previous fracture had so united the skin and subjacent tissues that the soft parts gave way with the bone, opening the joint freely. Extensive suppuration ensued and the patient died.<sup>4</sup>

Thomas A. Gallagher, æt. 17, fell, May 24, 1880, thirty feet, striking with his right knee upon a rock, and breaking the right patella at its lower and outer third into several fragments—the wound communicating with the joint. He was placed immediately under my charge, and the limb was laid at rest in the horizontal position. No bandages or other restraints were employed. On about the fifth day suppuration occurred in the joint, and the limb became greatly swollen. I opened the joint freely, removed all of the small fragments, and made a counter-opening, through which a large drainage-tube was passed. Hot water fomentations were applied to the whole limb, and the knee-joint was daily washed thoroughly with a weak solution of carbolic acid. The inflammation and suppuration began to subside from this date, and on the first day of July, thirty-seven days after the accident, he was walking on crutches, the wounds having nearly closed, the joint being free from inflammation, and sufficient motion remaining to render it probable that the functions of the joint will be completely restored.

## CHAPTER XXXI.

### FRACTURES OF THE TIBIA.

*Development of the Tibia.*—The tibia is formed, usually, from three centres of ossification—one for the shaft, and one for either extremity. Ossification commences in the shaft at or about the fifth week of foetal life. In the upper epiphysis it appears at birth, and unites with the

<sup>1</sup> Eve, Southern Med. and Surg. Journ., 1848; also Boston Med. Journ., vol. xxvii. p. 427.

<sup>2</sup> Lewitt, Medical Independent, Sept. 1856.

<sup>3</sup> Levergood, Amer. Journ. Med. Sci., Jan. 1860.

<sup>4</sup> Mason, N. Y. Journ. Med., April, 1875, p. 416.

shaft at about the twenty-fifth year. Generally it forms the tubercle, but occasionally the tubercle has a distinct point of ossification. The lower epiphysis commences to ossify during the second year, and unites with the shaft at about the twentieth year. The malleolus internus is occasionally formed from an independent centre.

*Etiology of Fractures of the Tibia.*—Fractures of the tibia alone are, in a large majority of cases, produced by direct blows, such as the kick of a horse, or a blow from a stick of wood; in one instance I have seen it broken by a kick from a Dutchman's boot. It is occasionally broken by a fall upon the foot, the force of the impulse being expended before the fibula gives away, but almost always the fibula breaks at the same moment, or immediately after the fracture has taken place in the tibia.

Heydenreich relates the case of a man 42 years old, in a Bordeaux hospital, whose tibia was broken above the tubercle in an attempt to straighten an ankylosed knee. The patient died on the eighth day, from a hæmorrhage caused by the pressure of the displaced fragment upon the popliteal artery.

Dr. Proudfoot, of New York, has reported an example of fracture of the tibia *in utero*, produced in the sixth month of pregnancy, by violent pressure upon the abdomen.<sup>1</sup>

*Pathology, Division, etc.*—In an analysis of twenty-seven fractures of the tibia, not including fractures of the malleoli, six were found to have occurred in the upper third, eleven in the middle third, and eight in the lower third. Six of the twenty-seven are known to have been transverse, or only slightly oblique. It is probable, also, that several of the remainder were transverse. In this respect, therefore, fractures of the tibia alone will be found to differ materially from fractures of the tibia and fibula; but it is only in accordance with the general observation that indirect blows produce almost constantly oblique fractures, and direct blows somewhat more frequently transverse.

According to Heydenreich<sup>2</sup> fractures of the upper third of the tibia occur most often between the 30th and 50th years of life, and he has not found a case recorded in a person under 22 years of age. I have myself, also, noted the fact that fractures above the tubercle are most common in old persons. Fractures of the tibia extending into the knee-joint are in most cases compound, or otherwise so seriously complicated as to render amputation necessary.

The malleolus internus is broken frequently at the same time that the ankle-joint is dislocated, and this accident will be considered in that connection, and in connection with fractures of the lower end of the fibula.

*Separation of Epiphyses.*—We have already mentioned that Madame Lachapelle has reported a case of

<sup>1</sup> Proudfoot, Boston Med. and Surg. Journ., vol. xxxv. p. 268, 1846; from New York Journ. Med.

<sup>2</sup> Heydenreich, Frac. Ext. Sup. du tibia, th. de Paris, 1877, No. 43.

FIG. 226.



Development of the tibia. (From Gray.)

separation of the upper epiphysis of the tibia, and of the lower epiphysis of the femur, occasioned by pulling at the foot during birth.

Blasius<sup>1</sup> relates the case of a boy, 16 years of age, in whom the upper epiphysis was separated completely from the shaft by having his foot caught in machinery. M. Peulevé<sup>2</sup> has in his possession a similar specimen obtained from a lad 6 years of age. The accident had been caused by the leg being caught in the revolving wheel of a carriage, and the severity of the injury was such that it became necessary to amputate. Fischer and Hirschfeld<sup>3</sup> have observed the same lesion in a boy 17 years old.

Dr. Voss, of New York, has seen a separation of the lower epiphysis in a boy 14 years old, who in falling had caught his foot between two blocks of wood. The upper fragment protruded through the skin. Reduction was effected, but subsequently a portion of the epiphysis became necrosed and was removed. He finally recovered with a useful joint.<sup>4</sup>

Dr. R. W. Smith has reported a similar case in a boy 16 years of age, and which, having occurred six months before, remained unreduced. The lower end of the shaft was displaced forwards. Richard Quain records one other example, in a lad 17 years old, which was easily reduced and maintained in position.<sup>5</sup>

N. A. Powell,<sup>6</sup> of Edgar, Canada, has reported an example of congenital displacement of the upper epiphysis of both tibiae in an otherwise healthy girl. Reduction was easily effected, but was with difficulty maintained. When about 14 months old, however, the epiphyses were kept in place by means of plaster-of-Paris splints with which she was permitted to walk about, and a perfect union was finally obtained.

Inasmuch as the *tubercle* has sometimes a separate point of ossification it may occasionally be detached, and the accident will then be distinguished from a fracture of the ligamentum patellæ, by the presence of a hard and movable body and by crepitus.

*Prognosis.*—No shortening can occur in this fracture unless one or both ends of the fibula are displaced, a complication which I have noticed in two instances, but in neither case did the shortening exceed one-quarter of an inch; unless, indeed, the fibula bends and remains bent, or the comminution and direction of the fracture are such at either end as to allow the femur or the astragalus to become impacted. I have never recognized either of these conditions.

Occasionally the upper fragment has been slightly displaced forwards. With these exceptions, and one other of delayed union which I shall presently mention, this bone, in my experience, has been found to unite promptly and without any appreciable deformity. Other surgeons have noticed occasionally that the upper end of the lower fragment has become displaced toward the fibula.

<sup>1</sup> Blasius, Poncet, *Nouv. Dic. Méd. et de Chir.*, t. 19, p. 513.

<sup>2</sup> Peulevé, *Bull. Soc. Anat.*, 1865.

<sup>3</sup> Berlin, *Klin. Woch.*, 1865, II. 10. (Poinot, *op. cit.*)

<sup>4</sup> Voss, *N. Y. Journ. Med.*, Nov. 1865, p. 133.

<sup>5</sup> New York Journ. Med., June, 1868; from *British Med. Journ.*, Aug. 31, 1867.

<sup>6</sup> Powell, *Canada Lancet*, July 1, 1881.

Delayed union has been observed pretty frequently in fractures of the upper third of the tibia, of which circumstance M. Duplay, according to a reference to one of his clinical lectures, contained in the *Lancet*, May 18, 1878, makes the following observations:

"In many of these cases there is no constitutional vice to which it can be attributed, and the usual local causes of non-union are absent. It has been stated that fractures above the entrance of the nutrient artery, which is directed downwards, unite less readily than those below it on account of their relation to the blood supply of the bone. But the upper end of the tibia is the most vascular part of the whole bone, and its nutrition may, therefore, be presumed to be in a very active condition." He regards, however, this very vascularity of the bone as the cause of the difficulty of union, as, when fractured, the great number of torn vessels pour out an unusually large quantity of blood between and around the broken ends of the bone, which coagulates, and thus impedes or altogether prevents the thorough organization and ossification of the callus. He states that in these cases he has met with distinct evidence of this extensive effusion of blood.

I have met with examples of delayed union in this portion of the bone, of some of which I shall hereafter speak more particularly.

Dr. Donne, of Louisville, has reported an example of delayed union in a simple transverse fracture of the upper end of the tibia. The man was intemperate. Ten weeks after the accident no union had occurred. Dr. Donne introduced a seton, and in about six weeks the fragments were firm.<sup>1</sup>

Muhlenberg, in his tables comprising 656 examples of delayed and non-union of long bones, records 84 of the tibia alone; of which number 2 were cured by friction, 7 by mechanical appliances, 3 by seton, 11 by resection, and 15 by drilling.<sup>2</sup>

If the fracture extends into either the knee- or ankle-joint, the danger of ankylosis is imminent, yet experience has shown that it may sometimes be avoided.

When the malleolus is broken off, it generally becomes slightly displaced downwards, and in this position a complete bony or ligamentous union of the fragments generally takes place.

*Treatment.*—The tendency to displacement, in a fracture of the shaft of the tibia, is usually so slight, if it exists at all, that simple dressings, light splints of leather, felt, or binder's board, with rest in the horizontal posture upon a pillow, fulfil nearly all the indications which are present. The following cases will illustrate the usual course of these accidents:

Mrs. W. fell, Oct. 19, 1848, striking on her right knee, breaking the tibia transversely just below the tuberosity. The fall was the result of a misstep on level ground, and was attended with only slight bruising of the soft parts. She says that on attempting to rise she discovered what had happened, the bone projecting very distinctly, and she pushed and pulled it into place with her own hands.

I dressed the limb by laying it upon a pillow, outside of which were

<sup>1</sup> Donne, *Amer. Journ. Med. Sci.*, vol. xxvii. p. 524; from *Western Journ. Med. and Surg.*, Aug. 1841.

<sup>2</sup> Muhlenberg, *Agnew's Surg.*, *op. cit.*, vol. ii. p. 806.

placed two broad deal splints, tying the whole snugly together with several strips of bandage. At a later period the leg and thigh were laid over a double-inclined plane. At the end of six weeks all dressings were removed, and the fragments were found to have united firmly, and so perfectly that the point of fracture could not be traced.

Peter Hamil, æt. 29, was admitted into the Buffalo Hospital of the Sisters of Charity, Aug. 31, 1849, with an injury to his left leg, which had occurred two days before. A young surgeon had examined the limb, and thought the femur was broken just above the joint. He had applied a roller from the toes to the thigh; and to the thigh were applied lateral splints. These dressings were on the limb at the time of his admission, and were not removed until the next day. I could not then discover any fracture or displacement, and the dressings were discontinued, the limb being merely laid upon pillows.

Oct. 4, when examining the limb, I detected a slipping sensation, like that produced in a false joint, through the upper end of the tibia, and I now easily understood what had been mistaken for a fracture of the femur. It was a transverse fracture through the upper end of the tibia, and without displacement.

No splints were afterward applied, and on the 25th of November, three months after admission, he was dismissed, the motion between the fragments having ceased, but the knee still remaining quite stiff.

The presence of inflammation, with other complications, may, however, occasionally render the treatment more difficult and the results less satisfactory.

John Mahan, æt. 39, admitted to the Buffalo Hospital of the Sisters of Charity, Feb. 16, 1853, with a compound fracture of the right tibia, near the middle of the leg. The bone was broken by a kick. I found the limb swollen and painful, and I laid it carefully over a double-inclined plane, and directed cold water irrigations; I also directed morphia in full doses. The inflammation for several days threatened the complete loss of his limb. On the tenth day the distal end of the upper fragment was projecting in front of the lower, and I depressed the angle of the splint and made moderate pressure upon the upper fragment. On the twentieth day the fragments were bent backwards, and I placed a compress behind. On the thirty-seventh day we took the limb from the inclined plane, and trusted alone to side-splints. On the forty-fifth day we removed all dressings. The fragments had not united. The limb was then laid upon a pillow, and six days later a firm gutta-percha splint was applied for the purpose of steadying the bone, but the splint was removed daily in order that the leg might be bathed and rubbed. He was allowed to sit up. On the fifty-ninth day motion could still be perceived between the fragments, and he was directed to use crutches. On the ninety-third day the union was found to be firm, the upper fragment remaining slightly displaced forwards.

In case the fracture extends into the knee-joint, it is best to lay the limb upon pillows in a nicely cushioned box, and nearly straight. No extension or counter-extension is necessary here any more than in other fractures of the tibia alone, nor are lateral splints or rollers necessary or proper at first as a general rule; but especial attention should con-

stantly be given to the prevention of inflammation, and of subsequent ankylosis. The omission to employ splints in a case of this kind was charged against a surgeon in Vermont as evidence of malpractice. I am happy to say, however, that, in this particular case, he was sustained by the testimony of the medical men and by the verdict of the jury; but the attempt which the reporter has made to defend this as a universal practice in fractures of the leg, or of the tibia alone, is unfortunate, and evinces a lack of practical experience.<sup>1</sup>

Whatever position is adopted, and whatever means of support or retention are employed, if bandages or splints are applied tightly or injudiciously, great suffering and irreparable mischief to the knee-joint may be the consequence.

A man, æt. 23, entered the Pennsylvania Hospital, July 18, 1839, with an oblique fracture through the head of the tibia. A physician had applied a bandage and splint to the leg, and sent him twenty miles to the city, and, on examination after his arrival, the whole limb as high as the groin was much swollen, red, and excessively painful. The knee-joint was distended and very tender. All dressings were immediately removed, and the limb laid in a fracture-box slightly elevated at the foot; cool lotions were applied, and the patient was freely bled, both from the arm and by the application of leeches. The limb was kept in this position about six weeks, and at the end of two or three weeks more he was dismissed, cured. Dr. Norris, who was the hospital surgeon in attendance, has, in his report of the case, very properly taken this occasion to warn surgeons of the danger of excessive bandaging and splinting in this kind of fracture, as well as in all other fractures of the lower extremities.<sup>2</sup>

Fractures of the malleolus, unaccompanied by any other accident, demand only that the limb should be laid upon its outer or fibular side, with the foot so supported that it shall incline inwards toward the tibia. In this simple disposition of the limb we have done all that can be done by any mechanical contrivance toward approaching the lower fragment to the shaft from which it has been broken.

*Treatment of Delayed Union.*—If improving the general condition of the patient by allowing him to go about with or without splints, or frictions of the ununited surfaces, do not succeed, we may be obliged to resort to other, strictly surgical expedients. It has already been stated that Dr. Donne, of Louisville, resorted successfully to the seton. I have succeeded by other means.

Mr. H. Lichstenstein, æt. 40, broke his left tibia Aug. 6, 1866, by twisting his leg violently in the upper third. There was only a slight forward displacement of the lower fragment. His surgeon dressed it with Swinburne's extension apparatus, without side-splints. I was called to see him, in consultation, sixteen weeks after the accident occurred, and found the fragments perfectly movable. He had not yet left his bed. I advised a firm gutta-percha splint to be moulded to the back of his thigh and leg, and that he should go about on crutches. My advice was followed, and in six weeks the bone was united and firm.

<sup>1</sup> Boston Med. Journ., vol. liv. p. 1, March, 1856.

<sup>2</sup> Norris, Amer. Journ. of Med. Sci., vol. xxiii. p. 291.

In the case of John J. Blair, of Brooklyn, with a transverse fracture just below the tubercle of the tibia, the union was delayed many months. He placed himself under my charge at St. Elizabeth's Hospital, in this city, and as he had been walking for some time, and his health was good, I perforated the bone with Brainard's drill several times, and, binding a firm splint upon the back of his thigh and leg, he was laid in bed. After the first week I pushed an ordinary shawl-pin between the fragments, and left it in place three days. This was repeated several times, and at the end of a few weeks union was complete.

## CHAPTER XXXII.

## FRACTURES OF THE FIBULA.

*Development of the Fibula.*—The fibula is formed from three centres of ossification—one for the shaft, and one for each extremity. Bone begins to be deposited in the shaft at about the sixth week of foetal life, in the lower extremity during the second year, and in the upper extremity during the fourth year. The lower epiphysis unites with the shaft about the twentieth year, and the upper about the twenty-fifth year.

FIG. 227.



Development of the fibula. (From Gray.)

*Epiphyseal Separations.*—Stimson relates that "in April, 1883, a child, about two years old, was run over by a street-car and brought to the Presbyterian Hospital. In addition to other wounds, which were promptly fatal, there was a lacerated wound on the outer side of the right leg exposing the upper end of the fibula and opening the knee-joint. The epiphysis of the fibula was completely detached from the shaft and from the tibia, and remained attached to the external lateral ligament and the tendon of the biceps; there was also an incomplete fracture of the shaft of the fibula three-fourths of an inch below the epiphyseal line, and the intermediate portion was denuded of its periosteum, which remained attached to the epiphysis."<sup>1</sup>

I am unable to refer to any other example of separation of either the upper or lower epiphysis of the fibula.

*Causes of Fracture.*—In a record of forty-eight cases I have been able to ascertain the cause satisfactorily in thirty-two, of which number six were the results of falls directly upon the bottom of the foot, but which were probably accompanied by a twist of the foot, eleven of a slip of the foot in walking on level ground or on ground only slightly irregular, and fifteen of direct blows.

<sup>1</sup> Stimson, op. cit., p. 586.

I shall here take the liberty of quoting the careful studies and observations of Poinsoot:

"Muscular contraction is sometimes the cause of fracture of the fibula. In this case, the superior extremity detaches itself from the rest of the bone. This variety of fracture, very rare however, was noted as early as 1854, by Professor Hergott, of Strasburg;<sup>1</sup> at the same time, two practitioners of the upper Rhine, Weber and Müller, reported each an observation of the same kind. Brand, in 1877, reported a case of fracture of the head of the fibula which complicated a dislocation of the leg forwards.<sup>2</sup> Similar facts were recently published by Messrs. Duplay, Perrin, and Terrier.<sup>3</sup> Hergott's patient, a woman fifty-two years old, fell; throwing herself quickly backwards, she felt a crack in her left leg on which her body was resting. A slight tumefaction was discovered opposite the head of the fibula, as also a manifest crepitus, felt by the patient as well as by the doctor. The fracture in Weber's patient, and probably also in Terrier's, was produced in the same way. In Müller's case, two young men were wrestling; one of them, on the point of being thrown, made a violent effort; but cried out so that his adversary let go; he did not fall, although he could not use his leg. Müller recognized a fracture of the head of the fibula. Brand's patient was knocked down backwards by a cow on a pile of stones and wood. The leg, in M. Perrin's case was caught between the ground and a fallen horse. M. Duplay's patients, men of forty-eight and sixty years, had been caught, one by the shaft of a machine, the other by a transmission belt, and their bodies, drawn in a rapid movement, struck a neighboring wall repeatedly. The patients explained perfectly, that in the movements of rotation to which they had been subjected, their legs came in contact with the ceiling, so that the inferior right limb (where the *arrachement* of the fibula existed) was struck from outwards inwards, and consequently tended to bend violently inwards. It seems to us that the mechanism admitted by Hergott can be applied to all the cases: the leg being slightly bent on the thigh, the biceps contracts with all its strength perpendicularly to the line of the fibula, which breaks at its feeblest point. This mechanism, which cannot be contested in Hergott's, Weber's, and Müller's cases, is equally admissible in Perrin's and Duplay's. One can well understand, that the upper part of the leg being fixed in slight flexion by contact with the ground or the ceiling, the biceps should act with more efficacy. As to Brand's case, it furnishes no details in reference to the mechanism of the lesion; it seems, however, that Hergott's theory may well be applied to it."<sup>4</sup>

*Pathology of the True Fractures.*—In all of the fractures recorded by me which have been produced by falls upon the bottom of the foot, and in all except one produced by a slip of the foot, the accident was accompanied by a partial dislocation of the ankle; the foot being turned out-

<sup>1</sup> Hergott, Gaz. Med. de Strasburg, 1854, p. 344.<sup>2</sup> Brand, Bayr. artzliches Intell., 1877, No. 52, p. 543.<sup>3</sup> Bull. Soc. de Chir., 1880, p. 218.<sup>4</sup> Poinsoot, op. cit., p. 652. See, also, *Lésions du Sciat. poplit. ext. dans frac. de l'ext. sup. du peroné.* Duplay, Prog. Med., Paris, 1880, viii. 257.