

The author must repeat what he has said in the preceding section, that he is not prepared to make any suggestions as to either the symptoms, prognosis, or treatment, unless it be to say that, in view of the tendency to suppurative action, the limb should be kept at rest.

§ 4. Fractures of the Shaft of the Femur.

Etiology.—Unless the fracture has taken place just above the condyles, or immediately below the trochanter minor, in a very large proportion of cases it has been produced by a direct blow, such as the passage of a loaded vehicle across the thigh, or the fall of a piece of timber directly upon it.

Pathology.—It has already been remarked that this bone is most frequently broken in its middle third, and usually at a point somewhat above the middle of the shaft. I have made the same observation in an examination of specimens belonging to Dr. Mütter. In his cabinet, of twenty-four fractures of the shaft, three belonged to the upper third, two to the lower, and nineteen to the middle third.

In the adult these fractures are, with only an exceedingly rare exception, oblique; and the obliquity is generally greater than in the case of other bones. This fact, which is very difficult to determine, in most cases, upon the living subject, I have established by a considerable number of observations made upon cabinet specimens. A transverse fracture is found only twice in Dr. Mussey's collection, containing thirty examples of fracture of the shaft; and in Dr. Mütter's collection, specimen B 71 is an adult femur, broken nearly transversely through its middle third; and it is united with a shortening of about one inch. Indeed, it is more common to find a transverse fracture in the middle third than at any other point of the shaft of the bone; but in the upper third the obliquity is extreme and almost constant.

At whatever point of the shaft the bone is broken, the degree of obliquity is generally such that the fragments cannot support each other when placed in apposition; unless indeed the fracture is near the condyles, where the greater breadth of the bone creates an additional support; but even here the cabinet specimens still present a striking obliquity, with more or less overlapping. I believe that in each of the three specimens of fracture at this point found in the collection belonging to the Albany Medical College, the obliquity is such that the fragments were not supported, and an overlapping has taken place. In specimen 719 the fracture extends into the joint; and although it is united by bone, a shortening of about one inch has occurred.

In two cases to which I shall hereafter refer, the upper fragment was projected through the quadriceps tendon, and became imprisoned under the skin.

In the case of children, and especially of infants, the bone is not unfrequently broken transversely or nearly transversely, or it is serrated or denticulated, so that complete lateral displacement is much less frequent.

The same remark is probably true of a few fractures occurring in extreme old age; but as the shaft of the femur is not often broken in

very old persons, owing to the readiness with which the neck yields to violence, I have not had an opportunity to verify this opinion.

The direction of the obliquity varies exceedingly, especially in the middle and upper thirds; in the middle third, however, it is generally downwards and inwards; but in the lower third its direction is, with only rare exceptions, downwards and forwards, and the superior fragment is found lying in front of the inferior.

The direction of the displacement, however, in fractures of the shaft of the femur, does not always depend upon the direction of the line of fracture. In fractures of the upper third, whatever may be the direction of the line of fracture, the lower end of the upper fragment inclines forwards and outwards, and the upper end of the lower fragment inwards; unless, indeed, this inclination is controlled by actual entanglement of the broken ends with each other.

In the middle third the fragments also generally take the same relative position, whatever may be the direction of the fracture; but when the fracture takes place at or near the condyles, where the diameter of the bone is much greater, the direction of the obliquity determines pretty uniformly the direction of the displacement.

Symptoms.—The symptoms which characterize a fracture of the shaft of the femur are those which are common to all fractures, namely, mobility, crepitus, displacement of the fragments, pain, and swelling, to which are added generally a shortening of the limb, with eversion of the foot and leg.

Owing to the great amount of muscle covering the thigh, or to the swelling which immediately follows the injury, it is sometimes difficult to determine at what precise point the fracture has occurred; and it is generally still more difficult to say whether the fracture is oblique or transverse; indeed, this latter question is sometimes decided approximately by a reference to the age of the patient rather than by the examination of the limb.

The immediate shortening varies from half an inch to an inch and a half, or even more; and it will average about one inch in the case of healthy adults.

Prognosis.—Whatever may have been the general opinion of experienced surgeons as to the question of shortening in other fractures, very few certainly have ever claimed that in fractures of the femur a complete restoration of the bone to its original length was generally to be expected. There seem, however, to have existed only certain vague and indefinite notions as to the proportion and amount of this shortening, and which have had for their basis nothing better than a few imperfectly analyzed observations.

Says Scultetus (quoting first from Hippocrates): "For the bones of the thigh, though you do draw them out by force of extension, cannot be held so by any hands; but when the first intention slacks, they will run together again; for here the thick and strong flesh are above binding, and binding cannot keep them down."—*Hippocrates de fract.* Which Celsus seems to confirm, lib. 8, cap. 10, where he writes as follows of the cure of legs and thighs: "For we must not be ignorant that if the thigh be broken, that it will be made shorter, because it never returns to its

former state.' And Avicenna, lib. 4, fen. 5, saith 'that it is a rare thing for the thigh once broken to be perfectly cured again.'

"These words admonish us," continues Scultetus, "that we should never promise a perfect cure of the thigh; but rather, using all diligence, we should foretell that it is doubtful that the patient will be always lame; but when this shall happen from the nature of the fracture, or, which most frequently falls out, from the impatience of the sick person, it may be imputed to our mistake, and, instead of a reward, bring us disgrace."¹

Says Chelius: "Fracture of the thigh-bone is always a severe accident, as the broken ends are retained in proper contact with great difficulty. The cure takes place most commonly with deformity and shortening of the limb, especially in oblique fractures, and those which occur in the upper and lower third of the thigh-bone. Compound fractures are so much more difficult to treat."²

Says John Bell: "The machine is not yet invented by which a fractured thigh-bone can be perfectly secured." And Benjamin Bell declares that "an effectual method of securing oblique fractures in the bones of the extremities, and especially of the thigh-bone, is perhaps one of the greatest desiderata of modern surgery." "In all ages," he adds, "the difficulty of this has been confessedly great; and frequent lameness, produced by shortened limbs arising from this cause, evidently shows that we are still deficient in this branch of practice."³

Velpeau says that "after fractures of the femur there is no limping unless the shortening exceeds three-quarters of an inch; and the same is true if the shortening occurs in the tibia." The reason is, that the pelvis inclines toward the shorter limb, and thus compensates for the deficiency in length. In speaking of the various contrivances for dressing the fractured femur, he remarks that "most of them fail to obviate the shortening, and produce eschars, ankylosis, or troublesome arrests of the circulation. This is the price that is usually paid for the employment of these complicated machines, and a shortening of a quarter to three-quarters of an inch is not avoided after all. The simplest apparatus that will maintain the adjustment of the fractured femur, so that union may take place with shortening of only half an inch, is the best."⁴

Nélaton holds the following language:

"A fracture of the body of the femur, with an adult, is always a grave accident, inasmuch as it demands so long a confinement to the bed, and especially on account of the shortening of the limb, which it is almost impossible wholly to prevent; accordingly, Boyer recommends to the surgeon, from the first day, to announce to the parents of the patient the possibility of this accident. With infants, on the contrary, it is almost always easy to avoid the shortening."⁵

¹ The Chirurgion's Storehouse, by Johannes Scultetus, a Famous Physician and Chirurgion of Ulme in Suevia. London, 1647.

² System of Surgery, by J. M. Chelius, translated, etc., by South. First Amer. ed., vol. i. p. 627, 1847. See also p. 626, paragraph 679.

³ System of Surgery, by Benjamin Bell, vol. vii. p. 21. Edinburgh, 1801.

⁴ Peninsular Journ. of Med., vol. ii. p. 384; also Memphis Med. Journ., vol. iv. p. 254, 1856.

⁵ Elémens de Pathologie Chirurgicale, par A. Nélaton, tom. prem. p. 752. Paris, 1844.

While Malgaigne declares his opinion on this subject thus, at length:

"When we do not succeed in drawing back the misplaced fragments, end to end, so that they may oppose themselves to the action of the muscles, it is impossible to preserve to the member its normal length, whatever may be the *appareil* or method employed. Surgeons are not sufficiently agreed upon this question.

"At a period quite recent, Desault pretended to cure all fractures without shortening, and his journal contains several examples. In imitation of Desault, various practitioners have modified, corrected, and improved the apparatus for permanent extension, and they claim to have themselves obtained as complete success. I ought then to declare here, in the most positive manner, that I have never obtained like results, either in the use of my own apparatus, or with that of others, nor indeed where, in pursuance of my invitation, several inventors have applied their apparatus in my wards. I have examined, more than once, persons declared cured without shortening, and yet, upon measurement, the shortening was always manifest. The misfortune of all those who believe that they have obtained those miraculous cures is, that they have not even thought of instituting a comparative measurement of the two limbs; I will say even more, that they are most generally ignorant of the conditions of a good and faithful measurement. Sometimes, also, they have been deceived in another way—in falling upon fractures which were not displaced, especially with young persons; and they have believed that they have cured with their apparatus a shortening which had never existed. In short, when the fragments are not displaced, or even when they are brought again into contact and maintained by their reciprocal denticulations, it is easy to cure the fracture of the femur without shortening; aside of those two conditions, the thing is simply impossible.

"Several distinguished surgeons of our day have acknowledged this impossibility, and have renounced, in consequence, permanent extension. They allege, moreover, that an overriding of even three centimetres is of little importance, and occasions no limping. I cannot agree with this opinion. I have seen persons walk very well with a shortening of one centimetre; beyond this limit, either they limp, or they have lifted the heel of the shoe, or, in short, the limping is only concealed by a lateral deviation of the spine.¹ We thus are made to comprehend how a fracture with overlapping is always serious, and how cautious we ought to be in our prognosis."²

That the foregoing remarks are intended by the author to be equally applicable to other fractures of the shaft of the femur as to those of the middle third, is made evident by what he has said before, when speaking of fractures of the upper third:

"The prognosis is sufficiently favorable when the fragments are denticulated (*engrenées*); when they ride, on the contrary, we must look for a shortening as almost inevitable."³

¹ Dr. Buck, of New York, thinks that with a shortening of one inch, or even one inch and a half, the patient may have "a useful limb, with little or no halting in his gait." N. Y. Journ. of Med., vol. xvi. p. 294.

² Traité des Fractures et des Luxations, par J. M. Malgaigne, tom. prem. pp. 723, 724. Paris, 1847.

³ Op. cit., p. 718.

In our own country several of the most distinguished surgeons have testified to the constant difficulty, if not impossibility, of curing fractures of this bone without a shortening. In a suit instituted against a surgeon in New York City, for alleged malpractice in the treatment of an oblique, comminuted, and otherwise complicated fracture of the femur near its condyles, Dr. Mott is reported to have testified that "more or less shortening of the limb is uniformly the result after fractured thigh, even in the most favorable circumstances."¹

In a very interesting communication made to the author by Jonathan Knight, of New Haven, late President of the American Medical Association, occurs the following passage:

"I have seen but few fractures of the femur in the adult, unless of the most simple kind, in which there was not some remaining deformity; often slight, so as not to impair the usefulness of the limb, and in others considerable and apparently unavoidable." Dr. Knight adds, however: "In the greater proportion of the fractures in children the recovery has been so nearly perfect that no marked deformity or lameness has followed."

Dr. Detmold, in his remarks made before the New York Academy of Medicine, at its meeting in March, 1855, declared his belief that a shortening of the femur always occurs after fracture, and that "but one inch of shortening in an average of twenty cases is a good result."²

Dr. J. Mason Warren, of Boston, writes to me as follows: "As you are making observations on fractures, I would state that, after a long and very careful observation, I have never yet seen, either in Boston or elsewhere, an oblique fracture of the thigh, in a patient over seventeen years of age, in which there was not some shortening. I have had cases shown to me in which it was averred that the limb was not shortened, but on measuring myself I have found the fact otherwise. In children, I believe that union without shortening may be accomplished."

Dr. Bigelow, of the Massachusetts General Hospital, writes to me, May, 1875, as follows: "In our hospital cases shortening is the rule in adults. Young subjects do better. Three-quarters of an inch shortening in the adult is a good result, and easily compensated by the pelvis. Greater shortening may occur."

In a paper published by Dr. Lente in the number of the *New York Journal of Medicine* for September, 1851, he states that he believes the average shortening after treatment in the New York City Hospital to be three-quarters of an inch; but subsequently, Dr. Buck, one of the hospital surgeons, has furnished Dr. Lente with more exact statistics. Says Dr. Buck:

"After carefully scrutinizing over one hundred cases of fracture of the femur, taken from the register of the New York Hospital, and eliminating such as involved the cervix, or condyles, or belonged to the class of compound fractures, there remained an aggregate of seventy-four cases, of both sexes, and of all ages from 3 to 63, in which the shaft of

¹ Boston Med. and Surg. Journ., vol. xxxiv. p. 450. See also opinions of Drs. Reese, Post, Parker, Cheeseman, Wood, etc., in relation to the prognosis in this particular case.

² New York Journ. of Med., second series, vol. xvi. p. 261.

the femur alone was fractured." In all these cases the difference in the length of the fractured limb, resulting from the treatment, was ascertained by careful measurement with a graduated tape, and the following deductions were drawn from the analysis:

"Of the 74 cases of all ages, 19 resulted without any shortening, a proportion of about one-fourth. The average shortening of the remaining 55 cases was a fraction less than three-fourths of an inch.

"Seventeen cases in the above aggregate were under 12 years of age, of which six resulted without any shortening, a proportion of about one-third. The average shortening in the remaining eleven cases was a fraction less than one-half an inch.

"Of the 57 cases over 12 years of age, 13 resulted without any shortening, a proportion of about one-fourth; and the average shortening in the remaining 44 cases was a fraction over three-fourths of an inch."¹

Mr. Holthouse, surgeon to Westminster Hospital, states that a careful examination of fifty cases of fractures of the femur in the various London hospitals, made by himself, showed that 90 per cent. (including twenty children) were shortened, the amount of shortening ranging from one-half an inch to three and one-third; and as some of these cases were still under treatment, he entertains a doubt whether the final result will prove to be as favorable as above stated. For himself he declares, with a frankness which is most creditable to his courage and honesty, that at Westminster, with all the appliances known to surgery at his command, he has never succeeded, in the adult, in effecting union without shortening. He has also examined more than one hundred specimens in the various museums of the metropolis, and they are all shortened.

After quoting the opinions of several writers upon this subject, including the author of this treatise, Mr. Holthouse adds in a footnote:

"Notwithstanding this strong testimony, surgeons are still to be found hardy enough, or ignorant enough, to repeat the fallacies which have been so often refuted, and to vaunt their success in the cure of oblique fractures in the adult without shortening. Why do not these surgeons, instead of publishing their cases in the journals, produce their patients at some of the medical societies?"²

Dr. Agnew,³ after referring to these statements of Mr. Holthouse, says: "My own experience accords entirely with these statements. I have not met with a single case among all the specimens in Philadelphia of fracture of the shaft of the femur, which was entirely free from deformity; and I am equally certain that neither in hospital, nor in private practice, save in the case of children, have I ever succeeded in curing a case without an appreciable deformity."

It is not to be denied, however, that a few surgeons in all parts of the world have claimed, and still continue to claim, in their own practice, or from the adoption of their own peculiar plans of treatment, much better success. Indeed, some of them do not hesitate to affirm that, as a general rule, any degree of shortening is quite unnecessary.

¹ Buffalo Med. Journ., vol. xv. p. 22, June, 1859.

Holthouse, *Holmes's System of Surgery*, 2d ed., 1870, vol. ii. p. 866.

³ Agnew, *Principles and Practice of Surgery*, vol. i. p. 948.

Mr. Amesbury declares, that when the fracture is in the middle or lower third, under a "judiciously managed" application of his own splint, "consolidation of the bone takes place without the occurrence of shortening of the limb, or any other deformity deserving of particular notice."¹

Mr. South, in a note, commenting upon an opposite sentiment expressed by Chelius, and already quoted, remarks: "In simple fractures of the thigh-bone, except with great obliquity, I have rarely found difficulty in retaining broken ends in place, and in effecting the union without deformity, and with very little, and sometimes without any, shortening. For the contrary results the medical attendant is mostly to be blamed, as they are usually consequent upon his carelessness or ignorance."²

Mr. Hunt, of the Queen's Hospital at Birmingham, who treats all fractures with the *apparatus immobile* of Seutin, has published the results of his observations; and of the simple fractures of the femur only one presented, after the cure, any degree of shortening; and he adds that all other fractures which he has treated by this method were followed by "equally good results."³ In relation to which statements, Mr. Gamgee exclaims: "This is conservative surgery. What other mode of treatment would have given such results? And those cases are not exceptional. Mr. Hunt tells us that he has selected them from amongst many others equally successful. They accord with the experience recorded in my little treatise on this subject; and the works of Seutin, Burggreve, Crocq, Velpeau, and Salvagnoli Marchetti record numerous cases no less remarkable and demonstratively conclusive."⁴

Desault, also, according to the passage from Malgaigne which I have already quoted, "pretended to cure all fractures without shortening." I do not find, however, any other authority for this statement, as here made; neither in his *Treatise on Fractures and Luxations*, edited by Bichat, nor elsewhere. Bichat even says positively that "Desault himself did not always prevent the shortening of the limb."⁵ He declares, however, that "Desault has cured, at the Hôtel Dieu, a vast number of fractures of the os femoris, without the least deformity."⁶

Dr. Dorsey, of Philadelphia, who employed the apparatus of Desault, as modified by Physick and Hutchinson (Fig. 152), was equally successful.⁷

Attention has already been called, in the chapter on General Prognosis, to the published statements of Dr. Sayre relating to this subject; but it will be necessary to note again in this place, that he asserts that *all* fractures of the femur may be made to unite without shortening; and

¹ Practical Remarks on Fractures, by Joseph Amesbury, vol. i. p. 384. London ed., 1831.

² Op. cit., vol. i. p. 627.

³ Researches on Pathological Anatomy and Clinical Surgery, by Joseph Sampson Gamgee. London ed., pp. 159, 160.

⁴ Op. cit., p. 167.

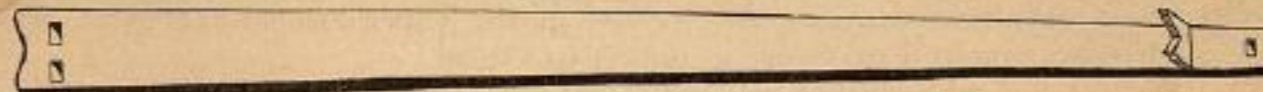
⁵ A Treatise on Fractures and Luxations, etc., by P. J. Desault, edited by Xav. Bichat. Amer. ed., p. 251. 1805.

⁶ Op. cit., p. 223.

⁷ Elements of Surgery, by John Syng Dorsey, vol. i. p. 163. Philadelphia, 1813.

to add that, in proof of the latter assertion, Dr. Sayre, at the meeting of the American Medical Association in Detroit, Michigan, in 1874, declared, when the accuracy of his measurements were called in question by some of the gentlemen present, that "he knew his measurements were correct, that Dr. Frank Hamilton had made the measurements, and

FIG. 152.



Physick's splint.—The splint is intended to reach to the axilla, but the counter-extension is made by a perineal band. Physick employed a second long inside splint.

that he was a man who was so violently opposed to the theory that, in his published writings, he had denied the possibility of any oblique fracture being cured without shortening. For this reason he (Dr. S.) had asked him to measure the patients. He said if seven successive cases would be presented, he would agree to give up his opposition to the theory. He found the cases and surrendered."¹

I was not present when these statements were made, but in the following number of the same journal in which they first appeared I called attention to their untruthfulness. And I will now repeat that I have never said, in any of my published writings or elsewhere, that it was impossible that any oblique fracture of the femur could be cured without shortening, and I never entertained such an opinion; but, while I have myself published several cases in which oblique fractures of the femur treated by me have united without shortening, I have declared this to be the exception, and not the rule. Further, I am obliged to say that no such conversation as that related by him ever occurred between us, and that I never measured or saw the cases mentioned by him. It is difficult for me to conceive, therefore, how this gentleman has fallen into these errors; and I confess I would have been very much gratified if, his attention having been repeatedly and publicly through the medical journals called to the matter, he had made some such public explanation or denial as would have rendered it unnecessary for me to allude to it in this place.²

Dr. Scott, of Montreal, Professor of Clinical Surgery in the McGill College and Physician to the Montreal General Hospital, has reported nineteen cases of fractures of the long bones, taken promiscuously and without selection, from his hospital service, of which three belonged to the clavicle, seven to the femur, eight to the tibia and fibula, and one to the condyles of the humerus. All of which recovered without any degree of shortening or deformity; except the case of fracture of the condyles of the humerus, which resulted in death.³

It is never a pleasant duty to call in question the accuracy of another's statements as to what he has himself alone seen and experienced. The circumstances which would justify such an expression of scepticism,

¹ Sayre, Detroit Review of Med., July, 1874.

² Hospital Gaz. and Archives of Clinical Surgery, April 11, 1878. Editorial.

³ Scott, "Medical Chronicle," of Montreal, vol. i. No. 7, 1853.

where the witnesses, as in this case, are presumed to be intelligent and honest men, must be extraordinary. Such, however, I conceive to be the circumstances in this instance. It is certainly very extraordinary that a few gentlemen, whose means and appliances are concealed from no one, are able to do what nearly the whole world besides, with the same means, acknowledges itself unable to accomplish. Such is the fact, nevertheless; and our lack of faith in their testimony is only a necessary result of our experience, and of the experience of the vast majority of practical surgeons, as opposed to them.

I might properly enough dismiss this subject with no farther argument than may be found in the overwhelming testimony of practical surgeons, that broken femurs do in their experience rarely unite without more or less shortening; but I cannot avoid calling attention to the evidence of the falsity of the opposite opinion, which is furnished by the testimony of the very persons who themselves claim to have obtained such fortunate results.

It is not, as might have been supposed, one particular form of dressing, which, in itself peculiar, and more perfect than all others, has furnished these results. On the contrary, the plans of treatment have been constantly unlike, and sometimes quite opposite. Thus, Desault used a straight splint, with extension and counter-extension, and he refused to adopt the flexed position recommended by Pott, because his experience and the experience of other French surgeons had taught him its inutility.¹ Adopting the straight position, he made perfect limbs; with the flexed position he found it impossible to do so.

Dorsey used the splint of Desault, as modified by Physick and Hutchinson. Sayre, who formerly used the double- or triple-inclined plane, or flexed position, has of late adopted the straight position, with plaster of Paris, and with both alike claims to have made only perfect limbs.

South, whose success seems to have been equal to that of Desault or Dorsey, adopts also the straight position; but he makes no permanent extension, except what may be accomplished through the medium of four long side-splints applied after "gentle" extension has been made by the assistants.

Mr. Amesbury, on the other hand, made perfect limbs only with his own double-inclined plane; and speaking in general of the various plans hitherto contrived, not excepting that invented by Desault, or the method practised by South, which had already been recommended by several surgeons, he declares that "they are seldom able to prevent the riding of the bone, and preserve the natural figure of the limb. Indeed, so commonly does retraction of the limb occur under the use of the different contrivances usually employed, that I have heard a celebrated lecturer (now retired) in this town publicly assert that he never saw a fractured thigh-bone that had united without riding of the fractured ends!"² And in his *General Inferences* he uses the following emphatic language: "The contrivances which are commonly used in the treatment of these fractures do not sufficiently resist the operation of the forces above

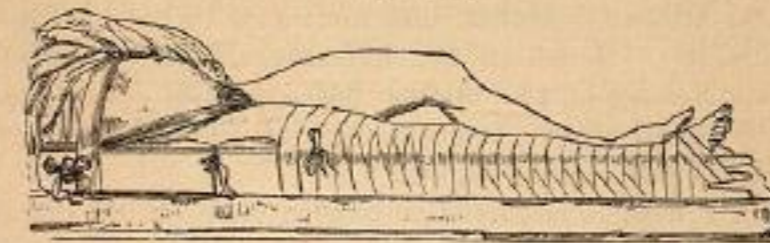
¹ Works of Desault, op. cit., p. 225.

² Amesbury on Fractures, etc., vol. i. p. 310.

mentioned, but suffer their influence to be exerted upon the bone, in all cases more or less injuriously, and at the same time often assist in producing displacement of the fractured ends; so that deformity, differing in kind and degree in different cases, is almost the constant result of fractures of the femur treated by these means."¹

On the other hand, Mr. Gamgee broadly contradicts the statements of Desault, South, Dorsey, and Amesbury, and does not hesitate to administer a severe rebuke even upon the illustrious Liston: "Pott's plan, the

FIG. 153.



Liston's method, recommended by Samuel Cooper, Fergusson, Pirrie, and others.

long splint, McIntyre, and their modifications, as a rule entail sensible deformity, which in many cases is very considerable. It is a significant fact that though the example established in University College Hospital by the late Mr. Liston, of treating fractures of the thigh by the long splint, and of the leg by the modified McIntyre (a double-inclined plane), which are admitted equal, if not superior, to other splints, was rigidly followed in that institution, the patients admitted with broken thighs or legs were frequently discharged with manifest deformity."²

With how much force Mr. Gamgee's own remarks as to the experience of the University College Hospital will apply to the starched bandages used by himself, the reader will be able to determine when referred to the opinion of Velpeau, already quoted, who claims no result better than an average shortening of half an inch. M. Velpeau prefers and advocates the starched bandages, but he does not claim to be able to prevent a shortening of the bone.

"What other modes of treatment would have given such results?" This question, propounded, no doubt honestly, by Mr. Gamgee, has here its fair and satisfactory answer. Almost any of the various modes named; for if we must receive his testimony, we are equally bound to receive the testimony of Desault, South, Dorsey, Amesbury, Scott, and Sayre. If we give credit to Mr. Gamgee, so far as to doubt the statements of these latter as to the degree of success claimed by them, by the same rule we must doubt his own statements also as to the degree of success claimed by himself. This I say with all sincerity and kindness, fully believing that these gentlemen are mistaken, and not that they intentionally misrepresent the facts.

By a reference to my Report on Deformities after Fractures, it will be seen that the average shortening in fractures of the upper third of

¹ Op. cit., vol. i. p. 384.

² Advantages of the Starched Apparatus, by Joseph Sampson Gamgee. London, 1853, pp. 54, 55.

the femur, in the cases examined by me, was about four-fifths of an inch; in the lower third it was a fraction over three-quarters, and in the middle third a fraction less than three-quarters of an inch; and the average of the whole number was almost exactly three-quarters of an inch (three-quarters and one forty-seventh). These analyses were made upon simple fractures, and were exclusive of those in which no shortening at all occurred. An analysis which included also those which had not shortened, reduced the average shortening to half an inch and about one-tenth.

An examination of cabinet specimens does not present a result so favorable even as this. Of nineteen fractures of the shaft of the femur contained in Dr. Mütter's cabinet, not one seems to have been shortened less than one inch. Specimen B 63, fracture of the middle third, is united with a shortening of two inches and a quarter; and specimen B 130, imperfectly united after a fracture through the middle third, is overlapped three and a half or four inches.

In conclusion, I wish to say briefly that, in view of all the testimony which is now before me, I am convinced—

First. That in the case of an oblique fracture of the shaft of the femur occurring in an adult, whose muscles are not paralyzed, but which offer the ordinary resistance to extension and counter-extension, and where the ends of the broken bone have once been completely displaced, no means have yet been devised by which an overlapping and consequent shortening of the bone can generally be prevented.¹

Second. That in a similar fracture occurring in children or in persons under fifteen or eighteen years of age, the bone may quite often be made to unite with so little shortening that it cannot be detected by measurement; but it must not be forgotten that with children especially it is exceedingly difficult to measure very accurately.

Third. That in transverse fractures, or oblique and denticulated, occurring in adults, and in which the broken fragments have become completely displaced, it will generally be found equally difficult to prevent shortening; because it will be found generally impossible to bring the broken ends again into such apposition as that they will rest upon and support each other.

Fourth. That in all fractures, whether occurring in adults or in children, where the fragments have never been completely or at all displaced, constituting only a very small proportion of the whole number of these fractures, a union without shortening may always be expected.

Fifth. That when, in consequence of displacement, an overlapping occurs, the average shortening of simple fractures in adults, where the best appliances, and the utmost skill have been employed, is from one-half to three-quarters of an inch.

¹ In the three first editions of this treatise the word "generally" is omitted; but a later experience, with improved appliances, has supplied to me, both in my own practice and in the practice of others, a few examples of perfect union under the conditions named. The word "generally" was therefore added in the fourth edition, and is retained in this. Exactly what percentage of perfect cures may reasonably be expected cannot at present be determined, but it is certainly very small. It has never been my opinion that a shortening must inevitably result as a consequence of the absorption of the ends of the bone. When shortening occurs I think it is always, or almost always, the result of overlapping of the fragments.

If we consider the muscles alone as the cause of the displacement in the direction of the long axis of the shaft, the shortening of the limb, other things being equal, must be proportioned to the number and power of the muscles which draw upwards the lower fragment. This will vary in different portions of the limb, but nowhere will this cause cease to operate, nor will its variations essentially change the prognosis.

I have not intended to say that other causes do not operate occasionally in the production of shortening, but only that muscular contraction is the cause by which this result is chiefly determined, and that its power will be ordinarily the measure of the shortening.

Conditions of a Faithful Measurement of the Thigh.—The fact that a patient walks without any halt, is no evidence that the limb is not shortened. In this regard patients are very unlike; one having a shortening of only half or three-quarters of an inch may limp perceptibly, while another with a shortening of an inch, or even an inch and a half, may not limp at all. This has been frequently observed; and it will be easily understood if, standing erect with the right foot on a block one and a half inches in height, the left foot is planted upon the floor. It will then be seen that the left foot can be brought to the floor without disturbing the erect position of the body. Nor is it any more a proof that the limb is not shortened because, while in the recumbent posture, the heel can be brought down to the level of the other.

Measurements made from the umbilicus, or from the symphysis pubis, are always indefinite and unreliable. Velpeau's idea of measuring from the folds of the belly, immediately above the ilium, is unsound. Mr. Bryant's suggestion that we measure from the trochanter major, by what he terms the ilio-femoral triangle, in order to determine the question of a fracture of the neck, is liable to the very serious objection that the exact position of the top of the trochanter cannot, in most cases, be clearly determined.

The method most generally practised, is to measure from the round end of the anterior superior spinous process of the ilium to the internal or external malleolus; but even this is not very trustworthy. It is exceedingly difficult to note accurately the same point upon the two sides; and an error of half an inch is very common when this method is adopted.

The patient should repose upon his back, upon an even surface, with the lower extremities as nearly as possible in line with the axis of the body, the two wings of the pelvis being in the same (horizontal) line. A flexible, but firm, graduated tape is to be preferred to the steel tape measure. The foot being steadied by an assistant, the surgeon should put his thumb-nail against the line where it joins the ring, and push his nail into the skin just *below* the anterior superior spinous process of the ilium, pressing firmly up and back, the flat surface of the nail resting upon the skin. In this way he will obtain a fixed point, and he can obtain an exactly corresponding point upon the opposite side. Below, the measurement may be made from either malleolus, but the outer has the most defined extremity, and is generally to be preferred. In most cases, for some months after the termination of the treatment, there is some swelling about the ankle, which renders it necessary to use great

care in defining the point of the malleolus. The thumb-nail of the opposite hand may be used for this purpose, resting vertically upon the skin (flat against the lower end of the malleolus). The same method may be employed in measuring a leg, as in measuring a thigh.

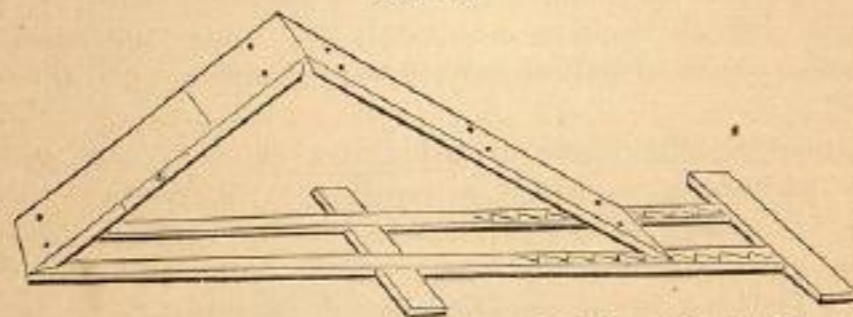
Dr. B. F. Gibbs, of the U. S. Navy, and Dr. S. B. Collins, of Philadelphia, have recently suggested and employed mechanical apparatus, of ingenious construction, for the purpose of rendering these measurements more accurate;¹ but neither of them is sufficiently simple to be brought into general use, except in hospitals and dispensaries.

Allusion has already been made in the chapter on General Prognosis to the fact that the bones of the lower extremities as well as other long bones are not always, nor perhaps generally, in the normal condition, of exactly equal lengths. J. G. Garson, of London, in the examination of seventy skeletons, ranging from twelve years upwards, found only ten per cent. which were of exactly equal length.² Corydon La Ford, Professor of Anatomy at Ann Arbor, however, in the measurement of skeletons, found the inequality of the length of the lower limbs exceptional rather than as constituting the rule. Garson and Wight agree that the left leg was most often the longest. In Garson's measurements the left leg was longest in 38 cases, and the right in 25 cases. In most cases these differences are slight, but occasionally they are considerable. As to the practical deductions to be made from this fact of asymmetry, it has been sufficiently considered in the chapter on General Prognosis.

Treatment.—All the early surgeons, so far as we know, adopted the straight position in the treatment of fracture of this bone, either with simple lateral splints, or with long splints, with or without extension, or with only rollers and compresses, or with extension alone.

Such was the unanimous opinion and practice of surgeons until about the middle of the last century, at which time Percival Pott wrote his remarkable treatise on fractures, a work distinguished for the originality and boldness of its sentiments, and which was destined soon to revolution-

FIG. 154.



Double-inclined plane formerly employed in Middlesex Hospital, London.

ize, especially throughout Great Britain, the old notions as to the treatment of fractures, and to establish in their stead, at least for a time, what has been called, not inappropriately, the "physiological doctrine," the peculiarity of which doctrine consisted in its assumption that the

¹ Gibbs, Collins, Amer. Journ. Med. Sci., Jan. 1877, pp. 139, 144.

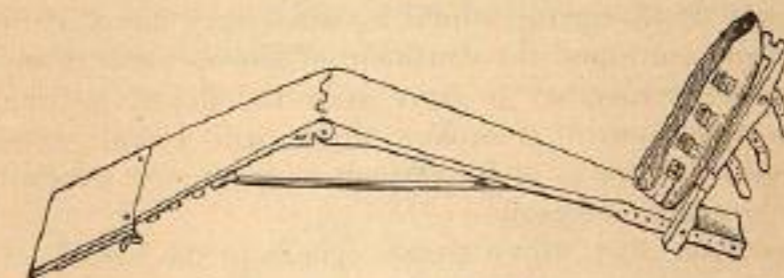
² Garson, Amer. Journ. Med. Sci., Oct. 1879, from Journ. Anat. and Phys., July, 1879, vol. 13, p. 502.

resistance of those muscles which tend to produce shortening can generally be sufficiently overcome by posture, without the aid of extension; and that for this purpose, for example, in the case of a broken femur, it was only necessary to flex the leg upon the thigh, and the thigh upon the body, laying the limb afterwards quietly on its outside upon the bed.

Very few surgeons, even of his own day, ever gave in their full adhesion to the exclusive physiological system as taught and practised by Pott himself, but multitudes, especially among the English, adopted in general his views, only choosing to place the patients upon their backs rather than upon their sides, and laying the limbs flexed over a double-inclined plane. To the support of this system of Pott's, thus modified, Sir Astley Cooper, C. Bell, John Bell, Earle, White, Sharp, and Amesbury, lent the influence of their great names, and its triumphs, so far as the judgment of British surgeons was concerned, soon became complete.

In France, and upon the continent generally, the reception of this system was more slow and reluctant; but Dupuytren, now for once taking

FIG. 155.



Amesbury's splint.

ground with his great rival, Sir Astley Cooper, adopted almost without qualification these novel views. The decision of Dupuytren determined the opinions of a large portion of the continental surgeons; and had it not been for the early and decisive opposition of Desault and Boyer, the

FIG. 156.



Amesbury's splint applied.

great surgeon of St. Bartholomew might have continued for a long time to have enjoyed a triumph upon the continent, and perhaps throughout the world, equal to that which had already been decreed to him in Great Britain.

On this side of the Atlantic, the practice of Pott, at least in so far as it applied to the treatment of fractures of the thigh, never gained a dis-

tinguished advocate; and but few ever adopted the practice as modified by White, Amesbury, Bell, A. Cooper, etc.

But whatever may have been the early success of these doctrines, either here or elsewhere, it is certain that a strong reaction has taken place, and that gradually, in all parts of the world, the opinions of practical surgeons have been settling back into their old channel. It would be difficult to find to-day, in France or Germany, a dozen distinguished surgeons who adopt universally the flexed position in the treatment of fractures of the femur; and in England the reaction is, if possible, even more complete.

FIG. 157.



Boyer's splint.

In my tour of 1844, during which I visited very many of the hospitals of Great Britain, and upon the continent of Europe, and in my later tour of 1872, I do not remember to have seen the flexed position once employed in the treatment of a broken thigh; and I shall presently show that the straight position is at the present moment very generally adopted by the best American surgeons.

There have been, then, three grand epochs in the history of the treatment of fractures of the thigh.

First. That in which the straight position was universally adopted, and which reaches from the earliest periods to the period of the writings of Pott, or to about the middle of the last century.

Second. The epoch of the flexed position, which, inaugurated by Pott, had already begun to decline at the beginning of the present century, and which may be said to have been completed within less than one hundred years from the date of its first announcement.

Third. The epoch of the *renaissance*, or that in which surgeons, by the vote of an overwhelming majority, have declared again in favor of the straight position. This is the epoch of our own day.

Although American surgeons have generally adopted the straight position in the treatment of fractures of the thigh, yet the form and construction of the splints employed have been greatly varied. The simple long splint of Desault, and the more complicated apparatus of Boyer (Fig. 157) have each had their advocates; but it is seldom that we meet with these, or with any of the other forms of apparatus originally employed in foreign countries, without noticing that they have been subjected to considerable modifications; indeed, most of the straight splints as well as double-inclined planes in use at present among American surgeons may fairly be regarded as original inventions.

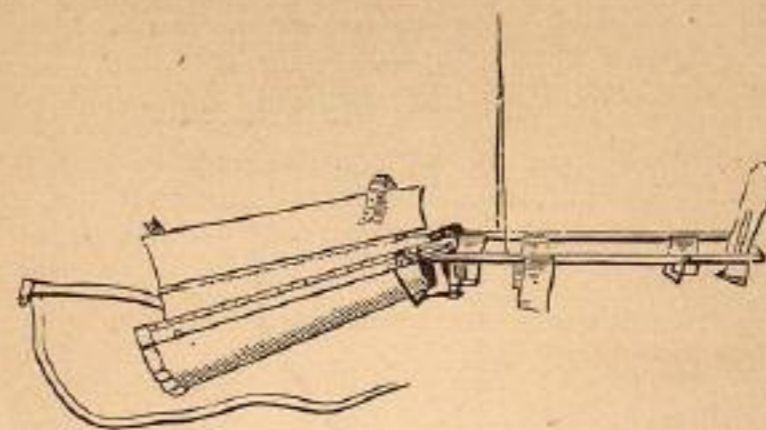
Nathan Smith, of New Haven;¹ Nathan R. Smith, of Baltimore;²

¹ Amer. Med. Rev., Philadelphia, 1825, vol. ii. p. 355; also Medical and Surgical Memoirs of Nathan Smith, pp. 129-141.

² Med. and Surg. Memoirs, pp. 143-162. See also Geddings, Baltimore Med. and Surg. Journ., vol. i., 1833; and Sargent's Minor Surgery, p. 171.

Dr. James McNaughton, of Albany;¹ J. T. Hodgen, of St. Louis; and Nott, of Mobile, are the only American surgeons of distinguished repu-

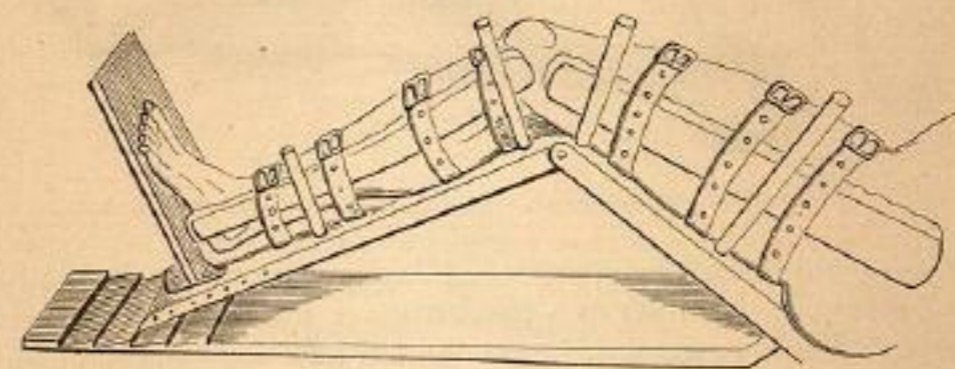
FIG. 158.



Nathan R. Smith's suspending apparatus, or double-inclined plane.

tation, and with whose practice I am familiar, who have recommended exclusively the double-inclined plane.

FIG. 159.



Josiah C. Nott's double-inclined plane.

In this apparatus the limb is secured to the splint by vertical pins and leather straps; the upper surface of the thigh-splint is carved out a little, to fit the thigh; the two portions are articulated by a joint like that of a carpenter's rule, and this joint may be steadied by a horizontal bar underneath. For the rest, the drawing sufficiently explains itself.

Dr. Nathan R. Smith has introduced a modification of the double-inclined plane in what is known as his "anterior splint," and which is

FIG. 160.



N. R. Smith's anterior splint.

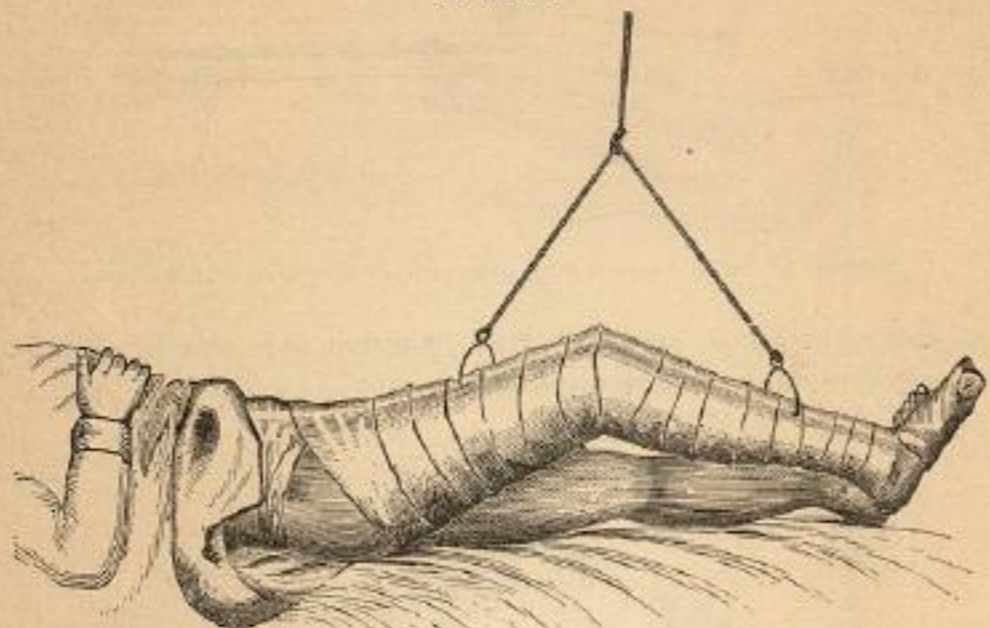
intended also as a suspending apparatus. I saw it employed a good deal in the treatment of gunshot fractures of the thigh and leg in our

¹ Trans. Amer. Med. Assoc., vol. x. p. 317. Rep. on Defor. after Frac.

various military hospitals during the progress of the civil war, especially at the South. It is my opinion, however, that it is more applicable to gunshot fractures of the leg than to those of the thigh.

The splint, if splint it can be properly called, is simply a frame composed of stout wire and covered with cloth, which, being suspended above the limb, allows the limb to be suspended in turn to it by rollers; the rollers passing around both limb and splint from the foot to the groin. Wire of the size of No. 10 bougie is usually employed. The length of

FIG. 161.



N. R. Smith's anterior splint, applied for a fracture of the thigh.

the splint should be sufficient to extend from above the anterior superior spinous process of the ilium to a point beyond the toes, the lateral bars being separated about three inches at the top and one-quarter of an inch less at the lower extremity.

In the case of a broken thigh, the upper hook, to which the cord for suspension is to be fastened, ought to be nearly over the seat of fracture, and the lower hook should be placed a little above the middle of the leg.

The modification of Smith's anterior splint, suggested by Dr. James Palmer, United States Navy, will be sufficiently explained by the accompanying woodcut,¹ Fig. 162.

Dr. G. E. Porter, of Lonaconing, Maryland, who prefers N. R. Smith's apparatus, elevates the foot of the bed to insure counter-extension with the weight of the body, but in doing this he practically yields the point of allowing the patient to rise and sit in bed. He employs, also, strips of "stout, unstretching brown drilling," instead of the continuous roller.²

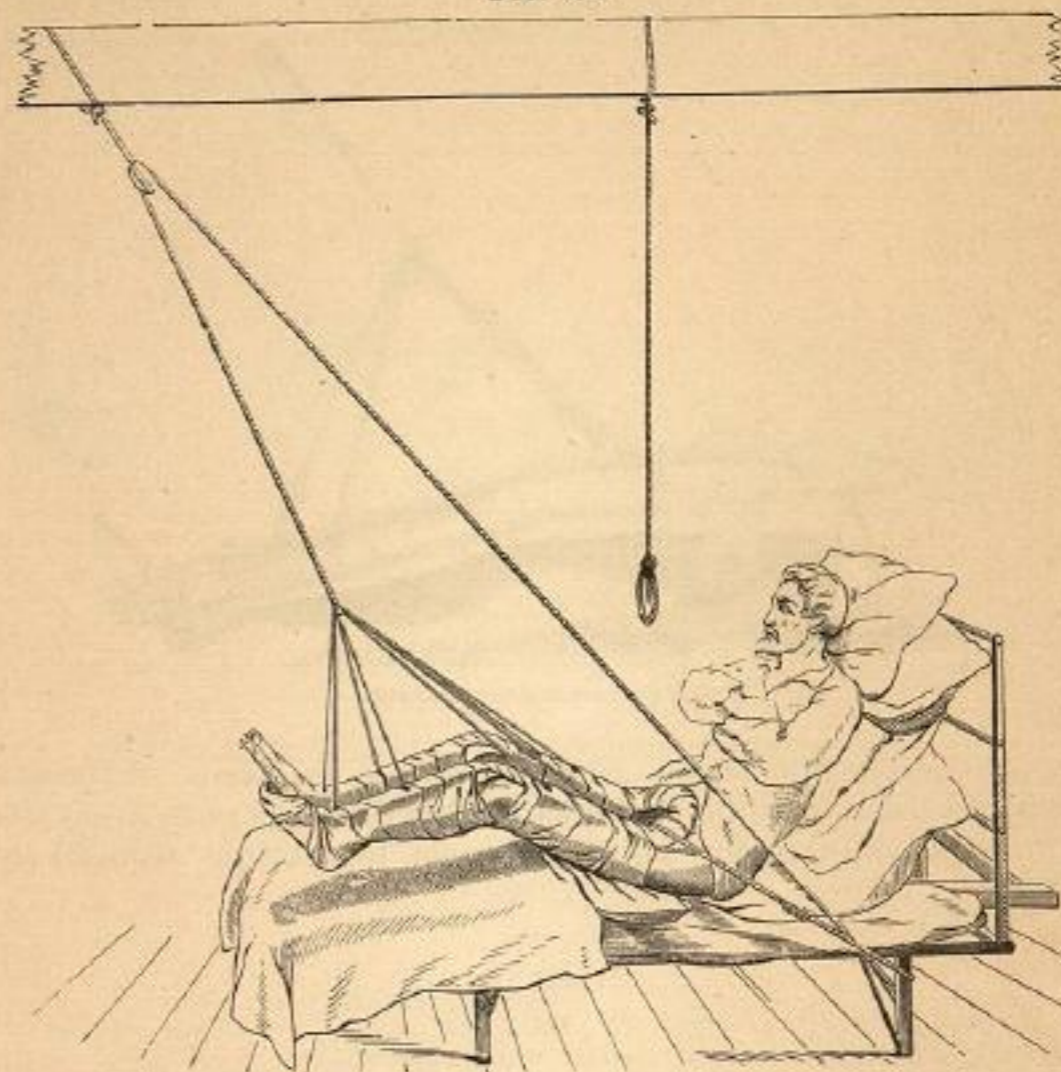
Dr. J. S. Hodgen, of St. Louis, Mo., has for many years employed a wire suspension splint, which I much prefer to Smith's. The bars of

¹ Amer. Journ. Med. Sci., 1865; also, Mechanical Therapeutics, etc., by Philip S. Wales, M.D., U. S. N., 1867.

² Porter, Med. and Surg. Reporter, March 18, 1876.

wire are traversed with a cotton sacking, upon which the limb is laid.¹ I regret that in earlier editions, when referring to this apparatus, I have spoken of it as having been employed by Dr. Hodgen in gunshot fractures alone, while in fact it is employed by him in all, or nearly all fractures of the femur. The error came, probably, from the circumstance that I had myself seen it used only for gunshot fractures.

FIG. 162.



Palmer's modification of the anterior splint.

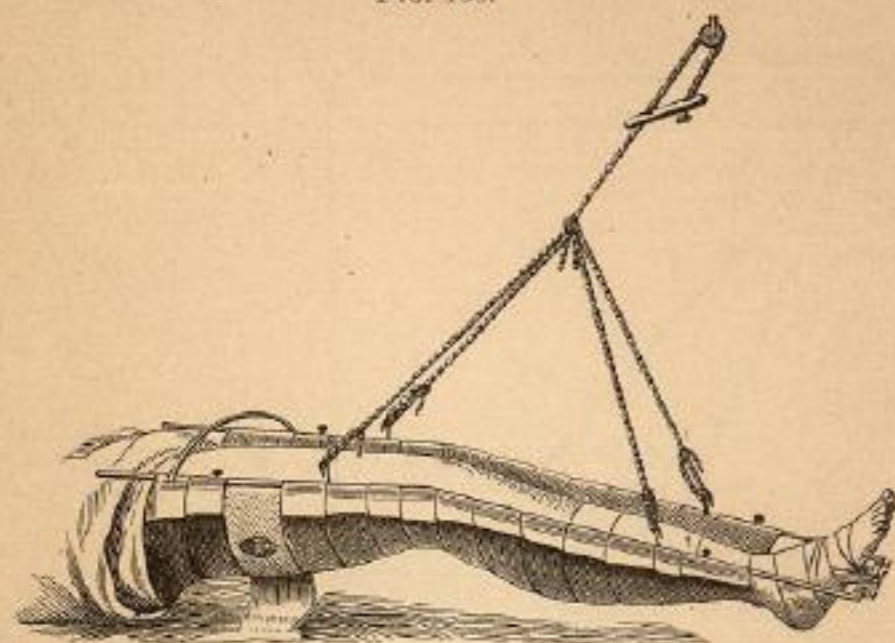
On the other hand, among the advocates of the straight position are found the names of Physick, Dorsey, Gibson, Horner, J. Hartshorne, H. H. Smith, Neill, R. Coates, H. Hartshorne, Norris, Gross, Ashhurst, Agnew, and Packard, of Philadelphia; Buck, Markoe, Stein, Post, Howe, Ward, Weir, Mason, Sands, and Little, of New York, and many others. In this city I know of no surgeon who employs habitually the flexed position.

Says Dr. Gross: "Many years ago, before I had much experience in this class of injuries, I occasionally employed the flexed position, but I soon found that it was objectionable, on account of the great difficulty in maintaining an accurate apposition to the ends of the fragments. Of late

¹ Hodgen, Treatise on Military Surgery, by F. H. Hamilton, 1865, p. 411.

years I have confined myself entirely to the use of the straight position, and I have never had any cause to regret it. In the adult, I sometimes employ the apparatus of Desault, as modified by Physick, but much more frequently one of my own construction, somewhat upon the principle of that of Dr. Neill, described in the *Philadelphia Medical Examiner* for 1855. I have used it for nearly twenty years, and it has

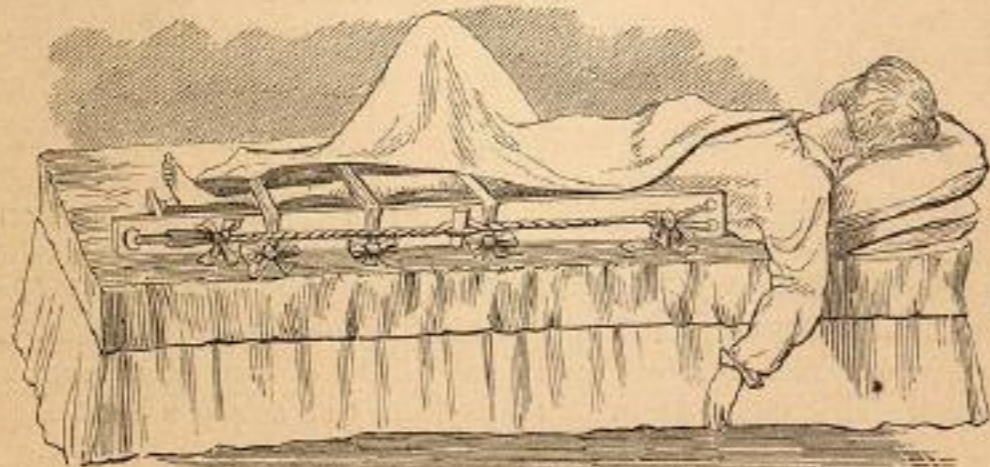
FIG. 163.



Hodgen's suspension apparatus.

generally answered the purpose most admirably in my hands. It consists simply of a box for the thigh and leg, with a foot and two crutches, one for the axilla and the other for the perineum, to make the requisite ex-

FIG. 164.



John Neill's straight thigh-splint.—Extension and counter-extension made at the same time.

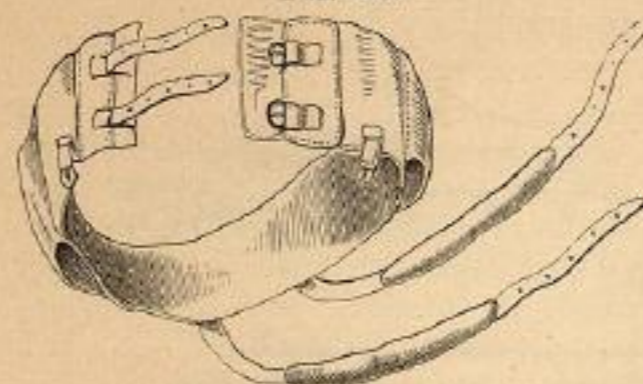
tension and counter-tension. With such an apparatus, an oblique fracture of the thigh can be treated with great comfort to the patient, and with the assurances of a good limb. In children, I have effected some

excellent cures simply by means of a sole-leather trough, well padded, and provided with a foot-piece.

"The great objection to the flexed position is the difficulty of keeping the ends of the broken bones in apposition; the upper one having a constant tendency to pass away from the inferior. Other objections might be urged against the flexed position, but this is quite sufficient to induce me to reject it."¹

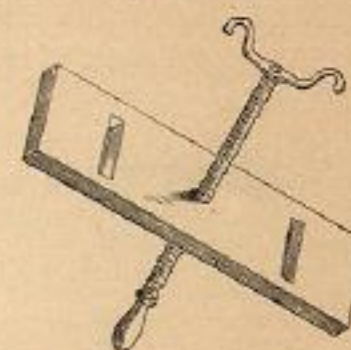
The following woodcuts, from Fig. 165 to 173 inclusive, illustrate the apparatus formerly used in the Massachusetts General Hospital, Boston. (From drawings furnished by Dr. L. M. Sargent.)

FIG. 165.



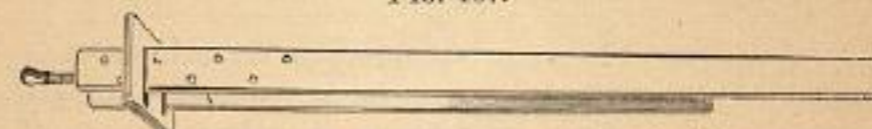
Pelvic belt and perineal strap.

FIG. 166.



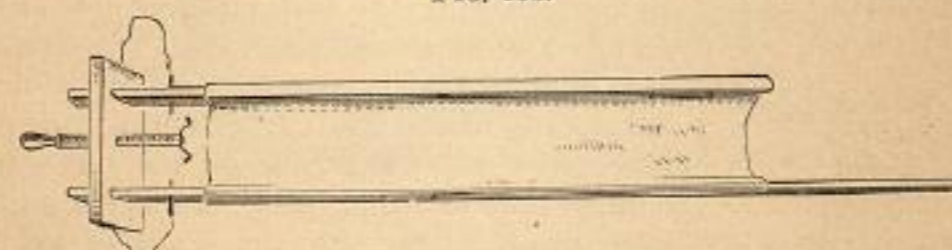
Foot-piece and screw.

FIG. 167.



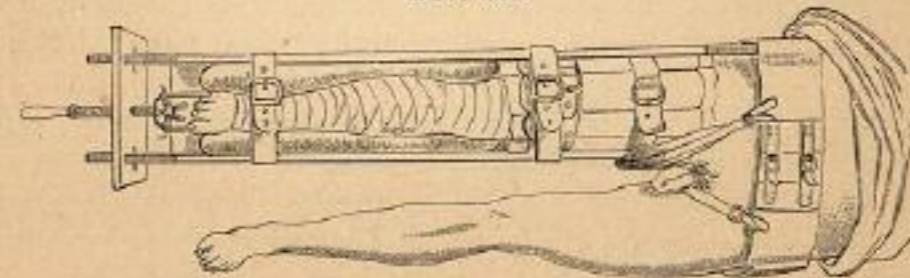
Lateral view of the apparatus, without the belt.

FIG. 168.



Front view of the apparatus, with folded sheet laid across.

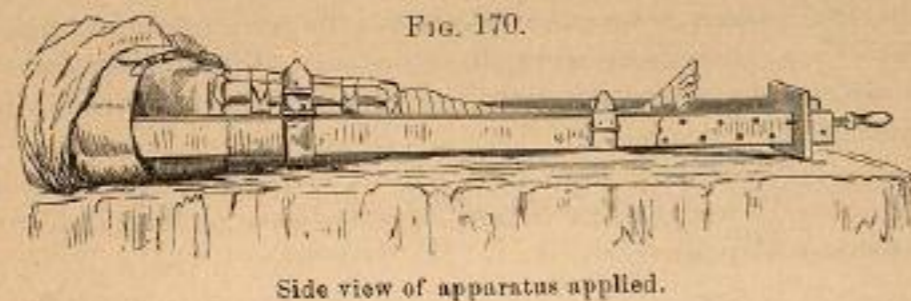
FIG. 169.



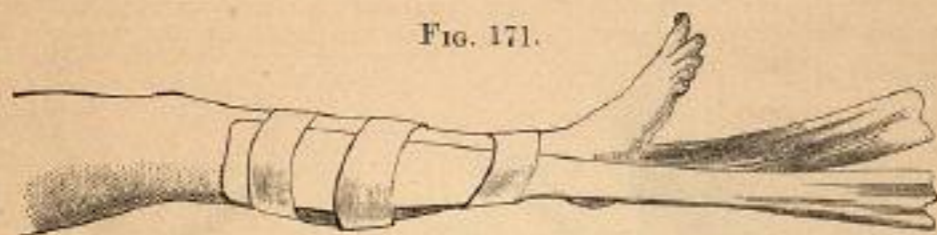
Apparatus applied.

¹ Trans. Am. Med. Assoc., vol. x.; also System of Surgery, by S. D. Gross, 1859, p. 221.

"The belt is made of strong webbing, having pockets on each side, to receive the long splint. It is also furnished with straps and buckles.



Side view of apparatus applied.

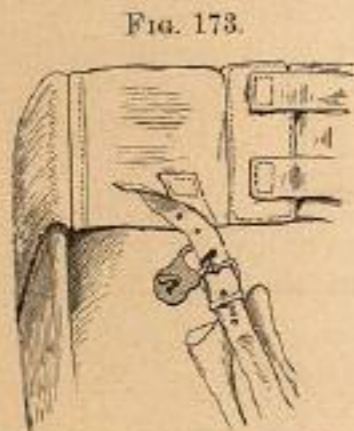


Mode of making extension with adhesive plaster.



Mode of making extension with adhesive plaster.

The perineal strap (Fig. 173), corresponding to the injured side, is kept constantly buckled, while the other may be occasionally loosened, or left off, as its purpose is only to steady the apparatus. Where the straps pass under the perineum, they are covered with wash-leather. Before applying the belt, a pillow-case or two may be passed around the waist. The padlock is only to be used in case the patient persists in unbuckling the straps. The splints, being applied (with also short side-splints, junks, containing bran or sand, etc.), are to be secured more firmly to the limb by bands of webbing and buckles."



Perineal band secured with a padlock. (Flagg's apparatus.)

much ingenuity, and serve to explain the gradual progress of improvement in the treatment of these fractures.

At present the surgeons of the Massachusetts General Hospital employ essentially the same apparatus which I at present employ and shall hereafter describe; extension being made by a weight and pulley, with the aid of adhesive straps, and counter-extension being effected by the weight of the body, by elevating the foot of the bed. After which, coaptation splints and junks are applied in the usual manner. Ether is

employed in all cases before making extension, the apparatus being applied at the earliest possible moment.

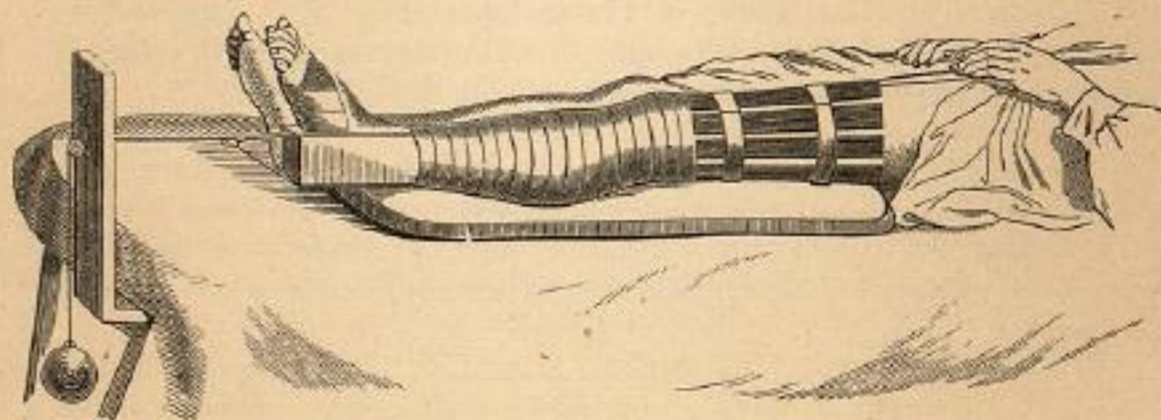
The late Dr. Neill, of Philadelphia, contrived a very ingenious mode of both extension and counter-extension at the same moment, by means of a twisted rope, which is fastened by its two ends respectively to the perineal band above and the extending band below. (For illustrations of this apparatus see five first editions of this book.)

The two Warrens, father and son, of Boston; Kimball, of Lowell; Sanborn, of Lowell, Mass.; Mussey, of Cincinnati, Ohio; J. B. Flint, of Louisville, Ky.; Armsby, of Albany;¹ Moore, of Rochester; and Potter, of Batavia, have also recommended some form of the straight splint. Said the late Dr. Reuben D. Mussey:

"For all fractures of the thigh-bone, I employ the extended position of the limb. There are but few cases in which extending force is not necessary to prevent the degree of deformity or shortening which would occur without it. Of thirty specimens of fracture of the shaft, in my collection, only two are transverse. In fractures of the neck, especially with old subjects, I sometimes avoid the application of any kind of apparatus for permanent extension; but in all cases, whether of the neck or shaft, where such extension is attempted, I have found the straight position of the limb to be the most reliable."

Daniell, of Savannah, Georgia, recommends the straight position, the limb being laid in a kind of long box, and the extension being made with a weight and pulley.² Dugas, of Augusta, Georgia, employs the pulley and weight also, but uses the long side-splint instead of the box.³ Howe, of Boston, recommended a similar method in 1824.⁴

Fig. 174.



Gurdon Buck's apparatus, with perineal band of India-rubber tubing, and an elastic cord for suspending the weight.

Dr. Gurdon Buck, of New York, used the pulley, without the long side-splint. His perineal band was composed of India-rubber tubing, "of one inch calibre, two feet in length," stuffed with bran or cotton lampwick, and covered with canton flannel, which covering may be renewed as often

¹ Trans. Am. Med. Assoc., vol. x. Report on Deformities after Fractures.

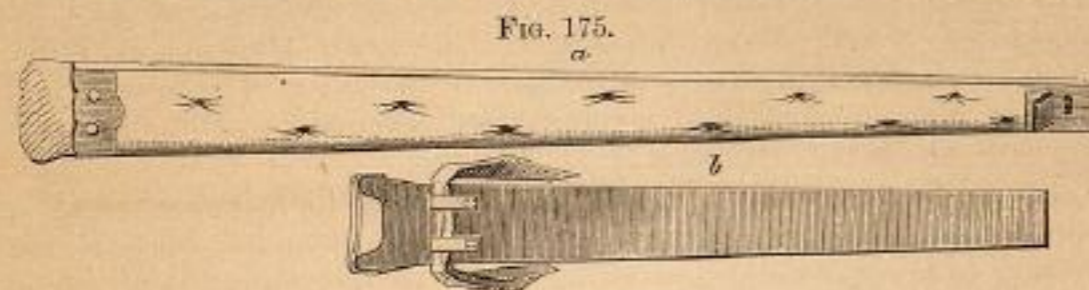
² Daniell, Amer. Journ. Med. Sciences, vol. iv. p. 330, 1829.

³ Dugas, Southern Med. and Surg. Journ., Feb. 1854.

⁴ Howe, New Eng. Med. Journ., July, 1824.

as may be necessary; the extending bands or adhesive plasters terminating below the foot in an elastic rubber cord. (Fig. 174.)

William E. Horner, of Philadelphia (Fig. 175), employed a long outside splint, extending into the axilla, and padded, so as to avoid the necessity of junks; with fenestra, for extending and counter-extending bands; and also a foot-piece; and a short inside splint, made to extend from the perineum to the bottom of the foot. Across the excavated upper end of this



W. E. Horner's thigh-splint.

splint, a strip of leather is stretched to receive the pressure of the perineum, while the perineal band is made to pass through two firm leather loops on the outside of the splint.¹



Joseph E. Hartshorne's thigh-splint.

Dr. Joseph E. Hartshorne, of Philadelphia (Fig. 176), rejected the perineal band altogether, and sought to make the counter-extension by means of the inside long splint alone; and for this purpose he cushioned the head of the inside splint, as will be seen in the accompanying drawing. The head of the outside splint may also be cushioned, but not for the purpose of employing it as a means of counter-extension. The outside splint is so adjusted to the foot-piece, that it may be removed in case of a compound fracture, without disturbing either the extension or counter-extension.²

Dr. David Gilbert, of Philadelphia (Figs. 177, 178), has published an account of a method of making counter-extension with adhesive strips, which he had employed not only in fractures of the thigh, but also of the leg, extension being made with the tourniquet of Petit. A broad piece of adhesive plaster also is made to encircle the pelvis, in order to bind down the counter-extending bands more firmly to the body. Additional strips are employed when they seem to be required.³

H. L. Hodge, also of Philadelphia, adopting the same means of counter-extension, namely, adhesive plaster bands, has modified the idea

¹ Horner, Treatise on the Practice of Surgery, by H. H. Smith, 1856, p. 417.

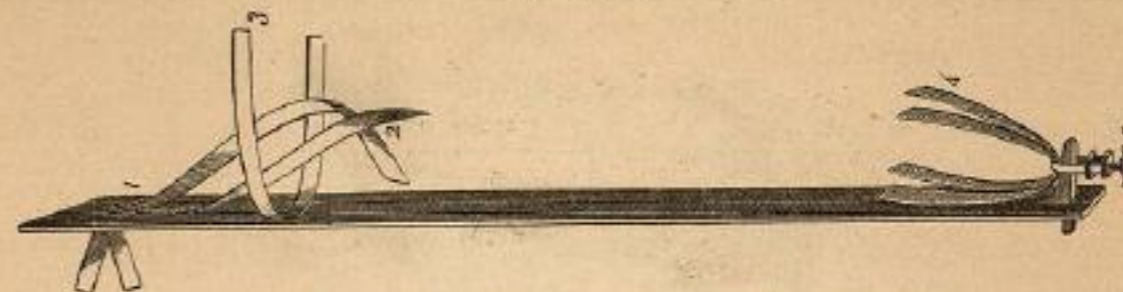
² Hartshorne, *Ibid.*, p. 418.

³ Gilbert, Amer. Journ. Med. Sci., April, 1859, pp. 410-424.

of Gilbert by securing the strips of plaster to the sides of the body instead of the perineum, and attaching them to an iron rod which is made to project from the top of the splint beyond the shoulder.¹ (Fig. 179.)

Lente, of New York, many years ago, before the value of elevating the foot of the bed, and depending upon the weight of the body to make

FIG. 177.

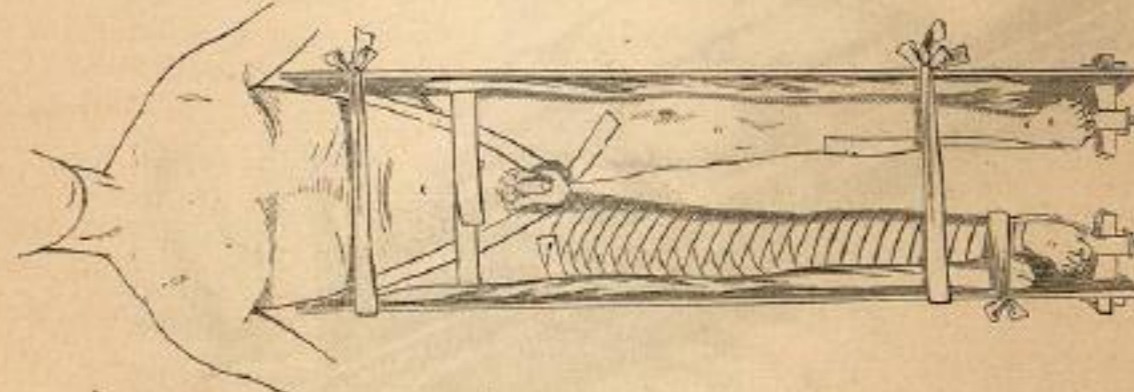


D. Gilbert's mode of making counter-extension and extension.

1. Anterior and posterior counter-extending adhesive bands, two and a half inches wide, crossing each other before they pass through the mortise holes. 2. The same, crossing at the upper part of thigh and perineum. 3. Horizontal pelvic band, which may be three inches wide. 4. Extending bands, receiving strap of tourniquet in the hollow of the foot. 5. Tourniquet.

counter-extension, was, understood, constructed an apparatus by which he hoped, in some measure, to obviate the inconveniences of the perineal band, by distributing the pressure between the tuberosity of the ischium and the groin. He, therefore, supplied his splint with an iron brace, extending in a curved line from the upper part of the external splint,

FIG. 178.



Gilbert's apparatus applied in a case of fracture of both thighs.

directly across the body, to the median line, and cushioned on its inner surface. To this is attached the anterior extremity of the perineal band. By this arrangement the pressure is not only in a great measure removed from the groin, and from the vessels, etc., on the inside of the thigh, but also the direction of the counter-extension is in a line with the axis of the body. The posterior extremity of this band is secured, not to the

¹ Hodge, Amer. Journ. Med. Sci., April, 1860.

upper end of the splint, as is usually done, but to the splint several inches lower down, where it will take a more secure hold upon the under surface of the tuberosity and nates. Both extremities of the band are elastic. Extension is made with a screw, inclosing a strong spiral spring

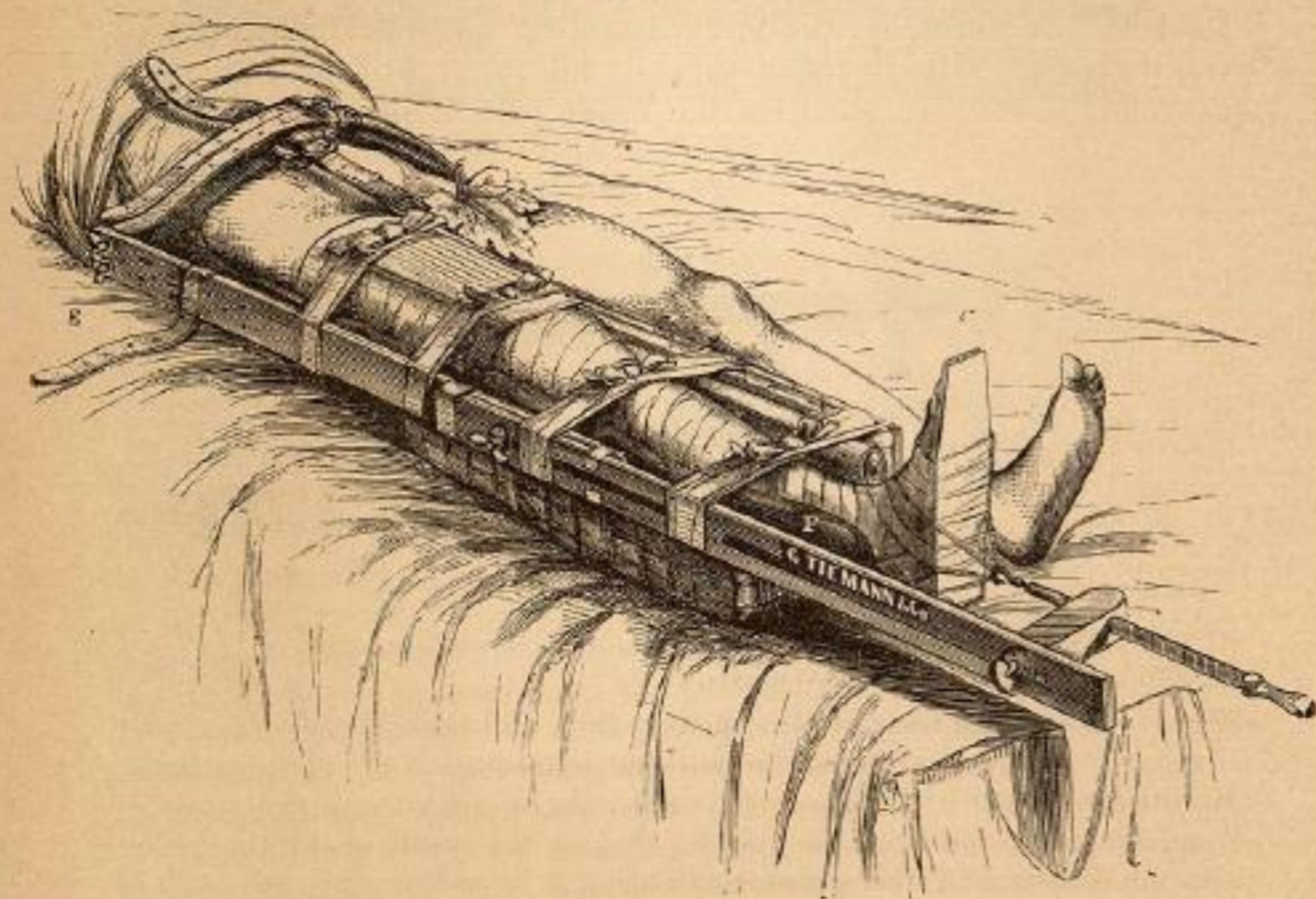
FIG. 179.



H. L. Hodge's method of counter-extension in fracture of the femur.

in its ferrule, or with adhesive plasters, a pulley and weight, at the option of the surgeon.

FIG. 180.



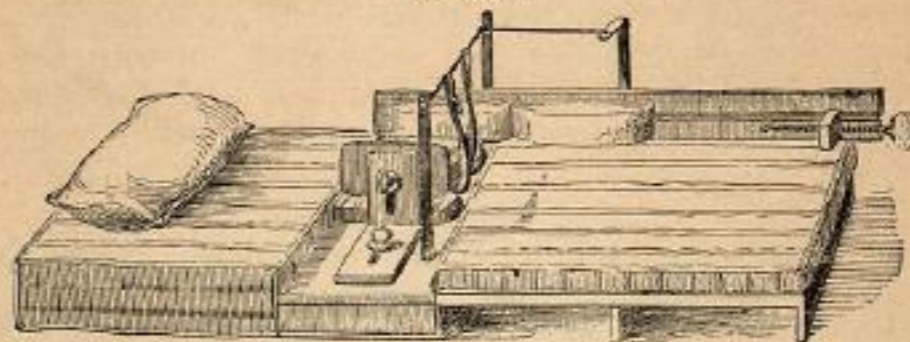
Lente's thigh-splint.

The splint is made in sections, for adaptation to different persons, and for convenience in packing. It extends no higher than the *alæ* of the

pelvis, and is secured to the body at this point by a padded pelvic band. The accompanying illustration (Fig. 180) will sufficiently explain the remaining features of the apparatus.

The apparatus invented by Dr. Burge, of Brooklyn, is both a fracture-bed and a splint, and was constructed with the same view of removing pressure from the front of the groin. The principles involved and the general plan of construction will be sufficiently explained by a study of the accompanying woodcuts. (Figs. 181, 182.)

FIG. 181.



Burge's apparatus.

Dr. T. W. Simmons, of Hagerstown, Maryland, who declares that he is unable to see how extension can be made in the flexed position, has constructed a suspension apparatus for *horizontal* extension in fractures

FIG. 182.



Burge's apparatus applied.

of the lower extremities. It is composed of a suspending bar, two side splints, and a foot-piece. (Fig. 183.)

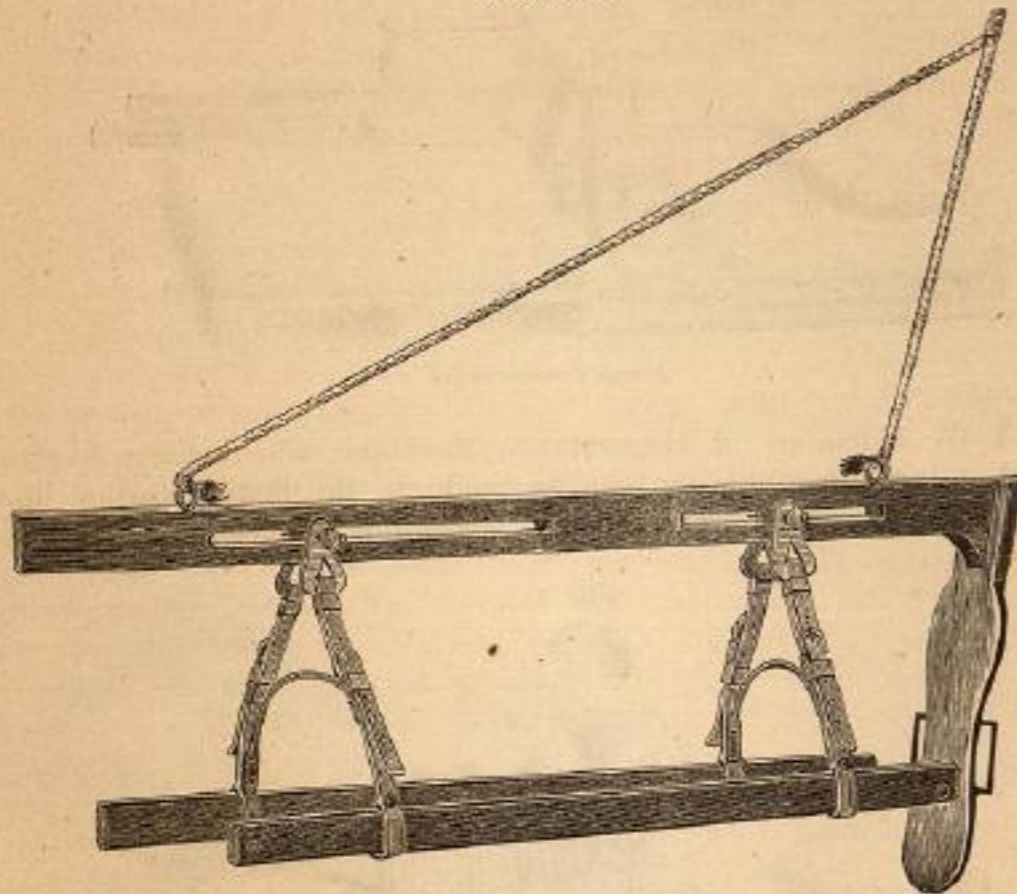
The suspending bar is made of iron, three feet long, one and a quarter inches wide in its vertical diameter, and three-quarters of an inch thick. It is furnished with slots, and eyes for suspension. The two side-pieces or splints are of wood, long enough to extend from the malleoli to the body, the outer splints being extended above the ilium. They are separated from each other by two strong wires, and suspended from the suspension bar by leather straps, which are made fast to the bar by the aid of metallic ears, through which the straps pass, the metallic ears being

secured in the slots by thumb-screws, thus providing for adjustment and fixation.

The apparatus is now suspended from the ceiling by two ropes, carried obliquely, as seen in the drawing, to the hook in the ceiling, and then brought down to the bed and tied.

A bandage is then made to inclose the whole length of the splints, from the ankle to the groin, by continuous turns from side to side. Upon this the limb is laid, and then the foot is applied snugly to the

FIG. 183.



T. W. Simmons's suspension-extension apparatus.

foot-piece and made fast by long and wide adhesive strips laid the whole length of the leg and passed beneath the foot-piece; this is to be reinforced by a roller if necessary. It may also be necessary to inclose the whole length of the splints, including the thigh and leg, in another roller. The long outside splint is secured to the body by a pelvic band or roller.

Great care should be exercised in adjusting the bearings so that the limb does not fall to the one side or the other, and that the foot applies easily and at the proper angle to the foot-board.

The same mode of suspension and extension may be employed in using a box or a plaster-of-Paris splint.¹

At the "German Hospital," in this city, under the observation of the late Drs. Krakowizer and of Guleke, visiting surgeons, five cases are reported as having been treated by Buck's extension and one by plaster

¹ Simmons, Amer. Journ. Med. Sci., April, 1875.

of Paris. Buck's extension had given the best results. At the "Presbyterian Hospital," also, Dr. D. M. Stinson reports that Buck's extension is generally employed. Dr. Alfred C. Post says:

"My ordinary practice is to treat fractures of the femur by extension with a weight and pulley. The method seems to me as nearly perfect as any plan of human device can be, in promoting the comfort of the patient, in facilitating the urinary and fecal evacuations, and in securing union without deformity. In some cases union occurs absolutely without shortening, and in other cases the shortening is so slight as only to be detected by careful measurement. In cases carefully treated by this method it is rare to meet with shortening much exceeding half an inch. I have never seen a case of simple fracture of the femur treated in this way in which there was any such shortening or deformity as I have seen in some cases which have been treated by the use of plaster-of-Paris bandages."

Says Dr. Weir, of St. Luke's Hospital:

"In hospital practice, and where in private practice I can myself apply plaster, I do it; but to my students I point out that Buck's apparatus is a much safer method for them to use, and generally for practitioners whose opportunities for acquiring large experience are few: because I find that unless carefully applied and watched, by frequent reopening, etc., curvature and shortening will sometimes occur unperceived, which cannot be the case in Buck's apparatus."

The late Dr. Paul F. Eve, Professor of Surgery in the Nashville Medical College, employed the plaster of Paris, but not as an immovable form of dressing. Extension and counter-extension are made as in Buck's apparatus, and the limb is exposed to view daily and sponged. In order that these necessary examinations may be made, the plaster is applied according to the Bavarian method, so that it may be spread open without breaking the splint.

The practice of treating fractures of the thigh, as well as all other fractures of the long bones, with the roller alone, and without either lateral splints or extending apparatus, first suggested by Radley, has found in this country but one distinguished advocate, the late Dr. Dudley, of Lexington, Ky.¹ Nor, with all my respect for that truly great surgeon, can I persuade myself that the practice is able to accomplish in any degree the indications proposed, nor indeed that it is, at least in the hands of inexperienced surgeons, wholly safe. Dr. D. of Aberdeen, Miss., has reported to me one example in which, after the application of this bandage by a pupil of Dr. Dudley's, to a negro slave, who had a fracture of the femur, death of the limb ensued, and amputation became necessary. The negro was sixteen years old, and healthy; the fracture was caused by the fall of a tree or a branch, and was simple. The bandage was applied from the toes upwards to the groin, and was not opened for several days, at which time the whole limb was found to be in a state of dry gangrene, with the exception of the upper two-thirds of the thigh, which was swollen enormously, and partially gangrenous as high up as the groin.

¹ Amer. Journ. of the Med. Sci., vol. xix. p. 270; Transylvania Journal, April, 1836; Boston Med. and Surg. Journ., vol. xxxiv. p. 35.