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FRACTURES
OF THE
LOWER EXTREMITY.
TREATED BY THE USE OF THE
SUSPENSORY APPARATUS.

N. R. SMITH, M. D.

NP 123

JOSEPH T. SMITH, Jr.

BALTIMORE, MD.

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TREATMENT
OF
FRACTURES of the LOWER EXTREMITY
BY THE USE OF THE
ANTERIOR SUSPENSORY APPARATUS.

BY
N. R. SMITH, M. D.

Professor of Surgery in the University of Maryland.

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INTRODUCTION.

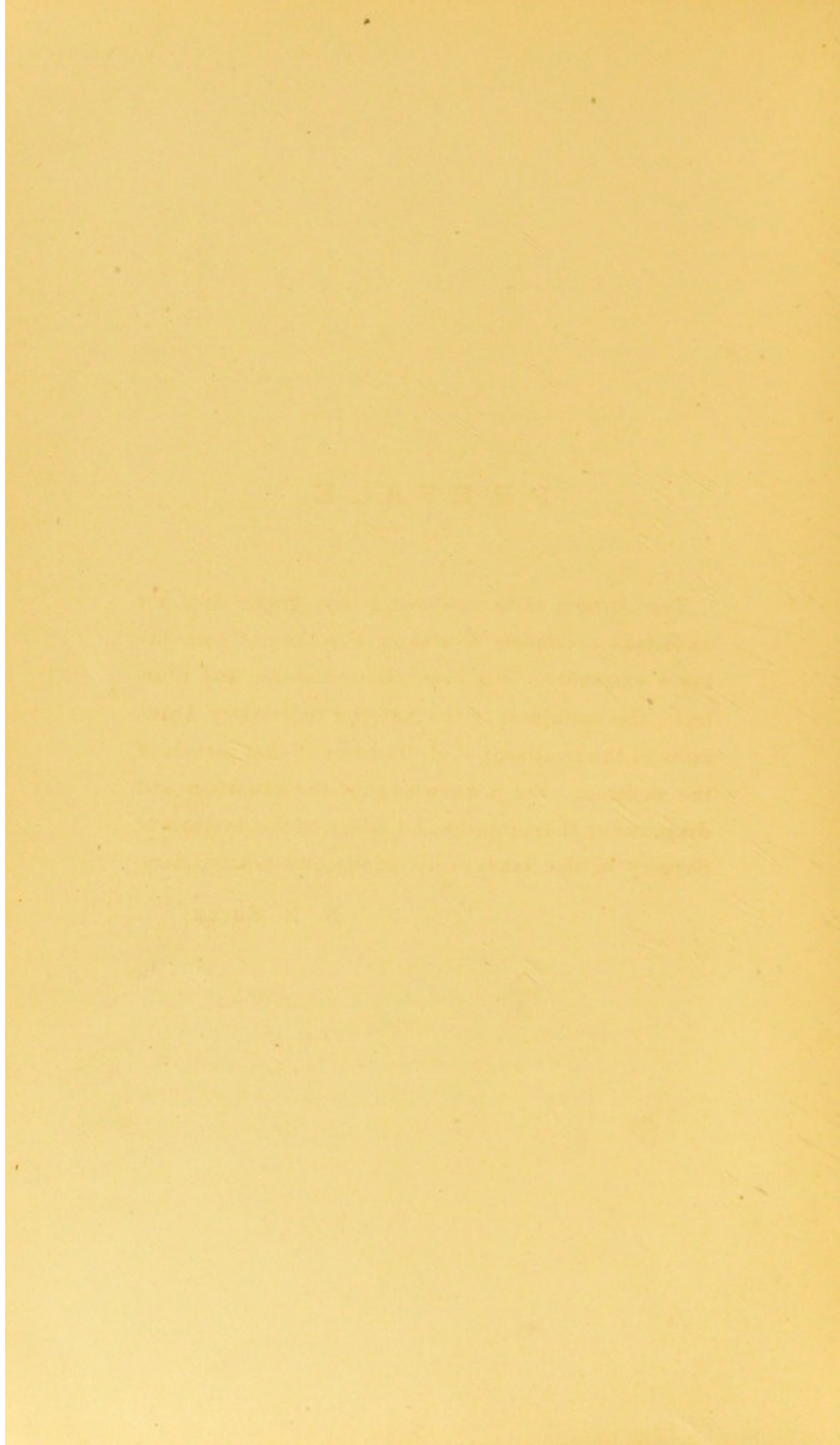
THERE is perhaps no department of Surgery, in which the mechanical appliances required are so imperfect, as that which relates to Fractures of the Lower Extremity. This may justly be inferred from the unhappy results—deformities and lameness—which so frequently follow from the treatment of such injuries by the mechanical means hitherto employed.

Indeed, I have heard it asserted by a very eminent Professor of Surgery, that the general treatment of such injuries, including that of the unskillful and uninformed, is more pernicious than useful, and that, in this department, Surgery has, on the whole, accomplished no good to mankind.

It will be shown, I think, in the following pages, that much of the apparatus employed is absolutely an incumbrance to the member and a source of annoyance to the patient, rather than productive of mechanical support and comfort.

The profession, indeed, admit the insufficiency of the means hitherto employed, by the constant exercise of their invention in contriving new appliances which shall answer the purpose better. Let the reader and the practitioner judge whether the author has accomplished anything in supplying the important desideratum.

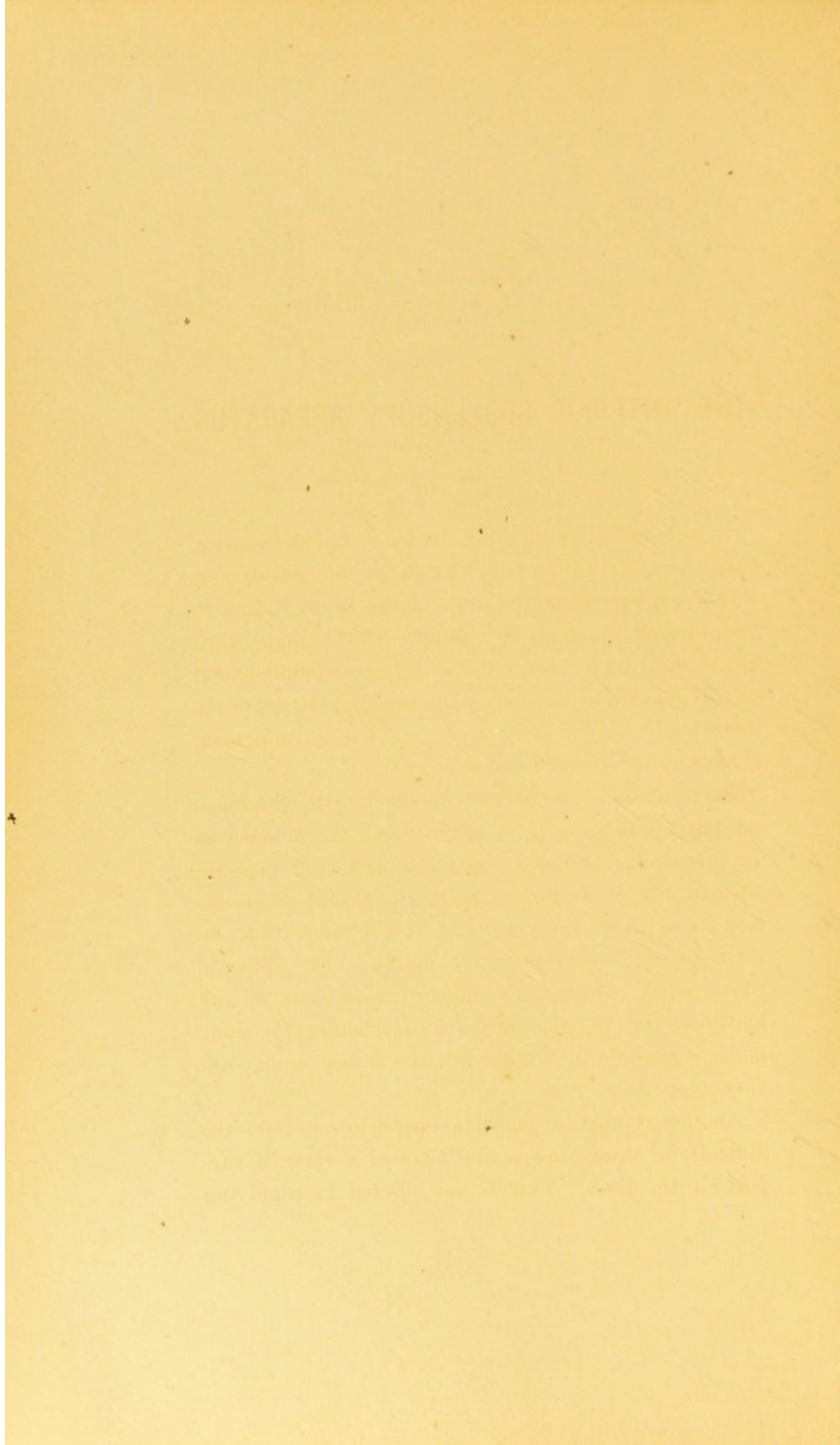
N. R. S.



P R E F A C E.

THE AUTHOR of the following monograph does not undertake a complete treatise of Fractures of even the lower extremity. His object is to describe, and illustrate, the usefulness of the Anterior Suspensory Apparatus in the treatment of all fractures of that portion of the skeleton. For a knowledge of the causation and diagnosis of those injuries, he refers to the systems of Surgery in the hands of all pupils and practitioners.

N. R. SMITH.



THE ANTERIOR SUSPENSORY APPARATUS.

IN the treatment of all fractures of the extremities, the general indication is to furnish mechanical support that shall supercede the office of the injured bone in maintaining the form and length of the limb, until union shall have been effected. The accomplishment of this object is attempted by the use of rigid materials, termed splints, formed of wood, iron, felt, gutta percha, or starched pasteboard and bandages.

There would be no difficulty in effecting the mechanical purpose in view, if we might treat the member as an insensible substance, capable of enduring pressure without the production of pain, sloughing, or ulceration; and if it were possible, at the same time, to maintain one unvarying posture of the trunk. But the living parts cannot long endure the pressure of any hard material, nor the continued constriction of a band; nor is it possible that the trunk can be kept in one unvarying posture.

Another source of embarrassment arises from the difficulty of furnishing a well-adapted surface of support for the limb. This is not effected by supplying

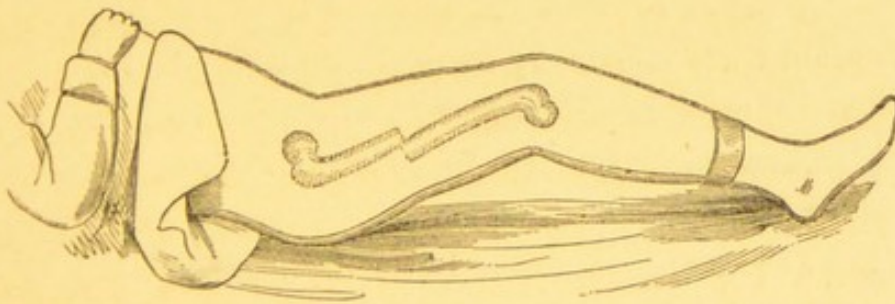
soft and yielding supports, such as pillows of down or feathers, or other soft bolsters, the name of which suggests comfort, but by no means furnishes it. As the member sinks into such supports, whatever part first touches the surface receives the greatest degree of pressure; and besides, such supports yield, and allow in the limb a change of posture in relation to the trunk. They are also otherwise objectionable, particularly in compound fractures, as causing too much heat, rendering it difficult to change dressings and to preserve cleanliness.

It is the duty of the surgeon to study carefully the physiological and mechanical causes of displacement, and to obviate them by posture and support rather than by severe mechanical restraint.

There is a source of deformity and shortening, especially in fractures of the thigh, which has been by surgeons surprisingly overlooked. When the patient has been placed in the ordinary posture in bed, with a pillow and bolster under his head and shoulders, there is a constant tendency in the trunk to slide toward the foot of the bed. This tendency occurs in all cases in which the patient cannot exert his own muscular strength to correct his position. It occurs in typhoid fevers and other diseases inducing great debility, and manifestly must, and does, in fractures of the thigh and leg. The trunk also otherwise changes its position in relation to the limb. This is partly attributable to the yielding of the bed, and partly to the utter impos-

sibility of maintaining the trunk in one immutable posture without the most intense suffering. The patient will instinctively change his posture in sleep, and will unconsciously do it when awake. If, then, the limb rests on the bed, and is embraced in a cumbrous apparatus, which also rests on the bed, it becomes incapable of obeying the motions of the body. The more firmly fixed the limb is in the apparatus, and the more immovable its posture, so much the worse in regard to the support of the fragments. The trunk *will* change its posture and disturb the upper fragment. The trunk controls the upper fragment, but does not carry with it the lower. When the trunk slides toward the foot of the bed, the upper fragment is jammed upon the lower—made to overlap it, and to assume an angular posi-

Fig. 1.



tion in relation to it. This I am satisfied, from the most careful observation is a much more fruitful source of shortening and deformity than is the contraction of the muscles, so constantly referred to by surgeons.

The objects to be attained, then, in the treatment of

fractures of the lower extremity are: 1st. To furnish a surface of support which shall be accurately and permanently adapted to the surface and form of the limb which reposes in it. 2d. To so adapt the surface of support as that the limb, sinking into it, shall maintain its form by its own weight, without the necessity of lashings here and there, to secure it to the rigid portions of the apparatus. 3d. To make the limb obedient to all the unavoidable movements of the trunk, so that the upper fragment shall not be jammed upon the lower, nor contorted in relation to it by the movements of the trunk. 4th. To obviate the contraction of the muscles by the employment of an extending force, uniform in its action, easily graduated, and not requiring the application of bands to the ankle. 5th. So to arrange the supports that in compound fractures we may have free access to the seat of injury without removing any of the essential supports of the limb. 6th. To effect these objects by an apparatus, simple in construction, capable of being anywhere procured, easy of application, not requiring to be readjusted, and of but trifling expense.

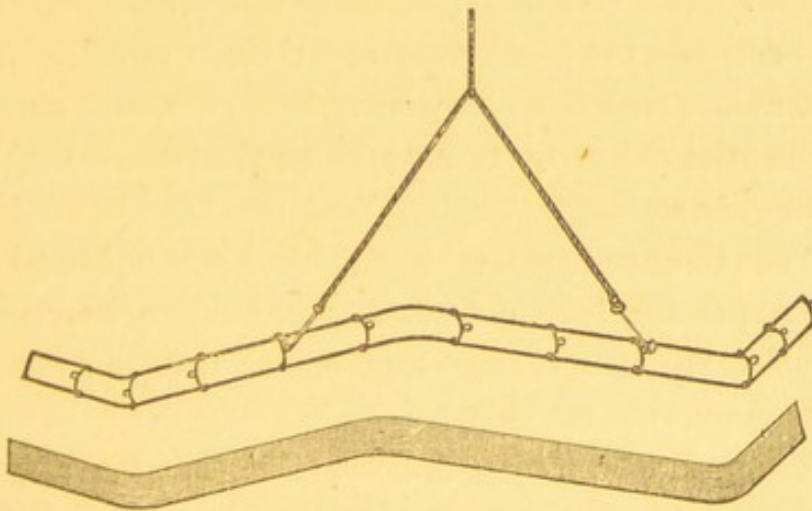
That these objects are satisfactorily accomplished by the apparatus here presented, I have demonstrated in the clearest manner, in hospital and private practice, during many years past.

The apparatus which I am about to describe is applicable to all fractures of the thigh and leg. I shall first describe it as employed in fractures of the thigh.

*

A single splint constitutes the whole of the rigid, or supporting, part of the apparatus. It may be made of wood or wire. The first employed by me was of wood. It was three inches broad, half an inch thick, and long enough to extend from above the spine of the ilium to the toes. It had an angle corresponding to that of the ankle, another at the knee more obtuse, allowing the leg to be very slightly flexed, and a third corresponding to the hip, still more obtuse, slightly flexing the thigh on the pelvis. Two staples, by which to suspend it, were attached to the upper surface, one a little above the knee and the other about the middle of the leg. It is represented in the plate. The splint may be sawed, in one piece, out of thick pine plank, or may be made of three pieces, united at the angles by nails or screws.

Fig. 2.

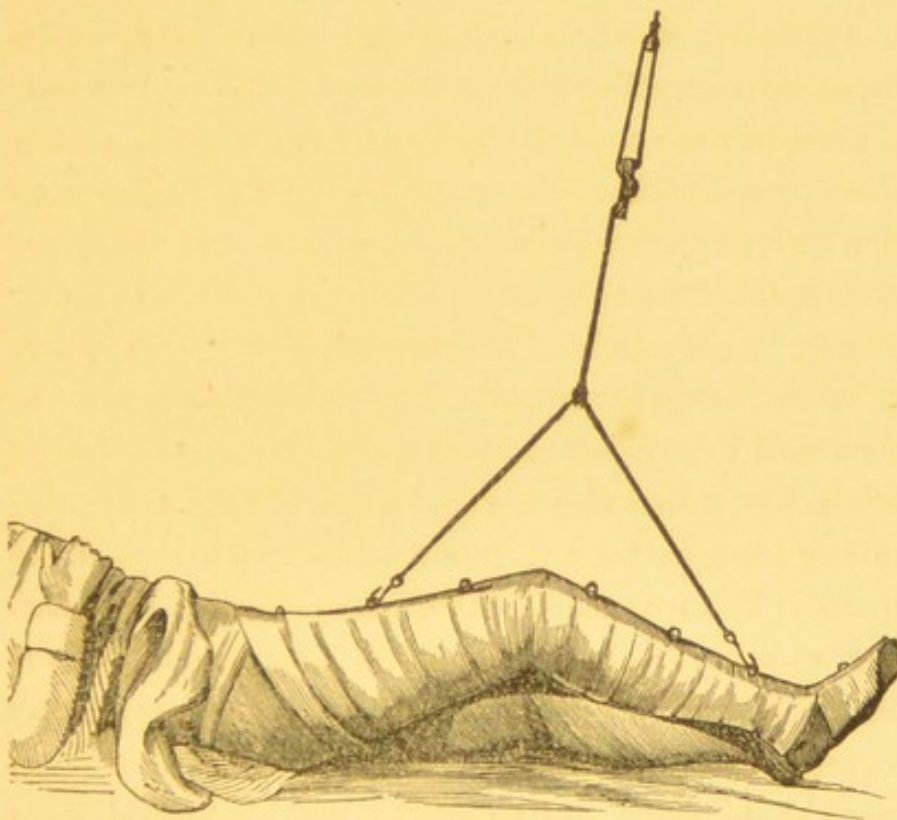


I now employ a splint of tinned wire, as represented in the plate. The size of the wire should be that of a No. 10 bougie. If lighter than this it is apt to spring too much. It is constructed of one piece of wire bent twice at right angles, at each extremity, in the form represented in the cut—that of a long parallelogram—being, however, three inches and a half wide at its upper extremity and two and three-fourths at its lower. It must be long enough to extend from a point a little above the anterior spinous process of the ilium, to an inch beyond the toes when the leg, foot and thigh are extended. Three feet eight inches will be sufficiently long for most adults. A little excess of length, above or below, is unimportant. The side-pieces are to be sustained by curved cross-pieces at distances of about five inches, firmly clinched and soldered upon them, and having loops in their centres for the attachment of the hooks. The wire frame is then to be bent by the surgeon to suit the case. The lower angle corresponds to the ankle, and is one of about 120° , to secure an easy posture of the foot. The angle at the knee is very obtuse—about 160° . The angle at the hip should be of about the same degree. The angle at the ankle should be about five inches from the extremity; that of the hip seven. The middle bend corresponds to the knee. The angles are easily made by bending the splint over the margin of a strong chair or table. It will often be necessary to vary these angles to suit particular fractures. The wire frame is now to be tightly wrapped

with a muslin bandage, and it is ready for application.

The suspensory apparatus is simple and easy of application. A small iron pulley is to be screwed into the ceiling, over the bed of the patient, perpendicularly

Fig. 3.

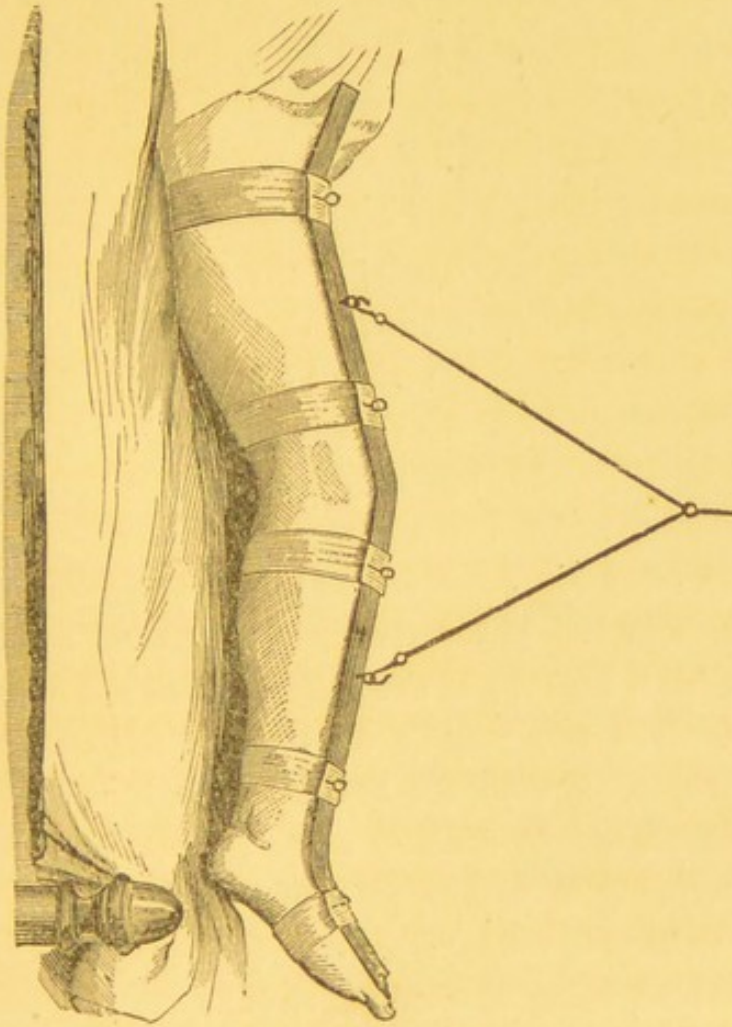


over the middle of the shin, or nearly so. A cord, about as thick as the wire of the splint, passes over the pulley and is reeved through a small tent block, as seen in the cut, by which, slipping it upward or downward, we elevate or depress the limb. The eccentric pressure prevents the weight of the limb from causing it to slip ;

if not, rub the cord with chalk. This single cord, which depends from the block, has a loop at its end, about two feet or more above the limb. Through this another cord, about five feet long, passes and hangs double from the loop, by its centre. Each end has a hook attached to it, of the form represented in the cut. It is made of much smaller wire. When everything is ready for suspension, these hooks are to be attached to the loops in the cross-bars.

The application of the apparatus is extremely simple. The limb (we are now supposing a fracture of the thigh) is to be carefully adjusted and laid on pillows, still supported by the hands of assistants. The splint is now to be laid along the upper surface of the limb, the foot portion an inch remote from the instep, the middle angle nearly corresponding to the knee. I formerly placed a long narrow compress under the splint, but it is generally superfluous. One may, however, be placed on the instep, and one under the hip extremity of the splint. I now pass a piece of wet bandage, long enough to embrace the limb and overlap, under the foot and over the splint, so as to embrace both, not tightly. I pass another also wet around the ankle, another beneath the knee, a fourth above the knee, and a fifth around the thigh near the hip.

Fig. 4.



The engraving above shews the member suspended by the slings, at four points, preparatory to the application of the bandage. It may, at that moment, be raised higher than the degree at which it is intended to remain permanently, in order to facilitate the application of the bandage.

Button-hole slits may be made near the ends of each sling, and these be buttoned on to the loops in the cross-wires of the splint.

The limb being still kept extended by the hands of assistants, the hooks are now to be applied. It is very important to select properly their points of attachment, so as to adjust well the centre of gravity of the limb. In fractures of the middle of the thigh, I attach the upper hook nearly over the seat of the fracture; the other a little above the middle of the leg. By pulling upon the tent-block the limb is now gently raised from the pillows, and hangs suspended in the slings. Observe now whether the upper portion of the splint presses down too much on the thigh, or springs up too much from it. If the former occurs, then attach the upper hook higher; if the latter, attach the lower one lower. But this may be corrected, if slight, by slipping the cord, with the hooks attached, through the loop of the single cord, so as to correct the bearings, and securing it with a piece of twine just below the loop, to keep it thus.

The limb being now raised, so that one may pass his hand under every part of it, the application of the roller is made. The surgeon commences with the foot, the splint being held steady. Three or four turns are to be made loosely around the foot, care being taken not to press it upward against the splint, which it must never touch; then figure of 8 turns are made around the ankle and foot, and the roller is carried upward

along the leg and thigh, reversing, where necessary to make perfect adaptation, and great care being taken not to crowd the limb too firmly against the splint. On reaching the hip with the roller, a few spica turns are to be made obliquely through the groin and around the pelvis, concluding with two direct turns around the pelvis. I often besmear the whole under surface of the bandage, thus applied, with starch. This prevents the slipping of the bandage, and preserves a uniform and accurately adapted surface of support.

The whole is now accomplished, except the application of the extending and counter-extending forces. This is in a moment effected by moving the bedstead of the patient head-ways (a word not found in Worcester), so far as to give a slight obliquity to the suspending cord, inclining toward the foot. It needs generally to deviate not more than one or two degrees from a perpendicular, but may be graduated to any degree of traction by simply moving the bed. Severe traction is not necessary, because the limb is supported in a manner to obviate the principal cause of retraction.

Counter-extension is made by the weight of the body. To obviate the descent of the trunk toward the foot of the bed, caused by posture, and slightly promoted by the traction of the oblique cord, there may be a block, two inches thick, placed under each footpost of the bed. Under the upper portion of the thigh I usually place a small pillow, to obviate the lateral swinging motion which the unavoidable movements of the trunk may

cause. The limb should be supported just high enough to lift the heel clear of the bed.

Let us now observe to what extent we have accomplished the indications which we proposed above.

1st. It will be seen that the member rests entirely on the turns of the bandage, and these are necessarily perfectly adapted to the form of the inferior surface of the limb. The limb cannot change its position in relation to this surface, even when the trunk moves and carries the member with it. So equally diffused is the pressure that the patient does not feel the contact of the support at any point.

2d. The apparatus being secured to the pelvis, the limb is obedient to all the movements of the trunk, and always preserves the same position in relation to it. Slung by the cord, it yields to the slightest impulse, and, therefore, the upper fragment cannot be disturbed in relation to the lower. If the body be inclined to the diagonal position, to right or left, this will not contort the upper fragment in relation to the lower, for the limb will instantly assume the corresponding position by the yielding of the cord, and the form of the limb will be preserved.

If the trunk descends towards the foot, the apparatus swings on the cord, and the upper fragment is not jammed upon the lower.

3d. To those who have not witnessed the action of the apparatus, it would appear difficult, by its use alone, to obviate angular deformity ; but in this I have

never found the slightest difficulty. The loops of the bandage on which the limb rests, exert a lateral concentric pressure, corresponding in degree to the weight of the limb, and tending continually to straighten it, and resist distortion. The traction exerted by the oblique cord conduces to the same result. A force thus exerted upon any angular and yielding substance will of course render it straight. Lateral concave splints may, if deemed necessary, be interposed between the bandage and the limb; but, although I have used them, and found them very easy of adaptation, I am satisfied that they are generally unnecessary, and especially because there are now no forces which tend to displace the fragments.

4th. The mechanism of the extension is sufficiently obvious. It is exerted by the obliquity of the cord, and is easily graduated by varying it. It is perfectly uniform and gentle, and does not require the tightening or relaxation of bands from day to day. It needs not to be strong, because the tendency to shortening is otherwise in a great degree obviated.

The force is exerted on the apparatus, and by it transmitted to the limb, through the embrace of the whole extent of the bandage, so that there is no galling pressure from distinct extending bands. The starching of the bandage, the more completely obviates the slipping. The splint, however, inclines to be a little drawn toward the foot, and, therefore, as stated above, the foot portion ought to be applied an inch remote

from the instep, to prevent pressure on that point, where it cannot be endured without injury.

It will be observed that, in the method of treatment here described, the necessity for severe mechanical constraint is superseded by evading the causes of displacement, rather than by contending with them. The limb does not become distorted at the place of fracture by the movements of the trunk, because the member thus suspended always maintains the same relative position to it; nor are the muscles provoked to spasmodic and unequal action, because there is no unequal and galling pressure.

This apparatus, with slight modifications, is applicable to all fractures of the femur. To none is it more appropriate, and in none has it accomplished more satisfactory results, than in fractures of the cervix, the events of which are so justly regarded as an opprobrium of surgery. So uniformly has non-union and deformity resulted, that eminent surgeons have denied that bony continuity is ever restored within the capsule. We hope to show that these results are rather the consequence of insufficient treatment, than defect in the reparative power of nature. This power is embarrassed by greater difficulties than in other fractures, and requires more efficient aid. This being furnished, union will often be accomplished.

Many surgeons, in fractures of the cervix, reject all mechanical means in the shape of splints, because so uniformly inefficient in promoting union, and because

producing so much mechanical irritation. But if we can furnish a support which shall sustain the member more comfortably than the softest pillows, and allow the trunk a little liberty in regard to position, it would be expedient to employ it, though bony union were not expected to be effected.

In fractures of the cervix there is required no particular modification in the application, as described above. The pelvic portion of the splint is here very important, and it should extend well upon the trunk, and should be firmly secured to the pelvis by the oblique and direct turns of the bandage. The falling outward of the knee, and the same contortion of the foot, with shortening of the limb, are the characteristic deformities, and are of course to be obviated. The apparatus being slightly angular at the knee, the bandage effectually prevents the falling out of that portion of the member, and the bandaging of the foot to the foot-piece effectually secures it in a natural posture.

The extending apparatus is here extremely important, and the obliquity of the cord must be carefully maintained.

In the treatment of no fracture is it so important to preserve a uniform posture of the limb in relation to the trunk, and to identify the motions of the former with those of the latter. We have already explained the mechanism of the apparatus in these particulars.

We shall present cases in which we have reason to believe bony union to have been accomplished. I would

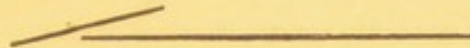
also direct the reader's attention to a case recorded by Prof. Geddings, of Charleston, (see *The American Journal of the Medical Sciences* for Jan. 1847, p. 248), in which bony union was demonstrated as having been effected by the posterior apparatus introduced by me, and involving the same principles in regard to support and extension.

In the treatment of fractures through the base of the great trochanter (apt to be comminuted), the anterior splint is adequate to all the exigencies. Besides the general indications above described, the mechanism obviates a peculiar tendency to displacement incident to this fracture. The glutei muscles, acting as abductors, turn outward the upper fragment, and produce a salient angle externally. To obviate this tendency, the limb, as suspended, must be allowed to swing outward, by which the distorting muscles are relaxed, and their effect obviated. Indeed, the limb will spontaneously incline a little outward the moment it is raised, and the deformity will cease in consequence. It should be allowed thus to incline during the whole treatment, and any attempt to force it into a position parallel to the other member is mischievous, and the maintenance of this position is a serious objection to many forms of apparatus.

In fractures immediately below the lesser trochanter, the upper fragment, when the limb is allowed to fall into the horizontal position, is tilted forward by the action of the flexors of the femur—the psoas and iliacus

muscles. The lower fragment, by the retraction of the muscles of the femur, is drawn upward, and the limb shortened, as may be illustrated by these lines :

Fig. 5.



To force the upper short fragment backward, into continuity with the lower, is impossible, by any force which can be endured. Here is a case, then, in which we must humor the muscles by posture, and not endeavor to coerce, by which we should defeat our own object. We must, therefore, elevate the lower fragment till we bring it into line with the upper, elongating the limb at the same time by traction, and thus adjusting the fracture.

This position is easily rendered permanent, and the coaptation made secure, by applying the anterior splint with the angles at the knee and hip more acute than represented in the cut, thus allowing a greater degree of flexion at the hip and at the knee—thus :

Fig. 6.



The traction of the supporting cord will be exactly in the direction in which the upper fragment presents.

In fractures of the middle third of the femur I have observed, in almost all cases, the deformity to result from a salient angle of the fragments externally. I have examined many femurs of those who have been treated for this fracture, and almost always have found an external convexity of the thigh.

In these cases the abductor muscles, being inserted into the upper fragment, draw that portion of the bone outward, while the adductors, having their insertion continued to the lower extremity of the femur, draw the distal extremity of the lower fragment inward. When, in the use of any apparatus like Dessault's, the limb is approximated to, and made parallel with, the other member, the abductors are then rendered as tense as they can be, and the adductors placed in the opposite condition, and cause the drawing outward of the lower end of the upper fragment. Carry the whole limb outward, and the deformity disappears without the use of pressure. Should one desire to grasp the thigh more snugly by the bandage, he may place, on the front surface of the thigh, a folded compress, then, over this, a piece of binder's board, broader than the splint, nearly as long as the thigh, and bent to fit the convexity.

To render the adjustment permanent, it is only necessary to suspend the limb in the apparatus—to allow it to swing outward, and thus to relax the abductor muscles. Indeed, the moment the limb is suspended, it will instantly assume that position by the action of the

muscles, they becoming relaxed by this movement, and ceasing to distort the fragment. Here is another instance in which we succeed by humoring the muscles rather than by forcing the fragments into place by direct pressure. Coercion is certainly an impracticable principle in this department of surgery, provoking secession and the non-union of the fragments.

In fractures near the condyles, the upper extremity of the lower fragment is drawn backward into the ham by the heads of the gastrocnemius, especially if the leg be completely extended on the thigh. If we flex the leg, and, applying the hand to the upper part of the calf, make traction in the direction in which the femur points, the deformity disappears. We make this position permanent, and the adjustment secure, by suspending it in the anterior splint, making the angle at the knee more acute than that seen in the cut. The gentle support of the turns of the bandage in the ham contributes essentially to the desired result.

In fractures of the patella I have employed the same apparatus with signal success and comfort to the patient. The apparatus for this purpose must be made straight at the knee—the heel kept well elevated, so as to flex the thigh in some degree on the pelvis—the cord made perpendicular, or rather inclining toward the trunk of the patient, inasmuch as no necessity for traction exists. A compress must be placed above and below the patella, and the limb bandaged snugly up against the splint.

The application of the anterior splint to the treatment of fractures of the leg, especially compound and comminuted, has been not less satisfactory than in those of the femur. Indeed, the first case in which its usefulness was demonstrated was one of compound and comminuted fracture of the bones of the leg. The subject was Edward English, who came under my care in the Baltimore Infirmary, September 28, 1854. He had been for months under treatment, in good hands, in a neighboring hospital. Amputation had been proposed, and would have been justified by the rules of conservative surgery. The patient however, demurred, and prevailed on his friends to take him to the Baltimore Infirmary, with the hope that I would make further effort to save the member. I had every motive, therefore, to accomplish the object, if possible.

The leg was a shapeless mass of disease. The comminution, and lesion of the soft parts, had been very extensive. Many necrosed fragments were still included in the tumid parts; many fistulous openings existed along the whole length of the tibia, discharging matter from numerous sinuses. The limb was enormously tumid and of a livid hue from impeded circulation.

I employed the apparatus of wood, but extending no higher than six inches above the knee. It had the usual angle at the knee, and at the ankle. Having placed it along the anterior surface of the leg, I first attached it loosely by adhesive strips, one passing un-

der the foot, one under the ankle, one below the seat of fracture, one above it, and one above the knee. I placed a compress under the upper extremity of the splint where it rested on the front of the thigh. Staples were attached to the splint, one near the knee and the other near the ankle, and by these the limb was suspended, the cord and pulley being employed as illustrated in the cut. I employed three bandages, two designed to be permanent and one movable. One was applied to the foot and carried up, with occasional reverses to effect accurate adaptation beneath, to the vicinity of the fracture. A second began above the fracture and was carried to the upper extremity of the splint, so as to grasp firmly the thigh. The region of the fracture was now exposed, but the support was complete. I now, after placing a basin beneath the limb and thoroughly washing it, applied the requisite dressings, and finally the movable or independent bandage, embracing the region of fracture and many of the fistulous openings, arranging the turns so as not to obstruct the free issue of matter.

I was exceedingly gratified at the immediate results. The moment the member was slung the patient exulted in the relief which he experienced from the rigid confinement and constrained posture, from which he had suffered while the limb lay an immovable mass, encumbered by splints, on the bed. He found himself capable of changing his posture at will, without the slightest hurt. The gentle concentric pressure of the bandage,

determined by the weight of the limb, began at once to express the matter from the sinuses, and it was seen dripping copiously from the limb. The sinuses were thus emptied, and their walls compressed. The same mechanism promoted the absorption of lymph and serum from the tumid parts, and, together with the slightly elevated posture, aided the return of blood from the limb.

Improvement was immediate and rapid. The dressings were accomplished without the slightest disturbance of the limb, by removing the movable bandage and exposing completely the seat of injury. I removed, from time to time, considerable portions of necrosed bone, and laid open sinuses. The result was complete recovery with a useful limb.

The wire splint for the leg is applied as described above. In all fractures of this member above, or at, the middle, it is essential that the apparatus should extend above the knee, and grasp the lower third of the thigh. All the unavoidable movements of the thigh will then be communicated to the splint and will not disturb the upper fragment.

In fractures above the middle, the splint must be straight at the knee, so as to extend perfectly the leg on the thigh, and thus relax the muscles which would elevate the superior fragment, especially in oblique fractures. In compound fractures, the splint should not be wrapped with muslin opposite to the seat of injury. Adhesive strips should then be employed to

attach the limb to the splint, before elevating it, because more cleanly. A permanent bandage should be applied below, and another above. A movable bandage encircles the wounded region. It may sometimes be expedient to interpose compresses at certain points between the shin and splint, to render the coaptation more perfect, but I have seldom found them necessary.

When the fracture is of the lower third, it is exceedingly important that the weight of the foot should be well supported, otherwise there will be a salient angle of deformity in front. This must be done without injurious pressure on the heel, and can be effected by supporting the sole of the foot well with the adhesive strap, which is drawn under the sole, and carrying the bandage, with several well-adapted turns, under the heel. The heel will then not suffer, because it rests on a surface perfectly adapted to its form. The turns may be starched after application, to render them permanent.

The weight of the limb, sinking into the apparatus, mainly exerts the force that restores and preserves the normal form of the member. The gentle traction of the cord, which should be but slight, contributes to the same result.

In compound dislocations of the ankle, complicated as they usually are with fracture, I have found the anterior splint far more satisfactory than any other means of support which I have employed. In those cases the foot must, as much as possible, repose upon its sole, where sustained by the adhesive strap. Another adhe-

sive strap should be carried under the heel and over the splint. In all cases of injury at the ankle or near it, the lower hook should be applied to the apparatus near the bend at the ankle.

When, in recent fractures of the leg, the member is first placed in the apparatus, the muscles will be, for a time, affected with a spasmodic rigidity and quivering which will, for a brief time, distort, in a degree, the fragments, and shorten the limb; but when it has reposed for a short time in the well-adapted concavity of the apparatus, the irritation ceases, and the fragments fall into their true relations. It is worse than useless to struggle with this tendency to distortion by direct mechanical pressure. If deformity continues, it is because the member is not well sustained by the proper adjustment of the supports.

If, in the application of the splint to fractures of the leg, the upper end of the apparatus is found to press too much upon the anterior surface of the member, the supporting cord must be slipped in the loop of the single cord, so as to shorten the portion to which the upper hook is attached. A compress should also be placed under the upper extremity of the splint. A pillow should be placed under the thigh, and the heel should be sufficiently elevated to clear the bed.

Care must be taken that the foot-piece does not press too much on the instep. It ought not to touch it when the apparatus is first applied. Often I interpose a thick, soft compress, and remove it in case the pressure becomes annoying.

It is generally not necessary, in fractures of the leg, to make extension. The cord, therefore, may be arranged perpendicularly. When it is necessary it will not usually be requisite to continue it in any considerable degree for more than four or five days.

It is worthy of remark that in the employment of this, or any other apparatus which furnishes nearly perfect support to the fractured bone, and allows no appreciable motion, there will be no provisional tumour, or callus. The apparatus is the provisional expedient, and nature, instinctively aware of its existence, produces no exterior callus, but proceeds to restore the direct continuity. The time, therefore, occupied in restoring the rigidity of the limb will be greater, in some cases, than where less perfect support is given; but the ultimate direct union is sooner effected and far more perfectly; nor will the muscles, after union, be embarrassed in their action by callus or by projecting fragments. The attention necessary for the evacuations of the patient is greatly facilitated by this apparatus. There is nothing in the way obstructing the use of the bed-pan. When raised for this purpose the limb may be correspondingly elevated by slipping the block on the single cord.

The suspensory apparatus, as above described by me, having attracted the notice of M. Charles Shrimpton, D. M. P., of Paris, that distinguished surgeon appears to have recognized at once its general utility, and especially its applicability to certain complicated inju-

ries. A very aggravated case of compound, comminuted fracture of the leg having fallen under his observation, he, aided by M. le Docteur Gantillon, of Paris, applied the apparatus of the author in a manner which shows that he had formed a just appreciation of its mechanism and usefulness.

The satisfactory manner in which the apparatus accomplished, in this case, the wishes of the surgeon, induced that gentleman to publish, in the *Medical Gazette* of Paris, a very flattering notice of the instrument, accompanied with a report of the case in which its usefulness was demonstrated. I quote from the *Gazette* the case alluded to, as well as the remarks appended thereto :

CASE I.

Madame W., very robust, of a good constitution, on visiting the falls of the Rhine, July 16th, 1864, stepped upon a wet plank and fell, with all the weight of her body, in the sitting posture, upon her left leg. There resulted a comminuted fracture, with protrusion of the tibia through a large wound, leaving another portion of bone completely detached within the wound. M. le Docteur X., who was called in haste, extracted the free portion of the tibia, closed the lips of the wound by means of sutures, and applied the apparatus "*a fanons*" of Larrey. He applied cold water dressings and prescribed suitable diet.

But very grave symptoms soon supervened. On the

20th a large incision was practised, in extent equal to three fingers' breadth, below the tuberosity of the tibia, for the purpose of opening a considerable abscess. The pulse at this time was one hundred and three; the condition of the patient adynamic. The member maintained in the apparatus was placed on an inclined plane, the foot being elevated one degree. Diet absolute and the dressing a cataplasm. The patient had had not one moment of sleep during five days. Soon erysipelas invaded the member, and a second abscess, with extensive sloughing, required to be opened on the 24th.

July 27th, M. le Docteur X. performed the resection of that portion of the tibia which protruded from the wound.

July 27th, the general condition of the patient was greatly aggravated, especially during the last three or four days. The enormous abscesses, which occupied all the superior portion of the leg, secreted nothing but a sanguinolent serosity, emitting a gangrenous odor. The lips of the wounds were pale, and gave issue to an abundance of gas. Observing the aggravation of all these symptoms, the attendant adopted the sad resolution of proposing an amputation, at the lower third of the thigh.

The family of the patient, distressed at the suggestion, and being thus insulated in Switzerland, called me to the patient, by telegraphic despatch, July 29th, thirteen days after the accident.

I happened at the moment to be absent from Paris,

and M. le Docteur Gantillon had the kindness to precede me, July 30th. He found the patient in a state of asphyxia, exhibiting an expression of extreme suffering, and delirious, pupils dilated, skin hot, brown and dry, tongue loaded and brown, the lips and teeth covered with sordes, pulse eighty-four, and feeble. The extensive wounds of the leg were very dry, in a gangrenous condition, and had filled the chamber with an infectious odor, yet they feared, as they said, to open the windows "on account of the erysipelas."

M. le Docteur Gantillon commenced by giving the poor patient, who had been kept, during fourteen days, on an absolute diet (thin soup, toast, water and a decoction of linden), a glass of wine (*vin de tonerre*), opened all the windows and replaced the cataplasm, with fresh water dressings applied with charpie, having first cut all the ligatures which could hinder the circulation in the member.

The next day, July 31st, on my arrival, we together applied the suspensory apparatus of Prof. Smith, exposing all the wounds to the air, and, with the aid of irrigation, practised by means of a syphon, we had the pleasure of seeing the wounds recovering a healthy aspect, and all the unfavorable symptoms disappearing under the influence of a good regimen so happily commenced by my friend and distinguished confrere, M. Gantillon. We took care to keep the windows open for ten days, not excepting the nights, up to the moment of our departure for Paris, August 10th.

The same day Madame W., reposing on a bed precisely as if in her chamber, without the slightest change in our system of suspension, was conveyed by rail-way to Paris, that is to say, a distance of nearly two hundred leagues, without any derangement of the fracture, and without the patient having experienced the slightest pain, notwithstanding the violent shocks inflicted upon the cars by the locomotives.

September 6th, the fracture was consolidated and all the wounds were healed, with the exception of a small fistula through which we have extracted some small fragments of necrosed bone.

The cure has been effected with but a slight shortening of the limb.

On the whole, we aver that the apparatus of Prof. Smith realizes at least the following advantages over every other system employed in the treatment of fractures of the lower extremity :

1st. The extremities of the fragments are maintained in perfect relation without the exercise of any constriction upon the limb.

2d. In cases of extensive displacement of the fragments, extension is easily accomplished, by the weight itself, of the member, and the reduction accomplished by the point d'appui attached to the apparatus, and this without any dragging.

3d. The method of suspension is exceedingly convenient for the employment of irrigation and for the dressing of all the wounds of the member, upon which

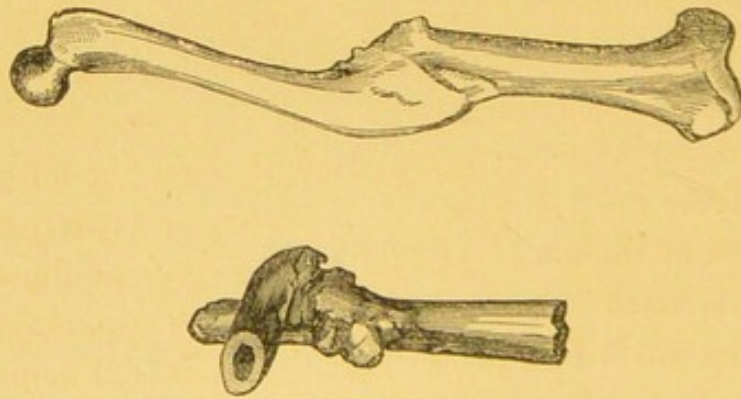
we may practice all the operations necessary without disturbing the apparatus.

4th. The heel, being uncovered, is exempt from pressure and from the acute pain which, in the use of other means, so often embarrass the surgeon.

5th. The patient can change his position and raise himself in his bed without inconvenience.

6th. Finally, what is not least important, the apparatus of Smith is the only one which, even in the most severe and complicated fractures, allows the patient to be conveyed to any distance without exposing him to any danger, and without causing the least pain."

I think it will be admitted that no other apparatus now in use would have effected the purpose so happily accomplished by M. le Docteur Shrimpton in the above case, by the suspensory apparatus.



The 1st engraving above represents a femur which has long been in my collection, and exhibits the deformity

which is likely to result from the treatment of fractures of that bone by Potts' apparatus. In the use of that mechanism, the limb being placed upon its outer surface, and in the semiflexed posture, the trunk, which inclines to assume the supine position, contorts the upper fragment inward. The lower fragment is not carried with it, and thus the relation of the fragments is lost. Union occurs, but the knee and toe turn out, and there is angular, as well as circumferential, deformity, and the limb is shortened, because the trunk descends in the bed and thrusts the upper fragment downward upon the lower, which is the more stationary because encumbered by the apparatus.

The next figure represents another bone in my collection, exhibiting union with still more remarkable deformity. The patient was treated with the fracture-box, which, by its weight and form, rendered the limb completely immovable on the bed, and therefore the less in relation with the trunk, when the position of the latter was unavoidably changed.

The upper fragment being jammed upon the lower, is, partly by the resistance of the latter, and partly by the action of the flexor muscles, made to present almost directly forward. And yet, in spite of this remarkable distortion, union took place. Some years after, I amputated the limb, it being an unendurable incumbrance to the patient.

The unbleached domestic muslin is the material which

I use for bandages. It should be of a good, firm texture. It is well, in applying it, to make small slits in it, and slip them over the loops in the wire cross-pieces. This keeps the bandage from slipping, and obviates the use of pins. The turns, direct and oblique, around the pelvis, must be made with care, and well secured to the top of the splint.

In suspending the apparatus, I have directed that a pulley be attached to the ceiling. A high point of attachment is better, as the obliquity of the cord will be more uniform, and may be increased or diminished by simply moving the bed; but sometimes this cannot be done, and then a piece of board may be laid across the tester and the pulley attached to it.

In the treatment of fracture of one of the condyles of the femur, which fracture is usually oblique, there occurs a tendency to displacement of the fragment upward; and thus the leg inclines outward or inward, rendering the patient knock-kneed or bandy-legged. This is effectually obviated by giving a lateral angle to the splint—bending it either outward or inward, at the knee.

I shall proceed to relate several cases of compound and comminuted fracture of the femur caused by bullet wounds, for the purpose of illustrating the usefulness of the suspensory apparatus in the treatment of such injuries.

The most eminent surgeons of the last half century

declare the necessity, especially in military surgery, of amputating the member in all cases of fracture of the femur by musket ball, some excepting that inflicted upon the lower third of the femur, and not involving the knee joint. I do not mean to assert that no cases of recovery from such injuries have occurred under ordinary treatment, but only that they are so rare as to justify the rule alluded to above. And yet the amputation of the thigh for such injuries, as recent statistics show, has not been generally followed by happy results.

The fatal results of gun-shot fractures of the femur, are, in my opinion, attributable to the use of imperfect mechanical support, and the use of apparatus which renders impossible the dressing and cleansing the wound, without removing the essential supports of the limb.

The apparatus which we employ, as I have shown, obviates these difficulties; and the results which have been obtained by its use justify the decided rejection of the rule to amputate, whatever portion of the shaft of the bone may have suffered.

I do not claim to have large experience in military surgery, but unfortunately, in our community, gun-shot wounds are not uncommon. Since I have employed the suspensory apparatus, numerous cases of such injuries have been treated by me, and with such success, as the following cases will shew, that unless there occurs some peculiar complication, or constitutional disease, I undertake the case without any apprehension in regard to the result.

CASE II.

George Coulson, twenty-five years of age, of herculean size and strength, weighing 200 lbs., suffered, September 7th, 1865, in a street fight, a bullet wound of the middle of the left femur, fracturing and comminuting the bone. He fell, and remained lying on the pavement for an hour before he was removed. He was then conveyed to some place of shelter, but the wound was not dressed for twenty-four hours. He was conveyed to the University Hospital at night, being roughly handled, and the member having no support. I saw him at mid-day. The limb was greatly distorted, swollen, tense and discolored. His pulse about 90.

I immediately proceeded to apply the suspensory apparatus, which was easily accomplished without inflicting pain. On suspending the limb it at once assumed its natural form, and the patient was immediately relieved of pain, and able to change the position of his trunk without disturbing the limb. An independent bandage was applied to the region of the injury.

September 9th.—The patient comfortable; the member, however, still tumid and discolored; pulse about 90; had slept a portion of the night; had taken sufficient nourishment.

Condition of the patient improving; pulse 80; bowels have been favorably moved; swelling and discoloration of the member abating; no pain.

10th.—Patient still improving. On removing the

independent bandage, which was done without removing the essential supports, the wound, which had been dressed with dry lint, was found in the process of healing by first intention.

Fig. 1.

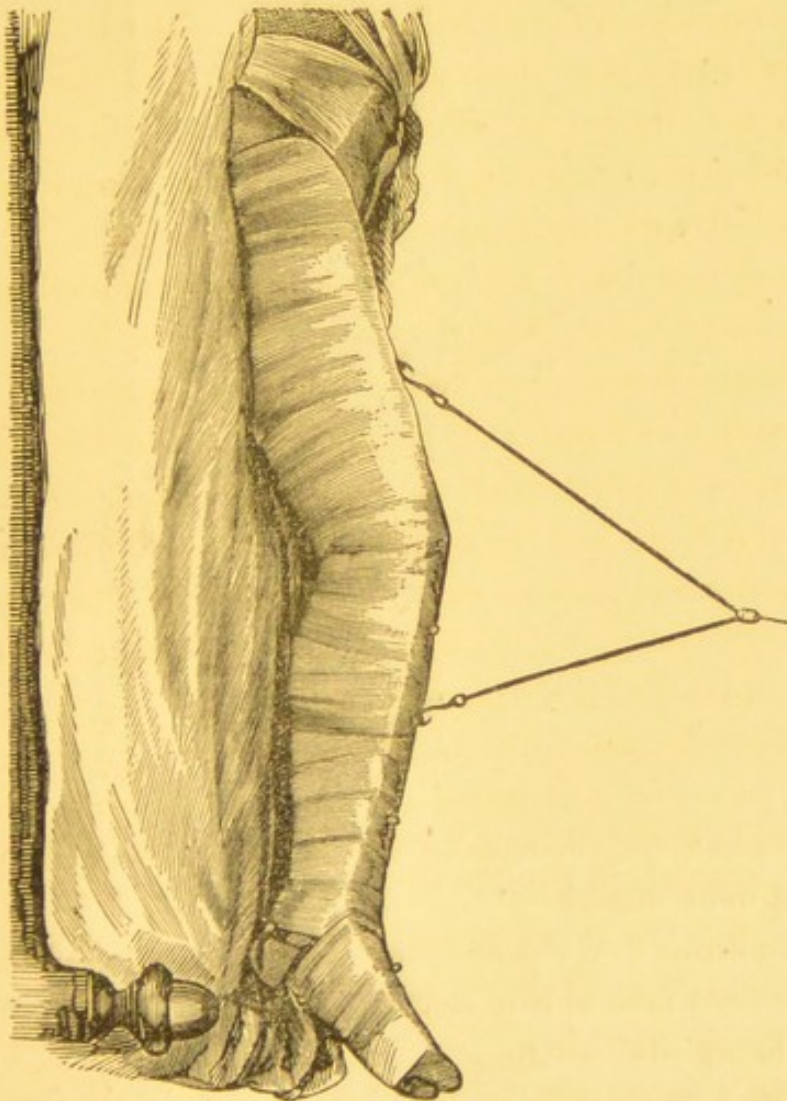
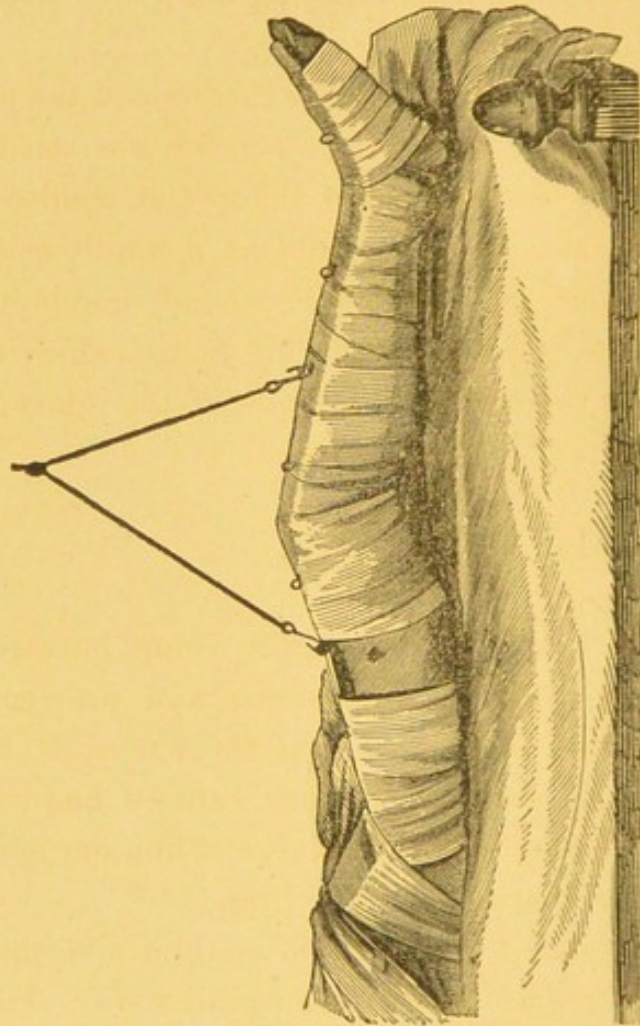


Fig. 2.



The two engravings here given illustrate this case. They were copied from photographs made by an artist at the bedside of the patient, and are therefore faithful representations of the member and dressings, without any fancy sketching.

Fig. 1 represents the member as completely dressed and suspended.

Fig. 2 represents the member with the independent bandage removed, and exhibiting the wound and adjacent parts.

It is not necessary to note the condition of the patient from day to day, as his improvement was steady and uniform. No suppuration of the wound resulted, and indeed it healed as kindly and as promptly as do the most favorable cases of simple wound, uncomplicated with fracture. When he left the house, which was at the end of six weeks from the time of the injury, there was no appreciable shortening.

CASE III.

B—— W——, a bounty-jumper, being pursued as a deserter, was shot by his pursuer, and suffered compound fracture of the middle of the femur, September 25, 1865. He was for some time exposed and roughly handled, the parties having charge of him not handling him with any particular tenderness.

The next day he was carried to the University Hospital, and "pitched" into the surgical ward. The suspensory apparatus was applied and admirably adjusted, cut, by Dr. Milholland, resident surgeon of the house. The member was tumid, tense and discolored. He bore his pain and the handling with stolid indifference; pulse about 90.

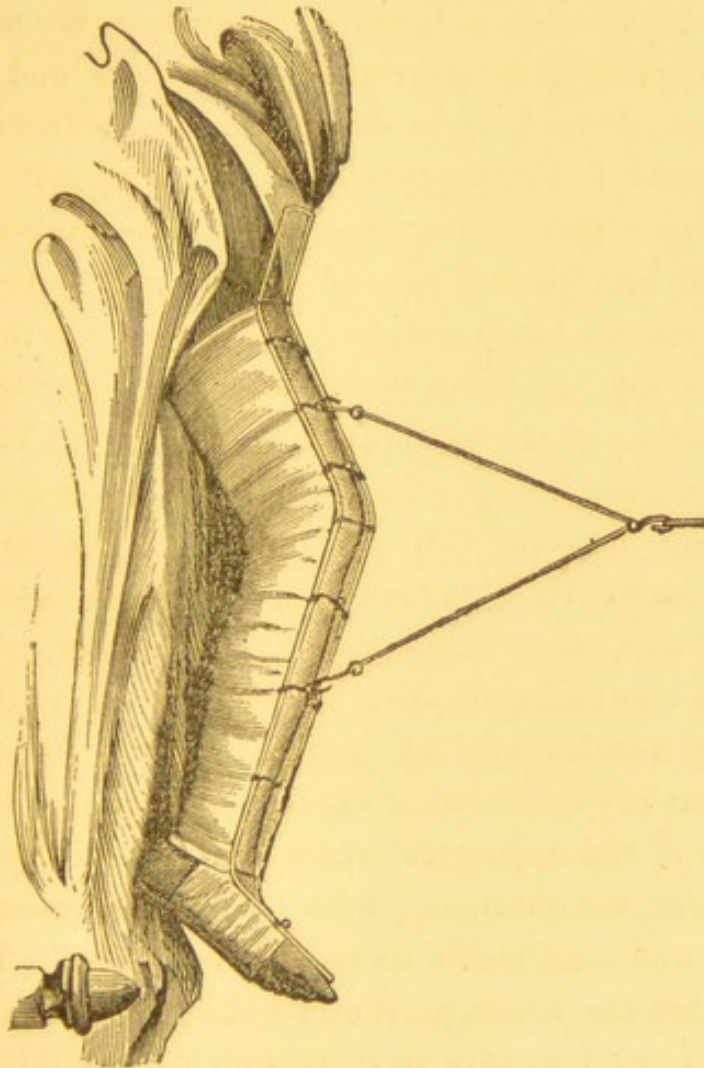
The next day (27th) he was free from suffering; had slept; taken nourishment; had but little heat of skin;

pulse 90 ; expressed himself as being perfectly comfortable since the adjustment of the member.

. . . . 28th.—In all respects doing well ; pulse 80 ; no pain ; one satisfactory alvine discharge.

. . . . 29th.—Case progressing favorably. We removed the independent bandage and exposed the wound, which had been dressed, as in the former case, with dry lint. We found it already closed, without suppuration, and altogether progressing favorably. Everything went on well with him till the end of the fourth week, when I directed the bandage to be sewed strongly to the wires on each side, all along the member, and then the anterior portion of the bandage to be cut away. Thus the limb remained suspended by the posterior loops of the bandage, and was entirely exposed to view in front, from one extremity to the other. Union had now taken place, with more callus than in the former case, and with a shortening of about three-fourths of an inch.

The member now lay in the trough of the support without any constricting bands. Sinking into the concavity of the apparatus, which had assumed perfectly its form, the member, by its weight, maintained perfectly and comfortably its length and shape. The patient left the house, at the end of seven weeks, with a perfect member, with the exception of the slight shortening mentioned above. Fig. No. 3 is taken from a photograph accurately representing the member as it appeared after the removal of the anterior portion of the bandage.



It is remarkable, that in neither of the above cases did there occur any necrosis. This result is exceedingly rare where such fracture is caused by a bullet, as such injury is always comminuted. The vitality of such fragments as are struck off is, in favorable cases, preserved, and they enter into the composition of the callus like pebbles in the composition of the rock called breccia, or pudding stone. The illustration on page 36 exhibits this result of nature's effort. The comminuted fragments are seen sticking in the mass of callus in all directions.

It will be observed that, in both the above cases, the dressings employed were the simplest possible. There was no adhesive strip employed, nor wet dressings. A pledget of dry lint and a small compress were applied under the independent bandage. In the treatment, indeed, of ordinary wounds, I never employ adhesive strips or sutures, unless they are absolutely necessary to maintain the apposition of parts. A simple pledget of lint, imbibing a little blood, is the best of all dressings, and most acceptable to nature.

In neither of the above cases, it will be observed, was any attempt made to extract the bullet. It could not be felt on careful manipulation, and any attempt to discover and remove it by incisions, probing, and the use of the forceps, would have greatly aggravated the mischief, and perhaps have brought about very different results. The practice of digging for bullets in deep wounds, when their position cannot be distinctly deter-

mined, is an opprobrium to modern surgery. The operator is often urged on to this absurd practice, by the popular belief that it is the presence of the bullet from which all the trouble is to arise, and that the extraction of it is everything. A surgeon sometimes gains a momentary eclat for discovering and extracting a ball, when, by so doing, he has inflicted ten times more injury than would have resulted from leaving the missile in the part, to become, perhaps, encysted and innocuous.

I could present other cases of almost equal interest that have been treated by myself, but I prefer to give those which I have received from the hands of others. The following is furnished by the sufferer himself, at the time of the injury, an officer of distinction in the Confederate army, now a graduate of the University of Maryland, and a practitioner of Medicine and Surgery. It is communicated by letter as follows :

CASE IV.

WILMINGTON, NORTH CAROLINA.

PROF. SMITH :

Sir :—As I am indebted to you for my lower extremities, I feel it my duty to give you a history of the remarkable cure effected by your (Smith's) "Anterior Splint." The history is as follows :

On the 3d May, 1863, about 7 A. M., at the battle of Chancellorsville, I was wounded by a minnie ball, piercing and fracturing the femur at the junction of

the lower two-thirds with the upper third. I remained on the field several hours after the wound was received, and when I was found life was almost extinct, from the great exhaustion. While being examined, I, several times, came near dying; but, at last, the wound was probed, my leg dressed and bandaged as well as could be done in a field hospital.

Next day I was sent to Richmond, Va. I was only two days there before I was conveyed to Wilmington, N. C., by request of my friends. When I arrived at Wilmington I was almost in a moribund condition. The travel, together with the imperfect splint applied, rendered the pain so intense that it was insupportable. The limb was perfectly black. I was there met and treated by my cousin, T. N. Ennett, who, after consulting other eminent physicians of the city, all of whom urged the operation of amputation, submitted the case to me. I absolutely declined having the operation performed. My cousin respected my decision, and immediately discharged the new attendants. He applied "Smith's Anterior Splint." At that time I knew nothing more of one splint than of another. I don't think Dr. Ennett had much idea of saving my limb, but (as he has since said) he was determined to adopt the most rational plan of adjustment and support. He, therefore, applied the Anterior Splint, and in a few minutes such was the great relief experienced that I slept sweetly and profoundly for the first time for several days. The splint was neatly and comfortably applied

to the parts, the suspension at the proper angle, and, in fact, everything was as if the splint had been intended for my case alone.

My leg was not examined for a week, and then only slightly, as I strenuously besought him to leave it alone. My suffering had been so great that I cared not to undergo even a slight pain; but at the end of the second week, he pronounced my condition flattering, much to the surprise of the surrounding community. At the end of the third week he pronounced my leg # able to support me, but, being fearful, I begged him to replace it, which he did. It continued to improve, and, at the end of the fifth week, the apparatus was removed and a common starched bandage applied. I could then raise my leg without pain. At the end of the eighth week I could walk, but being so anxious to escape shortening, I kept my room till the end of the twelfth week, when I could go where I wished, but was always very careful. At the end of the twentieth week, I returned to my command with a good leg, without shortening, and as strong as the other, and no deformity whatever. My appearance and resumption of my command, was almost as surprising as though I had been raised from the dead; but, after an explanation, I succeeded in convincing them that I was earthly, and that my presence was due to "Smith's Anterior Splint," after which, every man, as soon as he was wounded, wanted to know if the splint could be applied beneficially.

In giving you a history of this case, I do so, believing it to be one of the most remarkable cases on record, and all, I think, due to the "Anterior Splint."

Since that time I have been a Student of Medicine, and can now appreciate its value.

CASE V.

The following case, furnished me by Dr. T. A. Reed, of Baltimore, is one of the most remarkable instances of recovery from complicated gunshot fracture on record:

Captain Edward Nichols, of the Sixth New Jersey Volunteers, at the battle of Gettysburg, was shot July 2d, 1864, through the left hip, with a minnie ball. The missile entered the groin, traversed the joint, fractured the neck of the femur and issued at the opposite point. He was brought to Baltimore next day, in a truck car, with the design of conveying him home at once; but, on reaching this city, his condition became such that the attempt was abandoned.

He was taken to the hospital of the Church Home, where I was doing duty as surgeon. The case wore a most discouraging aspect. The patient was greatly exhausted, suffering an agony of pain, and the member much swelled and discolored. A high degree of irritative fever existed.

The case presented an aspect so hopeless that, as a dernier resort, an eminent army surgeon, who saw the case with me, at once advised an amputation at the hip

joint. The patient, however, refused to submit, and chose the alternative of probable death without an operation.

I then, with a view to rendering him as comfortable as possible, and with some hope of saving life, placed the injured member in your anterior splint, carefully adjusting the bandage and giving the proper obliquity to the suspending cord. The patient was well nourished, and stimulated freely with whisky. The next day, July 4th, the condition of the patient was decidedly improved. The pain had much abated, and the swelling had, in a measure, subsided, febrile symptoms much abated, pulse about one hundred.

Simple dressings were applied to the wound, in which there took place no considerable amount of suppuration.

It is probably not important for your purpose that I should relate all the particulars of the subsequent treatment. It will suffice to say that the patient went on to improve, from day to day, till September 3d. I then removed the bandage, and found the wound closed, and that union has been effected in the bone. Indeed, I removed the apparatus completely, but, fearing that the callus might not yet be sufficiently firm, I replaced it and maintained the support till the 1st of October. On then liberating the member, it exhibited scarcely the least deformity, and a shortening of not more than half an inch. He then left for home.

At Christmas he visited Baltimore, and I had the pleasure of entertaining him at my house. He then

walked without crutch or stick, and with but very little halting.

I regret that, as I am now confined to my bed by sickness, I cannot give you a more particular description of this remarkable case.

Very truly yours,

T. A. REED, M. D.

CASE VI.

The following case is furnished by my friend, Dr. Wm. Whitridge:

Charles H., a medium-sized, but very muscular man, a bricklayer by occupation, whilst at work upon a scaffold, fell a distance of some thirty feet. On visiting him, about an hour and a half afterwards, he was found suffering considerably from the shock, and, in addition to several bruises and abrasions, the left os femoris was found to have sustained a fracture about the point of juncture of the middle and lower thirds. He was greatly depressed by the ideas he had formed of the suffering and constraint he would be compelled to endure for the next month. As he expressed himself, it was not the injury, but the confined position in bed that troubled him. The fracture was a transverse one, and the lower fragment was strongly drawn up to the right of the upper. After considerable traction, gradually and steadily kept up, the lower fragment was

drawn down and brought in opposition, the anterior splint being properly bent and fitted to the limb, was securely bandaged and suspended from the ceiling. When told that the operation was now completed, he expressed himself as feeling decidedly comfortable, and relieved of his preconceived ideas of suffering and restraint. His limb was kept undisturbed in the apparatus from October 1st until nearly Christmas, although a perfectly firm union existed much earlier. He appeared, and expressed himself, so comfortable, that I felt reluctant to remove it and subject him to the risk of having any deformity whilst the bony deposition was pliant. For this reason he was kept in bed longer than was perhaps necessary. Upon removing the splint, I was agreeably surprised to find the limb barely perceptibly shorter than its fellow. The patient assures me that he can perceive no difference in his gait.

Very respectfully, yours,

WM. WHITRIDGE.

The two following cases were furnished by my son, Dr. A. P. Smith :

CASE VII.

On the 8th January, 1863, E. W., aged seven years, was run over by one of the city passenger cars, whereby he sustained a terrible compound, comminuted fracture of the right femur, accompanied by much laceration of

the soft parts. For the twelve hours succeeding the injury, he was much depressed, and it seemed very doubtful whether reaction would occur. The limb was, however, suspended in a small anterior splint, and stimulants cautiously administered. An "independent bandage" was applied over the wound, which was situated upon the inner surface of the thigh, and was very extensive. In this it was possible to dress the wound twice a day without disturbing the fracture in the least. In four weeks the bone had firmly united, although it was some time longer before the wound in the soft parts had entirely healed. He has now perfect use of the limb, and there exists shortening to the extent only of one-eighth of an inch.

CASE VIII.

T. H., aged twenty-five years, was wounded on the night of November 18th, on the outer side of the left thigh, by a pistol ball, which passed directly across the limb, fracturing the femur at its middle, and lodging under the integument of the opposite side. When seen, a few hours after, the limb was much swollen, and he was suffering great pain. The splint was applied the next morning, a small pledget of lint being placed upon the wound. From the moment of the application of the apparatus, he expressed himself perfectly comfortable, and, four weeks afterward, upon the removal of the splint, the wound was found closed and

the bone was quite solid. As he was anxious, however, to be removed to his home, which was some hundreds of miles distant, the instrument was re-applied and he was transported with perfect ease and safety. A week after reaching home, in attempting to use his crutches, he fell, again fractured his thigh, and was immediately replaced in the splint. A few days ago I had an opportunity of examining his limb, and find, that, in spite of the repeated injuries which it has sustained, there is only shortening to the extent of one-fourth of an inch.

But the usefulness of the suspensory apparatus is not restricted to the treatment alone of fractures of the lower extremity. If it gives the support which we claim that it does, it must be appropriate in all affections of the lower extremity in which accurate support and perfect repose are required, and where frequent dressings may be necessary without disturbing the essential supports,—where, also, it may be necessary to maintain a particular angle at the knee or hip.

In wounds of the knee-joint, I have found the apparatus eminently serviceable. Penetrating wounds of the joint are often followed by high inflammation, supuration, intense irritative fever, the necessity for am-

putation, and even death. These disastrous results of such injuries are in a great measure attributable to the impossibility, in ordinary modes of treatment, of keeping the injured parts in a state of perfect repose, and free from traction on the ligaments. While the person who has suffered such an injury is resting in the ordinary way on his bed, with the limb never so carefully resting on pillows, or other immovable supports, it is impossible to prevent the mechanical disturbance of the joint, by the unavoidable movements of the trunk necessarily imparted to the femur. The patient cannot stir his body in the least degree without provoking acute pains in the injured part. The leg, too, is contorted by the weight of the foot, and thus a strain is exerted on the ligaments of the knee very difficult to obviate. The patient then suffers seriously from two sources: first, the local irritation caused by unavoidable movements; and secondly, from the distress and tedium caused by one unvarying posture, which he cannot change without intense suffering. He cannot have his evacuations without suffering hurt. Bed-sores on the sacrum and heel are likely to result.

All these difficulties are at once obviated by the suspension of the member. The movements of the trunk no longer affect the knee; the patient can change his posture with ease; the angle of the knee is preserved; the foot, being supported, no longer contorts the leg; the patient can have his discharges without difficulty. A degree of obliquity of the cord exerts gentle traction

upon the ligaments of the joints, and obviates the mischievous pressure of the head of the tibia against the condyles of the femur, caused by the tension of the joint.

I have seen patients exulting in the relief which they have almost instantly experienced from the use of the support, and sleeping quietly, after nights and days of sleeplessness and pain.

In violent sprains of the knee-joint the apparatus is equally appropriate; so also in spontaneous inflammations. Not the least of the advantages furnished by it is the facility with which, in its use, irrigation can be practised. For this purpose the syphon may be employed, as by Dr. Shrimpton, in the case related above.

In chronic inflammations of the knee-joint resulting in arthrocacy—white swelling—the same mechanical management is appropriate. Dr. Sayre and other surgeons of our country have devised mechanical means for making permanent extension in such cases, and thus obviating injurious pressure. In bad cases I have found nothing to effect the object so well as the suspensory apparatus. In its use, the thigh and leg are each placed upon an inclined plane, and therefore recede from each other by their own weight making traction on the ligaments. The effect is increased by the obliquity of the cord. Should the disease have advanced so far as that ankylosis is inevitable, it will be easy to adjust the angle so as to give the greatest degree of usefulness to the limb.

In disease of the hip-joint, repose and extension are important mechanical indications. I have found them accomplished in the most satisfactory manner, by the use of the support regulating the extension by the obliquity of the cord.

CASE IX.

BALTIMORE, March 27th, 1867.

PROF. N. R. SMITH:

Dear Sir:—I append a brief account of two cases of compound comminuted fracture of the femur, treated in the anterior splint, shortly after the battle of Gettysburg, at Jordan's Springs Hospital, of which I then had charge. The first was a Confederate soldier (name not remembered), who had received a gun-shot wound producing compound comminuted fracture of the femur, about the junction of the lower and middle thirds. He came under my care about ten days after the injury, up to which time he had received no other treatment than an attempt at the comfortable adjustment of the limb by a simple arrangement of pillows.

The wound was at this time in an extremely bad condition. The pus failing to make its exit from the inferior orifice, which was pretty effectually closed by the pressure of the limb upon the bed, had dissected the muscles to a considerable extent, collecting in large

quantity in the more dependent portion of the leg. A small bed-sore was found over the lumbo-sacral junction, where a knot in one of the poles of his soldier's bed pressed upon the part. Several fragments of bone were removed, the pus carefully pressed out through the lower orifice, and a bandage applied tightly from the hip to the wound; and the anterior splint was closely, though not tightly, adjusted to the leg. An independent bandage covered the wound, which permitted it to be readily cleansed without at all displacing the splint. As soon as the pain consequent on the altered position of the limb had subsided, the patient professed himself comfortable, and experienced comparatively little suffering afterward, being now able to move freely in bed. His bed-sore gave him no further trouble.

Notwithstanding the bad food, bad nursing, uncleanly condition of the wards (owing to the scarcity of nurses), and the depressing mental influences this patient was compelled to endure, he continued slowly, but steadily, to improve; and when, at the expiration of ten weeks, the splint was removed, the fractured extremities were found strongly united, with the limb not more than an inch shortened.

CASE X.

In an adjoining ward was a second soldier, wounded on the same day, in the same situation, whose leg was encased in a splint made of the bark of an oak sapling, which he said had been adjusted by the field Surgeon about an hour after he was shot. It fulfilled a good part so far as the retention of the fragments in apposition was concerned, but the slightest motion of the body occasioned great suffering, and cleanliness, with its use, was not a possible thing.

There was less comminution in this case, and it was not found necessary to remove any fragments of bone, but, when the splint was removed, the inferior surface of the limb was found completely excoriated by the pus which had collected beneath it, and from which there proceeded such an offensive odor as would, in a very short time, have impaired the general health of the patient. After being nicely washed, the leg was swung up in the anterior splint, which was applied as in the other case, and here, also, as soon as the muscles had adapted themselves to the altered position of the leg, all pain ceased ; and, six weeks afterwards, the splint was removed, union was perfect, and no appreciable shortening existed. I am convinced that with no other splint could that cleanliness so essential in the treatment of compound fractures, together with the ease and comfort of the patient, have been so effectually preserved, and, when the exhausting influence of con-

stant pain, and the depressing effect of nauseating odors are considered, it may fairly be presumed that, had they continued, death would have been a more probable result than recovery.

Very respectfully,

Your obedient servant,

THOS. S. LATIMER, M. D.

CASE XI.

W. G., Esq., a citizen of Baltimore, on the 28th inst., was thrown, with great violence, from an open buggy, which he was himself driving, and alighted upon his left foot with such force as to cause, by counterstroke, a very comminuted fracture of the tibia and fibula, extending into the ankle joint.

He was twelve miles distant from the city when the accident occurred. He was immediately brought to town in a carriage, over a rough road.

The limb was simply wrapped in a blanket, which furnished, of course, no adequate support. He suffered greatly, therefore, from the jolting, and undoubtedly the injury was thereby still further complicated. I saw him a few minutes after his arrival. I found the member greatly distorted; the sharp angular fragments urged against the integuments, but there was no external wound.

The tibia was fractured obliquely near the ankle, and the lower fragment comminuted, the fracture extending into the joint. The fibula was also fractured, some two inches from its extremity. Of course it was impossible, in the tumid condition of the ankle, to determine the precise number of fragments or their form. The member, however, was greatly deformed; the angles of the fragments were distinctly felt projecting, and the foot was contorted outwardly. I promptly reduced the fracture by extension and careful manipulation, restoring as perfectly as I could the natural form of the member. I then applied, for the night, the starched, movable apparatus, described in this volume.

29th.—The patient had had a somewhat restless and painful night; pulse, however, nearly natural. The member had become more swelled, and I found it necessary to divide, with a knife, that portion of the bandage embracing the injured portion of the limb. The portion above and below was undisturbed and sufficiently supported the limb, which, with the apparatus, was placed on pillows. I directed whisky and water to the tumid portion.

In the evening, Prof. Ch. Johnston, the family attendant, saw him with me. The patient was now free from pain, and, as the inflammation appeared to be subsiding, we determined to let it thus rest till the next morning.

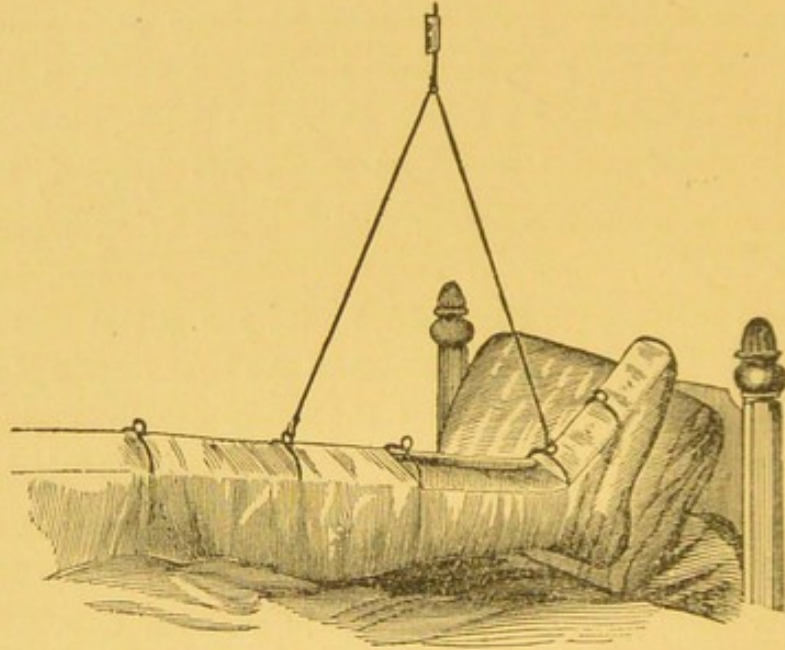
30th.—The patient, with the aid of an anodyne administered hypodermically, by Prof. Johnson, had slept

well ; was suffering no pain, and the swelling had still further subsided. We now proceeded to apply the anterior splint. Four strips of bandage were passed, one under the foot, another under the ankle, a third under the calf, and a fourth under the thigh, above the knee. The splint was laid along the member, that portion immediately over the fracture not being wrapped with muslin.

The strips were then folded over the splint and secured by pins. We now attached the hooks—one above the middle of the leg, and the other over the ankle. Gently drawing upon the tent-block, we raised the limb from the pillow without causing the slightest pain. We then applied the bandage, commencing at the foot, and carefully wrapping the whole member to a point above the knee. An independent bandage was applied to the heel, carefully adapting the turns to the whole surface, so as to diffuse the pressure.

I now sewed the turns of the bandage, corresponding to the fracture, to the wires of the splint, and then cut away, with scissors, that portion of the bandage which covered, in front, the injured portion of the member. Thus our support was perfect, while the injured portion was open to view, and accessible to our local applications.

31st.—The patient has had a good night. He is free from pain ; the swelling has much abated ; he is, in all respects, doing well.



The engraving is made from a sketch taken at the bedside, and faithfully represents the apparatus as applied.

I here introduce the following report, illustrating the efficiency of the anterior apparatus. It is taken from the Confederate States *Medical and Surgical Journal* :

Statistics of Compound Fracture of Femur. A report of cases of Compound Comminuted Fracture of the Thigh from Gun-shot Wounds treated in Winder Hospital, Richmond, Va., since its organization, April 1, 1862, to December 1, 1863. By Surg. A. G. Lane, in charge.

NO.	NATURE AND SEAT OF WOUND.	CHARACTER OF OPERATION, TIME AND POINT OF SAME.	TREATMENT.	RESULT.
1	Fracture at middle third.....	Amputation, flap operation, primary, at upper third..	.....	Died.
2	Fracture at lower third.....	Amputation, circular operation, secondary, at middle third.....	.....	Died.
3	Fracture at lower third.....	Amputation, flap operation, primary, at middle third,	.....	Recover'd
4	Fracture at lower third.....	Amputation, circular operation, secondary, at middle third.....	.....	Recover'd
5	Fracture at lower third.....	Amputation, circular operation, secondary, at middle third.....	.....	Recover'd
6	Fracture at upper third.....	.....	Treated with double inclined plane....	Died.
7	Fracture at upper third.....	.....	Treated with double inclined plane....	Died.
8	Fracture at upper third.....	.....	Treated with double inclined plane....	Died.
9	Fracture at upper third.....	.....	Treat'd with Smith's anterior splint....	Died.
10	Fracture at upper third.....	.....	Treat'd with Smith's anterior splint....	Died.
11	Fracture at lower third.....	.....	Treat'd with Smith's anterior splint....	Died.
12	Fracture at upper third.....	.....	Treat'd with Smith's anterior splint....	Died.
13	Fracture at middle third.....	.....	Treat'd with Smith's anterior splint....	Died.
14	Fracture at upper third.....	.....	Treat'd with Smith's anterior splint....	Recover'd
15	Fracture at middle third.....	.....	Treat'd with Smith's anterior splint....	Recover'd
16	Fracture at middle third.....	.....	Treat'd with Smith's anterior splint....	Recover'd
17	Fracture at middle third.....	.....	Treat'd with Smith's anterior splint....	Recover'd
18	Fracture at lower third.....	.....	Treat'd with Smith's posterior splint...	Died.
19	Fracture at middle third.....	.....	Treated with long, straight splint....	Died.
20	Fracture at upper third.....	.....	Supported on pillows.....	Died.
			Supported on pillows.....	Died.

SUMMARY.

	RECOVERED.	DIED.	TOTAL.
Operations, primary, flap.....	1	1	2
Operations, secondary, circular.....	2	1	3
Amputation at upper third.....	0	1	1
Amputation at middle third.....	3	1	4
Number treated with double inclined plane.....	0	3	3
Number treated with Smith's anterior splint.....	4	4	8
Number treated with Smith's posterior splint.....	0	1	1
Number treated with long, straight splint....	0	1	1
Number supported on pillows.....	0	2	2
Number of fractures at upper third.....	1	7	8
Number of fractures at middle third.....	2	3	5
Number of fractures at lower third.....	0	2	2
Number recovered, 7; number died, 13; total number treated, 20.			

It will be observed that the only cases which recovered without amputation were those treated by the anterior apparatus. All that were treated by other apparatus terminated fatally. Only fifty per cent., it is true, were saved by the use of the suspensory apparatus; but by other means, none. This is highly favorable, when we consider that the apparatus used in the Southern hospitals was very imperfect,—the wire too small and yielding, and the instrument unprovided with important improvements since made by me.

It is to be presumed, also, that the application of the apparatus was less perfectly understood than it now is.

There occur cases of fracture of the leg, in which, after treatment by the suspensory apparatus and the accomplishment of union, the callus is not yet firm enough to justify the removal of all mechanical support. In these cases, if we allow the patient liberty, any imprudent use of the member, or violence from a fall likely to occur from the weakness of the limb, the fracture may be repeated, or serious deformity be produced. I have now in my mind a case of fracture of the bones of the leg, in which the apparatus having been em-

ployed with a most satisfactory result, serious deformity of the member was induced by its imprudent use.

I have, therefore, in many cases, after releasing the member from the anterior apparatus, applied for a few days a modification of the starched bandage.

The resistant portions of it are two pieces of band-box board, or thin binder's board, about eighteen inches long, three and a half inches wide at the upper extremity, and three inches at the lower. These I soften in warm water, and then besmear thoroughly with stiff starch. Then I wrap them with a muslin bandage, thus:—



No starch is applied to the outer surface of the bandage, as it is intended to be a movable apparatus. I now wrap the leg, rather loosely, with a bandage, and having done so, apply the two supports on each side of the member,—the upper extremities reaching the knee, and the lower extending two inches below the sole of the foot. These projecting lower extremities are made to overlap each other below the sole of the foot. I then

apply the bandage, beginning at the foot, and by its pressure and by manipulation, moulding the starched supports to the form of the foot, ankle and leg. Care must be taken that the turns which pass under the foot shall secure well the ends which overlap each other.

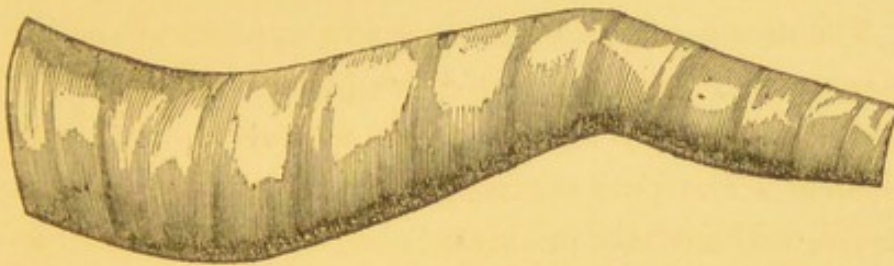
The member, thus dressed, is now exposed to the air of a warm apartment. In a few hours it becomes dry and firm enough to fortify effectually the yet weak member. The patient may then exercise on crutches freely, without risk of injury, and without the production of swelling.

It may not, perhaps, be necessary to disturb this apparatus for ten or fifteen days, at the end of which time support will no longer be necessary. But sometimes, in drying, the edges of the boards turn in and sharply impress the skin, and sometimes irritate. Then unwrap the bandage (which does not adhere), remove the supports, and, after, with pincers or the fingers, having turned out the edges, reapply the whole.

In simple fractures of the leg, especially below its middle, and in treating the member of a child, or that of an adult not very heavy, I often employ this support primarily. Indeed, I often treat a simple fracture of the thigh in a young child by this method, using but one piece of binders' board on the outer part of the hip, thigh, and upper portion of the leg. The bandage is, of course, to be carried round the hips and abdomen.

Such a support is far better than a cumbrous appa-

ratus of wood, which is incapable of obeying the movements of the body.



The accompanying cut, from a photograph, represents a splint of this kind, removed from the limb of a little boy of four years, in whom I treated a fracture of the thigh two years ago.

I once treated, some twenty-five years ago, a fracture of the thigh in an infant, produced in the birth by the manipulation of turning and delivering. It was broken at the junction of the upper third with the middle. From the great volume of the thigh in proportion to its length, and the perpetual motion of the short upper fragment, caused by the irresistible contraction of the flexor muscles in infants, I found it impossible to maintain perfect co-aptation, or to prevent motion. Union took place, but with so much deformity as to give me no small concern. To my great gratification, however, on examining the member a year afterward, the de-

formity had almost totally disappeared. The member is now perfect.

I would take occasion here to remark, that generally, in fractures occurring in young children, in whom the bones are undergoing rapid development, the deformities, occurring from any untoward circumstance, are to a surprising extent corrected by the future development of the bone. Nature has great control, at that early period, in restoring the mechanical relations of the bone to the action of the muscles.

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