SURGEONS' SPLINTS

AND

IMPROVED

Apparatus for Fractures.

BY

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Advertisement.

To Surgeons and Physicians :

The object of the following circular is to describe, and invite attention to a new form of Surgeons' Splints and Improved Apparatus for Fractures and other Injuries and Diseases of the bones or joints requiring mechanical support, and to direct to the appropriate and effectual methods for their application and use. In presenting to Surgeons and Physicians the Splints here described, the subscriber hopes to supply an acknowledged desideratum in the treatment of this important class of injuries. The want of some more available, convenient, and efficient means of giving mechanical support, and maintaining the position of injured or diseased parts than any in general use, is, it is believed, universally felt.

The Splints consist of light and elastic cases or coverings, formed of very thin strata or layers of wood or "cut veneers," cemented together by interlayers of gutta percha, of such thickness as is required to maintain their form, and pressed into the form of the part for which they are designed. By this method of constructing Splints, the fibres of the wood all run longitudinally or parallel with the surface, which gives them great superiority to Splints carved from solid blocks of wood, however skilfully performed and fitted to the part; for when so thin as to be elastic, they are necessarily liable to split and break, and do not retain their form when wet.

Gutta Percha used by itself, was at one time supposed to constitute the *ne plus ultra* as a dressing for fractures, on account of its perfect plasticity and strength, and resistance to the action

of fluids; but experience soon demonstrated that it had not sufficient firmness, at the temperature of the body, to resist the pressure to which it was exposed.

This may be introduced in any proportion required to give strength and durability and resistance to the action of fluids, and when properly applied, it adheres with more firmness to the wood, than the fibres of the wood do to themselves. Another circumstance attending this arrangement of considerable practical importance is, that the Splints are made more flexible and elastic in the lateral or parallel direction of the fibres of the wood, than in the longitudinal; hence, what may seem somewhat paradoxical, they readily accommodate themselves to changes in the dimensions of the limb, resulting from increase or diminution of inflammation, or from interstitial absorption, while they give perfect support to the injured or diseased part. When necessary to adapt them to limbs of individuals differing in the form and size of their limbs, they are made sufficiently flexible by immersion in hot water, or simply enveloping the Splint, or such portion of it as may be necessary, in cloths wet with hot water for a few minutes, and then, on cooling, they will immediately become unyielding and elastic as before. This peculiarity can scarcely be too highly appreciated, for of all the materials heretofore proposed capable of being moulded to the part and hardening after the Splints are applied, none has been found which has not proved decidedly defective in practice. They possess great strength and durability, so that the same Splint may be used a long time, and for the treatment of many cases of fracture. They do not preclude the use of evaporating lotions, water-dressings, or moisture in any manner applied, except when heated much above the temperature of the body. They are applied with great facility, rendering the dressings simple and easy to both surgeon and patient, and allow constant access to the injured part, to detect inflammation at its commencement, or any irregularity in the position of the bones; and after the tendency to inflammation has subsided, dressing or examination by the surgeon is required much less frequently than when ordinary Splints are used. In short, they have combined with the property of being made sufficiently soft and yielding to be moulded, with accuracy, to the surface of the part for which they are designed, all the properties of insolubility, lightness,

elasticity, strength, and firmness, necessary to constitute a *perfect Splint.*

Little need here be said in relation to the effect of such means of support in relieving or curing the injuries or ailments for which they are designed. In favorable and appropriate cases, these have been witnessed in the remarkable and speedy cures accomplished by what is termed the immovable apparatus, or bandaging with starch, gum, or dextrine. We obtain all the advantages of this mode of dressing, probably in nearly or quite an equal degree, without the disadvantages unavoidable in the method of bandaging here referred to, arising from having the parts constantly, or for so long time, concealed from view; being entirely inadmissible in all cases where a high degree of inflammation exists or is apprehended until the inflammatory symptoms are reduced, and too great or unequal compression when unskilfully or injudiciously applied, many times resulting in extensive ulcerations and gangrene, and, as it is said, whole limbs even dropping off.

One circumstance is deserving of especial notice, which is but just beginning to receive the consideration its importance demands. I refer to the complete support given to the muscles implicated in the injury, as a means of preventing contraction, and consequently displacement or shortening of the bones, and also the involuntary twitchings or spasms often so annoying when the dressings are defective.

Complete and uniform support is also an efficient means of preventing inflammation in the lacerations and contusions which attend fractures and gun-shot wounds. On this subject we are especially indebted to Prof. Dudley, of Transylvania University, Kentucky, for demonstrating the efficacy of the bandage, by which, he tells us, not only contraction, but all susceptibility to muscular action, is effectually suspended. He effected this by a "sheath of properly prepared canvas," with so much skill and success, in both gun-shot wounds and fractures, as to triumphantly demonstrate the success of this mode of treatment, and cause him to be emphatically styled "the hero of the bandage." This, it must, however, be admitted, is little else than a modification or simplifying of the dextrine bandage; and it would seem no one can doubt that additional advantage may be derived from a well-adapted case or covering when the support of the

bony structure is destroyed, rather than to trust wholly to position and the immovable confinement of the patient upon his couch.

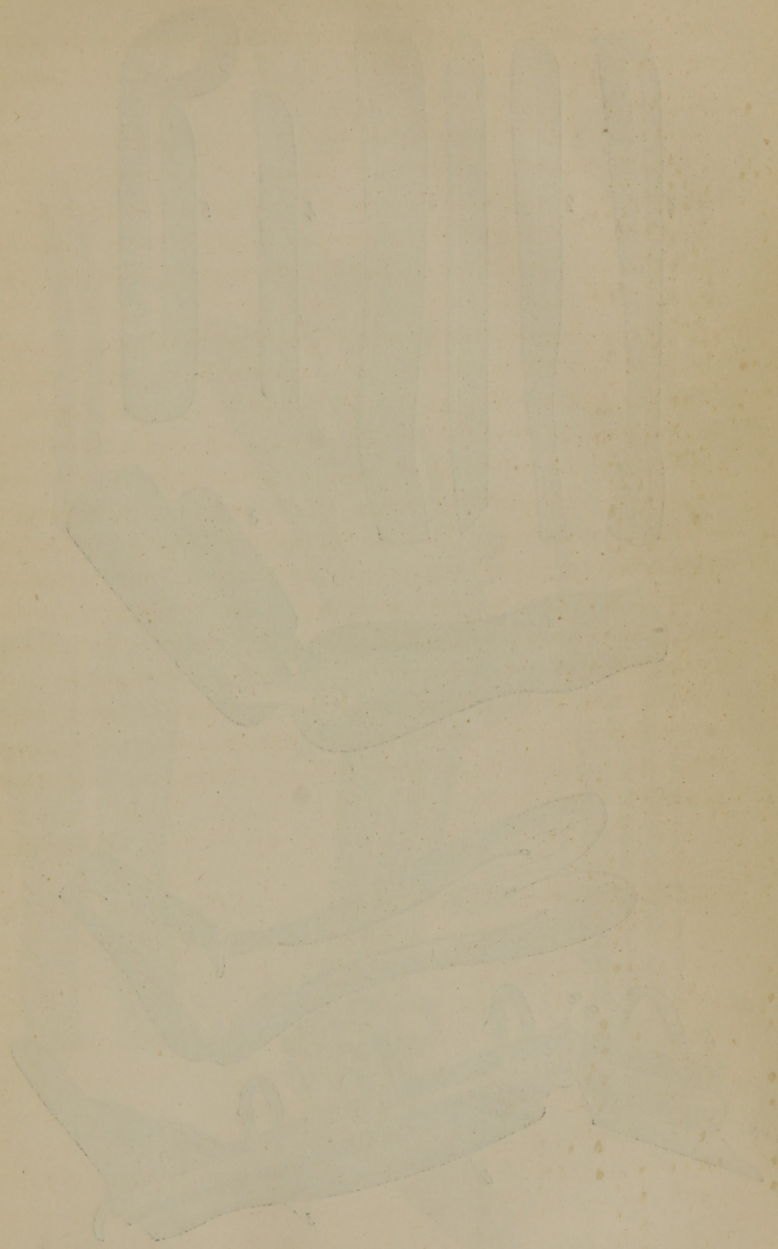
In connection with the above Splints is apparatus for maintaining permanent extension in fractures of the thigh, and for fixing the joints of both the superior and inferior extremities in the extended position, or at any degree of flexion of the limb required. These will be described with the consideration of particular injuries.

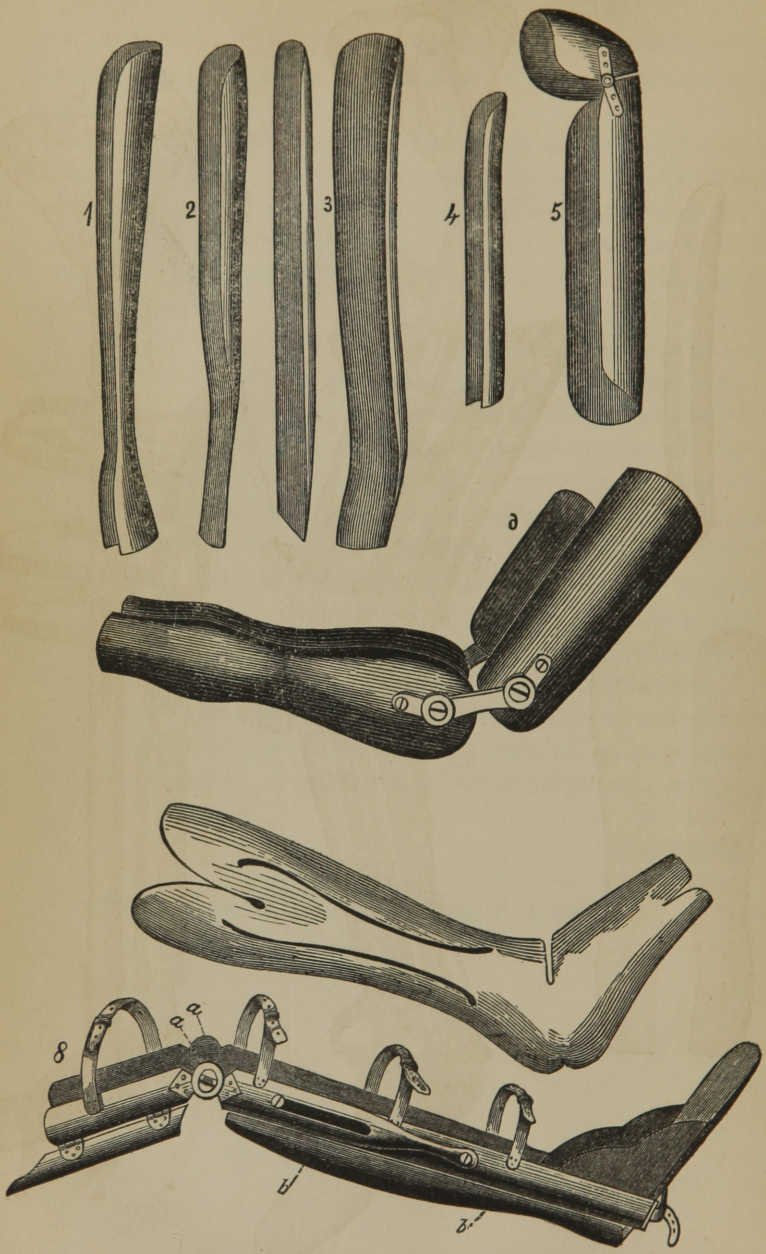
The entire apparatus is made with especial reference to allaying the tedium of confinement consequent to fractures, by allowing changes of position and exercise not inconsistent with the perfect quiet of the particular muscles implicated in the injury, and allowing such removals as circumstances often imperiously demand, as when persons are injured at a distance from their homes; and this will not be found so inconsistent with the greatest success in the treatment as has been generally supposed, for the more complete the support given, and the more perfectly the action of the muscles is suppressed, the greater may be the amount of general exercise without deranging the fracture.

With this simple preliminary statement, a careful examination of the apparatus is solicited, and such approval as an intelligent judgment dictates. Let nothing be set down in error or extenuated, but in verity.

B. WELCH.

Lakeville, (*Salisbury*,) *Conn.*, *Aug.* 1, 1852.

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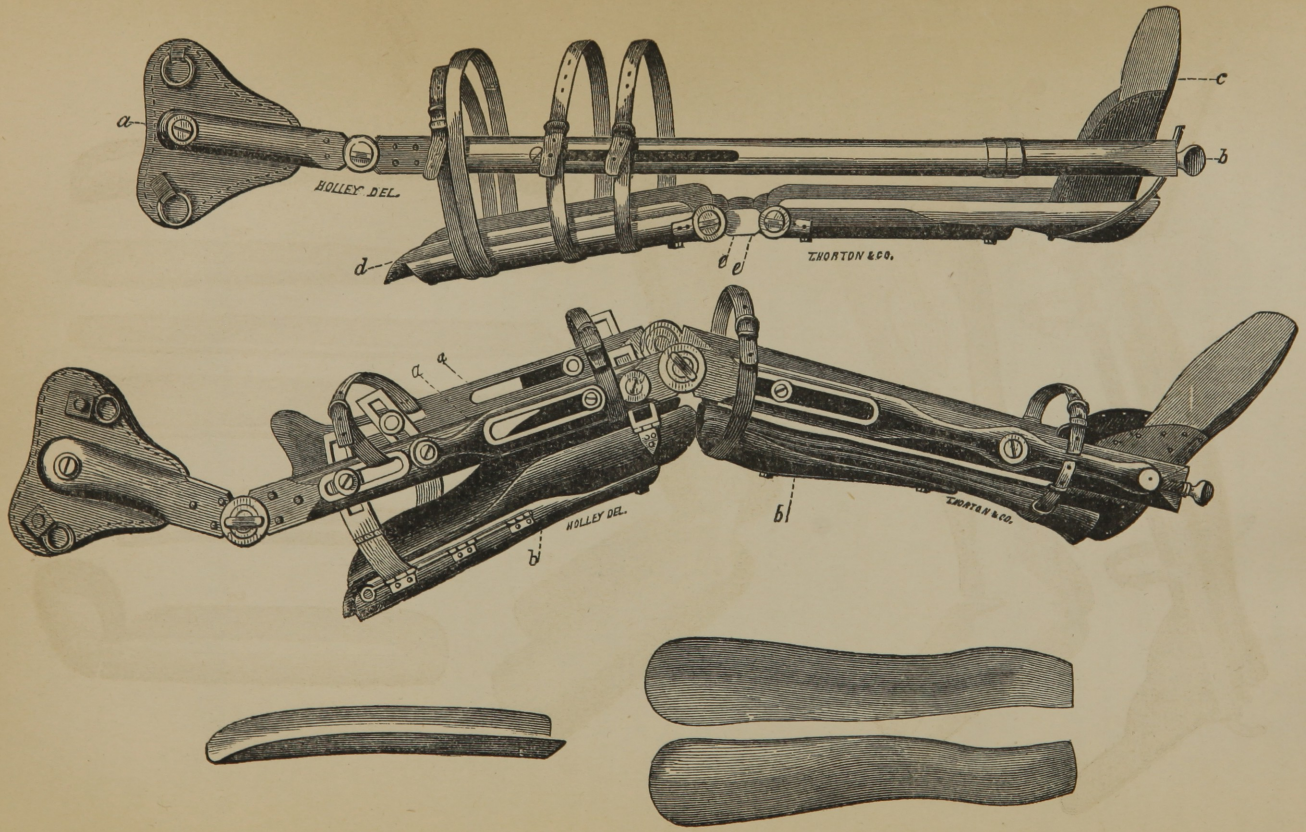
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EXPLANATION OF THE PLATES.

Plate One.

ARM SPLINTS.

Forearm, 1. Ulnar Splint, fitted to the ulnar side of the forearm, with the hand strongly abducted.

2. Dorsal, fitted to the back side of the forearm.

3. Palmar, fitted to the inside of the forearm and hand.

4. Straight hollow Splints of different sizes for the arm.

5. Shoulder Splints, fitted to the top of the shoulder and outside of the arm. The joint is required to accommodate the upper portion of the Splint to the different positions of the shoulder.

6. Splints for injuries of the elbow-joint. These are fitted to the two sides of the arm, and may be fixed at any degree of flexion or extension required by turning the screw, which serves also as a pivot for the hinges *a a*. The hinges may be transferred to Splints of different sizes, as required.

LEG SPLINTS.

7. Longitudinal half-boot, in pairs for the right and left limbs.

8. Jointed apparatus with flexible side Splints for fractures of the leg.

This may be flexed or extended, and fixed in the position required by the hinges *a a*. This is done by means of pinion-like teeth at the circumference of the hinges which are held in contact by screws forming the pivots of the joints. It is fitted to limbs differing in length by sliding joints at the sides of the limb, and in the Splint which supports the under side of the limb *b b*. The depth is increased or diminished by turning a screw at the bottom of the foot-piece *c*. (See Plate 1.) Flexible side Splints are confined by a bandage to the sides of the limb; another may be placed on the top of the thigh to support the thigh straps.

Plate Two.

THIGH SPLINTS.

1. Single extension Splint for fracture of the thigh, with double inclined plane, which may be used separately for fractures of the leg.

a. Extension Splint for the outside of the limb, with an extension screw *b* at the bottom, by which the extending force may be regulated.

c. Foot-piece, which may be raised or depressed by a screw under the foot.

d. Flexible Splints for the under side of the limb, which may be converted into a double-inclined plane, when it is desired to place the limb in the flexed position, or when used separate from the extension Splint for fractures of the leg. It is then fixed in the position required by the hinges *e*, *e*.

f, *f*, *f*. Flexible Splints of different sizes, for the thigh and leg.

2. *Double-jointed extension apparatus for the thigh.* This is used either in the extended or flexed position of the limb.

a, *a*. Extension Splints, inside and outside of the limb. The joints are fixed as in the single extension Splint.

b, *b*. Hollow Splints for the under side of the limb.

c. Foot-piece.

d. Extension Screw.

f, *f*, *f*. Flexible Splints for the thigh and leg.

General Directions for the Application of the Splints.

The Splints, if not perfectly adapted to the surface, are first immersed in water as hot as can be borne by the hand until they are sufficiently flexible; or if more convenient, and only portions need to be changed in form, envelop either the entire splint, or such portions as may be necessary, in cloth wet with hot water. If water, at or near the boiling temperature, be used, some care is requisite that it is not continued so long as to completely melt the gutta percha, so as to separate the layers of veneers. Then a cloth, or if preferred, a very thin cushion of cotton batting, is laid on the splints, and they are fixed upon the limb by a bandage. For a bandage, I usually prefer the roller, which is applied with

more ease and uniformity, and gives better support to the muscles than the bandage of strips or Scultet's bandage. This is first bound upon the limb from the inferior portion of it upwards, the splints are then applied and secured by the roller passed downwards over the splints. If it is afterwards desired to convert this into Scultet's bandage, as it may be, especially the portion of it which comes in immediate contact with the limb, divide the alternate turns with scissors at convenient distances, and they may easily be drawn to suitable positions on the limb.

Application to particular Fractures and Injuries.

FRACTURES OF THE FOREARM.

For Fractures of the Radius, or Ulna, or both these bones together, the apparatus required is—

1. The Forearm Splints, palmar and dorsal.
2. Compresses, to be applied along the interosseous space.
3. The Roller.

After adjusting the bones, first apply the compresses to compress the muscles between the bones; then the roller, previously moistened, from the roots of the fingers to the elbow; after this, the splints; then complete the dressing by passing the roller downwards to the ends of the fingers.

A still lighter and effectual method of securing the splints, is by four or five tapes passed through perforations in the edges of the splints, in such manner that the tapes shall traverse the convex portion or dorsum of the splints and enclose the edges beyond the perforations.

This method of dressing fractures of the forearm is at once simple, easy, light, and effectual in all cases, except where the fracture is seated very near the joints, either of the elbow or wrist; then, different methods of maintaining the position of the bones are required.

Fracture of the Radius near the Wrist, and Fracture with Dislocation of the small Head of the Ulna.

Next to the common form of fracture of the forearm, near the middle of the bones, the treatment of which is so simple and satisfactory, we are immediately met by one of the greatest annoyances in the entire range of fractures, being accidents of fre-

quent occurrence, and annoying to the patient because unavoidably painful, slow in recovering, the fingers and wrist remaining a long time stiff, and rotation of the hand difficult or permanently impaired, and sometimes, also, resulting in permanent deformity of the joint; and annoying to the surgeon, because it is difficult to persuade the patient that an injury so trifling in appearance is necessarily attended with consequences so serious.

Simple fracture of the Radius at the lower extremity near the wrist, as it usually appears, when resulting from falls upon the hand, with projection of the inferior portion on the back of the wrist and corresponding projection of the superior portion anteriorly, can only be mistaken for dislocation of the wrist backwards. If such a mistake occurs, and the case is relinquished after reduction, without mechanical support, the displacement quickly returns, and the deformity is as unsightly as before. A careful examination will enable the surgeon to easily discriminate the injuries. In fracture, rotation is particularly painful, and the displacement is increased by pressing the radius with the thumb in the palmar direction, while we rotate the hand outwards. The precise point of the displacement may be more accurately detected by flexion and extension of the hand. Too much reliance must not be placed on the absence of crepitation, as this sympton can only be produced by forcible extension with rotation of the hand, and, sometimes, not even then. It will usually be perceived at the time of replacing the fracture, and other attempts to produce it only occasion unnecessary pain. There are cases of this accident with only slight displacement, which, in the swollen condition of the parts, cannot be detected. The principal characteristic is, then, painful rotation with the pain referred to this portion of the bone ; but guided by this circumstance alone, subsequent developments will not often show the surgeon at fault in his diagnosis.

The difficulty in the treatment of this injury is greatly increased when complicated by either fracture or dislocation of the ulna, but especially by dislocation. Dislocation of the head of the ulna from the radius may occur also without fracture of the radius, but the fracture is much more commonly present. All these different forms of injuries are usually produced by the same cause, that is, falls upon the hand, and require essentially the same form of mechanical support for their treatment. The dislocation, whe-

ther complicated or simple, is known by the absence of the prominence on the outside of the wrist caused by the small head of the ulna with a corresponding projection in the palmar direction, the head of the ulna lying nearly on a level with the os-pisiforme. This is the direction of the dislocation, at least, in all the cases I have witnessed. When reduced, there is always great liability to displacement, owing to the small and superficial articulating surface of the radius. When there is also fracture of the radius, the tendency to displacement is increased by the strong action of the muscles of the forearm, and the difficulty of binding the head of the radius to the ulna without compressing the superior fragment so far into the interosseous space as to prevent rotation of the forearm, and occasion very considerable deformity of the wrist. In the worst forms of the accident there is much injury of the soft parts, followed by high inflammation and severe pain, which wholly preclude efficient bandaging until the inflammation has subsided. I have, in repeated instances, witnessed this form of injury occurring, to a greater or less extent, in both the wrists at the same time, by persons who, in falling from a height, and naturally projecting the arms to save themselves, have received the principal force of the fall upon the hands.

The treatment of these accidents is, it appears to me, but imperfectly considered in the books. Boyer remarks, concerning fracture of the radius near the wrist, that "There is always, in this case, a considerable swelling of the adjacent articulation, and afterwards more or less difficulty in its movements;" and in complicated fracture, "As we cannot foresee the period when we can apply the apparatus, and as at this time the bones may have united in an unnatural position, it is proper to advise the patient of the probable loss or difficulty in the action of pronation and supination."

So far as the difficulty in these cases arises from the difficulty of retaining the bones in their proper position, it may, I think, in all cases, be overcome, provided the necessary applications are made speedily after the injury is inflicted, before inflammatory action has commenced, and the patient will exercise any tolerable share of submission to the restraints imposed upon him.

The indications are, first, to secure absolute rest of the part, with the thumb pointing upward. 2. The ulna being re-

garded as the fixed point of support, the inferior portion of the radius is to be constantly and forcibly impelled towards it. 3. The head of the radius and hand, strongly abducted, are to be retained in their proper position in relation to the shaft of the bone.

The first and second of these indications may be fulfilled by means of what I have denominated the ulnar splint, (*pl.* 1, *fig.* 1,) and are not fully answered, so far as I am acquainted, by any other means. The splint being properly softened by immersion in warm water, and a narrow compress placed under the ulna, extending to the small head of the bone, the arm is placed upon the splint, and secured by a roller, and the principal force being applied to the hand while the roller is loosely applied over the radius, the interosseous space is increased rather than diminished, and the radius held firmly pressed upon the ulna. We have now accomplished just what is done in all analogous injuries: for example, by the splint of Dupuytren in fractures of the fibula, with dislocation of the ankle outward, or fracture of the inner malleolus of the tibia, with dislocation inwards; just what we practice in fractures of the condyles of the femur or humerus. Resistance is made upon the sound side of the limb, and the displaced part is impelled towards it. What reason can be assigned for a departure from these principles in the case before us? This much being accomplished, the palmar and dorsal forearm splints are applied, and the remaining portion of the bandage continued down upon the arm to the ends of the fingers, and the dressing is completed. It is an improvement to bandage each finger separately, to prevent swelling, before commencing the dressing. I can assert the complete success of this method of treatment in numerous cases, and without any failure, where the prescribed directions have been complied with.

The rigidity of the tendons and stiffness of the fingers which harass the patient for so long a period after this injury, may be diminished by early resorting to passive motion and frequent dressings, with frictions during convalescence.

Fractures of the Elbow-Joint.

This comprehensive and rather indefinite title is chosen because all the injuries included by it are treated by the same form

of apparatus, viz., the hollow-jointed elbow splints. (See Plate 1, fig. 6.)

These splints are adapted to the two sides of the arm, are capable of any desired change in regard to flexion or extension, are readily adapted to limbs differing in size or length, giving complete support to the joint, and thereby preventing all motion or displacement of parts; they are at once convenient and effectual, and better adapted to the purpose than any which have been before, and, I venture to assert, better than any likely to be hereafter produced. I know it may be considered dangerous to predict what may not be accomplished, and that this is the language of exultation. Be it so—and I would not willingly adopt it unworthily—yet where the intention is so fully accomplished, by means so entirely simple, there seems to be little room for more to be expected or desired, and I do not hesitate, therefore, to let the bantling go to the light, challenging competition.

Fractures of the Inferior Extremity of the Humerus.

Whether the fracture is oblique, separating either the internal or external condyle, or transverse, including both, or if with the last, as occasionally happens, a longitudinal fissure, extending from the transverse, through the cavities for receiving the olecranon and coronoid process to the joint, separates both the condyles; in either case the apparatus consists of: 1. The hollow-jointed Splints for the outer and inner sides of the arm. 2. A compress and one or more rollers of sufficient length to extend from the hand to the shoulder, including the necessary turns about the elbow, and then from the shoulder to the hand including the splints. 3. If the fracture is transverse, with projection of the detached portion backwards, resembling dislocation of the elbow in that direction, a light narrow Splint to extend from the point of the olecranon nearly to the shoulder.

Treatment.—This consists in first bending the arm and drawing it forward to effect a replacement of the bones, or if the displacement is lateral, with fracture of but one condyle, forcing the arm in the opposite direction. The arm is then held and the bones kept in place by an assistant, while the surgeon applies the roller from the roots of the fingers to the elbow, when the compress is applied to the side of the limb opposite to the dis-

placement, extending from the point of displacement to the shoulder; or in the transverse fracture the narrow Splint, slightly padded, to the back side of the arm, and supporting the olecranon process. These are now secured by continuing the bandage to the shoulder if but a single roller is used, or the remaining turns of the first roller, if more are used, are expended about the elbow, and a second bandage passed from the shoulder to the elbow, the more effectually to press downward the muscles upon the arm. Lastly, the Splints, fixed at the angle required, are placed on the limb and secured by a bandage covering the entire arm. Lotions should be applied to prevent or reduce inflammation.

After the first week or ten days changes should be made in the position of the arm at every dressing. These should be more or less extensive, according to the amount of inflammation existing at the time. The arm may in this way be gradually brought to the extended position, and then again to the flexed, and, by this means, the liability either to deformity or anchylosis is prevented.

Fracture of the Olecranon.

I will propose the following method of dressing this fracture: I must acknowledge, however, without having, as is here recommended, applied adhesive straps to assist in bringing down and securing the detached portion of the olecranon, and without having applied the flexible splint over the triceps muscle to prevent it from drawing the bone upward. So much of this method of dressing the injury is, therefore, no more than a suggestion.

Apparatus required.—1. The jointed elbow splint with toothed hinge for preventing motion, fitted to the outside of the arm. 2. Three rollers, one to be expended on the forearm with a few turns about the elbow—the second to be passed from the top of the shoulder of the injured arm around the body under the opposite arm, to prevent the bandage slipping down; it is then continued from the top of the shoulder to the elbow. The last is used to confine the arm upon the splint. 3. A compress and flexible hollow splint fitted to the back side of the arm. 4. Adhesive straps one and a half inches or more in width, and twelve or more in length.

Method of procedure.—Extend the forearm, bring down the detached olecranon process in close contact with the ulna, and

retain it in this position by the adhesive straps, one on each side of the arm, passing spirally and crossing immediately above the olecranon and thence down upon the sides of the forearm, drawing downwards the detached portion of bone, to be held in this position by an assistant while the surgeon applies the first bandage from the roots of the fingers to the elbow; the compress and flexible splint are then applied over the triceps and supporting the extremity of the olecranon, and then the second bandage is applied. After this the jointed splint is placed upon the arm, and confined by the third roller extending from the fingers to the shoulder.

As this injury is usually produced by direct falls upon the elbow, and attended with considerable contusion, it may be necessary for the inflammation resulting from this to subside before the apparatus can be efficiently applied. An obvious necessity exists for the splint on the back of the arm. The insertion of the tendon of the triceps muscle into the olecranon is such as to leave a considerable space at this point between the humerus and tendon; consequently, pressure directly upon the tendon must force it too closely inward, and by tilting the superior portion of the fractured bone upon the humerus, throw outward and separate the lower portion from its attachment to the ulna, leaving too great a space for bony union to be accomplished. Hence in this fracture we almost uniformly have only ligamentous union with some separation between the fragments, and "owing to this, the arm long remains weak, and sometimes never recovers its former strength."—(Prof. Gibson.)

Fractures in the Middle or Body of the Humerus.

The treatment of these easily managed fractures, which seldom result in deformity, scarcely needs explanation. The splint, pl. 1, fig. 4, may be applied to the back of the arm, enclosing nearly one half of its circumference, and a light narrow splint on the forepart of the arm and both secured in the usual manner by a roller, or two similar splints nearly equal in width, may be applied to the two sides of the arm, and in like manner secured upon it.

Fractures of the Neck of the Humerus.

This fracture, though not difficult to manage, is but little benefited by ordinary splints, which, owing to the form of the part

and shortness of the detached fragment of bone, can give but little support. The splints always project, giving an unwieldy appearance to the dressings, and require the additional support of pasteboard, leather, or other flexible material.

The form of splint here recommended for this fracture is original, forms a neat and convenient dressing, and fixes the bone in its proper position with great security and firmness. It is represented pl. 1, fig. 5. No directions are required for its application, except that one or more turns of the roller should be continued from the top of the injured shoulder around the body, under the opposite arm, to keep the dressings in place.

Fractures of the Inferior Extremity.

It will be convenient here, as in the consideration of apparatus for the superior extremity, to commence with the more simple, these being the inferior portions, first. It is not necessary here to make comparisons between the apparatus described, and a multitude of very excellent forms which have from time to time appeared and had their day, and have then been superseded by others, or, as would now seem to be the tendency, by none at all. However others may regard the subject, I have no expectation that, in private practice at least, surgeons will often recommend to their patients, or that patients will be often found to submit to dole away their thirty, forty, or sixty days of absolute confinement in a prescribed position, without the relief of such changes of posture, and such movements of the body or limbs as can only be allowed where a good apparatus is used. With such help, experience has abundantly demonstrated that in many cases free motion, and in some almost unlimited exercise, may be safely allowed.

The Longitudinal Half-Boot.

For the introduction of this form of splint we are indebted to the late Professor Nathan Smith, M. D., of Yale College. For all the important fractures of the leg he required splints to be nicely carved from solid blocks of wood, to fit every particular case of fracture, which can only be well accomplished by an artist, at considerable expense, and the same splint will seldom serve for the treatment of more than a single case of fracture. This splint, and the mode of treatment adopted by Dr. Smith, are described

in the American Medical Review, published at Philadelphia, A. D. 1825, vol. 2, p. 355. Splints of a similar form, constructed of wood and gutta percha, may be adapted to limbs differing largely in size, and either to the inside or outside of the limb, as the case may require, and will serve for the treatment of many cases of fracture.

They are adapted to all cases of fracture of the inferior third of the leg. In fractures of the fibula, or inner malleolus of the tibia, we apply the splint to the side of the limb opposite the fracture, with a compress extending from the ankle-joint upward, then applying a roller from the toes to the knee, the splint is secured to the leg, and the foot is forced in the direction opposite to the displacement. When both bones are fractured, the splint may in general be most conveniently applied to the outside of the limb.

Improved Apparatus for Fractures of the Leg.

These fractures may all be well and conveniently treated by either the form of apparatus represented Plate 1, fig. 8, or the double inclined plane connected with the single extension splint for the thigh, and flexible side splints, represented Plate 2, fig. 1. Both differ from any of the forms now in common use: Firstly, in the arrangement of the joint for the knee, by which flexion and extension of the limb may be performed without changing the relative length of the splint and the fractured bone. This is effected in the first, by a joint at the side, instead of under the knee, and as high on the limb as the centre of motion of the joint, giving a more extended motion opposite, corresponding to the ball and socket; in the second by a double joint, similar to that employed for the elbow, and attached to the sides of the splint. This alone is of sufficient importance to give this apparatus a decided advantage over all others in which this circumstance is disregarded. To illustrate the absurdity of attaching the joint, in the ordinary manner, under the knee, we have only to place a common jointed measuring rule under the limb, with the limb flexed to a right angle, then extend the limb and the rule together, and it will be found that the relative length of the limb below the knee and the rule will have changed from one to two inches. The neglect of attention to this circumstance is, I do not doubt, often the cause of displacement of the bones, and

shortening of the limb. Secondly, in both forms of apparatus, the screw which serves as a pivot for the joint, also fixes the joint in the position required, by means of pinion-like teeth at the circumference. Hence we avoid the inconvenience of a projecting rod or screw under the knee, which is employed in all other forms of apparatus extending to the thigh that have come to my observation. Thirdly, the sliding joints for adapting the apparatus to limbs differing in length, are, in one, placed under the limb, in the other at the sides, avoiding the encumberance of a projection beyond the foot. Fourthly, the method of attaching the foot-piece to the main support, by which the depth of the instrument may be increased or diminished, and the foot raised or depressed, and by which also the different portions of the apparatus are connected, giving it firmness and strength without increasing the weight, are also original. All these improvements, as well as the material of which the flexible portions are constructed, I consider give to these forms of apparatus a sufficiently distinctive character to be designated as new and improved.

In all cases where the fracture of the bones is situated above the middle of the leg, the support should extend to the thigh, and be capable of fixing the joint, though occasional changes in the position should be allowed.

The method of dressing is singularly simple and easy. The limb having been prepared by the reduction of displacements or coaptation of the fractured bones, a roller is passed from the toes to the knee. The side splints, softened by hot water, are then adjusted to the limb, and secured by the bandage continued down again to the foot. The limb is now placed on the frame, slightly cushioned with cotton or folds of cloth to receive it, when it is secured in the proper position by the screw at the side of the foot-piece and the side straps, and the joint at the knee is also fixed at the degree of flexion required.

Improved Apparatus for Fractures of the Thigh.

There are two different forms of apparatus for the thigh, possessing all the advantages which have been shown to distinguish the apparatus for the leg, and are adapted either to the flexed or extended positions of the limb, as the practitioner may prefer, or the circumstances of the case may require. The ability to change the position of the limb, I regard, in some circumstances,

as essential to success, and the only possible means of avoiding very serious deformity. This is true of some cases of fracture below the neck of the femur, but near the hip, and also of some cases of oblique fracture near the knee. It is also important to be able to flex or extend the joints to some extent after union of the fracture is accomplished, during the period of convalescence. We may thereby very much diminish the protracted stiffness caused by fractures near the joints, when kept constantly in the extended position.

Both forms of apparatus are represented, (*pl.* 2, *fig.* 1 and 2,) and are sufficiently described in the explanation of the plate. The first includes and forms a part of the apparatus for the leg, as has been described, and is the most simple and economical for such practitioners as desire a single instrument adapted to every condition or form of fracture of the inferior extremity. The second is adapted only to fractures of the thigh, and possesses, in a higher style of finish or workmanship, all the advantages which have been attributed to the other forms of the apparatus.

Directions for Dressing Fractures of the Femur.

If, as is now frequently practised, adhesive straps are used for making permanent extension, the straps prepared with tapes or loop-holes at the lower extremity, by which they may be secured to the foot-piece of the apparatus, are applied, extending from the knee, or near the seat of the fracture, to a level with the bottom of the foot. A roller is now applied, commencing with the foot, and extending upward nearly to the fracture. Another bandage is secured by a few turns about the pelvis, and after proper adjustment and coaptation of the bones, is continued downward upon the thigh, connecting by a few turns with the first-mentioned bandage. Flexible splints of wood and gutta percha are now applied to the sides and top of the thigh, of the length of the thigh, and secured by the remaining turns of the bandage. A sufficient cushion of cotton or cloth being placed upon the extension frame, which ever is used, the limb is placed upon it, and the necessary extension made by means of the counter-extending perineal band and adhesive straps or gaiter, or both, as may be preferred: the whole is then secured by the straps passing around the limb, and a band around the pelvis.

General Observations on the Treatment of Fractures.

UNION OF FRACTURES.

The union of fracture of the bones is the result of the laws of health—healthy action developed in the recuperative power of the animal economy—strong in proportion as the vital powers are vigorous and healthy, weak in proportion as they are feeble or disordered.

It hence follows that all the appliances of art must be wholly powerless in any degree to promote or accelerate the process any further than we can remove hindrances to the development of healthy action.

Thus far I shall not be disputed; yet the principle seems to be too much lost sight of and neglected in practice. As the obvious effects of this tendency of nature, we have a certain amount of inflammatory action, accompanied by some increase of heat, pain, and swelling of the soft parts. If these fail, the process is interrupted or retarded. On the other hand, these symptoms being in excess, instead of a secretion at first fluid, then fleshy and vascular, then ligamentous and flexible, and finally unyielding bone, we have the common results of high inflammatory excitement, great swelling and pain, and it may be the formation of pus and extensive suppuration or gangrene of the part. Hence indiscriminate flooding by wet applications, and by cold, or unnecessarily encumbering the parts and increasing heat by a multitude of cushions and bandages, cannot but be highly injurious and censurable.

Another point to which I especially wish to draw attention: as the process is a natural one, so also nature has established a period for the accomplishment of her purposes, which must, while the laws of the animal economy remain the same, remain unalterable. We do not, therefore, expect to expedite the process beyond what is already known as the period of health. On the contrary, by the perfection of our instruments we may even retard union; and not unfrequently the most perfect cure is rather slow in its accomplishment. Let there be some imperfection in the adjustment of the bones—let there be some irritation in consequence of imperfect support of the parts,

if so much is not allowed as to lacerate the forming fibres, and there will be an exuberant and rapid growth of callous—a large ridge may be formed around the place of fracture, it becomes quickly solid, and the patient has the use of his limb, it may be somewhat deformed, but still quickly restored.

Bearing these principles in mind, we are at no loss in accounting for an admitted fact, that bones of the superior extremity usually heal much more rapidly than those of the inferior; for there is less of absolute restraint, less to impair the energies of healthy action, and all the processes of health are more fully sustained. The ribs, when fractured, though never at rest, heal with remarkable rapidity. So also with the bones of animals. The animal limping and deformed, yet the bones solid and healed in a remarkably short space of time. The very obvious import of this is an important practical lesson: that is, in all cases, allow as much motion and general exercise as is consistent with the paramount objects of exact coaptation of the bones, and safety as regards the reproduction of the fracture.

Pain or spasms beyond what necessarily attends the injury to the soft parts, is not a necessary condition of the union of fractures. Healthy bone itself is perfectly insensible, and is no more sensible than the soft parts during the process of healing, unless inflamed, when it becomes most exquisitely sensible and painful. This, as an abstract proposition and physiological fact, is well known by the intelligent practitioner, but greatly at variance with popular notions in relation to fractures, and practically surgeons, I fear, will not be ready, in all cases, to stand manfully to the test.

In fractures of the superior extremity we seldom hear more complaint than would be expected from the manifest inflammation and injury to the soft parts, without spasm or twitching of the muscles, obviously because the fragments of bone are not allowed to rub upon or irritate each other. But not so in fractures of the leg and thigh. The greater weight of the parts to be supported, and the means of support employed altogether more inadequate, and the restraint imposed upon the patient being more severe and more imperfectly complied with, and in addition to all this, the dressings such as are used often being unskilfully applied, we should expect involuntary twitchings of the muscles would be excited by the constant irritation—that sleep would be

disturbed, and its approach regarded with terror in consequence of the spasms, which only await its approach—that, finally, inflammation of the bone itself would be excited, as well as in the surrounding soft parts, so that we should have irritation, fever, pain, such as inflammation of bone only can produce.

In this connection, we can scarcely forbear to notice the proposition sometimes asserted and acted upon, that as bony union does not commence in many days after the infliction of the injury, so dressings may be omitted until the inflammatory symptoms have subsided. This is but to delay the most effectual means of prevention and cure both of pain and inflammation, until the most urgent necessity for them is removed, and to trust only to the feeble expedient of extending the limb upon a pillow exposed to agitation by the slightest motion or involuntary twitching of the muscles. Absolute rest of the parts implicated in the injury, both bones and muscles, should be immediately secured and maintained as long as the liability to excessive inflammation exists.

Un-united or Tardy Union of Fractures.

This apparatus, on account of its lightness, and being accurately fitted to the limb, is peculiarly adapted to Amesbury's method of promoting union by compression in both the lateral and longitudinal direction of the bones, by which absorption of the perhaps superabundant soft and yielding substance which has accumulated between the fragments of bone is promoted, a degree of healthy action excited, and soon bony matter deposited, and finally solid union produced.

Such, I can confidently assert, from repeated trials, will be the result in most, of what may be termed, recent cases. I believe very few if any cases of not more than ninety days duration will be found to resist this method of treatment. I have met with none. Perhaps not the least efficacious part of the treatment consists in allowing a very considerable amount of bodily exercise without endangering a reproduction of the fracture.

The system has become debilitated by long confinement,—vascular action in the affected limb is especially weak,—when suffered to remain in a depending position it becomes livid,—when blood is pressed from the capillaries by the finger, it is slow in returning; but by resuming, as the patient may now be allowed

to do, some general exercise, such as hopping on crutches, riding, or if no more than sitting up and removing from the bed to the chair, with friction, showering, stimulating lotions, &c., to the limb, health improves, circulation becomes more vigorous, the bones evidently become more unyielding, and soon union is complete.

Conditions other than Fractures requiring Splints.

These are sprains, inflamed joints, rheumatism, and wounds, either incised, contused, or lacerated, extending to muscles, tendons, or joints. To describe all these cases particularly, would exceed my limits, and is not necessary. These splints are well adapted to all such cases, and there can be no doubt that the advantages of mechanical support have been strangely overlooked, since motion and the separation of divided parts are in all cases the principal obstacles to union.

In cellular and muscular structures, this especially holds true —*perfect apposition or contact, and perfect rest in the healthy constitution, are the only conditions required for union by first intention.* If means to diminish inflammatory action are required, as washes or wet applications, it is because there exists partial disorganization in consequence of contusions, or too much heat is excited by improper dressings or other applications, or excessive general excitement or feverish action exists in the system.

Incised wounds of the knee or other joints, which are justly regarded with terror, and are in a high degree dangerous if neglected, heal with the same, or perhaps I should say almost the same certainty as wounds of other parts, if the conditions above stated are strictly complied with.

The success of Professor Dudley, by the use of the bandage alone in gun-shot and other wounds, before referred to, I regard as proof of what may be better accomplished with less of the gift Divine, less skill, and less experience than he possesses, aided by a light casing of well-adapted splints, giving support not only to the injured muscles, but to all the muscles so implicated, as to cause motion in the injured part.

Business Note.

Dr. B. Welch's Surgeons' Splints and Improved Apparatus for Fractures, &c., manufactured at Lakeville, (Salisbury), Connecticut. "Letters Patent" granted for Splints, U. S., September, 1850. These instruments will be sold at the following prices, viz.:—

1. Arm and Forearm Splints, consisting of		
2 shoulder Splints, each	$00 75	$1 50
6 Arm do.	00 25	1 50
3 Pair Forearm do.	00 75	2 25
2 " Ulnar do.	00 75	1 50
1 Set Elbow Joint Fixtures,		1 25
The set,		$8 00
2. Thigh and leg:		
1 Single Extension Splint for thigh, and Double Inclined Plane for leg and thigh, with flexible Splints, different sizes,		17 00
The set, 1 and 2, for arm, thigh and leg,		25 00
3. Double-jointed Extension Apparatus for the thigh, in either the flexed or extended position, with flexible Splints,	20 00	
Jointed Apparatus and flexible side Splints for the leg, do.,	12 00	
Together,		30 00
4. Three pairs longitudinal Half-Boots,		
No. 1. Each Splint,	1 50	
2. do.	2 00	
3. do.	2 50	
The set, 3 pairs,		12 00
The set, 1, 3 and 4, for arm, thigh and leg,		$50 00

Orders accompanied by cash or a certificate of deposit or other evidence of credit at a bank, directed as above, will be immediately supplied by Express, or either the Housatonic or Harlem Railroad. When sets or Splints to the amount of $25 or more are ordered, Express or freight charges, not exceeding 10 per cent. of the amount, will be pre-paid.

SURGEONS' SPLINTS

AND

IMPROVED

Apparatus for Fractures.

BY

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