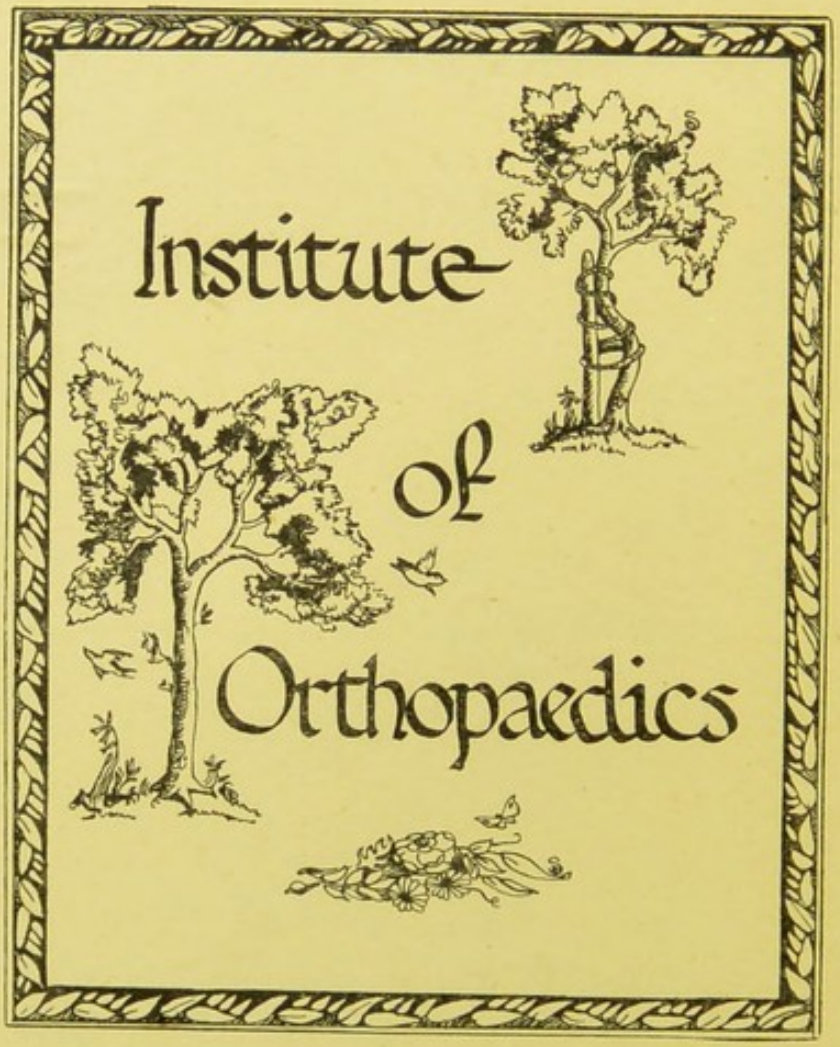
On the advantages of the starched apparatus in the treatment of fractures and diseases of joints : being the first part of an essay to which the Council of University College have awarded the Liston Clinical Medal / by Joseph Sampson Gamgee.

ADVANTAGES
OF THE
STARCHED APPARATUS

GAMGEE.



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OF THE

STARCHED APPARATUS

IN THE TREATMENT OF

FRACTURES AND DISEASES OF JOINTS.

John Birkett Esq.
with Mr Gamgee's compliments

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BEING THE FIRST PART OF AN ESSAY TO WHICH THE COUNCIL OF UNIVERSITY COLLEGE HAVE AWARDED THE LISTON CLINICAL MEDAL.

BY

JOSEPH SAMPSON GAMGEE.

"On ne porte dignement le titre de médecin qu'à condition de travailler toujours."—VELPEAU, *Leçons de Clinique.*

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TO THE MEMORY OF

ROBERT LISTON, ESQ.,

IN TESTIMONY OF PROFOUND ADMIRATION FOR HIS GREAT SURGICAL GENIUS, AND OF SORROW FOR HIS IRREPARABLE LOSS.

ON THE ADVANTAGES

OF

THE STARCHED APPARATUS.

INTRODUCTION.

The starched apparatus is made up of pads to protect the bony prominences from pressure, bandages, and pasteboard splints smeared with starch. So soon as the latter is dry, an exceedingly firm yet light casing for a limb is formed.

It is applicable to all fractures, whether simple, comminuted, or compound; and is of great service in the treatment of sprained and diseased joints, as a means of setting them perfectly at rest; and in a variety of other surgical affections hereafter to be noticed.

Its peculiar features are extreme firmness and lightness; whereby a patient with a broken thigh or scrofulous knee-joint is enabled to walk about on crutches with perfect ease, and is relieved of all the discomfort and injury to health incidental to long confinement to bed. Another of its peculiarities is, that it is so constructed as to admit of being cut open for the examination of the parts inclosed, and thereby obviates the great objection urged against other immovable apparatuses: that while the limb is hidden from view for the treatment of an injury, much mischief may go on without the surgeon being able to take cognizance of it.

It was while studying surgery in the hospital of Santa Maria Nuova, in Florence, during the winter 1851-52, that I had the opportunity of learning the uses of the starched apparatus from its inventor, Baron Seutin, then passing through that capital on his return from Russia. For this opportunity I am indebted to Professor Regnoli, who was pleased to invite the Baron to his clinique, and thereby give

his students the opportunity of hearing his doctrinal expositions, and seeing his practice. Professor Regnoli's assistant, Dr. Palamidessi, zealously adopted the use of Seutin's apparatus after his departure; and, in a subsequent visit to the Siena hospital, I learned from its resident medical officer, Dr. Consari, that he and other surgeons had for several years followed Seutin's practice in the hospitals of the Tuscan Maremma, with unparalleled success. Thus I had ample means for the formation of a judgment, the correctness of which was confirmed by a study of the writings of those who have defended and opposed this practice; and by an opportunity afforded me last autumn of witnessing, in the theatre of University College Hospital, the application of Seutin's apparatus by one of his most zealous followers, Dr. Crocq.

The result of these observations was a determination on my part to extend to English practice a system productive of such auspicious results in the hands of foreign surgeons. A perusal of these pages will prove to what extent, and with what probability of doing good, I have availed myself of the opportunities offered by my position as house-surgeon in University College Hospital, in carrying that resolve into execution.

It gives me much pleasure to acknowledge myself deeply grateful to Mr. Erichsen for having assented to my proposal for experimenting with the starched apparatus, as soon as I made it known to him. To Mr. Quain likewise, I am indebted for similar opportunities of practice; in availing myself of which, I have been very materially assisted by my able and kind friend Mr. Thomas Hillier.

I owe to Mr. Clover the having in my absence condescended to revise the proofs of these sheets, a favour which, is, however, one of the smallest amongst the many he has conferred upon me during the five years he has been Resident Medical Officer in University College Hospital.

Palazzo Corsi, Florence,
5th August 1853.

CHAPTER I.

GENERAL CONSIDERATIONS AS TO THE MANNER OF APPLYING, AND THE PRINCIPLE OF ACTION OF, THE STARCHED APPARATUS.

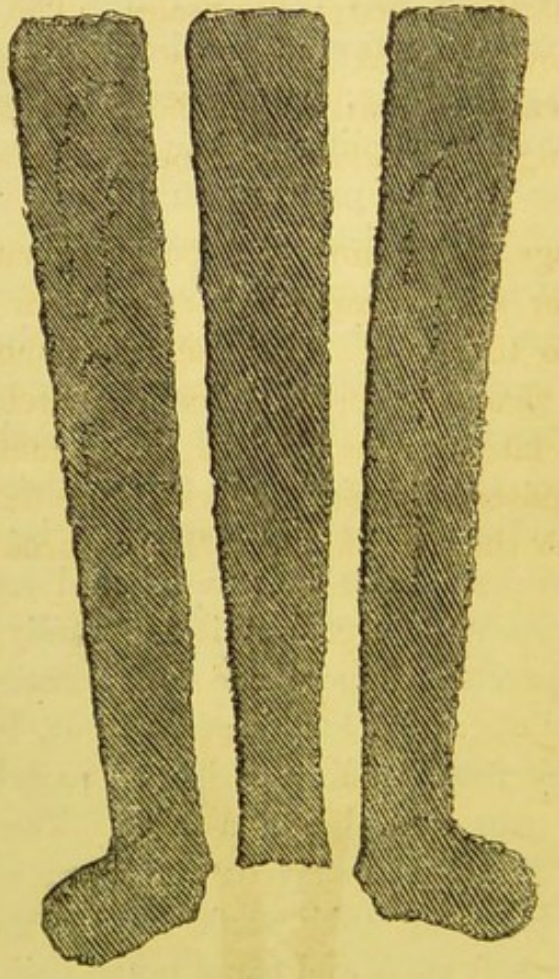
The requisite materials for making this apparatus are: 1stly, cotton-wool, or soft tow, and lint, or linen rag, to make pads for the protection of the bony eminences; 2ndly, common bandages; 3rdly, pasteboard for making splints; 4thly, starch, made according to the fashion of laundresses. A few words as to the preparation of the splints. The pasteboard should be thick and porous, so as readily to soften on immersion in water, and be easily moulded to the shape of the limb. If only thin pasteboard be at hand, the splints may be made of sufficient strength by smearing their surfaces with starch after they have been soaked in water, and then putting them together in two or three thicknesses.

The stout millboard, usually employed by bookbinders, is not so easy to manipulate as is pasteboard less compressed and of more porous texture; but it is equally efficient. A point of great practical importance to be noticed is, that in making the splints, they should not be cut, but torn; this is facilitated by first bending strips of pasteboard of the required width over the edge of a table. The advantage of the tearing is great: for, whereas the sharp edge produced by the cutting-pliers or knife would have a great tendency to dig into the soft parts and cause much pain, there is no danger of such an unpleasant occurrence when the splints are torn, the ragged edges being then bevelled off, and more easily mouldable to the exact shape of the limb, without the risk of injuring any part of it.

In the pursuit of this part of the subject, the preceptive

remarks we have to make will, it is hoped, be rendered of greater practical utility by illustrative example. Let us suppose a case of recent simple fracture of both bones of the leg, a little above the ankle-joint; the tibia being broken obliquely, so as to allow of projection of the upper fragment forwards. The requisite materials being at hand, three splints are required: a straight one to be placed at the back, and to reach from an half an inch above the heel to four inches above the knee; and two lateral splints, reaching from the same point above to the foot, to fit which each splint requires to be cut with a foot-piece (fig. A). From the

Fig. 1.



commencement, one assistant is charged with the duty of making extension from the foot, while another counter-extends from above. Reduction having been effected, the tendo Achillis, the instep, the ball of the great toe, and the proximal end of the fifth metatarsal bone being well padded

with cotton-wool, a dry bandage is applied from the root of the toes, over the heel, and up the leg, with the precaution to reverse at the back, and not over the crest of the tibia, where the ridges caused by reverses would be very liable to occasion painful pressure. The crest of the tibia may be additionally protected by a strip of cotton-wool placed immediately over it; this is especially advisable when, from emaciation or deformity (*e. g.*, in ricketty children), the crest is unduly prominent. The bandage is continued over the extended knee to a little below the middle of the thigh, care having been previously taken efficiently to pad with cotton-wool the head of the fibula, the tuberosity of the tibia, the patella, and the tendons of the hamstring muscles. The surface of this bandage is now smeared uniformly with starch, in doing which the open hands will be found more expeditious and effectual, though somewhat less neat and agreeable than a brush.

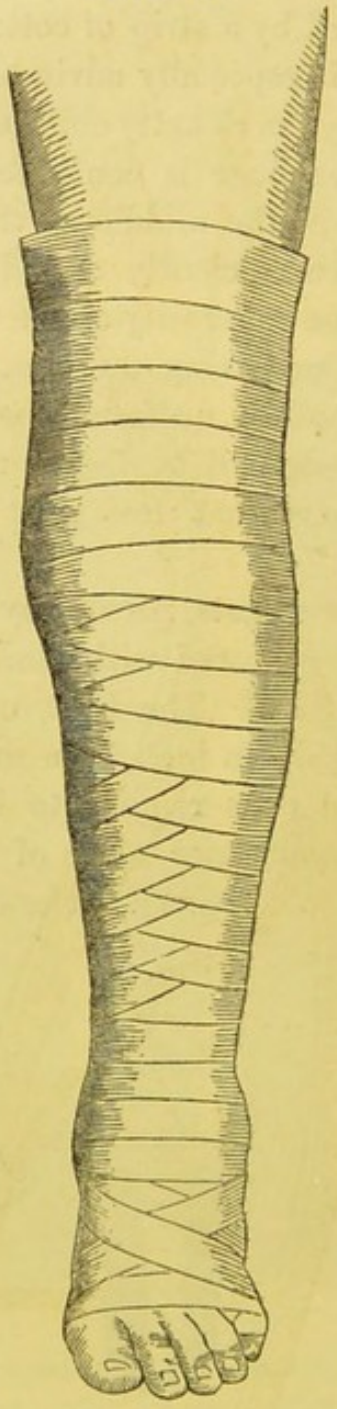
At this stage, the splints, previously softened by soaking in warm water and smeared with starch on both surfaces, are applied to the limb. The back one should not reach further down than half an inch from the heel; but the foot-pieces of the lateral ones require to be moulded so as to embrace the outer and inner edges of the foot respectively, and turn in to the sole (fig. 2). These three splints should

FIG. 2.

extend on to the thigh as far as the first bandage: care must be taken that they do not overlap anywhere, and that neither of the lateral ones reaches as far forward as the crest of the tibia. The assistant who holds them in position, manipulates

them, so as to mould them accurately to the limb, while the surgeon fixes them by bandage applied with moderate and even pressure from below upwards. The apparatus is completed by starching the outside of the last bandage (fig. 3).

FIG. 3.

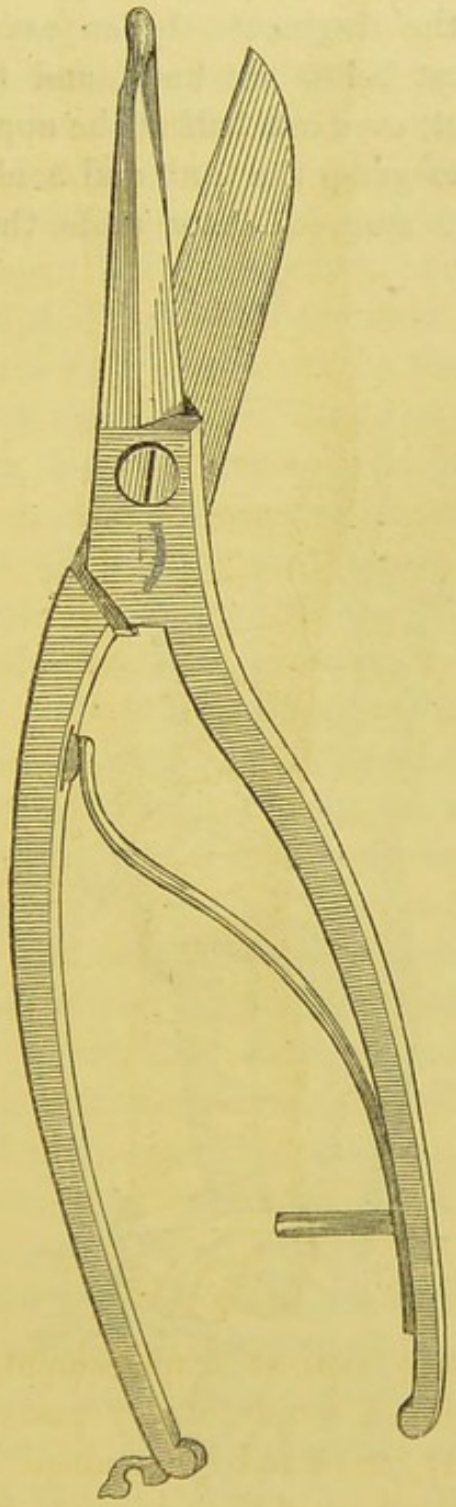


As a preventive against displacement, so long as the apparatus is moist, a couple of dry pasteboard splints may be placed laterally, and fixed by bandage. If the individual be very muscular, a sand-bag, varying from four to eight

pounds in weight, may be placed over the front of the apparatus, to a little above the seat of fracture, as an additional precaution during the drying stage—the first thirty-six hours.

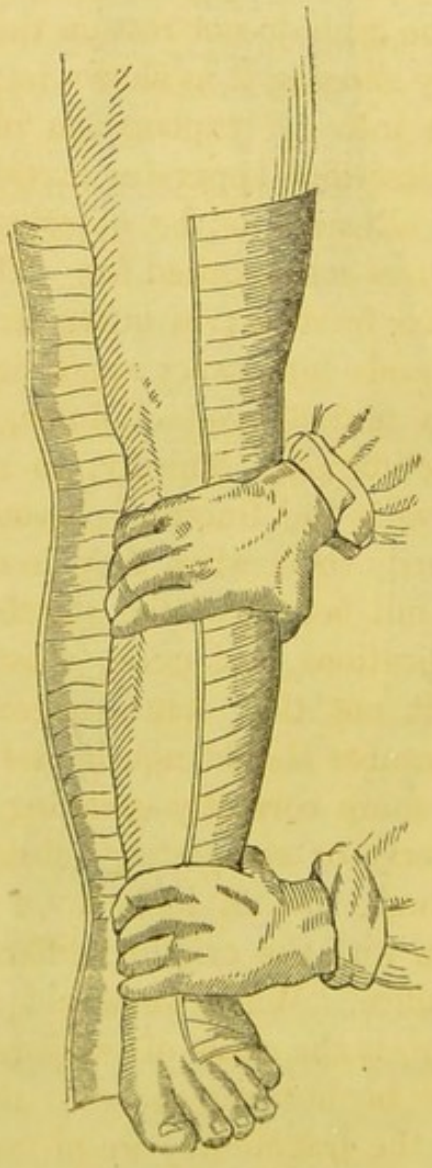
So soon as dry, the bandages are cut along the front, and

FIG. 4.



in the middle line of the sole of the foot, to admit of the limb being examined. The pliers represented in fig. 4 are convenient in making this section; but, in their absence, a pair of pocket-scissors serve the same purpose, the apparatus being expressly constructed so that there are only a few thicknesses of bandage in the front to cut through. The examination of the limb may be completed without in the least disturbing the fragments, by an assistant gliding his hands, the one just below the knee, and the other on the dorsum of the foot, over one half of the apparatus and under the other, so as to grasp the limb and hold it firmly to the former, while the surgeon turns aside the latter (fig. 5).

Fig. 5.



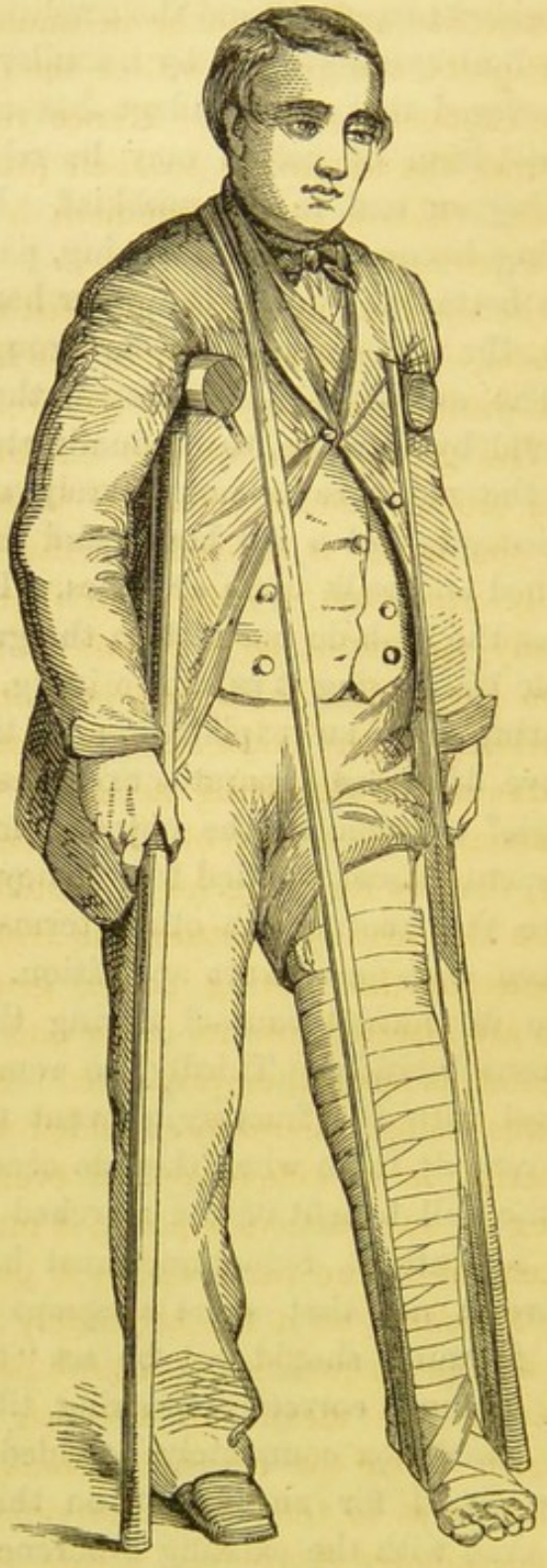
After having thus examined one side, the two halves of the apparatus are brought together, and the condition of the opposite side of the limb is ascertained by a similar manœuvre.

If it is discovered that the bandage has constricted any part, the interposition of cotton may be relied upon as a means of putting an end to the mischief. In case of the apparatus having become loose in drying, paring its edges will ensure its better fit; or on the other hand, if swelling have occurred, the edges must not be brought into close apposition. The examination completed, the apparatus is again made solid by bandage, to be finally starched on the outside. As the moisture is now merely superficial, the drying stage occupies but a few hours, and then the patient may leave his bed and walk upon crutches. In so doing, it is advisable that the limb do not rest on the ground; an end easily attainable by slinging it as shown in fig. 6.

Before entering into an explanation of the manner in which the above described apparatus exercises its beneficial influence, a brief allusion to the objects aimed at in the treatment of fractures seems called for. They are threefold; 1stly, to reduce the fracture; in other terms, to bring the displaced broken ends into exact apposition. Secondly, to maintain them in mutual contact during the whole time requisite for consolidation. Thirdly, to remedy the complications coeval with the fracture, prevent the occurrence of others, and remedy them when they do occur.

To ensure the full benefit of the starched apparatus, the first of these indications, reduction, must be immediately fulfilled. Were it not that some surgeons of distinction maintain that fractures should not be set "till after three or more days, or more correctly speaking, till the swelling has ceased, or nearly or completely subsided," it would be unnecessary to dwell for an instant on this part of the subject. But even with the existing differences of opinion, few words will suffice. What, we would ask the partisans of the delay system, is the cause of swelling around a broken bone? There can be but one answer: the injury done to the soft parts by the fragments; we of course except those

Fig. 6.



cases in which, the fracture being occasioned by direct violence, the soft parts are predisposed to swell by bruising from without. But even then, the injury done to soft parts by the fragments must be an additional cause of swelling.

This being admitted, it follows that the longer the fragments of a broken bone are suffered to be in unnatural positions among the soft parts, the greater will be the mischief to the latter, and its exponent swelling. Hence results the propriety of restoring the fragments to their proper position as early as possible. This *à priori* argument is borne out by the results of experience.

How far is the starched apparatus efficient in fulfilling the second indication,—the maintenance of the broken ends in proper position during the whole time required for the consolidation? The great cause of the displacement of the fragments of a broken bone is muscular action; and it is in proportion as the latter is neutralized that the former is most effectually prevented. Hence, in inquiring into the efficiency of any apparatus, as a means of maintaining in proper position the ends of a broken bone, one of the best methods of arriving at the truth is, to investigate the power of the apparatus in counteracting muscular effort. Studying in this manner the action of the starched apparatus, we find: 1stly, that by its fixing (as it should do as a rule) the joint above the seat of fracture, the communication to the broken bone of the moving power generated by the muscles which are inserted into its upper end for the movement of the joint, is altogether prevented: 2ndly, by virtue of the apparatus being accurately moulded to the limb, its surface of bearing is so extensive and even that, without unduly pressing on any particular point, it must of necessity render displacement of the parts within it physically impossible, so long, of course, as it fits accurately: 3rdly, its nice adaptation to all the inequalities of a limb prevents shortening, by rendering it a means for effecting extension and counter-extension when the occasion demands. Whenever the muscles act so as to tend to cause riding of the fragments, and consequently shortening, fitting as the apparatus does into every depression and prominence, it mechanically prevents the approximation of the upper and lower ends of the injured member.

These general considerations, as to principles of action,

admit of being rendered much more clear by studying the *modus operandi* of the apparatus for fractured leg, the application of which is described at the commencement of this chapter. Allusion is there made to the treatment of a case in which both the tibia and fibula are broken obliquely, in such a direction as is known to lead to displacement of the upper fragment forwards, and to more or less shortening. One of the prominent features of the apparatus applied in this case is, that it extends to about the middle of the thigh, thus confining the knee-joint, and neutralizing the power which its under muscles would possess in displacing the fragments. Moreover, by its accurate adaptation to every point of the limb's surface, the apparatus must necessarily exercise a very powerful influence in maintaining coaptation. Embracing, as the lateral splints do, the sides of the foot, fitting accurately to the prominences and depressions about the ankle and knee-joints, shortening is rendered impossible by the mechanical impediment which the dovetail-like fitting of eminences and depressions offers to approximation of the foot to the knee.

It now behoves us to inquire how far the starched apparatus fulfils the third indication in the treatment of fractures, which has been stated to consist in remedying the complications coeval with the fracture, preventing the occurrence of others, and remedying them when they do occur.

These complications are of two kinds, *general* and *local*. The former admit of further division into two classes: 1stly, those which are due to the mere existence of a fracture: 2ndly, those dependent upon some unfavourable complication. These last we shall, for the sake of convenience, consider presently, together with local complications. It is to disturbances of the system, dependent upon the mere existence of a fracture, however in itself simple and favourably progressing, that we here wish to refer.

A man about sixty years of age, the subject of emphysema and cardiac disease, fractures the neck of the thigh-bone outside the capsule. How is it to be treated? According to Pott's plan, the long splint or other similar contrivance.

The employment of these means demands long confinement to bed, which, in a person of that age, is apt to engender visceral complications, always tedious, often serious, and not unfrequently fatal. But let the starched apparatus be applied, so soon as it is dry—and this is in about two hours—the patient may leave his bed; and, while sitting in a chair, walking on crutches, or riding in a carriage, avoiding the constitutional disturbance, the fragments are ever more firmly held in position than by the other contrivances in the recumbent posture.

To take another case.—A person of weak and irritable constitution meets with a fracture of the patella. The rule of practice is, confinement to bed in a semi-sitting posture with extended knee and raised heel, for six or seven weeks: restless nights and impairment of the general health are a frequent result; but when the starched apparatus is applied the period of confinement is reduced from weeks to as many days, and the general well-being of the individual is as perfect as if nothing had happened.

These examples might be multiplied, though not to much profit; for it can require little evidence to prove that any method for the treatment of fractures which does not entail confinement to bed, must do away with the impairment to health incidental to such confinement.

Of the local conditions which are usually found complicating fractures at the time they first come under the surgeon's notice two in particular deserve mention: *swelling* without injury to the integuments, and *external wound* communicating with the broken ends.

1stly. Swelling without wound as a complication of fractures recognises two distinct causes; extravasation of blood, and inflammation; the former manifests itself within a few hours after the accident, the latter at a later period. To exemplify the former: a man is seen a few hours after he has fallen from a height, the result of which has been a fracture of the femur and considerable extravasation of blood beneath the integument. By the application of the starched apparatus a beneficial effect may be anticipated by virtue of a twofold

mode of action: (*a.*) Inasmuch as its application necessitates immediate reduction, and by its agency the fragments are permanently maintained in their proper position, the cause of the increase of the bloody extravasation—injury to the soft parts by the ragged ends of bone—is removed. (*b.*) In cases where swelling is due to infiltration of soft tissues with blood, the application of the starched apparatus, involving as it does the principle of gradual compression, may be supposed likely to prove advantageous; for general surgical experience teaches that much pressure is calculated to promote absorption of the the effused fluid.

We have next to consider the propriety of applying the starched apparatus when a broken limb is swollen in consequence of inflammation. In all such cases its application is advisable, provided the inflammatory action have not advanced to such a degree as imminently to menace disorganization of the limb. It is easy to understand how under certain circumstances gradual pressure may relieve the pain of an inflamed part; and its probable efficiency in promoting the absorption of the effused plastic product is strictly in accordance with the established principles of surgery. Moreover, by the pressure diminishing the calibre, at least, of the superficial vessels, it cannot but tend to moderate the afflux of blood; in other terms, to lessen the cause of the inflammation and its effect, *swelling*. So apposite are the following remarks of M. Velpeau, that apology for their citation would be out of place. To reap the good effects of the compressing agency of the immovable apparatus applied in cases of fracture with swelling, "I cannot * too frequently repeat that the bandage must be applied in a very methodical manner; because, though the compression well exercised be a truly heroic means in such cases, I must also warn you, that when employed by incompetent hands it may become the cause of more or less serious accidents. Never forget it:—it is a powerful resource in surgery; but (allow me the expression) it will not admit of mediocrity."

* Velpeau, Leçons orales de Clinique Chirurgicale. Bruxelles, 1841. Page 638.

2ndly. When a fracture is compound, and it is decided that an attempt be made to save the limb, the starched apparatus may be applied, either so as to leave the wound exposed from the commencement, or if it be at first covered, a trap-door for its exposure can be made so soon as the apparatus is dry. The wound being thus provided for, and having proved that, so far as the broken bone is concerned, the starched apparatus is eminently conducive to a salutary end, its applicability to compound fractures can no longer be matter of question.

The facts and arguments adduced in this chapter appear calculated to convince all those whose minds are unpre-occupied, and even many of those who from habits of thought and practice have hitherto entertained different opinions; but it would be too arrogant to suppose but that many will still remain unconvinced. To such I would say, that in entering upon explanations as to the principle of action of the starched apparatus, I merely hoped to pave the way to some, in understanding the great utility of its clinical application; to facilitate the propagation of the teachings of experience by doctrinal exposition. In this I hope to have succeeded in some extent, but whatever be the measure of this success, is immaterial for the definite solution of the question, whether or not the starched apparatus surpasses all other modes of treating fractures? This can only be decided by an appeal to experience, and it is to such appeal that the following chapter is dedicated.

CHAPTER II.

CLINICAL EXPOSITION OF THE METHOD OF APPLYING, AND OF THE EFFECTS PRODUCED BY, THE STARCHED APPARATUS, IN PARTICULAR FRACTURES.

Fracture of the Humerus.

Case I.—Henry Rothwell, æt. 26, healthy and robust, presented himself on the 26th November, 1852, in the out-patients' room of University College Hospital, having injured his left arm in falling from some steps. On examination, the soft parts, near the seat of injury, proved healthy, the skin not even being bruised; but the humerus was fractured somewhat obliquely (half an inch shortening), at about the point of junction between the middle and lower third. I at once applied the apparatus in the following manner. After padding with cotton-wool the lower ends of the ulna and radius, and the bony points about the elbow (the fore-arm being flexed at a right angle, and in the semi-prone position), a bandage was applied from the hand to a little above the insertion of the deltoid, and its outside smeared with starch. A pasteboard splint, about two and a half inches wide, soaked in water, was next placed posteriorly from the upper extremity of the bandage-part, bending over the point of the elbow, to a little beyond the middle of the fore-arm, and three narrow splints of the same material, in front, inside and outside the arm: the two last-named ones extended along the sides of the elbow, the first one to the bend of the joint. While an assistant moulded the splints to the shape of the limb, I bandaged over them from the wrist upwards, and starched the outside. Each of the fingers was then bandaged separately, and a few turns of roller passed round

the hand; and the arm finally fixed to the side by means of a sling and a few turns of bandage round the body. During the whole time of the manipulation, an assistant maintained the humerus of proper length, by drawing the elbow downwards, while he fixed the upper end of the bone.

November 28th.—The man complains of pain along the ulnar border of the hand, and over the styloid process of the ulna. The bandage cut through in these parts, and cotton wool placed between it and the skin. No pain whatever in the arm. To ascertain its condition, the apparatus cut through from above downwards, in the space between the anterior and outer splints; the parts beneath being in perfect condition; the starched bandage refixed by the aid of a few turns of roller.

December 30th.—A fortnight ago, finding the apparatus on the arm loose, I re-adjusted it, by placing folds of lint between it and the limb. To-day I removed the whole. The callus was of moderate thickness and quite solid; the arm of perfect length and shape, and the movements of the elbow unimpaired. The man asserted that, at no time since the first application had he felt any pain in the seat of fracture. I again fixed the elbow with a portion of the apparatus, and bandaged from the hand upwards, intending this as a precaution for another week.

Fracture of the Radius.

Case II.—George Cole, æt. 16 months, admitted as an out-patient in University College Hospital, on the 7th February, 1853. Three days previously he had injured the right fore-arm, by falling down twelve steps; and had ever since been very restless, and apparently in great pain. The fore-arm was much swollen, but not discoloured. Ulna sound. Radius broken through its middle. The starched apparatus immediately applied in the following manner. The elbow being bent at a right angle, and the fore-arm in a semi-prone position, a narrow pad of folded lint, with over it a somewhat narrower strip of moist pasteboard, placed along the

front and back of the inter-osseous space. Having well padded the lower ends of the radius and ulna, and the margins of the hand, I bandaged from this to the elbow. After starching this layer, a pasteboard splint was placed on the dorsal aspect from the elbow to the wrist, and another one on the palmar surface of the fore-arm, from the elbow to the tips of the fingers. Another layer of bandage, and starching this, ended the application. The arm to be kept in a sling.

9th February.—The child has been perfectly easy and playful ever since the application. The apparatus is now loose. I opened it along the radial border, cut off about one-fifth of an inch from one margin, to compensate for the great abatement of swelling; refixed by bandage, and starched the outside.

Comminuted Fracture of the Elbow.

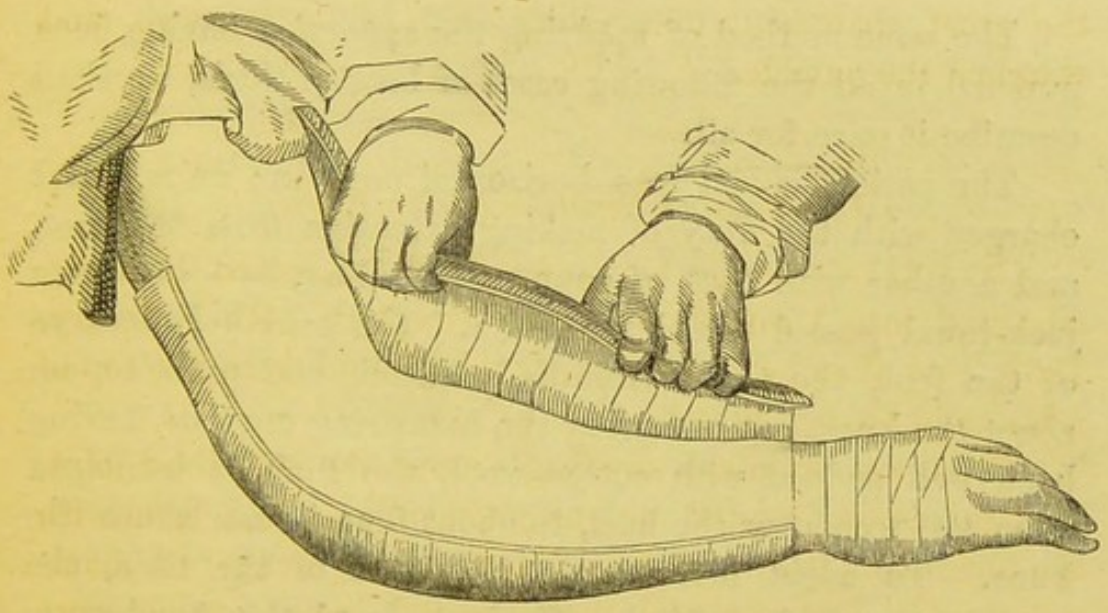
Case III.—George Goward, æt. 35, a robust labourer, admitted into University College Hospital, 14th February, 1853, just after he had fallen to the ground from the top of a house in Gower Street.

There was so much swelling around the left elbow-joint, that in circumferential measurement, taken on a level with the olecranon, it exceeded its fellow by two inches; on manipulating it, preternatural mobility and bony grating were detected. More careful examination proved the inner condyle of the humerus to be completely detached and displaced upwards and backwards; there was also distinct grating in the outer part of the joint; but so great was the swelling, that it could not be determined whether the outer condyle, or the head of the radius, were broken. The application of the starched apparatus was at once proceeded with. The fore-arm being in a state midway between pronation and supination, and bent at a right angle with the arm, I bandaged from the wrist upwards, over the swollen joint, to a little above the middle of the arm. After starching this bandage, a pasteboard splint, about four inches wide, softened

by soaking in water, and bent at a right angle, was placed on each side, in the whole extent of the first bandage, and accurately moulded to the shape of the limb by manual pressure. A dry bandage applied from the fingers over the whole of the splints, and then starched externally.

16th February.—The apparatus cut up in the interval left between the splints, posteriorly. Its edges pared to the breadth of half an inch, to make up for the great diminution in swelling. The integument is in perfect condition. The two halves again approximated, surrounded by bandage, and this starched. Fig. 7 illustrates the manner in which the

Fig. 7.



examination of the limb, in such a case as the one under notice, is conducted without disturbing the apposition of the fragments. The section having been made along the posterior interspace, while the arm lies flat on the bed, an assistant raises the uppermost half, which he is enabled to do with facility, in consequence of there being another interval between the splints in front, so that the bandage in this situation readily bends. To examine the opposite surface, the limb is raised from the bed by firmly grasping it with the outer splint, while the inner one is drawn aside. The manner of conducting this examination will be rendered

clearer by reference to fig. 5, in which the process of inspecting the leg is represented.

This case, as well as the preceding one of fractured radius, exemplify the advantages of this method of treatment in fractures with swelling. Ill-health prevented my following the progress of these cases to the end; but I examined Goward's elbow several days after the last report, and found that the swelling had completely disappeared. I have since heard that he was discharged cured towards the end of March.

Fracture of the Femur.

The same method of applying the apparatus having been pursued in all the following cases of broken thigh, we shall describe it once for all.

The patient is laid in a horizontal position; an assistant charged with the duty of making extension from the foot, and another with that of counter-extending, by means of a jack-towel passed round the groin. The bony prominences of the foot, the tendo Achillis, malleoli, and prominences about the knee, not excepting the hamstring tendons, having been well padded with cotton-wool, the limb is bandaged from the toes, over the heel, to about four inches above the knee. To avoid pressure on the crest of the tibia, the reverses are made behind. The outside of this bandage is starched, and three moistened pasteboard splints, like those represented in fig. 1, are thus placed. The straight one posteriorly, from a little above the heel to as far as the bandage reaches above the knee; of the two others, one is placed on each side, so that the foot-pieces embrace the sides of the foot, and that neither their posterior edges meet the back splint, nor that they advance so far forwards as to press the crest of the tibia. The surgeon now bandages from below, all over the splints, to adapt which to the shape of the limb they require to be moulded by the hands of an assistant. Three other splints are required for the thigh; an internal one to extend from the rami of the ischium and

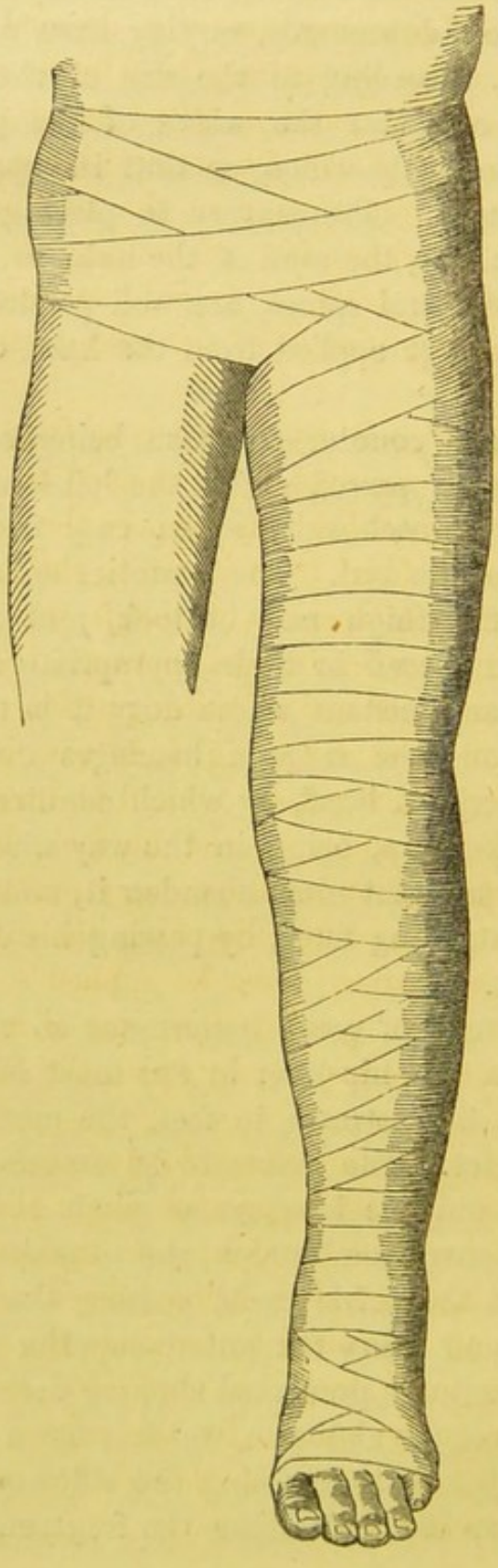
pubis to the knee; an external one, from the outer part of the crista ilii to a couple of inches below the knee; and a posterior one also from the iliac crest to the same point below. The outer and inner ones should be of uniform width from above downwards, varying from one and a half to four inches, according to the size of the thigh. The posterior one, of about the width of the popliteal space below, must gradually widen, so that its upper part cover the whole buttock. Preparatory to placing these splints, the great trochanter, the rami of the ischium and pubis, the iliac crests, and sacral spines, are well padded with cotton-wool, and a bandage applied from the knee over the thigh and buttock.

Extension and counter-extension being constantly kept up, a jack-towel is passed under the loins, and confided to an assistant, one each side, as an easy means of raising the patient from the bed. The posterior splint can thus be glided under the thigh and buttock, and the outer and inner ones are placed in their appropriate situations, and held there by an assistant whose duty it is to mould them into shape, while the surgeon bandages over them from below. The perineal band, by which counter-extension has been hitherto kept up, being in the way while the pelvis is bandaged, the assistant must abandon it, and oppose resistance to the extending force, by passing his arms round the patient's trunk.

It is a matter of great importance so to bandage the pelvis as to fix the hip-joint in the most effectual manner possible. Fig. 8 illustrates, in fact, the method I adopt to attain this object. The points to be especially attended to are, to spread out the bandage as much as possible posteriorly, so as to cover the buttock, and to make several figures of eight round the pelvis itself, passing the bandage alternately above and below the antero-superior spines; by this means it is effectually prevented slipping over the iliac crests on to the sides of the abdomen, which it has a great tendency to do; thereby greatly lessening the efficiency of the apparatus as a means of maintaining the fragments of the femur

in apposition. Smearing the outer surface of the bandage with starch completes the apparatus.

Fig. 8.

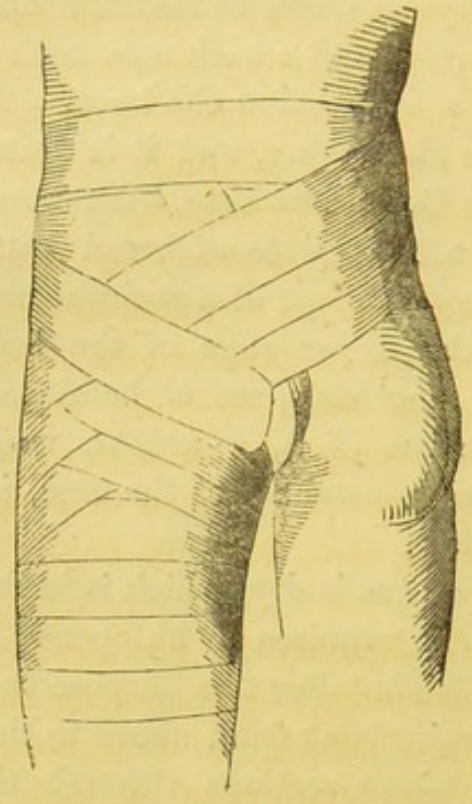


If the thigh be very muscular it is advisable, as a precaution during the drying stage, to add a couple of dry pasteboard splints, an outer and a back one, both extending from the iliac crest to a little below the knee. When there is a great tendency to shortening, and it is deemed desirable to keep up extension for a short time, the following plan will be found effectual: a long piece of broad bandage is pressed round the groin in the shape of a perineal band, its two ends projecting over the upper edge of the bed and a weight secured to them: another piece of bandage is fixed to the ankle; and by means of it, a weight, varying in amount according to the circumstances of the case, is slung over the lower end of the bed.

When the apparatus is dry, which is in from thirty-six to forty-eight hours, it requires to be opened to ascertain the condition of the thigh. For this purpose the bandage is cut in the middle line in front from above to the knee; by here making two transverse sections through the sides of the apparatus, to as far as the interval between the lateral and back splints: or an inner and an outer portion may be alternately turned aside, as shown in fig. 5, in case of fracture of the leg. At this visit the patient should be turned round in order to see that the whole of the buttock, including the natal fold, is covered with bandage; very probably this will be found deficient: if so, after starching the exterior of the apparatus, another bandage must be applied so as to attain the desired object. Fig. 9, taken from one of my patients, is a good illustration of the manner in which the buttock should be covered.

When it is deemed necessary to examine the leg, the best plan is to cut up the apparatus along the front, from the foot to the knee; here making two transverse incisions so as to admit of lateral halves being turned aside from the leg. After these are re-united by bandage the section of the apparatus in the thigh may be proceeded with from the transverse section at the knee. By this means scarcely any motion is imparted to the limb, though the surface to be examined be very extensive.

FIG. 9.



Extra-capsular Fracture of the Neck of the Femur.

CASE IV.—Robert Pavia, æt. 73, admitted into University College Hospital, January 27th, 1853, stating that he had fallen down two days previously, striking the left round bone, and had ever since been unable to move.

Careful examination led to the inference that the neck of the left thigh bone was fractured, but it was found impossible to decide whether the injury were within or outside the capsule. There was no ecchymosis over the great trochanter, but a good deal, with evident swelling, in the groin and inner side of the upper half of the thigh: shortening to the extent of two inches.

In putting up the limb in the starched apparatus, while assistants made extension and counter-extension, I commenced by placing a large pasteboard splint, wider above than below, at the back of the limb, from just above the knee to the crista ilii. After fixing it by bandage, the starched apparatus for fracture of the thigh, as already described, was applied;

so that at last there were two pasteboard splints at the back of the thigh and buttock. The object in first fixing the hip was to diminish the pain during the remainder of the process. I ended by placing a dry pasteboard splint at the back during the drying stage. The limb was left of good length, and the patient quite free from pain.

28th January.—In the morning he complained of a good deal of cough, during the fits of which he felt some pain in the limb. It was painless at other times. During the day he suffered a good deal from sickness, suffering which was aggravated by his being the subject of asthma. In the evening I found him much troubled by cough and vomiting; with pale face, cold skin, clammy hands, and very small pulse.

Autopsy. 29th January (2 P.M.).—Death occurred at half past six this morning. On removing the apparatus, not one mark of a turn of bandage to be seen on the limb, which is everted, and three-quarters of an inch shorter than its fellow; measurement taken after removal of the apparatus, and therefore after displacement of the fragments. The fracture of the femoral neck proved to be outside the cápsule.

Though, from the very speedy fatal termination of this case, it does not prove much in favour of the starched apparatus, it yet proves enough to warrant us in anticipating very good results from its employment in other instances of a similar nature. The ease afforded by its application to our patient was immediate and decided; and when, from difficulty of breathing and repeated vomiting, it became necessary for the patient to sit up in bed, it was very evident that his sufferings would have been very materially increased, had the mobility of the fragments not been limited by so very efficient a retentive apparatus.

Well-established as is the fact that intra-capsular fractures of the neck of the femur exceedingly rarely, if indeed ever, unite by bone, and probable as is the explanation which recognizes insurmountable anatomical and physiological obstacles as causes of this new union, it is not probable

that even by such an improved method of treatment as I have reason to regard the starched apparatus to be, the cases of bony union will be more frequent. But facts are at hand to justify the expectation, that by the adoption of this method and very early getting the patients out of bed, not a few lives may be spared which would be sacrificed by confinement to bed.

It is in fractures outside the hip-joint capsule in old people that the good effects of the starched apparatus are likely to prove particularly great, for in them its superiority as a means of retention has a good opportunity of demonstration, bony union often occurring; and by its allowing the patient to leave his bed without pain or other local mischief, it must eventually contribute in no small degree to the saving of lives, which, owing to the infirmities of advanced age, so often fall a prey to long confinement in the recumbent posture.

Of these unfortunate cases the following is a striking example.

Case V.—On the 28th July, 1851, I admitted James Glass, æt. 59, into Ward 1, University College Hospital. He stated that he had always enjoyed good health; and that about half an hour before admission, while jumping to get out of the way of a cab, he slipped, and fell directly on the left hip.

I diagnosced fracture of the left femoral neck outside the capsule, from the following signs:—(*a.*) Eversion of the foot. (*b.*) On placing the hand over the great trochanter and slightly rotating the limb, very distinct grating felt. (*c.*) Shortening to the extent of one inch. (*d.*) Fulness behind the great trochanter and in the interior and upper part of the thigh. (*e.*) The distance between the upper border of the great trochanter and the antero-superior spinous process of the ilium on the left side was one inch and a quarter less than on the right. The long splint applied at once.

Throughout the whole treatment the state of the bowels, rather too confined or too relaxed, was a great source of annoyance. A bed-sore was soon formed over the sacrum

and attained a large size, the spines of that bone becoming exposed by the ulcerative action. The appearance of another bed-sore over the left iliac crest rendered it necessary to remove the long splint and put the patient on a water-bed on the 22nd September. The sores extended, strength gradually diminished, and death occurred on the 3rd November. Dissection proved that there had been an extra-capsular fracture of the left femoral neck, but that it had become perfectly consolidated. The specimen is in University College Museum.

It is scarcely reasonable to entertain a doubt but that this man would have been discharged from the hospital cured of his fracture, and in good health, had the starched apparatus been applied, and he allowed to leave his bed within a few days after admission.

Comminuted Fracture of the Femur.

Case VI.—Catherine Cox, æt. 14, admitted to Ward 5, University College Hospital, on the 9th November, 1852, stating that she had broken her right thigh about half an hour previously, in falling over a chair. I found shortening to one inch and a quarter; and on manipulating the femur, great preternatural motility and bony grating. That bone proved to be the seat of a double fracture; a transverse one just above the condyles, and an oblique one from without inwards, and from below upwards at its middle. By the application of the starched apparatus, in the manner above described, the limb was restored to its original length and the patient completely relieved of pain. No dry splints were added.

10th November.—As I was going through the ward at 1 A.M., she complained of slight pain in the heel. I relieved it by suspending the leg at about a couple of inches from the bed, in a sling of bandage from the cradle.

11th.—Forty-eight hours after admission the apparatus was cut open for examination of the thigh; its condition was perfect.

30th November.—Since the last report I have twice opened the apparatus: a little excoriation was yesterday detected at the natal fold. After moistening the sore part with tincture of myrrh and covering it with a rather thick layer of cotton wool, the apparatus re-adjusted. There has been no other complaint of pain since the 10th. General health is excellent.

1st January, 1853.—On the apparatus being removed yesterday, both lower limbs were found to be a perfect match in shape and length. The degree of perfection may be judged of by the fact, that a very intelligent gentleman, who entered the ward after the removal of the apparatus, having evinced his anxiety to criticise, by remarking that the broken limb was the shorter, pointed to the sound limb when asked which was the broken one. The callus is rather below the average thickness. The knee and thigh to be supported for a few days longer, by two pasteboard splints and bandage. For about the last three weeks—viz., from the expiration of one month after the accident—this patient had been walking about (and she had done so contrary to my instructions), by the aid of a walking-stick, treading on the foot of the injured limb, instead of on crutches, with the foot raised from the ground in a sling, as in fig. 6.

Transverse Fracture of the Femur.

Case VII.—James Barnet, aged 4 years, admitted into University College Hospital on the 20th October, 1852. It was while wearing an apparatus for the correction of very marked ricketty deformity of the lower limbs that he fell down, a short time before admission. I found the left thigh curved, as the result of rickets, but the right one was much more so. On making extension, the excessive curve of the latter disappeared. Grating readily felt about its middle. No swelling; no bruise of the skin.

The starched apparatus being applied at once, the child appeared comfortable, and expressed itself free from pain immediately afterwards. In consideration of the peculiar

curve of the bones, I was especially careful in padding all their prominences, especially the very convex crest of the tibia.

November 2nd.—The apparatus is firm; the child does not complain; is made an out-patient.

November 5th.—The toes being swelled, and somewhat painful, the apparatus was cut up in the middle line in front to a little above the ankle; after padding with cotton wool, it was re-adjusted by means of a few turns of bandage, starched on their outer surface. This was attended with perfect relief.

November 15th.—The child rolls over actively in bed, and is perfectly well. The whole apparatus being rather loose, I have cut it open and re-adjusted it. The position of the limb perfect. Skin not abraded.

February 1st, 1853.—Union perfect. I had intended keeping on the apparatus rather longer than usual, in consideration of the disease of the osseous system, but should have removed it rather sooner, had the child been brought to me.

Oblique Fracture of the lower end of the Femur.

Case VIII.—Henry Ponfrit, a healthy looking lad, æt. 17, admitted to Ward 1, University College Hospital, the evening of the 37th December, 1852. He had fallen over a bench a short time previously. I found the left femur fractured obliquely, with displacement of the lower fragment upwards and backwards, about an inch and a half above the condyles. Grating distinct. Shortening to an inch and a half. On making extension, it was easy to restore the limb to its natural length; but the fragments continued separate, owing to antero-posterior displacement. Coaptation could only be effected by pressing on the upper fragment while extension was being made. There was no swelling; no bruise of the skin.

I at once applied the apparatus, and left the boy with two perfectly matched lower limbs, and free from pain. In order to maintain coaptation, a sand-bag, about six pounds

in weight, was placed on the part corresponding to the upper fragment. Thirty-six hours after admission, I made the lad get out of bed, and walk up and down the ward on crutches. He did so with perfect ease, the foot being supported in a sling, so as not to touch the ground.

30th December.—It became necessary last evening to open the apparatus, in the middle line, to just above the ankle, becanse the patient complained of tightness in this situation. He has since been perfectly easy.

16th January.—The apparatus being rather loose on the thigh, I opened it as far as the knee, and placed a few folds of lint between it and the skin. I then re-bandaged tightly, and starched outside. The condition of the limb is perfect.

6th February.—Apparatus opened: union solid: re-adjustment effected by means of an outer roller, but only as far up as the great trochanter. Above this point the bandage and pasteboard cut away, to allow free motion to the hip joint.

14th February.—No difference whatever in the shape or length of the two lower limbs. Callus of average thickness. The knee can be bent to a considerable extent. Discharged without apparatus.

27th February.—Nine weeks after the accident, the boy presented himself in the out-patients' room; he could bend his knee to a right angle, and stated that he had walked seven miles, with the sole aid of a stick, on the day previously.

With a view to demonstrate to those around me the efficiency of the apparatus, I had, ever since the middle of January (seventeen days after the accident), been daily in the habit of raising the limb, and striking it down forcibly on to the form on which the boy sat. The noise thus produced was audible all over the ward, yet the boy felt no pain. The first result proved how perfect the apparatus was as a means of retention; for it did not allow of the least displacement of the fragments.

From the second day after the accident the boy was constantly in the habit of early rising, walking about on

crutches, helping the nurses in doing the light work of the ward, and only retiring to bed at an advanced hour in the evening.

The case very satisfactorily illustrates the great advantage which the surgeon derives from this plan of treatment as a means of economizing labour. Throughout the whole time the patient only complained of pain once, and that was of tightness on the foot, on the third evening after the accident, which was instantaneously relieved. I kept account of the time I devoted to the first application of the apparatus, and to subsequent manipulations. On the whole it did not exceed four hours.

Admitting, for the sake of argument, that this was an exceptionally fortunate case (though I have no reason for supposing it to have been such), what other plan of treatment could have given such a result in a similar case, even under peculiarly advantageous circumstances? Treating of oblique fracture of the os femoris, just above its condyles, precisely the kind of injury of which Henry Ponfrit was the subject, Sir Astley Cooper remarks:* "This is a most formidable injury, from its consequences on the future form and use of the limb; for it is liable to terminate most unfortunately, by producing deformity, and by preventing the flexion of the knee-joint . . . . . It appears, then, in the treatment of this case, that a most firm and continued extension must be supported, to prevent the retraction which will otherwise ensue; but it will be seen by the two following cases, that this defective union is with great difficulty prevented, and that the complete flexion of the limb afterwards was not in either instance accomplished." The report of the first of these cases, in which the accident happened on the 20th July, 1821, is thus concluded by Sir Astley:† "October 16th, the union was considered complete, and the patient allowed to get up. On November 1st he resumed his professional duties as an advocate. For a considerable period he suffered great pain and swelling of the limb, but has

* A Treatise on Dislocations and Fractures of the Joints. 1842. Page 244.
† Op. cit. Page 247.

gradually and slowly improved. May, 1822.—At this date he can walk about his room without assistance either of crutch or stick. He has little power of flexion at the knee-joint. The joint is, however, apparently movable to a certain extent beneath the patella, which bone is fixed beneath the projecting edge of the upper portion of the femur, which evidently overlaps and displaces it. There is visible shortening of the limb, and the contour of the thigh is somewhat bowed outwards." The termination of the second case was still more unfortunate. The accident happened on the 9th of November, 1819. "On January the 29th, 1822, he was, for the first time, on crutches; and on February the 24th he first walked out of doors. His present state (March, 1822) is as follows:—The bone above the knee is excessively enlarged; the patella is fixed below the broken extremity of the shaft of the bone, the point of which adheres to the skin."*

The serious impression which these cases are calculated to produce, is not a little added to by the reflection that after commenting on the very formidable nature of the injury, they are the two only examples of it related by Sir Astley, who has thereby afforded ground for the inference, that in his immense experience he had not witnessed any cases of perfect recovery from it. . . . . .

Oblique Fracture of the lower end of the Femur.

Case IX.—Thomas Ponfrit, a healthy looking lad, æt. 16, admitted in University College Hospital on the 29th January, 1853, a few minutes after slipping down on the pavement. There was marked projection forwards in the lower half of the right thigh, due to a very oblique fracture just above the condyles. The lower fragment was displaced backwards and upwards; only the breadth of the little finger intervened between the sharp inferior extremity of the upper fragment and the edge of the patella. The limb was an inch and three-quarters shorter than its fellow. There was

* Op. cit., p. 249.

neither bruise of the skin nor swelling beneath it. The application of the starched apparatus was at once proceeded with; when finished, both limbs were of equal length, and the patient free from pain. In order to keep the upper fragment in position, two sand-bags, weighing about fifteen pounds, were placed over it.

After a couple of hours, the boy complained of very intense pain at the tendo Achillis. I now remembered that by mistake I had only protected this part by a layer of cotton wool, instead of a good pad. I uncovered the foot and ankle, and re-bandaged them lightly, merely with a view to prevent swelling. After this he was quite easy.

31st January.—Complaint of pressure of the bandage on the left hip, and of a sense of weight in the thigh. With the usual precautions the bandages were cut open as far down as the knee. Finding all right, I re-adjusted, not, however, bringing the edges into close contact, but leaving between them a space of about an eighth of an inch, as I thought that the sense of weight was probably due to too great tightness. Before bandaging over the left hip, it was well padded. The patient now complained of pain along the shin. On section from below, there proved to be a little redness. After padding this part with cotton wool, and re-applying to the foot the part of the apparatus which was removed shortly after admission, I completed by bandaging upwards from the toes, and starching externally. The boy now confessed himself free from pain, and could bear to be turned over in bed.

6th February.—While lying in bed, he is quite easy, but has not been able to get up, on account of feeling slight pain in the thigh when he attempts it. The apparatus above the knee has felt rather loose for some days, and I should have re-fitted it before, but for the pressure of other duties. On again opening it, the thigh's shape appears perfect. All swelling has subsided. The cut edges of the apparatus pared, a fold of lint placed beneath them, and then another bandage firmly applied. Immediately afterwards, I got the boy out

of bed, and he walked on crutches without any pain—a week after the accident.

Circumstances having prevented me observing this case to the end of the treatment, its value is comparatively small; yet it is very considerable as supporting the opinion that the success in the case of Henry Ponfrit, just related, was not exceptional, but that similar good results may be hoped for in cases of an equally serious nature, provided the same plan of treatment be adopted.

Transverse Fracture of the Femur, the Knee being Anchylosed in the semi-flexed position.

Case X.—Margaret Cain, a very stout woman, æt. 35, admitted into the University College Hospital on the 28th January, 1853, stating that she had broken her left thigh just previously, in slipping down while walking over some boards.

About three inches above the condyles, mobility and grating denoted fracture, which appeared to be almost perfectly transverse. I found the corresponding knee anchylosed in the bent position, so that the left heel was five inches nearer the spinous process of the ilium than was the right one. The patient stated that she had been the subject of this deformity from her childhood.

My friend, Mr. Hillier, who had charge of this case, consulted me as to the propriety of applying the starched apparatus. I suggested that he should first place a well-padded pasteboard splint, broader above than below, from the upper part of the buttock, along the back of the thigh, to the knee-joint; fix it by bandages, and then proceed with the application of the ordinary starched apparatus for broken thigh. My reason for recommending the first splint was, to keep the fragments in position, and prevent pain during the subsequent manipulation. After-reflection suggested, however, that this aid would have been more effectually accomplished — owing to the peculiar shape of the knee — by placing, at first, two lateral pasteboard splints from the

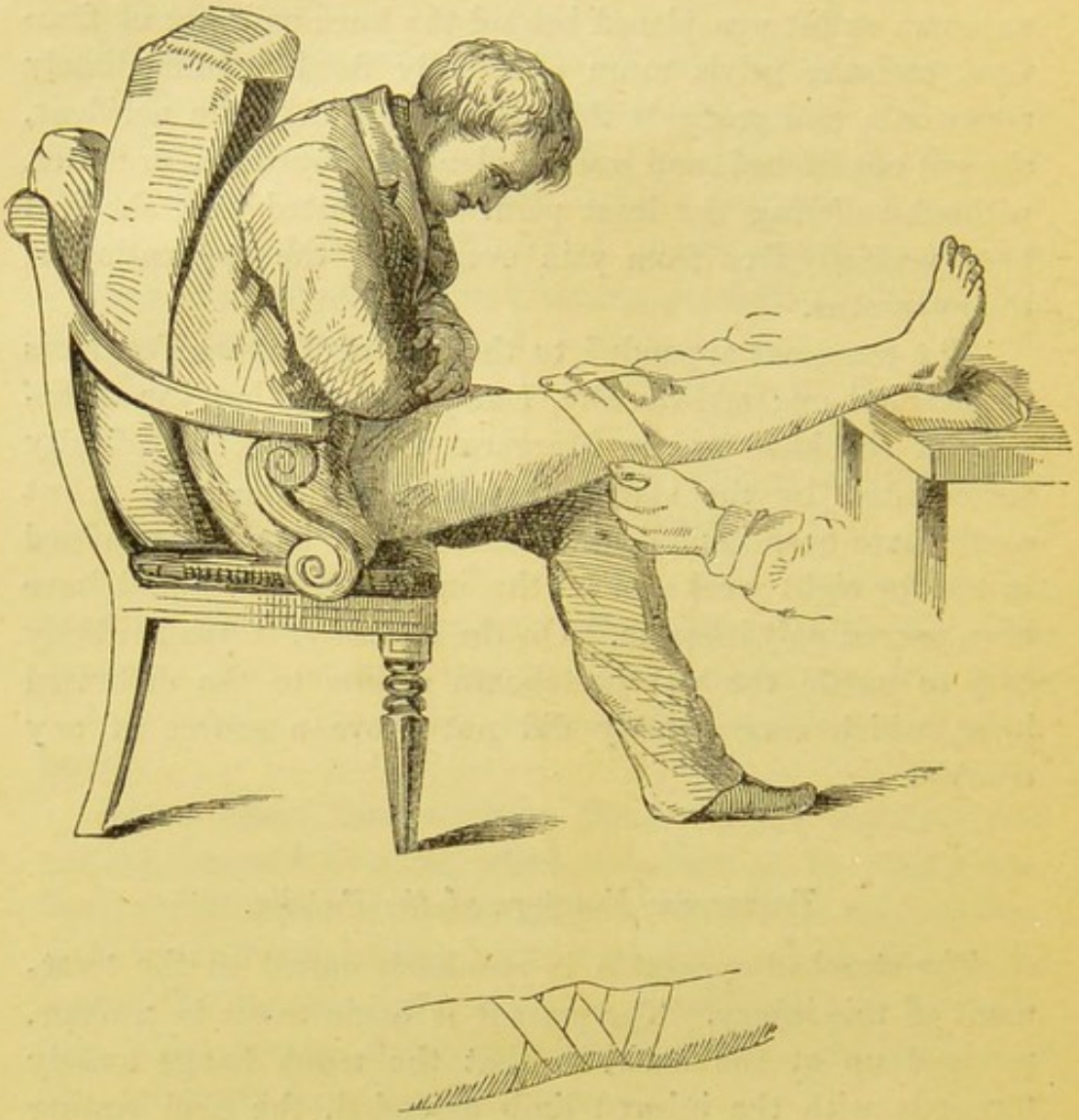
middle of the thigh to the middle of the leg. On the 30th, an extra splint was placed behind the knee and seat of fracture, and the pelvis more effectually fixed. Immediately afterwards, and precisely thirty-six hours after the accident, she got out of bed, and walked along the ward on crutches, without suffering the least pain. She stated that she had been perfectly free from pain ever since the application of the apparatus.

The comment appended to the case of Thomas Ponfrit is applicable here; additionally, I may observe, that the deformity of the knee was, in Margaret Cain, a special difficulty surmounted by the starched apparatus. The long splint would have been inapplicable; and to have kept her confined in bed for eight weeks, or on the inclined plane, would have been exceedingly irksome. On the contrary, it was perfectly easy to mould the wet pasteboard splints to the deformed knee, which consequently did not prove a source of any trouble.

Transverse Fracture of the Patella.

The starched apparatus is peculiarly suited to the treatment of this injury. The patient is made to sit in a chair, propped up at the back, so that the trunk hangs loosely forwards, with the injured limb extended, the heel resting on a higher level than the buttock, with a view to relax the quadriceps extensor as much as possible. A pad, made by folding cotton-wool, or soft tow, in lint, measuring about one inch and a half in breadth, by ten inches in length, is placed just above the patella; and an assistant, holding its two extremities, presses obliquely downwards and towards the foot, so as to approximate the upper to the lower fragment (fig. 10). The surgeon now pads with cotton-wool the upper half of the spine of the tibia, the bony eminences about the knee-joint, and the hamstring tendons; and bandages from the middle of the leg to the middle of the thigh, taking care to bring down and fix the upper fragments, by appropriate figure-of-eight turns of the roller. The outside

Fig. 10.



of this bandage is starched, and a pasteboard splint (fig. 11), placed at the back of the limb to the extent to which it has been already covered. A few turns of roller suffice to fix it, preparatory to placing another back-splint from a little above the heel to within an inch of the natal fold (fig. 12). To protect the skin, the surface of this splint, which is to correspond to it, is covered with cotton-wool above and below the part which has been already bandaged. It is important to place a thick pad of wool between the tendo Achillis and lower end of the splint; and to prevent its upper edge chafing the thigh by similarly padding it. Finally, a dry bandage is applied from the toes, over the heel, to the

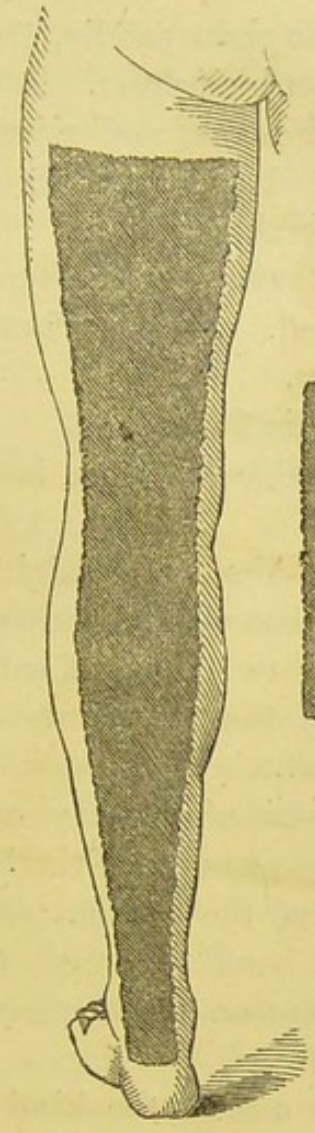


FIG. 12.

FIG. 11.

upper part of the thigh, and then starched. A little care is required not to bend the knee in removing the patient to bed; where he must be kept in the semi-sitting posture, by means of a bed-chair; and the extended limb raised on an inclined plane until the apparatus is dry. Alterations in the size of the limb are easily compensated by opening it in the middle line in front. One or twice during the course of the treatment, it is requisite to remove the bandage from the knee, and make new efforts to approximate the fragments of the patella.

CASE XI.—William Johnson, a robust, middle-aged labourer, admitted to Ward 1, University College Hospital,

on the 7th December, 1852, with a transverse fracture through the middle of the right patella, the fragments being rather more than half an inch apart. After having placed the limb on an inclined plane, and raised the trunk to a semi-sitting posture, a lead and spirit lotion was applied to the knee, it being considerably swollen.

December 9th.—All swelling having disappeared, the starched apparatus applied. Feels perfectly easy. To continue in the same position.

December 16th.—To lie flat in bed.

December 24th.—Discharged from hospital, walking on crutches.

February 2nd, 1853.—About a fortnight after discharged, he left off crutches, and has walked with a stick ever since. In this interval I have twice examined the limb. On removing the apparatus, the fragments are found barely a quarter of an inch apart.

Mr. Erichsen, at his visit of this day, called the attention of the students to the case, as one of the best results he had ever seen after fracture of the patella. To prevent elongation of the ligamentous bond of union, the old apparatus re-applied, with the intention of keeping it on for about another fortnight.

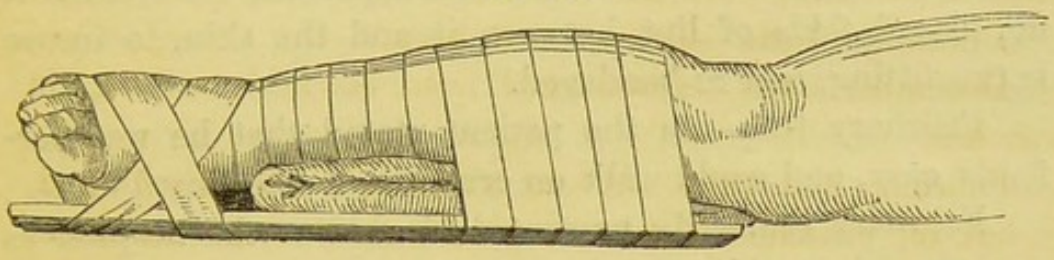
This case is the only one of the kind which I have had occasion to treat by this method; and as it was under my care, at a period when my personal experience with the starched apparatus was comparatively small, I was particularly cautious. Had I now to treat a similar case, I should have recourse to the application immediately after the accident, irrespectively of the swelling, even though much greater than it was in Johnson. I should let the patient lie flat in bed so soon as the starch had dried, and get up within a week.

Fracture of the Tibia and Fibula.

The method of applying the apparatus when both bones of the leg are fractured has been described in the first

chapter at p. 4. When only the fibula is fractured, there is, as a rule, no need of fixing the knee-joint, and it is sufficient to apply the pasteboard splints and bandages as far up as the tuberosity of the tibia; but, in case there were displacement of the foot, and particularly if the subject were very muscular, fixation of the knee or the application of the Dupuytren splint (fig. 13) might be advisable during the

Fig. 13.



drying stage. Moreover, it is not always necessary to fix the knee, when splintering of the inner malleolus is associated with fracture of the fibula, or in the rare instances in which the tibia alone is broken, the tendency to displacement being then very slight.

Case XII.—James Smith, a robust labourer, admitted in University College Hospital on the 24th January, 1853, with transverse fracture of the lower end of the fibula, and a good deal of heat and swelling about the ankle-joint. Starched apparatus applied at once to a little below the knee.

January 25th.—Complains of bandage being too tight at instep. Section effected along the middle line; the edges of the apparatus again approximated by bandage, a slight interval being left between them on the dorsum of the foot.

January 26th.—No pain. The hospital being very full and beds in demand, he is discharged, walking on crutches—forty-eight hours after admission. He subsequently came under my notice two or three times as an out-patient. The recovery was perfect.

Case XIII.—Samuel Townsend, a robust labourer, æt. 28, admitted to Ward 1, University College Hospital, on the

1st February, 1853, stating, that in slipping up on the right side the previous evening, he had injured the corresponding ankle. I found the fibula fractured across about one inch from its lower end. The surrounding soft parts were much swollen, red, hot, and painful. The starched apparatus applied immediately as far as the knee.

February 2nd.—The pain has been less since last evening, but was again getting worse. The swelling having so far diminished as to render the apparatus loose, I cut it up, placed folds of lint between it and the skin, to insure better fitting, and re-bandaged.

February 4th.—As the patient stated that he was perfectly easy, and could walk on crutches, I discharged him.

February 7th.—He presented himself at the hospital as an out-patient this morning, stating that he was perfectly easy up to yesterday afternoon. Since then, had had a good deal of aching pain at the seat of injury. I found that the swelling had almost completely disappeared; and that the apparatus was loose in consequence. After opening it, I pared the edges and re-adjusted. The patient spontaneously entreated me to draw the outer bandage tight, as a means of relief. It was starched; and he walked away from the hospital on crutches quite free from pain.

This and the preceding case afford good illustrations, not only of the safety with which the apparatus may be applied to swollen parts, but of its great efficiency in reducing the swelling and allaying pain. They also exemplify the economical advantages of this mode of treatment; for, whereas collectively the two men were only in hospital five days, they would have been in-patients for at least five or six weeks if treated by the ordinary method—the Dupuytren splint.

Case XIV.—William Pond, æt. 40, admitted the evening of the 19th February to Ward 1, University College Hospital, only a few minutes after a waggon had passed over both his legs. On the right one is a simple graze; on the front of the left one, just above its middle, is a deep graze measuring three inches in length, by half an inch in width.

It is almost directly over the spine of the tibia, which bone is broken obliquely, a little below its middle; the upper fragment riding over the lower one, and projecting beneath the skin. By extension and counter-extension, reduction is easily effected; but there is a great tendency to displacement so soon as the extending force is removed. From the degree and site of mobility, the fibula is judged to be broken on about the same level as the tibia. Starched apparatus applied immediately, and a well-padded wooden splint, with foot-piece at right angle, fixed at the back of the limb—the foot being well-secured to it by figure-of-eight turns of bandage. A sand-bag, about six pounds in weight, placed over the upper part of the leg, to within a little of the seat of fracture, as an additional preventive against displacement.

February 20th, 11 P.M.—The sand-bag was removed this morning. I have just taken off the wooden splint, and regretted finding the inner pasteboard-splint broken opposite the ankle, this being evidently owing to the foot having been drawn down just after the starched apparatus was applied, for the purpose of fixing it to the wooden splint. As he complained of pain over the knee, the apparatus was now cut up from above to the middle of the leg; the condition of the subjacent parts being perfect, outer bandage re-applied. During this process, the fragments of the tibia readily became displaced, and extension was again required to effect coaptation.

21st.—The apparatus opened throughout. Finding that there was some swelling and redness in the neighbourhood of the graze, which was precisely opposite to the line of section, I cut out about three quarters of an inch from each edge, so as to leave the graze and a little of the adjoining integument free. The two sides were then approximated and fixed by bandage, the sore being still left uncovered. To this a small poultice was applied, and over it a piece of oil-silk and fold of lint, maintained in position and gradually compressed by means of four slips of bandage on the many-tail principle.

February 25th.—The swelling and redness in the neigh-

bourhood of the graze much less. A slight slough has separated from its surface. Thick water dressing was yesterday substituted for the poultice. General health good.

February 28th.—As the man complained of occasional pain, "close," to use his own terms, "to starting of the broken bone," I this morning opened the apparatus, with the assistance of my friend Mr. Carter, one of Mr. Erichsen's dressers. We noticed that the inner pasteboard splint was broken opposite the ankle, fully explaining the inefficiency of the apparatus as a means of maintaining coaptation. We observed, moreover, that the redness about the wound accurately corresponded to the part that had been left uncovered for the application of dressing; the precise extent of the starched apparatus was indicated by the limit of colourless and healthy-looking integument. The upper fragment of the tibia was displaced, as at admission. For about an inch and a half below the seat of fracture, the skin covering the seat of fracture had a bluish tint.

A pasteboard splint, with broad foot-piece, was placed on the inner side. So soon as I had bandaged to a little above the ankle, I caused one assistant to make very forcible extension from the foot, while another counter-extended by means of a jack-towel, used as a perineal band. The bandage was then continued as far above the knee as the apparatus extended, the wound being left uncovered. An old starched apparatus being at hand, it was fixed by bandage on the outside, during the drying stage. The wound, which was improving in appearance, dressed as usual with water dressing. Six hours after I had thus fixed the limb, the man expressed himself perfectly easy.

The startings did not recur until three or four days afterwards, when the wound was perfectly healed, and the size of the limb notably diminished. The outer bandage was then removed, the edges of the apparatus pared, and re-adjusted. Before doing so, extension and counter-extension again resorted to for the purpose of correcting slight displacement of the tibial fragments.

Illness prevented me watching the progress of this case

to its termination; but I was informed by my friend Mr. White, who kindly acted as my substitute, that consolidation of the bones occurred in the usual period, and without any deformity.

Several facts, mentioned in the foregoing report, require particular notice. The obliquity in the line of fracture in the tibia, and the great tendency to forward projection of the upper fragment, was a formidable difficulty, especially so, being conjoined with wound on the front of the upper part of the leg. Displacements of this kind are often the cause of great annoyance to the surgeon: of pain and permanent deformity to the patient. When in the habit of using the M'Intyre, two cases of oblique fracture of the tibia occurred to me, in which the upper fragment projected forwards, and could not be maintained in position, at whatever angle and however firmly bandaged. In a case of this kind, which was in University College Hospital three years ago, a variety of splints were tried, and, as a last resource, the tendo Achillis divided; but all to no purpose. Consolidation occurred, but with great deformity; the sharp edge of the upper fragment could be very distinctly felt beneath the skin.* In the case of William Pond, above related, the riding of the upper fragment was prevented, and the limb restored to its pristine shape. It is interesting to notice, that when the inner splint was broken at the ankle, or the apparatus was loose owing to diminution of the swelling, displacement occurred; but coaptation was perfectly main-

* Though foreign to my immediate purpose, I cannot abstain from briefly commenting on the cause of the upper tibial fragment's forward displacement in the above-named class of cases. It is very generally attributed to contraction of the muscles of the calf dragging the lower fragment backwards and upwards. That this was not its real cause in the last mentioned case is obvious; for, by the division of the tendo Achillis, the action of the great sural muscles was utterly prevented; whereas I have never seen any good result from bending the knee in these cases: its extension has always proved of more or less service in correcting the displacement. From these facts it would appear that the quadriceps extensor femoris mainly contributes to the displacement, by pulling the upper fragment forwards. Once this movement has occurred, it is easy to understand how the lower fragment, having no opposing force, may be drawn a little backwards and upwards by the muscles connected with it, and thereby aggravate the deformity.

tained when the apparatus was solid, so as to fix both knee and ankle, and fitted accurately to the limb. Be it noted, that so good a result was obtained when the existence of a wound above the middle of the leg for several days prevented firm bandaging in this situation. The ease with which this wound was managed is worthy of attention, as is also the fact, that when the starched bandage was cut away from it, and emollient dressings applied, the surrounding inflammation extended to the edge of the apparatus, but not a line beyond it, illustrating the influence of compression in preventing the spread of inflammatory action.

Case XV.—George Ball, æt. 45, admitted in University College Hospital, on the 12th January, 1853. A few minutes previously, a heavily laden cab, on the driving-seat of which he was sitting, upset, and his left leg was caught under it. The inner malleolus was fractured obliquely; the fibula broken across, four inches from its lower end; and a wound through the soft parts in this situation. There was slight abrasion of the integument over the instep; but no subcutaneous extravasation of blood. No swelling. The foot was slightly inverted. The case being under Mr. Hillier's care, he requested me to assist him in the application of the starched apparatus, after we had mutually agreed on the propriety of giving it a trial. The foot and seat of fracture were well padded with cotton-wool, and the apparatus extended to three inches above the knee. As the man was tipsy, it was deemed necessary to place a wooden splint at the back, and to fix it with a few turns of bandage, in order to prevent displacement during the drying stage.

January 13th.—Has passed a good night. Has only felt occasional throbbing in the limb; it has lessened with the drying of the apparatus. Is now perfectly easy. The apparatus opened for the examination of the limb, and re-adjusted on its being found to look perfectly well.

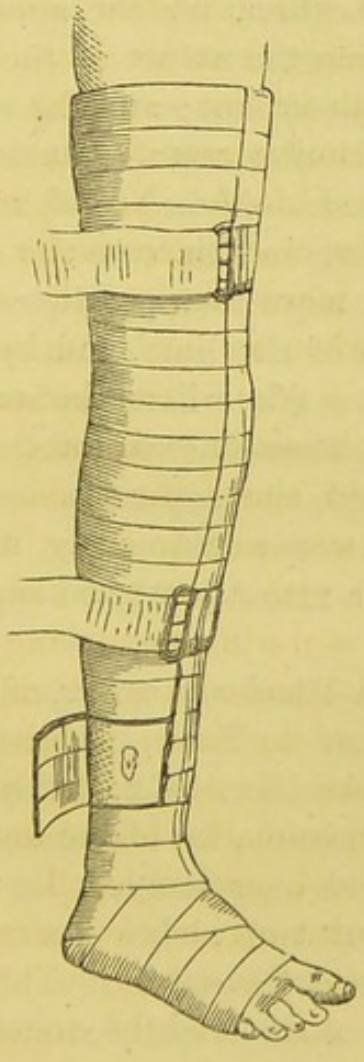
14th.—The apparatus opened, and a trap-door cut out of the outer half, opposite the wound. The two halves above and below the trap-door brought together by bandage,

and this starched (fig. 14). The wound bled a little on removing the lint which covered it. There was a little vesication near the seat of injury, but no inflammation. Lint placed over the wound, and the trap-door lightly fixed in its former position by bandage. The man says he is perfectly comfortable. He can lift the limb off the bed without pain.

15th.—Two or three large blebs have formed under the trap-door; but there is no constriction, for the fingers can be readily introduced under the edges of the apparatus. The limb placed on an inclined plane, with the heel slightly raised. The wound has been throbbing; there is a little sero-purulent discharge from it. Water-dressing applied.

17th.—The wound is suppurating. There are several

Fig. 14.



blebs in its neighbourhood, some filled with dark red serum, others with pus. The part is not tense.

18th.—The leg examined throughout its whole extent. There is very extensive yellow discoloration of the integument, evidently owing to altered extravasated blood; and additionally numerous blebs containing purulent fluid; these are chiefly on the outer side.

Superficial ulcers formed at the base of some of the blebs; and the apparatus required to be opened daily for the purpose of dressing them. They soon healed; and on the 14th of February (a month after admission) the patient left his bed; he had, however, been well enough to get up a fortnight earlier, according to the information I received from Mr. Hillier.

This patient's sufferings were throughout peculiarly slight. The blebs which formed on the integument, could not be due to constriction, for the apparatus was applied unusually loose, as from the nature of the fracture there was not much fear of displacement; and the subsequent swelling was very slight. In similar cases—fracture from the fall of a heavy weight on a limb—blebs are of very frequent occurrence. That they were in this case the sequels of external violence is rendered more than probable by the extensively ecchymotic condition of the limb, and by their being more numerous on the outer side, where the wound in the integument was situated. Though some of the blebs, as well as the wound, suppurated, one apparatus lasted for the whole treatment; and it was subsequently useful as an outer casing to strengthen a recently-applied apparatus until dry.

Case XVI.—John Rhodes, a carter, of rather intemperate habits, æt. 48, admitted to Ward 1, University College Hospital, on the 24th November, 1852. The accident was occasioned just before admission, by his falling out of a van, the wheel of which passed over the left leg; I found both its bones fractured about two inches above the ankle. The lower end of the upper fragment of the tibia was a good deal tilted forwards, and the skin tightly stretched over it. There

was a small oblique wound to the extent of about one inch, on the inner surface of the limb, opposite the seat of fracture; a little blood oozed from it, but the bone not seen protruding. The swelling about the seat of fracture was considerable, owing, no doubt, to subcutaneous extravasation of blood. Starched apparatus applied at once to nearly the middle of the thigh, and a sand-bag, about five pounds weight, placed over the front of the leg, from the knee to a little above the seat of fracture.

26th November (10 P.M.).—Complaint of pain across the roots of the toes, and on the instep. Relief afforded by opening the apparatus on the dorsum of the foot, and re-bandaging rather loosely.

27th November.—No complaint of pain. The whole limb examined. The wound appeared quite healed; but on the inner and outer side, and also in front of the small of the leg, were several rather large oblong vesications, disposed in the course of the turns of the bandage; the skin slightly livid, but sensation perfect; swelling, about as at admission. The coaptation of the broken ends appeared perfect. I placed a thick layer of cotton-wool over the small of the leg, and rather loosely re-adjusted the apparatus.

28th November.—The leg not painful, but rather numb. The man can lift it off of the bed. The vesications contain less fluid. The dorsum of the foot and leg is slightly discoloured, from subcutaneously extravasated blood.

29th November.—The limb is no longer numb. The skin has acquired a mottled yellowish colour, evidently owing to change in the effused blood. The blebs are drying; the wound appears quite healed.

1st December.—As the limb was quite easy, the apparatus was not opened yesterday. This morning, however, the patient complained of pain in the seat of fracture; on exposing the limb, a good deal of swelling was found in this situation; the wound open, its edges red; no discharge; a large bleb on its inner side. Temperature of the small of the leg, on the injured side, 93°; on the sound side, 85°. The position of the fragments perfect.

With a view to experiment, the starched apparatus removed, and the M'Intyre substituted. In so doing, great caution was observed, and immediately afterwards the coaptation continued perfect; but after the lapse of a few moments, Mr. Hillier, who had kindly lent his assistance, noticed with me, that as the man moved his body a very little, there was some motion at the seat of fracture, and a little reddish serosity exuded from the wound.

2nd.—Complains of a good deal of pain at the seat of fracture, and of feeling low. Has felt a good deal of pain at the heel during the night. On palpating the swelling, it feels boggy, but not fluctuating. Tongue dry and cracked; red at sides and tip, brownish in centre.

6th.—Since the last report, the limb has, on the whole, appeared to improve in condition, but the displacement of the lower end of the upper fragments, forwards and outwards, has much increased, in spite of various efforts made to counteract it.

From this time, the soft parts about the fracture got into a sloughy state, and the system in so low a condition, that Mr. Erichsen deemed it necessary to amputate below the knee. Henceforward, the man slowly but constantly improved, and eventually recovered with a good stump.

The subject of this accident was a carter, of somewhat intemperate habits: the fracture was comminuted, and there was a wound in the integument, produced by direct violence. It is the contrary of surprising, according to what we know of such accidents in London hospital practice, that, though this man was supported by stimulants, he fell into so low a condition as to render amputation of the limb necessary. As a means of maintaining coaptation, the starched apparatus proved perfectly efficient. At the moment of its removal, the fragments were in perfect position, but they became displaced almost immediately after the limb was put on a M'Intyre, though much more than ordinary care was observed in its adjustment. The fact that vesications occurred, is in itself no proof that the apparatus did any mischief; for it is well known that the skin usually

vesicates over a fracture that has been occasioned by severe direct violence; but it is the peculiar position and shape of the blebs in this case, which may be regarded as evidence that the apparatus produced mischief by constricting. It is stated in the report of the 27th November (the third day after the accident), that the patient did not complain of pain; that the wound appeared quite healed; but on the inner and outer side, and also in front of the small of the leg, were several large vesications disposed in the course of the turns of bandage; there had been no sensible increase or diminution of the swelling since admission. The absence of pain, the comparatively healthy nutritive activity of the limb, as indicated by the wound having healed, and the swelling not having increased, are facts which seem to prove that the apparatus did not exert baneful pressure. The case was undoubtedly one in which blebs are very apt to form on the integument in consequence of the injury done to the subjacent parts, and altogether independently of the treatment adopted; yet I confess that the fact that the blebs appeared opposite the turns of bandage seems proof that the compression was here a little greater than elsewhere. I am disposed, from observing the other conditions, to consider that the excess of pressure at the turns was just sufficient to determine the situation of the blebs, but that they originated independently of it. It is recorded in my note-book that, contrary to usual custom, I did not in this case surround the seat of fracture with cotton-wool when the apparatus was first applied. Had this been done, the constriction at the turns might have been prevented; but it is more than probable that blebs would still have formed, though not of the same shape and in the same situation. An impartial study of the facts stated in the history impels me to attribute the unfortunate termination of the case to the severity of the injury and the state of the patient's constitution. I submit this opinion the more freely as I have already stated the facts for the formation of an independent judgment.

Fracture of the Os Calcis.

Case XVII.—James Palmer, æt. 44, admitted to Ward 1, University College Hospital, on the 7th February, 1853. While walking on a board, which was raised about two feet from the ground, it broke, and he dropped on his feet, injuring the right one. The malleoli were sound, but on grasping the foot with one hand, I could, with the other, move the posterior part of the os calcis, and produce very distinct grating. The fracture appeared to be through the bone, about its middle, but there was no displacement. He complained of considerable pain, and there was a good deal of ecchymosis over the inner malleolus, but especially between it and the point of the os calcis. Swelling so great, that round the malleoli the right ankle measured one inch more than the left. There was also considerable fulness on the sides, between the malleoli and the point of the os calcis. Moreover, the foot was swollen on its dorsum. The starched apparatus applied to below the knee, as for fractured fibula.

8th (7 A.M.).—Has suffered a good deal of pain all night. Nothing abnormal in the appearance of the toes. (6 P.M.)—The pain has gradually lessened since morning, and he has now scarcely any.

14th February.—Has been perfectly easy, and (since the 11th) in the habit of getting out of bed. Since the last report, the apparatus has been thrice opened, and its edges pared, to compensate for the decrease in the size of the limb. To-day I find that the swelling has almost completely disappeared. The ecchymotic discoloration on the outer side has extended to the middle of the leg. A few days since I placed a pasteboard splint over the whole sole of the foot, for the purpose of preventing motion in the tarsal joints. Discharged, walking on crutches.

21st.—Came to the hospital, as an out-patient, without pain. The apparatus being very loose, I removed the outer bandage, pared the edges, and firmly re-adjusted.

As evidence that the starched apparatus may be applied even when considerable swelling complicates a fracture, this case needs no comment. The rapidity with which the pain and swelling disappeared are, I think, fairly referable to immobilization of the joints, and to the application of pressure.

Studied individually, no less than collectively, the cases narrated in this chapter are substantial testimony of the merits of the starched apparatus. True it is that their number is not great; still it is so considerable, and such is their nature, as to render it incumbent on those who entertain opinions at variance with the conclusions deduced from them, to appeal to facts for their refutation. Hitherto, the subject has been discussed in too theoretical a manner. Though several writers have expressed more or less disapprobation of the starched apparatus, I know of none who in doing so have founded their objections on a sufficiency of well-established facts; while its advocates, whose opinions, with very few exceptions, I have studied in writing, and with the practice of many of whom I have made myself personally acquainted, base their teaching on vast experience, the results of which, obtained under very widely different circumstances, are expressed in terms so unanimous, that they thereby derive additional claims to respect, as bearing one of the most irrefragable evidences of truth.

In a series of cases, like those above related, would any other system of treatment have led to equally favourable results? Would they have been obtained, even by the selection of peculiar plans of treatment according to special indications? In my opinion, these questions must be replied to in the negative; but even holding them *sub judice*, the facts above recorded are such as to call for further trial of the method, for their definitive solution.

I have not yet had occasion to adopt this method in the treatment of severe sprains, for which its continental advocates highly extol it. M. Seutin even applies the starched apparatus to stumps, and his example appears especially to deserve imitation in army practice, where the jerking of the

stump by muscular action, aggravated by moving the patient from one locality to another, is cause of much distress. A means of setting a stump perfectly at rest, without constricting or otherwise injuring it, cannot but be valuable in many cases.

CHAPTER III.

ON THE COMPARATIVE SUPERIORITY OF THE STARCHED APPARATUS IN GENERAL PRACTICE, BUT PARTICULARLY IN HOSPITALS AND IN MILITARY SERVICE.

Even should it be generally admitted that the evidence adduced in the foregoing chapter, is sufficient to prove that fractures may as a rule be successfully treated, from the first, with the starched apparatus, the question whether or not it be superior to other methods of treatment, remains to be considered.

In investigating its comparative merits, we shall first consider it as regards the patient. It sensibly lessens the amount of pain. With this as with all other modes of treatment, the art of reduction and the appliance of means for maintaining coaptation, occasion pain; it is in the after-treatment that the difference is apparent. Once the limb is put up in the apparatus, whether it be desirable to examine it frequently or not, it continues immovable and therefore painless. The using the bed-pan and changing bed-linen, painful processes to patients subject to the ordinary plans of treatment, are absolutely painless when the starched apparatus is employed; and great indeed has been the difference which I have perceived, in the pain usually felt by fractured patients in particular parts, the instep and heel for example. The long splint to the former and the M'Intyre to the latter, are frequent causes of severe pain; but the use of the starched apparatus completely does away with those complaints.

As this method greatly abridges the period of confinement to bed, it materially ministers to ease and comfort, and in many cases may prove very economical as a means of

saving the patient's time. Whether a senator, merchant or artisan, a patient with a broken thigh, knee-cap, or leg, is usually confined to bed, and thereby incapacitated for the fulfilment of his duties for many weeks; scarcely as many days are, as a rule, needed with the starched apparatus; at the expiration of which, the patients suffering from the above-named injuries may leave their beds, and with perfect comfort pursue any avocation that admits of the sitting posture. One of the most distinguished European surgeons,* in criticizing the merits of the starched apparatus, has stated that there does not appear to be any benefit derived from treating patients with fractures, propped up in chairs, instead of allowing them to lie quietly in their beds. But the patient with the starched apparatus sits comfortably, and is not propped up in a chair; and it is not in conformity with experience, to state in general terms, that patients lie quietly in bed, whose broken thighs are treated by the long splint, the double inclined plane, or their modifications; whose body and limbs are confined in an unnatural position for the treatment of a fractured patella, or whose leg is fixed for six weeks on a M'Intyre, for a broken leg.

In addition to the abridgment of the period of confinement, greatly ministering to the patient's comfort, it is a means of saving life in some cases; this is especially true of aged patients, in whom long confinement to bed not unfrequently breaks up the constitution, however well the repair of the bony injury may have proceeded.

The last aspect in which the relative advantages of the starched apparatus to the fractured patient require to be viewed, is, as to its efficiency in lessening deformity. Pott's plan, the long splint, M'Intyre, and their modifications, as a rule entail sensible deformity, which in many cases is very considerable. It is a significant fact, that, though the example established in University College Hospital by the late Mr. Liston, of treating fractures of the thigh by the long splint, and of the leg by the modified M'Intyre, which

* Principles of Surgery, by James Syme. 3rd ed., 1842. Page 165.

are admitted equal if not superior to other splints, was rigidly followed in that institution, the patients admitted with broken thighs or legs, were frequently discharged with manifest deformity. How far superior have been the results attendant upon the adoption of the starched apparatus, may be judged of from the cases recorded in this work.

We have next to inquire whether the starched apparatus have any special merits as regards the surgeon. I here allude particularly to his convenience, because having endeavoured to prove, that in so far as regards the result to the patient, the treatment by the immovable apparatus is superior to all other methods, it is needless to dwell further on this point. The fact that the materials requisite for its construction are to be met with in almost every locality, is a great convenience to the practitioner; moreover, the fact that, once applied, it has no need of being changed, and admits of examination of the limb, with almost as little trouble to the surgeon as pain to the patient, is an advantage not reaped when other methods of treatment are employed.

The general tenor of the foregoing considerations affords scope for more lengthened comment on the peculiar advantages of the starched apparatus in civil and military hospital practice. Its advantages in the former are chiefly on the score of economy, as proved by the cheapness of the materials employed, and by the fact that many patients with fractures of the lower extremities, who under other systems would be kept in hospital a month or two, can by its employment be discharged in less than a week. The advantage of being able to do this is peculiarly apparent in small hospitals. In University College Hospital, where the number of beds does not exceed a hundred and fifty, great advantage has been reaped from being able to discharge many patients with broken legs, within three days, so as to admit fresh cases, and proportionally extend the means of clinical instruction.

In the belief that this plan of treatment is peculiarly applicable to military practice, I am opposed to no less an authority than Sir George Ballingall, who thus expresses

himself on the merits of the starched apparatus.* "It may be easily supposed that it will form a most perfect and secure encasement. I had an opportunity, about ten years ago, of seeing this plan executed with great address by one of its most distinguished advocates, M. Seutin of Brussels, where it was then uniformly practised; but I saw also in this gentleman's hands, a little patient, of about two or three years old, with a fractured thigh, where the apparatus, having been put on immediately after the accident, had become too tight, and was obliged to be slit open with M. Seutin's scissors. In another case of fractured thigh, the apparatus, which had become slackened from the subsidence of the swelling, was slit open, a portion of it removed by paring off one of the edges of the slit, so as to adapt it accurately to the diminished size of the limb, and was then replaced with the starched bandage over it. This mode of dressing fractures has been so much approved of by the Russian authorities, that their army and navy surgeons have been ordered to adopt the starched bandage. In my opinion however, none of these practices should be looked to as preventative measures, or used indiscriminately. In many cases they had better be deferred until it is seen whether the injury is likely to be accompanied with any excess of inflammation; and I am further of opinion, that upon the continent, where the habits of the people are comparatively temperate, and still more amongst the natives of India, all these practices will be found more generally satisfactory and successful than amongst our hospital patients in this country, many of whom are much given to the abuse of intoxicating liquors."

Sir George's implied doubts as to the inconvenience accruing from alterations in the size of the limb, and his avowed suspicion that M. Seutin's practice is not likely to prove successful in our own country, were certainly sufficient reasons for the merits of the new method to be held *sub judice*, by one who candidly impresses his readers with the

* Outlines of Military Surgery. 4th ed. Edinb., 1852. Page 359.

belief that he had not tested them experimentally. The histories of cases which I have narrated in Chapter II., would, however, appear to be adequate to prove that the doubts expressed cannot be regarded as real objections, for they prove that the changes in the size of the limb are easily provided for; and that in English, no less than in Belgian and Russian practice, are the beneficial effects of the starched apparatus greater than those obtained by treating fractures according to the old plan.

Further critical analysis of the teaching of Sir George Ballingall, and other military surgeons, adds strength to the conviction, that it is especially in fractures of the lower extremities in military practice that the starched apparatus is likely to prove superior to every other mode of treatment.

"It is chiefly* in reference to fractures of the thigh-bone that the question of relaxing the muscles have been considered of paramount importance; and the different view of this subject, adopted by the English and French surgeons, was followed for a series of years by a very marked difference in their practice—the former adopting the bent position, and the latter the extended. Of late, however, I believe that the surgeons of both countries are disposed to take a less exclusive view of this matter; and my own experience tells me, that in the infinite variety of fractures which one has occasion to see in the course of a long run of hospital practice, he will find that a fractured limb sometimes lies best in one position, sometimes in another, without his being always able to see distinctly the reason why. An early bias, derived, perhaps, from the study of Mr. Pott's writings, and the observation that the limbs naturally fall into the bent position during sleep, have made me partial to this position in fractures of the lower extremities. I am not, however, insensible to the objections to Pott's position; and the extended posture is unquestionably the favourite mode of treatment with many of the best surgeons in this country at the present day. There is one important consideration by

* Ballingall, Op. cit. Page 355.

which I have often been guided, and which army and navy surgeons, above all others, must never lose sight of. In military practice we are not always able to have recourse to the measures we may think positively best; but must resort to those which, under all the circumstances of the case, we can command most readily and use most effectually. This applies particularly to fractures of the femur; for although we may not always be able to command the finished apparatus of Desault, Boyer, or Hagedorn, we can seldom be at a loss for a long splint upon which to extend the fractured limb; and, even in defect of this, we may be able to keep up a continued extension, by fixing the patient's trunk, and then apply a lac or the strap of a tourniquet, so as to draw down the fractured limb towards the bed-post, or to a fixed point in the floor, as suggested by my predecessor, Dr. Thomson. There is also a mode of effecting this object by means of a weight attached to a cord which is fixed to the patient's ankle, and passes over a pulley at the end of the bedstead. Independently of the facility with which an apparatus for the extended posture of the limb may always be procured, it is to be observed—with reference to gun-shot fractures particularly—that where extensive, profuse, and long-continued suppurations must necessarily ensue, the patient, if placed on his back, with his limb over a double inclined plane, will have the thigh in such a position that the matter will gravitate towards the pelvis, will tend to lodge, to impede the cure, and perhaps to extend the mischief. For the treatment of broken limbs in the last position, all the common pieces of apparatus are modifications of the double inclined plane; and of these, Mr. Earle's, Mr. Amesbury's, and Mr. M'Intyre's are the best with which I am acquainted. The last, upon which some improvements were made by Mr. Liston, I have now been in the habit of using for years with satisfaction and success. The practice of swinging or suspending fractured legs in a sort of cradle is one which I have repeatedly seen in several of the continental hospitals, and more recently in some of the hospitals of this country. I am inclined to think that this might be extended

with advantage to many cases occurring in military life. Such an apparatus, placed in one of the doolies or litters used in the Indian army, would afford great comfort to a soldier compelled to travel with a broken leg."

It is sufficiently evident, from a perusal of this quotation, that amongst the very numerous contrivances that have been proposed for the treatment of broken thighs, Sir George Ballingall finds it difficult to make a selection suited to military practice. It is equally that, in making the selection, he regards, as the two principal conditions to be fulfilled, the facility of obtaining the requisite materials; and secondly, to afford comfort to the soldier when compelled to travel.

The starched apparatus is better calculated than any other to fulfil these indications: few, indeed, are the localities where the materials requisite for its construction are not to be met with at very short notice; and no sooner is it applied, than the patient can be moved with perfect ease, provided a few bits of stick, pasteboard, or other rather stiff material, be secured lengthways on its outer surface, until it has had time to dry. To say that a number of soldiers with broken legs and thighs could be conveyed with perfect ease, within a few hours, on a long journey from the scene of action, may appear somewhat exaggerated, but is undoubtedly practicable.

Mr. Guthrie teaches* that, "in order to attempt with a reasonable hope of success, the management of a compound or gun-shot fracture of the thigh, it is desirable the patient should be placed on a proper bedstead, of sufficient height to render him easy of access, and capable of affording him every necessary comfort and accommodation *without moving*. This will be best accomplished by a bedstead and mattress invented by Mr. Gardiner and myself in 1815 . . . . . The battle of Toulouse gave forty-three fractures of the thigh, out of 1,242 wounded, which were attempted to be saved, and this may be considered as a fair average; and I should say, that a corps of 10,000 men ought to be supplied with a

* Clinical Lecture on Compound Fractures of the Extremities, &c., by G. J. Guthrie, F.R.S. 1838. Pages 35–38.

reserve store of at least twenty of these double bedsteads, at an expense, perhaps, of 200*l*. In Spain and France, we had nothing of the kind; the consequence was, that many suffered intolerable torments that might have been greatly alleviated; and many lost their lives . . . . . It is possible to succeed in saving thighs, fractured anywhere except at their extremities, if you have at hand all the necessary appliances of surgery; but if you have not, and the sufferer must be kept in a constant state of motion and of irritation, you had better cut off his thigh, or, as a brave but unfortunate French officer said to me at Salamanca: "Pray, sir, kill me in any way you please, but do not let me die by inches." Splints for fractured thighs must be of three kinds, with proper pads for all of them; and the material to make these pads should accompany them in considerable quantity. 1. Long Dessault splints, improved. 2. Amesbury's leg and thigh splints, to be used straight for the thigh. 3. Common solid wood and tin splints."

Dr. Busci, the Professor of Clinical Surgery in the University of Pisa, whose opportunities of studying gun-shot fractures were very considerable during the campaign in Lombardy, in 1848, thus expresses himself:* "In a recent memoir on gun-shot fractures of the lower limbs, Malgaigne advises military surgeons not to be too hasty in amputating the thigh when the femur is broken; for, by appropriate treatment, consolidation may be obtained . . . . . Admitting the possibility of this occurrence, I should not be disposed to follow this advice, even though the fracture were not complicated with wound; for the difficulties experienced in conveying, from the field of battle to the hospital, soldiers, whose thighs have been broken, are great; and they are exposed to continual shaking of the limb whenever it is necessary to move; for coaptation is not maintained with sufficient accuracy by the apparatus in ordinary use. Amputation on the the field deserves preference."

* Intorno alle ferite per arme da fuoco, operate e curate in Lombardia durante la campagna del 1848. Annotazioni del Dottor Carlo Busci. Pisa, 1849.

In regarding gun-shot fractures of the thigh as a very serious accident, Guthrie and Busci entertain an opinion common to all military surgeons. Neither are they at variance in recommending primary amputation in the great majority of such cases, and in the reasons which they adduce in support of that severe practice;—in many cases, the disorganization of the limb is so great as to render any attempt to preserve it quite hopeless. And in those instances where the comparative integrity of the soft parts, and not extensive splintering of the bone, would afford hope of cure, without resorting to the knife, it had better be used, for the therapeutic indications cannot be fulfilled by the apparatuses in ordinary use. The beds recommended by Mr. Guthrie are expensive; but what is a much greater objection, the difficulties of transport render it impossible to have them generally at hand.

Baron Larrey, the constant follower of Napoleon's standards, became impressed with the inefficiency of the common treatment of fractures at the early period of his glorious career; and he devised a method of fixing the whole limb in a solid casing (composed of compresses, bandages, and straw cushions, soaked in a mixture of comphorated spirit, acetate of lead, and white of egg beat up with water), which, whether the fracture were simple or compound, was not removed until the period requisite for consolidations of the bones had expired. How far he carried the principle of immobility, how little he cared to examine and dress wounds in soft parts, so long as their mutual contact was accurately maintained, and air excluded, is strikingly exemplified in the case of the veteran Delage. "This soldier, whose arm* I amputated at the shoulder-joint, at the terrible battle of Moscowa, in 1812, at my request, set out immediately on his journey homewards, and reached Provence without ever having had the stump dressed, in accordance with the assurance I had given him at his departure, that he would not need it; and that all he had to do was, from time to time,

* Rélation médicale de Campagnes et Voyages de 1815 à 1840. Paris, 1841. Page 268.

to sponge the outside of his apparatus, and then to cover it with a good sheep-skin, for the purpose of excluding from it the cold and moist air of the season. My instructions were scrupulously obeyed; and, on the soldier's reaching Provence, and removing the first apparatus, he was agreeably surprized at finding the wound perfectly cicatrized."

In 1837, the Baron advocated the immovable apparatus, on the basis of "more than twenty years' experience;" and in 1840, in giving the results of his visit to the English hospitals in 1826, he says of the treatment of fractures*: "I confess that this branch of surgery is far from having attained the same degree of perfection in England as in France. My immovable apparatus, which I have constantly employed with such great success, was unknown there. Having had occasion to employ it in Liverpool and London, the English surgeons, who had themselves invited me, appeared very satisfied with its simplicity and solidity. They were not a little agreeably surprised with its efficiency, when, on removing it, at the period I had stated, the wounds were found healed, and the union of the bones perfect, alike in shape and strength."

The case of the veteran Delage was no doubt exceptionally successful, and the mode of treatment pursued not deserving general imitation. But it is interesting, and extraordinary circumstances may render it particularly useful, to know that it was possible to relieve a man of a shattered limb by amputation at the shoulder-joint, and to restore him to his distant fatherland safe from the horrors of the bloody retreat of 1815, simply by inclosing the shoulder in a case capable of maintaining absolute rest, and excluding the air. Notwithstanding Larrey's great success, and the now well-known advantages derived from immobilization in the treatment of fractures, many—I, for one—would be disinclined to enclose a limb, the seat of compound fracture, with the intention of not looking at it for five or six weeks. Happily, Baron Seutin's modification of the

* Op. cit. Page 108.

immovable apparatus, which admits of the limb being kept perfectly at rest, and yet easily inspected for observation of its general state, and dressing its wounds, enables us to reap all the advantages of perfect rest, without incurring the risks of pent-up pus and sloughing muscles.

We have already incidentally remarked that the Russian military authorities so much approved of the method of treating fractures by the starched apparatus, that as early as 1837 they commanded the army and navy surgeons to adopt it. I have now to add that, on the occasion of Baron Seutin's visiting St. Petersburgh in 1851, the Emperor requested him to proceed to his army of the Caucasus, in order that its surgeons might receive the benefit of his teaching in active service.*

Contemporary French military surgeons countenance the principles of treating fractures propounded by Larrey. Amongst the many highly-interesting communications on gun-shot wounds to the French National Academy of Medicine, after the unfortunate days of June, 1848, is one by M. Bégin, the late distinguished surgeon-in-chief of the military hospital of Val-de-Grâce. He thus expressed himself on the subject of gun-shot fractures:† "... Immobility is the first and fundamental condition of success in their treatment. ..... My friend and colleague, M. Roche, informed me that during his experience in Spain, almost all the comminuted fractures of the thigh were lost. The Spaniards, on the contrary, frequently cured them by placing the limb in an immovable apparatus, made with tar, chalk, and white of egg, smeared with a mixture of oil and wine, and having holes in it opposite the wounds." Having been prisoner of war amongst the Spaniards for forty days, M. Roche saw a large number of patients thus injured cured, or in process of recovery; he saw the treatment commenced in many others, of whose ultimate recovery the Spanish

* Oral communication.

† Des Plaies d'Armes-à-feu. Communications faites à l'Académie Nationale de Médecine par MM. les Docteurs Bauders, Roux, Malgaigne, Bégin, &c. 8vo. Paris, 1849. Page 192–3.

surgeons entertained no doubt. The Council of Health of the Army, in re-organizing the *matériel des ambulances,* has provided various means for the immovable treatment of fractures. Thus, powders, susceptible of immediate mixture or solution, in tepid, or even in cold water, and suited to the solidification of bandages, with splints of different shapes, sufficiently wide and solid to act as boxes, &c., have been placed at the disposal of army surgeons, and their judicious employment will certainly be productive of very good results.

In carrying into execution the principles mentioned by these high authorities, I believe the starched apparatus has no rival, either on the score of simplicity or efficiency. So fearful is the result of gun-shot fractures, so simple this method of treatment, that it deserves to be put to the test of experience by every one who has them confided to his care.

CHAPTER IV.

ON THE ADVANTAGES OF THE STARCHED APPARATUS IN THE TREATMENT OF DISEASE OF THE JOINTS.

Inasmuch as in the arrangement of the scrofulous diseases of joints, many of the other great principles which should guide the surgeon in treating various other articular affections are exemplified, it is hoped that, notwithstanding the somewhat special nature of the following remarks, their more extensive applicability will be perceived.

With the teaching of Sir Benjamin Brodie,* that the scrofulous disease of the joints is always indicative of defective bodily powers, and that whatever tends to their further depression is injurious, many surgeons are agreed; nor is the number of those great who dissent from the principle of treatment laid down by him in the following terms: "The abstraction of blood, even by means of leeches, can be required only under some peculiar circumstances, and even when it is thus required, the good which is done is not unmixed with evil. The repeated application of leeches may be regarded as never necessary, and as being invariably injurious. The same may be said of all kinds of what has been called counter-irritation, such as blisters, issues, setons, and the use of the tartarized antimonial ointment. . . . . With respect to local treatment, the question here will arise, If the Surgeon is precluded from the use of leeches, blisters, and issues, what is there left for him to do? The answer is, That in the early stage of the disease, the simple negative treatment, of keeping the diseased joint in a state of complete repose, is all that is required." With a view to give

* Pathological and Surgical Observations on the Diseases of the Joints. 5th ed., 1850. Page 128.

this rest, in the case of hip-joint disease, the same high authority enjoins, "that the patient should be placed on his back, with the thigh, if not absolutely in a line with the trunk, bent only in a very small degree forwards. . . . . With a view to prevent the motion of the joint, and at the same time to maintain the limb in a proper position, a splint, made of thick and stiff leather, or of gutta-percha, may be applied so as to embrace one side of the pelvis and two-thirds of the circumference of the thigh, and extending from the short ribs nearly as low as the knee. This being fixed by a strap and a buckle to the pelvis, and in the same manner to the thigh, will be very convenient to the patient, and will at the same time answer the intended purpose. . . . . When the disease is seated in the knee, the joint is best supported by two lateral splints, broad enough to enclose two-thirds (or more) of its circumference, and extending from the middle of the thigh to the middle of the leg.

Finally, as the principle of rest in the treatment of scrofulous joints is here insisted on, the means proposed for the attainment of that end are not so effectual as the starched apparatus. By virtue of the accuracy with which it fits the limb, and in accordance with the principles of its application —fixation of the joints, particularly the one above the seat of disease, and circular compression, we should even à priori be disposed to regard it as a very efficient means of giving rest. That it really is so, is proved by the cases related in Chapter II., and especially by the two cases of fracture of the thigh bone, just above the condyles, in the brothers Ponfrit. No one can doubt, but that leather or pasteboard splints, extending from the middle of the thigh to the middle of the leg, however well fitted and firmly fixed, would not have succeeded in those cases anything like as well as did the starched apparatus.

If it be desirable to shorten the period of confinement to bed of patients with broken bones, how much more is it so in the case of the poor weakly subjects of scrofulous joint diseases, in whom the confinement in an almost unvarying recumbent position, as a means of curing the local affection,

engenders great weakness, and thereby aggravates the cause of the disease, which must be admitted to be a debilitated constitutional state. Rest to the joint and exercise of the body are the great indications in treating scrofulous articular affections, and the most effectual means of fulfilling them, consists in the application of the starched apparatus as practised by me after the teaching of Baron Seutin; in whose wards at the hospital Saint Pierre, of Brussels, the beds of patients with scrofulous joints are almost all the day empty, whilst those who would otherwise be their constant, withering inmates, are sitting or walking about the halls or gardens of the hospital. The rest given by this means to the joint does not only do good by allowing general exercise and thus augmenting the bodily vigour, but by putting an end to the painful night-startings, and thereby enabling the patient to sleep.

It is especially in the early stages of those diseases that the application of the starched apparatus is of great benefit, but at no stage is it contra-indicated. In addition to its action as a means for giving perfect rest, it very efficiently effects gradual compression, a therapeutic agency, not sufficiently insisted upon in the treatment of these diseases, but of the great value of which there can be no doubt. The facility with which the materials for the construction of the apparatus can be obtained and applied, the ease with which it admits of being opened for the examination of the limb and of apertures being made in it for the escape of pus, or for the local application of remedial agents, are arguments as urgent in proving its advantages in the treatment of diseases of the joints, as in fractures of the limbs.

Scrofulous Disease of the Knee Joint.

Case. R. S., æt. 21, had been under the care of a physician for three weeks previously to my seeing him. Thirty-six leeches had been applied in thirty-three times, salines exhibited and opiates at bed-time; low diet had been enforced. A practitioner with whom I saw the patient the

first time, suggested that the knee should be supported by a back-splint, and calomel and opium be the internal treatment. I entertained a different opinion. The grounds of my dissent, the practice which I based thereon and its results, will I trust be rendered clear by the following report, for the length of which the great importance of the case must be an apology.

Present state, 15th January, 1853. Temperament, decidedly scrofulous; emaciation considerable. Tongue good, pulse 112, tolerably full but weak and soft. Respirations 24. Has two or three loose motions daily. Sweats profusely at night, does not sleep soundly. Appetite very good, but has been kept on low diet with beef tea. No enlarged glands.

Right lower limb completely everted, with knee slightly flexed. This is its constant and most easy position. Cannot raise the knee from the bed, and considerable force is required to extend it; severe pain over the patella attends this operation. During the day he suffers comparatively little, but in the night much painful starting.

MEASUREMENT OF KNEES.

	Right.	*Left.*
At upper border of patella,	14½ inches . . .	13 inches.
At lower ditto	14¼ „ . . .	12½ „

The bony prominences about the right knee are completely effaced. Pulsation on the sides of the patella gives a feeling of decided elasticity, but not of fluctuation. The cuticle is detached on the outer side of the knee in consequence of a blister, which was applied three or four days ago. The integument over the right trochanter major is red and tender, in consequence of long lying upon it.

The starched apparatus was applied at once as for broken thigh, care being taken to pad every bony prominence and the smaller joint, with cotton wool; gradual tractions and pressure on the top of the patella, had sufficed to straighten the knee, and to keep it so, a sand-bag, about eleven pounds in

weight, was placed over it. The patient pronounced himself quite comfortable, but in course of about two hours, complained of pain on the top of the knee. This was relieved by removing the sand-bag, after which he was perfectly easy and sleepy, which he had not been for a long time.

17th.—Is perfectly easy. Has got out of bed and walked on crutches, without the least pain. Meat diet, with half-pint of porter.

20th.—At this morning's visit, he stated that the knee had been quite easy since the application of the apparatus, with the exception of slight pain in it when he moved. On examination I found the apparatus rather loose on the thigh, and especially so over the buttocks. With a view to obtain complete immobility, I divided the bandages in the mesian line in front, and cut off from one edge a longitudinal slip barely half an inch wide. After placing a narrow pasteboard splint in front of the thigh, from the groin to the knee, and a large one behind from the leg upwards, to encase the buttock, I bandaged firmly from the leg over the pelvis; immediately after which the patient was easy, even when turned over in bed and when the limb was lifted up.

January 22nd.—He yesterday complained of a little pain in the knee. It gradually grew worse during the night, and was so severe this morning, that I removed the whole apparatus. There was not the least sign of constriction by the bandage; the knee was decidedly hotter than its fellow, but otherwise no difference could be detected in it, since I last took notes of its condition. Two dozen leeches to be applied to it.

January 29th.—The leeches did some, but only very slight, good. Last night the knee was worse than ever it has been. The pain in it was throbbing—frequent startings. The knee is hot—in the semi-flexed position, the foot everted; no other change in the joint. When asked (leading questions especially avoided), he says that he was more comfortable with the starched apparatus; but fears its re-application, as the least movement of the joint is a cause of pain. He at once assents to it, on condition of having chloroform.

February 1st.—The apparatus re-applied last evening under chloroform. Whereas the knee was intensely painful it is much less so to-day. Last evening the circumferential measurement of the joint, at the lower margin of the patella, was thirteen inches and three quarters; at the upper border, fourteen inches; none of the elastic feel, noted at the first examination, could be detected then; and the bony prominences were much more distinct than formerly. General health about as usual.

13th.—The apparatus on the thigh being loose, it was refitted about three days after the last report. He now only has occasional pain in the knee—a kind of darting through it from side to side; that is mostly perfectly easy. No startings. Can raise the limb off the bed, turn over and lie on either side; gets up, sits in the chair, resting the heel of the affected limb on the floor, or on a cushion; walks on crutches with perfect ease. A few minutes ago, one of the crutches slipped, and he fell suddenly on to the floor, but made no exclamation; and when asked if he had hurt the knee, he said he had only felt a kind of jerk on its outer side. Has no night sweats. Appetite good. Is gaining flesh; and a florid colour begins to pervade both cheeks. Sleeps soundly all night.

To account for the great improvement in this patient since he was committed to my care, two therapeutic agencies must be taken into account, *the general* and *the local.* Regarding the articular disease as a manifestation of a weak constitution, I set aside depletive remedies, and substituted for the antiphlogistic regimen previously enforced, a meat diet with beer. Long confinement to bed and sleepless nights were, to a person under such circumstances, obvious agents in aggravating the disease. By means of the starched apparatus, the whole limb was set perfectly at rest, startings prevented, and movement of the body allowed. Had the treatment, instituted by the gentleman who first had charge of the case, been continued, there is good reason for believing that the constitution would have continued to grow weaker, and the knee to be a greater cause of pain, and the seat of

more extensive disorganization, until its removal by the knife would have been called for as the only means of saving life. Scarcely seven weeks had elapsed from the time that this patient was committed to my care, when I left him stout, and in the enjoyment of excellent health; able to walk without crutches, and to move the knee a little, the starched apparatus having been removed.

This case is a typical illustration of the soundness of the principles, according to which scrofulous articular diseases should be treated: perfect rest to the joint, and the adoption of such measures as are calculated to invigorate the general health. In contributing to the fulfilment of these indications, the starched apparatus is singularly happy; and I anticipate that, by its introduction into general practice, the excruciating sufferings of the unfortunate subjects of these diseases will be very materially lessened, and many limbs, and not a few lives, spared.

CHAPTER V.

THE METHOD OF TREATING FRACTURES BY THE STARCHED APPARATUS NOT NEW TO ENGLISH SURGEONS.—M. MALGAIGNE'S OBJECTION TO IT.—DIFFERENT MODES OF CONSTRUCTING IT AND OTHER IMMOVABLE APPARATUS.—HISTORY OF THEIR DISCOVERY, PROGRESSION, IMPROVEMENT, AND ADOPTION IN PRACTICE.

Mainly actuated in the preparation of the preceding pages by a desire to be practically useful, I have endeavoured to state facts concisely, and reason plainly; it has also appeared advisable to avoid as much as possible encumbering them with criticisms and bibliographical references. In executing this plan, I have been obliged to omit matters, which, though comparatively of secondary value, are nevertheless important: it is to the reparation of such omissions that this chapter is dedicated; hence, its somewhat desultory character.

In expressing, in the first chapter, a determination "to extend to English practice a system productive of such auspicious results in the hands of foreign surgeons," I have implied that the plan of treatment by the starched apparatus (the system alluded to) is unknown to English surgeons. *Absolutely* this is incorrect; ever since it was promulgated on the Continent, it has been, to a greater or less extent, adopted by practitioners in this country; but, with very rare exceptions, they have only used starched bandages in the advanced period of the treatment of fractures—consolidation being then all but perfect; or, if in early stages, in cases so simple that, whether any apparatus were used or not, the result would not be materially altered. In proof of how little the starched apparatus has attracted the notice of

English surgeons, it is sufficient to point to the last editions of the text books on surgery adopted in our schools.

The surprise excited by reflection on the indifference with which this important modification of surgical practice is regarded by the most eminent British surgeons of the day, is not a little increased by a knowledge of the fact, that so far back as 1838, a very able writer in the British and Foreign Medical Review zealously defended the high claims of the starched apparatus, on the basis of his own experience; and that in a thesis by Dr. Markham, to which the Senatus Academicus of the Edinburgh University awarded a gold medal, at the graduation in 1840, the most unqualified approbation is given to the apparatus in question, after extensive observation of its beneficial effects. "The treatment of nearly all kinds of fractures by the starched bandage," says Dr. Markham, at page 69 of his thesis, "is now almost generally adopted by the Parisian surgeons: M. Lisfranc and M. Jobert (of St. Louis) alone, I believe, raise their voice against the practice. It is adopted in the practice of Roux, Velpeau, and Blardin, and with the most favourable results; and if equal pressure, firm support, and well-adapted support, too, and an apparatus which no movements or efforts of the patient can displace, are advantages in the treatment of fractures, this '*appareil amidonné*' certainly deserves the highest praise; and, from the results of its application, which I have witnessed so frequently during the past winter, I should say (with deference) that, according to my judgment, it is one of the greatest acquisitions of modern surgery, inasmuch as it is called in to the aid of perhaps the most numerous and important class of surgical accidents."

Such is the tenour of these writings, that one would have thought them calculated to awaken a spirit of inquiry for the purpose of deciding the value of the innovation on its real merits. But the result has been widely different. Criticisms have been emitted in conformity with preconceived notions, but observation has not been appealed to, as the only means of arriving at really useful definitive con-

clusions. Without fear of exaggeration, we may now remark, in the words of Mr. Earle,* though thirty years have elapsed since he emitted them, "that the difference of opinion which prevails among many of the most enlightened members of our profession as to the most eligible mode of treating these cases—[alluding particularly to fractures of the lower extremities]—and the great variety of instruments which have at different times had their advocates, may be stated generally as convincing proofs that perfection in this department has not yet been attained."

The obviously theoretical character of most of the objections that have been urged against the method of treatment indicated in these pages, dispenses with the necessity of confuting them; but there is one opponent in particular, M. Malgaigne, whose opinions demand notice, as those of the author of the most recent treatise on fractures†—a work, for vastness of erudition, having few rivals in surgical literature—teaching in the country where the great utility of the starched and other immovable apparatuses has found some of its most strenuous defenders.

M. Malgaigne objects to them—1stly. Because they exercise compression; and he quotes in his support‡ M. Velpeau's admission, that while such compression is a truly heroic resource in surgery, if properly employed, it may do harm in inexperienced hands. But in thus warning his students, M. Velpeau was merely giving another proof of prudent caution in a surgical teacher, who, in due course, would feel it his duty to warn his hearers against rashly using the knife in dividing the stricture for hernia, lest the gut should be wounded—to warn them against using the knife too freely in the deep incisions for lithotomy, and to give them other similar admonitions. Would it be fair to argue from the fact that improper use of the knife in herniatomy and lithotomy may do harm, therefore they should

* Practical Observations in Surgery, by Henry Earle, F.R.S. London, 1823. Preface, p. v.

† Traité des Fractures et des Luxations. Tome i. Par J. T. Malgaigne. Paris, 1847.

‡ Op. cit. Page 250.

not be performed, when it is known that by taking due precautions, they are the means of saving a multitude of lives? The true moral of the accidents is to use prudence for their avoidance: so in the case of the starched appararus; the possibility—nay, the probability—of its being productive of injury when improperly applied, is no argument against its proper use. In point of fact, instead of M. Velpeau's admission being an argument against his teaching, it is a great reason for respecting it; for it proves that, while the advocate of a system, he preserves that spirit of impartiality and candour which is indispensable to a professor who loves to teach the truth.

Four cases are cited by M. Malgaigne to prove the injurious effects of the compression exercised by immovable apparatuses. "On a girl, who had a double fracture of the humerus, M. Megnier had applied *l'appareil albuminé;* the day afterwards appearance of yellowish ballæ, livid discolouration of the integuments about the elbow; the apparatus was removed without delay, but the symptoms were so severe for several days that the surgeon entertained fears of being obliged to remove the arm at the joint. M. Defer has seen gangrene supervene in consequence of the premature application of the starched bandage for a fracture of the humerus and one of the patella. M. Blandin has seen fatal accidents determined by the same cause. Even were there no fear of gangrene, we have all seen in one of our most distinguished Russian colleagues, Professor Doubovitzki, the serious effects of a starched apparatus applied immediately after fracture of the elbow. When it was removed, on the 25th day, the flexor muscles of the wrist and fingers were hardened, blended into one hard and cartilaginous-like mass with the adjacent cellular tissue; it was impossible to pinch up the skin that covered them; the wrist and fingers were completely paralyzed."*

I have seen four cases within the last twelvementh, in which the application of the ordinary fracture apparatuses

* Op. cit. Page 250.

was followed by results no less unfortunate than those above-mentioned. In one case, a fracture of the humerus, lateral wooden splints having been applied, and the limb once bandaged, the supervention of gangrene necessitated amputation at the shoulder joint. In a second, in which Dupuytren's splint was applied for fracture of the lower end of the radius, the fore-arm died *en masse* in a few days. Both these patients repeatedly complained of the bandages being too tight, but the surgeons refused to remove them until the third day. The time for healing had then passed, for amputating arrived. Such occurrences cannot in justice be admitted as evidence against the system of treatment. Means, in themselves most innocent, not unfrequently prove destructive when improperly used. Whether the practitioners mentioned by M. Malgaigne were in any degree blameable we have not the means of judging, but certain it is that in a class of injuries so numerous as fractures, always demanding much care, after the most accomplished surgical skill in their treatment, it is inadvisable to argue from the results in a few unsuccessful cases, without being accurately acquainted with the histories of their progress.

2ndly.—M. Malgaigne* objects to immovable apparatuses as powerless against transverse displacements and riding of the fragments. The cases related in chapter II., particularly those of comminuted and oblique fracture of the femur, transverse fracture of the patella, and oblique fracture of both bones of the leg, furnish reasons for replying in the words of Seutin, "cette objection va juste à l'encontre des faits."†

3rdly.—In the fact that the starched apparatus allows patients with broken legs and thighs to leave their beds much sooner than they can do under any other system of treatment, M. Malgaigne sees no advantage; "it is of no therapeutic utility; by it the surgeon only aims at pleasing his patient, at dazzling the eyes by a kind of *tour de force*,

* Op. cit. Pages 218, 246.

† Traité de la Méthode Amovo-Inamovible, par le Docteur Seutin. Bruxelles, 1851. Page 88.

which is not wanting in originality."* He does not object to a patient moving about with the starched apparatus whose fibula is fractured, or whose tibia and fibula, having been the seat of a simple fracture, are to a considerable extent reunited; but condemns such practice as highly imprudent in recent fractures, especially in those where there is most tendency to displacement. "As to fractures of the femur,† which the best constructed apparatuses, with the aid of confinement to bed, so rarely succeed in curing without shortening, to add to the already existing difficulties of the fracture the dangerous chances of walking, without even having to anticipate the slightest advantage therefrom, is a temerity which happily it is not necessary to combat, for I know of no French surgeon who has attempted it." That circumstances may occur which may render it eminently desirable to get a patient with a broken thigh out of bed shortly after the accident, is proved by the case of James Glass—by no means a very rare one; that a very oblique, and even a comminuted fracture of the femur may be treated with the starched apparatus, the patient allowed to walk about, and the consolidation of the limb perfected, without the slightest shortening, is proved by the cases of Catherine Cox and Henry Ponfrit.

Of the various authorities which might be cited in opposition to M. Malgaigne I shall only quote one, and that because, weighty as it is, it is difficult of access, being the result of a foreign government commission. In the Medical Statistics of the Tuscan Maremme, compiled by command of the Grand-Duke of Tuscany, by Dr. Talongudi Marchetti, he states that,‡ "being convinced of the utility of Seutin's apparatus, he endeavoured that it should be put into practice by all the surgeons of the province, and particularly in hospitals. With this object in view, he attempted to demonstrate its great advantages, leaving, however, to every surgeon the liberty to adopt that method which seemed best

* Op. cit. Page 263. † Op. cit. Page 264.

‡ Saggi, Illustrativi Tavole della Statistica Medica delle Maremme Toscane. Firenze, 1845. Page 58–59.

to him. The majority adopted the new practice, which is exclusively pursued in the hospitals of Grosseto, Massa, Campiglia, Piombino, Follonica. . . . . Some surgeons remained faithful to the old methods, and I availed myself of this circumstance for the purpose of accurately comparing the bad effects and advantages of the ancient methods with Seutin's, and, from the numerous and constantly successful results, its superiority appeared to me so manifest, as no longer to admit of doubt as to the preference which its application deserves in almost every case. . . . . In the province of Grosseto, since 1842, Seutin's apparatus has been applied with invariable success in fourteen fractures of the femur, ten of the leg, two of the humerus, eight of the clavicle, ten of the fore-arm. In the Royal Hospital of Grosseto, patients with fractures of the thigh, as well as of the leg, are commonly seen walking about on crutches a few days after the application of the apparatus."

The instructions laid down in the first chapter for the application of the starched apparatus may, in some particulars, be departed from without lessening its utility. Moreover, some surgeons, while advocating the principle of treating fractures by immovable apparatuses, employ in their construction various solidifiable materials in the place of starch. The most important of these peculiarities of practice demand notice.

Baron Seutin directs that a tape, about a finger's breadth, and three or four inches longer than the apparatus, be placed on the front of the limb, next the skin, and consequently under the first bandage; as its ends project beneath the superior and inferior edges of the apparatus, it admits of being drawn upon, so as to ascertain the degree of tightness of the latter; accordingly he has called it the *compressimeter*. Another purpose which it serves, is the prevention of injury to the skin by the ends of the pliers in cutting up the apparatus. Not being convinced of its utility, from what I saw in the Baron's practice, I did not use it on first applying the apparatus; neither has any subsequent circumstance made me feel its necessity. Too great tightness is judged of by

the humidity of the toes and fingers, and by the patient's complaints; looseness, by the feel of the apparatus along the front, where it simply consists of two thicknesses of starched bandage. When the pliers are at hand, there is no danger of injuring the skin; under other circumstances, and particularly if in the absence of more fitting instruments, the necessity is foreseen of using common scissors for making the section, the use of the tape is advisable."*

Professor Burggraeve advocates† the starched apparatus as described in this work, minus the first bandage. He directs that the limb be first covered with a layer of cotton-wool, about an inch and a half thick; outside it, the starched pasteboard splints are fixed by bandage. The chief advantages claimed for this modification are, that it facilitates, inasmuch as it simplifies, the application of the apparatus on the part of the surgeon, and saves the patient the painful shakings unavoidable when the limb is being bandaged. "Moreover, the cotton-wool employed in sufficiently thick layers, accurately adapts itself to the shape of the limb, and, by virtue of its elasticity, follows it in its decrease in size, so that whatever be the degree of the primary swelling, and of its subsequent diminution, no space is ever formed requiring section of the casing for the purpose of paring or overlapping its edges."‡

Before perusing the monograph just quoted, I used the cotton-wool extensively; usually as a protection to the limb, in addition to the first bandage, sometimes as a substitute for it; for the latter practice I selected cases in which there was no fear of displacement, and the results were successful; but the thick layer of cotton-wool impairs the efficiency of the apparatus when its contentive faculty is called into requisition by a fracture with much tendency to displacement.

* Besides differing from Seutin, in not using the compressimeter, I have not adopted the name *amovo-inamovible*, which he has given to the apparatus, on account of its allowing mobility of its parts for examination of the limb, without impairment of its immobility as a whole. The term is complex, and so long as the mode of construction is correctly understood, no good purpose can be served by abandoning for it the simple names *starched* or *immovable* apparatus.

† Nouveau Système de Pansements Inamovibles. Bruxelles, 1853.

‡ Op. cit. Page 20.

Apart from experience, it occurs to one that, as the starched pasteboard and outside bandage form a hard, unyielding casing, when the close adaptation to the limb ceases, in consequence of the latter diminishing in size, the displacement of the fragment is only opposed by the pressure which the cotton-wool exerts in virtue of its elasticity, a very slight obstacle to the tilting forwards of a fragment of the tibia or femur. Concerning the application of the apparatus for fractured thigh, M. Burggraeve observes: "Throughout it, assistants keep up extension; at its termination, this is replaced by Dessault's permanent extension-splint, which may even be left in place by fixing it outside the apparatus; this precaution is indispensable in oblique fractures of the thigh:"* that it may, however, be dispensed with is proved by the cases of the brothers Ponfrit and Catherine Cox. That M. Burggraeve should have deemed it necessary to enjoin that precaution in such decisive terms, cannot but be regarded as evidence of practical acquaintance with the inability of his apparatus to counteract riding of the fragments, and as implying a contradiction to the statements contained in the preceding quotation. The first bandage may be omitted, cotton-wool interposed between the splints and the limb, and section of the apparatus omitted, when, from the nature of the fracture, displacement is known to be impossible; but under other circumstances, the practice recommended in this work, after the example of Baron Seutin, is deserving of preference.

M. Velpeau† employs dextrine instead of starch, and in fractures where there is little tendency to displacement, does not use pasteboard splints, but merely envelopes the limb in a dry bandage, and outside this applies a roller soaked in a solution of dextrine. The advantages claimed for this solidifiable material are, that it dries in four or five hours, viz., much quicker than starch, and forms a firmer casing. In the latter respect I can see no advantage; once it is dry, the starched apparatus is quite hard enough in all cases. It

* Op. cit. Page 56. † Leçons Orales, cit.

certainly does dry more slowly; but while moist, it is easy to strengthen it by fixing strips of dry pasteboard or of wood outside it; the quicker drying of the dextrine is more than counteracted by the much greater difficulty of cutting the apparatus constructed with it than with starch; whereas the latter admits of being opened with very little difficulty, so hard is the dextrine apparatus as to render it expedient to remove the whole apparatus by soaking it in water and unrolling, even at the trouble of re-applying it, instead of attempting to cut it open. I have used the dextrine several times, and, besides the objections above stated, have found it, from its stickiness and colour—whereby it dirts the bed-linen—less pleasant to use than starch.

Immovable apparatuses have been constructed of various other materials; *e.g.*, circular strips of paper, soaked in starch or dextrine, have been substituted for the pasteboard splints; plaster of paris has been extensively employed for making moulds in which to keep broken limbs at rest during the whole period required for re-consolidation; and a mixture of plaster of paris and starch has been employed by others;* on the whole, neither of these modifications possesses advantages equal to Seutin's apparatus, but in many cases the one may be substituted for the other without practical disadvantage.

Whoever reflects on their number, bearing in mind the eagerness with which questions relating to priority of discovery are always debated, will not be surprised in learning that there have been several claimants to the honour of treating fractures by immovable apparatus.

This question admits of definitive settlement by documentary evidence.

* Muthray, De cruribus fractis gypso liquefacto curandis (Dissert. Inaug Berlin, 1831). Some observations by Richter on the same subject are contained in Abhandlungen aus dem gebiete der practischen Medicin und Chirurgie (Berlin, 1852). For a notice of these works, *vide* Malgaigne, in Gazette Médicale, 1832, p. 525, and 1833, p. 285. Aiguilhon, Mémoire sur le Traitement des Fractures par l'Appareil Inamovible en Papier Amidonné, par M. Laugier (Gazette Medicale, 1838). Lafargue (de Saint-Emilion), Appareil Inamovible, instantanément solidifiable (Montpellier, 1839). Seutin, Du Bandage Amidonné; ou, Recueil de toutes les Pièces composées depuis son Invention jusqu'à ce jour (Bruxelles, 1840).

When the bone of a limb is broken, the first idea that naturally suggests itself is the necessity of at once substituting an artificial solid support, and of not removing it until nature has had time to re-consolidate the broken bone. The most natural mode of effecting this object appears to be enclosing the limb in a firm casing. Accordingly this, the instinctive mode of treating fractures, has, from time immemorial, prevailed amongst civilized nations, and is still practised by bone-setters in different parts of Europe.*

The bold practice of wrapping up a broken limb in pledgets of tow, soaked in yolk of egg, and hiding it from

* M. Amedee Joubert communicated to M. Hipp. Larrey that Persian surgeons scarcely ever change fracture apparatuses during the whole course of treatment. Sedillot (Gazette Médicale de Paris, 1838, p. 135, and Traité de Méd. Opér., tome 1er, p. 67) had the opportunity, after the siege of Constantine, of examining an immovable apparatus that had been applied to the broken arm of one of the natives. The ancient, no less than the modern, Greeks, according to De Pouqueville (Voyage en Grèce), employed a permanent apparatus, which was applied soon after the receipt of injury, and which, with perfect security, enabled the patient to move the limb in any direction; for the purpose of consolidating the apparatus, which was not removed from the moment of its application to that of perfect cure, a composition, into which mastic entered largely, was used. Dr. Paperi (Lettera sullo Stato dello Medicina nel Regno di Tunisi, al Prof. Barzellotti, Siena, 1821, p. 103) states, that among the nomadic tribes in the interior of the kingdom of Tunis, it was customary to treat fractures of the limbs with plaster or mortar, just as walls are repaired. In the work of Sir George Ballingall, already quoted, we find at page 358, "The practice of enveloping fractured limbs in splints and bandages, without undoing them for weeks together, is akin to that followed by the natives of India, of inclosing fractured limbs in moulds of clay. Of the successful result of this practice I remember a remarkable instance in the case of a little boy, who was brought into my tent one morning, having been run over by a waggon in the line of march, and having sustained a severe compound fracture of the leg. I was preparing to amputate this boy's limb, when his parents came in and carried him away to the potter in an adjoining village, who enveloped the leg in clay, and, I believe, finally cured the patient." In Cheselden's Anatomy, allusion is made to the treatment of fractures with rags dipped in a mixture of flour and white of eggs, pursued by a bone-setter of Leicester. Fodere, quoted in Velpeau's Leçons Orales, relates that, as far back as the time of Hippocrates, a class of bone-setters were in the habit of treating fractures with a permanent apparatus; and Prof. Biagi (Del Trattamento di alume Fratture con l'Apparecchio inamidato, Lettera al Prof. Antonio Raikem: Firenze, 1843) concludes a valuable clinical paper on the advantages of the starched apparatus in the treatment of fractures with the following remarks: "Were it not for the reprovable tendency which men have of always despising those things which have not the appearance of the specious and the sublime, I certainly think that we should, long ere this, have discovered the rudimental idea of this surgical proceeding in the humble practice of our peasants, who have long been in the habit of encasing broken limbs in tow, soaked in white of egg, and surrounded by circular bandage."

view in a casing of mortar for several weeks, was not, however, the dictates of confidence from knowledge acquired, but of untutored instinct striving to obey the urgent impulses of necessity. Such boldness was unwarrantable temerity in the estimation of the learned, as may be inferred from the principles according to which fractures were treated by Hippocrates, Galen, Celsus, and Paulus Ægineta.

The learned Mr. Adams, in one of his commentaries to the sixth book of Paulus Ægineta, has expressed a belief "that the waxed apparatus of the ancients in the case of fractures was probably quite as efficacious as the starched bandages which have been introduced of late years with so much advantage;"* but, in point of fact, the waxed apparatus of Hippocrates and his followers, constructed as it was on the principle of waiting for completely fixing the limb until the period for the subsidence of swelling had elapsed, and of frequently exposing it for the purpose of ascertaining its condition, differs widely from the starched apparatus, applied immediately after the fracture, with the intention of not removing it until the bony fragments have been firmly re-united.

As it did almost every other branch of medicine and surgery, the Hippocratic teaching, for a long succession of centuries, influenced the therapia of fractures, as may be gleaned from the terse protest of Fabricius ab Aquapendente against a slight modification of it proposed by some of his contemporaries: "Nos autem principes medicinæ sequemur," alluding to Hippocrates and his illustrious commentator, Galen.†

Mention of fracture apparatus, constructed with albuminous substances and various powders, is made in the writings of Fabricius, as well as in those of Ambrose Paré, and Wiseman;‡ but Belloste appears to have been the first

* Ed. Sydenham Society, 1846. Page 464.

† Op. Chirurg. Patavii, 1647. Page 156.

‡ Paré (Œuvres Complètes, ed. Malgaigne, vol. II. p. 306) gives a prescription in imitation of Hippocrates for making a solidificable mixture, to be spread over the nose when fractured. Amongst other things, it contains Armenian bole, alum, and white of eggs, and is vaunted as having "puissance de

to dare to oppose, by argument and example, the doctrine and practice of the ancients. "The method of Hippocrates," he observes, "is to remove the apparatus three days after its application; many delay till the seventh day, and I to as late as I possibly can. Experience has taught me that it is more advantageous for the patient not to meddle with him until the callus is completely formed, unless the bandages be loose, or some unforeseen disorder, such as pruritus, pain, uneasiness, &c., supervene. . . . . A soldier of the regiment of Condé, named La Tulipe, was conducted to this place with a comminuted fracture of the femur, about its middle. . . . . I at once made vigorous extension, reduced the fracture, and applied a piece of linen, soaked in egg beaten up with oil (*huile rosat*) and a small quantity of vinegar; outside this, I placed some compresses, three or four sufficiently long bandages, and some pasteboard splints. . . . . The apparatus was not touched for twenty whole days." *

That Belloste's invention produced little, if indeed any, impression, appears from the orthodox Hippocratism of his successors, Heister† and Jean Louis Petit. Not many years elapsed, however, before the antiquated rule of practice was again departed from by Cheselden‡ and Moscatí. The

repercuter et reprimer la fluxion, astraindre, tarir, et desseicher l'humeur ja deflué, et aider à tenir les os en leur lieu." Wiseman speaks of a fracture of the femur in a boy being successfully treated by an immovable apparatus constructed with whites of eggs, &c. Being unable to obtain his Chirurgical Treatises at this moment, I quote from memory. (Florence.)

* I quote this passage from Seutin, being unable to procure Belloste's original work, Le Chirurgien d'Hôpital.

† Institutiones Chirurgicæ.

‡ The directions which Petit gives for the treatment of fractures are in the main unmistakably Hippocratic; but it is just to notice that he very successfully employed wet pasteboard in constructing fracture apparatuses. In his Traité des Maladies des Os, 3rd ed., p. 38, after remarking that tolerably thick compresses are generally sufficient to act as "*attelles*," he continues, "Supposé, cependant, qu'on eût besoin d'une plus grande résistance, on pourrait mettre dans ces compresses, des bandes de carton, parce-que mouillées elles peuvent exactement se mouler à la partie, et qu'ensuite, en se durissant, elles acquièrent assez de solidité pour soutenir toutes sortes de fractures, celles même qui semblent le plus difficile à contenir." This account of the use of pasteboard splints is perfectly in conformity with the results of experience; not so that of M. Malgaigne. He says of them: "Avant la dessication elles sont mouillées, conséquemment incapable d'agir; après la dessication, elles sont parfaitement inutiles."—Op. cit., p. 218.

former thus describes and comments upon the method of treating fractures pursued by Mr. Cowper, a bone-setter at Leicester, who set and cured a fracture of his cubit when a boy at school.* "His way was, after putting the limb in a proper posture, to wrap it up in rags dipped in the whites of eggs and a little wheat flour mixed; this drying, grew stiff, and kept the limb in good posture, and there is no way better than this in fractures, for it preserves the position of the limb without strict bandage, which is the common cause of mischief in fractures." In a memoir on fracture of the neck of the humerus, communicated by Moscatí to the Royal Academy of Surgery of Paris, in 1751, he observes that in all kinds of fractures, it is necessary that the two fragments be so well placed and held together that they accurately correspond the one to the other, and that they be maintained in this condition firmly and immovably.† Deeming these indications incapable of fulfilment by the means in ordinary use, in a case of separation of the epiphysis of the upper end of the humerus, which came under his notice, he proposed the construction of an apparatus "which he had long meditated, and which was to consist in placing the part in a kind of mould made upon itself, by constructing, so to speak, a box which should embrace the humerus, and extend over the clavicle and scapula, and so to fix the part as to maintain it absolutely immovable during the whole period required for perfect consolidation." He accomplished his purpose by encasing the arm and shoulder in an apparatus made up with squares of linen, compresses, pledgets of two, and whites of eggs. The patient was afterwards placed horizontally in bed, with the arm supported on hard pillows, and requested to keep perfectly quiet until the apparatus was dry; when it became so, there was no more fear of displacement, because the parts of the apparatus were mutually glued together, so as to fix the part immovably. On removing the apparatus on the thirtieth day, the bones were found united; but, as a precautionary measure, a lighter apparatus of the same kind

* Cheselden's Anatomy of the Human Body. 7th edit.

† Octavo edition of the Mémoires de l'Académie de Chirurgie, Vol. X, p. 70.

was re-applied for another fortnight. The cure was perfect in this case, as well as in another of fracture of the humeral neck, which Moscatí treated by the similar method.

Though emanating from such high authorities on the basis of sound reasoning and experimental evidence, the principle of treating fractures by solid, immovable apparatus did not attract the notice of the generality of surgeons. True it is that the Hippocratic principles were soon to be rudely handled, but for the introduction of a totally opposite method; mechanical contrivances for effecting and maintaining coaptation were soon to be set aside for what may be called the physiological mode of treatment of which Mr. Percival Pott was the chief propounder. Observing that, once a bone is broken, muscular action is the cause which displaces its fragments and resists their re-aptation, he sought to counteract the effect by removing the cause; this he did by placing the limb in the semi-flexed position for the purpose of relaxing the muscles. Supported by Mr. Pott's vast experience, this doctrine soon gained ground amongst his fellow-countrymen; but the opposition of the towering genius of Desault absolutely prevented its spread in France. He was for permanent extension. Sharp and White, renowned as practical surgeons, were great supporters of Mr. Pott, and the invention by the latter of the double-inclined plane was a useful contrivance for carrying out the physiological principle. On the other hand, the arguments with which Dessault opposed the English innovation received new vigour from the exposition of his illustrious pupil and commentator, Xavier Bichât. In time, however, Petit's plan gained advocates, even in France, and among them was no less than Dupuytrer. "The advantages of this method," he remarks, "exaggerated perhaps by Pott, but too much ignored by Dessault, were so evident, that we hastened to adopt it and popularize it in France."*

Notwithstanding that the great hospital surgeons, at the close of the eighteenth and commencement of the present century, took no notice of the immovable principle of treat-

* Leçons Orales de Clinique Chirurgicale. 2de ed. Tome I. p. 2.

ing fractures, it was not without finding a powerful advocate. The experience of numerous battle-fields had rendered Larrey familiar with the disastrous consequences resulting from the necessity of moving soldiers with broken limbs treated by the methods in common use; during the campaign of Egypt he had had opportunities of witnessing the successful treatment of fractures by the natives with the aid of immovable apparatuses, and having devised one of new form, he submitted it to the test of his immense experience; such was the result as to enable him to announce it as the method, *par excellence,* for the treatment of fractures.* About the earliest trial of it in civil practice was made by M. Velpeau, in 1830,† but I cannot find that he applied it to any other fractures than to those of the upper limb, or that he was so impressed with its advantages as to advocate it with eagerness; indeed, it appears to have fallen into disuse even in the very hospital where his experiments were conducted, for in 1833 Bérard, jeune, observes that,‡ "having for one year had the charge of the surgical patients in the Hôpital Saint Antoine, he had submitted almost all those with fractures to the application of the immovable apparatus, his object being to ascertain the advantages and inconveniences of this method, so much vaunted by M. Larrey, but completely neglected by all the surgeons of the civil hospitals of Paris." He narrates twenty-five cases in which he employed it with more or less success; insists on gradual and uniform compression as prophylactic and therapeutic in fractures complicated with swelling;§ remarks that of all the accidents which complicate a fracture, it is only excessive swelling that calls for delay in applying the apparatus;‖

* Clinique Chirurgicale, et Rélation Médicale de Campagnes et Voyages (*ante cit.*). So also Hippolyte Larrey, Traitement des Fractures des Membres par l'Appareil Inamovible (Thèse Inaugurale, Paris, 1832). Rapport sur le Traité de la Méthode Amovo-inamovible de M. Seutin (Bulletin de la Société de Chirurgie, Tome II. p. 487. 1852).

† An account of this experience of M. Velpeau in the Hôpital St. Antoine was published by his *interne,* M. Hipp. Fournier, in the Journal Hebdomadaire de Médecine. 1830. Tome VIII. p. 419.

‡ Mémoire sur l'Appareil Inamovible dans le Traitement des Fractures (Archives Générales de Médecine. IIme. Série. Tome II. p. 218).

§ Op. cit. Page 386.

‖ Op. cit. Page 388.

alludes to the cheapness and facility of finding and applying the materials requisite for the apparatus, as some of its advantages; states that by its employment, patients with fractures of the leg may walk about on crutches; and that whichever be the injured limb,* be the fracture simple or complicated, the patient may, in the carriage, undertake a long journey. Such testimony was undoubtedly loud in support of Larrey, but still the immovable principle was only a favourite with a very small minority.† As hitherto put into practice, a *sine quâ non* was exclusion of the whole limb from view, whether wound existed or not, during the whole period requisite for bony reproduction. General experience made surgeons hesitate to adopt so bold a practice, a state of doubt which resolved itself into decided opposition so soon as cases became known in which swollen and wounded limbs had suffered during the long confinement in the solid casing. It remained to discover a solidifiable material wherewith an immovable, yet light and easily manageable, apparatus could be constructed—a discovery realized in the employment of starch, to which, to use M. Seutin's own words, he was led by a fortuitous circumstance in 1834. "Though it be true that before M. Seutin published the result of his experiments at the Hôpital Saint Pierre, immovable apparatuses were employed by some

* Op. cit. Page 389.

† At utmost, Bérard's Mémoire must be regarded as a valuable adjunct to the evidence of Larrey; but it is not fair to characterize it as the most complete work that has appeared on the subject, as the authors of the Compendium de Chirurgie Pratique (commencé par Bérard et Denonvilliers, continué par Denonvilliers et Gosselin, Tome II. p. 244) have done; nor is there ground for their indignation at the mere fact of a dispute having arisen since the publication of that Mémoire between Seutin and Velpeau as to a question of priority. Their modern apparatuses, with starch and dextrine, are essentially different from, and superior to, Larrey's, as employed by Bérard. There is reason to believe that, but for the labours of Velpeau and Seutin, the treatment of fractures by immovable apparatus would never have been generalized. "Lors de mon voyage à Paris," says Seutin (op. cit., p. 64), "en 1839, en visitant l'Hôpital Necker, je remarquai avec surprise que M. Bérard, qui paraissait attacher tant d'importance à la priorité de la déambulation, ne mettait pas en pratique dans son service l'innovation donc il se proclamait l'inventeur. Je ne pus y découvrir aucun appareil de Larrey, ou autre qui permit la marche; un des internes m'affirma, en présence de M. le Docteur Pigeolet, qui m'accompagnait, qu'il n'avait jamais vu dans cet hôpital, aucune trace de cette methode de traiter les fractures."

practitioners; that most of the facts relating to the practice were known and recorded in the annals of science, it must also be confessed that it is this surgeon who has known how to arrange those ideas, and with them construct a body of doctrine. It is, accordingly, since that period, and only since then, that the employment of immovable apparatuses has been generalized." Emanating, as this testimony to Baron Seutin's merit does, from Professor Velpeau,* who, long previously to 1834, experimented with the immovable apparatuses, and since then has, by example and precept, very materially contributed to its useful modification and general adoption, its weight, in the settlement of the pending question, is too great to need comment.

In summing up all that we have said of the new fracture apparatuses, we believe that they are superior to all others; that, in a great number of cases, they cannot be replaced by any other surgical contrivance; that their mode of action offers immense advantages in practice, and particularly in the treatment of simple fractures; that their use is not confined to those injuries, but that they may be very advantageously employed in the treatment of compound and gunshot fractures, of caries necrosis, dislocations, sprains, white swellings, excisions of joints, wounds having a tendency to deformed cicatrization, and to deformities from other causes. Moreover, we regard as chimerical, or easily avoidable, the evils which have been attributed to the method; and it is matter of surprise that a plan of treatment so valuable should not already have been generally adopted in the practice of surgery, and have caused the old plan of treating fractures to be completely forgotten." I concur in this opinion expressed by Professor Velpeau, in conclusion to a clinical lecture many years since delivered at La Charité.† That the system I advocate does possess real advantages in a large number of cases, can no longer be matter of doubt. Whether or not all my anticipations respecting it admit of realization is a question well deserving further clinical observation for its solution.

* Leçons Orales, cit. Page 637.

† Leçons Orales. Page 659.