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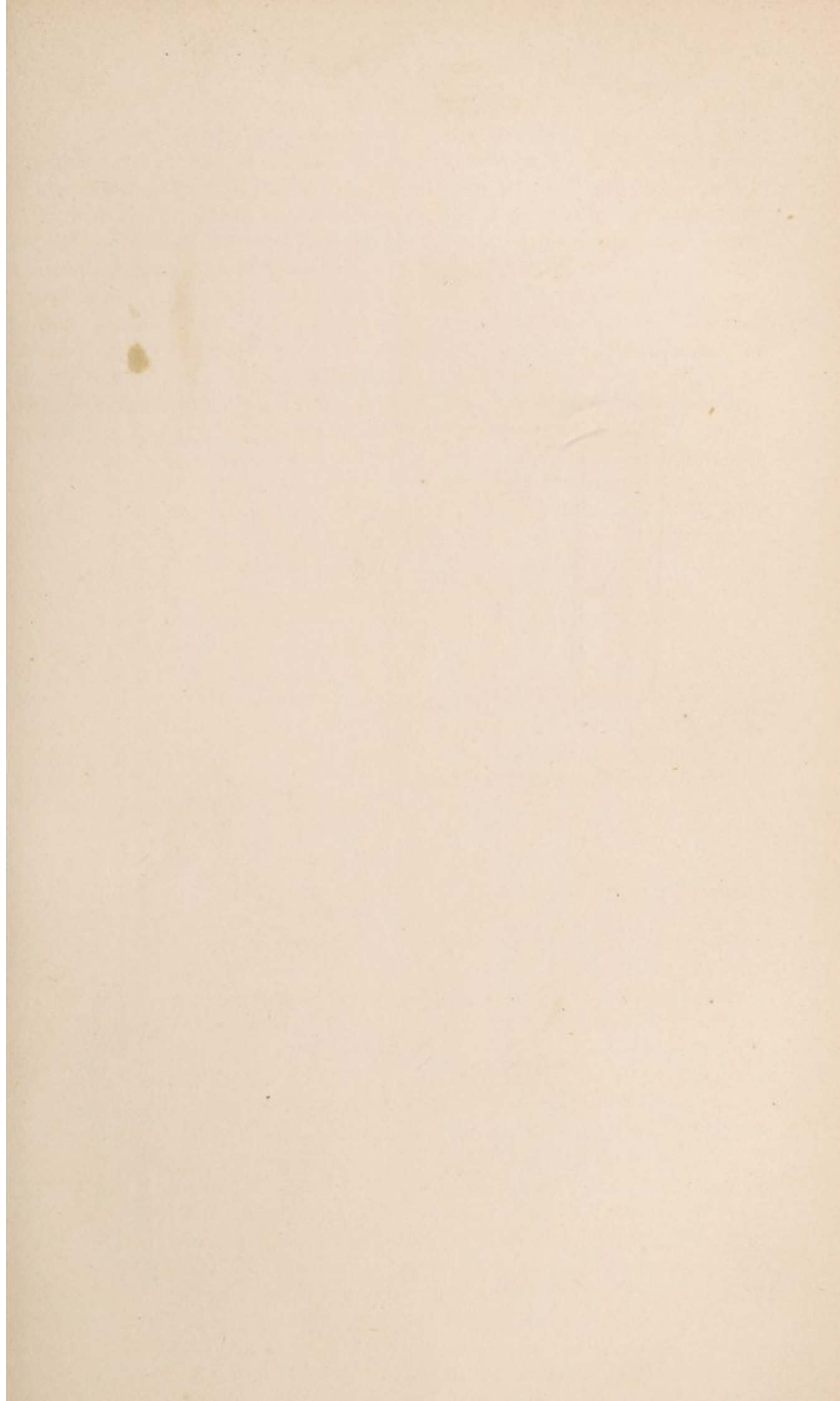
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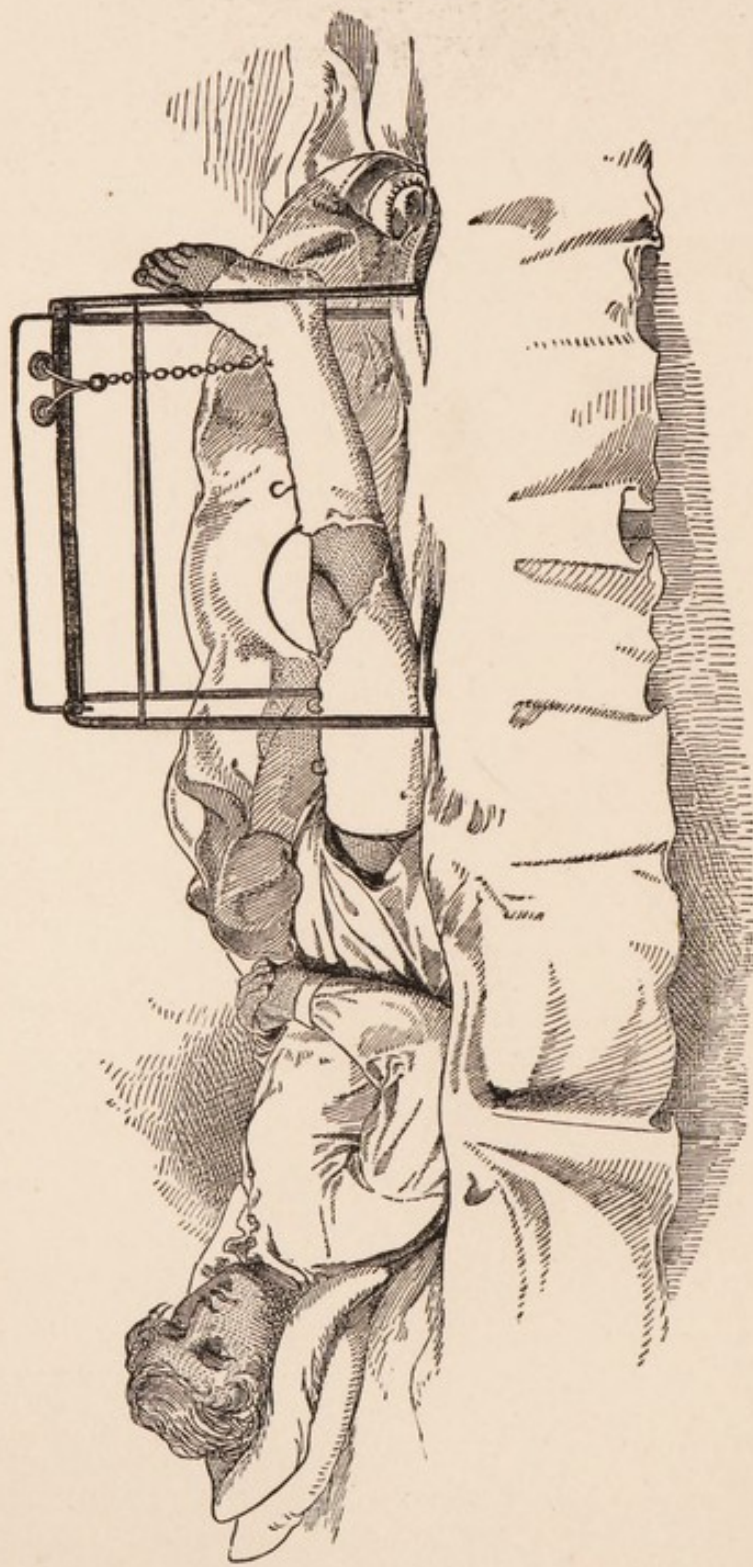
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Shows apparatus applied to limb, and slung by the ankle-hook of suspension-rod from a Salter's Swinging Cradle. Two or three other hooks for suspension are introduced; although sometimes useful, as affording a sense of change of position to the limb, they are not material to the apparatus.

16  
EXCISION OF THE KNEE-JOINT:

A DESCRIPTION

OF A

NEW APPARATUS FOR THE AFTER TREATMENT;

WITH

ILLUSTRATIVE CASES.

BY

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EDINBURGH:

MACLACHLAN AND STEWART.

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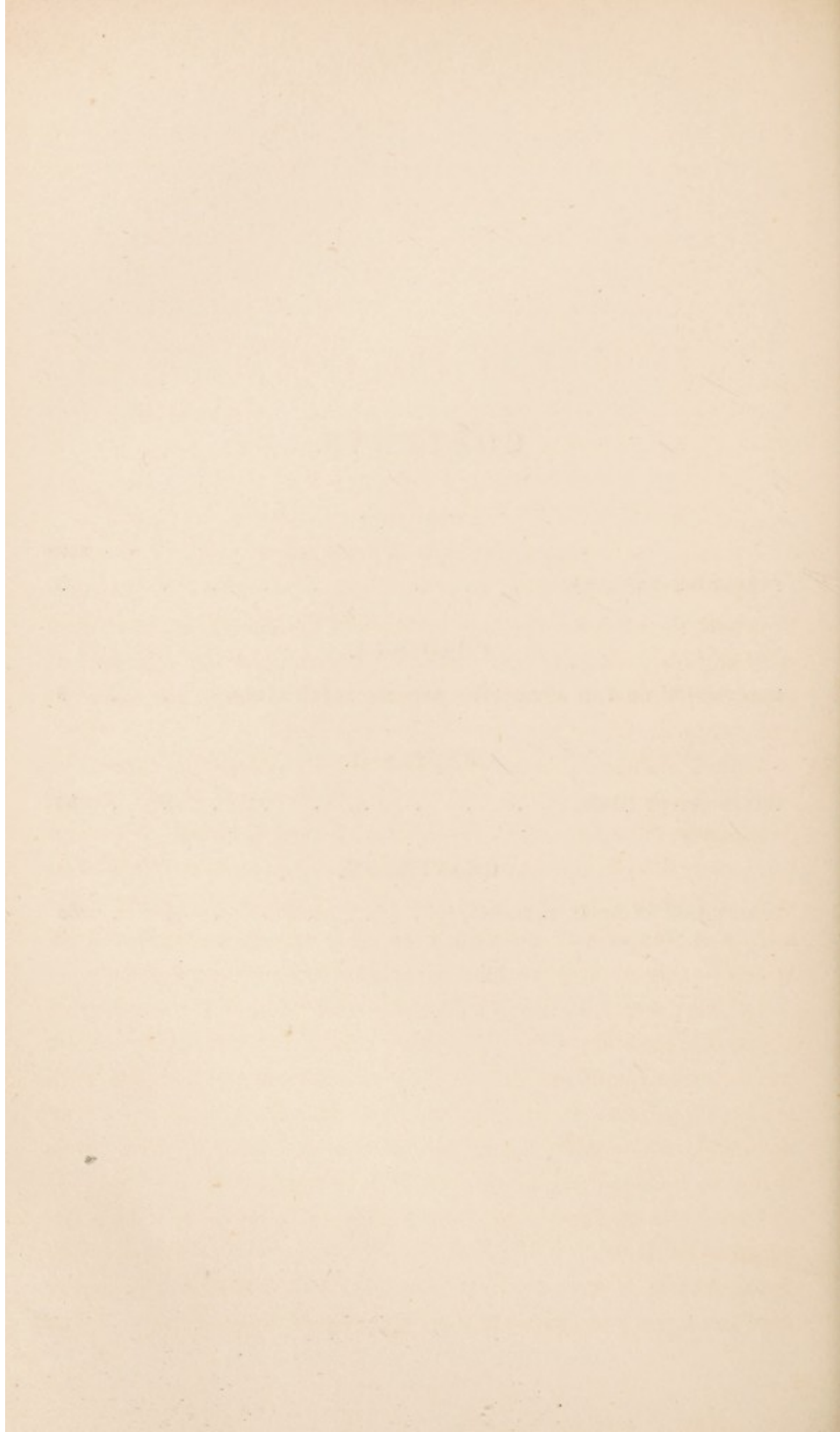
1867.

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## CONTENTS.

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|                                                       | PAGE |
|-------------------------------------------------------|------|
| PREFATORY REMARKS, . . . . .                          | 5    |
| CHAPTER I.                                            |      |
| DESCRIPTION OF THE APPARATUS AND ITS APPLICATION, . . | 9    |
| CHAPTER II.                                           |      |
| ILLUSTRATIVE CASES, . . . . .                         | 36   |
| CHAPTER III.                                          |      |
| CONCLUDING CLINICAL REMARKS, . . . . .                | 68   |



## EXCISION OF THE KNEE-JOINT.

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### PREFATORY REMARKS.

IT is with the after-treatment of excision of the knee-joint, more than with any question as to the mode of operation, or the selection of cases of disease of this articulation suited for the operation of excision, with which my remarks have to deal.

I have no intention, for I cannot think now-a-days, after the admirable writings of Sir W. Fergusson and of Messrs Jones, Mackenzie, Butcher, and Price, that it would serve any good purpose to discuss the questions of how far excision of the knee-joint will serve as a substitute for amputation of the thigh, or how far it will bear comparison and rank with other articular resections with which in this country we have long been favourably acquainted.

I should prefer, so far as I am concerned, to accept it as a settled point, that excision of the knee-joint is a good operation, one which has, in so many different hands, yielded such successful results as to render its admission into the common list of operations, not only defensible as something more than an experiment, but justifiable as being an accepted procedure of modern surgery.

I am perfectly aware that such a position is denied to it by some surgeons of repute. Their hostility, however, may be traced to different causes, in some to their ignorance of the procedure, as at present employed; in others, to their jealousy of the success which has

crowned the efforts of the chief promoters of the operation ; and in others, to an unfortunate want of success in its employment, which speculatively might be said as reasonably to indicate something blame-worthy in the unsuccessful operators themselves, as in the operation which they refuse to recognise.

The procedure, as revived at the hands of such men as Sir William Fergusson and Mr Jones of Jersey, has stood the test of a sixteen years' trial, during which it has been performed by the chief surgeons of every medical school, not only in this country and in its dependencies, but upon the continent of Europe, and has gained a verdict, if not upon all the issues which its adoption involves, yet upon so many of them as to render its future progress, in civil practice, no doubtful matter. Many of those who at first opposed its employment have changed sides in this controversy ; some have passed away from this, as from all else, on this side of time ; and those who still continue stout in their opposition to what they regard as a dangerous innovation, have probably done as much to diffuse a knowledge of the operation by attracting the attention of others who would never have concerned themselves about the matter had it not become a subject of dispute, as any ill which may have accrued to the operation from their energetic denunciatory efforts, or their abstinence from its practical employment.

There are two reasons, it seems to me, which may encourage any one whose experience of the operation has been satisfactory, to do what he can to extend his own favourable opinion of it. The one is, that it is still practically excluded from military surgery ; the other, that even in civil life the substantive objections taken to the operation apply to what may be regarded as contingent and remediable evils.

Mr Park, the great originator of this procedure, with characteristic modesty, insists in the letter in which he describes his new operation to Mr Pott, "I am conscious that the mode of operating, which I have described, is by no means perfect, but still stands in need of the finishing hand of a more able master." Several such hands as he desiderated have been engaged in the process of per-

fecting it for more than half a century (even excepting the period of comparative oblivion into which it was permitted to fall), and still there are some who regard the procedure as far yet from the standard of perfected art. It may not therefore seem, I hope, a too ambitious effort which I would propose to myself, if I enter the field in which the greatest men of our age in surgery have been engaged, setting before me no greater work than that of gleaning after them, and endeavouring to add a little grain of practical experience to the great harvest wherewith their labours throughout a long day have been so deservedly crowned.



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## CHAPTER I.

### DESCRIPTION OF THE APPARATUS AND ITS APPLICATION.

SHORTLY after the restoration of the operation of Excision of the Knee-joint to the list of creditable procedures by the precept and example of Sir William Fergusson, followed by the gratifying successes which attended upon its practice by Mr Jones of Jersey, the late Dr Richard Mackenzie of Edinburgh performed excision upon four patients suffering from disease of the knee-joint. Two of these were adults, two were adolescents. All these cases came more or less immediately under my charge as his house-surgeon. Thus my attention was early directed to the subject, and I confess that, notwithstanding excellent results in the adult patients, I then formed a very unfavourable opinion of the procedure chiefly on two grounds:—1. The extreme difficulty I experienced of maintaining the limb at rest, and in good position, during convalescence; 2. The risk encountered by the formation of extensive bed-sores during the necessarily long period of confinement to bed, required by the methods of after-treatment of the limb then in use.<sup>1</sup> These very manifest practical difficulties certainly gave great countenance to the opinion, then somewhat strongly expressed by the greater part of the profession, against the adoption of the operation as a substitute for amputation, and led to its all but universal rejection by military surgeons. Even one of so fair and judicial a mind as Sir George Ballingall, while he taught the operation in his surgical class, and

<sup>1</sup> The apparatus employed by Dr Richard Mackenzie was precisely that more recently recommended by Mr Butcher of Dublin, see page 14.

descanted upon it in glowing terms, as one of the greatest improvements in the surgical procedures of the day, spoke of it "as an operation unsuited for military surgery in the field, where the appliances of a fixed hospital could not be depended upon."

Mr Guthrie, also, speaking favourably of excision for gunshot wounds of the knee-joint, pointedly introduces the proviso, "provided every accommodation, and, particularly, absolute rest can be obtained for the sufferer."<sup>1</sup> With such eminent practical military medical authorities at one upon this point, it is no wonder the influence of their opinions showed itself, in the late campaign in the Crimea, by the rarity of the performance of this operation. In that campaign, excision of the knee-joint was only once had recourse to; then, as a secondary operation, and with a fatal issue.<sup>2</sup> The applicability of this operation to army practice, as regarded from a purely military point of view, may further be gathered from the retrospective remarks of Deputy-Inspector-General Matthew. They are all the more interesting as coming from a man brought up under the auspices of Mr Liston, and assuredly one of the foremost among the operators of that campaign. Though decidedly hostile to its employment, one is glad to see that the ground of objection is found to exist, not in the operation itself, but in the insurmountable difficulty of the after-treatment. "Gunshot wounds," says he, "of the knee-joint are generally looked upon as demanding either amputation or excision; and, were these operations attended with less danger, it might seem advisable to have recourse to one or other in almost all cases where the bone is implicated beyond the most trifling amount, for there can be no doubt that the risk to life from such a wound treated without operative interference is very considerable. Unfortunately, however, the experience of the past war demonstrates but too clearly that amputation of the thigh after

<sup>1</sup> Guthrie, "Commentaries on the Surgery of the War in Portugal, Spain, France, and the Netherlands." Fifth edition, p. 94.

<sup>2</sup> Medical and Surgical History of the British Army during the War against Russia, vol. ii. pp. 352, 379.—Macleod, Notes on the Surgery of the War in the Crimea, p. 349.

gunshot injury is a very formidable operation, terminating fatally in a large proportion of cases, while the difficulties to be encountered in disposing of a case of resection of this joint during active service, and when the removal of the patient may at any time become necessary, will probably always render the success of the latter operation in field surgery very doubtful.”<sup>1</sup> And again,—

“Resection of the knee-joint has only once been attempted, and then as a secondary operation; and considering how vitally essential to its success is the most complete immobility of the limb after its completion, it remains doubtful if the operation will ever be practised to any extent in the field hospitals; and before proceeding to its performance the surgeon will always require to weigh well the possible circumstances in which his patient may be placed during the progress of the case.”<sup>1</sup>

Macleod, too, referring to the circumstances of a campaign as experienced in the Crimea, expresses himself as unfavourable to the procedure; but that opinion is arrived at only because the difficulties in conducting the after-treatment seem insuperable. “Admiring, as I do, the brave attempts which have been made in civil practice to save limbs by excising the knee, I regret that it should not also be extended to military practice; but except in rare circumstances I fear that cannot be accomplished, from the careful after-treatment, and the long period of convalescence necessary to effect a cure.”<sup>2</sup>

Although Professor Longmore does not enter into any consideration of the question of excision in military practice, his statement in cases suited for such an operation is positive against its employment. “When the fracture is comminuted, and affects the knee or ankle-joint, opening the capsule, amputation is necessary. The

<sup>1</sup> Medical and Surgical History of the British Army during the War against Russia, vol ii. pp. 352, 379.—Macleod, Notes on the Surgery of the War in the Crimea, p. 349.

<sup>2</sup> Notes on the Surgery of the War in the Crimea, with Remarks on the Treatment of Gunshot Wounds. By G. H. B. Macleod, M.D., F.R.C.S. 1858. P. 354.

knee-joint was once excised in the Crimea, but the patient died: as was the case in the only instance where this operation is known to have been performed for gunshot injury in the Schleswig-Holstein campaign."<sup>1</sup>

The late Dr John Brown, in his *Notes on the Surgery of the Indian Campaign of 1857-58*, remarks: "If there is a class of cases in military practice which demands that the knife should follow the wound, it is this class in which the knee-joint is injured by a musket ball. Occasional recoveries do not affect the question at all; for operative measures should always be had recourse to when there is no chance of recovery without them; and that chance is too remote to be considered in comparison with the greater chance of a fatal result in this form of injury. The operation of resection of the joint, while still doubtful in most cases of disease, seems to me to be applicable to some of the cases of gunshot injury of the knee, provided there be little injury to the bones, and the camp be a standing one; in marching armies the operation is decidedly inadmissible."<sup>2</sup>

These extracts I have made in illustration of what I have already stated,—viz., that the great practical objection in connexion with the introduction of this operation consists not in the operative procedure itself or in the fatality as compared with amputation, but in the difficulties which have been found to attend on the after-treatment of the case. The operative procedure of itself is admittedly easy of performance, requiring no greater skill than an amputation, preferable surely to an amputation in the case of a wound of the knee-joint, when the injury inflicted on the articulation is confined to the epiphysis of either bone entering into the formation of the joint, because attended with less mutilation, and certainly entailing less life risk, requiring no great amount of skilled assistance, for no bloodvessel of importance is wounded; but rejected, as we have

<sup>1</sup> Holmes' *System of Surgery*, vol. ii. p. 84.

<sup>2</sup> *Notes on the Surgery of the Indian Campaign of 1857-58*. By John Brown, M.D., Assistant-Surgeon Bengal Medical Service. *Edinburgh Medical Journal*, Sept. and Oct. 1860.

seen, from two considerations: 1, The difficulties which are supposed to attend upon the after-treatment; and 2, The impossibility, by means of any apparatus in common use, to afford such an amount of immobility of the limb, combined with freedom from restraint, as shall permit the sufferer, if need be, readily to be removed from place to place. Similar objections taken to the effort to save the limb after gunshot or compound fracture of the thigh, which has usually sacrificed all these cases to primary amputation, has assuredly been met, in a large number of cases during the late war in America, by means of a simple method of effecting continuous extension.<sup>1</sup> The cases so treated have resulted in saving limbs scarcely, if at all, shorter than their fellows, and of so seemly a form and contour that nothing better could possibly be desired. If such a result, so unexpectedly favourable, has been attained in the analogous, though, I think, more serious, injury of gunshot fracture of the shaft of the thigh-bone, it seems unreasonable to doubt that in cases of excision of the knee, were an apparatus designed for the after-treatment which, while simple and readily obtained, admitted of the easy removal and application of dressings, and permitted the movement of the patient's body and limb, without any disarrangement of the original adjustment, a like favourable result would, even in the difficulties of a campaign, or on shipboard, be found to attend upon the employment of this resection.

The methods adopted for maintaining repose of the limb after excision of the knee-joint, since its earliest employment, have been various. First and foremost, there is the "*case of tin* sufficiently long to receive the whole limb, from the ankle to the insertion of the glutæus medius muscle," employed by Park on his famous patient, Hector M'Caghen. Since that time (1781), various devices have been fallen upon to keep the parts at rest, varying in the degree of complexity of their construction.

The apparatus employed by the older Moreau, he describes as

<sup>1</sup> Gross, *System of Surgery*, vol. i., pp. 1034, 1035; Redfern Davies, Esq., *Lancet*, 6th June 1863.

follows: "This machine was composed of a board, the length of the diseased limb. It was bevelled at the upper end, that it might not hurt the thigh; and scooped out before, that it might receive the heel. It terminated in a sole; and at the side it had ledges of wood, which slipped easily into grooves; and as those ledges rose higher than the dressings, there was no need of a basket to bear up the bed-clothes. I likewise prepared cushions of baked hair, one of which I put between the limb and the underboard, and the other two I placed, one on each side, between the limb and the side boards. The foot rested against the sole, to which it was fixed by a tape."<sup>1</sup>

The splint recommended by Mr Butcher of Dublin, and with the aid of which he has produced such admirable results in resection of the knee, closely resembles the splint of Moreau. "A wooden case which I had made for the purpose. The sides were attached to the back part by hinges, so as to allow of being let down at the time of dressing; they were likewise of unequal length—the internal extending nearly as high as the ramus of the pubis, while the external passed up to the axilla, similar to the long splint used by me in fractures of the thigh; the lower end of each lateral piece presented on the inner surface a number of grooves, about an inch apart, so that when the sides were elevated, the foot-board was received into any opposite pair of them, according to the distance required. This lower piece acted in two ways; not only did it maintain the foot at a right angle with the leg, but it steadied the sides and prevented their being pressed inwards from their vertical direction, by the tapes and buckles which girded the apparatus on the outside. The box was supplied with hair cushions carefully adapted to its entire extent, some being covered with oil silk. In addition to the posterior, lateral, and foot support, a broad splint well padded had to be placed over the anterior surface of the thigh, extending from a little below Poupart's ligament, as far as the junction of the upper and middle thirds of the leg, and secured

<sup>1</sup> Jeffrey's Cases of Excision of Carious Joints. By H. Park and P. F. Moreau. P. 133.

firmly down by the surrounding web belts, so as to counteract the powerful tendency towards the distortion of the limb forwards. The external side of the case passed up to the axilla, the object being to insure the straight position for the limb. It was kept in contact with the trunk by a wide girth passed around both. . . . . The bed was prepared in the following way: A hair mattress was laid over a feather-bed, raised towards the feet; a blanket folded several times was placed over the part on which the shoulders and hips rested; thus the returning circulation was favoured, and the chances of excoriation of the prominent parts of the buttocks guarded against.”<sup>1</sup>

The late Mr R. C. Price, in a paper communicated to the *Lancet*,<sup>2</sup> recommended the employment of a splint or apparatus of his invention, which he describes as follows: “The apparatus is an improvement on the ordinary M‘Intyre splint. It consists of two concave portions, the upper part corresponding to the lower half of the posterior surface of the thigh, and the other to the entire length of the leg. These two portions are connected by a narrow plate of the same substance as the splint, which is of enamelled tinned iron, and when in position corresponds to the popliteal space. The lower end is provided with a wooden foot-board, which can be regulated by means of a screw and slide to suit the length of the limb. The plate connecting the upper and lower portions, together with the part corresponding to the lower third of the leg, can likewise be regulated according to convenience. When the splint is in position, sufficient support is given to the popliteal space by this narrow plate, and at the same time no obstruction is offered to the daily dressing of the sides of the wound. By the sliding arrangement of the portion of the splint corresponding to the lower third of the leg, a space is left between it and the foot-board, so that the heel, which is very liable to become affected by the slightest pressure when the patient has

<sup>1</sup> *Essays and Reports on Operative and Conservative Surgery.* By Richard G. Butcher. Dublin, 1865.

<sup>2</sup> *Lancet*, 24th January 1857.

been confined to bed for a length of time, is left perfectly free. I have had on more than one occasion to regret the formation of a sore over the insertion of the tendo Achillis, which has acted injuriously as a troublesome source of irritation. The outer side of the splint is provided with hooks, whereby a long side splint of wood furnished with corresponding eyes, may be fastened. This splint ought to extend about two or three inches below the foot-board, and to reach a little higher than the crest of the ilium. I have had the two portions connected by a strong round iron hoop, which, if made sufficiently high, enables the wound to be dressed without the inconvenience of disturbing, in any way, the apparatus. The hoop, or arch, also answers the purpose of a cradle in keeping off the bed-clothes when the limb is not placed in a swing. All the advantages of the long splint are thus gained, without the inconvenience of daily removal, and the liability of injurious pressure being made on the outer margin of the wound, in instances where there is great swelling of the soft tissues. The use of the side splint is the same as in fractures of the femur. By it, in conjunction with the perineal band, extension of the thigh is regulated, and the entire limb kept perfectly at rest."

Dr Frank Hastings Hamilton, in the latest edition of his work upon *Military Surgery*,<sup>1</sup> recommends "the limb to be laid in a long, well-fitted, and well-padded box or splint. The box may be made of zinc or tin, and supplied with floating sides opposite the knee, to enable the surgeon to dress the wound from time to time without disturbing the limb."

Thus, a simple posterior padded splint, the same with lateral splints, the old-fashioned fracture-box, sand or bran bags, the double-inclined plane or M'Intyre splint—simple or combined with one or two side splints, with requisite fenestræ—have been recommended by different operators, and have chiefly constituted, in more or less complicated combination, the methods of after-treatment hitherto employed by those whose efforts have been

<sup>1</sup> A Treatise on Military Surgery and Hygiene. By Frank Hastings Hamilton, M.D. New York. Pp. 516-17.

directed to obtaining firm ankylosis. By Langenbeck the immovable plaster-of-Paris apparatus has been recommended, and I am informed, constantly employed in the early period of after-treatment; in the later, passive movement of the limb is commenced, with the view of obtaining a movable articulation in imitation of the natural joint.

In the cases of excision practised by Dr R. Mackenzie, and in two of the cases under my own care, I resorted to the use of several of these devices, but found them inconvenient and irksome in the last degree to both patient and surgeon. In all of them I found, that while the leg and foot were certainly fixed with security, and frequently immovably, the thigh followed the movements of the body, and, consequently, a greater or less degree of displacement resulted in proportion to the restlessness of the patient. The displacements of the thigh I found, as described by every operator, to be of two kinds, rotation in a direction outwards, and abduction with a slight degree of projection forwards. These displacements, I furthermore found, could not be overcome when they had once occurred, without giving great pain, and without the complete re-application of the apparatus.<sup>1</sup>

<sup>1</sup> Both Mr Park and Mr Syme allude to this difficulty. *July 5th.*—"Had not passed so good a night, complaining much of pain in the back from posture."

*10th.*—"His bed becoming very uncomfortable, he was removed into a fresh one."

*12th.*—"Spasms in the thigh."

*14th.*—"Spasms still troublesome; had gotten the limb into a bad position, in consequence of turning too much on the side—the posture in which he has been accustomed to sleep for several years, but at present a very unfavourable one, as by this means the end of the femur was raised too high, and cast outwards: *this was rectified, though not without some pain and trouble. It may be sufficient to mention here, once for all, that this circumstance gave me a good deal of trouble at different times during his whole confinement.*"

*March 23d.*—"The knee very slightly bowed outwards, owing to the difficulty of keeping him in a good position, which I have already mentioned."—Mr Park's case of Hector M'Caghen, pp. 27, 28, 36.

"In order to prevent displacement of the bones, which all our efforts had been insufficient to effect completely, I cut away about two inches of the femur

It was in such circumstances that, about two years ago, I devised the following apparatus, which I have employed in every instance since that time in which I have performed the operation of excision of the knee. Since my introduction of it to the attention of my colleagues in the Infirmary, it has, I am glad to say, met with their sanction and practical approval, having been most successfully employed by Professor Spence and Dr Gillespie in several cases. I have also understood, from the communications of friends and former pupils, that it has received even already a wide reputation, not only at home, but even abroad, commending itself to the attention of practical surgeons chiefly on account of its simplicity, comfort, and ease of application. It consists essentially of two parts—1. A suspension-rod made of iron, about the size of No. V. of trade wire gauge; 2. A modelled Gooch splint, long enough to extend from the tuberosity of the ischium to beyond the heel.

*The suspension-rod* extends from the groin to the extremities of the toes, and is bent to the outline of the limb, departing from it only in the situation of the excision, where it forms a bow or arch. To the upper surface of the rod are attached one or more hooks by which the suspension is effected.

FIG. 1.



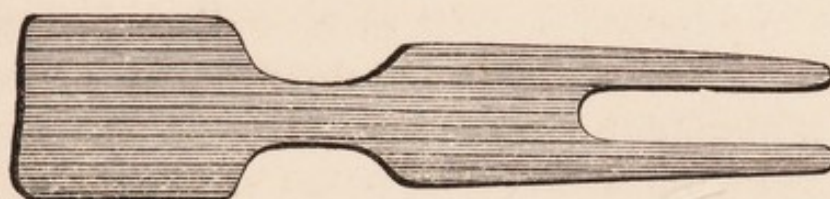
Suspension-rod for front of limb—the arch corresponds to the site of excision, the suspension-hook to the ankle-joint, upper end should terminate at the fold of the groin.

*The Gooch splint* should not be made too wide, and should certainly not surround the thigh and leg to more than two-thirds of their circumference. It should be scooped away laterally, at a part corresponding to the site of the excision, and should have an aperture cut corresponding to the tendo Achillis and heel. The inferior

with the pliers, and then observed with much concern, that the bone was denuded beyond the farthest extent to which my finger could reach.”—Syme on Excision of Diseased Joints, 1831, p. 139.

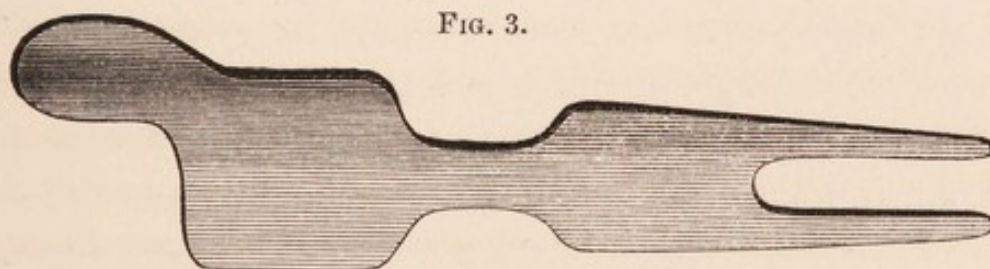
extremity of the splint is thus of a horse-shoe or stirrup shape, and admits of the ankle and foot being supported by the lateral horns of the splint, as they fold on each side of the malleoli, without the risk of inordinate pressure being made upon the tuberosity of the os calcis.

FIG. 2.



Posterior "Gooch" splint of ordinary form—hollowed out in each side on the level of the operation wound, and cut out at the lower part in a horse-shoe or stirrup form, so as to relieve the heel and tendo Achillis from any pressure.

FIG. 3.



Alternative form of "Gooch" splint for excision, hollowed out as in Fig. 2.; the rounded part above, adapted to the os innominatum, and secured by means of strips of adhesive plaster.

In application, the limb is first laid and carefully adjusted upon the posterior splint, which should preliminarily be padded with lint, and covered with gutta-percha tissue, or hot paraffine, in the situation which corresponds to the site of operation. The iron rod is then placed in front, and folded lint laid between it and the limb at the groin (where the rod terminates above), at the upper part of the tibia, and at the bend of the ankle. These two parts of the apparatus are then retained in contact with the limb by means of an *open-wave* roller bandage applied from the toes upwards, the site of the incision alone being left uncovered. The whole is then rendered immovable by means either of plaster-of-Paris applied by the hand, of a consistence like thick cream, or of paraffine, which, having been rendered temporarily liquid by heat, is

applied by a large painter's brush. When the application has solidified, the patient may then be removed to bed, and the limb suspended from the running pulley of a Salter's swinging cradle, or from the roof-bar of the common iron-wire cradle employed to support the weight of the bed-clothes. I do not regard it as a matter of indifference whether plaster-of-Paris or paraffine is used. Each has its advantages. The plaster-of-Paris is firmer and not liable to be affected by heat like paraffine, but it has the disadvantage of permitting soakage of discharge; it takes longer to consolidate, and when consolidated, is less easily clipped through by means of bandage-shears than the paraffine apparatus. I have of late, in the treatment of excisions and of compound fractures, employed the plaster-of-Paris as the substantial substratum, and thereafter applied the paraffine over it as soon as consolidation and drying has become complete, so as to secure its greater toughness, and its complete impermeability to fluids of any kind, whether blood, serum, or pus, from the line of incision, or water from the wet dressings which may be applied during the healing of the wound. The foot and limb should not be much raised above the level of the mattress upon which the patient lies, as this is apt to lead to an awkward position of the limb when the patient first begins to move about. When in bed, the sacrum and hips must be protected from all risk of inordinate pressure, by means of a large square corrugated air-cushion completely covered with a blanket and draw-sheet. This will be found to be most evenly and comfortably supported upon a firm hair-mattress, laid either on a thick hair-palliasse, or better, a spring-bed. The patient should be encouraged to sit up as much in bed as he can, even within a day or two of the operation, and as soon as it is possible should be removed out of bed during the day, either to another bed or couch, or should such not be attainable, to a mattress laid upon the floor. In sitting up, the air-pillow placed beneath upon the seat will be found a great comfort, as it admits of easy relief to the irksomeness of maintaining nearly the same sitting posture for a period of several hours.

The chief merits which I have observed in this method of after-treatment are :—1. The comparative comfort the patient experiences from the ease with which he can shift his lying posture or assume the sitting position without disturbing the adjustment ; 2. The facility with which dressings are applied without detaching or removing any portion of the apparatus ; 3. The permanence of the apparatus, never requiring, when properly applied in the first instance, to be renewed during the whole period of after-treatment ; 4. The ease with which the apparatus can be obtained, its simplicity and cheapness.

A few words in explanation of these advantages may seem opportune.

1. *The comparative comfort the patient experiences from the ease with which he can shift his decubitus, or assume the sitting posture, without disturbing the adjustment.*

From what I have premised, it is manifest that the plans of treatment previously adopted imply either a persistent recumbency, the limb being steadily fixed to an immovable apparatus, which, lying upon the bed, admits of no adjustment corresponding to any accidental or intentional movement of the patient's body, or the employment of a lighter apparatus less calculated to maintain accurate apposition, but which, being adapted to the sling of a Salter's apparatus, admits of some degree of movement on the part of the patient.

Between the two plans, certainly the latter is in many respects to be preferred. It has the clear gain of admitting of some degree of motion of the trunk, and is therefore less irksome and less likely to be accompanied with the formation of bed-sores.

But this alleviation of the uneasiness attending upon the continued maintenance of one posture is somewhat shorn of the benefits it undoubtedly confers, by the apparatus, partly from its weight, partly from its exerting a greater purchase on the leg and foot than upon the thigh, admitting of some degree of displacement in the direction of rotation outwards, abduction and advancement of the thigh-bone.

The fixed apparatus treats the case as one of fractured thigh-bone, combining in its construction the old fracture-box with the long splint of Desault. Here the limb is steadily fixed to the bed, and the leg is therefore, to all intents and purposes, immovable as the bed itself; while the thigh, subject to constant displacement, shifts the accuracy of adjustment with every effort on the part of the patient to raise himself in bed, or to shift the position of his buttocks. But as any such movement must be at best limited, the chief risk to be encountered with this apparatus is the formation of bed-sores on the sacral region. Another serious objection to this method of treatment has, however, been found to obtain in practice, viz., that in spite of every contrivance to prevent the displacement of the lower end of the femur at the site of operation, or to reduce it to a minimum, some degree of displacement will and must occur. For example, a patient cannot long lie in the recumbent posture without some degree of sinking of the buttocks into a hollow in the bed produced by the intrinsic weight of the part; this, if the thigh is free, is followed by a commensurate tilting of the femur in the direction of flexion, abduction, and rotation outwards. If the thigh is fixed, this of course cannot take place to the same degree, but must occur in some measure. Lest this objection should be considered a merely hypothetical one, I may mention, in addition to the undoubted fact, that such displacements are observed in nearly every case where the operation has been performed which I have had an opportunity of examining—explain them as we may,—this sinking of the pelvis is recognised by Malgaigne as an important “mechanism” in the production of the well-marked displacement always encountered in cases of sub-trochanteric fractures of the thigh-bone, especially when treated by the long splint,—“Plus tard encore, j’observai que le bassin du malade faisait un creux dans le matelas et attirait ainsi en dedans la tête fémorale, laissant en dehors l’autre bout du fragment supérieur;”<sup>1</sup>—and is overcome by him by the following device:—“Je fais coucher le malade sur un lit plat, une large planche passée sous le matelas.”—(P. 719.) A plan scarcely cal-

<sup>1</sup> Malgaigne, *Traité des Fractures et des Luxations*, tome i. p. 716.

culated to tempt one to imitate it, risking, as it must in a great degree, the occurrence of bed-sores.

It appears to me, therefore, that the great objects to be desiderated in any apparatus for the after-treatment of excision of the knee-joint are,—1. Commensurate adjustment of the sawn ends of the bones not only at first, or at each dressing, but constantly throughout the whole period of after-treatment. 2. Such equipoise of the whole limb, that the thigh-bone shall be able to follow the inevitable movements of the trunk without losing its proper relations to the tibia.

The light nature of the new apparatus, its equal hold upon the thigh and leg, and its suspension from a single point providing for all these requirements, seems theoretically, therefore, well suited to obtain a satisfactory result. The amount of movement on the part of the patient permitted by this apparatus is infinitely greater and more varied than any other. It permits every possible degree of flexion and abduction or adductive movement of the thigh, so that the patient can incline the hips from side to side without the slightest disarrangement of the apparatus or of the adjustment. By a slight modification of the mechanism by which suspension is effected, the patient can even turn completely upon the sound side.<sup>1</sup> To effect this, a piece of tape or bandage, or a circular wire hoop, if it can be obtained, is passed round the apparatus on the level of the lower part of the calf of the leg, and to this, instead of the hook in

<sup>1</sup> I may here mention that in one of Dr Mackenzie's cases, that of a young lad who sank from exhaustion, after excision of the knee-joint, the difficulty created by the occurrence of bed-sores in spite of the use of every preventive and palliative measure which could be devised, I was obliged to have a large bed-table constructed half the height of the greatest diameter of the ossa innominata, upon which the limb and its splints might be laid, while the patient was turned upon the sound side. This plan, although it relieved the patient's back, and afforded him for days a respite from the dorsal decubitus, was so exceedingly troublesome of adjustment to any variation in the lateral posture of the trunk, that I was obliged to lay it aside and have the limb and its apparatus buoyed upon a large thick air-cushion obtained for the purpose, which, although more comfortable, was not satisfactory in maintaining quiescence of the femur and tibia.

front, the chain of the swinging cradle is attached. If the tape tends to slide over the surface of the plaster-of-Paris case, this can be prevented by the application of some fresh plaster, by which the tape may be at once fixed to the under surface of the plaster case at any level. I have by this device enabled patients, within a few days after the operation, to lie upon the sound side, and thus pass a more comfortable night than on their back. Should they during sleep turn upon the back, the tape sliding within the hook of the chain, or the whole case turning within the wire hoop, permits the limb to follow the movement of the body without awaking the patient, or requiring the aid of a nurse or other extraneous assistance to help him to modify his position.

The patient can also sit up in bed at an early period after the operation. In the second last case of excision of the knee which is narrated in the sequel, on the day following the operation I found, on entering the ward, the patient sitting up in bed combing her hair, and so turned round as to permit her long back hair to fall over the edge of the bed, while the foot of the sound limb was supported upon a seat on the other side of the bed. On inquiry, I found that she had assumed this posture of her own accord without assistance, and that, at even so early a period, neither pain nor displacement followed upon so considerable an amount of freedom of motion. I find that the lightness of the apparatus admits of the patient being easily moved out of bed within a few days after the operation. This I regard as no unimportant matter in securing a favourable result, and in avoiding the risks of pyæmia. It is impossible, so long as a patient lies in one bed, to have that bed made, aired, and properly cleansed, as is essential after an operation, if the health of the patient is to be maintained; even with draw-sheets, air-pillows, and the most sedulous use of all that painstaking care which really good nursing can secure, the patient's health must suffer so long as he is obliged to maintain the recumbent posture day after day in the same bed. I think it, therefore, as no inconsiderable element in the excellence of this apparatus that it affords a wonderful facility for removing the patient from bed to bed, and out of bed to the couch or chair.

Furthermore, I am confident from my experience of the employment of this plan of after-treatment, that it is admirably adapted to the exigencies of a campaign, and that it is likely to prove advantageous to the military surgeon, by enabling him on active service to undertake the operation of excision of the knee-joint in the midst of all the uncertainties of a regimental camp hospital, or even when on the line of march. In other words, the military surgeon may, with it, safely excise the joint where he knows that he cannot have the advantages of a fixed and permanent hospital for his after-treatment of his patient. I must confess that I have had no practical personal experience of this procedure under such circumstances, but having had ample experience of the exigencies and difficulties which do arise and which must be met in the treatment of surgical cases during a campaign; and, furthermore, having made experience of what is to be obtained from this plan of after-treatment, I can say with every confidence, that were I myself engaged in the surgical treatment of patients during another campaign, I should never hesitate to employ excision in preference to amputation in cases of injury of the knee which have hitherto been supposed to require amputation, or from which, at all events, excision has been withheld, not because the operation was deemed improper or insufficient, but because the means necessary for after-treatment were not to be obtained.

It was one of the great benefits Park anticipated as likely to accrue from his successful introduction of this excision into practice, that it should become, in army practice, a means of saving life and limb. Accordingly, writing in 1805, twenty-three years after the publication of his letter to Mr Percival Pott, in which he details with just satisfaction his well-merited success, he sorrowfully remarks,—“I have not yet learned that it has hitherto proved the means of saving a single limb in the whole of the British dominions; and since its publication, this country has passed through a long and bloody war, without this practice being at all adopted, or scarcely known either in the army or navy of Britain.” “However, as we are now but just entering upon the serious part of another war, I hope it is yet in time to do infinite good by preserving a

great number of limbs, if the knowledge of it can be generally diffused through the army and navy.”<sup>1</sup> “When I speak of diffusing the knowledge of this subject through the army and navy, I feel myself justified in using this language, by having been assured by gentlemen of the profession, who had seen much service during the late war, that the only idea then entertained respecting wounds of the large articulations, was, that such limbs were to be considered as fit objects for amputation.”

Were Mr Park alive at the present day, I fear he would still have much reason to adhere to the same language and still to express the, as yet, unfulfilled wish, that his new operation might prove the means of benefit to his fellow-creatures. He was himself apparently sufficiently aware wherein lay the difficulty, for he remarks further on in the same sagacious letter,<sup>1</sup>—“To the solicitude I have expressed to introduce this practice into the army and navy, it has been objected, that the accommodation in these situations are not always such as to admit of such attempts; and that the hurry of an action may often oblige a surgeon to have recourse to the most expeditious method of saving his patient. These objections I admit to a certain degree. I allow that the excision of the knee may be wholly inadmissible in ships, as the necessary state of quietude can hardly be obtained there for a sufficient length of time to accomplish a cure; and, perhaps, similar difficulties may occur in military hospitals belonging to an army in action.”<sup>2</sup>

<sup>1</sup> Subsequent observations by Mr Park, appended to the former work, in Jeffrey on Excision of Joints, pp. 60, 61, 63, 64.

<sup>2</sup> “The following example we believe to be the only successful case of excision of the knee-joint made for gunshot injuries ever yet placed upon record. The operation was made by R. B. Bontecue, surgeon, U.S.N.; and for this brief history we are indebted to Dr J. W. Lyon, House-Surgeon to the Bellevue Hospital, who is engaged in preparing an elaborate paper on Exsections.—A man, aged 20, was wounded in the right knee, 22d October 1862. The ball passed through a portion of the external condyle of the femur and lodged in the popliteal space. On the second day after the injury, Dr Bontecue removed one and a-half inch of the lower end of the femur with a saw, and with a pair of bone-forceps cut away the exposed surface of the tibia until the bone was exposed. The patella was dissected out. A portion of the wound healed by the first intention; on the twenty-eighth day the wound had entirely closed; and at the end of little more than two months from the date of the operation

2. *I have next to consider the special advantage which this method of treatment affords for the application of dressings to the site of operation.*

the patient was discharged. There was then 'no pain or tenderness about the joint.'—Hamilton's Military Surgery, p. 514.

*Table of Cases of Excision of Knee practised on Account of Gunshot Injury of the Articulation.*

|                                                        |          | Deaths. | Recoveries. |                                       |
|--------------------------------------------------------|----------|---------|-------------|---------------------------------------|
| <sup>1</sup> Textor, senior, . . . .                   | 1847     | . 1     | . ...       |                                       |
| <sup>2</sup> Fahle—Schleswig-Holstein, . . . .         | 1851     | . 1     | . ...       |                                       |
| <sup>3</sup> Lakin—Crimea, . . . .                     | 1855     | . 1     | . ...       |                                       |
| <sup>4</sup> Brown—Alumbaugh, . . . .                  | 1857     | . 1     | . ...       |                                       |
| <sup>5</sup> London Hospital—Hutchinson, small shot, } | 1861     | . 1     | . ...       |                                       |
| <sup>6</sup> Birmingham case, . . . .                  | 1861     | . ...   | . 1         |                                       |
| <sup>7</sup> Verneuil's, . . . .                       | 1863     | . ...   | . 1         |                                       |
| <sup>8</sup> Bontecue, . . . .                         | 1862     | . ...   | . 1         | { "Trough stuffed with hay."          |
| <sup>8</sup> Heller, . . . .                           | 1863     | . 1     | . ...       |                                       |
| <sup>8</sup> Hinkle, . . . .                           | 1863     | . 1     | . ...       |                                       |
| <sup>8</sup> Bently, . . . .                           | 1863     | . 1     | . ...       |                                       |
| <sup>8</sup> Bently, . . . .                           | 1863     | . 1     | . ...       |                                       |
| <sup>8</sup> Homans, . . . .                           | 1864     | . 1     | . ...       | Fracture box.                         |
| <sup>8</sup> Unknown, . . . .                          | 1864     | . 1     | . ...       | Fracture box.                         |
| <sup>8</sup> Bontecue, . . . .                         | 1864     | . 1     | . ...       | { Bandage of Scultetus and bran bags. |
| <sup>8</sup> Rush, . . . .                             | 1865     | . 1     | . ...       |                                       |
| <sup>8</sup> Fairfax Seminary Hospital case, . . . }   | 1862     | . 1     | . ...       |                                       |
| <sup>8</sup> Thorne, . . . .                           | 1863     | . ...   | . 1         |                                       |
|                                                        | 18 cases | 14      | 4           |                                       |

<sup>1</sup> Fuchs' Dissertation, 1854; and O. Heyfelder's *Traité des Résections*, par E. Boeckel. Paris, 1863, p. 106.

<sup>2</sup> Friedrich Esmarch, *Die Resectionen nach Schusswunden*. Kiel, 1851. Stathams Esmarch, p. 113.

<sup>3</sup> Medical and Surgical History of the British Army during the War against Russia, vol. ii. pp. 352 and 379.—Macleod, *Notes on the Surgery of the War in the Crimea*, p. 349.

<sup>4</sup> Brown, *Edinburgh Medical and Surgical Journal*, October 1860.

<sup>5</sup> *The Lancet*, April 20, 1861.

<sup>6</sup> *Medical Times and Gazette*, May 1861.

<sup>7</sup> *Gazette Hebdomadaire*, November 1862; *Soc. de Chirurg. de Paris*, Séance du 10 Juin 1863.—Ligoues, *Traité de Chirurg. d'Armée*, p. 750.

<sup>8</sup> Reports on the Extent and Nature of the Materials available for the Preparation of a Medical and Surgical History of the Rebellion. Circular No. 6, War Department, Surgeon-General's Office, Washington, November 1, 1865, pp. 58, 59, 60.

This is no matter of secondary importance either to patient or surgeon. Pain, which can scarcely fail to be excited by the removal of any portion of the apparatus essential to the quiescence of the limb, is thus prevented, while the complete exposure of the line of incision throughout its entire extent admits of a thorough drainage being effected so far as discharge of any kind is concerned, and while the free circulation of air around the area of the operation keeps the parts cooler and more comfortable than they can be when shut in by splints or a box and cushions. In operating, I have hitherto always adopted the semilunar incision, by which the soft parts over the knee, including the patella, are raised in one flap.<sup>1</sup> I have deviated from this plan only in one case of compound fracture of the patella, where the double elliptical incision, originally recommended by Mr Syme,<sup>2</sup> was adopted as a means of including the bruised and lacerated integument together with the patella, and corresponding to the site of injury. In the semilunar incision the perpendicular length of the flap raised from the front of the knee is about five inches, and the open space left between the bandages upon the leg and thigh amounts to fully six inches. In this space, the whole extent of the line of incision is exposed, and the extreme angles, which correspond to the level of the upper end of the distal epiphysis of the femur, are both the most dependent part of the whole wound, and are at the same time free from all confining dressings. I have accordingly found little trouble with bagging of matter within the excision wound, little occasion for making counter-openings to allow of the escape of pus, and since I employed the paraffine as a varnish to the padding of the splint and to the gypsum, no annoyance from

<sup>1</sup> This long anterior flap incision, originally recommended by the late Dr Richard Mackenzie, and employed by him in three out of the four cases on which he operated, is a modification of the incision proposed by Mr Park in his brochure on this subject, where, in the postscript of his letter to Mr Pott, he says, "*Query*, May not the end be in some cases obtained by means of a single incision, made transversely half round the joint, so as to divide the lateral ligaments?"—P. 45.

<sup>2</sup> Syme on Excision of Diseased Joints, p. 133.

either soiling with discharge, or in warm summer weather the formation of maggots beneath the margins of the gypsum bandage. The discharge as a rule has not proved copious; and in some cases I have scarcely ever applied the smallest portion of any dressing to the line of incision throughout the whole progress of the case. In one example, in fact, I employed no dressing whatever, permitting the serosity which escaped immediately after the operation to form an incrustation which remained untouched until it fell away spontaneously.<sup>1</sup>

I conceive that the best dressing which can possibly be applied is well-carded tow, which has the power of absorbing whatever discharge flows from the wound without plugging up the orifice of escape, which constitutes a serious objection to the employment of either cotton, lint, or charpie.<sup>2</sup> It is very rarely necessary to remove the metallic sutures which have been introduced immediately after the operation till the union of the soft parts is complete. These, if not too numerous, and if no great tension occurs from oozing, inflammatory action, or the advent of phagedænis,

<sup>1</sup> Edinburgh Medical Journal, July 1865.

<sup>2</sup> I am glad to find this view of the usefulness of tow as a material for dressing, long since recognised in the Edinburgh Infirmary, confirmed by the experience of Mr Redfern Davies in the late American campaign. "One of the objects in applying lint to a suppurating wound is that it may absorb the discharges. Lint is composed of cotton. If a bale of cotton is immersed in a river for a month, the cotton in the centre of the bale will be found to be upon examination perfectly dry. If the same quantity of picked oakum be similarly treated, it will be found in a few hours to be completely saturated. So, when a pad of lint over a suppurating wound is removed, after having been upon it for many hours, it will be found to be—save at its points of immediate contact—quite dry, and the pus beneath will gush out. Thus the pad of lint acts as a tampon, preventing the free escape of pus, which necessarily burrows in different directions, giving rise to extensive and dangerous abscesses. Now, when *picked oakum* is placed over such a wound, upon its removal the wound will be found dry and clean, the oakum saturated with pus. The picked oakum acts like a syphon, discharging the pus as it is secreted by capillary attraction, and, partly from its fibres being tarred, is a very excellent antiseptic, and removes all unpleasant odour."—*Lancet*, June 6, 1863.

will usually be found to retain their position, maintaining satisfactory apposition of the edges of the wound, without exciting any irritation. It is usually well to leave the dependent angles of the wound for fully an inch without any sutures, that a free drain for blood and fibrinous serosity may be afforded in the early period of the case, when the confinement of either in a decomposing state would determine more extensive after-suppuration than would otherwise in all probability have occurred. Immediately after the operation, however, after securing the actually bleeding vessels, and applying the immovable gypsum apparatus, without introducing any sutures, I am in the habit of applying a common roller bandage firmly around the knee, so as to afford a temporary support to the flap, and thus prevent as far as possible the distention of the cavity with blood clot. To do this satisfactorily, openings in the bandage must be left or made at two points corresponding to the angles of the incision. Were this not attended to, the bandage, while by its pressure it restrained the oozing in some measure, would only the more certainly confine the blood which oozed out after the closure of the wound. This bandage is, however, merely a temporary one, to be removed in about six or eight hours after the operation, when the sutures should be introduced.<sup>1</sup> Should acupressure have been employed in the operation, the needles may safely be withdrawn at the same time.

3. *The Permanence of the Apparatus.*—As a rule, I never have required to shift the apparatus, from the moment of its first application, till it is finally removed,—consolidation of both soft and hard parts having advanced so far as to render this safe. In my earlier cases, I have done so if the discharge undergoing decomposition has rendered the splint or margins of the gypsum bandage in any degree offensive. Latterly, the paraffine, as a waterproof varnish

<sup>1</sup> I am strongly impressed with the advantage to be obtained by employing carbolate of glycerine or carbolic acid diluted with twelve volumes of olive oil, as a disinfectant solution with which to sponge out the wound and in which to soak the tow employed as a dressing from the commencement to the termination of the case.

for both splint and gypsum bandage, has rendered even this unnecessary.

In this respect, the apparatus contrasts strongly with the other measures recommended for effecting retention during the after-treatment, and tends, therefore, to render the progress of the case a much more agreeable one, both for the patient and his surgeon.

I can quite conceive that the permanence of the apparatus may, in certain circumstances, form a theoretical objection to its employment. One is so ready to think that a permanent apparatus which does not yield, which covers up the greater part of the limb concealing it from observation, must be liable to impede the circulation of the extremity, to cause constriction or undue pressure at some part, to interfere with swelling, in fact, to preclude that constant and close attention to every part of the limb during the after-treatment which, by some, is considered an essential of any good apparatus. To those who have familiarized themselves with the employment of the starch, dextrin, gypsum, or paraffine apparatus, in the treatment of fractures, and especially of compound fractures, this objection is not likely to have much weight; and, when we recollect how safely the patient's sensations of ease, or the contrary, may be taken as a true exponent of the progress of matters within the hard case, the objection to the use of such an apparatus in the treatment of excision of the knee will at once be removed. Should we wish to remove the apparatus, either partially or completely, at any period of the after-treatment, this is easily effected by shears for the purpose. The powerful curved instruments, with short blades, of unequal length, made by Lutter, of Berlin, seem to me preferable to those (*Suetin's scissors*) commonly supplied by instrument makers in this country, which, by the length of blade, in proportion to the handles, lose power and accuracy in their application.

4. *The Ease with which the Apparatus can be obtained, its Simplicity, and Cheapness.*—An iron rod, easily procured from any smith, a long Gooch splint, fashioned for the purpose by the carpenter, or made of two common Gooch splints, of a size suited for the thigh or leg, stitched together, and then cut to suit the limb in length and contour,

two *open-wove* bandages, a pound of gypsum, and a couple of ounces of paraffine, are all the requirements. A few points, even in regard to such simple matters, may as well be mentioned. The measurements for the iron rod should be made by the surgeon himself, and in making them, he should commence from below upwards, measuring in detail with a piece of common tape. The measurement from the tip of the toes, to the flexure of the ankle, should first be made for the foot piece; then, from there, to an inch below the tuberosity of the tibia, for the leg piece; then, five or six inches should be allowed for the diameter of the portion of a circle which arches over the knee; and, last of all, the measurement for the length of the thigh portion should be made from two inches above the patella, to the fold of the groin. This allows for the ordinary amount of bone removed in the excision, which usually varies from one and a half to two inches. If these measurements are not carefully taken, the surgeon may find to his annoyance a rod quite unsuited to the limb presented to him for application after the completion of the operation, which will necessarily delay the final adjustment till a properly constructed rod has been procured.

The Gooch splint should not be made too broad, nor of too *thin* wood. The amount and extent of the cutting out on each side of the splint is of less moment. If not sufficient, it can easily be rectified by means of a pocket-knife at the time of the operation. The opening below for the heel and tendo Achillis should, however, be seen to, that it may be at least three-quarters of an inch wider than the transverse width of the tuberosity of the os calcis. If it is not so, it is apt to press unpleasantly, even when well padded, against the malleoli. Should this have been overlooked, and occasion annoyance after the apparatus has been applied, the pressure can easily be relieved at any time by inserting a portion of wood beneath the heel, between the two lateral extremities of the splint, where they project beyond the sole of the foot. This piece of wood, to be of use, must be longer than the greatest breadth of the malleoli.

It has been oftener than once suggested to me that, with the

gypsum bandage, the Gooch splint, or, in fact, any posterior splint, is an uncalled-for addition and complication of the apparatus. I think this is a mistake, for, after the operation, when the parts are very movable and easy of displacement, even when the patient is fully chloroformed, it affords a great additional security that the apposition of the cut osseous surfaces shall be maintained till the gypsum has consolidated, that we can adjust the limb upon a splint. Thus it is rendered more firm than it could possibly be with the rod alone, not only during the application of the bandages, and the application and setting of the cream of gypsum, but throughout the whole period the apparatus is retained. Furthermore, the splint behind serves to diffuse the pressure of the bandage, and to prevent its girding the limb, and interfering with its circulation. The open wove bandages are preferable to the common cotton or linen bandages, because their open structure fits them better for readily absorbing the gypsum, and forming along with it a tough and hard case, softly padded on its inner surface.

The gypsum may sometimes constitute a difficulty in employing this apparatus. When the plaster-of-Paris is of fresh quality, recently burnt, or, at least, if old, secured from air and moisture since it was first burned and ground in an air-tight case, no difficulty should be experienced. Mistakes may be made by one unused to its application, in mingling it with water; and the usual mistake is rather on the side of making the cream too thick than too thin. The plaster powder can usually be best mingled by being sprinkled into the water from the one hand, while the plaster and water are stirred together with the other. This should be effected in a common wash-hand basin. If experienced in the use of the gypsum, or if possessed of an abundant supply, the whole quantity likely to be required may be prepared at once, just before it is to be applied. If, however, the operator is inexperienced or inexpert in its employment, he may have it made in two or more smaller quantities, so as to secure himself against the plaster hardening too quickly for his rate of application.

I have been asked if this method of treatment is original? I

believe it is. So far as I know, the only anterior suspension splint which has been employed or recommended is that of Dr Nathan Smith, of Baltimore,<sup>1</sup> and that only in the treatment of fractures. The nature of that splint, and its essential difference from the splint and apparatus I have just described, will be at once perceived from the following extract from Professor Gross's work on surgery : <sup>2</sup>—

“ Professor N. R. Smith has for a long time treated fractures of the thigh with great ease and success with what he calls the *anterior splint*. It consists of a single piece, made of wire, of the size of a No. 10 bougie, and bent at each extremity—the whole representing the form of a long parallelogram, 3 inches wide above, and  $2\frac{3}{4}$  inches below. It must be long enough to reach from a point a little above the anterior spinous process of the ilium, to an inch beyond the toes, when the thigh, leg, and foot are extended, 3 feet 8 inches being a good average length for adults. The side pieces are firmly connected by cross pieces, at a distance of about 8 inches. Thus constructed, the wire frame is easily bent to suit the case in hand. The angle at the tibio-tarsal joint, 6 inches from the extremity, is about  $120^{\circ}$ , to secure an easy posture for the foot ; that at the knee, and the one at the hip are each about  $160^{\circ}$ ,—the latter being 7 inches from the upper extremity. The splint, properly padded, or lightly wrapped with a muslin bandage, and secured to the limb by a roller extended from the toes upwards, is suspended, by means of a pulley, cord, and loops, to the ceiling,—a compress being placed upon the instep, and another upon the groin, to ward off pressure. The proper position of the hooks is a matter of great consequence. In general, the upper one should be attached nearly over the seat of the fracture, and the lower a little above the middle of the leg,—the object being thoroughly to equalize the pressure of the splint. The roller confining the apparatus should

<sup>1</sup> See Treatment of Compound Fractures of the Thigh from Gunshot Wounds. By Redfern Davies. Lancet, 6th June 1863.

<sup>2</sup> A System of Surgery. By Samuel D. Gross, M.D., Philadelphia. 1862. Pp. 1033-34.

be well stitched, to prevent it from slipping, and great care taken that it do not make undue constriction. This apparatus, the efficacy of which has been thoroughly tested in numerous cases, is exceedingly light and comfortable, and is equally well adapted to fractures of the thigh and leg, in every portion of their extent."

This apparatus of Dr Smith would, I have no doubt, be perfectly capable of adaptation to cases of excision of the knee, just as it is for cases of compound or gunshot fractures of the thigh or leg, or for cases of excision of the head of the femur; but the advantage over the single rod apparatus would, I think, be more than doubtful. Its double line of wire on the outer and inner side of the anterior aspect of the limb would, I should fear, give rise to a considerable interference with the line of incision, while the want of the posterior splint and the adherent gypsum bandage, which forms an essential part of the apparatus I now recommend, would detract considerably from the firmness and immobility of the leg and thigh during the process of gradual healing and consolidation.

## CHAPTER II.

## ILLUSTRATIVE CASES.

THE ensuing cases will serve, I trust, to exhibit the effects of this method of treatment. They, at the same time, illustrate the nature of the cases in which the operation has been resorted to, and the progress made under very various forms of disease, conditions of constitution, age, and of external circumstances. I have thought it well to enter into particulars and details, as I believe such minutiae confer an additional value to the narration, and afford data for those who have not seen the cases, nor employed this operation or mode of after-treatment, for arriving at their own conclusions as to its expediency.

CASE I.—W. F., aged 24. A farm-servant from Ayrshire. Admitted to Chalmers' Hospital on the 24th May 1864, under Dr Watson's care.

This lad has suffered for four years from a chronic affection of the left knee-joint, consequent upon an injury received in the stable. From the account given by the patient, the joint appears to have been violently wrenched, then to have inflamed, and to have been greatly swollen. After a brief period of quiescence, which had permitted the first effects of the accident to subside, he had once and again attempted work, and as frequently been laid aside. This alternation of repose and work continued for some months, till he was obliged to give up his place, and, from want of means and friends, he had no resource but to become an inmate of the poorhouse. While there, after severe and long-continued suffering, an abscess

formed in connexion with the joint, and discharged itself by lateral and posterior openings. This occurred about a year since.

On admission; *generally*, the patient is extremely feeble and anæmic. His appetite is voracious. He has lately suffered from diarrhoea, and is subject to copious night-sweats. He cannot sleep without opiates. *Locally*, the knee is bent at nearly a right angle. There are several openings from which purulent matter is copiously discharged, especially from a large aperture on the outer side. A probe introduced at this sinus comes in contact with the posterior surface of the condyles of the femur in a carious condition. The slightest effort to move the limb occasions excruciating pain.

After a few days' repose to recover from the exhausting effects of his journey, excision of the knee-joint was performed by the long semilunar flap operation. After laying bare the condyles of the femur, the patella was detached from between the condyles of the femur, by means of the bone-pliers, the flap of soft parts, including the patella, now turned upwards, was released from its attachments to the soft parts by a few sweeps of the knife. The articulating surface of the femur and tibia were then found partially ankylosed, and all traces of the crucial ligaments gone. The leg was accordingly forcibly flexed upon the thigh till the heel was brought in contact with the buttock. The extremity of the femur thus exposed, projected from the wound, and was seen to be riddled with worm-eaten cavities. The whole extent of disease, limited by a line passing through the spongy texture of the bone, just above the inner condyloid pit, was removed by a few strokes of a saw, provided with movable back. Space was now obtained to clear the posterior aspect of the head of the tibia, the knife being carried close to the bone, so as to avoid the popliteal artery. A thin slice of the head of the tibia was removed by the saw, applied from behind. The entire extent of bone removed was close upon an inch and a half, but rather less. The rough torn surface of the patella was smoothed by means of the gouge. Five vessels were secured. The limb was temporarily placed upon a common gouch splint, well padded, and secured in its place by roller bandages. The patient

was carried to his bed, which had been meanwhile carefully arranged with a water-pillow and draw-sheet. To maintain repose two thick round sand-bags were placed on either side of the limb, which was kept in a state of rigid repose by broad pieces of flannel bandage. These were placed over the thigh and leg on four different levels, so that when carried beneath and around the sand-bags, and pinned in front, the weight of the bags secured the immobility of the limb. A large opiate was administered, so soon as the patient had sufficiently emerged from the chloroform as to be able to swallow. During the ensuing week he suffered severely from sickness and entire loss of appetite, only partially relieved by ice and bismuth. The retching and restlessness consequent on this unfortunate state of stomach, produced so much disquietude of

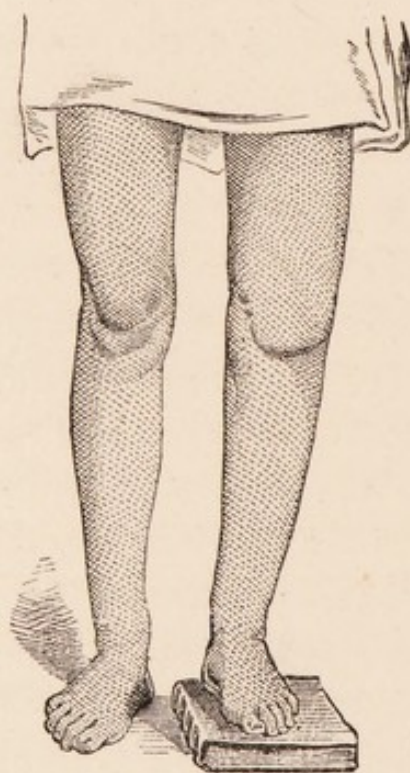


FIG. 5.—CASE 1.

the limb, and such a tendency to displacement of the osseous surfaces that the sand-bags were removed, lateral splints adjusted, and the limb and apparatus laid in the Salter's swinging-cradle. This afforded very great relief, permitting any degree of movement which was wanted, but was found inconvenient, from the necessity of

taking off the side supports each time the dressings were changed. To obviate this, the movable gypsum apparatus, already fully described, was applied.

*8th June.*—The sutures were removed, the entire surface wound having soundly healed. The only openings which remained being those of the old sinus.

The sickness has completely gone. His appetite is re-established—he is free from pain, and is usually sitting up all day long, with the sound limb hanging over the side of the bed. In the middle of July, after all discharge had ceased, except a drop or two in twenty-four hours, he was attacked with rigors, followed by some degree of swelling about the joint, and an increased amount of discharge from the sinus, which had nearly closed. This exacerbation was attributed to his catching cold, as he spent most of his time smoking in the lavatory of his ward. The abscess which resulted required careful management, numerous counter-openings having to be made. This unfortunate intercurrent inflammatory attack, although delaying the ultimate cure, did not in the least interfere with the satisfactory progress of the consolidation of the osseous surfaces, which in August was so complete as to enable him to move about without the employment of any support to the limb.

He was retained in hospital, however, till the 25th of January, till, in fact, he was fit for work, the sinus having entirely healed, and the limb having so regained its strength and muscular energy as to enable him to walk about with ease, without further auxiliary aid than a cork heel in the inside of his boot, corresponding in thickness to the amount of bone removed in the operation, and amounting to nearly an inch.

CASE II.—A. M., æt. 30, a servant, was admitted into Chalmers' Hospital on 3d February 1865.

Patient states that more than a year ago she sustained a severe bruise of the right knee-joint, in consequence of a fall upon the stair in carrying coals. This occasioned considerable pain and swelling at the time, but with repose, and some degree of relaxation of work,

she continued in her place till the ensuing term. The pain has, however, never altogether subsided, and she walked very lame all that time. She states that the pain has always been increased by exercise, change of weather, or alternations of temperature, and that she has frequently been obliged to spend whole nights sitting up in bed through sheer pain. After leaving her place, finding herself incapable of work of any kind, and being destitute of means or friends, she was obliged to seek parochial relief. She was then admitted to the workhouse, and was transferred to the sick ward of the establishment. There she had remained ever since, with the exception of two occasions, when she had been placed under surgical care elsewhere; but as the only relief then suggested consisted in amputation, she refused to submit, and returned to the parish infirmary.

When admitted to Chalmers' Hospital, she was weak and bloodless, much emaciated, though cheerful and full of hope. Her appetite was good, but her sleep at night was broken in consequence of the pain in the knee. The whole limb was much shrunk, the knee was flexed at nearly a right angle, and firmly ankylosed in that position. The slightest pressure over the head of the tibia, or inner condyle of the femur, gave rise to very great pain.

She was quite ready to submit to any treatment except the removal of the limb.

As her condition was as favourable as it was likely to be at any future period for the operation, and as her sleepless nights demanded some speedy relief to suffering, the knee-joint was excised upon the 8th of February. The operation was practised in the method usually employed by Dr Watson. That is to say—having been fully put under the influence of chloroform, the patient was placed upon the operating table, and the sound limb being confined by means of a towel to the leg of the table, the tourniquet was applied. An incision was then made, commencing above and a little behind the external condyle of the femur, and, with one curvilinear sweep brought down towards the tuberosity of the tibia, then onwards and again upwards, when it terminated at a point exactly opposite to its

commencement, and on a level posterior to the inner condyle. This flap having been dissected up as far as the lower margin of the patella, that bone was detached by the bone-pliers from its ankylosis with the condyles of the femur. The adhesions between the posterior part of the articular surface of the femur and head of the tibia were now broken up by an assistant forcibly flexing the leg upon the thigh till the heel touched the buttock. The condyles of the femur now projected from the wound, and were sawn off. The posterior margin of the head of the tibia being cleared for the saw, had a thin slice removed from behind forwards. The bleeding was very copious, but readily arrested by ten needles. No sutures or dressing of any kind applied to the edge of the wound. The limb was immediately adjusted upon the posterior splint, and the iron rod applied with gypsum bandage.



FIG. 6.—CASE 2.

In the evening, as all oozing had ceased, the requisite wire sutures were introduced. The needles were not withdrawn till the next day at the hour of visit.

*13th February.*—Patient keeps well, perfectly free of pain, and which she somewhat hyperbolically expresses, by saying she is in

heaven. A little serosity escaping from the inner angle of the incision, amounting to about an ounce in the twenty-four hours.

16th.—There is still about a tablespoonful in the day. This fluid has daily been examined by the microscope by my most attentive and painstaking resident surgeon, Dr Coull Mackenzie, and no trace of pus can be detected in it. No dressing. 18th.—The quantity of fluid oozing from the wound is much diminished, and to-day (eleventh from the operation) is found to contain a few pus corpuscles.

20th.—Fluid still scanty. Contains microscopic traces of pus.

22d.—Discharge has entirely ceased.

28th.—Patient well. No discharge since the 21st instant.

10th March.—There is neither pain nor redness about the knee; the soft parts feel firm, and pressure occasions no uneasiness. The patella is firmly fixed to the bone beneath.

31st March.—The last of the crusts which had formed along the line of incision fell off to-day, leaving the whole line of the incision soundly healed.

10th April.—To-day the whole apparatus was removed; the ankylosis was found perfect. The apparatus has never been touched since its original application to the limb, sixty-one days ago.

The shortening of the limb is less than one inch. This is determined by the thickness of the book required beneath the heel to set her straight upon her limbs. This patient has again returned to service, and I lately saw her walking along the street at a pace of more than three miles an hour.

CASE III.—M. M'D., æt 30. Admitted to the Royal Infirmary on the 28th of June 1866, on account of acute disease of the left knee-joint.

This patient states that for some time past she has suffered severely from pain in the knee, from which she has obtained relief only by the administration of large opiates. She is in a state of great nervous excitement, due partly to pain and feverishness, but

also in part to taking morphia, and perhaps to other habits of intemperance. The knee-joint has become greatly swollen within the last few days, previously throughout the whole progress of the case there has been very little swelling. When I saw the knee for the first time, upon the 29th of June, I found the patient sitting up in bed clasping the thigh firmly between her hands to prevent the muscular twitchings, which are constant. The slightest effort to move the knee causes frightful pain, and gives rise to a sensation of rough grating of two exposed bony surfaces. The patient was put on antimony and morphia, and the operation of excision arranged for the following day.

*30th June.*—Excision of the joint performed in the ordinary manner. In turning up the flap of soft parts to expose the bones, a quantity of turbid serum, containing flocculi of purulent lymph, and portions of cartilage, escaped. A large mass of fawn-coloured lymph was contained in the upper part of the articulation. The crucial ligaments were gone, and both osseous surfaces completely exposed and spicular. The extent of bone removed from the femur and tibia did not exceed an inch. Bleeding stopped by five needles. Dr Watson's immovable apparatus applied, and the patient removed to bed. A large opiate given as soon as she could swallow.

In the evening the edges of the incision were approximated by wire sutures. Brandy and ice ordered to check the incessant vomiting, which had induced great depression of the circulation.

*1st July.*—Patient passed a tolerable night, and had some sleep, in spite of the vomiting, which, when awake, is nearly constant. Pulse 120.

*10th July.*—The vomiting continued with little abatement for three days, the pulse ranging from 100 to 120. Nothing staid upon the stomach, and her restlessness and exhaustion were so extreme that death was apparently imminent. The vomiting resisted the employment of all remedies, but has now gradually subsided since yesterday, when a blister was applied to the epigastrium, and morphia administered, in the form of quarter grain pills, repeated so frequently as to maintain a narcotic effect. The gradual

subsidence of the swelling of the limb, withdrawing it from close contact with the apparatus, together with the constant restlessness, has produced some degree of displacement of the thigh bone. The whole apparatus was accordingly removed and re-applied.

20th.—There is still great gastric irritability, which is kept in check by repeated doses of the effervescing citrate of potash and hydrocyanic acid. The knee is, however, progressing rapidly—there being very little discharge in the course of the twenty-four hours. All that there is escapes by the dependent angles of the wound, while the line of incision in front is perfectly and soundly healed.



FIG. 7.—CASE 3.

8th August.—Wound all but healed. Patient is now out of bed throughout the whole day.

1st September.—Apparatus removed. Wound completely healed. When moving about the ward, to have lateral leather splints applied, and secured with straps. From this period she commenced the use of crutches; and although retained in the hospital till the 25th November, because she had no home to which to go, she might have been dismissed in September, as she was perfectly well, and the

limb healed and consolidated. The shortening amounts to a little over an inch.

CASE IV.—C. M., æt. 21. Admitted to Dr Watson's ward in the Royal Infirmary, on account of disease of the left knee-joint, 1st August 1865.

She states that she has suffered from disease of this joint for more than two years. The disease commenced in the soft textures, accompanied with swelling and stiffness of the articulation. These symptoms increased, and pain became superadded. Latterly the pain has been very great, attended with loss of rest, and starting of the limb. The joint is partially flexed, and the ham-string tendons rigid. The slightest attempt to move the joint, or any pressure over the condyles of the femur, gives rise to great agony. She had twice previously been in hospital, when, by repose, the employment of Scott's dressing to the joint, and constitutional treatment, every effort had been made to check the progress of the disease.



FIG. 8.—CASE 4.

She is now, so far as her general health is concerned, losing ground daily, in consequence of irritation, loss of rest, and impairment of the appetite. She is extremely anxious that something should be done to

relieve her from the disease, and so restore her as to enable her to follow her occupation as a dressmaker.

Excision of the joint was proposed, to which she gladly assented.

8th August.—The joint was to-day excised in the manner usually adopted by Dr Watson, by means of a long anterior flap retaining the patella. Fully an inch and three-quarters of bone was removed. These vessels were secured by acupressure. The apparatus applied, and the patient removed to bed. In the evening, as there was no oozing, the acupressure needles were withdrawn, and the flap secured *in situ* by several points of interrupted wire suture. For the next twelve days, as there was some slight redness of the skin, simple cold water dressing was applied. The patient was quiet, and comfortable, free of fever, and able to take nourishment of a light kind freely.

20th.—The entire line of incision has healed, except at the ultimate *cornua*, from which some purulent discharge still escapes.

6th September.—Lateral apertures reduced to mere points, from which not more than a speck of discharge escapes in the course of twenty-four hours. Dry dressing.

18th.—Wound entirely healed. Apparatus removed. Lateral leather splints applied. The patient desired to move about with crutches.

25th October.—Can walk with little or no inconvenience without the assistance of crutches, a thick pad being placed beneath the heel.

5th January.—Supplied with a boot, the cork heel inside measuring perpendicularly one inch and a half.

CASE V.—G. M., æt. 18, a clerk. Admitted to Chalmers' Hospital, 19th September 1865.

In early life he states that he had suffered from disease of his right knee-joint. He had recovered from this after protracted suppuration. The joint was, however, ever since, more or less tender, and as it was bent to nearly a right angle, he was unable to move about without the assistance of a crutch. As this state of matters forms a serious obstacle to his occupation, preventing his

promotion in the government office with which he is connected, he is anxious to have anything done which will secure a useful and a straight limb.

His general health is good, his complexion florid, his appetite excellent, and in the meantime he has no pain, and sleeps soundly.

The articulation on examination was found to be firmly ankylosed, the patella fixed to the femur, and the hamstring tendons rigidly contracted. There was some degree of increased temperature of the soft parts around the joint, and pressure over the osseous prominences, or jerking of the limb, gave rise to great pain. In these circumstances excision was determined upon as preferable to forcible rupture and extension of the ankylosed limb.

*28th September.*—To-day, Dr Watson excised the articulation in the ordinary way. The soft parts were found greatly condensed, and adherent to the hard tissues. The cartilage of incrustation entirely gone, and the ankylosis so firm that it required to be partially sawn through before the condyles of the femur could be exposed, by forcibly bending the limb for the application of the saw. The extent of bone removed did not exceed an inch and a quarter; the amount of the head of the tibia to be taken away was determined after the condyles of the femur were removed by the tension experienced on attempting to straighten the limb. The bleeding chiefly came from the surface and margins of the flap; the vessels were secured by acupressure. The limb was arranged in the ordinary manner, with splint and rod; the gypsum bandage was immediately applied, and the patient conveyed to bed.

In the evening, as a good deal of oozing had been going on all afternoon, the flap was raised, a large coagulum removed, and the surfaces left exposed for an hour or two. At the end of this time, as all bleeding had ceased, the acupressure needles were withdrawn, and the interrupted metallic sutures introduced.

*29th.*—He has been very sick all night, and is quite unfit to take any food. To have ice and soda-water.

30th.—Had a slight rigor, which speedily passed off. The sickness has quite gone, and his tongue is clean and moist. To have five grains of quinine twice a-day.

15th October.—He has progressed rapidly since last report. The sutures were removed to-day, the wound having entirely healed, except at the angles, from which a very scanty discharge, scarcely sufficient to stain the dressings, escapes in the course of twenty-four hours.

30th October.—The plaster of Paris apparatus removed, and lateral splints substituted. To move about with crutches, as union is tolerably firm.

20th December.—He has been perfectly well for more than a month, walking about with the aid of a stick and one crutch, but



FIGS. 9. and 10.—CASE 5.

always complaining of a sharp pricking pain at one spot, at the lower part of the semilunar flap. A few days since, he complained of feeling shivery and feverish; a reddish blush appeared over the front of the knee. This was relieved by a dose of purgative medicine and saline diaphoretics, but there is a small abscess

formed in the line of incision, over the head of the tibia. On opening this about a teaspoonful of pus escaped.

21st.—He says that on removing the dressing this morning he felt something hard in the opening. On examining this I found the twisted wire, which is attached to the eye-end of an acupuncture needle. On laying hold of it with a pair of dressing forceps, and exerting considerable force, I withdrew an acupuncture needle, which must have been interposed between the osseous surfaces since the day of the operation.

30th *January*.—The wound is soundly healed. He can walk with perfect ease, with a high heel in the inside of his boot. To-day he walked more than half a mile to the photographer, to have a portrait taken of his limb.

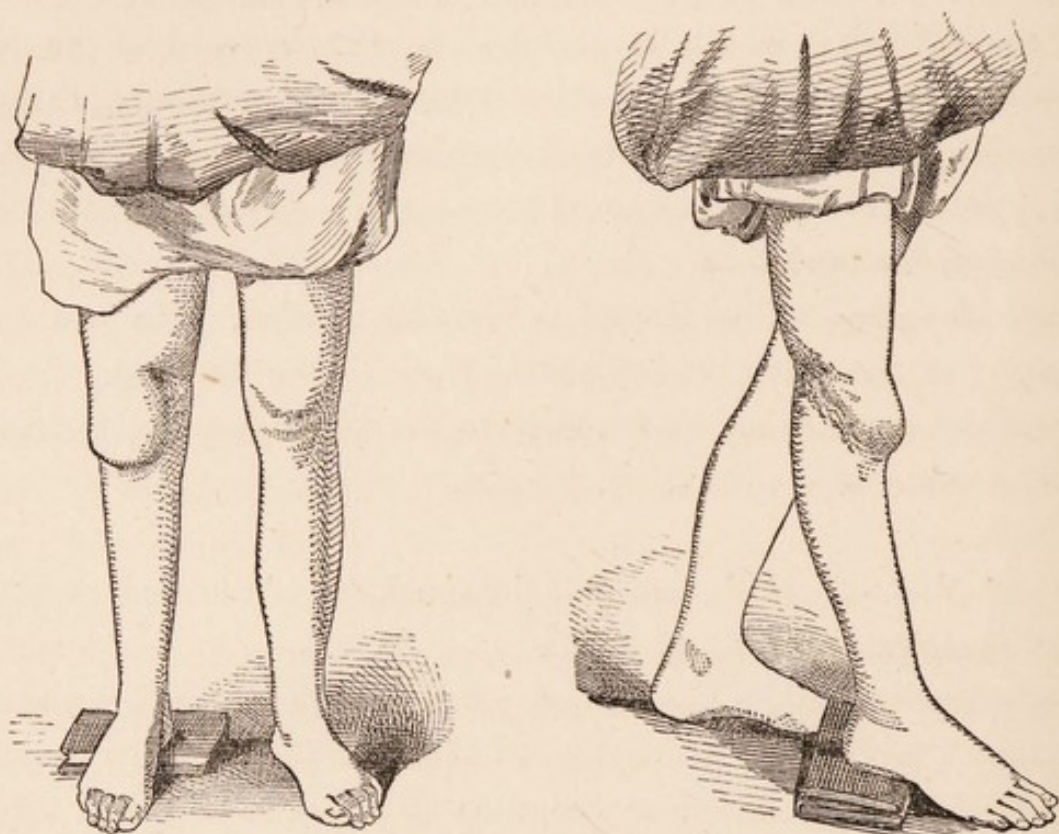
CASE VI.—F. M'P., æt. 26, dressmaker. Admitted to Chalmers' Hospital, 25th April 1866.

Patient states that about seven years ago she sustained a severe fall, which produced a dislocation of the knee-joint. This luxation was satisfactorily reduced at the time of the accident, and after a period of rest she was again able to move about. The joint has, however, since that time been stiff, and of late has become increasingly painful, and more and more contracted. About five months ago, abscesses formed around the knee, discharging themselves laterally and posteriorly by three openings. The whole limb is shrunken, and she is incapable of employing it for progression. There is a considerable degree of puffy swelling in the interval between the condyles of the femur and the head of the tibia. The temperature of the soft parts over the joint is increased, and pressure over the knee at any point, or an attempt to move the limb, however gently, gives rise to great pain. There are three openings, two on the outer side, one upon the inner side of the joint, from which matter is copiously discharged. Her general health has failed. She has lost flesh rapidly of late. She sweats at night, and her appetite is gone.

2d *May*.—The articulation was excised by Dr Watson in the

usual manner, the limb placed in the apparatus he employs, and the patient removed to bed.

During the ensuing six weeks all went on most satisfactorily,



FIGS. 11 and 12.—CASE 6.

and the wound, healing rapidly, had become reduced to two small apertures, from which scarcely enough discharge came in the interval between the dressing to make a mark on them; while, for a fortnight, the patient had been out of bed all the day long, sitting in a chair with the limb and apparatus supported on a bench.

*15th June.*—A patient lying in the adjoining bed has had an attack of sloughing phagedæna of the side and flank, following the removal of a fatty tumour from this part, from which she is only now convalescent. To-day, the knee-joint has assumed a swollen puffy appearance, the skin is glazed, and of a dusky red hue around the sinus upon both the outer and inner side of the joint, and a curdy offensive discharge issues from the opening. She complains of feeling cold. Her pulse is quick and feeble, her face flushed, her tongue coated, and she has no appetite. To have an emetic,

followed by an opiate, and to commence as soon as the sickness has abated the use of iron in effervescing draughts internally, while the pure Condyl's fluid is applied over the knee.

For the next fortnight the phagedænic ulceration spread, opening up the whole line of incision, which gaped widely, disclosing the osseous surfaces covered with a white pulpy substance. The ulceration next spread towards the outer side of the popliteal space, exposing the external hamstring tendons, and threatening the central part of the space. Chloride of zinc solution was applied by means of balls of cotton wool soaked in Sir William Burnet's solution. These were introduced into the gaping wound, and built up one on another till it was entirely occupied with them; a bandage was then applied, to keep the mass in its place.

That evening the patient passed a quiet night, sleeping soundly, and awaking refreshed and hungry for food.

*7th September.*—Since the separation of the slough caused by the caustic, the wound at once assumed a healthy aspect, and has cicatrized rapidly. The patient's strength is quite restored, the apparatus has been removed, union of the osseous surfaces is complete, and without the aid of crutches she can walk about the ward. Lateral gutta percha splints are still, however, applied to the limb when she moves about, as a precautionary measure. The shortening is very slight, and measures exactly one inch.

CASE VII.—H. N., æt. 22. Admitted to the Royal Infirmary on the 22d of December 1863, under Dr Watson's care, on account of gelatinous degeneration of the synovial membrane of the left knee-joint.

The disease had continued for several years in the chronic stage, attended with no pain, but characterized by gradually increasing swelling and stiffness of the articulation. Latterly she has suffered occasional attacks of pain, which has subsided under rest and counter-irritation. The knee is generally enlarged, of an ovoid shape, the thigh and leg being greatly wasted. She complains of pain on the slightest movement, upon pressure, and during the night from

spasmodic jerking of the muscles of the limb. Her pulse is excited, her tongue coated behind, and red at the tip. Appetite very capricious, and she is liable to attacks of diarrhoea. For some time she has suffered from nocturnal diaphoresis.

The limb was placed between lateral bent leather splints, moulded to the outline, and clothed with chamois leather, so as to maintain perfect repose. To have quinine and acid before meals, and morphia at bedtime.

*10th January.*—She has generally been much relieved since her admission; but the condition of the articulation has changed for the worse, in so far as the swelling is considerably increased by the effusion of fluid into the cavity of the joint. The limb was laid upon a wire cradle splint, and the knee covered with hot lead and opium fomenting cloths.

*1st February.*—Since last report some improvement manifested itself. The fluid became absorbed, in great part the pain subsided, and the general health began to improve, with coincident gain in flesh.

*28th February.*—Shortly after last report the joint again became more painful, and the swelling was reproduced. The pain has steadily increased. Now the slightest movement, even coming roughly against the bed, causes severe agony. The ligamentous apparatus is so relaxed that lateral movement, accompanied with a rough grating of the osseous surfaces, can be distinctly felt. A troublesome tickling cough has annoyed her for some nights, and the expectoration is streaked with blood. There are symptoms of softening tubercle in the left apex. The propriety of operative interference, which had previously been rejected by her, was again insisted upon. The operation of excision of the articulation was finally determined upon.

*4th March.*—To-day, resection of the knee-joint was performed in the usual manner. The patella was left, its roughened surface having been removed by the gouge. The extent of the articular surfaces removed amounted to rather less than an inch and a quarter. A large abscess, situated on the outer side of the limb be-

neath the vastus externus, was at the same time freely opened, both in communication with the excision wound, and also by a free and dependent counter-opening at its upper part through the skin. There were five vessels secured. Metallic sutures introduced. A gooch splint was applied behind the knee, extending from the tuberosity of the ischium to the heel, and secured in position by roller bandages, leaving the site of the operation free. After being removed to bed, the limb was kept in position by means of lateral sand-bags.

*Vespere.*—Constant vomiting; pulse 120. Ordered ice, brandy, and morphia.

*5th March.*—Sickness not so constant; some sleep; pulse 100; limb easy. To have essence of beef and brandy throughout the day in small quantities. Water dressing applied over the line of incision.

*12th.*—Patient has progressed favourably till to-day, when the sickness returned. The mouth and throat covered with aphthous spots. She has a sunken look, and quick feeble pulse 120–130. To have bismuth in scruple doses, with hydrocyanic acid. To be fed on milk and lime-water.

*13th, 14th, 15th.*—Sickness continues unabated. To have gr. v. of nitrate of silver in an ounce of distilled water, immediately. To have brandy in ærated lime-water, and essence of beef, as she can take them.

*16th.*—Sickness entirely checked. Aphthous patches on mouth and throat quite gone. The pulse has fallen to 100. Splint, which has become soiled with discharge, removed, and freshly re-applied. The wound looks healthy, though weak.

*18th.*—Diarrhœa has set in. Pulse 130; very feeble. To have hot fomentations over the bowels, lead and opium pills, and as much brandy and essence of beef as she can take.

*19th.*—Quite collapsed at the hour of visit, and is unable to take nourishment or medicine. Sank gradually, and died at 6 P.M.

CASE VIII.—Miss I. A., æt. 52. I was requested to see this lady on the evening of the 9th September 1864, having come to

town to place herself under my care, on account of an affection of the knee-joint.

She states that about eighteen months ago she sustained a fall, and twisted or bruised her knee, and from that time onwards she has suffered from pain, which has been more or less severe. She was at first treated with rest and hot fomentation, then with blistering, and splints with firm bandaging. During this time she was able to move about with crutches, but latterly the pain has been too severe to admit of this, having been almost completely deprived of her night's rest through excruciating agony. The limb is slightly bent and quite rigid, the thigh and leg completely atrophied, the knee apparently enlarged to a great extent, which was, however, considerably greater in appearance than reality; there is, however, some fluid around and beneath the patella. The patient is extremely exhausted, very thin and meagre, with a dry skin, and pulse constantly about 100. Suffering extremely from dyspepsia. To have a mild nutritious diet. Bismuth, with charcoal throughout the day; mindererus and morphia at bed-time. The limb to be confined in splints, and the recumbent posture to be maintained.

*3d October.*—The condition of the patient has greatly improved, so far as her constitutional condition is concerned. She sleeps well. The pulse has fallen to 76. Her appetite is fair, and the dyspepsia is relieved. The state of the knee is much the same.

*12th November.*—Has remained much as before till within the last ten days. She complains of a considerable increase of pain, and there are two swellings situated on either side of the knee, one over the outside of the head of the tibia, the other behind the head of the tibia, which manifestly contain purulent matter. In these circumstances it was determined to perform excision of the joint.

*16th November.*—Excised Miss A.'s knee in the usual way. No vessels required to be secured. Abscess behind the head of the tibia opened where it pointed. The usual apparatus applied, a portion of the splint being cut away behind in the inner side to allow of a free drainage from the abscess.

*Vespere.*—Free of pain; has slept well all afternoon; free from sickness, but complains of flatulence.

*24th December.*—The wound is now almost entirely healed; the two cornua alone remain open, but the quantity of discharge does not amount to a quarter of a teaspoonful in the forty-eight hours. There is no pain, and for the last ten days she has been able to be in the drawing-room, sitting on a couch all day, busied writing, reading, or working. The only complaint she has to make is, that the acidity of stomach and flatulence are very troublesome. She is, however, greatly relieved by bismuth and Belloc's charcoal.

*5th February.*—Miss A. has made steady progress, able to move from room to room with her crutches. Sleeping well at night, and in all respects going on most satisfactorily till to-day, when she was suddenly attacked with a fit of colicky pain in the region of the caput cœcum coli, followed by violent diarrhoea.

*Vespere.*—This has been checked with hot turpentine stupes and chlorodyne.

*8th.*—Diarrhoea has again commenced to-day with abated violence, and has assumed a dysenteric type; great pain along the whole of the colon. Lead and opium pills every four hours.

*12th.*—Diarrhoea excessively foetid; pain continues. To have morphine pilules and the carbolate of lime in pills.

*16th.*—Diarrhoea, accompanied with greatly increased pain along the course of the colon, passing blood in every motion. Evidently sinking fast. Died towards evening.

A post-mortem examination showed the remains of old tubercular disease of the lungs, and of the mesenteric glands, a waxy liver, and ulceration of both the large and small intestine. The joint was removed for more careful examination, when union between the osseous surfaces was found to be complete. This consisted of a granulation material undergoing ossification, which was furthest advanced at the margins; all the discharge within the last period must have come from that portion of the cavity where the abscesses had originally formed, and with which the sinuses, which discharged matter alone, communicated.

CASE IX.—I was requested, on the 15th of July 1864, to see R. S., æt. 18, who had long suffered from disease of the left knee-joint.

I found him with the limb confined in a box, and enveloped in a rude many-tailed bandage, in the fashion of Scott's dressing, but in which the medication consisted, as I was told, of Archangel tar. This had been applied on the recommendation of some local quack. There was no pain in the joint so long as the limb was kept at rest and no effort made to move the articulation, or to rest any weight upon the foot. Pressure, however, over the head of the tibia or condyles of the femur, elicited a complaint of very great and intolerable suffering. The joint was generally swollen, and swelling and stiffness constituted the commencement of the disease two years ago. The patient was thin, tall, pallid, and anæmic, in spite of living in the country, and sitting constantly when the weather admitted of it in the open air.

I suggested the propriety of operative interference with as little delay as possible, as suppuration was manifestly impending. To this the friends objected, desiring delay for consideration. In the beginning of August his friends, having considered the subject, consented to the excision of the joint. He was accordingly brought into town, and placed under my care in the Infirmary.

*10th August.*—To-day, the joint was excised in the usual manner, leaving the patella. A large abscess on the outer side of the lower part of the thigh was freely opened, both externally at its most dependent part, and also into the excision wound. Immediately thereafter, the ordinary apparatus employed by Dr Watson was applied. No dressing of any kind was applied to the site of the operation, the wound being left open until evening.

In the evening, the oozing having ceased, the flap was laid in position, and retained by means of sutures. He is very sick and depressed from the chloroform; to have six ounces of brandy during the night.

*12th.*—Sickness still continues, but the depression has quite passed off. Wound adhering throughout its entire superficial extent.

16th.—Some redness of edges of flap, and a little pus escaping at the angles posteriorly. Water dressing applied.

5th September.—The entire wound is healed, with the exception of the openings at the angles, from which a small quantity of pus is still discharged. He is daily out of bed for some hours.

30th October.—Since last report he has had several small limited abscesses forming here and there in the thickened synovial textures, and has suffered from an attack of erythema, followed by a phagedenic state of the sores. The abscesses were evacuated by incisions; the phagedenic surfaces treated by means of strong nitric acid, and the deranged state of system with *mindererus*, and afterwards with iron and *taraxacum*.

17th November.—The openings corresponding to the abscesses still continue to discharge. A probe passed in at them fails to discover anything else than tracks through the thickened synovial tissue. This has been treated, first, by repeated blisters; and, latterly, by freely laying open all the sinuses.

7th December.—He is very much better in general health, the swelling of the knee is nearly gone. There is still, however, some discharge from the sinuses posteriorly. The osseous surfaces have consolidated, and there is neither lateral nor antero-posterior motion. The limb is kept between lateral splints, and he is encouraged to move about with crutches. To return home.

22d September 1865.—He was placed under my care in Chalmers' Hospital, the sinuses still continuing unhealed. The osseous textures do not communicate with the track of the sinuses, but these latter all pass towards the patella.

12th October.—Having administered chloroform, Dr. W. laid open the sinus upon the outer side of the limb, which seemed to communicate most directly with the parts beneath the patella, and introduced his finger to explore the condition of parts. He found the patella covered with a granulation membrane, and in no part exposed; Chassaignac's drainage tubing passed along all the sinuous tracks.

1st November.—The swelling is now almost gone, the discharge from the tubes is daily getting less.

16th.—Alarming hæmorrhage suddenly occurred from one of the sinuses, and had gone on to a great extent before its existence was recognised by any one, the patient himself being sound asleep. This was checked by plugging the wound with dry lint and applying a bandage.

20th.—The bleeding has recurred on the 18th, 19th, and again to-day. It is obviously of arterial origin, and comes, Dr Watson believes, from the anterior tibial artery, either before or immediately after it perforates the interosseous membrane. The bleeding has only been staunched by plugging with lint soaked in the solution of the perchloride of iron, and retained in position by a bandage.

21st.—Bleeding still going on. The patient greatly exhausted. Dr Watson, in considering all the circumstances of the case, determined to amputate without further delay. This was executed in the lower third of the thigh. Acupressure employed.

22d.—Patient has rallied wonderfully; he is squeamish from the chloroform. Acupressure needles withdrawn.

*Vespere.*—Bleeding has taken place, the cavity of the stump is distended, and blood and clots come oozing and rolling out between the sutures. Dr Watson opened up the stump, cleared out the clots, and found the face of the stump perfectly dry, but the oozing coming from the side of the bone. On sponging away the blood, the femur was found to be stripped of its periosteum for more than four inches,<sup>1</sup> and the bleeding seemed to come from the inner sur-

<sup>1</sup> This stripping of the periosteum from the bone is no uncommon occurrence after amputation of the thigh in scrofulous or cachectic patients. I have seen entire denudation of the shaft of the femur follow the excision of its head and neck. Its occurrence after excision of the knee has been put on record by Mr Syme, as occurring in one of his two original cases: "On the 6th January, in order to prevent displacement of the bones, which all our efforts had been insufficient to effect completely, I cut away about two inches of the femur with the pliers, *and then observed*, with much concern, that the bone was denuded beyond the farthest extent to which my finger could reach."—(Syme on Excision of Diseased Joints, p. 139.) So far as I am aware, however, the occurrence of copious bleeding in such cases from the nutrient artery of the bone has not been recorded.

face of the periosteum. To reach the bleeding point, Dr Watson extended the external angle between the flaps upwards, dividing periosteum and muscles in the incision as well as the skin. The bleeding was then found to come from the *nutrient* artery of the bone. This was secured by means of a needle, when all bleeding at once ceased. The denuded portion of the shaft of the femur was then removed with the saw, the flaps brought together by means of sutures, and the stump supported by means of pads of lint and a roller bandage.

23d.—Patient very weak and exhausted all night and morning, but rallied a little this forenoon. Ordered small quantities of champagne to allay the sickness. Towards evening he began to sink, and died about 9 P.M.

His friends did not permit any examination of the body. But on dissecting the amputated limb, my house-surgeon, Mr Hamilton, found that my surmise as to the anterior tibial artery being the source of the hæmorrhage was correct, the aperture in the vessel exactly corresponding to the point where it penetrates the interosseous membrane. The whole extent of surface of both femur and tibia was united together by granulation substance undergoing ossification from the margin towards the centre.

CASE X.—I was sent for on the evening of the 24th of January 1866 to the country to see Mrs E. S., æt. 32, who, in a fit of temporary insanity, had precipitated herself, from a window some 25 feet above, upon the pavement in front of the house. I found that, in addition to several other injuries, she had sustained a compound comminuted fracture of the right patella, the fragments of which were driven into the cancellated substance of the articulating end of the femur.

Having laid the limb upon a well-padded splint, and supporting her on a mattress, I had Mrs S. brought into town, and placed in Chalmers' Hospital.

As she was in a very collapsed state, and some doubt existed as to the extent of her other injuries, Dr Watson deemed it expedient

to do nothing further till he saw her again at the hour of visit on the following day.

*25th January.*—Reaction has taken place. Her hallucinations have all passed off. She is perfectly calm and collected. The state of the knee-joint having been represented to her, she at once acceded to the proposal to excise the articulation.

This was done by means of two semilunar incisions, including, between them, the patella and the lacerated wound lying over the bone. The extremities of the two incisions met together over the outer and inner condyles, and were then extended backwards as a single incision to the level of the posterior aspect of the joint. The articulating surface of the femur was alone removed, the tibia, being uninjured, was left untouched; the inter-articular cartilages were also left attached to the head of the tibia. The limb was put up in the mode usually adopted by Dr Watson.

*Vespere.*—The edges of the incisions approximated by means of sutures.

*26th.*—Patient passed a tolerably easy night, and is now quite free from all pain in the knee. The acupressure needles removed.

*30th.*—Continues very well indeed. Some purulent discharge escaping from the angles of the wound; the central part entirely healed. Pulse feeble.

*31st.*—To have wine, four ounces. Brandy and water at bed-time.

*10th February.*—Everything has gone on most satisfactorily till to-day, when Mrs S. was suddenly seized with rigors, followed by feverish reaction and copious sweating. To have five grains of quinine, twice a-day; opiate at night.

*16th.*—She has had the rigors and fever with sweating repeated daily since last report. Her breath has a sweet odour, like newly mown hay. She has a sunken look, and no appetite for food. A violent attack of pain seized her to-day, about 11 o'clock. She complains of it chiefly in the lower part of the right side, shooting up to the shoulder, so that she cannot draw a long breath without it catching the breathing. Over the lower part of the right side of

the chest there is a distinct friction sound recognised. To have a blister applied over that side, and to have iodide of potassium in five-grain doses, three times a-day. Continue the quinine and opiate.

20th.—The pain was greatly alleviated by the employment of these measures. Mrs S. has become distinctly icteric. She sleeps the greater part of the day, and is more or less delirious every night. Omit the medicine. Continue nothing but nutriment.

24th.—Has lain since last report in a semi-comatose state, passing her urine in the bed. Pulse feeble and rapid.

26th.—Died comatose in the afternoon.

The post-mortem examination revealed recent pleuritic adhesions of both sides, especially of the right, with considerable effusion of serum. There were numerous metastatic abscesses throughout the substance of both lungs, especially of the right.

On the upper surface of the arachnoid there was a collection of a jelly-like substance. The other organs were healthy. The parts engaged in the excision were in a most healthy condition, but the open surfaces were quite ununited.

CASE XI.—I was requested, in the beginning of May 1865, to see C. W., æt. 24, clerk. He has suffered from disease of the knee-joint for many years, which obliged him at an early period to relinquish business, and turn his attention to the occupation of a clerk. For a time there was no change for the worse in his symptoms, but within the last six months the joint, in addition to being swollen and stiff, has been painful, so much so, as almost entirely to prevent his moving about, or to admit of sleeping at night.

30th May 1865.—On admission to hospital, the whole limb was found to be atrophied. The knee generally swollen, presenting an ovoid spindle shape between the emaciated thigh and leg. There is severe pain experienced when any attempt is made to move the articulation, or pressure is made over the articular ends of the bone. The patella floats, and the capsule of the joint is distended with fluid.

Blisters were applied on either side of the joint, and as soon as the blistered surface permitted, a bandage was applied around the articulation. The whole limb was confined in bend-leather splints, moulded to the limb and lined with chamois leather.

*14th June.*—All pain is gone, but the quantity of fluid in the joint remains undiminished.

*20th.*—The most complete repose has been maintained since last report, while tincture of cantharides and iron have been administered internally. The fluid effusion continues unabated. To-day Dr Watson tapped the joint with a hydrocele trochar, and withdrew about a pint of turbid serosity. Nearly an ounce of tincture of iodine was then injected into the articulation.

*21st.*—The swelling this day at visit is reproduced to the full extent. The heat of surface over the joint is increased, and the skin is suffused of a reddish colour. To have an evaporating lotion applied.

*26th.*—Swelling has gradually diminished since last report. The temperature of the skin and the redness have also subsided.

*8th July.*—The swelling is now nearly gone. What increase in bulk there is, is more apparent than real. There is, however, still some puffy swelling, due to a thickened state of the synovial membrane. The limb strapped with the gum and mercurial plaster, and the side splints again applied. He left the hospital at his own desire.

In the month of January 1866, I was again requested to see him, as of late the knee had occasioned him considerable pain. The swelling anteriorly is rather less than when I had formerly seen him, but there is more emaciation of the leg and thigh. Posteriorly over the head of the tibia and also above the head of the fibula there are two fluctuating swellings, which on pressure are painful.

Desired to foment the knee, and keep it at rest; while means of a dietetic and medicinal kind were employed with the view of improving his appetite, and strengthening his system.

*22d January.*—C. W. was admitted into Chalmers' Hospital, as

the fluctuating swellings had gradually increased. The pain in the joint was now very severe, and as this was attended with loss of rest, complete absence of all appetite for food, a quickened pulse, night sweats, and general exhaustion, it was determined to excise the knee-joint. Meanwhile, the abscesses were opened, and about half an ounce of thick, adhesive, ropy pus escaped from each.

*4th February.*—The pain has not abated since the opening of the abscesses, the swelling of the entire joint has been reproduced, and a large fluctuating swelling exists above the patella beneath the extensors of the leg.

*6th.*—To-day, Dr Watson excised the knee-joint in the method he usually adopts, removing the patella, however, on account of the degree of ulceration of its articular surface which was present. In clearing the femur and tibia for the application of the saw, quantities of thick, almost cheesy, masses of purulent substance adhering to the surface of the synovial membrane were observed and wiped away with the sponge, and a large mass of gelatinous lymph matter was removed from the upper part of the capsule of the joint. The usual gypsum apparatus with splint and suspension-rod was applied, and the patient removed to bed.

In the evening, the flap was laid down in its position, and secured there with sutures.

*20th.*—Ever since the operation he has suffered from more or less sickness and vomiting, everything he took for five days being ejected from the stomach. Along with this an almost constant hiccough tormented him, which prevented rest. Nothing afforded so much relief to these painful symptoms as a heavy weight (eight pounds) applied over the epigastrium, and morphia administered by subcutaneous injection, in pilules, or by the rectum as circumstances admitted. Ether, ice, chloroform, prussic acid, cannabis indica, musk, champagne, were all tried, as well as bismuth and grey powder, but none seemed to afford more than temporary relief. He is now reduced to an extreme state of emaciation from the inability to take food, which till to-day has

continued, without anything but a very little essence of beef remaining on the stomach. He has become icteric within the last three days. A bed sore has formed over the sacrum in spite of every care and precaution. To have essence of beef and champagne or sparkling hock every hour.

*3d April.*—The jaundice rapidly subsided under the use of liq. bismuthi. He has commensurately gradually gained appetite and strength. The bedsores are now completely healed. The limb has progressed satisfactorily, the only trouble being occasioned by the tendency in matter to bag in the hollow left by the removal of the patella. To-day, to obviate this, a free opening was made through the skin, in this situation evacuating a quantity of pus.

*6th June.*—With the exception of the sinuses, which continue to discharge purulent matter, the whole original incision is healed. On laying open one of these apertures to examine into the cause of the delayed consolidation, Dr Watson felt in the head of the tibia a large portion of dead cancellated tissue. To effect the removal of this as speedily as possible, and to permit the osseous surfaces to come in contact with each other, Dr W. laid open the whole line of the incision, and forcibly bending the leg upon the thigh, disclosed the cut surface of the head of the tibia, with a portion of dead cancellated tissue about the size of a five-shilling piece situated in the middle. This was partially detached from the surrounding osseous tissue. Its removal was effected by taking away a slice of the tibia, which included its entire thickness, and left a healthy osseous surface beneath. Limb adjusted and apparatus applied as at first.

*12th.*—He has gone on well till to-day, when rigors, followed by febrile reaction, hiccough, and vomiting, set in.

*15th.*—This was attendant upon an attack of erysipelas which, seizing the limb, has spread upwards, and is now occupying the abdominal and thoracic regions on the same side. A blister applied over the region of the liver. Effervescing citrate of potash draughts with ten minims of tincture of the muriate of iron every two hours. To have sparkling hock with aerated lemonade.

*20th.*—The erysipelatous attack has subsided, leaving the

limb, however, greatly swollen. A severe attack of diarrhoea has come on, which requires him to have a  $\frac{1}{4}$  gr. of morphia every four hours, with 3j. doses of bismuth to subdue the pain and irritation.

*5th July.*—Diarrhoea subdued. The appetite is returning in some degree. The swelling of the thigh, which was so great as to require the cutting up of the bandage, is rapidly subsiding. There is still, however, great tympanitic distention of the abdomen in front, and some degree of dropsical effusion in the lateral and posterior part of the cavity.

*30th.*—The diarrhoea again set in after a brief period of improvement which seemed to promise a rally, and after great abdominal uneasiness, which resisted everything but the employment of large opiates, he has gradually become more anæmic and exhausted, and died in the course of this evening. No sectio permitted.

CASE XII.—J. G., æt. 35, admitted 8th October 1866. Patient states that about two years ago, when in India as a private in the 28th Regiment, he received a blow from a cricket ball upon the left knee, which laid him up in hospital for some time. About two months after the receipt of the injury he returned home with his regiment and proceeded with it to Aldershott. While there, he was attacked with pain and swelling and stiffness of the joint, which obliged him to go into hospital; there he continued till discharged from the service some months ago. During his residence in hospital there were two abscesses opened, one over the head of the fibula, the other along the line of the outer hamstring tendons. Since his discharge from the service, he has resided in Stirlingshire with his friends. The gradual deterioration of his general health has led him to come into the infirmary.

On admission, the knee is greatly swollen, the swelling being elastic in its characters, and engaging chiefly the subcrural pouch of synovial membrane. There is considerable freedom of movement of the joint both passive and active; the patient cannot, however, employ the limb in progression, as bearing his weight even partially upon it occasions severe pain. There is a copious

gluey discharge from both openings. A probe introduced through either enters the joint cavity, but comes in contact with no osseous texture. Hot opiate fomentations were applied over the joint, and the limb was laid upon a wire splint.

18th October,—Two fresh abscesses formed on the outer side, above and below the level of the patella. These were opened, water-dressing applied, and quinine and sulphuric acid ordered to check the copious night sweats.

22d.—Splint removed as the posture is uneasy; warm opiate fomentations continued.

31st.—Complains of great pain and starting of the limb at night. To have an opiate.

4th November.—Patient's health failing rapidly. He is now anxious that anything short of amputation should be had recourse to, which affords the slightest prospect of relief from the severe pain he constantly suffers in spite of large and repeated opiates.

6th.—To-day, Dr Watson excised the knee-joint in the usual manner. With the view of removing as little of the femur as possible, he sawed off the condyles on the level of the condyloid pit by a transverse section, and then removed the upper and posterior portion of the articulating surface by applying the saw at right angles to the original section, *i.e.*, parallel to the long axis of the bone. The amount of the femur and tibia removed amounted exactly to an inch and a quarter. A large abscess beneath the *quadriceps extensor cruris* was then opened, and the whole suppurating surfaces pencilled over with strong tincture of iodine. The patellar surface was perfectly sound. Acupressure was employed to arrest the hæmorrhage, which was unusually profuse, owing to the vascularity of the diseased structures. The limb was immediately put up in the ordinary method employed by Dr Watson, and on removing the patient to bed, the limb and apparatus were attached to the running pulley of a Salter's swinging apparatus. There was considerable sickness and depression after the effect of the chloroform passed off, which was relieved by the

administration of brandy and ice while he was surrounded by pans of hot water.

7th.—Patient had a good night. The bandage round the knee was clipped away, and the margins of the plaster bandage varnished with hot paraffin to prevent soakage of discharge.

8th.—Acupressure needles withdrawn. Bismuth and hydrocyanic acid ordered to check an inclination to vomit. To have essence of beef and milk with aerated lime-water for food with brandy. The limb is dressed with water-dressing, and an ice-bag is suspended over the site of operation. As matter seems to collect at one point beneath the flap, an incision was made to-day to evacuate it directly. The whole amount of the discharge in twenty-four hours does not exceed one ounce.

12th.—Patient still improving.

From this period until the 20th November he continued to progress favourably, and, although feeble, took nourishment readily. He then, however, began to manifest unmistakably the existence of pyæmia, from which he sank upon the 24th November. The only situations, however, in which there was even a suspicion of any metastatic deposits were the sheath of the *rectus abdominis*, and the temporo-maxillary articulations.

*The sectio cadaveris* revealed the existence of obsolete tubercle in the apices of the lungs, with œdema of their lower lobes. Old adhesions between the liver and diaphragm, enlargement of the spleen, pericardial effusion, and purulent collections in the right temporo-maxillary articulation and sheath of the rectus.

## CHAPTER III.

## CONCLUDING CLINICAL REMARKS.

I HAVE arranged these twelve cases in two sections, placing the successful results before the fatal cases, not that I would give them an undue value, but because I have less now to say about them, for they speak for themselves; while having more to say about the fatal cases, I have detailed them last, that the reader may the more readily follow my remarks.

With the exception of the one case of primary operation the others were all instances of long-standing disease. In four of these five cases the disease which destroyed the joint had undoubtedly originated in the synovial membrane, and the patients' condition gave evidence of an originally enfeebled constitution. In the first of the fatal cases, Case VII., there was hæmoptysis and physical symptoms of phthisis pulmonalis. In Case VIII., dysenteric diarrhœa and pulmonary symptoms with constant dyspepsia had existed for a long period. In Case IX., the lad was tall, overgrown, and emaciated from the very first. In Cases XI. and XII., the patients were anæmic, had suffered previously from hepatic affections of warm climates, and from the whole progress of their cases indicated the existence of some internal mischief. In only two of these cases, IX. and XI., was the operation of excision a matter of choice; in the others it was undertaken at the strongly expressed wish of the patient, that (whatever the result) they selected it in preference to amputation, to which they would not submit.

Furthermore, in Case IX., feeble constitutionally as the lad

undoubtedly was, there was nothing decidedly to contra-indicate excision, and the fatal result is assuredly attributable to the accidental occurrence of hæmorrhage,—a complication which no prescience could have foreseen or prevented, any more than after the amputation, the recurrence of hæmorrhage from the separation of the periosteum of the femur, opening the nutrient artery of the bone, could have been anticipated. In Case XI., the violent attack of continued hiccough which immediately succeeded the operation threatened to prove fatal of itself, and had, in my opinion, a very decided influence in determining the necrosis of the cancellated tissue of the head of the tibia. To this last unfortunate complication of the operation must be referred the want of union of the osseous surfaces, and the spongy unhealthy condition of the surrounding soft parts. Had no necrosis followed the operation, had no hiccough disturbed the limb and exhausted the patient, I am convinced the extremity would to-day have been as sound and useful as that of any of the successful results.

In Case VIII. the dysenteric diarrhœa, due to tubercular disease of the intestines, may have been excited during the progress of the post operation period, but a careful inquiry into the antecedent health and history of this lady's case convinces me that it was an old and insidious mischief, long lingering about her, and now called into fresh vigour from the long track of bad health, the unavoidable confinement, and the difficulties of digestion which had all come in upon her during the last few months. Still, with all this, the progress of the knee up to within a week of her death was all that could be desired, and had the intercurrent illness not proved fatal, all seemed to promise a prosperous result.

In Case X. the fatal issue due to pyæmia is a result which may be said in no respect to have any connexion with the operation being one of excision. It is the most frequent cause of death in all surgical procedures, great and small. It has been known to prove as fatal after such trifling operations as tying hæmorrhoids or cutting a squint, as in the greater procedures of surgery.

In Case XI., as in the others, we may reasonably question if

any other line of practice would have afforded a better issue. In none of these five fatal cases was the operation undertaken as an *opération de complaisance*. It was necessary that something should be done to relieve each of these patients from a condition of the textures which afforded no prospect of other relief than death if left to follow its own course ; and the only question at the time was, whether excision or amputation should be undertaken in the circumstances with what we knew at that period of the patient's condition and antecedents ? The answer in favour of excision seemed clear ; but in looking back to what influenced me then, and carrying the mind forward with what I know now of the progress and issue of each of those cases, I do not think I could come to any other resolve now than that amputation—the progress of which in regard to these patients and their systems we cannot really know—would have proved in all human probability equally fatal, and possibly much more rapidly so.

Are there, however, any indications from the successful cases as compared with the unsuccessful ones, whereby we can in anticipation regard the prospects of a given case as better or worse in undertaking excision ? I think there is. I am inclined, next to the employment of the operation in cases of accident or injury, to regard its success as probably greatest,—1. When the disease has commenced in disease of the hard textures of the joint, or at least when there is but little chronic change in the synovial membrane ; 2. When there is no great burrowing of matter beneath the muscles or in the popliteal space ; 3. When the acute stage of the disease is on the decline, or has declined, leaving the patient with no manifest evidence of original defect in constitutional vigour ; 4. Where no bedsores already exist, in such a situation as to prevent a dorsal decubitus. But because my experience in my own cases, and in those of others, leads me to such a practical conclusion, I do not think myself justified in deciding that all outside this selected number must necessarily be given over to amputation. A like selection to that I have indicated no doubt would have afforded the most successful results when amputation alone was employed ; yet the

others, because less hopeful, were not permitted to perish simply because they were unfavourable for recovery. If the existing condition which urged the necessity for surgical interference were a fatal one, no man could hesitate to employ what held out never so slender a chance even of recovery because it was a slender one. Should we, therefore, at the present day, withhold the employment of excision in such unsatisfactory cases because they are for the most part unsatisfactory? I believe not, unless one of two things could be proved,—1. That amputation would have succeeded better; or 2. That these cases are so unsatisfactory as to prove uniformly fatal. The ordinary method of determining such questions by a reference to statistics seems to me fallacious in the extreme, for statistics in such circumstances place upon the same platform of dead figures living quantities which differ oftentimes *toto cælo*. If an operator selects his cases, and refuses his operative aid in instances where a fatal issue is to be feared, he may produce to the wondering gaze of the profession results of the most astonishingly successful kind so far as numbers are concerned, but miserable in the extreme, I am inclined to think, if the greatest amount of relief to suffering humanity is to be accepted as the aim of all surgical interference.

There is only one way in which a surgeon, in regarding the propriety of any course of practice as estimated by the results of another's practice, can really arrive at any useful conclusion, and that is by placing himself mentally alongside of the practitioner who was in charge, and attempting, from the data afforded at a certain point, to decide whether at that time any other procedure was then more suitable, or if anything in the symptoms should have enabled him to prognosticate the unfavourable or favourable result.

No man would ever submit to amputation if he knew that by excision he would get rid of his disease, and at the same time preserve life and limb. No man, again, would ever for an instant submit to excision of the knee could it promise nothing more than certain death. But after these points have been determined, the

risks in each case, not as gauged by numbers, but as of a determinate nature, and as specially likely in a certain given condition of constitution and external circumstances to influence unfavourably the one operation or the other, should alone be permitted to weigh in the balance and turn the scale one way or another. A vital element sometimes, however, must come into our calculation in deciding upon our operative procedure, and that is the wish of the patient himself. Holding such views as to the principles which should alone influence a surgeon in his choice of an operation, where a choice does exist and operative interference is unavoidable, I do not think, had I again in those twelve cases to decide upon the line of action to be taken, that I should pursue a different course from that which I took. Nor do I see any reason to think that, had I resorted to amputation instead of excision, the results would have been less fatal than they proved under the treatment adopted.

Before concluding this paper, I have a word to say in regard to several moot points connected with this operation. First, then, with reference to the allegation that incisions freely laying open the whole extent of a suppurating joint, combined with complete repose, effected by splints, gypsum apparatus, starch bandages, or otherwise, may with perfect propriety be substituted in most cases where excision of the articulation could be satisfactorily substituted for amputation. Such a statement can only hold good where the lower extremity is concerned, and where the limb is nearly in the straight position, or where with tenotomy and forcible extension under chloroform a like position could be obtained. I apprehend, in all such cases, there is a very great difference in the after progress and result to be observed from the conditions obtained by excision. Where the bones undergoing more or less diseased action are kept in steady contact, no excision being practised, the tension and counter-pressure of the osseous surfaces thus maintained must tend, in many cases, to determine farther suppurative progress, farther ulceration, it may be, in some cases, actual necrosis of considerable fragments of the cancellated tissue of the opposed bony surfaces. When, on the other hand, excision is practised,

complete relief is at once afforded to all the tension, and ill results due to further destruction within the limits of the field of operation rarely occur.

2. It may, perhaps, be asked, when such admirable results are obtained from excision of the elbow-joint, in the shape of a movable articulation, scarcely less useful or seemly than the natural joint, and infinitely more serviceable than an anchylosed one, why should we rest content in excision of the knee with a stiff limb? There are both theoretical and practical objections to this suggestion. The theoretical or analogical reasons are:—1. That the elbow-joint is useful in virtue of its freedom of movement in every direction, so long as the approximated osseous surfaces do not actually pass each other, while in the knee any movement which interferes with the complete rigidity of the limb as a column of support, capable of sustaining the weight of the whole trunk, renders the limb almost unserviceable in progression. When, for example, the ligaments and muscles fail to lock the knee-joint in complete extension, walking is almost an impossibility. Again, while an ununited fracture of the arm is more an annoyance than a cause of incapacity in the affected arm, an ununited fracture of the thigh disables the patient till the limb is in some way rendered rigid. It is further easily demonstrated in any case of excision of the elbow-joint where the arm is in every respect most perfectly useful as a prehensive organ, that the patient can rest no weight upon it. I have seen a patient whose elbow-joint has been excised scrubbing a floor most energetically with the affected arm, and resting her weight upon the sound limb; on asking her to transfer the scrubbing-brush to the hand of the sound limb and support herself upon the arm operated upon, she made the attempt and at once fell over upon that side, the limb doubling beneath her weight. There is this manifest difficulty in attempting, in excision of the knee-joint, to obtain a movable articulation which shall be of any use to the patient, that in making the union flexible in one direction it must be flexible in all directions equally. Thus the tendency to bend outwards or inwards would be as great as the extent of the

motions of flexion extension, and as we have seen that in the after treatment there is a tendency to bow outwards, this would, in all probability, be the direction in which the flexure of the limb would occur when the weight of the body was borne upon that extremity.

2. The practical difficulties which have occurred in attempting the formation of a useful limb with only a fibrous union at the site of the excision are, I think, sufficient, so far as our knowledge at present goes, to forbid its repetition. It is no new proposal this of a movable joint. Mr Syme, so long ago as 1831, seems, in his early essays, to have been in favour of such an attempt. He says:—“During the cure, it does not seem proper to insure absolute rest in order to obtain a true ankylosis or osseous union, since the very long bone that would thus be formed, besides being extremely inconvenient to the patient, by rendering the limb perfectly rigid, could not fail to expose it to a great risk of fracture, by affording long levers to forces acting at the extremities. A great degree of flexibility, on the other hand, would unfit the limb for support and progressive motion, so that while perfect immobility and free motion ought to be avoided, a slight degree of flexibility ought to be promoted. The chief difficulty of the cure consists in preventing the tendency to bend outwards, which is always strong, and if not counteracted, most injurious to the appearance and usefulness of the limb.”<sup>1</sup>

I am also informed that in those cases in which Langenbeck has performed excision of the knee, he has adopted measures calculated to obtain a movable articulation, but that the result has been the necessity of resorting to amputation in every case. Such are the reasons, theoretical and practical, which have prevented me from making any attempt in this direction, and which meanwhile appear to me likely to influence practical surgeons against the adoption of any method of after treatment calculated to obtain such unsatisfactory results.

3. The method by which I have practised the excision has, in every instance except one, been by means of the semilunar incision

<sup>1</sup> Syme, *Treatise on the Excision of Diseased Joints*, p. 134, 135.

raising a long flap from the anterior surface of the articulation. The one exceptional case in which I employed an elliptical incision, crossing the front of the joint, and including the patella within its limits, was one in which the operation was practised on account of compound comminuted fracture of the patella. Here the lacerated condition of the integuments, together with the necessity to effect the removal of the comminuted bone, made this method preferable to any other. In employing the long anterior flap as a means of gaining access to the articulation, I have preferred it for four reasons, chiefly:—1. That while it opens up the parts to be dealt with to both sight and touch more thoroughly than any other, it is easily and rapidly mapped out by a single curvilinear sweep of the knife. 2. That when its extremities are carried behind the line of the condyles they form a complete and efficient drain for the whole extent of the cavity formed by the excision. 3. That its margin corresponds in a less degree than any other to the line of section of the osseous surfaces. 4. That the flap so raised will serve for amputation of the thigh through the condyles, should the state of the joint render that advisable after excision has been completed. The H incision, the simple transverse incision, the lateral incisions, both straight, or one straight and the other curvilinear, I have employed on several occasions in operating upon the dead body, but none of them have seemed to me to possess any such superiority over the long flap as to lead me to employ it in practice. They have certain advantages, it is true, which I readily grant, such as admitting in the case of the H, the transverse, or the elliptical incision, a more easy removal of the mere patella, if that is thought essential or desirable in any given case; but as I have always attempted to retain the patella where this is possible, incisions specially suited to favour its easy removal have not seemed to me to possess any advantage in this operation.<sup>1</sup> If the articular surface of the patella is affected by disease,

<sup>1</sup> In cases of extensive synovial disease, where it is deemed expedient to effect the removal of the altered synovial tissue to as great an extent as possible, this is easily effected by the long semilunar flap. In performing the operation with this object in view, the flap raised should consist of skin and

the gouge will usually enable its diseased tissue to be easily removed to the desired limits as regards both superficial extent and depth. Besides, it is well to bear in mind the practical fact that it is rare to find any such extent of disease in the patella as to determine the necessity for its removal,—an observation in morbid anatomy which its position as a sesamoid bone might almost lead one *à priori* to anticipate. The lateral forms of incision, straight on each side, or straight on the inside of the knee and curvilinear upon the outside, were devised for the purpose of leaving, not only the patella intact, but the ligamentum patellæ as well. This may seem at first sight an advantage, and were a useful movable articulation attainable as a result, it would be so without doubt; but as such has not hitherto been known to follow upon this method of operating, the difficulties which it creates in the manual procedure should be sufficient to condemn it.

Perhaps it may be asked, why I have retained the patella? My reply is, that (1) its removal is unnecessary in most cases; (2) its presence in the flap bears up the soft parts from the line of incision, and, without preventing consolidation, helps to keep them away from the cut margin of either osseous surface; (3) that its removal occasions more bleeding; and (4) that the hollow left after its removal from the centre of the long flap leaves a hollow cavity in which matter bags, and requires a separate incision to drain it efficiently.

4. The patients whose cases I have narrated are all adults. I have not performed the operation in any child or adolescent. I have been deterred from doing so by the small prospect which the removal of the epiphysis of the femur and tibia must afford of the after growth of the limb proving commensurate to that of the rest of the body. In children I have hitherto regarded amputation as a preferable operative procedure. I believe I shall con-

areolar tissue alone, the quadriceps extensor and ligamentum patella should next be divided, the synovial membrane and capsular ligaments on either side being next cut through, the patella surrounded with the greater mass of diseased synovial tissue is at once completely excised. The operation is in its further steps executed precisely as already described.

continue to do so until I have had satisfactory evidence that the limb grows, or that the short and shrunken limb is capable, with the aid of a wooden pin, to support the superincumbent weight of an adult body more satisfactorily than a thigh stump and a wooden leg.

5. In regard to instruments requisite for the performance of the operation, I need say nothing further than that I have required nothing more than a large bistoury in a firm handle, and a common amputation-saw with a back which yields as the blade cuts its way through the condyles of the femur or broad head of the tibia. Various ingenious devices have, however, been recommended and employed by others in this extremely simple operation for dividing the osseous tissues. Among these, Mr Butcher's saw, Symonovsky's saw modified by Lüer, the old double-toothed saw of Moreau, and the chain saw recommended by the late Dr Jaffray of Glasgow, in his edition of Park and Moreau's works on excision of the joints, specially deserve mention. There can certainly be no objection taken to their employment if the section of the bone were more easily or nicely effected by means of them than by the common amputation-saw. But as one and all of them are less easily manipulated, and there is no evidence in favour of their effecting this work more smoothly, I cannot conceive why instruments, certainly well suited for the key-hole work or the pattern sawing of the cabinetmaker, should be imported into the armamentarium of surgery, or made of such great moment in the performance of an operation which requires neither sections in curves, in zigzags, nor in dovetail patterns.

I once heard a surgeon desiderating some instrument by which two smooth sections of the tibia and femur might be easily effected in excision of the knee, as he had seen difficulties occur from a want of capacity in the operator to cut two flat surfaces, which, when laid *in situ*, produced a straight limb. It may have been a legitimate wish upon the part of so clumsy an operator, and were the saws we have named capable of affording such facilities, we should strongly recommend them to his attention; but, as they are certainly not

fitted to afford such assistance, a simpler expedient would perhaps be more easy of adoption, viz., that until a man acquires the very moderate degree of command over his hands and eyes necessary for the performance of so simple an operation, he had much better totally abstain from engaging in the operative department of his profession.