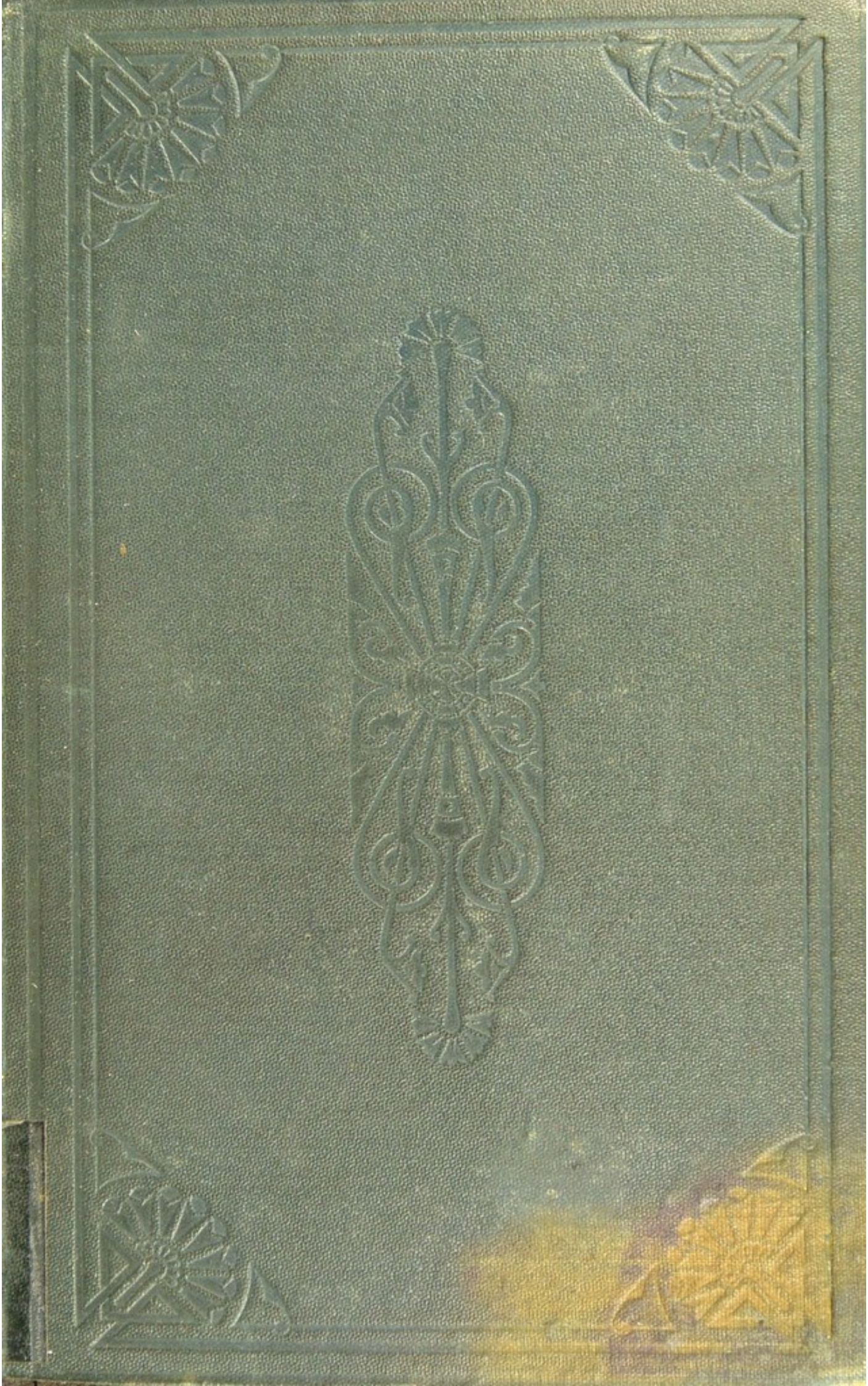

ON THE

TREATMENT

OF

FRACTURES OF THE LIMBS

BY

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"SI QUID TAMEN OLIM
SCRIPSERIS . . . . NONUM PREMATUR IN ANNUM,
MEMBRANIS INTUS POSITIS.
Q. HORATII FLACCI ARS POETICA."

DEDICATED

TO THE

REV. CHARLES CLARKE,

THE CHAIRMAN, AND TO THE OTHER MEMBERS OF THE COMMITTEE

OF THE

QUEEN'S HOSPITAL, BIRMINGHAM,

IN GRATEFUL RECOGNITION OF THEIR CO-OPERATION WITH THE

MEDICAL STAFF, IN DEVELOPING THE RESOURCES OF THE HOSPITAL

AS A

CLINICAL SCHOOL,

BY THEIR FAITHFUL COLLEAGUE,

THE AUTHOR.

PREFACE.

In his recollections of the last days of Shelley and Byron,* Mr. Trelawny relates the following anecdote:—"Drifting leisurely along the Italian coast in the brig Hercules one evening near Lonza, a Neapolitan dungeon, Byron said, ... 'I should like to see, from this our ark, the world submerged, and all the rascals in it drowning like rats.' I put a pencil and paper in his hand, saying, 'Perpetuate your curses to tyranny.' After a long spell, he said, ... '*I must chew the cud before I write. I have thought over most of my subjects for years before writing a line.*'"

Believing that this example is very well worthy of imitation by surgical writers, I have thought over the contents of this volume so long and carefully that, although only now published, they are in part old.

The volume consists of two parts:—1st, of eight Lectures; 2nd, of an Appendix.

The first seven Lectures are published with only verbal alterations, as they have been delivered at various times

* London, 1858. Page 159.

since 1862, to the students at the Queen's Hospital. Reference to digital compression in the sixth lecture has led to a digression, in the translation of a pamphlet by Professor Vanzetti, on the treatment of imflammation by digital compression. The teachings of the great Italian surgeon on the treatment of aneurism are fairly known and practised; but not many surgeons are aware of the great advantages to be derived from digital compression in controlling muscular spasm, and reducing congestion and inflammation, which are amongst the most serious complications of severe cases of fracture of the limbs.

The eighth Lecture of this series is a condensation and revision, of several addresses to students and papers to medical societies.

The Appendix contains concise directions for carrying into practice the principles of treatment taught in the Lectures.

The author admits, with unavoidable regret, that busy practitioners who consult these pages on occasions of emergency, may have reason for finding fault with the arrangement, which is somewhat fragmentary and irregular, as clinical work and study are in actual practice, not consecutive and methodical as in a course of systematic lectures.

This volume lays no claim to being a complete treatise ;

nevertheless it is hoped it may contribute to the establishment of sound first principles, to the recovery of lost treasures of surgical learning, to the education of the student's judgment in clearness and accuracy, and to the transference of one of the most important departments of surgical practice, from the stage of contradictory teaching to scientific generalization.

Birmingham,

November, 1871.

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PART II.

LECTURE I.

CONTENTS.

Gentlemen,—Fractures of the bones of the limbs deserve your attention as the class of injuries with which you will most frequently have to deal. They will be found to constitute, in quantity and kind, the most serious part of the surgery which may fall

to the lot of those amongst you who engage in general practice.

In the aged, in all stations, even a simple fracture frequently involves the alternative of life or death; occurring in infants, upon the result of treatment depends whether or not the child is to grow into a comparatively helpless cripple. Amongst the labouring population, no greater fracture than one of the lower end of the fibula or radius may sentence a family to pauperism by disabling its head; amongst the wealthy, similar lesions may prevent the enjoyment of that comfort and the performance of those graceful movements, which are held in estimation only second to life itself. Comminuted and compound fractures in civil, and still more in military, practice repeatedly suggest the question of amputation, and not unfrequently involve loss much greater and more terrible than that of a limb. Whether your practice be in workhouse infirmaries or civil hospitals, amidst the din of steam hammers in the manufacturing districts or of cannon in warfare, fractures will be amongst the most frequent and amongst the most formidable accidents you will be called upon to treat.

The management of some fractures is a matter of extreme simplicity, whereas many others demand the most accomplished skill, and the most sedulous

yet humble care; I say humble, because these are cases in which the surgeon does not reap the ephemeral glory commonly associated with the performance of a bloody operation, yet does the bloodless procedure very frequently demand equal manual dexterity and more philosophy.

Sometimes, especially in the neighbourhood of joints, the diagnosis of a fracture is attended with extraordinary difficulties, — sometimes, notwithstanding the perfectly obvious nature of the case, the smallness of the bone injured, and the simplicity of the fracture, the result is so unfortunate that an action for damages may be brought against the surgeon, for alleged malpraxis. It is my impression that more actions of this kind are brought for badly united fractures, than for any other class of injuries. An unjust verdict is often pronounced in consequence of the defective system in use for taking scientific evidence in our Law-Courts, and not unfrequently the reputation of a very good practitioner is imperilled, by the contradictory teaching of the masters in their books and hospitals; for I beg you to note, what I shall presently have occasion to prove, that it is as substantially true now as it was in 1815, when John Bell wrote, that "this is one of those subjects which has fallen into almost inextricable confusion."

Anxious, on the one hand, to prepare you for the study of the subject by impressing you with a due sense of its great importance, and of its many and very considerable difficulties, I am, on the other hand, no less concerned lest you should suppose that, like many men who have carefully studied a matter, I have formed an exaggerated estimate of one of my favourite pursuits. Therefore it is that I call to witness one of the most recent, and certainly one of the most learned, eloquent, and impartial, writers in our profession. *"Constant in their occurrence, and often extremely difficult of diagnosis and management, fractures frequently involve consequences hardly less serious and disastrous to the surgeon than to the patient himself. If I were called upon to testify under oath what branch of surgery I regarded as the most trying and difficult to practice successfully and creditably, I should unhesitatingly assert that it was that which relates to the present subject, and I am quite sure that every enlightened practitioner would concur with me in the justice of this opinion. I certainly know none which requires a more thorough knowledge of topographical anatomy, a nicer sense of discrimination, a calmer judgment, a more enlarged experience, or a greater share of

* A System of Surgery, by Samuel D. Gross. Philadelphia, 1859. Vol. ii., p. 97.

vigilance and attention; in a word none which requires a higher combination of surgical tact and power."

You may remember that in the remarks I have frequently taken occasion to address you at the bed-side of fracture patients, I have been in the habit of treating the subject somewhat dogmatically,—strong in the correctness of the principles to which I adhere, as opposed to those held by the vast majority of surgeons;—a majority which, I am in honour bound not to conceal from you, is not merely one of numbers, for in its ranks, with not very many exceptions, are the most notable authorities,—ancient and modern, British and Foreign.

I have now worked at the subject so long in the study and at the bed-side,—I have treated such a large number of cases of fracture of all varieties, at all ages, under all manner of circumstances, with such uniform results,—my efforts to promulgate the new method have been so generously encouraged and, in so many instances, practically followed up, that I thought the truth was rapidly making way, and that the antiquated prejudices and scholastic errors had been uprooted, never again to be planted. The illusion has been dispelled by two publications which I have had occasion to study since we parted for the last vacation. One is a Lecture by Mr. Le

Gros Clark,* a gentleman worthily holding a foremost position in that glorious arena for surgical practice, the London Borough Hospitals; the other is a Memoir by Mr. Hornidge, in the first volume of the System of Surgery which Mr. T. Holmes has had the very honourable privilege of editing, with such collaborators as Simon and Paget, and altogether, under such auspices as to claim for it the most respectful and serious consideration.

Mr. Le Gros Clark's Lecture acquires importance even beyond that necessarily attaching to his name, in that he in a measure endorses one of the most serious errors propounded by his colleague, Mr. South, from whose translation of Chelius' text I am about to quote. (Vol. i, p. 507). "Many moderns comply with the general maxims heretofore followed by the older surgeons in reference to setting, and to the application of apparatus after from the first four to eight days, to allow and to await for the passing by of the inflammation, till the pain and swelling have diminished, and thereby a more secure position of the limb obtained. This advice is manifestly objectionable, and the putting off the setting to be restricted only to those cases where decided inflammation has set in." I agree with Chelius, and as you will

* Medical Times and Gazette, March 16, 1861.

presently learn, I go much further than he does by way of practical protest against the ancients, and their contemporary followers. Very different is the opinion of the senior surgeon of St. Thomas, who thus comments on his colleague of Heidelberg. (Loc. cit.) "As a general rule I do not at all agree with the principles here laid down by Chelius. I am quite certain that no fractures, excepting those of the collar-bone and very oblique fractures, in which the ends of the bone threaten to penetrate the skin, should ever be set, that is, put in splints and bandaged, till after three or more days, or more correctly speaking, till the swelling has ceased and nearly or completely subsided." The continuation of this commentary is, if possible, more instructive in error. It was penned, I beg you to note, a considerable time after the reliable text,—another illustration of Liston's apothegm that "years are not the measure of experience."

Destined as the new System of Surgery is, on account of the really erudite and ripe work of some of its contributors, to take a foremost position in the Literature of Surgery, the importance of Mr. Hornidge's Chapter on Fractures cannot be over-rated. The aim, doubtlessly conscientious, of the writer has been to write fully, truthfully, and progressively; but, on the great question of treatment, I think it

would be difficult to conceive a less impartial digest of past and cotemporary experience.

To pass from general to particular criticism, I quote from Mr. Le Gros Clark's Lecture. "The fracture of a bone is always succeeded by some swelling in the neighbourhood of the injury, and it is generally proportioned to the violence of the injury inflicted. The source of this early swelling is extravasated blood and serous effusion, and this is to be distinguished from that inflammatory effusion which takes place at a later period; the former is inevitable and innocuous within moderate limits; the latter should be watched suspiciously, and controlled if possible, as it may usher in phlegmon and suppuration even in simple fracture. But early œdematous effusion may be converted into a serious evil by injudicious management. Thus, if a limb be at once tightly swathed in bandages to fix it to a splint, whilst this swelling is going on, the lower part of it may be strangulated, and the patient may not only suffer acutely, but irreparable mischief may be the consequence; I have known gangrene result from this cause. You will perceive that, in the foregoing cases, my practice is to afford support at once to a fractured thigh, but without the application of any tight bandage. This is essential for the comfort of the patient; it is almost impossible to keep a broken

thigh comfortable on a pillow, but an easy position may be obtained in an angular dish splint, or by fixing the limb lightly to the long straight splint on which you mean to keep it. In the latter case little else is needed just at first than a foot bandage and a pelvis strap; after the lapse of forty-eight hours, the limb should be properly rolled and extended. I generally leave the thigh uncovered, as I am not aware of any advantage in carrying the bandage over it, and its exposure facilitates examination of fracture. The utmost caution must be exercised in fixing the splint, that the ankle and instep do not suffer from the pressure of the splint or bandage; .....this leads me to remark upon the principle of treatment to be adopted, in fractures of the lower extremity. That which has relaxation of the muscles for its basis is unquestionably the best, wherever it is practicable. ..... One word of caution in conclusion respecting the mechanical treatment of these fractures. Inspect them frequently."

I may at once take exception to the statement that the fracture of a bone is *always* attended with some swelling in the neighbourhood of the injury. A very considerable number of fractures are, if properly treated, unattended with any swelling whatever. To dwell upon the danger of gangrene when

a limb is *tightly* swathed in bandages, and to advise, as the only alternative, fixing the limb *lightly* to an angular dish splint, or to a long straight splint, is begging the question, and tends to obscure the real issue by the use of extreme expressions. It is possible to exercise a considerable yet perfectly safe degree of pressure intermediate between *tight* and *light*, a compression widely different in itself and in its effects from constriction on the one hand, and looseness on the other. As a general precept, I consider that which enjoins the *frequent* inspection of fractures decidedly not a reliable one.

In the Chapter on Fractures, (Op. cit. p. 772), Mr. Hornidge writes: "There are two classes of cases in which immediate reduction is either impracticable or inadvisable. If there has been from the first excessive ecchymosis, or if when the patient is first seen much inflammation has already supervened, the attempt may be not only unbearable, but highly injurious, causing laceration of the soft parts, spasms, convulsions or even tetanus. The inflammation must be combated by the ordinary means, and reduction deferred till it is duly subdued. Still more serious is the obstacle presented, in the other class of cases, by excessive spasm. Spasm is a very constant accompaniment of fracture, especially if in the neighbourhood of a joint, so constant, indeed, as to

be considered, in doubtful cases, almost diagnostic. Its degrees are variable from the slight nocturnal twitchings, ceasing after the second or third day, to uncontrollable oft-recurring contractions, accompanied, it may be, by general convulsions. The severer form of continued spasm is far less frequent than the intermittent. The causes of spasm are these: the irritation of the fragments, injury to nerves, and the altered position of the muscles themselves, whether increasing or diminishing their habitual tension. If they are much bruised, the spasm may be less severe at first than at a later period after they have recovered their functions. The defeat of spasm by violence is hopeless. Laceration of the muscles or even of the vessels will be the only result. Boyer induced fatal hæmorrhage by violent and abortive efforts to reduce a fracture of the femur. In other cases such efforts have led to convulsions or tetanus. Still more hopeless will be the attempt if inflammation is super-added. The two main remedies to be relied upon are position and energetic antiphlogistic treatment. For pure and simple spasm full doses of opium are of great service; but if it is combined with inflammation they only tend to mask without abating the evil. The same may be said of the inhalation of chloroform, but it is necessary to give it repeatedly in small

quantities, so as to sustain its narcotising influence; for, in severe cases, the spasms will return, whenever its effects pass off, for many days. The limb should be placed in the position of semi-flexion, relaxing the muscles to the utmost. But when all these means fail, recourse may be had to subcutaneous division of the opposing muscles, an operation which has hitherto been practised only in the lower extremity."

Of ecchymosis and inflammation as contra-indications to immediate reduction I shall simply observe, for the present, that I only so regard them in excessive, and extremely rare, degree. I often reduce a fracture and apply the apparatus when the swelling, ecchymotic, inflammatory, or both, is so considerable as altogether to obliterate the bony outline of a knee, or ankle, joint. Inflammatory heat, and the additional complication of a bleb an excoriation or a wound, does not deter me, provided mortification be not so seriously threatened and probably imminent, as to induce me to entertain the question of amputation. So far as spasm is concerned, I never deem it an obstacle to immediate reduction, and I never fail to overcome it by the application of firmly, but gently, applied pressure. Violence is always superfluous and commonly injurious, and I should no more think of attaching weight in the solution of this question

to Boyer's accident, than I should be disposed to predicate against the taxis in strangulated hernia, or catheterism in retention of urine, because some surgeons have burst the bowel and perforated the urethra by rude attempts.

Mr. Hornidge's objections to circular compression (op. cit. 774) are so far a repetition of the arguments of other writers that I shall postpone reply; but in order to give you another illustration of the difficulties which beset the investigation in consequence of contradictory statements on the most simple matters of fact, I beg your attention to another statement of the same author (loc. cit.) "Pasteboard splints, which admit of being accurately moulded to the limb, may be used for nearly all fractures in children, and for those of the phalanges in adults. In other cases the support they give is insufficient." More than a century ago Jean Louis Petit wrote,* "Les bandes de carton mouillées peuvent exactement se mouler à la partie, et en se durcissant elles acquièrent assez de solidité pour soutenir toutes sortes de fractures, celles même qui semblent le plus difficile à contenir." Petit was right: pasteboard splints rightly employed are capable of affording perfectly efficient support in all kinds of fractures;

* Traites des Maladies des Os, 3rd Ed. p. 38.

yet in 1847 one of the most erudite surgeons of any epoch thus wrote in an elaborate treatise on fractures, (Malgaigne, Fractures, p. 218.) "Les attelles de carton avant la dessiccation sont mouillées, conséquemment incapables d'agir; après la dessiccation, elles sont parfaitement inutiles." I think it would be extremely difficult, in the whole range of surgical literature, to adduce a more glaring instance of begging the question, on the basis of a purely imaginary pre-occupation directly contrary to the results of experience.

The study of a subject so important and complicated is necessarily rendered much more difficult by the contradictory teaching of eminent surgeons, of which I have just adduced a few examples from the multitude at hand. Happily we know that truth cometh sooner out of error than out of chaos. In this instance the true doctrine is already ascertained, but it requires larger exposition than it has yet received,—the collection of its scattered elements into a body,—the elimination of the errors with which it is interwoven;—in fact, a serious and thorough examination of the whole question of the treatment of fractures is what is wanted. The knowledge to be found in surgical text books on the causes and signs of fractures is abundant, and, for the most part, good and reliable. The treatment is the defec-

tive part; the teaching respecting it requires more thorough revision and more substantial change than I formerly believed. The errors to be combated are not of detail merely, but of principle,—fundamental and essential.

In illustration of the general critical remarks embodied in this Lecture, with a view to prepare you for the deeper consideration of the subject, I invite your attention to the three patients before you.

CASE I.—*Oblique Fracture of thigh in a lad.—Immediate reduction and application of Starched Apparatus.—Out of bed the fifth day.—Perfect recovery.*

The boy, George Gray, æt. 12, you may remember, was admitted an inmate of V 5 Ward seven weeks ago, just after breaking his right thigh in a fall. The fracture was at the junction of the middle and the lower third, slightly oblique, with no injury to soft parts and only quarter-inch shortening. Preternatural mobility and grating very obvious. Abrasion of the skin on the outer side, and swelling from extravasation of blood. I applied the starched apparatus immediately. The third day (meanwhile comfortable and altogether free from pain) I opened case in front of thigh, finding parts in perfect condition, pared edges, and fitted and strengthened with additional inner splint to below knee, binding

the whole firmly but gently with roller; I then fitted an additional buttock splint, and fixed it according to my usual practice. (I simply invite your attention to these cases as results. A subsequent demonstration will be directed to practical instruction in the method of applying the apparatus in different fractures.) The fifth day after the accident the boy got out of bed, the third week he left the hospital, and now the bone is quite solid, the thickening at the seat of injury is so very slight as to be scarcely distinguishable, the length and shape of the two limbs is identical, movement of joints perfectly free. It is only by way of precaution that I have advised crutches to be used another week.

Case II.—*Fracture of fibula, with great swelling, heat and pain.—Fomentations for two days useless.—Third day Starched Apparatus; immediate relief.—Fifth day swelling subsided.—Sixth day patient discharged.*

This mechanic, John Ward, æt. 33, in slipping off the kerb the 4th inst., fractured his left fibula. When admitted in the hospital, the swelling was so considerable that the Assistant on duty thought it advisable to order fomentations. I did not see the case until the 6th. Notwithstanding the hot flannels

had been continued, the swelling was so great as to obscure the bony lines and points of the ankle; the skin was hot, pain considerable. I at once applied the starched apparatus as far as the knee, and left the man quite comfortable. Two days later (the 8th) quite free from pain; apparatus loose, opened in front; limb much cooler and smaller; edges pared; outer roller applied and starched. The next day the man left the hospital, but returned two days afterwards, when I met him walking on crutches in the hall, and he remarked that the last few hours the joint had been painful, spontaneously adding, "I expect it is because the bandage has got loose." Such proved to be the case. I removed the outer roller, and again pared edges. Swelling had completely subsided. Apparatus re-closed, and ordered to be continued one month from the date of injury.

Case III.—*Oblique Fracture of tibia, and comminuted fibula, in a drunken man.—Extravasation of blood, spasm and shortening.—Immediate reduction, immobilization and compression. — Discharged third week.—Perfect recovery.*

This stout Irish labourer was admitted in the same ward, at the same time as the lad just dismissed. The poor fellow was drunk and very quarrelsome, and

had about half an hour previously fallen, with his right leg under him. I found both bones broken, on the same level, in the small of the leg; the fracture of the tibia oblique from within outwards, and from below upwards. Fibula broken in two places, middle piece quite movable, and one end of it pointing under skin. Shortening to $\frac{3}{4}$ inch, with eversion of the foot. Considerable subcutaneous extravasation of blood. Skin sound. The muscles of the big calf spasmodically, and very powerfully, contracted. Frequent jerking. Pain intense. I instantly reduced; applied starched apparatus from foot to mid-thigh, with outer wooden splint from foot to knee, during drying process. The fellow reported himself easier, but still hollowed. I did not busy myself to discriminate between the effects on the nervous system, of the injury and the debauchery, but to secure the grand requisite—perfect quiet, prescribed a drachm of laudanum, to be repeated as frequently as necessary to ensure sleep. The next day was passed comfortably, but still occasional twitching; third day case loose from subsidence of swelling. On opening mid-line anteriorly, no blebs, skin cool, but deeply discoloured from ecchymosis; edges pared; the whole made firm again with roller, and this starched. The man was discharged the third week, and now, you observe, the limb is quite solid, and so perfect

is its outline to the eye and touch, that it would be scarcely possible for a stranger to trace the direction of the fracture. As to the length of the two limbs, it is absolutely identical.

I have not selected the cases before you, but have taken advantage of their attendance, as convalescents in the out-patients' room this morning, to request their presence here. I shall now read you the notes of four cases which formed the basis of a paper I addressed to the Midland Medical Society, the 16th October ult. I do so because these four cases all occurred in one week, and because, notwithstanding their uniformly good result, the plan of treatment pursued was questioned by many of the members present.

Case IV.—*Oblique Fracture of femur; half-inch shortening.—Immediate reduction and immobilization. —Bed left the fourth day.—Perfect recovery.*

Joseph Sable, æt. 7 years, admitted A V Ward October 8th, having broken the right thigh-bone in jumping from a height. Direction of fracture, slightly oblique. Seat, junction of middle and lower third; shortening to half an inch. No abrasion, no swelling. Immediate reduction, and application of starched apparatus so as to fix the entire limb from the crest of the ilium to the foot. Dry

pasteboard splints fixed to the front and back of the thigh until the 12th, when the apparatus was cut up in the middle line in front, and re-closed on finding parts in excellent condition. An additional pasteboard splint fitted on the inner side to below the knee. Boy perfectly free from pain, even when the limb, raised from the bed by the foot, is allowed to drop suddenly. Able to turn round and sit up with perfect ease.

The 16th October, eight days after admission, I exhibited the boy at the Midland Medical Society. He was discharged next day, and made a perfect recovery, without the slightest shortening.

Case V.—*Fracture of tibia with inversion.—Immobilization.—Out of bed the third day.—Perfect recovery.*

Mary Birch, æt. 9 years, admitted A V Ward October 12th, having broken right leg in falling down stairs. Fracture slightly oblique, through the tibia, in the small of the leg. No shortening, but decided inversion of the foot. Starched apparatus applied, to the middle of the thigh. After which, dry pasteboard splint fixed along the outer side.

October 15th. Apparatus opened in front, and re-adjusted on finding parts in excellent condition.

The limb can be lifted, and the child moved, without causing any pain.

The patient was discharged within a week. I saw her about six weeks afterwards, completely recovered, without any appreciable thickening of the bone.

CASE VI.—*Transverse Fracture of tibia from direct violence.—Abrasion of skin.—Extravasation of blood.—Immobilization.—Discharged fifth day.*

Maria Franks, æt. 45, admitted A 5 Ward October 11th, 1860, with transverse fracture of the tibia below the knee, caused by the fall of a heavy gate upon the limb. Abrasion of skin, and considerable extravasation of blood beneath it. The starched apparatus applied immediately, from the foot to the middle of the thigh.

October 13th. The patient has only complained of slight pain. Apparatus is now loose from subsidence of swelling; opened along the middle line in front, and edges pared to insure better co-aptation. Two additional pasteboard splints fixed on each side of the knee.

October 16th. Quite comfortable and free from pain. Left the hospital. I regret inability to report the termination, as I lost sight of the case.

Case VII.—*Fracture of both bones of leg from direct violence.—Blebs and swelling.—Starched apparatus.—Out of bed third day.—Perfect recovery.*

John Price, æt. 43, admitted V I Ward 2 a.m. October 13th, 1860, having just previously been knocked down in the street. Both bones of the leg were broken across at the middle, and the skin was abraded just below the seat of fracture. The Resident Medical Officer temporarily applied lateral wooden splints.

When I saw the case, eight hours after admission, the man complained of great pain. On removing the splints, I found the leg hot and swollen, with a turn of the bandage adherent to a bleb, which had formed over the seat of injury. I did not hesitate to apply the immovable apparatus forthwith, from the foot to mid-thigh. Immediately afterwards the man expressed himself perfectly easy. He suffered some pain however in the next twenty-four hours, but it gradually decreased, and on the morning of the 15th (two days after admission), the apparatus being then quite dry, he was altogether free from pain, and could bear the limb raised and moved about, without the least discomfort. Opening along the front, swelling almost subsided, the edges pared, and additional pasteboard splints on each side of the knee.

October 16th. Perfectly easy; says the only discomfort he suffers is from lying in bed. Ordered to get up.

At the expiration of a week after admission the above-mentioned bleb broke, and the man suffered some pain from a slight ulcer which ensued. I made a trap-door for the purpose of dressing it; it healed rapidly, and at the expiration of eight weeks the injured limb was as strong and as perfectly shaped as its fellow.

Reserving comment on these cases, I beg you to note, that the peculiarity of the treament is not the starch employed,—this is a very trivial and comparatively insignificant matter. The warning is indispensable, because the profitable study of this subject has been materially checked by a very prevalent and erroneous notion, that the great feature of the treatment was *a starched bandage.* The starch is little more than an efficient substitute for the pins ordinarily employed in bandaging. The characteristics are, 1stly, Immediate reduction, regardless of spasm, blebs, extravasation of blood, or inflammatory swelling; 2ndly, Circular compression; 3rdly, Immobilization.

LECTURE II.

CONTENTS.

Gentlemen,—The previous Lecture, intended as an Introduction to the study of the subject in hand, consisted of two parts;—the first controversial and argumentative, the second dogmatic and expository of facts, some of the most important of which you had the means of testing, by examination of convalescents before you.

In submitting evidences of contradiction between some eminent authorities, I felt bound to caution

you, that those were only a few examples of the unsettled state of knowledge in this important department of Surgery, and that the views here taught, by precept and example, are opposed to those entertained and inculcated by the majority of surgeons.

The convalescent patients presented seemed to bear out the propositions enunciated. Whatever the merits of the arguments, the facts appeared cogent. Similar, but often more serious and equally successful ones, have from time to time fallen under your notice in our Clinique; and I might be induced to wait the ripening of time to complete the work, but for the teaching of experience, that it is not so easy to convince. In the anxiety to spread beyond these walls the influence of this endeavour at a reconciliation of differences, scientifically inglorious and practically mischievous, the history of all professions, but more especially of our own, reminds me of the difficulty to disabuse the mind of fallacies, venerable with age and powerful in authorities. Regarding these, I would have each of you protest,

"Nullius addictus jurare in verba magistri;"

and I would advise you, to be particularly jealous of the right of independent judgment, on the facts and reasonings which I myself submit to you. It was one of the old masters who appositely wrote, "The

neglect of the literature of the profession deprives the student of all enthusiasm and love for it; he is brought up deficient in liberal views, and is taught to over-rate the importance of the person under whom he is educated, and to content himself with walking in the trammels of his particular practice."

It has been already mentioned that the four last histories embodied in the previous Lecture failed to persuade many of the members of the Midland Medical Society, although the two most serious cases, a fracture of the thigh, and a complicated fracture of both bones of the leg, were exhibited before them. When in 1852 Mr. Erichsen and Mr. Quain very kindly complied with my desire to be allowed to use my opportunities, as House Surgeon in University Hospital, to demonstrate the relative merits of the different methods of treating fractures, I obtained, with the immovable apparatus, results so successful, that it might reasonably have been hoped its use would not hastily be abandoned; not at least within those walls. Widely different however was the result. I received a public appointment abroad, and on return, in 1856, found the long splint and the Macintyre again in quiet possession of the field, which Mr. Liston's vigorous hand really appeared to have won for them for ever. With the further advantage of the experience acquired, I repeated the

demonstration; with equally good results; and it is a satisfactory reflection that two fellow students and friends, Mr. Benjamin Hunt, in 1852-53, and Mr. David Boswell Reid, in 1856, were so impressed with the principle and practice, that they have applied it with the most successful result;—Mr. Reid in Australia,* Mr. Hunt while House Surgeon to the Queen's Hospital. Although Mr. Hunt's successes were most brilliant, and their results published,† the victory was again to be very short lived. Three years elapsed from his retirement, as House Surgeon, to my appointment to the Surgeoncy. In the interval all traces of the new method had vanished, tradition had re-asserted its sway, and the long splint, the Macintyre, and Sharp's splints, enjoyed the monopoly. The simple, uniform, and philosophical, principle once more proved powerless, before the complicated Armamentarium of empirical Chirurgery.

I was all the more impressed with these signs of discomfiture, that I had just previously returned from Paris, where, to my unspeakable astonishment, I found fractures of the thigh treated with Dessault's splints at the Charité, in the very wards of Monsieur Velpeau, the great Surgeon, whose practice, oral

* Quarterly Clinical Reports. No. I. Geelong, 1861.
† British Association Medical Journal. 1855.

teaching and writings* had, nearly twenty years previously, been so vigorously directed to the reform of the doctrine, of which Percival Pott's most worthy rival may be styled the great apostle, and Xavier Bichat the most eloquent disciple.

At the same time I found Professor Jobert at the Hôtel Dieu treating fractures in near conformity with Pott's principles; and I took occasion of a visit to St. Louis, to discuss with the very learned commentator of Ambroise Paré, some of the questions in the treatment of fracture, which had been the theme of controversy in his great works and in my Memoirs. I flattered myself that I had successfully answered Monsieur Malgaigne's objections, on the basis of fact, when he convinced me of the hopelessness of the endeavour, by remarking,—"Alors, Monsieur, les faits chez vous ne sont pas tels que les faits chez nous." It had not previously occurred to me that English and French surgical facts were different. After such a suggestion from such an authority, the truth, so aptly expressed by Sir Charles Bell,† dawned upon me in all its breadth. "What are professionally called facts are, for the

* Considérations Pratiques sur le Traitement des Fractures. Leçons Orales de Clinique Chirurgicale, données de 1837 à 1840, par M. Velpeau. Bruxelles, 1841. P. 627 et seq.

† Observations on Injuries of the Spine and of the Thigh-bone. London, 1824. P. 37.

most part, only those notions which a man insensibly adopts in the course of his practice, and which take a colour from his education and previous studies. It is this which makes the facts of one age differ from the facts of another age; and the opinions of men differently educated to vary, on what they are inconsistent enough to call matters of fact."

Nevertheless, as this is essentially a question of fact, it must be solved by facts, which to be valid, for the purpose, must be, individually, well ascertained, and, collectively, logically handled. The grand requisites, in the pursuit of such an investigation as we are engaged in, are, that the inquiry be conducted in a thoroughly impartial and comprehensive spirit,—that every due care be taken to eliminate those plausible and specious fallacies which vitiate the reasoning of surface thinkers,—that pathological phenomena be studied with the light of a sound physiology, with the discriminative power of an instructed, a severe and a well-balanced judgment,—that while the *à priori* and the *à posteriori*, the analytical and the synthetical, the inductive and the deductive view of the subject are kept distinct, they be collated and alternated;—that we study deeply the history of Surgery and of this subject in particular;—and that we never lose sight of the necessarily very complex nature of Medical facts

and of their causal relations, lest we incur those risks of error, to which is owing the confused state of a multitude of questions, in our Science, in matters concerning the treatment of disease.

So much for the principles which are to guide us, and the method to be pursued in this enquiry into the treatment of fractures of the limbs. Now, setting aside all controversial questions, endeavouring to divest the subject of its complications and difficulties, let us, for a few moments, contemplate a hypothetical case of simple fracture of the femur.

The solution of continuity is across the middle of the bone, with scarcely perceptible obliquity, and the offending agent has not wounded or bruised the elastic skin; the patient has not been moved since the accident, and our attention is called to him a few moments after its occurrence. The limb lies on its outer side, with the hip and knee joints slightly bent. Considerable pain is complained of, but no deformity is at first observable. It is only on very careful comparative measurement, that shortening to nearly a quarter of an inch is detected. The will has lost its power of control. On grasping the upper and lower end of the thigh-bone, and moving the hands gently in opposite directions, unnatural mobility is perceptible to the eye and touch, in the length of the bone, and grating may

be felt. If, as unfortunately too frequently happens, some imprudently inquisitive by-stander have raised the patient to his feet, with the object of ascertaining the nature and extent of the accident, the information will have been acquired, that he is unable to stand, and that when he attempts to do so the limb bends under him. These signs and effects are precisely what you would anticipate from a fracture of the thigh-bone, and a suspension of its two-fold function, as a column of support and as the arm of a lever.

On studying the immediate signs and effects of this fracture, we find the first and most important one, because the one to which all the others are referable, and which in fact *per se* constitutes the fracture, is the preternatural mobility in the bone. Some of the pain may be referable to the original cause of the accident, whether a blow or a fall, but the main part of it, may reasonably be attributed to the displacement of the broken surfaces, which, though assumed to be nearly transverse and not splintered, must be a source of irritation to the immediately surrounding muscular tissue, and, through the nerves which supply it, to the muscles of the limb generally. Assuming that the cause which produced the fracture, then and there, displaced the fragments, however slightly, the irri-

tating action of the broken surfaces, just referred to, would come into operation, and the opposing muscles thereby irritated would augment the displacement, being no longer able to act upon the bone, according to the physical law which regulates the resultant of antagonistic forces. To move the limb, as a whole, the muscles are powerless, and consequently their action produces motion at the weakest and most movable part,—the seat of fracture.

To the physical condition of the broken bone just commented upon, and to the subsequent inoperativeness of the will on the limb, is owing its falling outward, its *eversion*, to use the technical term, in the case we have assumed. The natural position of a lower limb whenever the normal action of its muscles is suspended, is to lie on its outer side, to be everted ;—to wit, the condition, with very rare exceptions, after fracture of the thigh-bone, during sleep, and after death. The reason is obvious. If you draw a line through the centre of gravity of a lower limb, you will find that the outer half is more bulky and heavy than the inner. This reason, in itself sufficient to explain the eversion when the subtraction of the will leaves physical laws to rule, is especially efficient in the production of the phenomenon in question, in consequence of the mode of construction of the hip joint, with the neck of the

bone oblique from above downwards and from before backwards, and with the muscles and ligaments so disposed as to allow great scope for outward rotation, but comparatively little, and difficult, for inward. Naturally, the limb is over-balanced to the outer side, and this disequilibrium produces its natural consequence, a fall outwards, whenever the controlling influence, the action of the muscles, is suspended, or rendered inoperative.

Upon the soundness of this argument hinges so much of that which is to follow, the point in discussion is of such cardinal importance in the anatomical and therapeutical history of fractures, that a further development is necessary; all the more so because an erroneous interpretation of the causes of displacement of the fragments of a broken bone, and a too narrow contemplation of vital, to the exclusion of physical, conditions and laws, led Mr. Percivall Pott into an error, which runs through the whole of his eloquent writing on Fractures, and which, notwithstanding its easily demonstrable fallacy, has continued to influence the minds of surgeons to the present day.

"The broken ends of the bone or bones," wrote Mr. Pott,* "are of themselves inactive; and if not

* Chirurgical Works. London, 1783. Vol. III. p. 385 et seq.

acted upon by other parts, they would always remain motionless. When any attempt is made to put them into motion, they of themselves can make no possible resistance; nor can any be made on their part, save an accidental one arising from the parts of the fracture being entangled with each other; and when they have been once, by the hand of the surgeon, placed properly and evenly with regard to each other, *they would of themselves for ever remain so.* What then is the reason why fractured bones always suffer a greater or less degree of displacement? why is a broken limb almost always shorter than its fellow? what creates the resistance which we always find in attempting to bring the fractured parts aptly together? whence does it proceed, that when we have done all that is in our power (according to this mode of acting) the ends of the fracture will, in many cases, become again displaced, and lameness and deformity frequently ensue? In short, what are the parts or powers which act on the bones, and which by so acting on them, produce all these consequences?

"These powers are the muscles, *the only* moving powers in an animal body. By the action of these on the bones, all locomotion is performed, and cannot be performed without them. ..... By the resistance of the muscles, and of these only, are we

prevented from being always able to put the ends of a fractured bone immediately into the most apt contact ..... Apply this reasoning to the os femoris; that bone whose fracture so often lames the patient, and disgraces the surgeon. Will it not be more cogent and more conclusive, in proportion as the muscles in connexion with this bone are more numerous and stronger? I would ask any man, who has been much conversant with accidents of this kind, what is the posture which almost every person (whose os femoris has been newly broken) puts himself into in order to obtain ease, until he gets proper assistance? Do people stretch out their limb, and place their leg and thigh straight, and resting on the calf and heel? I believe seldom or never. On the contrary, do not such people almost always bend their knee, and lay the broken thigh on its outside? and is not the reason, why this must be the necessary practice, obvious?"

The practice of treating fractures of the thigh in the bent position, the limb lying on its outer side, was founded on the just quoted reasoning. As I am about to expose its fallacies, I feel bound to premise that, considering the epoch and circumstances under which Mr. Pott wrote, the state of Surgery before his time, and the influence which his "Remarks on Fractures and Dislocations" exer-

cised on the practice of his contemporaries and followers, it must be regarded as a Memoir of the very first importance. It is rich in original views, if sometimes unsound, always instructively suggestive; it breathes the independent spirit which, above all others, sounded the note of emancipation from the thraldom of authority,* and it contains many important truths which have been generally disregarded, to the detriment of patients and to the discredit of Surgery. And yet, nevertheless, the passages quoted are pregnant with error; and chiefly for this reason: Mr. Pott contemplated *vital*, to the exclusion of *physical*, causes and effects. They both play an important part in almost every fracture. It is incorrect to state that but for the action of the muscles, the fragments of a broken thigh-bone would for ever remain properly and evenly with regard to each other, once so placed by the hand of the surgeon. Even apart from the displacing physical agency of the bony fragments themselves, Mr. Pott erred in assuming that it is possible so to place a limb as to

* "Our ancestors deserve our best thanks for the assistance which they have given us; where we find them to be right, we are obliged to embrace their opinions as truths; but implicit faith is not required from man to man; and our reverence for our predecessors must not prevent us from using our own judgments. Ancient and modern are mere sounds, and can signify nothing in this case, unless with the former we can connect an idea of truth established, and confirmed by time and experience, and with the latter, that of demonstrable improvement upon what has gone before."—Pott op cit. p. 379.

render its muscles powerless; the position most propitious to the inactivity of one set being consistent with, and as a rule favorable to, the action of the other. But for the sake of argument, given complete inaction of the muscles, the fragments would, in a large number of cases, *fall* apart, for, though the muscles be the active moving powers in an animal body, the movement or disposition of parts is regulated by the law of gravitation, in proportion as the action of the muscles is suspended, interfered with, or neutralized. It is an error to suppose that a person, with a broken thigh, *prefers* slightly bending it, and resting it on the outer side, to stretching it. The everted position of the broken limb is not one of election, but of necessity; not an effect of the will, but of the withdrawal of the member from the influence of the will, and of its consequent subjection to the law of gravitation; a proposition, in illustration of which may be cited the condition of the lower limbs during sleep and after death.

Reverting to our hypothetical case of fractured femur, we find that, as solidity is the great essential to the discharge of the functions of the healthy bone, as a column of support and the arm of a lever, fracture, and its attendant mobility, is the cause why these functions can no longer be fulfilled. If so, it follows that, were it possible, after replacing the

broken surfaces in accurate apposition, to restore solidity to the bone, it would again be equal to its offices as the arm of a lever and a supporting column. The loss of the requisite solidity and preternatural mobility are synonymous expressions for one and the same condition, and it consequently follows that the fragments once fitted, the consequences of the fracture would cease, so soon as an end were put to the preternatural mobility;—in other words, so soon as the fragments were rendered immovable. *Mobility* being the first and great character of the fractured bone, and the immediate cause of its phenomena, it follows that *immobility* should be the condition sought, *immobilization* the principle of cure, and *immovable* the means.

Theoretically considering the principle of action of an immovable apparatus, closely fitting as it does to the elevations and depressions of the limb, the fragments having previously been placed in accurate apposition, it may be said to act the part of an outer skeleton, whilst the solution of continuity in the bone is being repaired, giving to the soft parts that support which the natural skeleton previously afforded. The surgeon, applying an apparatus of the kind, closely follows nature's example. The soft parts of the animal frame are supported on two principles,—by an outward shell, as in the crab; by an

interior skeleton, in man. When a part of the interior bony framework is broken, what more rational than, during its repair, to support the soft parts by nature's other scheme,—an investing shell? This is precisely what a surgeon does, in treating a broken thigh or leg with an immovable apparatus.*

Let us now leave the region of hypothesis and argument for that of actual fact and demonstration. We have been contemplating a supposed case of simple fracture of the thigh, and shall now revert to the study of the two real cases of that injury related in the preceding Lecture, (Cases I. and IV.) Both were cases of slightly oblique fracture of femur in lads, with little shortening. Reduction was effected immediately, by an assistant extending at the foot, another opposing the extension by holding fast to a towel passed round the groin, and, myself, moulding the fragments into accurate apposition. This done, moistened pasteboard splints, lined with a layer of cotton wool, were applied, posteriorly, internally, and externally, and accurately moulded to the surface of the limb, from the crest of the ilium to the sole of the foot. The splints were

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* On the Relative Merits of the different Methods of Treating Fractures of the Lower Limbs, in Researches on Pathological Anatomy and Clinical Surgery. By Joseph Sampson Gamgee. London, 1856. P. 155-6.

starched and so was the outside of the rollers, which were applied with care, and gentle pressure, throughout. When the apparatus became dry and somewhat loose, it was cut open in front and re-fitted; the one lad left his bed the fourth day, tho other the fifth. In both recovery was equally perfect, without any shortening, and with very slight thickening of the bone at the seat of injury.

The patients being able to leave their bed so early, and, that, in perfect comfort, coupled with the final result of the treatment, is proof of how thoroughly the apparatus was efficient in maintaining the fragments, immovably, in the precise position in which their broken surfaces were adjusted in the process of reduction. It was only when consolidation was perfect, that the bone regained its functions as a column of support and as the arm of a lever; but, during the interval, the patients were relieved of the principal discomforts attending such accidents, they suffered no pain, were not confined to bed, and were able to take exercise on crutches. Deferring the consideration of the absolute and comparative merits of the plan of treatment adopted, a cardinal point deserves notice;—the very perfect outline of the injured bone so soon as consolidation was effected,—"the thickening at the seat of injury being so very slight as to be scarcely distinguishable." By what

physiological process was this result brought about? The reply involves solution of the very interesting question—By what physiological process is a broken bone repaired?

As the whole question of compound fractures is deferred for the present, it is only with the repair of simple fracture that we have now to deal.

For nearly forty years the doctrine of Duhamel* and Dupuytren prevailed in the schools. Nature, (to condense the latter authority,)† *never* effects the consolidation of a fracture except by the formation of two successive calli, the one the *provisional*, the other the *definitive* callus. The former, *(the tumour of the callus)* is a kind of ferule surrounding and binding together the broken ends; its formation occupies between thirty and forty days from the date of injury, while the deposition of the definitive callus, directly between the broken surfaces, is not complete for eight, ten, or twelve months.

This doctrine, based upon experiments in animals, and upon the results of faulty practice in human surgery, has been productive of incalculable mischief, by teaching the surgeons of two generations

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* In Histoire et Mémoires de l'Académie des Sciences, 1739-43.

† De la Formation du Cal, Leçons Orales, Vol. II, p. 47 et seq.—Exposé de la Doctrine de M. Dupuytren sur le cal avec des Observations à l' appui, par M. L. J. Sanson.—*Journal Universel des Sciences Médicales*, Vol. xx.

to regard, and to aim at attaining, as a healthy condition, essential to the repair of every fracture, that which is exceptional and abnormal. The Hippocratic sentence, "Experimentum fallax," cannot be applied to the results of any of the many faulty investigations which have checked the progress of medical science, more aptly than to Baron Dupuytren's in question.

Modern researches* have demonstrated that fractures in man sometimes unite by the first intention, that the union as a rule takes place by direct deposit between the broken surfaces, that *provisional* callus is exceptional, and that, when it does occur, it is owing to extensive injury to the soft parts, at the time of the accident, or to their subsequent irritation by the fragments, when not kept perfectly at rest; whence it follows,—that the treatment of a fracture is perfect, in proportion as the thickening at the seat of injury is slight, as in our cases.

It is especially noteworthy that between the epochs of Duhamel and Dupuytren, Percivall Pott wrote; and that on this important subject—the union of fractures—he perceived and expounded the

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* *Vötsch* die Heilung der Knochenbrüche per primam intentionem. Mit 5 Taf. Heidelberg, 1847. *Stanley.*—A Treatise on Diseases of the Bones. London, 1849. *Paget.*—Lectures on Surgical Pathology. London, 1853. Vol. I.

truth so clearly, that he may be said to have forestalled the researches of Stanley and Paget, his successors in the great Hospital rendered glorious in the annals of our art by their common labours. Yet did Dupuytren's erroneous doctrine, of the provisional and the definitive callus, retard the victory of Pott's philosophical interpretation nearly three quarters of a century.

*"That this callus or uniting medium does oftentimes create tumefaction or deformity, or even lameness, is true; but the fault in these cases does not lie in the mere redundance of such juice; it is derived from the nature of the fracture, from the inequality of it when set, and from the unapt position of the broken ends with regard to each other; nor is surgery or the surgeon any otherwise blameable in this case, than as it was or was not originally in their power to have placed them better. It is the inequality of the fracture which makes both the real and apparent redundance of callus, and the tumefaction in the place of union. When a bone has been broken transversely, or nearly so, and its inequalities are therefore neither many nor great, *when such broken parts have been happily and properly coaptated, and proper methods have been used to keep*

* Pott, op. cit Vol. I., p. 407 et seq.

them constantly and steadily in such state of coaptation, the divided parts unite by the intervention of the circulating juice, just as the softer parts do, allowing a different space of time for different texture and consistence. When the union of a broken bone under such circumstances has been procured, the place where such union has been made will be very little perceptible, it will be no deformity, nor will it occasion any inconvenience. It will indeed be discoverable, like a cicatrix of a wound in a softer part; but there will be no redundance of callus... .....But when a bone has been broken very obliquely, or very unequally, when the parts of a fracture are so circumstanced as not to admit of exact coaptation, when such exact coaptation as the fracture perhaps would have admitted has not been judiciously made, when from unmanageableness, inadvertence, or spasm, the proper position of the limb has not been attended to or preserved, in all such cases there must be considerable inequality of surface; there must be risings on one side, and depressions on another; and in such cases the juices circulating through the bone, cannot accomplish the union in the same quantity, the same time, or in the same manner. The broken parts not being applied exactly to each other, there cannot be the same aptitude to unite; and according to the greater

or lesser degree of exactitude in the coaptation will the inconvenience and the deformity be."

This comparison, instituted by Pott, between the direct consolidation of simple fractures, and the healing of wounds of the soft parts, the stress he laid on the necessity of effecting and maintaining accurate coaptation, and his reference of redundant callus to mobility of the fragments, either from the nature of the fracture, from spasm, or from inattention on the part of the surgeon, is the sum and substance of the results of modern researches, and is a confirmation of our proposition that when a fracture has been reduced, *immobilization* is the principle which should guide the treatment, the result of which will be perfect in proportion as the principle is adhered to.

The two cases on which we have been commenting during this Lecture were so simple that, although efficient for our present purpose, any further reasoning founded upon them might be held defective in foundation. Therefore it is that I beg your attention to the report of

Case VIII.—*Oblique Fracture of femur just above condyles.—Shortening to an inch and a half.—Immediate reduction, and immobilization by starched apparatus.—Thirty-six hours after the accident the patient walked on crutches with perfect ease.—At the end of*

*nine weeks union solid, without shortening; walked seven miles with the sole aid of a stick.**

Henry Ponfrit, a healthy looking lad, æt. 17, admitted to Ward I, University College, London, the evening of the 27th December, 1852. "He had fallen over a bench a short time previously. I found the left femur fractured obliquely, with displacement of the lower fragment upwards and backwards, about an inch and a half above the condyles. Grating distinct. Shortening to an inch and a half. On making extension, it was easy to restore the limb to its natural length; but the fragments continued separate, owing to antero-posterior displacement. Coaptation could only be effected by pressing on the upper fragment while extension was being made. There was no swelling; no bruise of the skin.

I at once applied the apparatus, and left the boy with two perfectly matched lower limbs, and free from pain. In order to maintain coaptation, a sand bag, about six pounds in weight, was placed on the part corresponding to the upper fragment. Thirty-six hours after admission, I made the lad get out of bed, and walk up and down the ward on crutches.

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* On the Advantages of the Starched Apparatus in the Treatment of Fractures and Diseases of Joints. (Liston Prize Thesis.) By Joseph Sampson Gamgee. London, 1853. P. 29 et seq.

He did so with perfect ease, the foot being supported in a sling, so as not to touch the ground.

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

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

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

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

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

With a view to demonstrate to those around me

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

From the second day after the accident the boy was constantly in the habit of early rising, walking about on crutches, helping the nurses in doing the light work of the ward, and only retiring to bed at an advanced hour in the evening.

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

LECTURE III.

CONTENTS.

Gentlemen,—Various reasons led me to conclude the preceding Lecture by reading you one of my cases published several years ago. It affords an example of one of the most formidable fractures,

both on account of the anatomical lesions attending it, and of the great difficulty of maintaining co-aptation; it was one of my earliest essays with the immovable apparatus, and may therefore be adduced in illustration of the value of the method of treatment, in the hands of one comparatively unskilled in its employment.

The line of fracture, I may briefly remind you, was oblique, just above the condyles; and the lower fragment was drawn upwards and backwards into the popliteal space, to such an extent as to produce an inch and a half shortening; this disappeared on effecting extension, but the fragments continued separate, owing to antero-posterior displacement. I reduced the fracture immediately, accurately adjusting the fragments and fixing them and the entire limb, by means of moistened pasteboard splints and starched bandages; a sand-bag, six pounds in weight, being additionally placed over the upper fragment. The lad walked on crutches without pain thirty-six hours after the accident; and, nine weeks later, he could bend his knee at a right angle and walk seven miles, with the sole aid of a stick; no difference whatever being discernible between the length of the two lower limbs.*

* "Admitting, for the sake of argument, that this was an exceptionally fortunate case (though I have no reason for supposing it to

have been such), what other plan of treatment could have given such a result in a similar case, even under peculiarly advantageous circumstances? Treating of oblique fracture of the os femoris, just above its condyles, precisely the kind of injury of which Henry Ponfrit was the subject, Sir Astley Cooper remarks:† 'This is a formidable injury, from its consequences on the future form and use of the limb; for it is liable to terminate most unfortunately, by producing deformity, and by preventing the flexion of the knee-joint . . . . . It appears, then, in the treatment of this case, that a most firm and continued extension must be supported, to prevent the retraction which will otherwise ensue; but it will be seen by the two following cases, that this defective union is with great difficulty prevented, and that the complete flexion of the limb afterwards was not in either instance accomplished.' The report of the first of these cases, in which the accident happened on the 20th July, 1821, is thus concluded by Sir Astley:* 'October 16th, the union was considered complete, and the patient allowed to get up. On November 1st he resumed his professional duties as an advocate. For a considerable period he suffered great pain and swelling of the limb, but has gradually and slowly improved. May, 1822.—At this date he can walk about his room without assistance either of crutch or stick. He has little power of flexion at the knee-joint. The joint is, however apparently movable to a certain extent beneath the patella, which bone is fixed beneath the projecting edge of the upper portion of the femur, which evidently overlaps and displaces it. There is visible shortening of the limb, and the contour of the thigh is some what bowed outwards.' The termination of the second case was still more unfortunate. The accident happened on the 9th of November, 1819. 'On January the 29th, 1822, he was, for the first time, on crutches; and on February the 24th he first walked out of doors. His present state (March, 1822) is as follows:—The bone above the knee is excessively enlarged; the patella is fixed below the broken extremity of the shaft of the bone, the point of which adheres to the skin.'†

The serious impression which these cases are calculated to produce, is not a little added to by the reflection that after commenting on the very formidable nature of the injury, they are the two only examples of it related by Sir Astley, who has thereby afforded ground for the inference, that in his immense experience he has not witnessed any cases of perfect recovery from it."—*On the Advantages of the Starched Apparatus. Op. cit. Page* 31-32.

* Op. cit. Page 247. † Op. cit. Page 249.

† A Treatise on Dislocations and Fractures of the Joints. 1842. Page 244.

What is the *rationale* of the method of treatment employed?

The situation and direction of the fracture, and the character of the displacement, render it extremely probable that some of the highly important soft parts in the vicinity—the knee joint capsule and the great extensor in front, the popliteal vessels and nerves posteriorly,—were bruised at the time, and might have suffered considerably, had not the offending agents—the pointed fragments—been immediately removed by effecting reduction, and very accurately and firmly maintaining co-aptation. Preternatural mobility was the cause of the phenomena present when the patient was first seen, and no sooner was its immediate effect, the displacement, removed by reduction, and the recurrence of the cause prevented by immobilization, than the danger of further mischief ceased, and the process of repair advanced uninterruptedly under the protection, and vicarious function, of the temporary exoskeleton.

In accordance with the doctrine that preternatural mobility is the cause of all the phenomena in a broken limb, I was very careful not to move the fragments any more than was imperatively necessary, to determine the principal features of the case. As a rule with rare exceptions, the diagnosis of a frac-

ture is an easy matter, and beyond ascertaining the existence of the lesion, it is inadvisable to move the fragments to solve questions of direction and comminution. In the event of complication with swelling, the determination of the exact condition of a fracture is sometimes difficult, not unfrequently impossible, without great manipulation, which is a very great evil. Once you have satisfied yourselves a bone is broken, and that the injury is not so severe as to suggest immediate amputation, proceed to reduce without a moment's delay, and to immobilize with the utmost delicacy and completeness.

Reserving to the following lecture the development of these principles in their application to the treatment of fractures complicated with swelling and wound, let us revert to the case of simple oblique fracture of the lower end of the femur, selected for present commentary.

Fitting the limb as the starched pasteboard and bandage case did very accurately, closely corresponding to the eminences and depressions of the foot, knee and pelvis, and fixing the joints above and below the seat of fracture, the apparatus was calculated to maintain the state in which the limb had been placed by extension and counter-extension, by preventing retraction, had the muscles been able

to act with their usual power. But I hold that the muscles were indisposed to, if not incapacitated for, action, by the constrained extended position of the limb, and by the gentle, uniform and circular compression exercised by the apparatus from the moment of its first application, and carefully maintained by subsequent re-adjustment.

You can, I feel confident, have no difficulty in understanding how the apparatus tended to keeping the limb fixed by preventing eversion, when you bear in mind that the outer pasteboard splints extended from the iliac crest to the sole of the foot, that the buttock was completely encased, that the knee was rendered immovable, and that the upper end of the apparatus was secured to the pelvis by a double (antero-posterior) spica, while the lower end embraced both sides of the foot.

One little matter mentioned in the history of the case still calls for notice. It has been stated that on making extension it was easy to restore the limb to its natural length, but that the fragments continued separate owing to antero-posterior displacement; to counteract which, after applying the apparatus, a sand-bag, about six pounds in weight, was placed on the part corresponding to the upper fragment. Once the apparatus was dry it was perfectly efficient in controlling even this ten-

dency to displacement, though the patient walked about from the second day after the accident. The cause of the antero-posterior displacement was probably twofold, 1stly, and chiefly I think, it was due to the falling backwards of the knee and lower fragment, and, 2ndly, to tilting forwards of the upper fragment. Once the splints and bandages acquired firmness, their circular action maintained perfect apposition. This antero-posterior displacement, due partly to muscular action on the upper fragment and to the falling back of the lower, is one of the chief sources of difficulty in treating fractures in the lower part of the thigh and leg, in which the line of separation between the fragments is oblique, from above downwards and from behind forwards. I know no better illustration than this of the necessity of studying physical as well as vital causes in their operation on a fracture; it is beyond doubt that much of the prevalent error on the great question of treatment of fractures is due to surgeons viewing the subject too exclusively, as physiologists or mechanicians; predicating too theoretically, or acting too empirically.

The sand-bag which was placed on the upper three-fourths of the thigh in Henry Ponfrit's case not improbably acted in two ways,—by its pressure indisposing the muscles to action, and by approxi-

mating the fragments. Under similar circumstances, whether of oblique fracture of the lower end of the femur or tibia, bearing in mind the natural anterior convexity of the bone, it is advantageous to place a nicely-adjusted pad of lint posteriorly, corresponding to the extent of the lower fragment. Not unfrequently, with this simple addition to very careful application of the ordinary immovable apparatus, it is possible to prevent the antero-posterior displacements in question, from the very first. Nevertheless I always add an anterior pasteboard splint, after the first section and re-adjustment of the apparatus; with a view of more perfectly encasing, more uniformly compressing, and more efficiently steadying and preventing motion in the entire limb. The sand-bag is useful in cases of oblique fracture with great displacement, but it is rarely required, even during the drying process.

When the subject of accident is very muscular, when the lesion is very oblique, when complications are present, such as swelling blebs or wounds, or when, as not very rarely happens in the first and most important stage of the treatment of fractures, the patient is restless, perhaps violent, through drunkenness, extra precaution should be taken to ensure absolute rest of the injured limb. The one desideratum of complete and immediate fixity may

be secured by the plaster of Paris bandage,* but, as I shall in due course take occasion to explain, it is not so manageable throughout the subsequent treatment, especially in the event of complications, as is the starched apparatus. Under the difficulties assumed, the latter may be strengthened by wire, dry pasteboard, or wooden, splints; but the method which is, at one and the same time, most agreeable to the patient and most approvable to the surgeon is that of suspending the injured limb.

The late Matthias Mayor, the impulsive and too exclusive, but always philosophically suggestive, Surgeon of Lausanne, was the chief, though not the

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* CASE IX.—*Fracture of Fibula with considerable swelling.—Instant immobilization, by plaster of Paris bandage.—Patient discharged hospital next day.—Perfect recovery.*

Peter Hayes, admitted in V5 Ward 15th September, 1859, having, the previous evening, slipped, with right foot under him. Right fibula broken 2½ inches above lower end of its malleolus. Skin sound but swelling on outer part of ankle very considerable. Much pain.

I, at once, applied a layer of soft bandage from toes to knee, and over it two layers of plaster of Paris bandage, with intermediate fold splint of same bandage on outer side. Almost immediately afterwards the apparatus was dry and solid, and the patient felt quite comfortable.

16th September.—Discharged.

22nd September attended as an out-patient.—Has been sufficiently well to do light work in his trade as a japanner.—The leg has been perfectly easy to within the last twenty-four hours, during which it has been slightly painful.—Apparatus loose from subsidence of swelling; opened, edges pared and closely re-adjusted with common bandage, after which quite easy.

October 16th.—Apparatus removed, good firm union,—no pain, no abrasion of skin,—movements of ankle perfect.

first,* advocate of the treatment of fractures by suspension and flexion. The plan of extension and immobilization he ridiculed with a force worthy of a Guy-Patin. I had carefully read the works of Seutin and Mayor, and had been a pupil of the former when, in 1852, I first visited the surgical wards of the little hospital on the borders of the Lake Leman, memorable in the annals of Surgery as the place of study, and the field of action, of the talented author of "La Chirurgie Simplifiée." I had found Seutin's results wonderfully successful, and Mayor's were scarcely less so. The former summed up his teaching in "L'Appareil inamovible," the latter inveighed against it as "ce rude et perfide inamovible;" yet both achieved signal practical successes with their respective methods;—another illustration of the proposition, that means apparently very different may resemble each other in their mode of action, and conduce to results substantially the same.

A little reflection, and the test of experience, soon convinced me that the ultimate physiological action of the two methods was similar, and that they might occasionally be combined with decided advantage for the attainment of the great desideratum,

* *Sauter*, Anweisung der Beinbrüche Gliedmassen ohne Schienen sicher zu heilen. 1812.

—perfect and immovable co-aptation of the fragments of a broken bone.

A few words as to the *rationale* of the suspension plan. The flexed position of the leg upon the thigh, and of the latter upon the trunk, tends to muscular relaxation; but, what is more particularly worthy of notice, is the manner in which the movements of the body, and the action of the muscles of the broken limb, are, by the swing, prevented displacing the fragments. This will best appear upon comparing a broken leg placed upon a Macintyre, and one, similarly injured, in a swing. In the case of the Macintyre, the leg is fixed to the apparatus, and this to the bedstead through the block on which it rests. If the patient's body move, or the muscles of the thigh and calf otherwise act, the motor power is concentrated upon the weakest and most movable part—the seat of fracture—the apparatus and bed being immovable; *ergo*, liability to displacement. In the case of a swing, the motive power is almost completely expended in moving the apparatus, and with it the limb as a whole, and very little of the impetus is felt at the weak spot; *ergo*, the less liability to motion and displacement of fragments. In this comparison, it will be observed that I have assumed precisely similar fractures, and equal motor power; but difference in the ap-

paratuses, so far as fixity;—the one to an immovable block, the other an undulating sling. It follows theoretically, that to ensure the great desideratum, —the communication of the least possible impulse to the point of fracture,—the swing should be as movable as possible, so as to exhaust in its undulations the motive power communicated to the limb, and thereby lessen the chances of a jerk in any part of its length. You often see these principles put into practice in our Clinique, and when you have a difficult fracture of the lower end of the thigh or leg you may, with great advantage, especially in the latter case, swing the limb, until the starched apparatus is dry and definitely adjusted.

Before proceeding further with the consideration of the subject, with special reference to the complications of fractures, such as wound or contusion of the skin, extravasation of blood and inflammatory swelling, it will, I think, be conducive to a more clear understanding of the principles already enunciated, and to a more rigid examination of the practice reported, if we test them by the standard of two of the great surgeons of our time,—Mr. Liston and Mr. Syme; but, before doing so, let me recall to your memory a passage in the preceding Lecture:— "*Mobility* being the first and great character of a fractured bone, and the immediate cause of its phe-

nomena, it follows that *immobility* should be the condition sought, (after accurate co-aptation of the fragments), *immobilization* the principle of cure, and *immovable* the means."

"In the treatment of fracture* as in solution of continuity in the soft parts, great advantage is gained by placing the disjoined parts as nearly in their original position as possible, retaining them so, and allowing of *no motion.* ..... In all fractures, whether simple or compound, comminuted or complicated, if an attempt is to be made to save the limb, *let reduction be immediate;* co-aptation and retention of the separated parts cannot be made too soon." In another and more recent work, Mr. Liston taught :† "The object of the surgeon in the treatment of all fractures must be to obviate pain and suffering, to put the parts in the most favorable condition for being repaired, and to preserve the limb of its normal shape and length. All these indications are fulfilled by the same means, viz. *instant co-aptation, and retention of the broken ends in the most perfect possible apposition.* The earlier the means are adopted, the greater and more immediate will be the patient's relief from suffering, and the less the surgeon's anxiety and labour."

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* Liston ; Elements of Surgery. 2nd Edit. 1840. P. 687.
† Practical Surgery. 4th Edit. London, 1846. P. 62.

The principles of treatment, thus expounded by Mr. Liston, are identically those taught in these Lectures;—instant reduction, perfect co-aptation, and retention so as to allow of *no motion.* But the long splint and the Macintyre, as modified and employed by Mr. Liston, are very imperfectly calculated to attain the object of which he recognized the importance in theory, without venturing to put into practice the means necessary for its attainment.

In the employment of Macintyre's splint, advantage is sought to be taken of the effects of the flexed position in relaxing the muscles; of extension and counter-extension in effecting reduction and maintaining co-aptation; the foot being the part upon which the extending force is exerted, while the counter-extension is kept up by the weight of the body. In a very considerable number of broken legs, this apparatus is consistent with excellent results: its employment, however, confines the patient in an uncomfortable position, renders the use of the bed-pan, and indeed any movement in bed, difficult if not painful, and is not unfrequently productive of very considerable suffering at the heel and ankle; particularly when it is necessary to bandage firmly for the maintenance of co-aptation. There are, moreover, some exceptionally difficult cases,—*e.g.*, fractures of the leg, with tendency of a

flute-mouth shaped upper fragment of tibia to cock up, and of lower one to be dragged upwards and backwards,—in the management of which, the Macintyre is very inefficient; and this for two reasons:—it cannot relax all the muscles, and is mechancially inadequate to fixing the fragments. The practice of suspending the foot in a stocking from the toe, with a view to relieve the heel of pressure, operates as an active cause of displacement, by depressing the upper end of the lower fragment; and even though the latter be withdrawn from the power of the muscles by the division of the tendo Achillis, observation has proved that sometimes co-aptation cannot be maintained with this splint, in spite of the nicest management. In fractures very near the ankle-joint, especially when compound, and in all fractures of the leg associated with bruises or other injury of the foot, the Macintyre fails—often altogether. In children it is always very inconvenient.

The long splint, applied according to Mr. Liston's directions,* maintains reduction by virtue of the extension power applied to the foot, and the counter-extension exerted above, through the perineal band. The circular bandaging from the foot to the upper

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Practical Surgery. Ed. lit. Page 87 et seq.

part of the thigh, likewise exercises an influence in maintaining the fragments in proper apposition.

There can be no question that the long splint thus applied, is an efficient instrument in treating many fractures of the femur. It is objectionable, however, as confining the patient in bed in a fixed position, during the whole course of treatment,—confinement peculiarly objectionable in children and old people. The use of the bed-pan is inconvenient, and, in consequence of the bandages becoming loose, it is necessary to re-apply them, and renew extension almost every fortnight; to the patient's suffering, and, it is fairly presumable, to the retardation of bony consolidation. But in oblique fractures just below the trochanters, with tendency of the upper fragment to cocking forwards and outwards; and in oblique fractures of the lower end of the femur, with displacement of the lower fragment backwards and upwards, the long splint is almost always an unsatisfactory instrument, often altogether inadequate, so to maintain co-aptation as to insure re-consolidation, without very manifest deformity. I do not lay great stress on the pain at the heel and ankle, and chafing in the groin, which the long splint is apt to occasion, for they may commonly be averted; yet they are so liable to occur in some cases, even in spite of much care,

that they must be regarded as special annoyances attending the use of that instrument.

Mr. Syme has summed up his teaching on this matter in three propositions.*

"1. That the great requisites for treating fractures successfully are co-aptation and immobility.

"2. That extension, or a struggle between the two opposing forces of muscular contraction and a mechanical power, is not consistent with either of these conditions.

"3. That therefore extension should be abandoned in the treatment of fractures."

The first proposition is wholly true; the second involves a *petitio principii*, in that maintenance of a limb in an extended position does not necessarily involve *a struggle* between the two opposing forces, of muscular contraction and a mechanical power; and the third precept could not be practically adopted, without certainty of accident in many cases. Extension and counter-extension are indispensable in the first stage of the treatment of all fractures attended with longitudinal displacement; and it is absolutely necessary to maintain the extended position of the broken bone, (though not

* Edinburgh Medical Journal, 1858. P. 292.

necessarily the extended position of the entire limb), throughout the whole period of repair.

"There are few principles (to quote from Mr. Syme's latest published work)* more firmly established, or, as it seems to me, more entirely erroneous, than that extension is essential for the successful treatment of a fractured thigh-bone. I long believed and taught this as an incontrovertible truth, but for some time past have been satisfied that it is equally unsound in theory, and opposed to good practice. The 'long splint' of Desault, which was contrived on purpose to effect extension by stretching the perineum and foot of the injured limb between the extremities of a wooden board, has been found so useful in the treatment of this fracture, that most people will probably regard the opinion just expressed with no less surprise than disapprobation. But if a case of the kind in question, which ultimately terminates favourably, is carefully watched during the process of recovery, it will be found that the bands employed for effecting extension are never tight, and merely tied with sufficient firmness to keep the apparatus in its place. It is when the fractured bone has been imperfectly set, and the limb is found to be shorter than its

* Observations in Clinical Surgery. Edinburgh, 1861. P. 1 et seq.

fellow, that the surgeon racks his patient by desperately tugging at the bandages, and all to no purpose, as the muscles are sure to conquer in this contest. . . . . Instead of exciting the muscles to contract by subjecting them to extension, the great object in treating a fracture should be to place them at rest, and by protecting them from all sources of irritation to oppose their contractile action. For this purpose the preventing of motion is of most consequence, since every displacement of the broken surfaces must tend to irritate their muscular coverings, and hence the great value of Mr. Pott's improvement in the construction of splints, by making them long enough to extend beyond the joints at both ends of the broken bone. It is upon the same principle that the splint of Desault proves so useful, since its influence extends over all the articulations of the limb, and by preventing any one of them from moving, keeps the whole in a state of perfect quiet.

"In treating a fracture of the thigh-bone, the first step should be to draw out the limb to its proper length, direction, and shape; and if this cannot be done readily on account of the patient's involuntary resistance, it may be accomplished through the aid of chloroform. Two splints of wood, leather, or pasteboard, the full length of the thigh, from the

trochanter major on one side, and the perineum on the other, to below the knee on both sides, are then to be applied and secured by four or five looped bandages, and lastly, the long splint wrapped in a sheet or table cloth, of which enough is left free for covering the limb, being placed by the patient's side, the loose portion is brought over and fastened to the board, after which, by means of the perineal and ankle bands, together with one round the body, the whole apparatus is rendered secure."

This criticism of the action of the long splint, assumes it to be identical with Desault's splint* for fractured thigh, whereas the two are really very different, in the fact of their lengths. Desault's extends no higher than the crest of the ilium, whereas the "long splint," properly so called, reaches to a level with the nipple. In the use of the latter, according to the practice of Mr. Liston and his school, once a broken thigh is reduced by extension and counter-extension, the long splint is placed on the outer side of the limb; the lower end is secured to the foot, while an assistant tightens the perineal band, so as to maintain the full extension; and fixes it, so soon as the limb is bandaged.

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* Œuvres Chirurgicales ou Exposé de la Doctrine et de la Pratique de P. J. Desault, par Xavier Bichat. Paris, 1801. Tome 1er, p. 207.

"The perineal band,* by which the splint, and with it the limb, is pushed downwards, is attended to from day to day, and tightened as it becomes relaxed, in order to overcome any tendency to shortening." This tightening the perineal band is absolutely essential to obtaining a good result if the long splint be employed; but it is not fair to designate such tightening as "racking the patient by desperately tugging at the bandages." Mr. Syme's counsel to secure the apparatus, *after the splints have been applied*, by means of the perineal and ankle bands, is inconsistent with the action of the long splint as employed by Mr. Liston and his school. The discrepancy may not, at first sight, seem great, but on examination and experiment it will be found to be of fundamental character.

The truth is that the apparatus employed for fractured thigh by Mr. Syme, and after the experience of which he discusses the action of the long splint, and denies its operation by extension and counter-extension, acts on different mechanical and physiological principles, though both aim at the same ultimate result,—the prevention of motion.

Before proceeding let us remark that Mr. Syme's practical precept is opposed to his 3rd aphorism,—

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* Liston's Practical Surgery. Cit. p. 88.

"That extension should be abandoned in the treatment of fractures." He tells you that "In treating a fracture of the thigh bone, the first step should be to *draw out the limb to its proper length.*" What is this but effecting extension? He then gives directions for the application of splints, &c. which are to maintain the fragments in apposition, that is, to keep the limb of its proper length. What is this if not keeping up extension? The question is how is the extension kept up, how is retraction prevented, how are the muscles kept inoperative with Mr. Syme's apparatus? When extension has been effected he directs leather, pasteboard or wooden splints to be secured on each side of the limb from the trochanter and perineum, respectively, to below the knee, and lastly the long splint to be secured to the outer side by means of a sheet and the perineal and ankle bands. This apparatus acts, in a measure, as an immovable apparatus, by fixing the joints above and below the seat of fracture, and by circularly compressing the muscles. It is inferior to the starched apparatus, however, in that it cannot fit so accurately, and does not so effectually immobilize the entire limb; while it compels the patient to keep his bed.

Mr. Syme's practice accords with his first aphorism, "that the great requisites for treating frac-

tures successfully are co-aptation and immobility," but he admits himself his apparatus for fractured thigh is imperfectly calculated to attain these ends, as results from a study of his remarks on "Ununited Fracture." I quite agree that, "This unfortunate result of a fracture,* although it has been attributed to other sources, unquestionably, with hardly any exceptions, proceeds from the broken surfaces not being maintained in a state of sufficient rest during the process of reparation." ..... "With regard† to the treatment of ununited fractures in general, I had long been satisfied that the expedients in ordinary use, or at all events usually recommended, such as rubbing the broken ends together, stirring up their connecting medium by the introduction of needles, or passing setons through it, if they were ever found to prove successful, did so not from their own direct agency, but from the enforcement of rest conjoined with their employment, which would have been equally efficient, although not associated with any other remedial means. By the careful application of proper splints the humerus may be kept sufficiently free from motion for the accomplishment of osseous union under ordinary circumstances; but to obtain that absolute immobility which is requisite

* Syme's Observations in Clinical Surgery, p. 13.
† Id, p. 14, 15.

for effecting consolidation when delayed beyond the proper period, is attended with no small difficulty. Indeed, the only mode of attaining this object seems to be the same as that employed in regard to disease of the hip-joint, with a similar view, which produces its effect by completely suspending action in all the articulations of the limb. In this case, however, such simple means as the long splint are not applicable, and the only way of keeping all the joints at rest is to envelop the whole limb, together with the scapular region, in a firm case of starched pasteboard, extending from the finger points to the back of the shoulder." This admission is all that I contend for;—that an apparatus of starched pasteboard affords the means of immobilizing the fragments of a broken bone more effectually than does the long splint, or the host of other like appliances commonly used in the treatment of fractures. If so, why not always employ an immovable apparatus, if, as laid down in Mr. Syme's first aphorism, and as is demonstrably true, "the great requisites for treating fractures successfully are co-aptation and immobility"? I believe the answer to this question is supplied in the present and preceding Lectures, but if the arguments and the facts adduced be insufficient or defective, I trust the want may be supplied before the completion of our course.

I was consulted about two months ago in a case of ununited fracture of the thigh. The accident had occurred six months previously; the patient was a healthy young man about 25 years of age. Ordinary splints, reaching only as high as the iliac crest, had been employed in the treatment of the primary accident. My opinion was specially requested, with reference to a proposition, which had been made, to cut down on the fracture (junction of middle with lower third of left femur), and resect the ends of the fragments. I submitted that this operation was a very serious one;—that the patient was not suffering from any constitutional disease; that this fact, in conjunction with the history of the treatment which had been employed, suggested the great probability of a local cause, for the local accident. The cause of the want of union, I held to be the imperfect means which had been employed to maintain co-aptation. Accordingly I recommended absolute immobilization. This counsel prevailed, and I am informed that the thigh-bone is now perfectly solid. The advice I gave was accepted with some reluctance, and I only succeeded in ensuring its practical adoption by remarking, that, assuming the cutting operation to be necessary, a month's delay could not

prejudice its result; and that a month's complete immobilization would be sufficient to test the disposition to bony consolidation. I endeavoured to strengthen my position by quoting Mr. Syme's remarks on Ununited Fracture; but it was objected, that he referred particularly to the Humerus. A fracture of one of the bones of the limbs is substantially the same whatever its situation. The causes of displacement are similar; the principles of treatment are identical; and the practice only differs, in comparatively unimportant detail. The numerous splints and contrivances recommended for different fractures of the upper and lower extremity, are evidence of an imperfect understanding of the subject, and must eventually give way before a philosophical appreciation of its fundamental principles, and a correct estimate of their practical application.

LECTURE IV.

CONTENTS.

Gentlemen,—The study of the treatment of Simple Fractures of the Limbs, which has occupied our consideration in the three preceding Lectures, has been proved, by quotations from the masters, and by a reference to facts as observed in nature, to be anything but a simple subject. I have not concealed intention to search out and reconcile differences, to contrast and to explain inconsistencies, with the ultimate view of theoretically and experimentally demonstrating the truth. We are frequently twitted with the discordance of Medical Authorities: often unjustly so, because there is undoubtedly a period in every department of human knowledge when the development of differences denotes the dawn of progress; and history, scientific and political, teaches us that unanimity is often the expression of unenlightened submission to authority,—at one and the same time the evidence, effect, and cause, of mental torpor. Yet it is true, that the great aim of a free growth of differences should be convergence to the legitimate end of all human endeavour,—the demonstration and definition of the truth.

Viewed in this light, the conflicting teaching of surgical writers on the subject matter of these

Lectures, is a stimulus to exertion; and, without presuming to convince everyone, I feel full of hope that the method of investigation we are pursuing may facilitate the construction of a body of sound doctrine, on one of the most interesting and useful subjects in practical surgery.

As we proceed to the study of the Complications of Fracture, and notably of swelling and wound of the soft parts, you will find that I differ still more widely than I have previously done, from the authors of the excellent text books on Surgery used in the Schools,—so much so indeed, that I forbear quoting in evidence; for partial allusion would be unjust, and a complete enumeration would almost amount to a catalogue of current systematic works on British Surgery.

In no fractures are the principles already enunciated to be more rigidly applied, than in those complicated with swelling, be it ecchymotic or inflammatory; only reserving extremely rare exceptions, to be noticed in due course. Those principles, let me remind you, are, firstly, Instant Reduction; secondly, Circular Compression; and, thirdly, Immobilization. The majority of surgeons strongly disapprove such practice, under the circumstances stated, and in so doing they but echo the teaching of the Macaulay of Surgical Literature,

Mr. John Bell, from whose full and eloquent, always inspiring though not unfrequently misleading, work I am about to quote.

"We* never roll a limb, but we are sensible of its absurdity, and aware of the danger of it. We cannot but remember the melancholy story of the black eunuch belonging to one of the princes of Arabia, 'who having fractured his leg near the ancle joint, had it bound up very firmly by the prince's body physician with compresses and rollers above the wound; but from that moment he neglected his patient entirely, except that he gave him strict injunctions not to undo the rollers. From the stricture of the bandage there came on a gangrene of the limb; and though I made no delay (says Albucasis) in undoing the bandages, and the eunuch had immediate relief from his pains, yet so much was the gangrene fixed in the limb, that it could not be stopped, and he perished.' This is one of a few melancholy cases that Albucasis sets up in the most conspicuous part of his preface as beacons for the guidance of young surgeons; nor has there been from his time a single book on fractures in which there are not related dreadful examples of this kind. Much as I have always remonstrated against rollers,

* The Principles of Surgery. Edinburgh. 1801. Vol. 1, p. 617.

I remember with horror, that a boy having a compound fracture of his arm, (very desperate indeed, but so much the less a proper subject for bandage), I committed him to the care of God knows who, a man, however, in an official situation; he bandaged the fracture with a roller, and at my morning visit I found the fore-arm bound more firmly than a mendicant's leg, the black skin appeared through the interstices of the roller, the hand swelled like a boxing-glove, perfectly black, and the cuticle separated: I need hardly say, that the arm fell into total gangrene."

To this graphic description is appended a representation of the gangrenous arm; and text and drawing have alike become memorable, in numerous reproductions in surgical works and lecture rooms, to exemplify, and strengthen, with the authority of Mr. John Bell, the teaching, that rollers should not be applied directly to a broken limb, especially when swollen. A few lines beyond the passage quoted, he inveighs against the "*vile pecus imitatorum*," who are characterized by Guy de Chauliac as regular birds of passage, to be expected at certain seasons, and "which follow each other like wild geese, all in a row;" little did Bell expect that he and his followers were to illustrate the moral in all its truth. The fact is the cases cited

by him from the practice of Albucasis, and from his own, have no bearing whatever on the point at issue. That a leg fractured near the ankle joint, bound up very firmly above the wound, and subsequently, as admitted, entirely neglected, should have fallen into gangrene is simply natural; as it is, that a similar result should have attended tightly bandaging a desperate compound fracture of the arm, from the wrist to the elbow. The wonder would have been, if even sound limbs, so treated, had not been completely disorganized. No argument whatever, deduced from such occurrences can be urged against the proper use of compression by bandages in any fractures; and yet the majority of surgeons who oppose the practice, adduce no better reasons in their defence than those of the head of the school, the traditions of which they so implicitly revere.

The doctrines of physiology and the practice of surgery teach us, that compression is a powerful agency in promoting the absorption of extravasated fluids, and especially so of blood; and, *à priori*, no valid reason is discoverable why the swelling, which often attends fractures, should be an exception to the rule. It is objected, that the swelling attending a fracture is a natural process, or effort, for the relief of the injured part, and, as such, should not be inter-

fered with; and on this assumption is based the expectant, and professedly prudent, practice of placing the swollen limb in an *easy* position, applying fomentations, or evaporating lotions, and deferring reduction and the application of apparatus until the swelling has begun to subside; or, at any rate, until it has attained its utmost limit and several days have elapsed. Such reasoning and practice appear about as reasonable as it would be to argue that, in a case of strangulated inguinal hernia, the tension, when due to the extravasation of fluid within the sac, is an effort of nature for relief; and to justify, upon such an assumption, soothing topical applications and delay of operative interference. Admitting that, in both cases, in the fracture complicated with swelling, and in the strangulated hernia with effusion into the sac, the extravasation is a relief to the distended vessels; it is yet true that so long as the cause of injury remains, in the one case the constriction of the gut, in the other the irritation by the fragments, the effect will, probably, continue and increase. Let it be additionally noted, that in both instances the extravasated fluid, whether blood or serum, becomes a cause of fresh mischief, by virtue of the compression which it exercises, in direct measure as it increases;—compression which may be, and often is, so great, as materially to interfere with

the local circulation, and to conduce to disorganization of the contained parts,—the intestine in the one case, the soft structures of the limb in the other. In accordance with these views, it appears to me, that the swelling, while a symptom and an effect of injury, acquires the importance of an independent and active pathological condition, requiring special treatment, and contra-indicating the expectant method. The first indication of treatment here, as in all other diseased conditions in which the cause is ascertainable, is to remove the cause, which, in the parallel assumed, amounts to effecting reduction; in the one case of the intestine, in the other of the fragments of the broken bone. If so much be granted, and if it be thus conceded that, in a fracture complicated with swelling, immediate reduction is advisable, it is still an open question if it be prudent to apply compression, to prevent the absorption of the fluid already poured out into the soft textures of the limb.

It is no use reducing a fracture unless means are employed to maintain accurate co-aptation of the fragments. The ordinary splints and apparatus unevenly press upon different parts of the limb, and are unequal to the duty of complete immobilization; a firm case, fixing the joint above and below the seat of fracture, and evenly compressing every part

of the limb, is, in my judgment, demonstrably the most efficient method of maintaining co-aptation, relieving pain, preventing increase of swelling, and promoting the absorption of such as may already have occurred, be it sanguineous or inflammatory.

The misfortune is that a great misunderstanding prevails as to the import of the term "compression," and the manner of carrying into execution the idea of which it is the definition. The gentle and perfectly uniform,—the evenly distributed and in no way *constricting* action, which I understand by compression, as applied in the treatment of fractures, is a therapeutic agency than which I know none more demonstrably beneficial. It is granted that, improperly applied, it is capable of great mischief; but is not this true of the abuse of almost all agents for good, in the exact measure of their value and potency when rightly used? This proposition admits of very wide application, but for our present purpose let us cite the action of opium and chloroform, and, above all, the action of the knife,—one and all infallibly fatal agents and heroic remedies, according to the manner of their employment. Who would think of disparaging their worth by alleging that their use demands skill and extreme care, and that their abuse involves suffering and death?

You will probably agree with me that, for the present, we have had enough of argument; although we have not exhausted the subject, and its great importance will require that we revert to it.

I may quote in illustration :

CASE X.—*Fracture of the Anatomical neck of the Humerus, with great extravasation of blood.—Application of starched apparatus; immediate relief; rapid absorption.*

Elizabeth Ball, æt. 48, was admitted into A 5 Ward the 26th May, 1861, with an injury to the right shoulder. I first saw her on the 27th, fomentations having been employed in the meantime. The shoulder and upper two thirds of the arm were deeply ecchymosed, and so much enlarged that the bony points about the joint were obliterated. The patient complained of great and constant pain. On careful manipulation it was established beyond doubt, notwithstanding the extensive swelling, that the humerus was broken through the anatomical neck. The accident was occasioned by the woman being pushed violently against an iron post. I applied the starched apparatus over the entire limb, with broad angular pasteboard splints in front of and behind the shoulder joint, so as to fix it effectually, and to enable me to effect uniform compression on the entire

swollen region. The patient acknowledged herself instantly relieved.

May 29th. Apparatus being loose from complete subsidence of swelling, opened, pared and re-adjusted. The patient being quite free from pain, and having a comfortable home, allowed to leave the hospital.

CASE XI.—*Fracture of right Os Calcis. Great swelling of both feet. Comparative experiment of effects of Compression and Evaporating Lotion.*

Ellen M'Gaulay, admitted into A 5 Ward the 26th November, 1860, having just previously fallen a considerable height on her feet, from a window which she was cleaning. Both feet were much swollen from extravasation of blood, and the patient was unable to stand; she complained of severe pain at the lower part of the back. Perfect rest enjoined, and evaporating lotion to be applied constantly to both feet.

1st December I first saw the patient. Both feet about equally swollen,—the outline of malleoli quite obliterated. Skin deeply mottled, as from extravasation of blood. Temperature and sensation unimpaired. Still complains of great pain in lower lumbar region. On manipulation I find distinct fracture across the middle of the right os calcis,

without displacement. Applied starched apparatus immediately, as far as the knee. No fracture in the swollen left foot, to which the application of evaporating lotion to be continued.

3rd December. Right foot has been much the easiest; the apparatus comparatively loose. On opening it, the swelling is found to have completely subsided; the outline of the right ankle is now perfect, whereas the swelling of the left one is undiminished.

6th December. Right foot is quite easy; the starched apparatus opened, and, after paring edges, refitted to the shrunken member. The swelling of the left foot is still unabated.

This patient remained in hospital many weeks, suffering from the effects of spinal concussion. The union of the right os calcis was perfect; and although both feet eventually regained their shape and function, it was only by very slow degrees that the swelling of the left foot diminished.

The case previously related, of fracture of the neck of the humerus with great swelling, was immediately relieved by the treatment adopted. The pain, doubtless, ceased, chiefly in consequence of the immobilization of the joint, but I believe that its subsidence was also due, in part, to the gentle compression uniformly exerted. That this was the

agency to which the rapid absorption of the extravasated blood was referable does not, in my estimation, admit of question, especially when the history of the case is studied in connexion with the one last related. In this instance we had to deal with two feet greatly and equally swollen ; they had both been injured at the same time, and by a similar cause,—a fall from a height, the weight of the body being about equally distributed on the two sides. The only appreciable difference between the two extremities, was the additional injury which the right one had sustained, in transverse fracture of the heel-bone. To test the effect of compression by a comparative experiment, an evaporating lotion was continuously applied to the left foot, whereas I applied the starched apparatus to the right one. The result was unmistakable ; the application of pressure was attended with rapid relief of pain and subsidence of the swelling, so that the right foot, notwithstanding the fracture of the os calcis, had regained its normal outline and was perfectly easy, while the left one continued painful and swollen, without sensible abatement, for many days. This left foot was severely contused and sprained ; the right one was in a similar condition, plus the fracture. The result proved the correctness of the popular dictum, that a sprain is often worse than a broken bone. The treatment turned the scale, in

favour of what was anatomically the major injury. The reason why sprains are so painful, why the attendant swelling is so persistent, and motion of the joint often so slowly regained, is, doubtless, the severe injury sustained by the ligaments and other adjoining structures. Lacerations of, and extravasations of blood into, the sheaths of tendons, rupture of ligaments and fasciæ, may take place without fracture or dislocation, and constitute an injury decidedly more severe and important than a simple fracture in the continuity of any of the large bones. The effects of such injury are aggravated by the treatment ordinarily pursued. Fomentations and lotions are of little use. The practice of applying leeches, when the sprained joint is much swollen, is only attended with some benefit when the enlargement is of an inflammatory character; if it be due to extravasation of blood, the leeches fail in reducing it, for they drink not of stagnant pools, but of the living stream of blood. But not only is their action fruitless in reducing the bloody swelling, for their bites, under the circumstances, are apt to irritate, and to add superficial, to the pre-existing deep-rooted, mischief. What is wanted is to keep the sprained joint in absolute repose, and to allay the pain, prevent swelling, and promote the removal of that which may already have occurred, by an

immovable and compressing apparatus, applied in the same manner as if one or more of the bones entering into the composition of the injured joint were broken.

As the swelling subsides the case must be opened and closely fitted, to keep up accurate and gentle compression, and prevent even the slightest motion. The rapid absorption of the effused fluid, the relief to pain, the comparatively speedy restoration of the functions of the joints, are results which you may prognosticate, with a certainty commensurate to your faithful adherence to the principles of treatment here advocated,—immobilization and compression.

Case XII.—*Fracture of both bones of the leg, with eversion, great swelling, and blebs. Application of starched apparatus. Rapid subsidence of swelling. Patient able to lift leg the fourth day; out of bed the ninth. Uninterrupted recovery.*

A. B., aged 38, admitted V. I. Ward the 24th December, 1861, in a state of intoxication, with injury to right leg inflicted in a fall, about ten hours previously. I found the limb everted; no perceptible shortening, but enormous swelling, to nearly 2 inches; the circumference of the left leg, in the middle of the calf being 11½ inches,—of the right, same level, 13¼ inches. The skin was very

tense and hot, and of mottled bluish red colour, with several small blebs on its surface. Preternatural mobility indicated fracture of both bones of the leg, at the junction of the middle and lower third. The swelling was so great as to efface the outline of the limb, and render impossible, without dangerous manipulation, a precise diagnosis as to the direction and character of the fracture.

The natural direction of the limb having been restored, I applied the starched apparatus immediately, to mid-thigh.

December 26th. Has suffered some pain during the night, but is now more comfortable. Toes cool. No sign of tightness.

December 27th. Comfortable. Apparatus beginning to feel loose, opened and pared to a quarter of an inch. Skin cool, of mottled yellow and brown colour. A large bleb is situated in front, and somewhat to the inner side, of the seat of fracture. A thin layer of cotton wool placed over the bleb, and the apparatus re-closed with outer bandage; directly afterwards the man, while lying on his back, lifted the leg from the bed, by the action of the muscles of his thigh, without any help and without pain,—conclusive evidence of the accurate and immovable co-aptation.

December 30th. Felt comfortable till yesterday,

but has suffered some pain during the night. The apparatus feels loose, opened and edges pared to half an inch; skin quite cool;—swelling almost completely subsided, line of tibia can be distinctly felt, apposition of fragments perfect. After re-adjusting the apparatus, the man pronounced himself quite comfortable.

January 1st, 1862. When asked how he is the patient unhesitatingly replies, "quite well." To be allowed to get up.

January 10th. Continues well and perfectly comfortable; apparatus somewhat loose, opened, pared a little, and re-closed accurately.

January 17th. Case opened. Good union, very slight thickening at the seat of fracture. In the situation of the large bleb is a dry thin scab. The whole limb is discoloured, yellowish, greenish and bluish; the discolouration is in longitudinal bands opposite the hollows on the under surface of the pasteboard splints; corresponding to the edges of the splints, where the pressure is most marked, the skin is of natural colour.

Patient discharged. To wear the apparatus another fortnight.

Case XIII.—*Fracture of Fibula and inner Malleolus,—immense swelling,—large tense blebs. Im-*

mediate application of starched apparatus, instant relief. Excellent recovery.

W. J., admitted V. I. Ward June, 1861, with an alleged dislocation of the astragulus, to endeavour to reduce which, considerable force had been employed, with the aid of pulleys. The accident had happened in a mine, two days previously. There were several extensive contusions on the back, and the man appeared exhausted with pain. The left leg and foot presented an extraordinary appearance;—immensely swollen, of bluish colour, with several large tense blebs. The temperature considerably raised. I could see no evidence of the dislocation of the astragalus for which the pulleys had been used, but, on the other hand, very little manipulation sufficed to demonstrate fracture, of the internal malleolus at its root, and of the fibula about two and a half inches above its lower end. The following are the measurements of the two limbs, taken immediately after admission, at corresponding points :

	SOUND LIMB.		INJURED LIMB.
Mid-calf . .	11½ inches.	—	12½ inches.
Ankle (over heel)	8½ inches.	—	10¼ inches.

No shortening, inversion, or eversion.

I applied the starched apparatus at once as far as the middle of the thigh, and the man pronounced himself relieved immediately afterwards.

June 31st. Has passed a comfortable night. Apparatus opened. Skin cool—no constriction; re-adjusted with outer bandage. In the evening complained of a good deal of aching in the ankle. Limb suspended from the cradle by three long loops of bandage, with decided relief.

July 2nd. Apparatus loose, opened and pared. Swelling has in great part subsided, blebs shrivelling, skin quite cool. Apparatus firmly closed. The man is perfectly comfortable, and can change his position in bed, so as to relieve from pressure the contused places on the back.

July 9th. Apparatus opened. Swelling has completely subsided. Thin dry scabs now occupy the place of the blebs. The outline of the limb is perfect. The man free from pain; allowed to get up after re-adjustment of the apparatus.

After this date, the case required no further attention. The man left the hospital in August, with perfect consolidation of the fracture, both as to position and strength. He had also regained considerable motion in the ankle-joint, but he was cautioned that its complete restoration was a doubtful matter, and, at best, would require a considerable period.

These cases (XII. and XIII.) are examples of severe injury and serious complication; the latter

especially, in consequence of the powerful efforts which had been made to reduce a supposed dislocation of the astragulus: the swelling was great in both, and blebs had formed before they came under my notice. Nevertheless, reduction was immediately effected, and an immovable and compressing apparatus applied. The relief to pain, and the rapid diminution of the swelling, have already been noticed, and you may confidently anticipate similar results under the like circumstances; for I cannot too often repeat, that I know no therapeutic agency more constant and more clearly demonstrable, than that of compression in reducing the swelling which so frequently complicates fractures.

Amongst the Reviewers to whom I am indebted for prudent counsel and much solid instruction, is one, who thus commented on a passage in my Liston Thesis for 1853:

"We confess we should shrink from applying powerful constriction to an entire limb in which any considerable amount of true inflammatory swelling was taking place. Pressure, under such circumstances, aggravates inflammation, and the admitted principles of surgery teach us to wait until nature has commenced the work of absorption before we apply it. So far from 'moderating the effusion of blood,' we believe that bandaging would have the

effect of exciting the large blood vessels to an amount of action sufficient to bring on rapidly a gangrenous congestion of the part, nor have we time to apply pressure as a 'preventive of swelling' in the majority of such cases, even if it were wise to do so. Inflammatory effusion is generally the result of considerable violence, and is so rapid in its occurrence, that a few hours suffice to light it up to such an extent, that ever so slight pressure will be followed by suppuration or gangrene."

I cite this passage as a fair exposition of the views entertained by a very considerable number of surgeons. The cases quoted may assist you in estimating it. It is indeed in accordance with the admitted principles of surgery, but inasmuch as these, in the particular matter under consideration, are merely the expression of tradition and are directly opposed to the result of carefully conducted experiments, they are unworthy of assent. When a broken limb is swollen, pressure, properly applied, does not aggravate the inflammation, but subdues it; does not produce suppuration and gangrene, but prevents them.

The writer, from whom I have just quoted, appended his criticism to the following passage from my former work:—"It is easy to understand how *gradual pressure* may relieve the pain of an inflamed

part, and promote the absorption of effused plastic product." What foundation is this for a protest against the application of *powerful constriction* to an inflamed limb? And yet, as I have had occasion to point out in a former lecture, this is the style in which the question has been generally argued. It is not surprizing that the result has neither enhanced the glory of Surgery as a Science, nor its usefulness as an Art.

CASE XIV.—*Compound and comminuted fracture of the leg, from direct violence;—great shortening,—violent spasm.—Immediate application of starched apparatus,—able to get up on the eleventh day.—Perfect union, without any shortening and very slight thickening.*

Thomas Snipe, a vigorous carter, æt. 30, admitted V. I. Ward, 3rd October, 1861, having a short time previously sustained a fracture of the right leg, the result of a kick from a horse. Measurement of the two limbs, at corresponding points, gave 1⅜ inch shortening, and 1 inch increased circumference, of the injured one. There was a small circular aperture opposite the fracture of the tibia, and, through it, projected a bony fragment. The seat of fracture was a little below the middle of the leg,—both bones were broken on the same level, the tibia dis-

tinctly comminuted; the wound bled freely, and a good deal of blood had already become extravasated into the adjoining soft parts: pain intense, spasm violent. I reduced the fracture immediately, covered the wound with a piece of dry lint, applied the starched apparatus to the middle of the thigh, and ordered a draught with forty drops of laudanum.

4th October. Skin cool, pulse 66, has had a fair night, but has occasionally been disturbed by starting of the limb.

6th. Has been very comfortable. The starting became gradually less as the apparatus became dry and solid. Skin cool.

7th. Case feels loose, opened, edges pared, and re-closed. Skin cool, position good, lint adherent to wound, not disturbed.

8th. Perfectly easy, no spasm; feels no pain when the leg is lifted up by the foot, and allowed to drop on the bed.

14th October. Case opened,—condition perfect. For the first time the lint removed from the wound, which is now only superficial and moistened with a drop of pus. Dry lint re-applied, the apparatus closed, and the man allowed to get up.

15th. General health excellent, limb quite easy,—the man proceeded from the hospital, in a cab, to the rooms of the Midland Medical Society,

to afford the members an opportunity of examining him.

26th. Gets up every day,—suffers no pain whatever, and enjoys vigorous health. The wound is nearly healed,—the little remaining is quite superficial and cicatrizing. Dry lint re-applied, case firmly closed, and patient discharged.

Nov. 2nd. Attended as an out-patient, wound quite healed, union solid, apparatus re-adjusted.

Nov. 9th. On removing the apparatus, its posterior part hard and dry, in consequence of saturation with the extravasated blood, is found adherent to the limb. The limbs are of identical shape and length. No thickening whatever along the fibula, and, only very slight, opposite the fracture in the tibia. Skin sound. Bones perfectly solid. The apparatus cut up, and the outer portion, from the foot to the knee, re-applied and ordered to be worn a week.

Discharged, cured.

Such a result, with so great an injury, is as successful as you can well hope to obtain in any department of surgery; a muscular man, with comminuted fracture of the leg, produced by direct violence, with protrusion of fragment, copious hemorrhage and violent spasm, constitutes one of the most serious cases which you can be called upon to treat.

Yet how perfectly and uninterruptedly efficient were the measures adopted,—how great the freedom from pain and constitutional disturbance,—how brief the confinement to bed,—how perfect the consolidation, —how striking the illustration of the principles enunciated !—to reduce a compound as quickly as a simple fracture, and to endeavour to place it in the same condition, by employing a gently compressing apparatus to maintain the fragments in accurate and immovable co-aptation, and by not disturbing the wound. Rest,—perfect, absolute rest,—is the great need,—motion the chief source of evil.

Amongst the cases which have occurred to me since the preceding lecture was delivered, the two following appear sufficiently important to be appended.

Case XV.—*Comminuted fracture of thigh, in a navvy, from direct violence,—great shortening and swelling. Application of starched apparatus. Patient walked on crutches the fourth day. Uninterrupted recovery.*

Joseph Wood, a navvy, æt. 25, conveyed to the Queen's Hospital, the 22nd July, 1862, in a Hansom cab, two miles from the seat of accident,

having sustained an injury to the left thigh, from a large fall of earth in an excavation.

On admission, great distortion, and distinct comminution, of left thigh-bone. The limb placed on a pillow, and the patient covered with warm blankets and left to recover from the shock. On measurement, four hours later, from antero-superior spinous processes of pelvis to upper edges of patellæ,—

Right side, 17¼ inches; Left, 15½ inches.

Circumference, same level, mid-thighs,—

Right, 17½ inches; Left, 19½ inches.

On effecting reduction, very little diminution in circumference, the swelling being chiefly due to extensive extravasation of blood in the substance of the limb. Skin sound. I now proceeded with the application of the starched apparatus.

23rd July. Has passed a good night, and is now quite easy. Case nearly dry. The swelling has in great measure subsided, as proved by the comparative looseness of the apparatus over the front of the thigh.

26th July. Has been quite free from pain until last night, when he felt some twitching in the limb. The apparatus loose in front of thigh, from complete subsidence of swelling, as proved on opening it. Skin cool, co-aptation perfect. Edges pared to ¾ of an inch; added front pasteboard splint from groin

to knee, and the whole made firm with outer bandage. Immediately afterwards (the fourth day after the accident), the man turned himself in bed on both sides, got up, and walked several paces on crutches, without the least pain.

31st July. Continues perfectly well, gets up every day.

15th August. Limbs of equal shape. Apparatus opened and re-adjusted. At his own request the man is allowed to leave the hospital.

I never saw this patient after his discharge, but I understand, from one of his relatives, that he has made an excellent recovery.

The manner in which the subject of this history was conveyed to the hospital (in a Hansom cab), deserves special notice and condemnation. When a bone is broken, it is of the utmost importance that the limb be not moved, lest the displaced fragments lacerate the surrounding soft parts, and perchance convert a simple into a compound fracture, by perforating the skin. No surer means of bringing about these evils, than by lifting a poor fellow, who has broken his thigh or leg, in and out of a Hansom cab. A man so injured should be carried in the horizontal position; and well-disposed persons may be reminded, that when a man falls and breaks his leg in the street, the common practice of engaging a

cabman to convey him home or to the hospital, is mistaken charity; a slower and less crooked mode of conveyance will be easier, and incomparably safer; and it is well to bear in mind that an excellent means of transport, a stretcher, may always be obtained by application at the nearest police station in all large towns. In its absence, a shutter or a hurdle answers the purpose perfectly well.

Case XVI.—*Supposed sprain of knee.—Discovery of oblique fracture of femur the fourth day.—Great inflammatory swelling.—Application of starched apparatus, with immediate relief. Perfect recovery.*

A. B., æt. 20, admitted into the Queen's Hospital the 11th June, 1862, having injured his right thigh in a fall. In the temporary absence of our very able House Surgeon, Mr. John St. S. Wilders, the patient was received by a gentleman who felt disposed to regard the case as one of severe sprain of the knee joint, and ordered the constant application of hot fomentations.

14th June. My notice was first directed to the case this morning. I found the right lower limb everted. A great deal of swelling, with redness and heat, about the knee joint and lower half of the thigh. On grasping firmly mid-thigh and knee, unmistakable preternatural mobility perceptible in

the femur, at a point a hand's breadth above the joint. On careful measurement, right leg proved to be an inch shorter than left.

Circumference over the middle of the patella,—

Right side, 14½ inches; Left, 12¾ inches.

Circumference 4½ inches above patella,—

Right side, 15¾ inches; Left, 14 inches.

Pain very considerable. The swelling had steadily increased since admission, in spite of the unremitting application of fomentations.

I effected reduction immediately, and applied the starched apparatus.

16th June. The lad has been perfectly easy since last report. The case is now loose on front of thigh; — opened, edges pared, and re-adjusted. The skin is cool, and the swelling has almost completely subsided.

27th June. Apparatus re-opened,—re-adjusted and finally fixed. Lad to get up.

August 8th. Union quite solid, without the slightest shortening. Seat of fracture indicated by a small callus. Can bend knee readily to a right angle. Walks with sole aid of a stick.

Discharged cured.

The diagnosis in this case required very careful examination. It has been remarked, in the preceding lecture, that very delicate manipulation is generally

sufficient to determine the existence of a fracture. When, however, several days have elapsed, and great swelling has occurred, especially if in close proximity to a joint, the diagnosis is often a matter of great difficulty, and no effort should be spared to ensure its accuracy, for an error may entail consequences, scarcely less painful to the surgeon than to the patient.

LECTURE V.

CONTENTS.

Gentlemen,—Without wishing you to accept the case (XIV.) of compound and comminuted fracture of the leg, related in the preceding lecture, as conclusive testimony of the value of the treatment employed, I think, the chief, amongst its many, points of clinical importance may be profitably studied, with a view to illustrate the effects of the Treatment of Fractures, complicated as well as simple, on the principles of immediate reduction, circular compression, and immobilization.

We had to deal with a muscular man in full vigour of health,—the fracture was the result of great direct violence,—both bones of the leg were broken, the tibia splintered,—the skin was wounded, —blood flowed freely outwards and within the substance of the limb,—the great displacement of the fragments was evidenced by the projection of one through the skin, and by great shortening of the limb,—and, to add to these grave complications, the muscles of the big calf were in a state of violent spasm. Nevertheless, with the treatment employed, the patient, five days after the accident, felt no pain when the leg was lifted up by the foot, and allowed to drop on the bed;—he was able to get up and walk on crutches the eleventh day, and made a

rapid and complete recovery, without a single untoward symptom.

Spasm is, amongst the complications of fracture, one of the most frequent;—to the patient, one of the most distressing,—and to the surgeon one of the most difficult of management, unless the proper measures be adopted. Its proximate cause, the irritation of the muscles by the displaced fragments, indicates the remedy;—immediate reduction, and the most accurate co-aptation. But we are told that this is often very difficult, sometimes impossible, on account of the violence of the spasm which it is intended to alleviate, unless such an amount of force be employed, as may produce laceration of the muscles, or even of the vessels. Never employ violence. As a rule, very moderate force, intelligently applied, will suffice to reduce the most oblique fracture in the stoutest man, however violent the spasmodic action of the muscles of the injured limb.

Fatigue, let it be borne in mind, is the physiological sequel of muscular contraction. If you watch the spasm in a man's leg, whose tibia is smashed, as in our case, you will notice that, while the muscles are in a state of almost constant increased tension, they contract violently at intervals, and then lapse into a state of comparative quiescence, to be again

incited, after repose of variable length, to spasmodic contraction. The state of comparative rest is the one most favourable for effecting reduction. In a case like the one under consideration, as it is very evident the bones are broken, the limb should not be touched, after the patient is in bed, until you are ready to begin, and complete, the treatment. Pass a jack-towel round the upper part of the thigh, on the injured side, and confide it to an assistant, while another grasps the foot with both hands, and you place one hand above, and another below, the seat of fracture to steady the bones, and grasp the muscles with gentle and gradually increasing firmness. Instruct each assistant to lean back by slow degrees, not tugging at the perineal band and foot respectively, but slowly weighing against them;—not relaxing, but neither increasing, if spasm commence; waiting patiently while the steady traction is kept up, you notice, after the lapse of a few moments, that relaxation commences; at this juncture it is especially necessary to avoid the slightest jerk, which may act as a stimulus to fresh spasm; if necessary, the antagonistic weight of the assistants can be slowly augmented, while you manipulate the limb, above and below the seat of fracture, to mould the fragments into place. In this proceeding, do not touch the limb with the ends of the

fingers, but grasp it gently, yet firmly, with the entire surface of both hands, compressing and rubbing the muscles, as a powerful means of relaxing them, and seizing the instant when they are quiet, and the limb has been drawn out to its normal length, to adapt the broken surfaces to each other. In this process it is desirable to engage the patient in conversation, or to interdict closure of the mouth, in order to prevent the fixity of the chest, which is so favourable to effort.

By this method I have never failed to reduce the most difficult fractures; but if ever you should encounter unusual difficulty in overcoming spasm, you can ensure the relaxation of the general muscular system, by the administration of chloroform.

When reduction has been effected, it is absolutely necessary to prevent all motion. The slightest disturbance is sufficient, by the irritation it produces, to excite muscular contraction, and this, once awakened, involves the danger of spasm and displacement, with all their attendant evils. In the case of Thomas Snipe, the assistants never relaxed the steady traction until pasteboard splints were accurately applied to the back and sides of the limb, from the sole of the foot to the middle of the thigh, in such manner as to ensure the accurate maintenance of co-aptation. It is reported that

occasional startings occurred in the limb, with decreasing frequency as the apparatus became dry and solid; but muscular action was so thoroughly controlled, that the accurate apposition of the fragments was not one instant disturbed.

The arrest of hemorrhage was demonstrably the result of the treatment employed. We have no means of determining precisely what sources yielded the flow of blood; but if, as is possible, some of it proceeded from the interior of the bone, it is very easy to understand how it was arrested, by close and persistent adaptation of the broken surfaces. The effect of pressure in stopping bleeding is too well known to need more than allusion, in explanation of the action of compression of the entire surface of a broken limb, in controlling the flow of blood, from the soft parts injured by the displaced fragments.

Hemorrhage is always a serious complication in fractures; more especially so, when a wound in the skin exposes the extravasated blood to the influence of atmospheric air, and increases the probability of its decomposition, and of the consequent formation of abscess. We have seen how speedily pressure arrests the flow, and the success which attended its employment in the particular case under notice was, so far as my experience extends, the invariable

result. You must not overlook the fact, however, that, for the pressure to be methodically and efficiently exerted, it is requisite that the fracture be first reduced; and thus you perceive, in the event of wound, hemorrhage, and spasm, it is equally important to reduce the fracture without delay. For all practical purposes it may be laid down as a rule, that the principle of immediate reduction, which should govern the treatment of fractures, becomes the more imperative as complications are superadded; excepting, of course, those cases in which wound of a large artery, or extensive destruction of the bone and soft parts, suggest immediate amputation; or excision, in the event of a joint being implicated. In the face of such a contingency, you must act according to the rules of surgery as prescribed in the books and sanctioned by experience; cherishing a wholesome disinclination to hasty mutilation, and very great regard for the conservative and reparative powers of nature; which, even in these days of undoubted progress in natural science, and of approach to medical philosophy, are scarcely held in sufficient estimation by the majority.

The wound in the skin, which, when it communicates with the fragments, is the distinctive characteristic of a compound fracture, is fruitful in evil

consequences, unless the surgeon's endeavour to secure its early union be successful. Such endeavour should always be made with promptitude, the instant it is determined that the amount of injury is not so great as to demand amputation. It is out of the question that the wound can heal unless the fragments are restored to position, and kept there; irritation is antagonistic to cicatrization. Reduction effected, if the wound be extensive, its edges may be approximated with one or more silver sutures, and whatever its size, there can be no doubt that the best dressing is a piece of dry lint; this becomes soaked with the exuding blood, or serum, and soon dries, forming an artificial scab, which should not be removed for many days, unless, which rarely is the case, heat and throbbing indicate the accumulation of matter beneath it. Wounds of the soft parts, as a complication of fracture, apart from constitutional peculiarities, derive their importance from the proximity of so great a source of irritation as the fragments of a broken bone. If these be speedily adjusted, and kept immovable, there is scarcely any fear of irritation; and practice proves the wisdom of the precept, to aim at reducing a compound to the condition of a simple fracture, and to treat both alike. Although the wound in Thomas Snipe was small, it was a serious one, because circular, and

produced by so violent a blow as a kick from a horse, which splintered the tibia and caused great flow of blood. It was not until the twelfth day that the lint was removed from the wound, the deep portion of which was then quite healed, and only a little pus moistened the superficial excoriation, the cicatrization of which was completed under the fresh application of dry lint and pressure.

It is stated in the notes of the case, that our patient with comminuted fracture of the leg, felt no pain when the limb was lifted up by the foot, and allowed to drop on the bed, the fifth day after the accident; whereas, on the eleventh day, the man was able to leave his bed;—unanswerable testimony of the perfect efficiency of the apparatus in controlling muscular action, and maintaining the fragments in accurate and immovable apposition. Long confinement to bed is never agreeable, and in many cases it is a source of great mischief, and sometimes the cause of death, particularly in the aged, and in persons with chest affections. Lying on the back for six or eight weeks with a fracture of the thigh or leg, may not be a matter of great importance to a healthy adult; but at the extremes of age the case is very different, and I know no better evidence of the superiority of the method of treatment, than that afforded by a child, or an old person, sitting

up the third day after a fracture of the femur, and able to be moved, without the slightest pain, and with the limb in the best possible condition for repair.

As the argument has now for some time been running one way, let us stop for awhile to hear the opposite side, and dispassionately to weigh the many objections which have been adduced against the treatment of fractures, in conformity with the principles enunciated, by the immovable apparatus. It is urged, that this very title begs the question and is not warranted by the facts, even by those who concede that when a bone is broken, the sooner it is put to rights, and kept so, the better. When a tibia and fibula are broken, and the ankle and knee joints are fixed by pasteboard splints, extending from the sole of the foot to the middle of the thigh, it is not difficult to explain how it is that the limb can be lifted and allowed to drop on the bed the fifth day after the injury, often much earlier, without the least discomfort; since the joints are absolutely motionless, and so are the fragments. It is apparently different in the case of fractured thigh. A patient who has sustained this injury is, by the aid of the immovable apparatus, frequently able to get up and walk on crutches the second or third day; and, with

perfect impunity, to bear the limb lifted by the heel and allowed to drop on the bed, as signally exemplified in the case (VIII.) of fracture of the femur just above the condyles, in which, in spite of the great obliquity of the lesion, its very close proximity to the knee joint, and the remarkable displacement of the pointed fragments, the patient was able to walk on crutches thirty-six hours after the accident, and regained the use of the limb so speedily and so perfectly, as to be in every respect one of the most successful cases on record of recovery from so formidable an injury, as oblique fracture of the inferior extremity of the thigh-bone. It is noted that, "ever since the middle of January (seventeen days after the accident) I had been daily in the habit of raising the limb, and striking it down forcibly on the form on which the patient sat. The noise thus produced was audible all over the ward, yet the boy felt no pain, and from the second day after the accident, was constantly in the habit of early rising, walking about on crutches, and helping the nurses in doing the light work of the ward." Notwithstanding the peculiar manner in which, in a case similar to the foregoing, the buttock is covered and the pelvis bandaged, a person witnessing such free movement is led to believe that the hip joint admits of considerable play. If so,

what becomes of the principle of fixing the joint above the seat of fracture, what of the vaunted immobilization of the entire limb? I admit the plausibility of the objection, and submit in reply; 1stly, that the motion occurs in great part in the lumbar region, and, at the hip joint, is much less real than apparent; 2ndly, that the result of experience proves, that the pieces of an obliquely-broken femur, whatever the situation of the fracture, can be kept in perfect contact, so as to ensure consolidation without the slightest shortening and thickening, and yet allow the patient to walk about a very few days after the accident.

The facts on which this statement is based have, in my experience, been so numerous and so uniform, that it is difficult to understand how the efficiency of a well constructed immovable apparatus can ever have been disputed. Neither could it have been, but for a misconception of fundamental principles, and a carelessness in important practical details. I remarked, on a former occasion, that the solution of this question has been materially impeded by the idea that "a starched bandage" is a fit means for treating fractures of the limbs. Such a statement, with reference to the immovable apparatus, is about as correct as it would be to allude to the long splint for fractures of the femur as a calico roller; the

splint is the foundation and chief feature of this apparatus, as in the former are the accurately fitting pasteboard splints, embracing the joint *above* and *below* the seat of fracture, so as to maintain absolute rest;— the one great need for the patient's present ease, and future restoration, with a strong and perfectly shaped limb. The better to impress you with the importance attaching to these precepts, let me contrast two of the greatest masters of our art. "Those accidental movements of a broken limb," wrote John Bell, (op. cit. 6, 512), "which alarm the patient, or even give him pain, and which he reports with great correctness and anxiety to his surgeon, are yet of no importance. You perceive with how little reason the justly celebrated Desault says, 'That it is a principle *which will admit of no controversy*, that to effect the re-union of fractured bone, nature requires, not only that the fractured ends be approximated, but that the limb be *preserved in a state of absolute rest*;' "—obviously referring to physiological repair. Desault had the best of reasons for his teaching—the truth; and accordingly it has survived the faulty criticism of his great cotemporary.

It is further objected that the examinations of the limb, and the necessary adaptations of the apparatus to its varying size, are inconsistent with

the principle of immobility,* and incompatible with undisturbed co-aptation of the fragments. Here again I must fall back on experience as an answer to the purely theoretical objections, and I have no doubt you can bear me out, by recalling to memory the many cases of fracture in our Clinique, in which you have seen the examinations of the limb so conducted, and the apparatus so adapted, as not to interfere in the least with the principle of immobilization.

The fact that fractures treated by the immovable apparatus are frequently re-united, so that scarcely any thickening is perceptible at the seat of injury, has been adduced as an objection to the method of treatment, by those who hold with Dupuytren, that an external provisional callus is essential to the repair of fractures. In point of fact the alleged ground of objection is valid evidence in favour of the apparatus. It has already been shewn (Lecture II.) that Dupuytren's doctrine is erroneous, and

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* "L'on cite un grand nombre de succès obtenus par le bandage amidonné ; je rejette son inamovibilité ; s'il existe un peu de tuméfaction inflammatoire, ou même une légère infiltration sanguine ou séreuse, bientôt le membre diminue de volume et les fragments sont mal soutenus ; il est impossible d'avoir alors la certitude qu'ils sont incapables de se déplacer. Sous l'influence d'une compression exercée pendant trente ou quarante jours, le membre s'atrophiera, et le malade sera encore soumis aux inconvenients que nous venous de signaler."—*Lisfranc, Clinique Chirurgicale de l'Hôpital de la Pitié.* Paris, 1841. Tome 1er. p. 101.

that external callus is so far from being essential to the repair of broken bones, that it is less apparent the better the method of treatment,—the earlier reduction, the more perfect co-aptation. External or provisional callus, as long since shewn by Pott, is the result of irritation; it is in fact an effect of pathological action, and its absence, when the reunion of a fracture is accomplished, is indicative of physiological repair under the most favourable conditions.

A more serious objection, in support of which the histories of cases are adduced, is that of the liability to congestions, strangulation and gangrene incurred in the treatment of fractures on the principles enunciated in these Lectures.*

"Four cases are cited by M. Malgaigne to prove the injurious effects of the compression exercised by immovable apparatuses. 'On a girl, who had a double fracture of the humerus, M. Megnier had applied *l'appareil albuminé;* the day afterwards appearance of yellowish bullæ, livid discolouration of

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* "The immovable apparatus, of whatever materials constructed, is under some circumstances a very simple, safe and efficient dressing; while under other circumstances it is, as we think, eminently unsafe and inefficient. Thus, in all those fractures which are accompanied with such injury to the soft parts as to render subsequent inflammation inevitable or probable, this form of dressing exposes to congestions, strangulation and gangrene.—*Hamilton, Practical Treatise on Fractures and Dislocations.* Philadelphia, 1860. p. 63.

the integuments about the elbow; the apparatus was removed without delay, but the symptoms were so severe for several days that the surgeon entertained fears of being obliged to remove the arm at the joint. M. Defer has seen gangrene supervene in consequence of the premature application of the starched bandage for a fracture of the humerus and one of the patella. M. Blandin has seen fatal accidents determined by the same cause. Even were there no fear of gangrene, we have all seen in one of our most distinguished Russian colleagues, Professor Dubovitzki, the serious effects of a starched apparatus applied immediately after fracture of the elbow. When it was removed, on the 25th day, the flexor muscles of the wrist and fingers were hardened, blended into one hard and cartilaginous-like mass with the adjacent cellular tissue; it was impossible to pinch up the skin that covered them; the wrist and fingers were completely paralyzed.'

"I have seen four cases within the last twelvemonth, in which the application of the ordinary fracture apparatuses was followed by results no less unfortunate than those above-mentioned. In one case, a fracture of the humerus, lateral wooden splints having been applied, and the limb once bandaged, the supervention of gangrene necessitated amputation at the shoulder joint. In a second, in

which Dupuytren's splint was applied for fracture of the lower end of the radius, the fore-arm died *en masse* in a few days. Both these patients repeatedly complained of the bandages being too tight, but the surgeons refused to remove them until the third day. The time for healing had then passed, for amputating arrived. Such occurrences cannot in justice be admitted as evidence against the system of treatment. Means, in themselves most innocent, not unfrequently prove destructive when improperly used. Whether the practitioners mentioned by M. Malgaigne were in any degree blameable we have not the means of judging, but certain it is that in a class of injuries so numerous as fractures, always demanding much care, often the most accomplished surgical skill in their treatment, it is inadvisable to argue from the results in a few unsuccessful cases, without being accurately acquainted with the histories of their progress."*

In the ten years which have elapsed since I penned the passage just read, I have seen several cases in which the treatment of fractures by the ordinary splints has been followed by mortification, which there could be no doubt, from an attentive examination of all the circumstances, was due to

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* Gamgee's Starched Apparatus. 1853. Pp. 75 and 76.

unequal and excessive pressure;* but I have in no single instance had to regret such an occurrence as a result of employing the starched apparatus.

This statement requires qualification, lest it might be accepted as implying that, since I abandoned the old appliances for the treatment of fractures, my practice has been uniformly successful. The cases hitherto adduced in these Lectures have not been selected on account of their fortunate termination,

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* "Si la compression bien faite constitue un moyen vraiment héroique dans les cas de rupture osseuse accompagnés de gonflement, je dois vous prévenir aussi qu'employée par des mains peu exercées, elle peut devenir la cause d'accidents plus ou moins redoutables. Ne l'oubliez jamais, c'est là une ressource puissante en chirurgie : mais, passez-moi cette expression, elle ne souffre pas de médiocrité."—*Velpeau, Leçons Orales de Clinique Chirurgicale.* Bruxelles, 1841. p. 638.—This passage has been quoted in opposition to the eminent surgeon of La Charité; but in thus warning his students, he was merely giving another proof of prudent caution in a surgical teacher, who, in due course, would feel it his duty to warn his hearers against rashly using the knife in dividing the stricture for hernia, lest the gut should be wounded,—to warn them against using the knife too freely in the deep incisions for lithotomy, and to give them other similar admonitions. Would it be fair to argue from the fact that improper use of the knife in herniotomy and lithotomy may do harm, therefore they should not be performed, when it is known by taking due precautions, they are the means of saving a multitude of lives? The true moral of the accidents is to use prudence for their avoidance: so in the case of the starched apparatus; the possibility—nay, the probability—of its being productive of injury when improperly applied, is no argument against its proper use. In point of fact, instead of Mr. Velpeau's admission being an argument against his teaching, it is a great reason for respecting it; for it proves that, while the advocate of a system, he preserved that spirit of impartiality and candour which is indispensable to a professor who loves to teach the truth.

but they have either been quoted because at the time in the Clinique, or on account of their gravity. The cases now to be related are all those in which, having employed the immovable apparatus, I have had to regret, for different reasons and in various degree, an unfavourable termination.

We have not yet exhausted the consideration of the theoretical objections alleged against the method of treatment; but since it is, as a rule, most conducive to the clear appreciation of a clinical subject to alternate reflection in the study and at the bed-side, it is hoped that the present investigation may not prove an exception, and that you may be the better able to weigh impartially those points reserved for consideration, when you shall have had brought under your notice the unfavourable, as well as the happy, results of experience, acquired under conditions sufficiently uniform to afford ground for comparison.

Case XVII.—*Fracture of the fibula and internal malleolus.—Immediate application of immovable apparatus.—Union in good position.—Persistent lameness.*

A. B., a carter, admitted in the Queen's Hospital Accident Ward in August, 1859, with injury to the right foot. The ankle-joint was very considerably swollen, and it required careful examination to

determine the precise condition of the bones. The inner malleolus was broken at its root, and the fibula about 2½ inches above its lower extremity. There was slight eversion of the foot.—Great relief to pain, and rapid subsidence of the swelling, attended the application of the starched apparatus. It was opened and re-adjusted the fourth day; and the patient was discharged at the expiration of six weeks, with solid union, with the foot in good position, and with very fair movement of the ankle-joint;—so good indeed, considering the nature of the accident, that I did not hesitate to prognosticate complete recovery of the functions of the articulation before many weeks elapsed. The event did not bear me out. I saw the man several times during the two subsequent years, and was unable to relieve persistent lameness, for which no anatomical causes were discernible, as the shape of the joint was perfect. I am disposed to refer the lameness to the changes which occurred in the ligamentous and tendinous structures surrounding the articulation, in consequence of the severity of the injury; and in corroboration of this explanation I beg attention to the following history.

Case XVIII.—*Fracture of the fibula, and rupture of the internal lateral ligament of the ankle-joint.*—

Great swelling.—Immovable apparatus applied at once.—Rapid decrease of tumefaction.—Delirium tremens, and death.—Dissection of the injured limb.

A. B., admitted into the Queen's Hospital the 24th October, 1861. He was very drunk, and had injured the right ankle in wrestling. That joint was hot and puffy, and measured round the point of the heel 10¾ inches, while the left ankle, on the same level, was 8½ inches. The fibula was fractured just above the articulation. The foot was inverted. The immovable apparatus was applied to mid-thigh, with Dupuytren's splint on the outer side, to ensure rest during the drying process in spite of the patient's drunken restlessness.

26th October, (10 A.M.).—Apparatus loose in consequence of subsidence of swelling; on opening it, the skin is cool, and the ankle is nearly as fine as the sound one. Edges pared and re-adjusted.

On the 27th October, symptoms of delirium tremens made their appearance, and proved fatal in forty-four hours.

Before proceeding to dissection of the limb, scarcely any difference was perceptible in the shape of the two ankles. On dividing the integument over the injured one, blood was found infiltrating all the soft tissues, and extending along the tendons and within their sheaths, to nearly the middle of the

leg. The ankle-joint also contained a considerable quantity of blood. The internal lateral ligament was sound, with the exception of its anterior portion, which was torn off with adherent bony spiculæ from the outer edge of the corresponding malleolus. The fibula broken obliquely from above downwards, and from before backwards, just above the upper margin of its articulation with the astragalus.

In this case the immovable apparatus was peculiarly efficient in keeping at rest the injured joint of the delirious patient, and, as usual, the swelling yielded very speedily to the gentle compression. Had the man lived, it is very probable, that, however perfectly the fracture might have been united, the movements of the joint would never have been completely regained, in consequence of the severe injury to its ligamentous and tendinous connexions. Fractures are injuries of which it may specially be said, that they are not serious in proportion to their magnitude;—proximity to a joint, whether in simple or compound fractures, always affects the prognosis adversely; and it is well to bear in mind, especially in connexion with fractures near the wrist and ankle joints, that independently of the bone lesion, some impairment of motion may persist, in consequence of the violence to the other structures entering into the composition of the articulation.

Case XIX.—*Double fracture of femur.—Immediate application of immovable apparatus.—Persistent lameness, notwithstanding consolidation without shortening.*

This case occurred in Mr. Erichsen's Clinique, while Mr. Henry Kiallmark was his House-surgeon. I accept the entire responsibility of the case, because my friend Mr. Kiallmark requested my assistance at the first application of the apparatus.

James M'N—,* aged 45, was admitted in University College Hospital the 10th October, 1854, having fallen forty-five feet from a scaffold. The femur was broken in two places, an inch or two below the trochanters, and in the middle of the shaft. The starched apparatus was applied to the limb immediately, before any swelling had come on. In evidence that effusion, and consequently swelling, had been prevented by the compression, it was noticed that at the fold of the groin, where the bandage ceased, a patch of ecchymosis appeared after a few days; but under the apparatus there was not the least discolouration of the skin.

On the patient's discharge, the 22nd December, the following note was made:—No shortening of

* These notes are compiled from the *Lancet*, 1855. Vol. I., p. 197 and 616.

the inferior extremity; no thickening or deformity in the shaft of the bone; some small amount about the seat of upper fracture.

I had an opportunity to examine this patient in May, 1855, at the Royal Free Hospital, London, to which I had the honour of being attached, and then made the following note:—"Is lame, on account of pain felt, when he places his foot to the ground, on the inner side of the thigh, from groin to knee. No sensible difference between the length of the two lower limbs. A decided angular prominence is perceptible at the trochanter; it is occasioned by this process being twisted, so that its anterior edge is now externally, its outer surface posteriorly, directed. Knees and feet can be placed in accurate contact; movements of hip-joint perfect." I was informed that during M'N.'s stay in hospital, Mr. Erichsen remarked to the dresser, that the apparatus was too loose, and that, if so left, its merits could not be tested.

It is certain that unless an apparatus fit closely to the limb it cannot fulfil the two-fold indication of circular compression and immobilization, and it has been objected* that it is extremely difficult to

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* "I had an opportunity, about ten years ago, of seeing this plan executed with great address by one of its most distinguished advocates, M. Seutin of Brussels, where it was then uniformly practised;

determine the medium between looseness and constriction; to avoid the danger of displacement of the fragments on the one hand, of mortification of the soft parts on the other. This is a lesson which precept cannot impart, and only personal experience can supply; just as in the deep incision for lithotomy, in cutting the flaps in amputation, in the division of the stricture in hernia, and in many similar contingencies, fixed rules cannot be laid down for the length of incision, but it must necessarily be left to the surgeon, well versed in the principles of the science, to acquire the art and to apply it with dexterity and safety.

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

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

CASE XX.—*Compound fracture of leg, with considerable swelling.—Immovable apparatus; phlegmonous erysipelas. — Amputation. — Recovery. — Compound fracture of the other leg.—Treatment by common splints; phlegmonous erysipelas. — Amputation. — Death.*

"John Rhodes, a carter, of rather intemperate habits, æt. 48, admitted to Ward 1, University College Hospital, on the 24th November, 1852. The accident was occasioned just before admission, by his falling out of a van, the wheel of which passed over the left leg; I found both its bones fractured about two inches above the ankle. The lower end of the upper fragment of the tibia was a good deal tilted forwards, and the skin tightly stretched over it. There was a small oblique wound to the extent of about one inch, on the inner surface of the limb, opposite the seat of fracture; a little blood oozed from it, but the bone not seen protruding. The swelling about the seat of fracture was considerable, owing, no doubt, to subcutaneous extravasation of blood. Starched apparatus applied at once to nearly the middle of the thigh, and a sand-bag, about five pounds weight, placed over the front of the leg, from the knee to a little above the seat of fracture.

26th November (10 P.M.).—Complaint of pain

across the roots of the toes, and on the instep. Relief afforded by opening the apparatus on the dorsum of the foot, and rebandaging rather loosely.

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

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

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

1st December.—As the limb was quite easy, the apparatus was not opened yesterday. This morning, however, the patient complained of pain in the seat of fracture. On exposing the limb, a good deal of

swelling was found in this situation; the wound open, its edges red; no discharge; a large bleb on its inner side. Temperature of the small of the leg, on the injured side, 93°; on the sound side, 85°. The position of the fragments perfect.

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

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

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

From this time, the soft parts about the fracture got into a sloughy state, and the system in so low a

condition, that Mr. Erichsen deemed it necessary to amputate below the knee. Henceforward, the man slowly but constantly improved, and eventually recovered with a good stump.

The subject of this accident was a carter, of somewhat intemperate habits: the fracture was comminuted, and there was a wound in the integument, produced by direct violence. It is the contrary of surprising, according to what we know of such accidents in London hospital practice, that, though this man was supported by stimulants, he fell into so low a condition as to render amputation of the limb necessary. As a means of maintaining co-aptation, the starched apparatus proved perfectly efficient. At the moment of its removal, the fragments were in perfect position, but they became displaced almost immediately after the limb was put on a M'Intyre, though much more than ordinary care was observed in its adjustment. The fact that vesications occurred, is in itself no proof that the apparatus did any mischief; for it is well known that the skin usually vesicates over a fracture that has been occasioned by severe direct violence; but it is the peculiar position and shape of the blebs in this case, which may be regarded as evidence that the apparatus produced mischief by constricting. It is stated in the report of the 27th November (the

third day after the accident), that the patient did not complain of pain; that the wound appeared quite healed; but on the inner and outer side, and also in front of the small of the leg, were several large vesications disposed in the course of the turns of bandage; there had been no sensible increase or diminution of the swelling since admission. The absence of pain, the comparatively healthy nutritive activity of the limb, as indicated by the wound having healed, and the swelling not having increased, are facts which seem to prove that the apparatus did not exert baneful pressure. The case was undoubtedly one in which blebs are very apt to form on the integument in consequence of the injury done to the subjacent parts, and altogether independently of the treatment adopted; yet I confess that the fact, that the blebs appeared opposite the turns of bandage, seems proof that the compression was here a little greater than elsewhere. I am disposed, from observing the other conditions, to consider that the excess of pressure, at the turns, was just sufficient to determine the situation of the blebs, but that they originated independently of it. It is recorded in my note-book that, contrary to usual custom, I did not in this case surround the seat of fracture with cotton-wool when the apparatus was first applied. Had this been done, the constriction

at the turns might have been prevented; but it is more than probable that blebs would still have formed, though not of the same shape and in the same situation. An impartial study of the facts stated in the history impels me to attribute the unfortunate termination of the case, to the severity of the injury, and to the state of the patient's constitution. I submit this opinion the more freely, as I have already stated the facts for the formation of an independent judgment."*

I have reproduced the notes of this case at length because, at the date of its occurrence, the loss of the limb was regarded by many as evidence against the treatment employed, and the sequel of the unfortunate man's career has proved the correctness of the commentary appended to the report. I learned in 1856, that Rhodes had sustained a severe fracture of the remaining leg, which was treated with ordinary splints by a very good surgeon, and that phlegmonous erysipelas again made its appearance, and necessitated amputation, which proved fatal. The man's habits of life and the history of the two accidents proved, almost beyond question, that the different methods adopted for the treatment of his fractures had nothing to do with the result; but that

* Gamgee, Starched Apparatus. P. 46-49.

he fell a victim to habitual intemperance, which is, certainly, one of the principal causes of the comparatively high rate of mortality, in the surgical wards of London hospitals.

CASE XXI.—*Compound fracture of leg, with extensive extravasation of blood and emphysema.—Application of starched apparatus.—Phlegmonous erysipelas.—Death.*

R. U., a very stout, hard drinking, man, above fifty, sustained a fracture of the right leg on Christmas eve, 1861. The policeman who took charge of him reported that he found him drunk, staggering near a lamp-post, and making vain attempts to walk; the right trouser and boot covered with blood, and the corresponding leg bending under him. I first saw the patient about ten hours after the accident. The right leg was broken a little below the middle; from a deep circular aperture opposite the fracture in the tibia, blood oozed freely; the limb, as far as the tuberosity of the tibia, was uniformly somewhat bigger than its fellow, the enlargement being due to infiltration of blood and air into the areolar tissue; emphysematous crackling was distinctly perceptible on gentle palpation. Antero-posterior displacement of the fragments was overcome without much difficulty, notwithstanding the

great muscular power of the patient. I covered the wound with dry lint, and applied the starched apparatus as high as the middle of the thigh, leaving the man quite comfortable.

December 27th.—Has been free from pain, with the rare exception of slight twitchings. Apparatus opened and re-adjusted. Skin cool and of normal colour, co-aptation accurate; no sign of undue pressure.

December 28th.—Has passed a restless night, dreaming of horrors, and frequently disturbed by shooting pain in the limb. Pulse 110; countenance anxious; tongue covered with brownish fur. Apparatus opened,—skin rather hot; a faint dusky red blush pervades it; emphysematous crackling not increased; no bogginess. Apparatus re-adjusted lightly, and limb supported in a swing.

December 30th. The redness and heat more marked; a quantity of reddish serosity escapes from an incision into a doughy spot a little below the tuberosity of the tibia;—a poultice applied to the front of the leg, from ankle to knee; apparatus left open but not removed, as the pasteboard splints are a support, and it is undesirable to add motion to the existing causes of local irritation and constitutional disturbance.

From this date phlegmonous erysipelas, of typical

character, spread rapidly to the middle of the thigh; free incisions were made according to local indications; and very generous support allowed, in the shape of strong beef tea, eggs and brandy; so soon as cleanliness demanded it, the remnants of the pasteboard apparatus were removed,—the swing being continued. The use of Chassaignac's drainage tubes was very serviceable in carrying off the immense discharge. I had the advantage of consultation with Dr. Fleming and Mr. Pemberton, who concurred with me in advising amputation, which however was declined. Large masses of dead areolar tissue were drawn out through the wounds, which assumed a healthier appearance, and at one time inspired hope for the limb and life; but, eventually, the poor fellow sank into a typhoid state, and died in the last days of January.

The result in this case, as in the preceding one (XX.), was no other than might reasonably have been anticipated; and it is very probable that injuries so severe, in constitutions so vitiated, must, in a considerable percentage of cases, have a similar termination, whatever the treatment employed. This admission recalls to memory a few more of the objections against the treatment of fractures of the limbs by the immovable apparatus. The great majority of these injuries, it is urged, do well

by any method, while, for the cure of some of the most serious ones, no plan is efficient;—the apparatus employed is a matter of secondary importance to the method of using it;—consequently, the best method is that which is most easy of application, least likely to interfere with the natural reparative process, least likely to be fruitful in accidents. Fractures, it is added, like all other injuries and diseases, present great variety, and it is most philosophical to adapt the means of cure to the circumstances of particular cases,—to eschew therapeutic systems, and to practise impartial eclecticism.

These objections are certainly plausible, if not formidable: and, though I may not address myself to them in their precise order, the consideration they deserve shall be as direct and explicit, as it is hoped the statement of them may be accepted as comprehensive and unequivocal.

It amounts to a truism to affirm that the majority of fractures, like many other injuries and diseases, have a curative tendency, which is sometimes so powerful as to accomplish its end independently, if not in spite, of the means employed to aid it. The animal frame is so organized that it can resist opposite extremes, often for a considerable period and with comparative impunity; and the power of endurance

is not confined to the state of health; to it is due the fact, that in disease life is preserved, or rather preserves itself, under the most opposite conditions; and to that power of natural conservatism is it also owing that, notwithstanding the marvellous delicacy of the organization on which life depends, its destruction is sometimes so difficult. This it is which, to cite one amongst a multitude of instances, has enabled our generation to witness the treatment of acute rheumatism by copious and repeated bleedings, and by the administration of large doses of brandy, and which has rendered it possible for the advocates of systems so antagonistic, to win fame from the credulous, and to compel thinkers to silence, on account of the difficulty of proving the evil effects of doctrines, no less painful in their operation than unphilosophical in their foundation.

It does not follow however that, in the event of injury or disease, the selection amongst methods of treatment is matter of indifference; though it is certainly true that the determination of their relative influence on the rate and completeness of the process of recovery is fraught with many and serious difficulties; one of the chief of which is the absence of a standard of comparison, owing to deficiency of information on the Natural History of Disease.

In the treatment of fractures, as in a multitude

of other matters in the practice of medicine and surgery, the problem, under existing circumstances, is, how can the natural reparative powers be economized,—how can pain be spared,—how can the chances of untoward local and constitutional complications be reduced to the minimum,—how can the attainment of the end be assured and expedited?

When a person's thigh is broken, it is not disputed that the fragments may re-unite, possibly in good position, though it be left unsupported; to say nothing of the wonderful recoveries sometimes witnessed after the most awkward management, there is certainly no doubt that with the long splint, Dessault's apparatus, and the various forms of inclined plane, broken thighs can be treated successfully, so far as affects the ultimate result, the re-consolidation of the bone. But, however able, however patiently attentive to details, however handy, be the surgeon, it is utterly impossible he can afford patients so much ease by other methods, I mean such perfect freedom from restraint and pain, as by the immovable apparatus; provided it be thoroughly well constructed, so as to carry out in their entirety the principles of treatment; neither is any other plan so efficient in preventing deformity and averting complications.

In our own, as in other arts, the form of instruments is of less importance than the manner of using them,—in other words—than the skill of the artificer. But it is none the less true that, given a certain ability, its efficiency will be enhanced if it be applied in accordance with intelligible and demonstrable principles, and with good instruments.* Though a matter be of secondary, it may yet be of absolutely great, importance; and recollecting the number of causes which usually concur in the production of effects in organic forms and actions, especially in their aberrations, as witnessed in disease, it seems superfluous to urge that nothing should be neglected which can in the slightest degree operate beneficially;—a clear understanding of physiological and therapeutic principles,—promptness in decision,—delicacy and completeness in executing well devised plans, with patient attention to the minutest details, are not more essential in any

* "Many people did very well under amputation before the double incision was practised: but is the double incision therefore no improvement? The operation for the bubonocele may be performed with that clumsy instrument the probe scissors, but is the bistory therefore not preferable? A surgeon may cut off some ounces or even pounds of flesh from a patient's back-side in order to cure a sinus, but is the cure by the simple division of that sinus therefore not easier or more expeditious? Neither of these can I think be proved, unless it can at the same time be proved, that pain is no evil, confinement not at all irksome, and that deformity and elegance of figure are synonymous terms."—*Percivall Pott on Fractures*, op cit. p. 430.

part of surgery than they are in the treatment of fractures.

While admitting in all its breadth the lesson impressed by the History of Medicine, and by every day's experience, even amongst many of the most reputed practitioners, that systems are fertile sources of error, our anxiety to generalize, and thereby raise to a scientific position, the treatment of disease should never have rest.

Fractures of the limbs, while presenting many varieties, have yet so many fundamental characters in common, as to admit of classification into groups, the simplest of which can certainly be treated on the same principles and by the same means. It will clearly be a great gain if fractures without complications be treated on the principles we have endeavoured to demonstrate. When trial has been made in simple cases, that faith which experience alone can impart will, by degrees, lead the practitioner to treat more severe injuries on the same method; and I have no doubt that, after experiments conducted with cautious, but persistent, diligence, it will be admitted, that it is very much easier to treat fractures well, by the immovable apparatus, than by any and all the many complicated and awkward machines and splints bequeathed by the older surgeons, and multiplied by the moderns. Of course every new

method requires to be learned, and it is no reasonable ground for objection that its application is attended with difficulty, until its principles and details have been mastered.

The yoke of authority, in Science, is so enslaving, and so fatally inimical to progress, that, on no condition could I myself support it, or counsel its being borne, however eminent might be the intellect which sought to impose it. When circumstances, like the present, happen to place me in the position of a teacher, I am ever fearful lest you should mistake earnestness of conviction in demonstration, for a desire to coerce into belief. Happily amongst my colleagues you have excellent opportunities for learning the orthodox surgery of fractures, and it is reasonable to anticipate that the present inquiry will afford no exception to the rule, which conduces to the more clear understanding of an intricate subject, the more abundant the means for comparison and contrast.

LECTURE VI.

CONTENTS.

GENTLEMEN,—It is not so much as a method of treating simple fractures without complications, that I deem the one taught in this Clinique to possess superior advantages; but these are most decided in

fractures complicated with swelling, or penetrating wounds, and in cases in which union has progressed slowly, if at all. Under these circumstances the principles of circular compression and immobilization* find their most convincing illustration, as may be inferred from the following cases, which have occurred since the preceding Lecture:—

CASE XXII.—*Dislocation of the ulna, fracture of the head of the radius, great swelling.—Reduction, hot fomentations, increase of swelling; its rapid subsidence after application of compressing apparatus.*

E. S., æt. 25, admitted to Hospital July 25th; states that, as he was walking along the street last night, he slipped and fell on the point of the elbow, which has since become swollen, painful, and immovable. On examination (twenty-four hours after the accident), the right arm, from the middle of the forearm to the same situation in the upper arm, was much swollen, and the ulna dislocated backwards—

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* It is curious how some of the best authorities, old and recent, agree in condemning what is right. Mr. John Bell said (op. cit. p. 492) "I must declare if there be any great and general error in ancient or in modern Surgery it is that of bandaging a broken limb;" and in discussing the treatment of compound fractures in Holmes' system of Surgery (vol. i., p. 781) Mr. Hornidge enjoins that "Whatever form of apparatus be used, ready access to the wound is indispensable. Accordingly all circular apparatus, movable or immovable, is to be rejected."

the head of the radius fractured. The greatest amount of swelling was just at the point of the elbow, and the parts in the neighbourhood felt tense and brawny. On bending the elbow, the ulna went into its place with a snap. The arm was placed on a pillow in the bent position, and hot fomentations applied.

The next day (July 26th) the swelling much increased, the greater part of the arm tense, hard, and very hot, and the man complained of severe pain, especially in the elbow. The circular measurements of the limb at this time were as follow:—

Middle of upper arm . . .	12½ inches.
Middle of forearm . . .	13 ,,
Point of elbow	15 ,,

I ordered the whole limb to be enveloped in a layer of cotton wool about half an inch thick, and pieces of well-softened mill-board, reaching from the hand to the shoulder, applied on the inner and outer side respectively; the elbow being bent at a right angle, and the forearm semi-pronated. An assistant moulded the splints to the limb during the process of bandaging. The outside was starched. Three hours afterwards the man reported himself nearly free from pain.

July 27th.—The bandage so much looser that it was necessary to cut it open, pare the edges to

nearly an inch, and re-bandage with considerable, but perfectly uniform, compression. The temperature and hardness of the limb had very sensibly decreased.

July 31st.—On removing the apparatus, for the purpose of experimental examination, I found the arm quite cool, soft, and free from swelling. Its circular measurements, taken at the same points as on the previous occasion, were:—

Middle of upper arm . . .	11½ inches.
Middle of forearm . . .	9½ ,,
Point of elbow	13 ,,

Apparatus re-applied. Progress, to complete recovery, rapid.

In this severe injury to the elbow—dislocation with fracture—the swelling, which had occurred in the twenty-four hours before the patient was seen, increased with heat and pain after reduction, though the limb was at rest on a pillow, and constantly fomented with hot flannels. Ease and absorption of the extravasated fluid began directly the compressing apparatus was applied,* so that in the course of five days the arm had become quite cool and painless, and the swelling, which was less

* "Le résolutif par excellence dans les contusions avec infiltration et gonflement, c'est la compression."—Velpean Leçons Orales de Clinique Chirurgicale. Bruxelles, 1841. P. 438.

throughout, had decreased at one point to no less than $3\frac{1}{2}$ inches in circumference.

By way of contrast I may quote the abstract of a case recently published by one of the leading surgeons in the metropolis. I state the main facts literally, though I abstain from naming the work, or the author; having no desire to enter into personal controversy with a learned and most kindly man, for whom I have the greatest respect; and not wishing to hold any one responsible for a practice which, unreasonable and mischievous as I may consider it, is, nevertheless, approved and imitated by a very large section, if not indeed by the bulk, of the profession.

A gentleman was flung out of his carriage with great violence, the right leg striking a gate post. Within a quarter of an hour of the accident he was found lying on the sofa, complaining of the most intense pain, which was greatly aggravated by the slightest movement. There was a small contused wound over the inner condyle, with so much effusion over the bone that it could not be felt on a careful examination, but with the slightest effort the limb could be moved to any extent outwards, from which it was inferred that the internal lateral ligament was torn through, and probably the crucial ligaments also. The patient was put to bed on the

injured side, with the limb everted. Twenty-four leeches were applied over the joint, and repeated every day until seventy-two were applied. The fifth day after the accident the limb was placed in an antero-posterior semiflexed position, keeping the foot upright by means of pillows: continuing the spongio-piline warm. . . . . A pasteboard splint was applied on the outer side in the course of a day or two, to support the limb and prevent any motion in the joint. Delirium supervened, the knee inflamed and gave signs of internal suppuration; a free incision was made into it, and eventually amputation of the thigh was performed to save the life. Dissection revealed fracture of the tibia into the joint, with rupture of the posterior crucial ligament.

The injury in this case was a very severe one, and one which under any plan of treatment may occasionally jeopardize life and limb; though it may be laid down as a rule that fractures into the joints, without penetrating wound, do well under proper treatment, with the exception of more or less subsequent stiffness. But if you imitate the treatment just reported, by position on the outer side, with three batches of leeches of twenty-four each, apply hot fomentations, then place the limb in antero-posterior position, trusting to one pasteboard splint

on the outer side, with pillows under the foot, you will inevitably condemn your patient to a great deal of needless suffering, you will jeopardize life, and, in complicated fractures in or near joints, only exceptionally witness recovery without serious deformity; even when you are not compelled to resort to amputation. What the patient required, whose history has just been quoted, was immediate reduction into the straight position, a proceeding which the administration of chloroform would have robbed of all terror; enveloping the whole limb, from the toes to the iliae crest, in a layer of fine cotton wool, and encasing the sides and back in moistened millboard splints, moulded by accurate bandaging into a perfectly-fitting and evenly-compressing case, special care being taken to fix all the joints. To think of giving rest to a knee-joint, injured like the one in question, by an outside pasteboard splint, with the limb in the semiflexed position, is utterly impracticable. A very trifling alteration in the position of the body, a jerk in the slightest cough or while dreaming, will be communicated to the seat of fracture, excite muscular spasm and pain, and be inconsistent with perfect co-aptation of the fragments. If you are to succeed, these must be absolutely immovable, the muscles powerless—a

twofold object, only to be attained with certainty by an apparatus, so moulded to the entire limb as to fix all its joints,* and by constant, even, circular compression, paralyze the power of its muscles.†

I have already taken occasion‡ to discuss the treatment of severe sprains, which are often serious fractures, though no bone, or only a bit, may be chipped off; the ligaments and fasciæ are ruptured,

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* Mr. Carsten Holthouse, in Holmes' System of Surgery (vol. ii., p. 620), writing on fractures into the knee joint, observes that "The treatment consists in placing the limb, very slightly flexed, on a Macintyre's splint for thirty-five or forty days, when passive motion should be commenced, to prevent ankylosis. If much inflammation arise, it may be reduced by leeches, fomentations, poultices, or evaporating lotions, as most agreeable to the patient's feelings." A Macintyre is quite unequal to maintaining perfect rest of a broken knee joint; and when this becomes the seat of inflammation, well-applied pressure, with absolute rest to the entire limb, is by far the most efficient treatment. Rest, position, and pressure are the principles; fixing the joints, circular bandage, and suspension the means.

† Percivall Pott wrote (op. cit. p. 417): "A short splint, which extends only a little above and a little below the fracture, *and does not take in the two joints*, is an absurdity, and, what is worse, a mischievous absurdity." This grand rule is one of the most valuable in surgery, yet the great master who first counselled it is little heeded. In his very useful little work on the Essentials of Bandaging, just published, Mr. Berkeley Hill enjoins (p. 74): "As a general rule, the joint at the lower end of the fractured bone should always be fixed, and that at the upper end also if the fracture is near that joint." But any one attempting to treat a fracture near the knee or ankle without fixing the joint above, though it be a good way off, is doomed to grievous disappointment. Some grand truths cannot be too often repeated; Mr. Pott's just quoted belongs to this class.

‡ Lecture iv., p. 88.

blood extravasated into the joints, into the sheaths of tendons, and for some distance, not infrequently, between the layers of muscles. The swelling is great, pain intense. The orthodox treatment, by leeches and fomentations, is valueless, compared with circular compression and perfect immobilization.

In the case of severe injury to the knee joint, the eminent consulting surgeon, from whom I have quoted, reports that he only saw the patient the fifth day after the accident, and it was then he changed the limb from the everted to the antero-posterior flexed position, and advised the application of a pasteboard splint on the outer side, in the course of a day or two. Once the necessity was seen for making any change in the posture of the broken limb, that should have been done thoroughly, so as to reduce to the minimum the probable necessity of further interference. Assuming a pasteboard splint on the outer side could do any good, which, under the circumstances, was, I think, most unlikely, the moment for applying it was when the limb was raised the first time. Motion in all such cases is a great evil, only justifiable on condition that means be at once adopted for ensuring subsequent rest, which must be absolutely perfect. These are eminently cases in which half measures

are no use. I should have looked upon the swollen and painful knee joint, the hot skin and constitutional disturbance, as urgent indications for the compressing pasteboard apparatus, and, unless it had afforded almost immediate relief, should, additionally, have resorted to digital compression of the main artery over the pelvic brim. In all cases of severe congestion or inflammation of the limbs, accompanying fracture or otherwise, the greatest advantage is to be derived from digital compression of the main arterial trunk, in addition to the perfect fixing of the joints, and the even, gentle, yet decided compression of the entire limb.

CASE XXIII.—*Compound fracture of the leg from direct violence.—Extensive wound and hemorrhage.—Immediate reduction, closure of wound, and application of pasteboard apparatus.—Perfect recovery.*

The patient before you this morning has kindly attended here to afford you the opportunity of inspecting the result of the treatment adopted, in one of the most severe compound fractures of which I can conceive the recovery to be possible. He was assisting two of his servants in lowering into the cellar an 18-gallon cask; it slipped, knocked him down, and rested on his right leg.

I was at the house within half an hour; both bones were broken nearly straight across, three inches above the ankle; the tibia comminuted; a triangular flap of skin and muscle, two and a-half inches long and nearly equilateral, was turned down towards the foot; the bony fragments being visible at the bottom of the wound; bleeding was very free, but both tibials could be felt below. I laid the patient on the bed, and, before undressing him, attended to the limb, first lightly sponging the wound to remove dirt and clotted blood, then placing the fragments in apposition. There were no loose spiculæ. I replaced the flap, which I held in position so as to ensure exact contact of the edges; this was maintained by narrow strips of dry lint, long enough to encircle the limb, and intersect each other; as the blood soaked through one piece, I laid on another diagonally. A thin layer of jeweller's cotton wool next surrounded the limb, from just above the ankle to the middle of the leg; and, to the same extent, I placed three well-softened mill-board splints, with torn and nicely-bevelled edges, behind and on each side of the limb, about three inches above and below the fracture; those splints were moulded to the limb and closed in by carefully-compressing bandage. The foot and upper part of the leg were now en-

veloped in a layer of cotton wool, and three other mill-board splints applied as far as the middle of the thigh; the back one reaching to within a couple of inches of the heel, the lateral ones embracing the sides of the foot; the whole bandaged, the outside starched, and extra pieces of softened mill-board fixed at the back of the knee and sides of the ankle, with several intersecting spirals of bandage, to render the immobility of the joints, above and below the fracture, as nearly as possible a matter of mathematical certainty; a narrow sand-bag on each side, from the foot to mid-thigh, affording additional security. I then prescribed a draught with half a grain of morphia at once, to be repeated in the course of a few hours if necessary. The quieting influence of a dose of opium, as full as compatible with safety in particular cases, and repeated when necessary, is of the greatest value, as a constitutional aid to local treatment, in the early stages of severe fractures.

Next day a small patch of bloody stain had penetrated through the front bandage, and it increased a little day by day; but the skin was cool, the pulse never above 80, the tongue clean and moist, the bowels acted regularly, and the broken limb was quite painless and free from spasm. Its shrinking was detected by some loose-

ness of the case which I cut up along the middle line the fifth day, paring the edges and refitting closely by circular bandage. I did not disturb the dry shield of lint soaked with coagulated blood, which covered the wound, until the tenth day, and then union was all but perfect. Not a single untoward symptom supervened, the man could painlessly lift the leg off the bed at the end of the first week, by the unaided power of the muscles inserted into, and springing from, the upper part of the thigh-bone; he was out of bed within the third week, and before you is the limb, the broad Λ-shaped cicatrix denoting the original wound. The bones united without any surrounding thickening, and the limb is not in the slightest degree shortened or deformed.

The fundamental principles, to which the success of treatment in this case were owing, were no doubt the exclusion of air by the immediate closure of the wound, and the prevention of all sources of irritation by movement, from within and without; all the means employed concurring to the same end. By pressure the edges of the wound were held together, the hemorrhage was arrested, serous infiltration prevented, absorption and healing promoted; by pressure the muscles were paralyzed, the bony fragments

held in position, the joints immobilized; pressure, in fact, with the strong and evenly-fitting circular case, was the chief therapeutic agency through which the great physiological desideratum, perfect rest, was secured.

"The late Mr. Bennion,* a surgeon who resided at Oswestry, in Shropshire, was remarkably successful in his treatment of cases of compound fracture, accidents of frequent occurrence in this district. So marked was his success in the treatment of these injuries, that it became matter of common observation that Mr. Bennion's cases generally did well, whilst the compound fractures treated by the other surgeons in the district were generally fatal. The plan adopted by Mr. Bennion was as follows:—

"1st. Immediate reduction; and, in securing a good apposition of the fractured surfaces, he would frequently employ more force than many surgeons might think prudent, so that he very rarely had occasion to saw off any portion of bone.—2ndly. He cleared away all the blood from the wound, considering that it interfered with the reparative process, and brought the edges of the wound in

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* A Sketch of the Principles and Practice of Subcutaneous Surgery. By WILLIAM ADAMS, F.R.C.S. London: 1857. P. 15, *et seq.*

apposition. He then covered the wound with a large bit of lint, saturated with compound tincture of benzoin, and bandaged the entire limb, first by itself, whilst extension was being kept up by an assistant, and then bandaged it to a well-fitting splint, adapted to the case; in the lower extremity, he used a long straight splint.—3rdly. He put the patient at once under the influence of opium, upon which he placed great reliance, and kept up its action for a considerable time, according to the circumstances of the case.—4thly. He never disturbed the first dressing or bandaging, unless urgent symptoms indicated the necessity of so doing. If such symptoms did not appear, he would allow the first dressing to remain for a month."

I have read you this passage to prove that the successful treatment of compound fractures depends not so much on the materials employed, as on the principles which regulate the treatment, and this is a truth which needs a little further development.

Baron Larrey, the constant follower of Napoleon's standards, became impressed with the inefficiency of the common treatment of fractures at the early period of his glorious career; and he devised a method of fixing the whole limb in a solid casing (composed of compresses, bandages, and straw

cushions, soaked in a mixture of camphorated spirit, acetate of lead, and white of egg beat up with water), which, whether the fracture were simple or compound, was not removed until the period requisite for consolidations of the bones had expired. How far he carried the principle of immobility, how little he cared to examine and dress wounds in soft parts, so long as their mutual contact was accurately maintained, and air excluded, is strikingly exemplified in the case of the veteran Delage. "This soldier, whose arm* I amputated at the shoulder-joint, at the terrible battle of Moscowa, in 1812, at my request, set out immediately on his journey homewards, and reached Provence without ever having had the stump dressed, in accordance with the assurance I had given him at his departure, that he would not need it; and that all he had to do was, from time to time, to sponge the outside of his apparatus, and then to cover it with a good sheep-skin, for the purpose of excluding from it the cold and moist air of the season. My instructions were scrupulously obeyed; and on the soldier's reaching Provence, and removing the first apparatus, he was agreeably surprised at finding the wound perfectly cicatrized."

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

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

The case of the veteran Delage was no doubt exceptionally successful, and the mode of treatment pursued not deserving general imitation. But it is interesting, and extraordinary circumstances may render it particularly useful, to know, that it was possible to relieve a man of a shattered limb by amputation at the shoulder-joint, and to restore him to his distant fatherland safe from the horrors of the

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Op. cit. page 108.

bloody retreat of 1812, simply by inclosing the shoulder in a case capable of maintaining absolute rest, and excluding the air. Notwithstanding Larrey's great success, and the now well-known advantages derived from immobilization in the treatment of fractures, many—I for one—would be disinclined to enclose a limb, the seat of compound fracture, with the intention of not looking at it for five or six weeks. Happily, Baron Seutin's modification of the immovable apparatus, which admits of the limb being kept perfectly at rest, and yet easily inspected for observation of its general state, and dressing its wounds, enables us to reap all the advantages of perfect rest, without incurring the risks of pent-up pus and sloughing muscles.

Contemporary French military surgeons countenanced the principles of treating fractures propounded by Larrey. Amongst the many highly-interesting communications, on gun-shot wounds, to the French National Academy of Medicine, after the unfortunate days of June, 1848, is one by M. Bégin, the late distinguished surgeon-in-chief of the military hospital of Val-de-Grâce. He thus expressed himself on the subject of gun-shot fractures* : " . . .

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

Immobility is the first and fundamental condition of success in their treatment. . . . . My friend and colleague, M. Roche, informed me that during his experience in Spain, almost all the comminuted fractures of the thigh were lost. The Spaniards, on the contrary, frequently cured them by placing the limb in an immovable apparatus, made with tar, chalk, and white of egg, smeared with a mixture of oil and wine, and having holes in it opposite the wounds."

To go back to the pasteboard apparatus: I shall read you the account of a case of compound and comminuted fracture of the thigh in a bricklayer, æt. 53, who was treated by Mr. Benjamin Hunt, while he was resident surgeon in this Hospital.

"While at work a short time previously, a plate of iron, four feet square and quite an inch in thickness, which was placed in an upright position, fell and jambed his left leg against a wall; it was with difficulty that he could be extricated from his painful position. I found his trousers cut through in two places, exposing a wound an inch and a half long with lacerated edges, and muscle protruding, three inches above the outer malleolus; another wound of equal size on the inner side, situated rather lower down, communicated with a comminuted fracture of the tibia. There was much swelling,

with contusion of the soft parts, and rapid oozing of blood from both wounds; the preternatural mobility at the seat of fracture left no doubt that the fibula was also broken. Dry lint was placed over the wounds, and also a pad of the same material along the shin; the apparatus was then applied as above described, but made to extend to midway up the thigh, and no cotton wool used. There was oozing of blood during the following night, and some starting of the limb, but the man complained only of numbness. On the next day, the bleeding which came from the wound on the inner side of the leg ceased. On the second day, forty-eight hours after the case was put on, it was found sufficiently dry to admit of being opened; this was done by cutting it up on the anterior surface, taking the fold of lint over the shin as a guide; one side of the limb was examined by drawing outwards one half of the case and using the other as a support, keeping it applied to the leg with the hands of an assistant; and the examination of the other side was similarly conducted. The fragments were found to be *in situ*, and the swelling of the soft parts much diminished; the edges of the wound on the fibular side were adherent, but the wound in the tibial region was inflamed and suppurating. A piece of the case was cut out opposite the wound to form a kind of trap-

door to facilitate inspection and the application of dressings, without disturbing the rest of the limb; folds of lint were inserted between the case and the leg as seemed requisite to keep up pressure after subsidence of swelling; and the edges of the apparatus having been adjusted, a starched bandage was applied, leaving uncovered only the part where an opening for the wound had been made. The treatment of this man was henceforth simple; the wound on the tibial aspect of the extremity was dressed daily, and healed up in three weeks; he sat up in bed on the third day, and when about to go to sleep, always turned upon his left side. The only discomfort his leg gave him was that he could not flex the limb, as the case included the knee joint; in two or three days, with my permission but without solicitation, he left his bed to go about on crutches. He was discharged from the hospital on the 2nd of June, forty-five days after the accident occurred; the fragments were firmly united, and without any displacement; he could bear his weight on the limb when the apparatus was on, which latter was cut down so as to allow movement of the knee-joint. A fortnight afterwards, the apparatus was removed, and an elastic stocking worn instead, to prevent that œdema which comes on after injuries of this kind."

It would be difficult to conceive a more brilliant result than this, or a more eloquent practical illustration of sound principles of physiology and therapeutics. Mr. Hunt had to deal with a comminuted and compound fracture of both bones of the leg near the ankle joint, with two wounds, protruding muscle, much swelling, and free oozing of blood; yet in three days the man was sitting up in bed, turning on his injured side to go to sleep; at the end of the first week he walked about on crutches, and in forty-five days from the accident left the hospital. How could such a result have been obtained by any other method than immediate reduction, closure of the wound, circular compression, and perfect immobilization of the entire limb?

Note on Digital Compression.

It is now some years since I first employed digital compression for the treatment of aneurism, and, in common with the majority of surgeons who have resorted to it, was impressed with its great value. It was not until I lately had the opportunity of frequent interviews with Professor Vanzetti, of

Padua, that I quite understood the advantages which may be derived from the practice of digital compression of arterial trunks in the treatment of injuries and diseased conditions of the limbs, other than aneurism. Professor Vanzetti's Memoir on this subject is so little known, and is so difficult of access, that its translation here may be of interest. I do not doubt that in some severe fractures digital compression of the main artery will be found to be a powerful aid to circular compression and immobilization of the limb, in checking spasm, and promoting absorption of bloody or inflammatory effusion. Unquestionably does digital compression hold the first rank amongst the resources of conservative surgery; for it is harmless, and, when not actively beneficial, a very short time suffices to determine its real value in particular cases. Physiologically, the principle of treatment is a sound one; clinically, it is of proved efficiency.

Observations on the treatment of inflammation by digital compression, by Dr. Tito Vanzetti, Professor of Clinical Surgery in the University of Padua.*

From the time when I ascertained that the true method of treating aneurisms, is to compress the arterial trunk with the unaided hand, I did not doubt that such obvious and perfect means of intercepting the flow of blood in an artery might also be available in the treatment of inflammations in any part, in which the principal artery admits of compression with the finger.

I have many times employed, without other help, digital compression of the femoral, the brachial, or the subclavian, in phlegmons, articular inflammations, &c., and I found it so efficacious, that I made it the ordinary method of treatment, in every emergency in my clinique in which it was practicable.

The cause of the salutary effects which must follow diminished supply, or retarded impetus, of blood to an inflamed part, is too manifest to need explanation. Obviously the surgeon can only look forward to reasonable advantages from that plan of treatment: but it is certain that these advantages will be very great. Compression will cure every

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* Giornale Veneto di Scienze Mediche, Vol. x. Serie ii.

incipient inflammation; but it is obvious that when the inflammatory action has made considerable progress, though it be checked by digital compression, the restoration of the part to its normal state cannot be anticipated, before time enough has elapsed for the absorption of the inflammatory products. It is finally clear that in every inflammation which is already too advanced and severe, in which the capillary vessels are broken, matter infiltrated amongst the tissues or collected in an abscess, or in which the parts are already sloughing, the harm already done cannot be prevented by compression; and a complete cure cannot then be effected without going through the successive stages of the lengthy process of elimination and repair. But even in these very serious cases compression of the artery will be the most apt method, not only for arresting the further progress of the mischief, but also for accelerating recovery; because it is the most ready method for lessening inflammation, the continuance of which would be opposed to the natural reparative processes. Digital compression will be indicated in the most serious cases, so long as it may be desirable to moderate the quantity and impetus of blood to the part affected; subsequently, it will be necessary to have recourse to all the means

suggested by art, for counteracting the disastrous consequences of the diseased action, against which compression was undertaken too late; viz., the abscess must be opened when necessary, counter-openings made, fomentations and expulsive bandages supplied.

In case of a patient suffering from a diseased condition, which may destroy the structure or function of a limb, if the surgeon be convinced that he has at command a resource at once safe, and more prompt than any other, he will surely not discard it because it may entail a little trouble; but he will apply himself *with good will and purpose* to put it into practice, and will always be able to make the necessary arrangements for the proper compression of an artery by the hand during several hours, and for one day, or two at the utmost, at intervals.

The method of which we are speaking has been theoretically proposed by some authors; but, far from having been put into practice, has been forgotten. The same surgeons who proposed it, spoke of the compressors which would be necessary to compress the artery alone, without intercepting the venous circulation; but to speak of the advantages derivable from the treatment of inflammation in a limb by compression, and at the same

time to advise its being accomplished by means of a tourniquet or other mechanical compressor, was tantamount to proscribing the excellent idea from being carried into effect; and this was actually the case.

It is truly wonderful that in the treatment of inflammation, as of aneurisms, the hand should not have been thought of as the invariable agent of compression. We not only advise its invariable execution with the fingers, but maintain that digital compression is preferable in practice to every other method of treatment.

The only difficulty attending the proper execution of digital compression is that one or two persons are required; but this should be no obstacle when the saving of a limb, perhaps a life, is in question. In cases of imminent danger, the surgeon should himself perform compression for two or three hours; and this might be sufficient to reduce the gravity of the inflammation, and save the threatened limb. In the greater number of cases, the patient can himself compress the femoral, the brachial, and even the subclavian, as is necessary when the whole arm is swollen; he can generally continue the pressure from eight to ten minutes, and after a short rest can repeat it: brief intervals do not materially lessen the eminently beneficial effects

of digital compression.—Moreover any one, instructed by the surgeon-patient, may, after a little fruitless endeavour, learn how to compress an artery.

The history of cases treated by this method will be worth more than precept: they will shew not only its practicability, but its efficacy, how the compression is to be made, and what precautions are necessary, in order to acquire the indispensable certainty that the finger really compresses, and not merely touches, the artery.

First Case.—*Very severe phlegmonous erysipelas of the left arm: digital compression of the subclavian: very speedy result.*

Peggio di Garzignano, a robust boatman, æt. 41, admitted 19th March, 1858, not previously been subject to any illness worthy of note. In the night of March 13, after a fatiguing day, was attacked with very severe pain in the left arm, accompanied with high fever: in the morning the limb was intensely red, swollen, and painful: went to bed and applied elder-flower fomentation: passed a sleepless night in consequence of excessive pain in the limb and high fever.

March 15th.—Sought medical advice;—blood letting, a brisk purge and elder-flower fomentation

prescribed; pain unrelieved, swelling still on the increase.

March 16th.—Venesection repeated, fomentations continued, pain very intense; redness and swelling on the increase, now reaching to the axilla.

All the symptoms became more intense until the patient was conveyed into the Clinique of the University of Padua.

March 20th.—State on admission. Since yesterday the excessive pain has ceased, the limb now feels numbed and heavy; its size is enormous, twice as large throughout as the healthy limb; no power of movement, not even in the fingers; the hand, especially on the dorsal aspect, is the seat of soft and elastic œdema. The fore-arm is of intensely blueish red colour; all its inner aspect from the carpus to the bend of the elbow, presents an immense bleb, filled with turbid bloody fluid; through some apertures in the red cuticle the blueish-red true skin is visible. All the dorsal aspect is closely maculated, as by infiltrated venous blood. The enormous swelling is hard, elastic, œdemetous in different places. An adherent cutaneous eschar, nearly an inch in diameter, covers the radius at the wrist, and the pulse can only be felt on pressing the eschar; traces of incipient

mortification of the integuments along the median line from the wrist to the bend of the elbow; from the latter situation hard swelling extends up the arm to the axilla; the redness here is of a brighter colour, the œdema is firm, the skin shiny and grained like an orange skin. Pulse 104, heat increased, but not burning; countenance moderately good; tongue moist, no complaint on examining and pressing the limb.

Diagnosis. Very intense phlegmonous erysipelas of the whole arm, with commencing gangrene of the integuments. How to arrest the progress of this deep, very intense, diffuse inflammation, how to save the limb and avert the necessity of amputation? According to the common practice, I should have made five incisions on the outer, and four on the inner, aspect of the fore-arm, and at least six on the arm, each incision two inches in extent, viz., fifteen incisions equivalent to a wound of thirty inches! Internally I should have given tartar emetic; I should also have repeated venesection, and applied an emollient poultice.*

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* With the greatest respect for the learned author, I think he has rather exaggerated the treatment by incisions in assuming that fifteen, of two inches each, were necessary. Instead of blood letting and tartar emetic an English surgeon would, under the circumstances, have advised good food, wine, and bark. I do not believe that so great and fundamental a difference in practice is called for by the

All this was left undone; the limb was merely covered with a double layer of damp muslin, and

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different constitution of the Italian and the English people. The systems of Rasori and Bronssais still exert a very pernicious influence in France and Italy, though faith in them has been somewhat shaken of late years. From my collection of notes, derived from personal experience of the antiphlogistic treatment in the Peninsula, I may be permitted to transcribe one, as concerning personages of historical interest. While on British Medical Staff duty in Turin, in 1854, I was requested by Sir James Hudson, K.C.B., to meet the Physician to the Sardinian Court, Chevalier Tarella, and Dr. Tommasi, Physician to the British Embassy, in consultation in the case of General Beckwith,—a distinguished officer who had spent his life, since Waterloo, amongst, and for the benefit of, the Waldenses. The old general had been feverish, but very low, some days, and it was proposed to bleed him from the arm a fifth time, Dr. Tommasi, however, dissenting. I found the distinguished veteran with a rapid feeble pulse, pale face, and drooping eyelids; a big, flabby, and indented tongue; the intellectual faculties disordered to muttering delirium. "*Ubi stimulus ibi fluxus*" was the Hippocratic maxim,quoted by Chevalier Tarella to explain the patient's condition and justify the proposed treatment; the brain was excited, too much blood flowed to it, blood must be abstracted. Instead of joining issue on this basis, I apologised for recalling to memory Dante's famous description of the death of Count Ugolino and his children, from hunger, in the tower of Pisa. The poet describes Ugolino delirious and blind, groping over his dead and dying children.

. . . . . ond 'io mi diedi
Già cieco a brancolar sovra ciascuno.

—*Inferno, Canto XXXIII.*

If you had obtained access to that delirious man, Chevalier Tarella, I enquired, would you have taken from him a glass of blood, or given him a glass of Chianti? That illustrious patient too was delirious, but his mental raving was that of exhaustion, not of the inflammatory process. In the consultation at General Beckwith's, as not unfrequently occurs on the continent, several members of the patient's family, and distinguished friends, were present during the professional deliberations. The quotation from Dante overbalanced that from Hippocrates. The general was supplied with quinine, chicken, and good old wine, and made rapid progress to complete recovery.

digital compression of the subclavian commenced immediately; as a preliminary, pieces of measuring tape were placed around the middle of the arm and of the fore-arm, a black mark denoting the points of measurement.

Compression was continued throughout the night, with interruptions sometimes due to the accidental escape of the artery from beneath the fingers, at other times inseparable from the substitution of one assistant for the tired one, and the delay in finding the vessel and selecting the precise point for compressing it; a matter always requiring some study and attention.

While the right hand was engaged in compressing the artery, the left, from time to time, examined the pulse at the wrist, to ascertain if the subclavian were efficiently compressed; this precaution is a very necessary one when digital compression is performed.

The patient slept during the night more than an hour while the artery was being compressed; and this was the first sleep he had had since the attack. On waking he was relieved by profuse perspiration.

Second day. After fifteen hours of interrupted compression the patient was in the following condition, reported in his own words:—"So soon as

an hour after the application of the finger to my neck, I saw the swelling of the hand diminish, and shortly afterwards I could begin to move the fingers, which I could not do previously. The arm, which at first felt all numbed, was not so after three hours; but the pain returned when the compression was interrupted; when it was resumed, the pain ceased. The measuring tape on the arm, which at first fitted it exactly, became so much looser during the night, that I began with passing one, then two fingers, under the tape, and towards 4 in the morning it admitted the whole hand. I can now bend the fingers and, a little, the wrist, which I was yesterday compelled to keep in an extended position, as a hard and inert object." Such, in reality, was the surprising change which I found in the affected limb; the upper measuring tape was so loose as to admit of the passage of four fingers beneath it; the fore-arm had not decreased so much in size, but yet one finger could be inserted between it and the tape which surrounded it. The redness of the arm was faded; the venous colour of the fore-arm was not so dark, but still it continued, apparently the result of extravasated blood. The hand was no longer swollen; the fingers, and the wrist partially, had regained free movement; with some effort the patient could grasp

an object. In consequence of so much diminution of swelling, the whole limb was softer, the joints more movable; the excessive tension had all disappeared; only comparatively slight œdema remained, with here and there alternating hard and doughy feel, caused by the mortified cellular tissue. In fact, I looked upon the inflammation of this limb as in great part overcome, the mischief stopped; and I was of opinion that all that remained to be done was to wait for the natural repair of the serious damage which had occurred, viz., the separation of sloughs from the skin and cellular tissue, and the process of cicatrization.

The tapes were re-applied, and the compression continued at intervals. At the evening visit the tapes had become loose, though less so than formerly, the remaining swelling being due to the products of inflammation, for the removal of which time was necessary. During the night compression was suspended, and a simple fomentation applied.

Third day. Slept greater part of the night; pulse 96; in the evening, temperature almost normal; no serious symptom. Suppuration commences; the cutaneous eschar on the wrist is already separated; the flexor tendons are seen denuded; only a little cellular tissue covers the radial artery; an emollient poultice applied to the

whole arm. Suppuration appeared to have occurred more promptly and copiously, than usual in cases treated by a different method. Digital compression, renewed from time to time, was discontinued altogether at 3 p.m.

Fourth day. Suppuration very copious and good; the limb almost reduced to its natural size; a well defined round eschar is visible at the bend of the elbow, and other cutaneous eschars, along the middle of the fore-arm, are in process of separation.

Sixth day. Suppuration very profuse; long shreds of sloughed cellular tissue drawn out at the points where the skin had mortified. The patient had been delirious during the night; pulse 94, soft; tongue in good condition. Poultices, and a scruple of camphor in an emulsion.

Seventh day. Gentle delirium during the night; pus very profuse, but more serous; separation of more sloughs of cellular tissue; the whole integument of the fore-arm loose, and baggy with large collection of matter. Three incisions on the dorsal and on the palmar aspect. One grain of opium morning and evening; poultice.

Eighth day. Along the whole inner surface of the fore-arm, from the wrist to the bend of the elbow, is a wound an inch and a half wide, the result of sloughing of the integument to that extent. At the

bend of the elbow the slough has left the tendon and part of the biceps muscle exposed.

Twelfth day. Good granulations.

Sixteenth day. Dry dressing; granulations healthy, but cicatrization rather slow; general condition of the patient excellent,—able to leave his bed.

The following points are worthy of notice:—

1stly. The extreme readiness with which the size of the limb diminished, and the acuteness of the inflammation ceased without any other help.

2ndly. The unusually rapid suppuration, and hence the more prompt and easy separation of the sloughs.

3rdly. I do not doubt that the inflammation might have been arrested before the skin and cellular tissue mortified, if digital compression had been applied earlier.*

SECOND CASE.—*Acute arthritis of the right hand: digital compression of the brachial: speedy recovery, without the employment of other means.*

Giovanni Marchiori, of Padua, æt. 31, a metal

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* Professor Vanzetti here dwells on the possibility of curing aneurisms of the axillary and the upper part of the brachial arteries by digital compression of the subclavian.

caster, of light build, admitted 28th March, 1858. Has had two attacks of acute rheumatism, one eleven, the other three years since; during the former one, was bled seven times; in the latter, nine. A week since, slight pain commenced in the joints of the right hand; it increased greatly, with swelling during the last two days. During the previous night the pain was so acute, as altogether to prevent sleep; the weight of the hand, and the slightest movement, greatly aggravated the pain.

On admission in the clinique, the morning of Sunday, 28th March, the patient supports the swollen hand, to prevent it hanging; the swelling is uniformly distributed, not œdematous but elastic. The colour of the skin is natural, with the exception of slight redness on the inner side; local heat increased. The slightest movement of the hand is impossible for pain; the most gentle pressure is also unbearable. The patient's expression is indicative of suffering, but there is no general reaction; pulse 88, and fuller and harder in the affected than in the sound limb. *Acute arthritis.*

Digital compression was at once commenced (noon of the 28th); it was executed at intervals, by pupils and by convalescents. They did not all learn with the same facility, but a peasant at once

understood the mechanism, and executed it very well. In order to compress the brachial or any other artery effectually, it is essential to feel the pulsations distinctly; to pass the finger over and on each side of the artery, to ascertain its volume and precise situation, as also its relations to the subjacent bone, against which it requires to be pressed. Whoever has performed digital compression will readily be persuaded of the difficulty of compressing arteries by artificial means. In the treatment of aneurisms, as of inflammations, compression can never become a *normal method* until it be *always* and exclusively effected with the finger.

At the evening visit I found the patient greatly relieved: the swelling was perceptibly reduced; while the artery was pressed, no pain was felt, but, on suspending compression, pain returned, though in a less degree. Considerable pressure borne with ease, and some movement of the hand possible, both in flexion and extension. Compression to be continued until midnight.

Second day. Has slept well during the night; pain in movement and under pressure still further diminished; scarcely any swelling remains. The patient learned to compress the artery efficiently in the middle of the arm; can do so for eight or ten minutes at a time while lying in bed; by the

relief he experiences, the patient can judge if the artery be well compressed; but, to be more certain, he asks a nurse to seek for the pulse at the affected wrist, while he presses the brachial.

Third day. All the movements of the hand can be executed to the fullest extent without any pain, with the exception of slight uneasiness opposite the first metacarpal joint.

Fourth day. The patient compressed the artery several times yesterday; no trace of the previous inflammation remains, but he is still retained in the clinique, because the pulsations in the right radial artery were somewhat stronger than in the left.

Fifth day. Pulse equal on both sides. Discharged.

Recovery was exclusively due to compression, without any external application or internal remedy; not even a purgative.

Note—1stly. The speedy effect of compression.

2ndly. That it could be executed by a peasant.

3rdly. That the patient could distinguish if the compression was well done.

4thly. That no other remedy was employed.

5thly. That compression was continued from time to time, until the pulse in the affected limb was not stronger than in the sound one.

1st April, 1858.

When we bear in mind how many trivial innovations acquire wide and speedy popularity in our profession, it is scarcely possible to suppress astonishment at the fact, that ten years have elapsed since the publication of the paper just translated, without the treatment of inflammation by digital compression being known to surgeons, with, numerically, insignificant exceptions. I might add several cases in illustration of the practice, but as this is a matter in which every practitioner has ample opportunity for settling the question experimentally, by a perfectly safe and easy method, it will not be necessary to do more than to express a decided conviction, that many attacks of inflammation of the limbs may be cured by digital compression of the principal arteries; and that, with very rare exceptions, this will form a powerful aid to treatment,—always easy, never dangerous; at once scientific in its principles, and conservative in its object. Digital compression will give relief, though often only secondary to other remedial measures, alike in whitlow and phlegmonous erysipelas, in arthritis and compound fracture.

LECTURE VII.

CONTENTS.

COMPOUND fractures are of very different degrees of importance, according to the extent of bruising which complicates the wound, and the relative position of the injury to a joint.

The case of compound dislocation and fracture of the ankle which I shall take as the basis of this Lecture, is one of the very few on record in which an attempt, made under similar circumstances, to save the limb, has proved entirely successful.

Case XXIV.—Henry Smith, æt. 35, was admitted into Ward I. of the Queen's Hospital, the 9th January, 1863. He stated that whilst standing a short time previously on the top of a wooden case containing glass, at a height of about twelve feet from the ground, he slipped and fell with great force, twisting his right foot under him.

On admission a lacerated wound about four inches in length, was observed immediately in front of, and a little below the level of the external malleolus.

The lower end of the tibia and fibula, with the bulk of the astragalus, protruded through the wound. The latter bone was only partially detached from its connexions above, but completely isolated from the other bones of the tarsus; the intervening powerful ligamentous connexions having been wrenched asunder. A small portion of the head of the astragalus had been broken off. The foot was displaced inwards and upwards, its outer edge facing the ground. The malleoli were uninjured, the lateral ligaments having snapped across just below those bony projections. All the soft parts were displaced to the inner side of the foot. No pulsation could be felt in the posterior tibial, but the dorsal artery of the foot pulsated distinctly. The muscles were in a state of violent contraction.

The note requesting my attendance at the hospital immediately on this patient's admission, stated as the object of my visit "to amputate the leg." On arrival I found the instrument table ready, and the Resident Officers did not conceal their astonishment at my expressed determination to endeavour to save the limb.

Chloroform was administered, and the partially detached astragalus was dissected out of its bed; the wound was then enlarged upwards to the extent of an inch, and the articular surface of the tibia removed with the malleoli, by means of a Butcher's saw. The wound was brought together by six points of metallic suture, and dressed with dry lint. The limb was placed in an extended position, covered with a layer of cotton wool, and supported by three well-moistened thick pasteboard splints, reaching from the middle of the thigh downwards; the two lateral ones embraced the sides of the foot, the posterior one reached to within two inches of the point of the heel. The pasteboard covering was made firm by accurately compressing circular bandaging, the outside was starched, and the limb laid on a tripartite pillow, having water in the centre, and sand in the lateral compartments. A draught prescribed containing forty drops of laudanum, to be repeated every twelve hours.

January 10th.—The patient described himself as having slept through the night, but was now and then troubled with slight pain and shootings in the limb. Temperature of the foot and of the body, $100\frac{1}{5}$; pulse, 108; respirations, 18. Milk diet.

11th.—Slept all night, suffers no pain-shootings or uneasiness in the limb. Pulse, 92; temperature, $100\frac{4}{5}$; respirations, 21.

13th.—Has passed a restless night, which he attributes to omission of opiate the previous evening. Some pain on instep; bandages stained with discharge. Pulse, 96; temperature, $99\frac{4}{5}$; respirations, 20.

14th.—Progressing favourably; suffers neither pain nor uneasiness in the limb.

15th.—Has had little sleep; during the night was delirious and wanting to get out of bed; hands tremulous; slight twitching of facial muscles; conjunctivæ jaundiced; tongue furred, swollen, and œdematous; bowels constipated; pulse, 105 (weak); respirations, 24; temperature, $101\frac{1}{5}$. To take an ounce and a half of castor oil.

16th.—Limb free from pain and swelling; dressed to day for the first time; free suppuration established. A piece of skin about two fingers' breadth, and three inches in length, is in a sloughy condition, close to the wound. Pulse, 102; temperature, 99;

respirations, 22. Dressed with a weak solution of Condy's fluid; the apparatus re-adjusted with evenly-compressing bandage, and suspended to a bed cradle, on the sand and water pillow having a slip of half-inch board under the central or water compartment.

17th.—Slept comfortably during the night; bowels acted naturally this morning; tongue moist and clean; pulse, 99; temperature, 99; respirations, 18. To have a mutton chop.

21st.—Limb carefully dressed to-day as before. The slough of skin has not yet separated; sutures removed; no redness or tension about the gaping wound, its edges having nowhere united. Pulse 96. The patient is allowed two eggs, a chop, and a pint of ale daily.

24th.—On opening the apparatus and removing the cotton wool from over the wound, the slough separated; discharge healthy, and diminished in quantity; a drainage tube inserted in the wound and passed round the outer side of the foot to the middle of the sole, here to emerge from between the pasteboard splints. Wound dressed as before, and limb bandaged.

February 2nd.—The drainage tube acts very satisfactorily; discharge greatly lessened; wound contracting rapidly; dressed once a week.

February 14th.—Drainage tube withdrawn; discharge very trifling; no pain in foot; the man reports himself in good health, and eats and drinks well.

February 28th.—There is but little discharge; the wound is nearly healed; a small abscess over the lower end of the fibula was evacuated to-day.

March 10th.—Since the last report the improvement has been very marked; the wound is almost cicatrized, and the gap, corresponding to the astragalus, is filled up and comparatively firm.

March 20th (nine weeks after the accident.)—Wound healed; union rapidly acquiring solidity; pasteboard apparatus continued as far as the knee; discharged from hospital and ordered to attend as an out-patient.

In another month the man was able to walk with a stick, which he gradually discontinued, and at the expiration of six months from the accident, I made the following note: "The foot is in perfect position, only differing from its fellow in the comparative constriction at the ankle, which is by no means fixed, as might be imagined, but admits of a considerable and very useful degree of motion. The injured limb is shortened to the extent of $\frac{3}{4}$ of an inch; to remedy which a thickly soled and heeled boot is worn, and the man is able to walk with a barely perceptible limp."

The commonly accepted rules of surgical practice indicated amputation of the leg as the proper practice in this case, for not only was the astragalus wrenched from its bed and thrust through the skin, with the lower ends of the tibia and fibula, but, bearing in mind the great strength of the bonds of union which had been severed, it was reasonable to assume that the deep-seated mischief was greater than could be estimated, on examination of the superficial parts.

I have long felt convinced that amputation is too frequently performed for compound fractures, and that many limbs are sacrificed, which, by wise management, might be retained and become very useful.

The question of primary and secondary amputation has not the importance in civil, which it has in military, practice. On the battle-field, or in an ambulance, conservative-surgery has unavoidably far less chance of success than in a healthy private house, or in a civil hospital;* and though I may

* "The Notes and Recollections of an Ambulance Surgeon," by Mr. William MacCormac (London, 1871), contain some very interesting facts gathered in his experience after Sedan. He was forced to the conclusion (page 119), "that of no rule in military practice, can there be less doubt than that immediate amputation should always be practised in gun-shot wounds of the knee clearly implicaing the articulation. . . . . Excision for wounds of the knee may be successfully performed in civil practice, but is not justifiable in military. . . . . Of our twenty-seven cases of gun-shot fracture of the femur, nineteen died. . . . . In somewhat

have some fears that amputation may become necessary in the course of a week or two, I endeavour to save some extensively-injured limbs which at first sight appear in a hopeless condition. I am satisfied with a reasonable probability that the treatment may be successful.

Reviewing the steps of treatment in the case under consideration, you will observe that chloroform was administered at the onset, not so much to save the patient's suffering, as to relax the spasmodically-contracted muscles, and facilitate reduction with the

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strong contrast to our experience is that of Stromeyer, in his ambulance at Floing, close by Sedan, where a good deal of hard fighting took place. He treated there thirty-four fractures of the femur; and in twenty-four, there was, at the time of the report, a prospect of cure, four were doubtful cases, and only six died. His table of results in fractures of the leg is also very satisfactory. Out of thirty-one fractures of the tibia or fibula, or both, caused by gun-shot injury, only three died, while the result remained doubtful in six instances. Out of thirty-four similar cases at Asfeld, of fractures of the leg, as many as fourteen perished. The mortality after operations in the lower limb was very great at Asfeld. I may say that scarcely any recovered, but those in which the operation was performed immediately after the receipt of injury: our secondary operations proved nearly all fatal." British surgery could not have had a better representative on the memorable battle-field than Mr. William MacCormac. His patients were all Frenchmen, dispirited with defeat, and in the worst hygienic conditions. Stromeyer's the reverse. Admitting the immense influence of these different conditions, I am inclined to think the Germans had other advantages. If a gun-shot fracture of the femur is to be saved, it stands a poor chance with a long splint and a weight attached, as compared with the German plan of padding the bony prominences with cotton wool, applying a flannel roller, and encasing the whole limb in a plaster of Paris case, which ensures absolute rest, and, by its compressing agency, prevents swelling.

least chance of injury. In all cases of fracture, simple as well as compound, attended with much displacement and spasm, it is advisable to produce general anæsthesia before applying the apparatus. When the muscular system is relaxed, and the patient perfectly at ease, the necessary surgical manipulations can be carried out with delicacy and with the most perfect efficiency; and once the joints above and below the seat of fracture have been securely fixed, circular compression may be safely relied on to maintain apposition of the fragments, and prevent spasm and pain when the anæsthesia has passed off.*

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* The number of deaths from chloroform has lately been so considerable, that without entering into the question of their cause, it is essential that every precaution be adopted to reduce the chances of accident to a minimum. I cannot but think that much mischief has resulted from insisting that chloroform and allied agents are perfectly safe. Granted that their beneficent operation cannot possibly be too highly esteemed, it is important never to lose sight of the fact, that they are all-powerful for the destruction of life, if administered to excess, or in an improper manner. Whether to reduce a fracture or pass a catheter in a severe case of stricture, in reducing a hernia or in performing ovuriotomy, I always insist that the administration of chloroform, as involving the great issue of life and death, should be entrusted to a competent practitioner, who shall have nothing to do with the operation. As to the manner of administration, I think the one which combines greatest ease and safety is that of sprinkling the anæsthetic on a cloth or handkerchief, after carefully measuring it so as to be certain of the quantity used. Mr. J. T. Clover's apparatus is a scientific and most ingenious contrivance, and in his hands apparently perfect; but extensively as anæsthetics have to be employed, it is too much to expect that a somewhat complicated and expensive instrument can become equally general. The fact that only air containing a fixed per centage of chloroform can be inhaled

The propriety of enlarging the wound to facilitate the reduction of a compound fracture, and the resection of protruding fragments, have given rise to much discussion. I did not hesitate to solve both in the affirmative in this particular case, enlarging the wound and resecting the protruding bony mass; and in doing so I acted on the principle, that if the limb is to be saved, reduction must always be effected at once; and that it is far better to divide the skin with the knife and resect bony protrusions, if in so doing the reduction is materially facilitated, and the chance is lessened of a piece of injured bone dying.

The plan adopted of closing the wound by sutures, conformed to what is usual after excisions, and it is beyond doubt that one or more points of metallic suture are often of the greatest service in keeping in contact the edges of wounds in soft parts over fractures. More recent experience has led me to rely on Dr. B. W. Richardson's styptic colloid as a preferable agent in closing the external wound in compound fracture, and in many other cases of

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through the apparatus, might induce exaggerated confidence in its safety. When complete insensibility has to be produced, a certain amount of risk must be incurred, and whether Mr. Clover's apparatus or the cloth be used, it is equally important that the administrator be most watchful and prudent, and the pulse and respiration must *both* be closely observed,—a cardinal rule of practice which no one has inculcated more strenuously and successfully than Mr. Clover himself.

incised or lacerated wounds inflicted accidentally, or in the performance of a surgical operation. My plan is to pour a small quantity of styptic colloid into a saucer, and steep in it strips of lint about half an inch wide and two or three inches long. After approximating the edges, I apply the strips of lint, prepared as directed, just like strips of ordinary adhesive plaister, blowing upon them to hasten evaporation and drying of the colloid. The firm retentiveness of this agglutinative dressing, its complete efficiency in excluding air, and its unquestionable antiseptic properties, make it most valuable in closing wounds and preventing suppuration. It is matter for astonishment that styptic colloid has not made its way more generally into the practice of surgery, as a most powerful aid in obtaining union by the first intention.

The limb did not swell throughout the course of treatment, and that was owing to the uniform circular compression from the ends of the toes to the middle of the thigh. It cannot be too often repeated, that as a preventive of swelling in fractures, and as a means of reducing it when it has been allowed to occur, compression is a therapeutic agency which has no rival.

Rare dressings were one of the chief peculiarities in the treatment of the case with which I opened

this Lecture. Once applied, the apparatus was not disturbed, the wound not looked at, until the 7th day; in the succeeding 17 days it was dressed three times, and then only once a week, until the patient's discharge at the end of the 9th week.

No precept is more delusive than that which enjoins the frequent examination of compound fractures, and the dressing of the wound so that it can be seen daily, for fear of hidden mischief, burrowing of matter, and other phantoms. Close the wound, hide it from light and air, and do not trouble to look at it except at rare intervals; trust to the temperature of the body and the pulse as sure indications of the local conditions. Exposure to the air and motion are the great causes of mischief in compound fracture. Rely on absolute rest, and gentle, uniform, compression, for a good result, after having accurately closed the wound. In effecting this object, as in affording facility for uniform compression, the cotton wool in which Henry Smith's limb was enveloped played a most important part. In limbs inflamed from a variety of causes, in cases of erysipelas with phlegmonous tendency, a covering of fine cotton wool and a nicely compressing bandage act in the vast majority of cases positively like a charm; while to all recent wounds, including those inflicted in amputations and excisions of large

tumours, no dressing equals the application of fine cotton wool in promoting the healing process, checking suppuration, and allaying pain.*

On first thought it might be imagined that the attainment of these objects was thwarted rather than otherwise, by the introduction of a drainage tube into the wound. Not so. It is a well-known fact that recently cut or suppurating surfaces are not irritated by a small India-rubber tube, which being always filled with matter by capillary attraction, is useful in preventing accumulations of pus, and in no way dangerous in admitting air, which cannot find its way along it. Surgical drainage† is a grand therapeutic resource, very imperfectly appreciated by the great majority of surgeons. It is itself most useful in many cases; but as an aid in treating compound fractures and suppurating wounds, on or near joints, on the principles inculcated in these Lectures, the system of drainage is invaluable.

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* *Vide* Burggraeve (of Ghent), Nouveau Système de Pansements Inamovibles, Bruxelles, 1853; and Appareils Onatés in Burggraeve's Génie de la Chirurgie, Gand, 1853. In advocating the treatment of gun-shot wounds by his cotton wool and pasteboard apparatus, the Belgian Professor says (op. cit., page 101), "It moulds itself accurately to the limb, and entirely excludes the air (entretient l'hermétisme le plus parfait). The cotton wool, moreover, admits of the application of compression, and thereby prevents inflammation; it likewise exerts a very marked sedative influence."

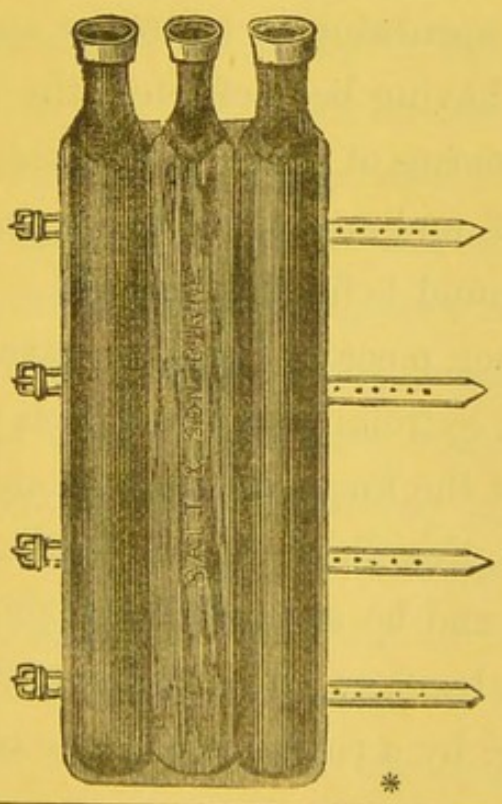
† Traité Pratique de la Suppuration et du Drainage Chirurgical, par E. Chassagnac. 2 vols. Paris, 1859.

The sand and water pillow, which proved so useful in the case of Henry Smith, is worthy of adoption as a very useful agent. I have now employed it in many cases with uniform advantage.

The idea of this pillow was suggested to me by the following passage in Mr. John Grantham's "Facts and Observations in Medicine and Surgery" *—"In the mechanical part of the treatment for fractures of the humerus, I have adopted the following plan, which combines two principles derived from Dr. Neill Arnott's invention for compressing tumours, viz., a resistible and an irresistible support. This plan effects support with security, and is applicable to the treatment of all fractures of the extremities. The means which I term resistible consist of an India-rubber cloth bag, made so as to fit the internal part of the splint, half filled with air." My fracture pillow is of India-rubber, and is divided longitudinally into three compartments, of which the middle one is filled with water, and the two lateral ones with fine sand. A strip of thin board, with straps under the water compartment, admits of the lateral sand partitions being brought close round the limb, and the whole being suspended to an ordinary swing cradle, as was actually done in the case of compound dislocation and fracture of the

* London, 1849. Page 2.

ankle joint. By means of this pillow, a patient with a broken leg or thigh may lie on an ordinary feather bed, and have a very suitably firm and easy basis of support for the injured limb. The elasticity of the central water compartment is a source of great comfort, and the long lateral sand bags give very efficient support. I have only used the pillow as an aid to circular compressing apparatus in the treatment of fractures; but I have no doubt that many simple cases might be treated throughout with the sand and water pillow alone, with the most satisfactory result.



* Messrs. Salt and Son, Surgical Instrument Makers, Bull Street, Birmingham, have successfully carried out my wishes, and are prepared to supply the Pillows of three sizes, with arrangements for suspending it to the Salter's, or any other swing in ordinary use.

In suspending the limb on the pillow to an ordinary fracture cradle, I only aimed at obtaining the benefit of position, and easing the circulation on the inclined plane.

To quote from one of my works, published in 1856:* — "The suspension plan is generally applicable to fractures of the lower limb; it consists in placing the broken limb upon a padded board, having a piece of rope from one to two feet long attached to each angle; the four ends secured above in a knot, may be suspended by a long rope from the ceiling, or from any contrivance over the bed. (Fig. 3, pl. 4.) This simple apparatus is suited to any broken leg. Co-aptation having been effected, the knee and foot are fixed by means of bandage, or a folded half-square handkerchief, and any complication in the shape of bruise or wound befittingly treated. For a broken thigh, another piece of board is attached by hinge to the upper extremity of the one on which the leg rests, so that the knee and hip-joint may be more or less flexed: this thigh piece should reach to the trochanters, and be secured to the thigh and round the pelvis by bandage; but the suspension is effected, as in the leg, by a cord on each side of the foot and of the knee.

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* Researches in Pathological Anatomy and Clinical Surgery. Page 146.

"Observation of numerous cases of simple and compound fractures of the thigh and leg, which I instituted a few years since in the Lausanne hospital, famed as the scene of Mayor's brilliant exploits in this and other departments of surgery, convinced me of the very great comfort accruing to patients, while under this treatment with fractures of the lower limbs, and of the facility with which good results may be obtained with it, even in spite of great tendency to displacement in consequence of the obliquity of fractures and of the power of muscles.

"A few words as to the *rationale* of the suspension plan. The flexed position of the leg upon the thigh, and of the latter upon the trunk, tends to muscular relaxation; but, what is more particularly worthy of notice, is the manner in which the movements of the body, and the action of the muscles of the broken limb, are prevented displacing the fragments. This will best appear upon comparing a broken leg placed upon a Macintyre, and one, similarly injured, upon a swing. In the case of the Macintyre, the leg is fixed to the apparatus, and this to the bedstead through the block on which it rests. If the patient's body move, or the muscles of the thigh and calf otherwise act, their power is concentrated upon the weakest and most moveable part—the seat of fracture—the apparatus and bed being immoveable;

ergo, liability to displacement. In the case of a swing, the motive power is almost completely expended in moving the apparatus, and with it the limb as a whole, and very little of the impetus is felt at the weak spot; *ergo*, the less liability to motion and displacement of fragments. In this comparison, it will be observed that I have assumed precisely similar fractures, and equal motive power; but difference in the apparati, so far as fixity;—the one an immoveable block, the other an undulating sling. It follows theoretically, that to ensure the great desideratum,—the communication of the least possible impulse to the point of fracture,—the swing should be as moveable as possible, so as to exhaust in its undulations the motive power communicated to the limb, and thereby render impossible a jerk in any part of its length. Experience is in accordance. I was much struck by the attention paid, in the hospital of Lausanne, to the carrying out the principles just expounded, and by the great comfort thereby accruing to the patients. The swinging machines commonly made by London instrument makers are so heavy, and the suspending medium (often a chain) so stiff and short, that, practically, there is scarcely any provision for undulation; the heel is almost a fixed point, and the movements of the trunk, or of the muscles

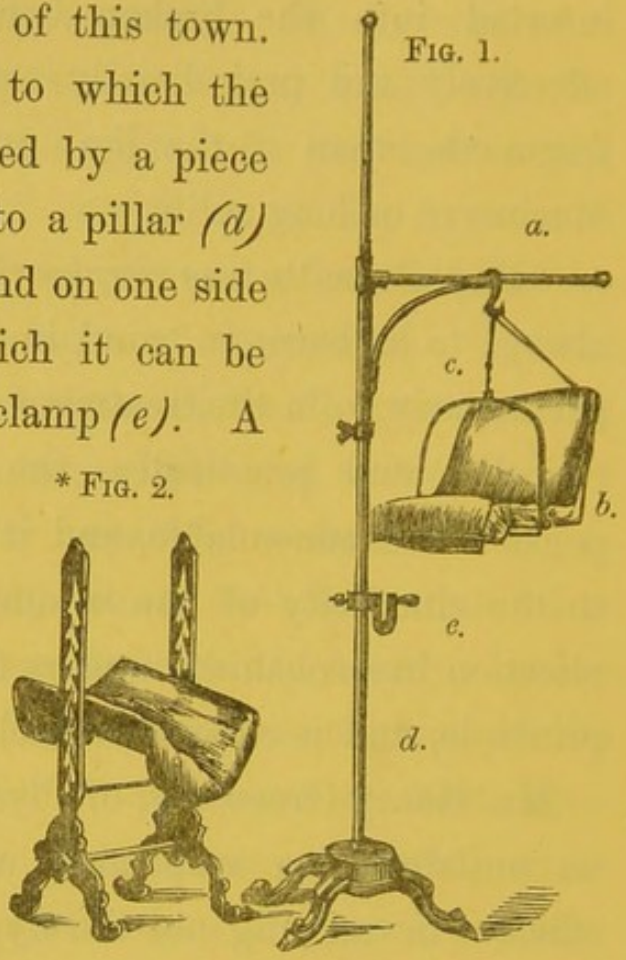
inserted into the broken bones, are little less effectively and prejudicially communicated to the fragments, than if the limb were placed upon a Macintyre or long splint.

"Mayor's motto was *simplex sigillum veri*,—a truth always to be borne in mind in surgical appliances, particularly so in the treatment of fractures. Theoretically, and practically, the principle of suspension is commendable, and it is so in proportion to the simplicity of the means employed. Complication in mechanism impairs the operation of that principle, and is commensurately inadvisable."

Mr. Henry Greenway, of Plymouth, has invented an unilateral leg suspender, unquestionably more efficient in carrying out the hypmarthesic principle than the swing cradles in general use. Mr. Greenway's apparatus* has the advantage of being supported from a framework secured to the bottom and one side of the bedstead, and does not rest on the bed; a firm basis of support is thereby insured, independently of the movements of the patient's body. The splint relies for its mobility, which is the very essence of the suspension plan, on a very ingenious mechanical arrangement. A more simple contrivance is a fracture swing contrived at my sugges-

* Obtainable from Messrs. Maw, Son, and Thompson, Aldersgate Street, London.

tion, by Mr. Restall of this town. The cross-bar *(a)* to which the swing *(b)* is attached by a piece of rope *(c)*, is fixed to a pillar *(d)* resting on the ground on one side of the bed, to which it can be firmly secured by a clamp *(e)*. A telescopic arrangement admits of the pillar being raised or lowered at convenience; and, speaking from experience, I feel confident that this simple apparatus will be found of great comfort to patients, and provide surgeons an effectual means for carrying out the principle of suspension. This principle is capable of much more extensive application than it has yet received, not merely as the basis of a plan on which any fracture may be treated successfully, but as an aid when other methods are



* Fig. 2.

* Fig. 2 represents a leg rest, likewise designed by Mr. Restall, and supplied by Messrs. Salt and Son, surgical instrument makers, of this town. The leg support is balanced on pivots, which rest in notches in the uprights, and can be raised or lowered to suit the patient. When patients with a broken leg or thigh first leave their bed, a comfortable leg rest is a great desideratum, which Mr. Restall's contrivance fulfils effectively and at moderate cost.

adopted, and when wounds, injuries, and affections of the limb, independently of fractures, have to be treated. "That trinity of healing graces," † rest, position, and pressure, are an arsenal of power in surgical hands; and even those who, from traditional pre-occupation, object to the application of pressure to acutely-swollen parts, will find suspension an invaluable aid in securing the advantages of rest and position; only let it be borne in mind that in direct proportion to the mobility of the suspending medium, is the efficiency of the suspension plan.

The general principles of treatment here enunciated are as applicable in cases of acute diseases of joints as of fractures, between which a therapeutic parallel may be conveniently drawn.* In both

† History of a successful case of amputation at the hip-joint, by J. Sampson Gamgee, London, Churchill, 1865, p. 23.

* "If it be desirable to shorten the period of confinement to bed of patients with broken bones, how much more is it so in the case of the poor weakly subjects of scrofulous joint diseases, in whom the confinement in an almost unvarying recumbent position, as a means of curing the local affection, engenders great weakness, and thereby aggravates the cause of the disease, which must be admitted to be a debilitated constitutional state. Rest to the joint and exercise of the body are the great indications in treating scrofulous articular affections, and the most effectual means of fulfilling them, consists in the application of the starched apparatus as practised by me after the teaching of Baron Seutin; in whose wards at the hospital of Saint Pierre, of Brussels, the beds of patients with scrofulous joints are almost all the day empty, whilst those who would otherwise be their constant, withering inmates, are sitting or walking about the halls or gardens

classes of cases rest is the great therapeutic indication to be fulfilled; and the great means for giving it effect are circular pressure, immobility of the joint above and the one below the seat of mischief, wherever practicable, and swinging the limb, if the means just described be insufficient to secure complete muscular relaxation and absolute rest.

Cases of acute disease of the knee-joint are to be constantly seen, professedly treated on the principles of rest, with a wooden splint at the back, and with or without the addition of side splints, extending from the middle of the leg to mid-thigh. Such an arrangement is altogether unequal to the emergency. If a knee-joint is to be fixed, whether to give time for the absorption of bloody effusion and consolida-

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of the hospital. The rest given by this means to the joint does not only do good by allowing general exercise and thus augmenting the bodily vigour, but by putting an end to the painful night-startings, and thereby enabling the patient to sleep.

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

On the advantages of the starched apparatus in the Treatment of Fractures and Diseases of Joints (Liston Prize Essay), by Sampson Gamgee. London: Lewis, 1853. Page 66, et seq.

tion of split condyles, or for the removal of active inflammation and its plastic products, the whole limb, from the iliac crest to the toes, must be encased in an apparatus, accurately moulded to every part, and exercising that uniform, gentle compression, which is all-powerful in controlling muscular irritability, preventing extravasation, and stimulating absorption. When these principles shall be thoroughly understood, and the proper means for carrying them out practised with skill and diligence, resection of joints for diseases, and amputations for compound fracture, will be amongst the rare operations of surgery.

One great principle cannot be too strongly impressed, or too strictly carried into practice. Alike in joint affections and in compound fractures, whatever is to be done should be done early and thoroughly, if mischief is to be prevented.

It is a reproach on the surgical practice of some hospitals, and evidence of imperfect appreciation of the high aim of surgery as a science and a humane art, that when a knee is to be excised for disease, or a thigh to be amputated for compound fracture, colleagues and students are convened, and every one looks upon the proceeding as a serious one demanding the utmost care; whereas a junior is often allowed to attend to the patient visiting in the

out-patient room with a big shining knee, or when admitted to the ward with a smashed limb. By all means let the sufferer have the utmost attention when the great operations have to be performed; but if they are to be prevented, the first stage of treatment is the most important. I would certainly do nothing to lessen the opportunities which juniors enjoy for acquiring experience; so far as practicable they should be increased; but every provision should be made to give patients the benefit of ripe experience. In the cases which have given occasion for these remarks, the process of immobilizing and compressing the knee, the attention to the constitutional state, the perfect dressing and adjustment of the compound fracture, demand the earliest exercise of mature judgment, gentle dexterity, and patience, if the sufferer is to have that to which he has the highest moral claim, the best chance of life without loss of limb.

LECTURE VIII.

CONTENTS.

THE preceding Lectures are published, with verbal alterations, as they have been addressed at intervals, during several clinical sessions, to the students at the Queen's Hospital in Birmingham.

It has been my method in clinical teaching to state clearly the proper treatment to be pursued in particular cases, and the reasons for it, avoiding theoretical disquisitions, and not troubling the student with controversial matters; but in comment-

ing on the treatment of fractures of the limbs, this general rule has been frequently and necessarily departed from.

The enquiries into this subject, which have occupied my attention from the commencement of my professional career, have been perseveringly followed up with a hope that they might result in a reconciliation of differences, and in establishing some therapeutic generalizations, on the basis of proved facts and sound principles. With this view the development of different modes of treatment, and the reasons for their difference, have been a subject of careful and unceasing study, the results of which have been interspersed throughout a number of Lectures to students, and papers to medical societies and journals, during the last fifteen years These scattered historical and bibliographical materials, re-considered and added to, are now grouped for convenience in this chapter, to which the title Lecture is prefixed merely for the sake of uniformity.

All the conditions and causes which have in turn acted as incentives and impediments to surgical progress, may be traced in active operation in studying the history of the therapeutics of fractures,—a pursuit which becomes all the more instructive from the fact that, for upwards of a century, a considerable proportion of those who have made their mark on

surgery, have specially devoted themselves to the study of fractures of the limbs.

The practice handed down by tradition, from the Greeks, through the Arabians, to the Italian schools, commanded implicit reverence long after the revival of anatomy, and the foundation of physiology as an experimental science. When Vesalius, with the help of Titian, was recording his anatomical discoveries; when William Harvey was learning from Fabricius ab Aquapendente, some of the cardinal facts by which he proved the circulation of the blood, Fabricius placed it beyond doubt that in surgical practice, and especially in the treatment of fractures, he was an implicit follower of Hippocrates and Galen.* Nor was the spell of tradition broken for upwards of a century later. "The method of Hippocrates for the keeping the parts of a fracture joined together, and to defend them from inflammation," taught by the Sergeant-Chirurgeon of Charles I.,† was substantially in force in the middle

* "Nos autem principes medicinae sequemur," Fabricii, op. Chirurg, Patavii, 1647. Page 150. For a commentary on the Treatment of Fractures, by the Greeks, Arabians, and Romans, see Dr. Francis Adams' Edition of the Seven Books of Panlus Aegineta, London Sydenham Society, 1846, vol. ii., page 459, et seq. See also Extraits du Traité des Fractures in œuvres, choisies d' Hippocrate par Daremberg, Seconde Edition, Paris, 1858, page 655, et seq. Also des Fractures in œuvres complètes, d' Hippocrate par E. Littré, Paris, 1841, Tome Troisième, page 338 et seq.

† Richard Wiseman's Chirurgical Treatises, London, 1676. Book vii., page 467.

of the eighteenth century, when Samuel Sharpe published his "Critical Inquiry into the present state of Surgery."*

The honour of protesting against the accumulated blunders of a faulty tradition, of rescuing this department of surgery from unenlightened empiricism, belongs unquestionably to Percivall Pott. His "Remarks on Fractures and Dislocations" have been fully commented upon in another part of this volume,† and for present purposes it is only necessary to recapitulate, that Pott rightly insisted on the necessity for immediately reducing a broken bone, and keeping it absolutely at rest,—he taught that, to secure this end, splints must embrace the joint above and below the seat of fracture, and his knowledge of the physiology of repair of such injuries was no less advanced than his therapeutics. With all these merits Pott committed an error which, as frequently happens, was remembered long after the

* In 1750, Samuel Sharpe wrote: "Having only considered such doctrines as, though generally received, in my opinion, are ill-grounded, or such improvements as are yet but little known, I had not made any observations on the treatment of luxations and fractures, in the conviction that all eminent surgeons are agreed on the method of treating them." Three-quarters of a century later, progress had wonderfully disturbed the unanimity due to subservience to the authority of tradition. In the preface (page v.) to his Practical Observations on Surgery, London, 1823, Mr. Henry Earle remarked: "That the difference of opinion which prevails among many of the most enlightened members of our profession as to the most eligible

† Lecture II., page 33, et seq.

great truths he had taught were forgotten. He took a too exclusive physiological view of the causes of displacement, and advocated the bent position of limb and trunk, which is so irksome as to be incompatible with perfect repose, for days and weeks together.

The great surgeon's error charmed his contemporaies by its novelty, and they adopted it to the disregard of his sound teaching. Superficial thinkers, then as now, in search of something new and plausible, embraced it with avidity, and did not trouble themselves with that strict analysis of facts and close examination of reasons, which is essential to the exclusion of fallacy, the confirmation of old truths, and the discovery of new ones.

The practical disadvantages of the bent position on the side were too many and real, to escape observation; and White, of Manchester, was held to have attained a great object by the discovery of the double inclined plane, which enables patients to lie on their back and enjoy the supposed advantages of the bent position in the treatment of fractures of the lower extremity. It would be superfluous to dwell on the varieties of fracture-beds and machines suggested by the idea of the double inclined plane;

mode of treating these cases—(alluding particularly to fractures of the lower extremities)—and the great variety of instruments which have at different times had their advocates, may be stated generally as convincing proofs that perfection in this department has not yet been attained."

frequently very ingenious and sometimes very mischievous, they had their day and have become matters of history.

As Percivall Pott's essay on fractures was the first scientific protest against the accumulated errors of ages, many years elapsed before any real addition was made to the knowledge of this department of surgery, either as a science or an art.

Instinct had been the chief guide of the ancients in treating broken bones, and the stimulus of necessity from time to time suggested modifications which are worthy of record, for the fruit they bore in material improvements, and in laying the foundation of a better system of practice.

The idea of muscular relaxation by flexion was plausible; the placing a patient with a broken leg on his side, with the knee bent was a novel practice; and a large number of surgeons needed no other recommendation to follow it. Germany had not then established any claim to distinction in surgical matters; the schools of Italy were in the decline, and Paris and London disputed the palm for surgical supremacy. The French capital had indeed a paramount claim to superiority. It was the seat of the old Academy of Surgery, the greatest surgical council that the world has ever known; but Cheseldon and Pott, were worthy rivals of Louis and Ledran,

and the surgeons of the two capitals studied each other's works and practice, sometimes to copy, at others to urge diametrically opposite methods of procedure. The treatment of fractures of the limbs was one of the subjects of the keenest controversy; at St. Bartholomew's, the physiological doctrine prevailed; at the Hôtel Dieu, Desault was for permanent extension. The opposite ideas were fertile sources of a host of those mechanical adaptations, which have made so-called splint cupboards receptacles of so many absurdities. It was very soon found that whatever might be said of its advantages with broken legs, the bent position on the side was not suited to the management of fractures of the thigh.

The disciples of the permanent extension school were not idle. Boyer's machine superseded Desault's, and surgeons prided themselves that in treating a broken thigh they were able, after strapping a broad splint to the pelvis, to draw down the foot and oppose the muscles by a windlass, which was so handy at the foot that it could be drawn down by a turn or two, whenever it pleased the surgeon to do so.

The meddlesome mechanicians were fitly criticized by John Bell.* "Those inventors had little fore-

* Principles of Surgery, Edinburgh, 1801. Vol. ii, page 610.

sight who ventured to appeal to the ranks of crooked and deformed bones, to be found in every museum, as proofs of the imperfect state of surgery. Alas! what have they done to lessen the number of the the lame and deformed? Their inventions have not been neglected, they took care that they should not remain unknown; yet, have not the machines of Aitken and Gooch been forgotton in less than twenty years? Though each machine was the occasion of writing a book, in that book only are the encomiums to be found. We perceive that Gooch and Aitken are anticipated by Hildanus; Belloq by the glossocomes of Galen, Paræus, and Vesalius; and Desault is anticipated by Petit, and by all contemporary authors. In short, the machines of Belloq, Aitken, and Gooch, the machinists of the present day, are more complicated than those of the ancients; the genius and inventions of surgeons seem to have been much on a level in all ages; we find the science full of schemes, expectations and disappointments; by perusing the history of these inventions, we really divest our minds of those prejudices which we are too apt to cherish, even while we disavow them. . . . . The ill success of machinery, which touches but at points, demonstrates to us that such kind of resistance cannot be made permanent like the contractions of the muscles

which always in the end prevail." After enumerating some of the advantages which result from simply stretching a broken leg out upon a well-made pillow, John Bell continues: "When the limb is merely extended upon its pillow the resistance is great, but when besides being merely extended upon its pillow, it is laid in a well-framed case, stiff, adapted to the shape of the limb, bending gently so as to allow of a relaxed posture, lined with woollen cloth, flannel or fustian, to increase the friction, and the bend of the ham secured by the bending form of the case, and each pillow padded up with little cushions of tow, another splint laid on the opposite side of the thigh, the whole braced down gently with ribbons, and then both the thigh and its case bound to the pillow by tapes, the fracture is at once very steady and very easy. The resistance to contraction is hardly perceived; because it is so generally diffused it is sensible only in its effects, not by causing pain; there is more of gentle uniform resistance than could be derived from these torturing machines, ... and much greater than can be procured by that cruel extension which Desault has decorated with the fine title of *permanent*." How near Bell was to the perception of the whole truth, yet how forcibly he illustrated his own doctrine (vol. cit. p. 594), that "nothing is more apt to estrange

medical men from simple and sensible methods than an unlucky theory." The cruelty of the fracture machines, the absurdity of the doctrine of active continuous extension, prejudiced both Percivall Pott and John Bell in favour of the bent position and its unlucky theory. Desault's mechanical views were no less unlucky, scientifically considered; but practically he had the best of it, in that, however carefully broken thighs he treated in the bent position, the results can not be so good as in the straight position, with average ease and skill. I have elsewhere (p. 78,) commented upon John Bell's prejudiced opposition to bandaging a broken limb. The well-framed stiff case, with splints on both sides and little pledgets of tow in the hollows, the whole bound to the pillow, and the *generally diffused and gently uniform resistance to contraction*, were all the elements of a successful mode of treatment, if the knee had not been bent and the apparatus had been made to fit close, and gently to compress the whole limb, instead of being braced down gently with ribbons, and friction relied upon to prevent displacement.

The contending theories and opposite modes of practice were put to a severe test in the wars of the first Napoleon. Whatever might be done with broken lower limbs in the bent position in civil prac-

tice, it was altogether inapplicable to the rude exigencies of the battle-field, the ambulance, and the military hospital.* Belloste had early set an example of bold innovation: . . . "A soldier of the regiment of Condé, named La Tulipe, was conducted to this place with a comminuted fracture of the femur, about its middle. . . . . I at once made vigorous extension, reduced the fracture, and applied a piece of linen, soaked in egg beaten up with oil (*huile rosat*) and a small quantity of vinegar; outside this, I placed some compresses, three or four sufficiently long bandages, and some pasteboard splints. . . . . The apparatus was not touched for twenty whole days."

Roche† records that during his experience in

* "In the early editions of this dictionary, I expressed a preference to Pott's method of treating broken thighs. More experience, however, made me a convert to the sentiments of Desault on this subject. The terrible compound fractured thighs, which I had under my care in the campaign in Holland, in the year 1814, could not have been at all retained by any apparatus put merely upon the thigh itself. The superiority of long splints, extending the whole length of the limb, was in these cases particularly manifest. With such splints, which maintain steady the fracture itself, the knee, leg, ankle, and foot, the patient may, in fact, even be removed upon an emergency from one place to another, without any considerable disturbance of the broken part. But, how could this be done in Pott's position, with short splints, merely applied to the thigh, affording no support to the leg, and not confining the motions of the knee and foot."—Samuel Cooper's Dictionary of Practical Surgery. 7th edition, London, 1838. Page 568.

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

Spain, almost all the comminuted fractures of the thigh were lost. The Spaniards, on the contrary, frequently cured them by placing the limb in an immovable apparatus, made with tar, chalk, and white of egg, smeared with a mixture of oil and wine, and having holes in it opposite the wounds. It was reserved for Baron Larrey, to introduce the practice on which the modern treatment of fracture was eventually based. He devised a method of fixing the whole limb in a solid casing (composed of compresses, bandages, and straw cushions, soaked in a mixture of camphorated spirit, acetate of lead, and white of egg beat up with water), which, whether the fracture were simple or compound, was not removed until the period requisite for consolidation of the bones had expired. How far he carried the principle of immobility, how little he cared to examine and dress wounds in soft parts, so long as their mutual contact was accurately maintained, and air excluded, is strikingly exemplified in the case of the veteran Delage, quoted in one of my Lectures.* If it be objected to this extraordinary case that it cannot be accepted as a proof of the value of a therapeutic method, I reply that it is only quoted as evidence of the strength of Baron Larrey's criticism, on the necessity of rest,

* See page 160.

and exclusion of air; and as a measure of his disregard for those so called precautions in the management of wounds, which are in reality impediments to the healing process. A surgeon who frequently inspects wounds, pays scrupulous regard to their cleanliness, and acts as if in constant fear of irritation, burrowing of matter and allied evils, may be commendable for conscientiousness, and claim credit for prudence, while he is in reality pursuing a meddlesome line of action, which is neither sagacious nor economical.

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

* Op cit. Page 108.

were found healed, and the union of the bones perfect, alike in shape and strength.

The great surgeon's astonishment at his practice being unknown in England, could not have been so great as mine, when visiting in 1869 the clinique of a leading British surgeon, to examine personally into his method of treating compound fractures, which was supposed to be novel and scientific, I asked him what he thought of Larrey's method; he replied with creditable candour that he had never read Larrey, and knew nothing about his work. Charles Bell was right when he wrote* that "those who are ignorant of the history of the art, and not aware of the observations and discoveries of the great men who have preceded them, are in constant danger, in straining after new inventions, of only restoring what has been discovered, tried, and rejected before their time."

The Essay from which I have just quoted, was, like all Sir Charles Bell's writings, a model of clear expression and fine reasoning, inspired by the broadest, deepest, purest love of truth; it was the production of a genius, an artist, and a philosopher in one; of a surgeon endowed with a cultivated mind and skilled hands;—yet in this matter of fracture of

* Observations on injuries of the spine and of the thigh-bone. London, 1824. Preface, Page v.

the limbs, Charles Bell was too warm in the vindication of his brother John's claims against Sir Astley Cooper, to see the whole truth in all its bearings; assuming that John Bell's works are incomparably superior as literary productions, and as a body of surgical teaching to Sir Astley's, it is to be regretted that so fine an intellect as Charles Bell's was much occupied with discussions of priority and relative personal merit, which amongst contemporaries are never productive of practical advantages, and usually of much personal animosity. A similar discussion was carried on thirty years later between the partisans of Velpeau and Seutin.*

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*The idea of treating fractures by means of an immovable apparatus is a very old one. M. Amedée Joubert communicated to M. Hipp. Larrey that Persian surgeons scarcely ever change fracture apparatuses during the whole course of treatment. Paré (Euvres Complètes, ed. Malgaigne, vol. ii. p. 306,) gives a prescription in imitation of Hippocrates for making a solidifiable mixture, to be spread over the nose when fractured. Amongst other things, it contains Armenian bole, alum, and white of eggs, and is vaunted as having "puissance de repercuter et reprimer la fluxion, astraindre, tarir, et desseicher l'humeur ja deflué, et aider à tenir les os en leur lieu." Wiseman speaks of a fracture of the femur in a boy being successfully treated by an immovable apparatus constructed with whites of eggs, &c. Sedillot (Gazette Médicale de Paris, 1838, p. 135, and Traité de Méd. Oper., tome ler, p. 67,) had the opportunity, after the siege of Constantine, of examining an immovable apparatus that had been applied to the broken arm of one of the natives. The ancient, no less than the modern Greeks, according to De Pouqueville (Voyage en Grèce), employed a permanent apparatus, which was applied soon after the receipt of injury, and which, with perfect security, enabled the patient to move the limb in any direction; for the purpose of consolidating the apparatus, which was not removed from the moment of its application to that of perfect cure, a compo-

Larrey's immovable apparatus for fractures, in spite of imperfections, possessed such practical advantages, and had done so much to lay the foundation of a new system, that it was in no danger of being forgotten. The siege of Antwerp presented an excellent opportunity for re-examining the vexed question of the best method of managing gun shot fractures, and the Berlin School under Dieffenbach, had revived and modified the old plan of encasing broken limbs in plaster moulds; but it was left to the surgeons of Paris and Brussels, to discuss and establish on a basis, at once scientific and practical, the first principles which should govern the treatment of fractures with or without complications.

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sition, into which mastic entered largely, was used. Dr. Paperi (Lettera sullo Stato dello Medicina nel Regno di Tunisi, al Prof. Barzellotti, Siena, 1821, p. 103,) states, that among the nomadic tribes in the interior of the kingdom of Tunis, it was customary to treat fractures of the limbs with plaster or mortar, just as walls are required. In the work of Sir George Ballingall, already quoted, we find at page 358, "The practice of enveloping fractured limbs in splints and bandages, without undoing them for weeks together, is akin to that followed by the natives of India, of inclosing fractured limbs in moulds of clay. Of the successful result of this practice I remember a remarkable instance in the case of a little boy, who was brought into my tent one morning, having been run over by a waggon in the line of march, and having sustained a severe compound fracture of the leg. I was preparing to amputate this boy's limb, when his parents came in and carried him away to the potter in an adjoining village, who enveloped the leg in clay, and, I believe finally cured the patient." In Cheselden's Anatomy, allusion is made to the treatment of fractures with rags dipped in a mixture of flour and white of eggs, pursued by a bone-setter of Leicester. Fodéré, quoted in Velpeau's Leçous Orales, relates that, as far back as the time of Hippocrates, a class of bone-setters were in the habit of treating

Velpeau* was one of the first (1830), to employ Larrey's apparatus in civil practice, but Bèrard (jeune)† three years later, made the most convincing demonstration of its merits, and particularly insisted "on gradual and uniform compression as prophylactic and therapeutic in fractures, complicated with swelling.‡ Still, Larrey's plan was only a favorite with a small minority. As hitherto

fractures with a permanent apparatus; and Prof. Biagi (Del Trattamento di alcune Fratture con l'Apparecchio inamidato, Lettera al Prof. Antonio Raikem: Firenze, 1843) concludes a valuable clinical paper on the advantages of the starched apparatus in the treatment of fractures with the following remarks: "Were it not for the reprovable tendency which men have of always despising those things which have not the appearance of the specious and the sublime, I certainly think that we should, long ere this, have discovered the rudimental idea of this surgical proceeding, in the humble practice of our peasants, who have long been in the habit of encasing broken limbs in tow, soaked in white of egg, and surrounded by circular bandage." Muttray, De cruribus fractis gypso liquefacto curandis (Dissert inaug Berlin, 1831.) Some observations by Richter on the same subject are contained in Abhandlungen aus dem gebiete der practischen Medicin und Chirurgie (Berlin, 1852.) For a notice of these works, *vide* Malgaigne, in Gazette Médicale, 1832, p. 525, and 1833, p. 285. Aiguilhon, Mémoire sur le Traitement des Fractures par l'Appareil Inamovible en Papier Amidonné, par M. Laugier. (Gazette Medicale, 1838). Lafargue (de Saint-Emilion,) Appareil Inamovible, instantanement solidifiable. (Montpellier, 1839.) Seutin, Du Bandage Amidonné; ou, Recueil de toutes les Pièces composées depuis son Invention jusqu' á ce jour. (Bruxelles, 1840).

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

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

‡ Op cit P. 386.

put into practice, a *sine quâ non* was exclusion of the whole limb from view, whether wound existed or not, during the whole period requisite for bony reproduction. General experience made surgeons hesitate to adopt so bold a practice, a state of doubt which resolved itself into decided opposition, so soon as cases became known in which swollen and wounded limbs had suffered during the long confinement in the solid casing. Velpeau* clearly perceived, and tersely insisted on, the great value of compression in the treatment of contusions with infiltration and swelling; but it was reserved for Seutin,† a pupil of the elder Larrey, so to modify the old pasteboard apparatus as to make it possible to encase the limb with sufficient firmness, while gently and uniformly compressing it, and yet admit of easy examination without disturbance of the contained parts. To strengthen and bind the apparatus, Seutin employed starch, and just as in Pott's case, the majority of surgeons were only struck with the novelty of the bent position, and disregarded the great precepts of immediate reduction and the employment of splints of sufficient length to embrace

* "Le résolutif par excellence duns les contusions avec infiltration et gonflement, c'est la *compression*." Velpeau Leçons orales de Clinique Chirurgicale, Bruxelles, 1841, Page 438, see also page 638.

† Traité de la méthode amovo-inamovible par la Docteur Seutin, 2me Edition, Bruxelles, 1851.

the joint above and below the injury, so in Seutin's case starch was the comparative novelty, and starched bandages become the fashion, while the essentials of his teaching were all but entirely overlooked. If the limb is to be saved, taught Seutin, always reduce immediately, do not be deterred by wounds, swelling, and blebs,—close and compress, and fix the joints above and below the fracture with pasteboard splints. Scarcely any one went deeper than the starched bandage which, being of itself quite unequal to maintain a broken bone at rest, soon fell into merited disrepute.

Seutin was a master in surgery; his labours were not altogether unavailing in founding a school* which however his contemporary, Malgaigne, strove hard to demolish before it could be firmly established. Full of learning but deficient in judgment, a keen critic but an awkward manipulator, Malgaigne exercised an influence on the surgery of France, from which it has scarcely recovered. His commentary on the works of Ambroise Paré is a monument of erudition, but his Treatise on Fractures and Dislocations is a singular specimen of poor surgery. Unfortunately, its fascinating style and parade of learning misled most readers, and

* See Crocq du traitement des fractures des membres, Bruxelles, 1851.

the doctrines of Larrey, Velpeau, and Seutin received a check, from which they have not yet entirely recovered.

It really seemed at one time as if the discussion on the different methods of treating fractures were destined to be interminable. Just as John Bell had charged the practice of Desault with cruelty, Mayor the chief advocate of the suspension plan, attacked Seutin's method as "ce rude et perfide inamovible," failing to perceive that hypmarthesis and circular compression, far from being antagonistic agencies, are theoretically reconcilable, and practically capable of very useful co-operation in securing the most perfect rest of an injured or diseased limb.

In the treatment of fractures of the thigh, Duverney's long splint, adapted by Syme and Liston, deservedly gained in repute over the machines contrived on the principle of the double inclined plane; but the introduction of the Macintyre,* for fractures of the leg, and the persistent favor in which William Sharpe's splints† are held to this day, dimmed the perception of the great principles on which the treatment of fractures should be based,—circular

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* Description of a splint invented for the treatment of fractured limbs, by James Macintyre, 8vo. Newcastle, 1825.

† "Account of a new method of treating fractured legs," 1767.

compression and fixity of the joints above and below the seat of injury, regardless of complications.

The stern exigencies of military practice had done a good deal to dispel the fallacies which prevailed during the wars of Napoleon and Wellington. Allusion has incidentally been made to the surgical results furnished by the siege of Antwerp in corroboration of Larrey's practice, but it was not until the Crimean war that any considerable progress was made towards the settlement of the great question in dispute. In Pirogoff's hands* the plaster of Paris apparatus was established as the best means for treating fractures on the battle-field, and subsequent campaigns have furnished evidence in conformation of that decision.

Of the comparatively small number of converts to the principles of compression and immobilization, very few indeed assented to them in cases of compound and complicated fractures, the treatment of which may now profitably be made the subject of a brief review.

John Bell† taught that "a compound fracture may frequently be made to adhere. This is always

* Klinische Chirurgie eine Sammlung von Monographien von Nicholas Pirogoff Leipzig, 1854. Zweites Heft. Die Gypsklever-band bei einfacher und complicirten Knochenbrüchen, &c.

† Op. cit. Vol. ii, page 659.

to be your object. . . . . When the wound is not large, the flesh is cut, and not much lacerated, it is not only possible to make it adhere, but perfectly proper (after reducing the bone,) to bring the lips as close as possible, and stitch them together . . . . When after a more terrible accident, the limb being torn by machinery, or by carriages passing over it, the laceration is great, you may be able, with the help of the needle to bring two points of the wound together, but the sides can seldom be made to meet fairly, stitches are seldom useful; the sides of the wound are to be generally supported by laying small and thin pieces of lint on each side of the wound; these pledgets of lint are soon soiled with blood, which unites and adheres to the open parts of the wound. By making small rolls and compresses of linen and soft lint, which you lay upon the edges of the wound (at those particular parts where you apprehend a gaping of the lips, as when you apprehend that suppuration and cavities will form,) you keep the parts very close . . . . The steady firmness with which you support the parts helps the adhesion, prevents suppuration, and hinders an effusion of blood to the limb; over all, you may pour a little of some spirituous balsam." The surgical principles on which this advice is based are scientific, and the

practice taught is sound; proving how far the distinguished author was in advance of his time, how much has been lost by imperfect acquaintance with his writings. The practice of closing the wound of a compound fracture by lint soaked with blood is generally ascribed to Astley Cooper, but clearly belongs to John Bell, who also had very definite and accurate ideas on the value of compression in promoting adhesion and preventing suppuration and swelling. In the discussions on this subject, which were so rife at the commencement of the century, many doctrinal errors and absurd practices became current; but, though temporarily obscured, the simple truths of scientific surgery were not lost. Thirty years ago, Mr. Amesbury* rightly insisted that in the treatment of compound fracture, "The great objects to be accomplished in dressing the wound, are to approximate the edges of the integument as nearly as possible, and to exclude the air." He recommends the wound to be closed with dry lint and plaster, and to be kept dry, and if there is no particular irritation, the dressing is directed to be left for ten days. The dry and infrequent dressing here prescribed, would ensure

* Practical remarks on the nature and treatment of fractures of the trunk and extremities, by Joseph Amesbury, London, Longman, 1831, vol. ii. p. 677.

closure of the wound in the majority of cases of compound fracture; but the fashion for water dressing, scarcely more favourable to healing than poultices, was fatal to the establishment of sound principles of treatment; and to add to the mischief, almost everyone seemed a victim to the prejudice that in compound fracture, especially if accompanied with much swelling and displacement, the wound must be left open to admit of frequent inspection and dressing; to fulfil this imaginary urgent requirement, a multitude of contrivances have been devised, which reflect credit on the mechanical ingenuity of some of their authors, but generally furnish conclusive proof of faulty physiology and unwisely tampering surgery.

But of all the remarkable theories and prescriptions promulgated for the treatment of compound fracture, none has ever rivalled Professor Lister's.* "In conducting the treatment, the first object must be the destruction of any septic germs which may have been introduced into the wound, either at the moment of the accident, or during the time which has since elapsed. This is done by introducing *carbolic acid of full strength into all accessible recesses*

* On the antiseptic principle in the practice of surgery by Joseph Lister, Esq., F.R.S. *Lancet*, 1867. Vol. ii., page 353.

of the wound, by means of a piece of rag held in dressing forceps, and dipped in the liquid."*

The principles of rest, position, pressure, and exclusion of air, union by the first intention, and the glorious simplicity of scientific surgery, were all to go for nothing in the presence of the heroic advice to cauterize wounds, in the hope of destroying Pasteur's hypothetical germs. As might have been supposed, the great therapeutic principles have survived, and after successively diluting the acid, and employing a variety of protectives against its irritating action on the living tissues, Mr. Lister states† that he now uses a solution of carbolic acid not stronger than one part to 100 of water; and he adds that "in direct proportion to the weakness of the solution used and to the smallness of its opportunity of acting on the tissues of the part, is the satisfactoriness of the results obtained, provided that the essential object of avoiding putrefaction be secured." In one of a series of papers on "The present State of Surgery in Paris," which I published in 1867, the following passage occurs, ‡"for

* That there might be no doubt as to the strength of the caustic to be employed, Professor Lister directed that the liquid to be used should be prepared by adding *a few drops of water* to the crystalized acid.

† Address on Surgery, to the British Medical Association, at Plymouth, in the *British Medical Journal*, August 26, 1871. Page 225, et seq. ‡ *Lancet*, 1867, Vol. ii., page 393.

the last six years an *antiputrescent** lotion, containing one part of carbolic acid to 100 of water had been regularly employed in dressing wounds in M. Maisonneuve's clinique* with the best results." On none of my visits to the Hotel Dieu in former years had I seen wounds look so well, and there could be no doubt that the old antiseptic† practice with a comparatively new agent had been generalized by Maisonneuve, with manifest advantage in resisting the pernicious influences of an unhealthy hospital.

The sensational circumstances under which the

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* The *italics* are in the original paper.

† Van Swieten advised *antiseptic* applications in very bad compound fractures (quoted in Percival Pott, Op. cit. Vol. i, page 451), Burggracve (Le Génie de la Chirurgie Gand, 1853, page 42), advises the application of hydrochloric acid and honey as a topical preventive of purulent absorption and hospital gangrene. With the same intention Sédillot (de l' Infection purulente ou pyoémie, Paris 1849, page 503) recommended the application to suppurating surfaces of aromatic wine, and decoction of bark with or without the addition of sulphuric acid, sulphate of copper, or corrosive sublimate. Philippe Boyer advised the use of the chlorides to counteract the putridity of the blood, and Gerdy (Chirurgie pratique complète, Paris 1853, Vol. iv, page 146), urged that the treatment of suppurations required, amongst other means, "les détersifs et les *désinfectants*;" surgical literature abounds in records to prove that the same principles have been carried out with a variety of disinfecting materials, such as benzoin, clay, Burgundy pitch, and tar. To the long list of disinfectants in general use, chloralum has lately been added. Leaving to larger experience the determination of its precise value, I can confidently state, after repeated and careful trials, that for surgical and domestic purposes, chloralum is an excellent antiseptic; its chief claims to preference are its freedom from odour and from poisonous qualities; and under its use wounds, previously unhealthy, progress admirably.

antiseptic system was revived in this country, excited an amount of interest which has detracted professional attention from great surgical principles. Rest, position, pressure, and exclusion of air, in healthy houses or hospitals, conduce to the healing of the majority of wounds. Pyaemia, erysipelas, sloughing phagoedena, and their allies, are diseases directly produced by the circumstances of unhealthy hospitals. In preventing these diseases, antiseptic agents are of great value; but it must be borne in mind that their use is not necessary in the practice of surgery out of unhealthy hospitals, or in the absence of other unhealthy conditions.

The disturbing influence of the carbolic acid controversy on the general practice of surgery has been especially marked in the treatment of compound fractures of the limbs; carbolic oil and putty, preservatives, gauze, and spray, have detracted attention from the real essentials of atmospheric exclusion, rest, position, and pressure; fundamental principles have been lost sight of, and a number of theories and appliances have acquired unmerited, but happily ephemeral, repute.

This retrospect is not presented as a complete bibliographical and historical account of the numerous methods of treating fractures. The aim of the critical survey has been to point out essential differ-

ences, compare their merits, and trace out the causes of their defects, in search of therapeutic generalizations.

Throughout the study of this subject, nothing is more remarkable than the paralyzing influence of routine, and the disturbing effect of plausible innovations,—opposite evils due to a common cause, lack of independent and ripe thought. Most persons, whatever their calling, prefer to have their thinking work done for them, and find it most congenial to their taste to move along in obedience to traditional impulse on beaten ways;—hence a chief cause of the disinclination to reform, characteristic of all professions. In proportion to servile obedience to authority is the tendency to fly to the opposite extreme, once the yoke is broken;—credulity and infidelity are extremes that often spring from and revert to, a common source. The greatest safeguard against these pitfalls is a knowledge of history, to ensure against errors and fallacies long proved to be such, and to render possible the cumulative growth of wisdom. No profession demands this testing and correcting, of present by past experience more than our own; in no profession is it practised less. The distinguished surgeon who was intent on a series of original enquiries on the treatment of compound fractures, and knew nothing of

the works of the elder Larrey and his school, was in a position scarcely, if any, better than that of an engineer who might profess a novel arrangement for the application of steam power, while totally ignorant of the discoveries of James Watt and the Stephensons.

The time has gone by for ever when a surgeon who aspires to the position of a teacher can with impunity affect to despise erudition; but no amount of intellectual acquirement can dispense with the necessity of skilled hands. Unfortunately manual dexterity and intellectual accomplishments, ingenuity and judicial impartiality do not often co-exist.

But of all obstacles to progress, none has been more powerful than the narrow and exclusive tendency of most minds. Impatient of results, curious and eager for explanations, men are very apt to jump at, and be satisfied with, partial truths and guesses, and to embrace ingenious theories which, in a large number of instances are destined to prove unlucky stumbling blocks in the way of progress. The scheme of nature which we profess to study is large and comprehensive; a marvellous spirit of unity pervades the design, a multitude of means infinitely varied in their combinations are in operation to produce the results

we witness and desire to imitate; and a spirit of narrow exclusiveness is fatal to the attempt.

The habit of predicating pathological effects from physiological premisses, of reasoning on diseased processes in the human body from the effects of experiments on animals, has been a fertile source of error in this as in many other departments of medicine; to wit, Pott's exaggerated idea of the influence of muscular action, and Duhamel's and Dupuytren's unlucky theory on the provisional callus, which so far from being a physiological necessity of bone repair, is a pathological condition due to imperfect contact of the severed fragments.

The difficulty inseparable from the treatment of some fractures on any method, and the fact that many surgeons are very imperfect mechanics and are unable to make a fracture apparatus what it should be, —a perfect piece of handiwork, have acted as two additional sources of confusion. Some plans have been condemned for faults due to the imperfect manner in which they have been carried out; while others have been judged with scarcely any trial at all; and the critics have taken refuge under the *dolce far niente* shelter of expectancy, which is so frequently a mere cloak for incompetency. It is in the matter of fractures as in so many other departments of medicine and surgery; physical diagnosis and

pathological enquiry, as comparatively easy and fruitful of results, have tempted many sanguine and industrious workers, when the slower, more complex, and intrinsically more difficult work of treatment has been comparatively neglected.

To say that a fracture, or a constitutional affection, may recover with very little aid to the natural powers, and that, therefore, the case may be left to nature, is to form a narrow and unjust estimate of the functions of true art, and to underrate our powers to mitigate evils of great, though not always of primary, importance. Freedom from physical pain, mental ease, the prevention of the slightest deformity, are objects well worthy of attainment, and can only be secured in many cases by the most gentle and incessant care, by a clear comprehension of therapeutic principles, and by attention to the smallest particulars in carrying them out.

The therapeutic principles which should guide the practitioner in the treatment of fractures, have been shown to be few and simple; the means for carrying them out are various, and a combination of them may be, and often is, necessary to secure the great end,—perfect and immovable contact of fragments. In the upper limb advantage is taken of muscular relaxation, by applying the apparatus so as to keep the joints in the bent position; in the

PART II.

Practical Directions for the Construction of Apparatus for the Treatment of Fractures on the principles expounded in Part I.

I.

Moulds accurately fitting the surface of a broken limb, are best adapted to fulfil the great object, of keeping the surfaces of a fracture in close and immoveable contact, after reduction has been effected; those moulds are preferable which combine sufficient strength with facility for examination of the limb, and for adaptation to the diminution of size which takes place in consequence of the subsidence of swelling, or of the shrinking of the soft parts, due to absolute rest and continuous though gentle pressure.

Wood and iron are not so well adapted for those purposes as substances which are pliant when applied to the limb, and speedily acquire solidity. Amongst the most available and efficient of the materials introduced at various times for these purposes, are pasteboard, plaster of Paris, paper, and

PART II.

Practical Directions for the Construction of Apparatus for the Treatment of Fractures on the principles expounded in Part I.

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Wood and iron are not so well adapted for those purposes as substances which are pliant when applied to the limb, and speedily acquire solidity. Amongst the most available and efficient of the materials introduced at various times for these purposes, are pasteboard, plaster of Paris, paper, and

gutta percha; the uses of the two last are comparatively limited. In military practice, plaster of Paris moulds are the best; but a pasteboard apparatus is the most serviceable one for the treatment of the great majority of fractures.

II.

PAPER SPLINTS FOR FRACTURES OF THE HAND.

Paper can be relied upon with certainty for fractures of the fingers, and these are better treated with gummed paper than by other means. In case of emergency, and in the absence of other materials, many other fractures can be treated with splints made with layers of any paper, gummed or pasted together, in sufficient number and thickness, to secure the desired strength.

Assuming the first phalanx of the index finger to be broken and apposition of the fragments accurately effected, the finger is to be covered with a thin layer of fine cotton wool, lint, or clean rag, extending from the tip to an inch and a half above the knuckle. Strips of common writing paper, cut the length of the lint covering, and the width of the finger, are to be gummed on both surfaces and laid over each other to form two splints; eight layers of paper will be sufficient for each. One of the paper splints is now to be placed on the dorsal, the other

on the palmer, aspect of the broken finger, which is not to be stretched out to unnatural straightness, but held so as to preserve the slight natural curve. With a bandage, not wider than three quarters of an inch, the paper splints are fixed in position, being accurately moulded to the part with the gently and evenly compressing bandage. Care being taken that the paper does not overlap or quite meet at the sides, narrow spaces are left, with only the thickness of lint next the skin and the covering bandage, along which a director or pair of blunt-pointed scissors can be readily passed to open the case, if necessary, without destroying the splints; the whole can be re-adjusted so as to maintain immobility if the soft parts shrink; and it is essential to success in the treatment of all fractures, that accurate contact be maintained between the the limb and the enclosing mould.

When the broken finger bone is united, it is important to bend the joints gradually, but persistently, to avoid rigidity, which is frequently an obstinate and unpleasant sequel, sometimes a serious one, of these comparatively trifling injuries.

Fractures of the metacarpal bones and of the thumb, may likewise be treated with perfect success with paper splints, but in those cases it is indispensable to fix the wrist; this can be done by applying

the layers of gummed paper on the dorsal and palmar aspect, with intervening cotton wool to a few inches up the forearm.

PASTEBOARD APPARATUS.

The materials requisite for the construction of a pasteboard apparatus are

a.—Cotton wool, or soft tow.

b.—Bandages.

c.—Pasteboard.

d.—Starch.

a. *Cotton wool.*—The best and most convenient is the cotton wool as sold for the use of jewellers; the thin layers in which it is subdivided, with intervening sheets of tissue paper, are a handy form for enveloping a limb. Two layers of this wool, with a little extra over bony projections if very marked, are a sufficient protection for the limb, and it will be found most convenient to surround it with the desired thickness of wool, so soon as reduction has been effected. Cotton wadding, or soft tow answers the purpose in the absence of the jeweller's wool; and in case of compound fracture the chloralum wool would be preferable, as combining the advantages of an antiseptic, with softness for uniform compression and impermeability to air.

b. Bandages.—These should be made of unbleached calico from six to eight yards in length, and not more than two inches wide. Good bandaging is the very essence of an efficient and comfortable fracture apparatus. The great object is to cover the limb smoothly and with the least chance of displacement; lightly, but decidedly, compressing every part, so as to adapt the apparatus to prominences and depressions, without constriction. This can only be done by training of the fingers, and refinement of the sense of touch, by careful and persistent experience.

I have been in the habit of conveying to my pupils the difference between a compressing and a constricting bandage, by a comparison which for its explicitness appears to deserve repetition; assuming that you meet two friends, one a lady for whom you entertain a high and warm regard, the other an old and attached schoolfellow; in shaking the lady's hand it is pressed lightly and evenly in every part; the old playmate's is squeezed across the knuckles; the first named pressure employed in surgical bandaging soothes and heals; the second constricts, gives pain, and is unendurable.

Reverses are objectionable in bandaging. If made at all they must always be on the most fleshy aspect of a limb, to avoid the risk of unduly pressing

on the bone with the double fold of the reverse. After a short trial it will be found quite easy to bandage a limb throughout, without any reverses, by a succession of figures of 8. This plan not only has the advantage of ensuring more perfect equality of pressure, but of lessening the chance of the turns of the bandage slipping, and proportionately increasing strength.

c. Pasteboard.—The pressed and polished mill-board usually sold by stationers is not so well suited for surgical purposes as rough unglazed and uncompressed mill-board, in the early stage of manufacture, just as it leaves the vat; one eighth of an inch is the preferable thickness. For some purposes, especially for making back splints for fracture of the thigh in the adult, a greater thickness of board is required, but that is best secured and with least chance of breakage, by employing two, or in exceptional cases three thicknesses, of the material above referred to.

In making the splints it is not desirable to use a knife, or pliers to cut the pasteboard, but to break it by bending it sharply over the edge of a table once or twice, until it can be torn along the line of indentation. The ragged edge thus left is useful in absorbing moisture and hastening the softening of the splints, equally serviceable in

giving out moisture and favouring the process of drying and hardening; but the chief value of the torn and jagged edge consists in the facility it affords for moulding the apparatus to the shape of the limb, without the risk of thick and hard edges indenting the soft parts. To perfect the bevel of the edges, it is well to tear off a little of the pasteboard from one of the surfaces for about half an inch from each margin. This is most easily done after the process of softening.

The pasteboard splints require to be well soaked; this may be done in a few minutes by pouring boiling water on them, after they have been made to the shape required for the particular case. It is convenient to lay the splints at the bottom of a foot-bath, or of a sponge-bath, or on a metal tray, while the water is being poured on them; the kitchen sink is a generally convenient place for the same purpose; a bucket, or basin is objectionable as very likely to break the pasteboard.

In bandaging the soft splints to the limb, the surgeon and his assistant should mould the edges to accurate contact with the cotton wool, with which the limb has been previously covered. The efficiency of the apparatus in preventing displacement is in direct proportion to the perfection with which it fits the limb, and the accurate nicety of the circular

compression; this requires that the bevelled edges of the softened pasteboard be moulded during the process of bandaging.

Size of Splints.—This must be regulated according to the size of the limb to be encased, bearing in mind that not less than an inch should intervene between the splints in front, and a quarter of an inch at the sides, or behind, to allow the apparatus to be slit up and opened without removal or difficulty.

The length of the splints must, as a rule, be sufficient to fix the joint above and below the seat of fracture. When the femur is broken the hip must invariably be fixed; so must the shoulder when the humerus is broken above the middle line, and the knee in the great majority of fractures of the leg.

Starch as prepared for laundry purposes, but a little thicker, is lightly smeared over the bandage in course of application, and externally when the apparatus is complete. It gives strength in holding together the turns of the roller and the splints, and prevents them falling apart when the case is opened. About a coffee cup full of starch is sufficient for an arm or a leg, and about twice that quantity when an apparatus has to be constructed for fractured thigh.

Opening the Apparatus. Immobility of the fragments has been insisted on throughout this volume

as the primary and fundamental indication to be fulfilled to ensure perfect bone repair; and the *immovable* apparatus has been represented as the one best calculated to fulfil the indication. At the same time it has been stated that the decreasing size of the limb, due to disappearance of swelling, or wasting of the unused muscles, renders necessary the opening and refitting of the apparatus;—a necessity apparently inconsistent with the desired immobility; in actual fact it is not so, but on the contrary, the inspection of the limb can be carried out without displacing the fragments in the slightest degree.

So long as the patient is comfortable, and the apparatus fits the limb closely, it is not to be opened; but so soon as it becomes a little loose it must be slit up in front and re-adjusted. For this purpose decidedly the best instruments are the scissors (Fig. 3, Plate 7,) manufactured by Messrs. Coxeter and Son, of London, after Mr. J. T. Clover's idea.

In slitting the case up from the foot or hand, it is essential to tie pieces of bandage, or to secure straps, round the divided apparatus at intervals of six or eight inches. After cutting up the whole length, the surrounding links are gradually loosened, while an assistant grasping the limb and one half of the apparatus with the thumb and palm of the hand, glides the fingers in contact with the limb under the

other half of the casing, which the surgeon draws aside to inspect the limb (Fig. 3, in Plate 1 and 5). By a similar manœuvre the other side of the limb is inspected; if necessary, to ensure accurate fitting, some of the bandaging on each side of the longitudinal opening is cut off, fresh cotton wool if needed is introduced, and the two sides are again firmly approximated by the straps or tapes, while an outer and compressing bandage is applied, one tape or strap at once being loosened and removed as the circular roller ascends. When the apparatus has been once opened and re-closed I rarely starch the outer bandage, so that it may be more easily unrolled and re-applied whenever inspection or re-adjustment is necessary; the precaution must, however, always be taken to close the case, firmly though temporarily, while the outer bandage is being removed and re-applied. By these means it will be found perfectly possible to examine the limb, and adapt the apparatus to it, without in the least disturbing the accurate apposition of the fragments. Once in eight days is sufficient as a rule to open the apparatus, which whether in simple or compound fractures lasts throughout the treatment without renewal. In compound fracture it may sometimes be necessary to cut a trap-door, as shewn in Fig. 2, Plate 5, to allow the wound to be dressed, and yet be efficiently closed and compressed

in the intervals, without interfering with the general apparatus. In former years I was frequently in the habit of making these trap-doors as originally advised by Seutin; but experience prove that the wound in the majority of cases of compound fracture can be closed without suppuration; and that when pus does form, it is sufficient to change the dressing once in eight or ten days, especially if the precaution is taken in cases of abundant suppuration, of introducing a drainage tube in the wound, and carrying it out through a perforation in the apparatus.

FRACTURES OF THE UPPER LIMB.

The splints in ordinary use are much more efficient in the treatment of fractures of the upper than of the lower limb; immobility of fragments in the former case being aided by the position in which the limb is held by a well adjusted sling.

A pasteboard splint on the outer and one on the inner side are sufficient for the construction of a firm case, for the majority of fractures of the forearm; but in fractures near the elbow and shoulder, the joint must be fixed by four layers of pasteboard, two on each side.

The splints should in all cases extend to the ends of the fingers, to steady the wrist and prevent the hand hanging, in which condition it acts as a weight

on a lever in displacing fragments in the forearm, or lower end of the arm.

Fractures of the lower end of the radius, if not attended with much displacement, can be treated very well with the pasteboard splints; but where the characteristic deformity of the wrist exists in a marked degree, no plan is better calculated to ensure a good result than the well known pistol-shaped splint.

Fractures of the humerus above its middle invariably require fixing of the shoulder joint. For this purpose the elbow is to be first fixed at right angles with the forearm in the semi-prone position, by means of pasteboard splints extending from the tips of the fingers to the middle of the arm. Reduction effected, and the upper arm axilla and shoulder well protected with cotton wool, right angled pasteboard splints are to be applied front and back from the sternal end of the clavicle, and the inner margin of the scapula respectively, to the elbow, and fixed in this position by spica bandage; bandaging with figures of 8 thoroughly covers the shoulder, and insures broad and efficient support in the opposite axilla, which requires to be protected by cotton wool; a few circular rolls of bandage, securing the limb to the trunk, add materially to steadiness.

ARM SLINGS.

In all fractures of the upper limb, with the single exception of that of the olecranon, great assistance is derived from supporting the limb in a sling with the elbow bent at a right angle. The common practice of merely passing the sling under the hand or forearm, or both, is very inefficient; it is the elbow which above all requires supporting to carry the weight of the arm; and this will be found to be quite as true if the injury be one of the soft parts or of the bones, of the thumb, or of the humerus.

To make such a sling for the right arm of an adult, take a piece of black alpaca or other suitable material 29½ inches wide, and 35 inches long; fold it corner wise with the smallest triangle inwards; the outer one will thus have about five inches projecting beyond the half square; the hand rests in the basis of the triangle, the opposite angle is at the elbow which is efficiently supported by the projecting portion of the outer layer being carried round the lower end of the humerus, and pinned or stitched to the inner part of the sling; its two other extremities are carried upwards, on the dorsal and palman aspect of the forearm respectively, and secured by a strap of the same material at the back of the neck.

FRACTURES OF THE LOWER LIMBS.

Fractures of the toes and of the metatarsal bones are commonly the result of direct violence, and are associated with contusion and laceration of the soft parts. The reparative power in the feet as in the hands is very great, and very ugly looking injuries in those parts often turn out remarkably well under a covering of cotton wool, with soft pasteboard splints through the agency of which gentle compression is effected and the parts are kept perfectly at rest.

The ankle must be fixed in all fractures of the feet, and to do that effectually, the pasteboard splints must embrace the sides of the foot. (Fig. 2, Plate 1,) and extend on each side to the middle of the leg. It is important in the subsequent bandaging to cover the point of the heel neatly and effectually, —terms which are practically synonymous, as the bandage will slip if not neatly applied. This plan of fixing the foot and ankle is not only the best for fractures of the foot, but affords the most speedy and complete relief in sprains of the ankle, which, under the ordinary system of fomentations, are a source of great pain, and are often followed by loss of power, due to consolidation of the plastic matter effused within and around the tendinous sheaths.

The so-called *Pott's fracture*, (fracture of the lower end of the fibula with rupture of the internal

lateral ligament and eversion of the foot)* may also be treated by lateral pasteboard splints reaching from the sides of the foot to the knee; but if the displacement at the ankle be very considerable, and the subject muscular, it is advisable to fix the knee also, and extend the apparatus nearly to the middle of the thigh. Dupuytren's splint, (Fig. 1, Plate V,) is an admirable contrivance for the treatment of Pott's fracture; the only objection against it is that, if relied on exclusively, it compels the patient to remain in bed during the whole course of treatment. In ordinary cases of Pott's fracture it will be enough to protect the ankle while the splints are drying, by bandaging a piece of dry pasteboard on each side of that joint, after the surface of the bandage covering the moist splints has been starched; but in the event of extreme displacement of the foot in a very muscular subject of Pott's fracture, the application of Dupuytren's splint, outside the pasteboard apparatus while it was drying, would add security and could be productive of no mischief.

If there be much swelling when the surgeon first sees the case, it will have so much decreased on the third or fourth day that the apparatus will be loose and require to be opened in front, the edges pared

* *Vide* Plate facing Page 435, in Vol. i, Pott's Chirurgical Works, 1783.

and re-adjusted with firm bandage. In fractures about the ankle particularly, patients complain of pain so soon as the bandage becomes loose; and they instinctively ask that the joint be fixed more firmly,—conclusive proof of the value of rest and compression.

In these and in all injuries of the lower extremity the assistance of the suspension plan is never to be overlooked; the inclined position towards the trunk is favourable, in proportion as it facilitates venous return; and the undulation of the swing powerfully aids the circular compressing apparatus in neutralizing muscular action, and in the same measure in keeping the contained parts at perfect rest.

Pott says of the injury under consideration "unless managed with address and skill, it is very frequently productive both of lameness and deformity ever after." The difficulty of treatment has been lessened by Dupuytren's researches and apparatus, but nevertheless a good deal of stiffness, if not lameness and deformity, is frequently the result, though the fibula unite perfectly and the foot be in natural position. The fact is, the wrench in many of these cases is very violent, and the injury to the deep structures of the ankle and leg proportionately great. (Lecture v, Page 125).

To prevent loss of motion, it is essential so

soon as the fracture is united, to flex and extend the ankle freely, apply cold douches, friction, and electricity, and enjoin as much use of the limb as can be borne.

Fractures of the tibia alone are as a rule without complication of swelling or wound, and displacement is practically impossible, so long as the fibula remains entire. Under these circumstances pasteboard splints from the sides of the foot to the knee are sufficient for the maintenance of co-aptation, and the patient may, in the absence of other reasons to the contrary, move about on crutches, or in a carriage, forty-eight hours after the accident.

Fractures of both bones of the leg are a much more serious injury, necessitating immobility of the knee, as well as of the ankle. The plan of treatment in such a case may be conveniently described by assuming a typical case of recent simple fracture of both bones of the leg, a little above the ankle-joint; the tibia being broken obliquely, so as to allow of projection of the upper fragment forwards, the lower fragment with the foot being drawn backwards and upwards. It is not frequently that a surgeon has the opportunity of examining the case on the spot where the accident happens; but if he do, the first thing to be considered is the removal of the patient to bed,—a comparatively simple matter on

which the safety of the limb often depends. The worst possible conveyance is a Hansom cab; it is impossible to carry a man in and out of it without giving him a good deal of pain; the position in the vehicle is most uncomfortable and the displacement liable to be augmented to the extent of pushing one of the fragments through the skin and converting a simple into a compound fracture,—a comparatively harmless injury into one endangering life. A stretcher is of all means the best for carrying a person with a broken lower limb; in its absence a shutter, or a hurdle answers the purpose. A ladder furnishes the basis for a very comfortable conveyance, to construct which a number of rounds of the ladder must be removed by the saw for a distance corresponding to the length of the patient, a couple of rounds being left at each end beyond the gap; a sheet is now to be folded round and fixed to the sides of the ladder, allowing a fall of a couple of feet between them as a kind of hammock in which the patient swings lightly, while carried along by a couple of men; a pillow or a small bundle of clean long straw tied round the limb affords ready and welcome means of steadying it during the removal.

When the patient is placed on the bed his clothes must be removed as gently as possible; boots,

stockings, &c., must be cut open; no pulling admissible. As rest is the great principle of treatment, so is all motion the evil to be avoided. The diagnosis effected by gentle manupulation, it is mischievous to meddle with a view to determine accurately, the line and position of fracture and the niceties of diagnosis which are often supposed to be essential to the scientific practice of surgery. Once it is determined that the leg is broken, the one thing to be done is to put the pieces in proper position, and keep them there beyond the possibility of displacement.

The requisite materials being at hand, three splints are required: a straight one to be placed at the back, and to reach from half an inch above the heel to four inches above the knee; and two lateral splints, reaching from the same point above to the foot, to fit which each splint requires to be made with a foot-piece. From the commencement, one assistant is charged with the duty of making extension from the foot, while another counter-extends from above, their force being exerted steadily and continuously, without jerk or violence, while the surgeon moulds the fragments into position. Reduction having being effected, the tendo Achilles, the instep, the ball of the great toe, and the proximal end of the fifth

metatarsal bone, are to be well padded with cotton wool, a layer of which is to cover the whole limb as far as the apparatus is to extend. Care must also be taken to pad the head of the fibula, the tuberosity of the tibia, the patella, and the tendons of the hamstring muscles. The crest of the tibia may be additionally protected by a strip of cotton wool placed immediately over it; this is especially advisable when, from emaciation or deformity (*e. g.*, in ricketty children), the crest is unduly prominent. The splints must not overlap anywhere, and neither of the lateral ones should reach as far forward as the crest of the tibia.

If on cutting up the case, when perfectly dry, it be discovered that the bandage has constricted any part, the interposition of a little more cotton wool may be relied upon as a means of putting an end to the mischief. In the event of the apparatus having become loose in drying, paring its edges will ensure a better fit; or on the other hand, if swelling have occurred, a very improbable occurrence under the influence of pressure, the edges must not be brought into close apposition. The examination completed, the apparatus is again made solid by bandage, and in a large number of instances the patient may at this stage leave his bed and walk on crutches; in doing so care must be taken

that the limb do not rest on the ground, and that the toe be raised so as not to catch ; these ends are attained by slinging the foot from the neck, the foot bandage being first passed behind the heel, crossed over the instep, and again under the sole of the foot, from the sides of which the sling ascends (Fig. 4, Plate I,) to be tightened above as much as is necessary to draw the lower limb efficiently, but not uncomfortably, forwards and upwards.

In double fractures in the small part of the leg associated with great displacement, one or more extra pasteboard splints may be required to render the apparatus sufficiently strong to resist displacement ; fixing the knee thoroughly and controlling the thigh muscles by compressing bandage, are measures of great service under the difficulties named ; the sand and water pillow described at Page 199, is also very useful, while the suspension plan is full of resource and comfort.

When the muscles of the calf are very powerful, and the fracture unusually oblique, two extra short pasteboard splints, reaching a few inches above and below the seat of fracture, and incorporated in the apparatus, give it additional and very useful strength. The knee must at the same time be effectually immobolized, and the muscles of the thigh compressed as far as its middle. These fractures

are frequently the result of direct violence, and though the surgeon see the case very soon after the accident, he may find a good deal of blood already extravasated under the skin and blebs on its surface; these must not be pricked, but reduction and compression proceeded with exactly as in the uncomplicated cases; when the mould is opened in three or four days, the blebs will be found to have lost their tension, their thin covering to be shrunk and withered; the surrounding parts simultaneously reduced in size, and to be in process of Castille soap mottling, indicative of the change which the effused blood undergoes preliminary to absorption. The shrinking with the mottling indicates healthy action, as contrasted with the humidity and tension associated with discolouration of progressing gangrene. If swelling and spasm be great when the apparatus is first applied, digital compression of the femoral artery in Scarpa's triangle will be found very serviceable, conjoined with the administration of morphia by the mouth or by sub-cutaneous injection; the latter a marvellous therapeutic resource, not yet sufficiently appreciated by the majority of the profession.

Compound fractures of the leg are to be reduced to simple ones, and to be closed and disturbed as little as possible. The first dressing and application of

apparatus is the important one; it requires to be done as perfectly as possible; and the production of anæsthesia will be found to be a great help in the process. If an attempt is resolved upon to save the limb, (and the vast majority of compound fractures may be saved,) reduction must be effected at once; the more perfect the co-aptation the better; if it cannot be secured without sawing off portion of a fragment or removing a loose piece, it must be done, but with the hard as with the soft parts, all must be saved that by every possibility can be. The wound must be lightly but effectually cleaned out, and the edges accurately brought together, by one or more points of metallic suture; strips of lint, or fine cotton wool soaked in styptic colloid complete the closure of the wound; if there be any extravasation and the contusion of the deep structures be so great as to render it improbable that union by the first intention can be obtained throughout, it is advisable to insert a drainage tube in the lower angle of the wound, and bring it out through a small aperture in the side, or at the back, of the apparatus. The wound once dressed the limb is to be surrounded with cotton wool, compressed and immobolized with pasteboard splints as recommended for simple fractures of the leg.

The sand and water pillow, suspension, digital

compression, and sedatives are of service in the subsequent management of the compound fracture, in proportion to its severity; and since many persons, particularly in hospital practice, are drunk when they meet with these accidents, the administration of a brisk purge, as soon as the apparatus is complete and firm, is a useful prevention against constitutional disturbance. As a rule the apparatus does not require touching for four or five days, or more, and after the first opening and readjustment, dressing once a week is usually sufficient. Chloralum, a weak solution of carbolic acid, or other mild and efficient antiseptic, may be employed if the state of the wound require it; but it cannot too often be repeated, that the great principles of treatment which should regulate the management of the wound are, exclusion of air, perfect co-aptation and rest; in securing which, circular compression and immobolization of the joints are the great agencies, while abundance of pure air to breathe is the sovereign antiseptic.

Fracture of the patella.—The pasteboard apparatus is peculiarly suited to the treatment of this injury. The patient is made to sit in a chair, propped up at the back, so that the trunk hangs forwards, with the injured limb extended, the heel resting on a higher level than the buttock, with a

view to relax the quadriceps extensor as much as possible. A pad, made by folding cotton-wool or soft tow in lint, measuring about one inch and a half in breadth, by ten inches in length, is placed just above the patella; and an assistant, holding its two extremities, presses obliquely downwards and towards the foot, so as to approximate the upper to the lower fragment (Fig. 1, Plate II). The surgeon now pads with cotton-wool the upper half of the spine of the tibia, the bony eminences about the knee-joint, and the hamstring tendons; and bandages from the middle of the leg to the middle of the thigh, taking care to bring down and fix the upper fragment, by appropriate figure-of-eight turns of the roller. The outside of this bandage is starched, and a pasteboard splint (Fig. 3, Plate II), placed at the back of the limb to the extent to which it has been already covered; a few turns of roller suffice to fix it, preparatory to placing another back-splint from a little above the heel to within an inch of the natal fold (Fig. 4, Plate II). To protect the skin, the surface of this splint, which is to correspond to it, is covered with cotton-wool above and below the part which has been already bandaged. It is important to place a thick pad of wool between the tendo Achilles and lower end of the splint; and to prevent its upper edge chafing

the thigh by similarly padding it. Finally, a dry bandage is applied from the toes, over the heel, to the upper part of the thigh, and then starched. A little care is required not to bend the knee in removing the patient to bed, where he must be kept in the semi-sitting posture, by means of a bed-chair, and the extended limb raised on an inclined plane, until the apparatus is dry. Alterations in the size of the limb are easily compensated by opening it in the middle line in front. The great essential is that the apparatus be adjusted so that it constantly and accurately fit the limb. Once or twice during the course of the treatment, it is requisite to remove the bandage from the knee, and make new efforts to approximate the fragments of the patella; the closer they are kept the greater the chance of bone union.

Fractures of the femur.—In whatever part of its length the thigh bone is broken, the case is best treated in the extended position, the limb being enclosed in a pasteboard apparatus from the roots of the toes to the iliac crest. The plan of procedure is as follows:

The patient is laid in a horizontal position; one assistant is charged with the duty of making extension from the foot, another with that of counter-extending, by means of a jack-towel passed round the groin; while they are exerting steady traction,

the surgeon effects apposition of the fractured ends, a process in which general anaesthesia is often of the greatest service to the operator, and comfort to the patient.

The first step is to secure co-aptation of the fragments by fixing the hip and knee and compressing the thigh muscles; for this purpose three splints are required; they should be long enough to reach from a couple of inches below the knee upwards; the inner one to the rami of the ischiun and pubis, the outer and the posterior one to the iliac crest. The outward and inner splints should be of uniform width from above downwards, varying from two and a half to four inches, according to the size of the thigh; the posterior one, of about the width of the popliteal space below, must gradually widen, so that its upper part cover the whole buttock. The splints having been effectually soaked, are to be covered with two or three layers of the fine cotton wool above referred to, before being placed in their proper positions to the limb.

Extension and counter-extension being constantly kept up, a jack-towel is passed under the loins, and confided to an assistant on each side, as an easy means of raising the patient from the bed. The posterior splint can thus be glided under the thigh and buttock, and the outer and inner ones are

placed in their appropriate situations, and held there by an assistant, whose duty it is to mould them to the shape of the limb, while the surgeon bandages over them from below. The perineal band by which counter-extension has been hitherto kept up, being in the way while the pelvis is bandaged, the assistant must abandon it, and oppose resistance to the extending force, by passing his arms round the patient's trunk, or standing at the upper end of the bed, placing each hand in the axilla and holding back with just sufficient force to prevent the patient slipping, in obedience to the extening force.

It is a matter of great importance so to bandage the pelvis as to fix the hip-joint in the most effectual manner possible. Figs. 2, Plate III, illustrates, in fact, the method I adopt to attain this object. The points to be especially attended to are, to spread out the bandage as much as possible posteriorily, so as to cover the buttock, and to make several figures of eight round the pelvis itself, passing the bandage alternately above and below the antero-superior spines ; by this means it is effectually prevented slipping over the iliac crests on to the sides of the abdomen, which it has a great tendency to do, and thereby proportionately lessening the efficiency of the apparatus as a means of maintaining the fragments of the femur in apposition.

The leg is now to be encased in pasteboard apparatus, extending from the sides of the foot upwards, as already described (Page 261), for fractures of the leg. As the leg-splints extend to nearly the middle of the thigh they overlap the thigh-splints already applied, and the knee-joint is fixed by a double set; two on each side, and two at the back. An outer coating of starch completes the apparatus.

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

When the apparatus is dry, which occurs in from thirty-six to forty-eight hours, it usually requires to be opened to be fitted to the decreasing thigh.

For this purpose the bandage is cut in the middle line in front from above to the knee; by here making two transverse sections through the sides of apparatus, as far as the interval between the lateral and back splints, an inner and an outer portion may be alternately turned aside, as shown in Fig. 5, in case of fracture of the leg. At this visit the patient should be turned round in order to see that the whole of the buttock, including the natal fold, is covered with bandage; very probably this will be found deficient; if so, after starching the exterior of the apparatus, another bandage must be applied so as to attain the desired object. Fig. 3, Plate III, taken from one of my patients, is a good illustration of the manner in which the buttock should be covered.

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

In three or four days the apparatus should be

opened, if anywhere loose. Possibly the re-adjustment may only be necessary in the thigh portion, which is then to be opened from above, only as far as the knee. If the whole case need re-fitting, the leg and thigh parts must be opened and re-closed separately.

The great object to be aimed at is to inspect the limb and re-adjust the apparatus, so as not to disturb the perfect apposition of the fragments; in the event of these having been displaced, and the limb shortened or distorted through loosening and imperfect fitting of the enclosing mould, the defect may be remedied by slight extension, and firm re-closure of the apparatus. A long and broad sand bag weighing between five and ten pounds, placed over the thigh from the groin to the knee, is a ready method for applying evenly diffused pressure, and thereby controlling unusual proneness to displacement.

While the foregoing remarks will be found reliable for the treatment of fractures of the femur generally, a few observations are called for, with reference to breakage of that bone in particular situations.

Fractures of the neck of the femur inside the capsule. Without assenting to the long prevalent opinion that these fractures never unite by bone, it is beyond question that such union is a very rare occurrence. If an old person with intracapsular fracture

of the femoral neck be allowed to remain in bed without any effort to obtain union, constitutional exhaustion eventually ensues from long confinement and pain. This result is most likely to be avoided, and the chances of bony union are in direct measure increased, by putting into practice the general principles of treatment inculcated in this volume. Occurring, as fractures inside the hip-joint capsule, almost invariably do, in old people, who are frequent subjects of pulmonary or curdiac disturbance, great advantage results from the possibility of raising the patients in bed almost immediately after the apparatus is completed, and being able to lift them out of bed with comparative ease the third or fourth day after receipt of injury.

Fractures of the femoral neck *outside* as well as *within* the capsule, demand very thorough padding over the great trochanter, after the limb has been restored to its proper length by well applied extension. The whole limb must be encased in a pasteboard apparatus from the sides of the foot to the iliac crest; the hip-joint requires to be thoroughly fixed by double layers of pasteboard, over the outer-side and over the whole buttock, closely moulded to the limb by double spica bandage applied with great care from before and behind as directed at Page 272. Throughout the treatment, it will be found that the

patient is most comfortable, the greater the care taken in maintaining the accurate fit of the apparatus, and in the same proportion will be the chances of recovery with firm union, and without deformity.

Fractures of the femur just below the trochanters, with displacement of the upper fragment forward and outward, are amongst the most difficult cases which a surgeon can be called upon to treat; whatever plan he adopts, he must be prepared for some rising of the upper fragment and shortening of the limb, if the fracture be immediately below the lesser trochanter, and very oblique; and the difficulty of maintaining co-aptation increases with the muscular development of the patient. In such a case too great care cannot be taken in fixing the hip-joint and the whole limb, and a sand bag as heavy as can be comfortably borne over the upper fragment, is very useful in helping to keep it in proper position.

There can be no doubt that various causes concur in producing the peculiar displacement in the injury under consideration. The lower and chief portion of the limb falls back by its own weight when the femur is broken obliquely through its upper extremity; and the powerful muscles inserted into the great trochanter, the deep notch behind it and

the lesser trochanter, give the upper fragment its characteristic tendency to tilt up and turn out. Circular compression acts mechanically in keeping the fragments together, and physiologically opposes their displacement by controlling muscular action. The most powerful of the displacing muscles, the psoas and iliacus, may be beneficially relaxed by raising the patient in bed, as can be readily done when the limb is immovably extended and closely encased in a pasteboard mould. When the apparatus has been opened with all due care and definitely adjusted, I am in the habit of applying an extra broad pasteboard splint in front, from a little above the patella to the level of the iliac crest, with an ample pad of cotton wool to carry it comfortably over the groin, and a firmly applied bandage to keep it accurately in place.

Fractures of the shaft of the femur, and transverse fractures through the lower extremity of the bone, do not require any special therapeutic directions, beyond the general ones already given for the treatment of fractures of the thigh-bone by the pasteboard apparatus.

Oblique fracture of the lower end of the femur is a formidable injury, requiring skilful and very diligent treatment, for the result does not merely involve a greater or less degree of shortening of the

limb, but the mobility or fixity of the knee-joint. The direction of the line of fracture is generally from behind and above, downwards and forwards, so that the lower fragment is of pyramidal shape, with its apex upwards, while the shaft of the femur has a pointed extremity below and in front; this fragment projects against the patella, whereas the lower fragment is drawn backwards and upwards into the popliteal space. Immediate reduction and accurate co-aptation, is the rule of practice to be followed; and to maintain apposition the thigh and leg are to be encased in closely-fitting pasteboard splints, as directed at Page 268-72; the apparatus must have additional strength at the knee, and it will be found convenient to apply the extra splint first, as soon as reduction is effected; the limb having been enveloped in a layer of cotton wool from the middle of the thigh to the middle of the leg, a moist pasteboard splint of that length, and about 3½ inches wide, is placed at the back, and fixed there by gently compressing bandage; the whole thigh is then encased as described at Page 269, and finally the apparatus is applied to the leg and foot. While the pasteboard splints are moist, immobility may be secured with the utmost certainty by placing a sand and water pillow on the front of the thigh, from a little above the knee to the groin. Not later

than the fifth week after the accident, the apparatus must be removed with care, twice or thrice weekly, to bend the knee-joint; this manœuvre must be repeated daily, and with increasing motion between the sixth and seventh week, the apparatus being re-applied in the intervals. To counteract the wasting of the muscles, in these and other severe fractures near joints, it is a good plan to pass an electric current through the limb for about a quarter of an hour daily; this may be done by applying one pole of the battery at the lumbar spine, and the other in the sole of the foot, which can be readily exposed by cutting the bandage in this situation.

In case of fracture of the arm requiring the electric current, one pole is placed in the hand, the other in the arm-pit or at the nape of the neck.

It is not pretended that electricity can be proved to be such a stimulus to local nutrition as to accelerate the normal process of bony consolidation; although defective union being often demonstrably due to weak nutrition, the employment of electricity is indicated by sound physiological reasoning, as calculated to promote the repair of fractures under circumstances of debility. It is however certain that the lameness which results, and often continues a long time, after many fractures are firmly united,

is not so much due to bony or articular injury, as to muscular atrophy; it is this wasting which can be most successfully counter-acted by the electric current, so that the motor power may be preserved, and be available for use, when the framework of the limb is restored. One great advantage, which results from keeping up the nutrition of the muscles, is, that the patient has confidence in using the limb when the fracture is solid; and it is only by careful, gradually increasing, yet persevering exercise, that the use of a limb enfeebled by long confinement can be restored.

The joints must be particularly attended to in this work of physiological rehabilitation. In fractures in the neighbourhood of joints considerable injury is often done to ligaments, fasciae, tendons and their sheaths, at the time of the accident; the plastic material thrown out in the process of repair, becomes consolidated and, by binding together parts which require perfect freedom, interferes with the power of the muscles in moving the joints, and is a cause of lameness altogether independent of the fracture, which may have become consolidated without the least displacement or impairment of the bone's strength.

The circumstances just referred to require the use of the so called *passive motion*, a term calculated

to mislead. The rigid joints and matted tendons which are the results of some fractures, often necessitate the repeated employment of very considerable force, before the subcutaneous adhesions can be severed, and the parts set free to obey the impulse of the muscles. The process is a painful one, and the administration of chloroform very considerably facilitates it.

In moving the rigid joint, the limb above it should be firmly held with the left hand, while the right grasps the limb below, and forcibly bends, extends, and otherwise moves the articulation. This process is often attended with audible cracking, of which the patient and friends should be previously warned, lest they fancy that the bone has been re-broken.

The fractures in the lower limbs which most frequently require the treatment just described, are those about the ankle, and through the condyles of the femur. The knee-joint is sometimes very stiff and requires forcibly bending, after fracture through or just below the tuberosity of the tibia. The rigidity of the knee after broken patella is a well known, and to some extent unavoidable, occurrence; but in such a case the joint must only be moved very carefully, for fear of extending the ligamentous bond which is so frequently the medium of union between the fragments. The rigidity of the wrist

joint which often follows fractures of the lower end of the radius, demands great perseverance on the part of surgeon and patient. It is not enough to bend and extend the wrist frequently, but each joint of the stiff and shining fingers must be similarly treated day after day. As aids to such manipulation the electric current, friction, cold douches, and exercise, are to be employed with discriminating but steady persistence, to restore and utilize the power of the muscles.

GUTTA PERCHA APPARATUS.

All fractures* may be treated successfully by the construction of gutta percha moulds, which, when well made and fitted, acquire sufficient solidity to maintain apposition of the fragments, although not so strong as the pasteboard apparatus.

The proper thickness of gutta percha to use varies somewhat with the size of the limb, and with the strength of splint required; as a rule one-eighth to one-sixth of an inch, is a sufficient thickness. The material is purchasable in sheets, and may be cut to the desired shape with an ordinary table knife, or with a pen knife; when the

* For a very interesting and complete account of the uses of gutta percha in the treatment of fractures, the reader may consult "De l'application de la gutta percha, au traitement des fractures, par Andre' Uytterhoeven, faits cliniques recueillis par le Drs. Buys, Bruxelles, Tircher, Imprimeur Libraire, 1851.

latter is used the gutta percha sheet is scored in the required outline, and may be very easily bent and cut, after re-tracing the incision two or three times. It will be found convenient at first to cut a paper pattern of the required splint, a preliminary step which the operator will be able to dispense with after a little experience.

The edge of the splint may be advantageously bevelled on both sides, by shaving off a thin slice of the material with a pen knife. In the absence of this precaution, the hard and thick edge is apt to indent the soft parts and occasion pain, if not ulceration.

In determining the length of the splint, the rule already laid down must be observed, that it is necessary to fix the joint above as well as the one below the seat of injury.

Whether the upper or the lower limb is to be encased in a gutta percha mould, it is most convenient to place the patient in a recumbent position, which allows of the softened material adjusting itself, partly by its own weight, to the surface of the body.

The limb is first to be covered with a layer of jeweller's wool, with extra thickness of this protective material over bony prominences.

To soften the gutta percha, it must be immersed

in water heated to nearly boiling point; when reduced to a limp condition, it is to be applied to the limb with light and even pressure; the process of hardening may be accelerated by passing a sponge just dipped in cold water outside the splint before it is bandaged to the limb. It is sufficient, in the majority of cases, for the gutta percha to cover two thirds of the circumference of a limb; but if the subject be very muscular, and the fracture from its position very liable to displacement, it may be necessary to enclose the whole limb; this is most conveniently done in two halves. Assuming for instance a fracture in the middle of the leg, reduction having been effected and the limb protected with fine cotton wool, a softened gutta percha splint is to be applied on the anterior surface from the middle of the thigh to the roots of the toes, sufficiently wide to embrace a trifle less than one half of the limb. When this splint is bandaged in position the patient may be turned round and another gutta percha splint, previously cut to shape and well softened, placed on the posterior aspect, from the same place above, downwards over the point of the heel and the side of the foot to the palmer aspect of the toes; the width of this back splint should be sufficient to complete the encasement of the limb, without overlapping the front splint. A nicely adapted

circular bandage completes the apparatus, which may be readily opened at any time, and adapted to alterations in size by varying the thickness of cotton wool, or paring the edges of the sides of the mould.

It has been incidentally remarked that a gutta percha apparatus is not so strong as one constructed with pasteboard, which, when applied to the limb in the moist state, acquires very remarkable and persistent hardness. The softened gutta percha acquires solidity sooner, but in a less degree, the temperature of the limb preventing its thorough hardening, and causing it to yield; to counteract this tendency a steel or iron rib half-an-inch wide, ene-eigth thick, and a few inches long according to position and requirement, may be incorporated in the main gutta percha splint, opposite the point of greatest strain; scraps of the plastic material softened in warm water will enable the surgeon to attach the metal support immovably in the desired position. Another efficient method of strengthening a gutta percha apparatus opposite a joint is to apply on each side a couple or more strips of the material three-quarters of an inch wide, and a few inches long, and diagonally crossing each other. If previously well softened and then nicely moulded in with well applied bandage, these intersecting strips add strength altogether beyond their own

resisting power, owing to the well-known mechanical advantages of diagonal supports. It cannot too often be repeated;— the parts to be fixed, in order to ensure perfect rest of an injured limb, are the joints above and below the seat of mischief; and if the surgeon devote his attention to secure absolute immobility of these joints, he will attain the greatest desideratum in the therapeutics of fractures, and joint diseases.

The foregoing directions will be found sufficient for the manufacture of a gutta percha apparatus to treat any fracture. The same instructions for special fractures apply, as already given for treatment with the pasteboard moulds.

PLASTER OF PARIS APPARATUS.

The German surgeons* since Dieffenbach, have most persistently and successfully advocated the use of plaster of Paris, in the construction of apparatus for the treatment of fractures. The objections usually adduced against this method have been the weight of the apparatus, and the difficulty of opening it, to examine the limb, without destroying it. The advantages, on the other

* The reader may profitably consult the Chapter "Die reposition und der verband der Fractur, in Handbuch der Lehre von den Knochenbrüchen, von Dr. E. Gurlt, Berlin, 1862, Erster oder Allgemeiner Theil, s 403-519.

hand, are the perfect immobility of the fragments in the encasing mould, and the rapidity with which it acquires solidity after application. In the hands of military surgeons these are incontestable benefits, and in the campaigns of 66 and 70, the gypsverband, or plaster apparatus, confirmed and added to the reputation it had acquired with the Russians under Pirogoff, in the Crimea.

Two Flemish surgeons Mathysen and Van de Loo have the credit of so modifying the plaster apparatus for fractures, as to preserve its solidity without excessive weight, and admit of the examination of the limb without destruction of the mould.

Before describing these modifications it may be convenient to give directions for the construction of a plaster apparatus as still in favor with the German military surgeons; and I cannot do so more effectually then by transcribing a note of my friend and pupil Mr. Priestley Smith, who served with great distinction, as a volunteer surgical assistant in the German ranks, during the late war with France.

The requisite materials for the construction of a plaster of Paris apparatus are,—

1.—*Flannel bamdages* sufficient to completely cover the whole surface on which the plaster is to lie.

2.—*Plaster bandages.* These are rollers formed of very open, loosely woven material, into which plaster has been well rubbed on both sides; they should be very loosely rolled up, and may be kept in readiness in a well closed jar.

3.—*Wadding*, or cotton wool.

4.—*Plaster of Paris* which must not have been injured by long keeping.

5.—*Warm water.*

Mode of application—

The patient should lie on a firm hard bed, and under the part to be bandaged should be a large sheet of waterproof.

Bandage the limb with the flannel bandages, placing previously over any prominences or spots that ill bear pressure, e. g. the heel, a pad of cotton wool.

Place the prepared plaster bandages for about two minutes in warm water, so that they become soaked through (hence the necessity of their being loosely rolled up).

Bandage the limb with these latter just as in applying any other bandage.

The bandage may be applied in many short pieces, each rather longer than the circumference of the limb, as in making a many tailed bandage, and this plan is preferable where windows have to be

left opposite wounds. The strips may be placed circularly, obliquely, longitudinally, or in any direction in which they will add strength without obstructing the opening which is to be left.

If this method be adopted the strips need not be prepared with plaster beforehand, but a sufficient number having been cut to length, should be dipped, at the time of using, by an assistant into a basin of semi-fluid plaster. This is to be prepared by adding the plaster gradually to about an equal quantity of water, and should be rather thicker than cream.

The limb being now enveloped in the plaster bandage, strips of very thin wood (walnut veneer,) may be laid on in various directions, and at once secured by a few more strips of plaster bandage. The wood is usually unnecessary, but in cases where very large openings are necessary it must be used. Bandages of this kind are sometimes made in which almost the whole circumference of the limb is left in one part exposed; the bandage above and below being held immovably together by strong strips of wood, about ane inch broad and half-an inch thick, placed on the two sides, or back and front. For ordinary cases where smaller openings are sufficient, the thin pliant veneer of walnut answers admirably, as for instance in strengthening

a bandage at the elbow or knee.

The wood having been applied and fixed in place if it is required, or otherwise when a sufficient covering of plaster bandage has been applied, an additional coat of the semi-fluid plaster should be smeared on. It may be smoothed and moulded with a piece of wood about an inch wide, used as a modeller's tool. A layer of plaster nearly a quarter of an inch thick may be thus laid on, and, if well managed and shaped presents an elegant, hard, strong, comfortable though heavy case.

The plaster becomes pretty firm in a few minutes, and after several hours is very hard.

To open it a knife made for the purpose is most

convenient, with this a groove is scraped through the outer layer of plaster, and the underlying bandages are then cut through with scissors similar to those used for starch bandage.

This case is usually spoiled by being opened, and cannot be re-applied.

The ruling idea of Van de Loo's* plaster of Paris

* Le Bandage platré amovo-inamovible d'emblée et Tricot platré, par le Docteur Van de Loo Bruxelles, 1867. The directions given in the text for the construction of plaster of Paris apparatus, are chiefly taken from Van de Loo's writings. I had previously taught his plan in the Association Medical Journal, September, 1853.

appliances for fracture is to combine the rapid and perfect consolidation of the materials employed, with the facility for examination of the limb, peculiar to Seutin's system of pasteboard and starch apparatus. The bandages known as lint bandages are the best for the purposes of plaster application, as their thin and open structure allows of the plaster of Paris being incorporated by friction in sufficient quantity to give strength, and yet be capable of being cut with a pair of strong scissors.

To prepare Van de Loo's apparatus for fracture of the leg, twelve or thirteen strips of dry plastered bandage are to be placed on a pillow, covered with a cloth, in the many tailed fashion, each layer of bandage overlapping the lower edge of the one above it; in the middle of these strips are to be placed two or three similar ones lengthways, (Plate VI. Fig. I), to give strength; over these place twelve or thirteen strips of bandage, not plastered; these are to be sufficiently long to extend beyond the plastered strips two or three fingers breadth on one side, and a little less on the other, (Plate VI, Fig. 2).

The apparatus thus prepared is placed under the fractured limb, after moistening the layers; those with and without plaster are first applied to the limb, on the side on which the non plastered strips

project least beyond those beneath them; the layers on the opposite side are next moistened and applied, after which plastered strips may be laid on lengthways, in front and at the sides, to strengthen the apparatus. According to this plan the layers of bandage with and without plaster on one side are all placed together over those of the opposite side, instead of each being crossed, one by one, with its corresponding half; the layers of bandage without plaster being the longest, the apparatus in drying does not adhere in front, and it may by commencing from below, be opened in two valves, and so dispense with the necessity of pliers.

PLASTER FLANNEL APPARATUS.

The principle of the plaster bandage just described may be put into practice with two pieces of flannel long enough to surround the limb, with two or three inches to spare; dry and fresh plaster of Paris having been rubbed into one side of each piece of flannel, the plastered surfaces are opposed to each other, with an intervening narrower piece of flannel, plastered on both sides to add strength posteriorly. The outside layers of flannel are notched with the scissors, (Plate 6, Fig. 3), to facilitate nice adaptation. The limb having been placed on the apparatus prepared as just described, it is moistened

by dropping on it sufficient tepid water from a sponge, and the two halves are applied in succession, so as to enclose the limb.

PLASTER STOCKING APPARATUS.

This form is of most service in the treatment of sprains, club-feet, and joint-diseases requiring perfect rest.

Take three stockings fitting the limb; dry plaster is rubbed into the first stocking on its outer surface, into the second on both sides, and into the third internally; the stockings having been drawn on in the foregoing order, and moistened from without, the result in a very short time is a light but very hard mould. One stocking will answer the same purpose, and present the additional advantage of being more easily cut open; it requires however to be strengthened by successive layers of plastered strips of bandage, lint, or flannel, placed longitudinally at the back and sides, with interspaces to allow a kind of hinge to be made, when the halves of the mould are turned back for examination of the limb.

PLASTER-FLANNEL APPARATUS FOR THE HIP-JOINT AND PELVIS.

Take two pieces of flannel, each shaped according to pattern in figure 5, Plate 6, and of sufficient size to surround the upper half of the thigh, and the

pelvis; after rubbing dry plaster of Paris into one side of both those pieces of flannel, the plastered surfaces are placed in opposition, with an intervening smaller piece of flannel, the latter having previously had both its surfaces impregnated by friction with dry plaster.

The apparatus thus prepared is laid smoothly on an even mattress, covered with a waterproof sheet, and the patient's pelvis is placed on the layers of flannel; these are moistened with tepid water, dropped gradually from a sponge, and the apparatus is completed as shown in figure 4, Plate 6.

The above form of application is most serviceable in cases of injury or disease of the hip-joint; if the pelvis be fractured and it requires to be fixed as a whole with both hip-joints, then, after fixing one side with the flannel plaster apparatus, the other side is to be similarly treated, and an additional broad flannel bandage, impregnated with plaster may be passed round the pelvis and hips, and then moistened. The resulting mould is a very efficient agent in the maintenance of rest.

EXPLANATION OF PLATES.

PLATE I.

Fig 1.—The three pasteboard splints for fracture of the leg, showing the torn edges and the shape of the foot pieces of side splints.

Fig. 2.—The side splints extending round the sides of the foot into the sole.

Fig 3.—Pasteboard apparatus for fracture of the leg, opened to admit of examination of the limb; an assistant grasping the limb firmly to one half of the apparatus, while the other is drawn aside.

Fig. 4.—Shewing the manner in which a bandage should be passed round the ankle to suspend the foot while the patient walks on crutches.

PLATE II.

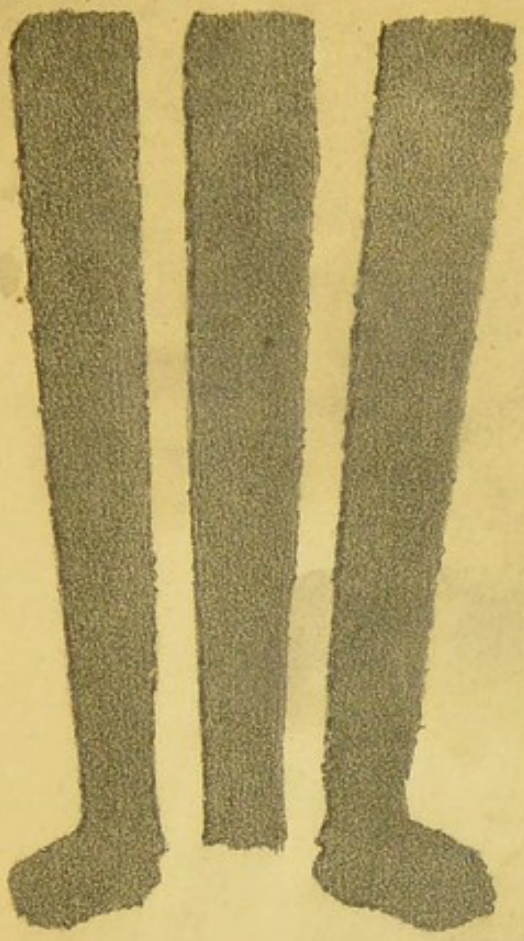
Fig 1.—Patient with fractured patella, sitting in a chair with trunk bent forward, limb extended and foot raised, while an assistant with a fold of lint or other material draws down the upper fragment.

Fig. 2.—Bandage to hold the upper fragment in position.

Fig 3.—Short pasteboard splint to be fixed by bandage at the back of the knee.

Fig. 4.—Long posterior pasteboard splint, extending from a little above the heel upwards, a little nearer the natal fold than shown in the plate.

Plate I.



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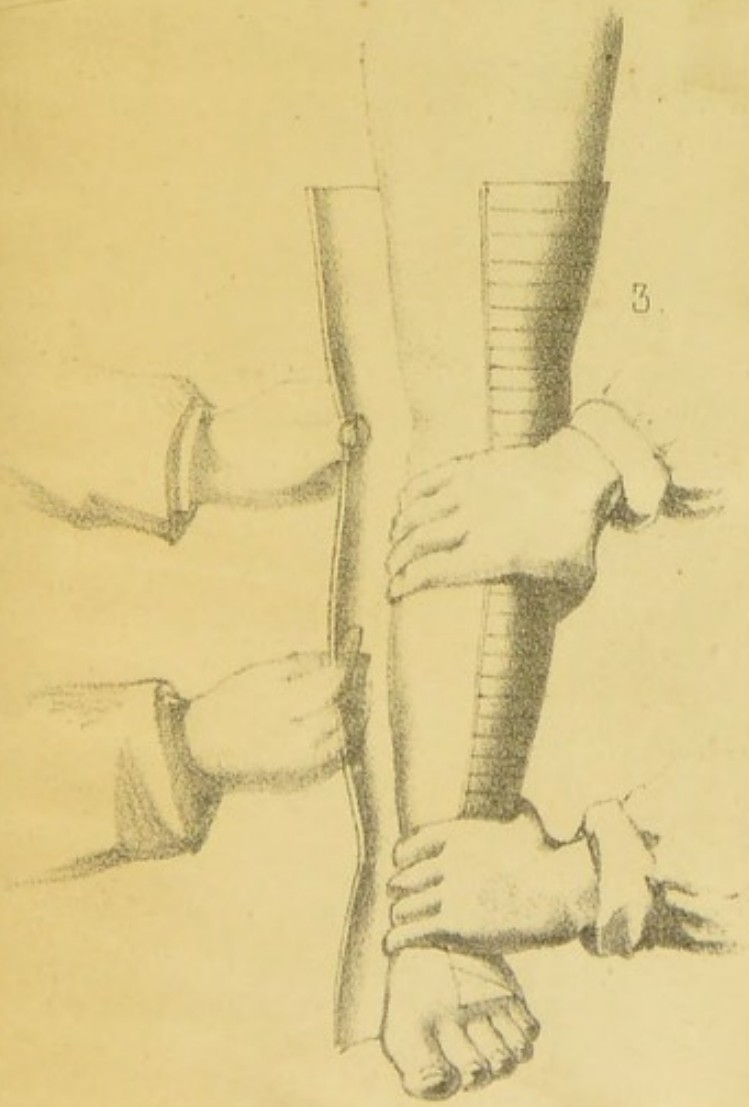

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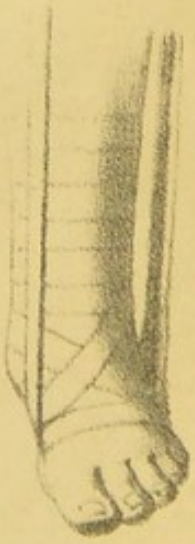

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Plate II.

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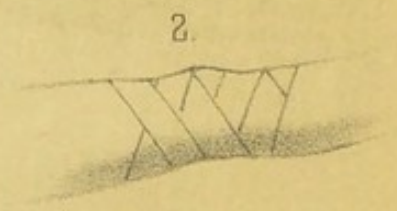

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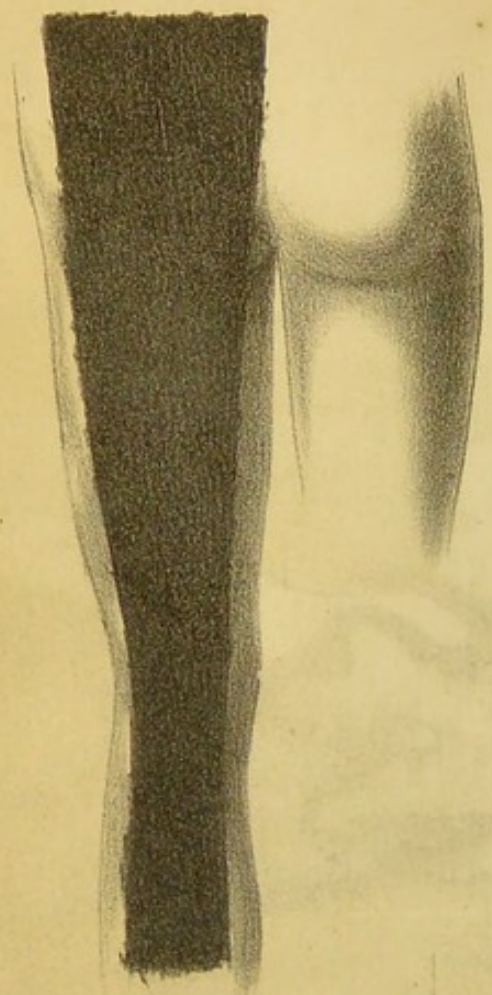
Plate III.



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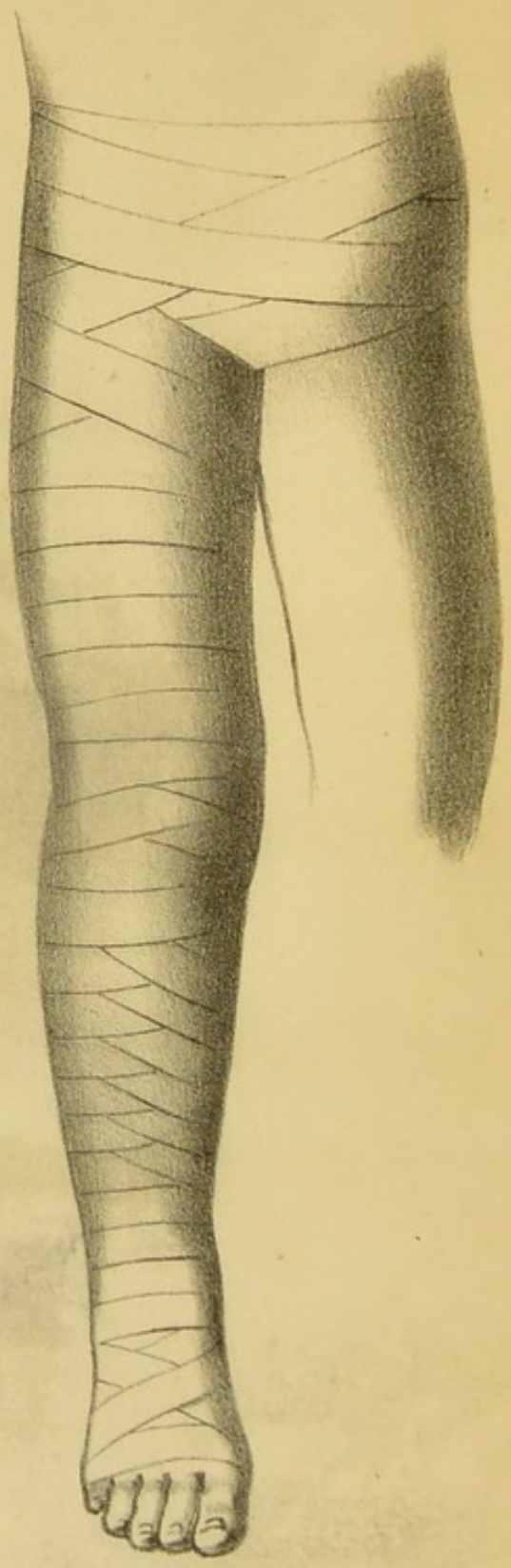

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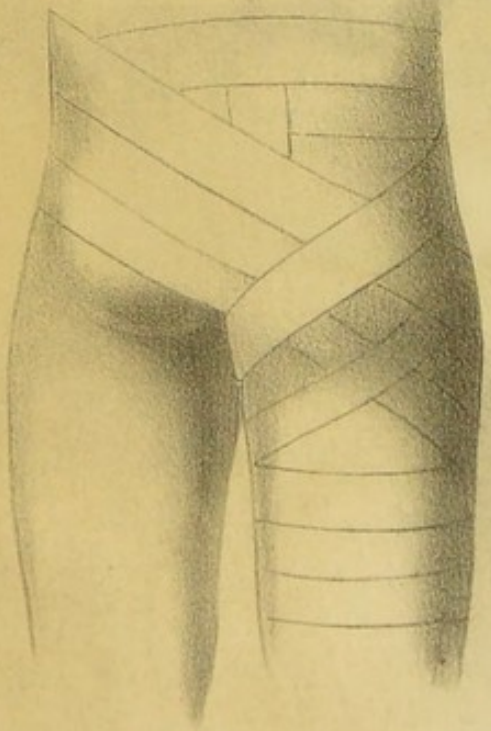

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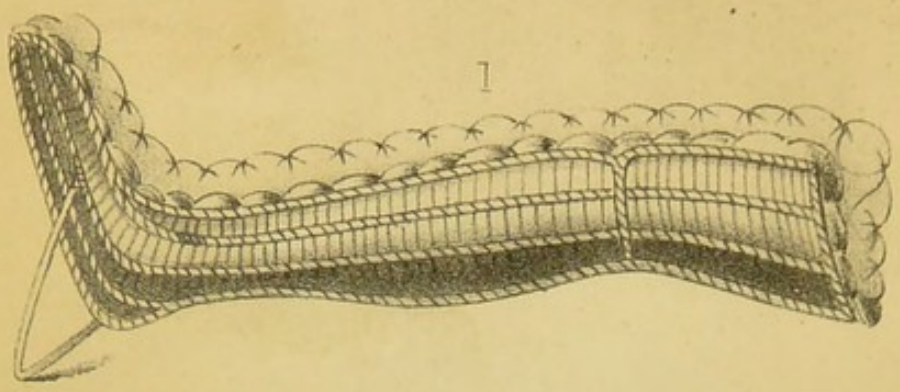
Plate IV.



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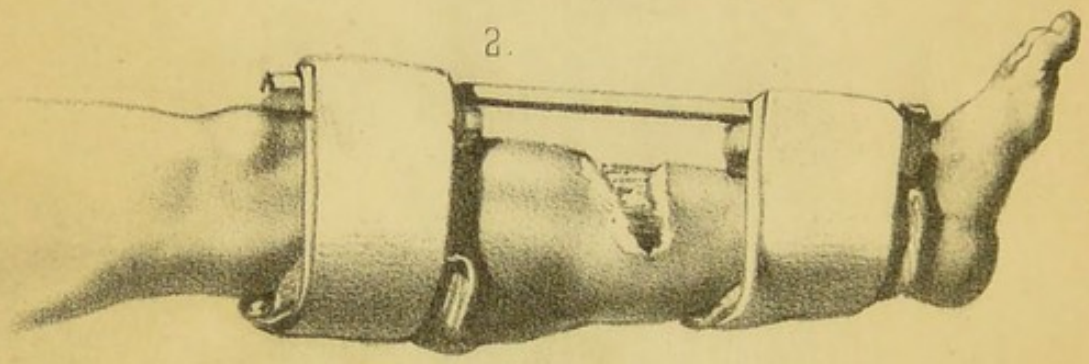

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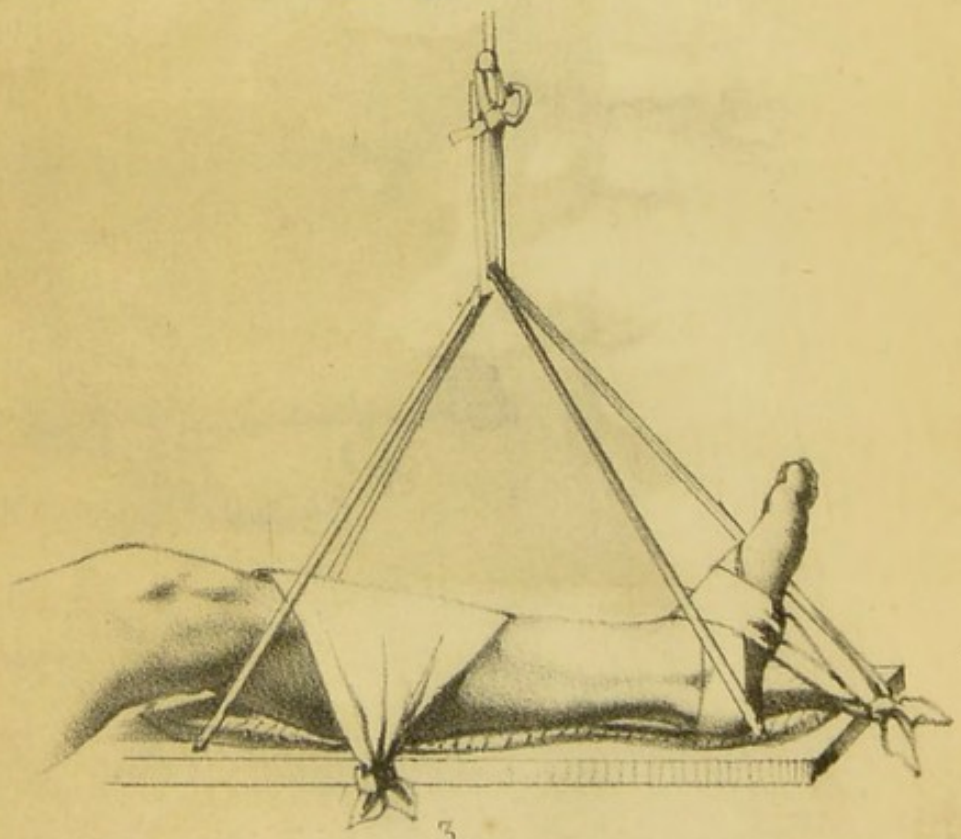

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Plate V.

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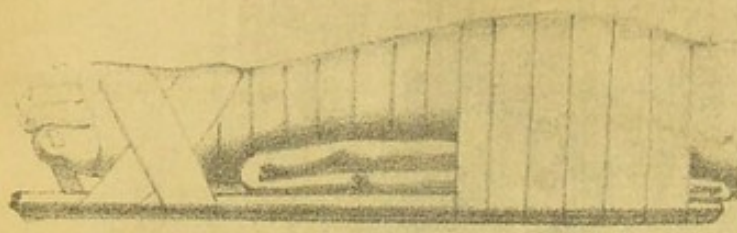

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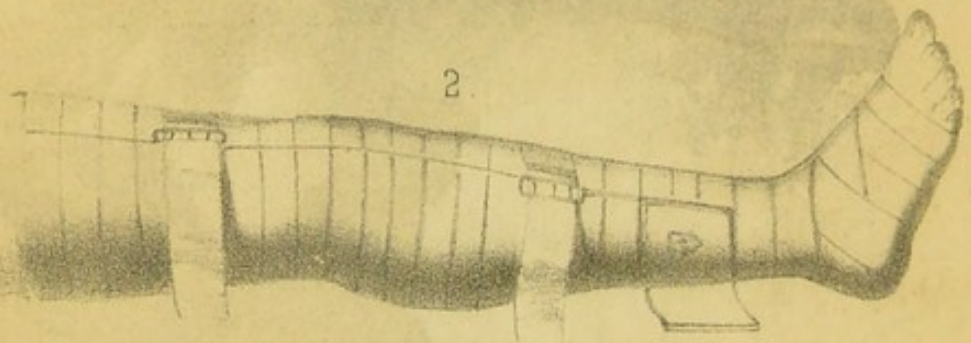

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PLATE III.

Fig. 1.—Long back splint, for fractures of the thigh.

Fig 2.—Pasteboard apparatus complete for fracture of the thigh, showing especially the manner of bandaging the pelvis, to secure immobility.

Fig. 3.—The buttock covered completely, as it must be if the hip-joint is to be fixed.

PLATE IV.

Fig. 1.—A wire apparatus well padded inside, for fracture of the leg.

Fig. 2.—Pirogoff's field-splint suited to a gunshot fracture; the pad at each end of the splint raises it off the seat of injury, while a few rolls of moistened plastered bandage, fix it to the limb, and allow of the patient's removal to a place of safety.

Fig 3.—A simple swinging apparatus after Mayor's plan.

PLATE V.

Fig 1.—Dupuytren's splint applied for Pott's fracture outside pasteboard apparatus during the drying process.

Fig 2.— A compound fracture of the leg, shewing the apparatus cut up in front, the two halves held together by straps, and a trap door cut during the process of dressing.

Fig. 3.—Pasteboard apparatus for the upper limb, opened to admit of examination without displacement of the entered parts.

PLATE VI.

Van de Loo's plaster of Paris apparatus.

Fig. 1.—The layers of plastered bandage arranged before application.

Fig. 2.—Strips of ordinary bandage covering the plastered strips, and intended to protect the limb.

Fig. 3. –Plastered flannel apparatus for broken leg.

Figs. 5 & 6.—Plaster flannel apparatus for fracture of the hip and pelvis.

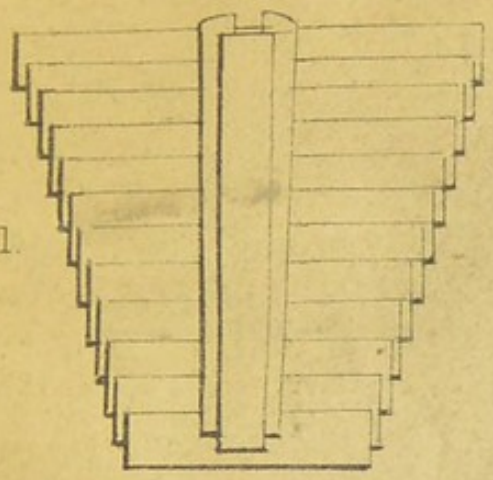
PLATE VII.

Fig. 1.—A hook to suspend a fracture apparatus to a swing cradle ; for convenience the artist has shown the object upside down ; the single wheel, and the hook which is moveable in its socket, admits of greater facility of swing than is obtained with the ordinary plan.

Fig. 2.—An improved form of Seutin's pliers.

Fig. 3.—Mr. J. T. Clovers's starch bandage scissors, as manufactured by Messrs. Coxeter.

Plate VI.



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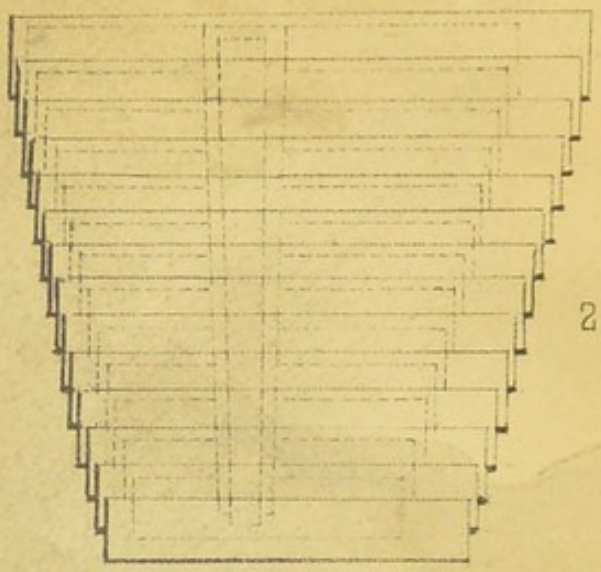

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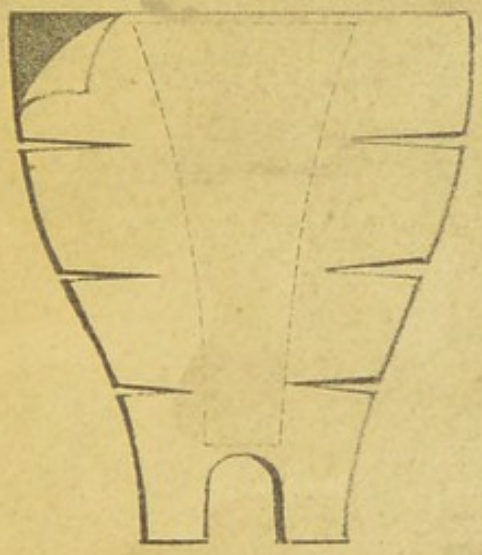

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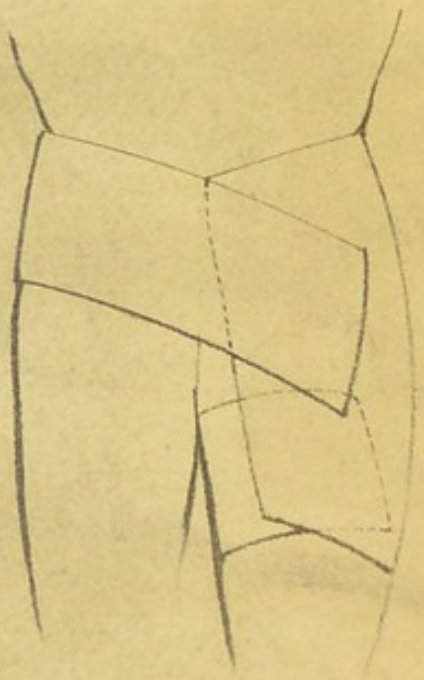

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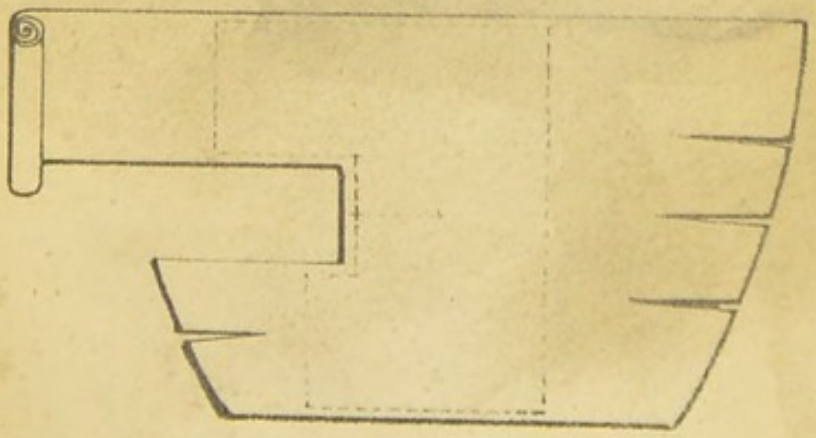
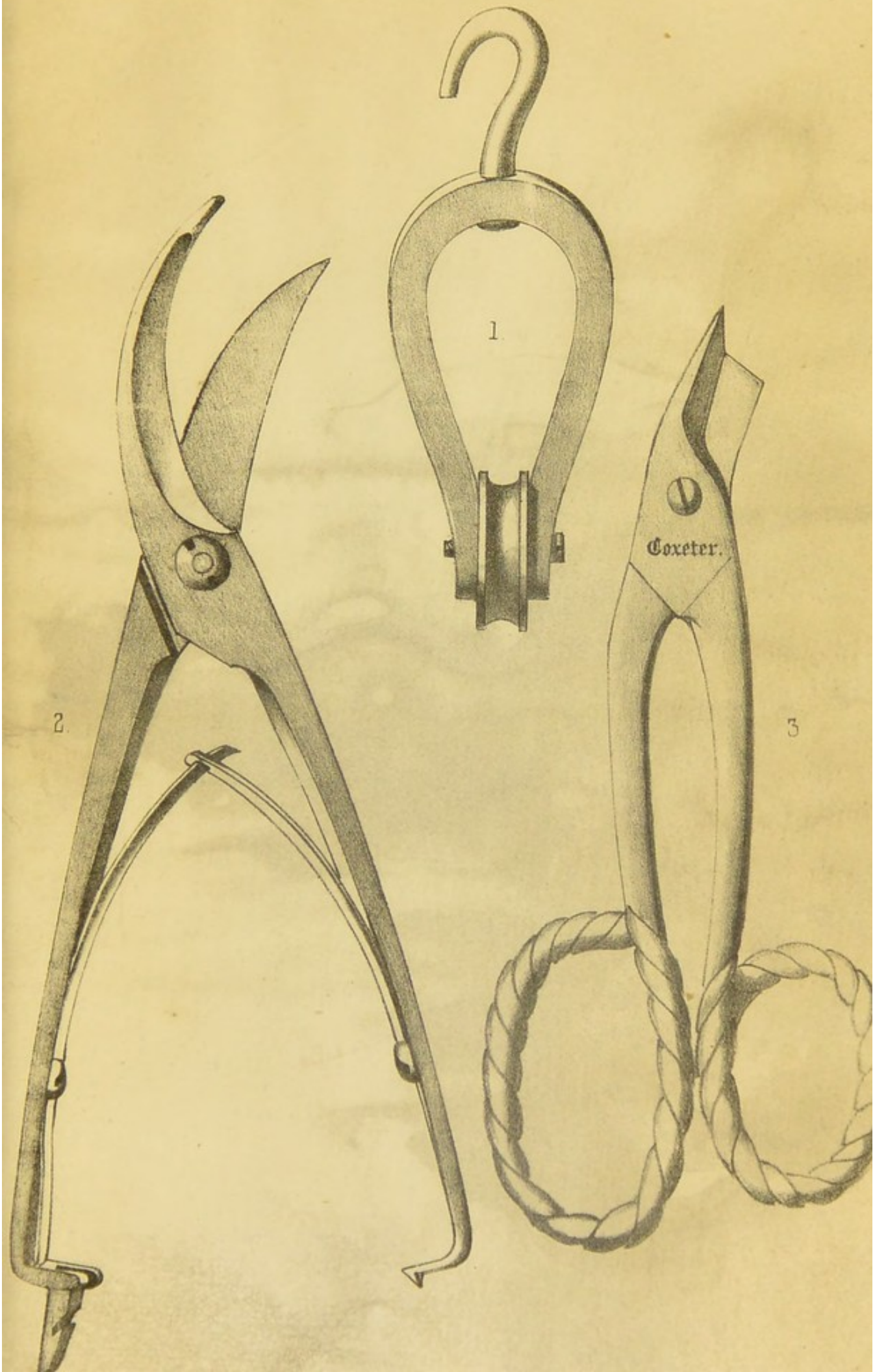


Plate VII



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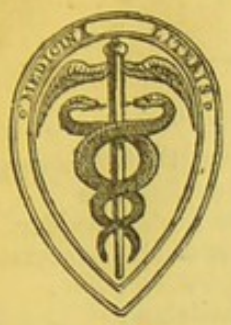

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