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Gamgee, Sampson, 1828-1886.
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Publication/Creation

London : J. & A. Churchill, 1883.

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ON THE TREATMENT

OF

WOUNDS AND FRACTURES:

CLINICAL LECTURES

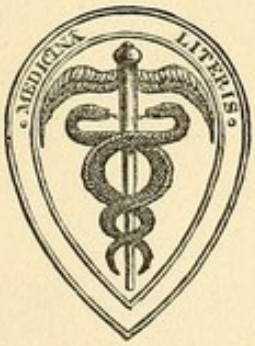
BY

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AND OF THE MEDICAL SOCIETY OF CHRISTIANIA.
ETC.

WITH FORTY-FOUR ENGRAVINGS ON WOOD.

SECOND EDITION.



LONDON:
J. & A. CHURCHILL,
NEW BURLINGTON STREET.
1883.

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* * * "The divided parts of a broken bone unite by the intervention of the circulating juice ; just as the softer parts do, allowing a different space of time for different textures and consistence."—The Chirurgical Works of Percivall Pott, by James Earle. London, 1790. Vol. I. p. 381.

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* * * "The treatment of fractures is the same in principle as that of wounds. The separated parts are to be re-applied and kept motionless."—John Abernethy's Lectures on the Theory and Practice of Surgery. London, 1830. p. 218.

ADDENDUM.

At page 361, after the Index, the reader will find a note on "Absorbent cotton-wool tissue, as a basis for moulds and splints, for the treatment of surgical diseases and injuries,"—the result of practical trials, concluded since this volume was printed.

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PREFACE.

THIS volume is a consolidated Second Edition of my Clinical Lectures, "On the Treatment of Fractures,' 1871), and "On the Treatment of Wounds," (1878). In recasting those works with my earlier and later writings on the same subjects, and with hitherto unpublished clinical records, into what is practically a New Work, the results of more extensive and mature experience have been incorporated, as concisely as was consistent with clearness.

The clinical material under my hand has so steadily increased, that the book has only been kept within moderate limits, and proportionately prevented becoming a burden to busy men, by excluding all matter not strictly relevant.

My chief endeavour has been to demonstrate the identity and continuity of the principles of Surgical Therapeutics, irrespective of the tissues affected. Wounds are fractures, and fractures wounds; differing in the situation and density of the structures involved, but essentially solutions of continuity, similar in causation, in processes of physiological repair, and in surgical treatment.

To preserve the colloquial style in which the information has been communicated to succeeding classes of students, at the bedside and in the operating theatre, the

form of Clinical Lectures has been retained; and I have added to them concise directions, for carrying into practice the principles of treatment.

To reduce the inconvenience of desultory treatment, which is of the essence of clinical instruction, each lecture is, so far as practicable, complete under its distinctive heading, and a full index is appended; but no attempt has been made to give the volume the completeness and method of a treatise, which it is not.

Practitioners who consult these pages will, it is hoped, not misinterpret my motives in dealing plainly, and in detail, with elementary and apparently trivial matters.

In surgery, as in some other subjects, if men had a clearer appreciation of first principles, and were more fully alive to the necessity of attending, at once and thoroughly, to beginnings, there would be less need to study the causes and remedies of complications, which would then be rare.

But, as a matter of fact, surgical complications and difficulties are of every day occurrence. Many of them are related in these pages, without unnecessary detail; yet plainly, enough it is hoped, for faithful, and not unprofitable, records of thirty years experience.

SAMPSON GAMGEE.

22, Broad Street,

Birmingham,

19th May, 1883.

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LECTURE I.

General analogy between Wounds and Fractures. Illustration of Simple Wounds and Simple Fractures. First and Common Indications of Wound and Fracture Treatment.

GENTLEMEN,

WOUNDS and fractures are alike interruptions of continuity,—the former of the soft, the latter of the hard parts. They differ in the density of the tissues involved, and proportionately in the time required for reunion; but they are essentially similar in processes of repair and principles of treatment. In wounds and fractures, division of tissue is the essential fact which gives rise to a common chain of events—mobility, disordered innervation, and effusion,—which become causes of ulterior pathological results, if their development be not checked by proper treatment.

The indication, common to the vast majority of wounds and fractures, is to bring the severed parts together and keep them so, during the process of repair. In the words of John Hunter's (*) epoch-making generalization "*The first and great requisite for the restoration of injured parts is rest.*" How that indication shall be fulfilled—what peculiar appliances are demanded by injuries in particular situations, and by such complications as contusion,

(*) A Treatise on the Blood, Inflammation and Gun-shot Wounds. London, 1812, by John Hunter; vol. I. p. 372.

hæmorrhage, and inflammation,—are questions, traversing the whole domain of surgery, on which we shall have to comment as cases come before us. Meanwhile, here are two very simple illustrations of the most elementary principles of wound and fracture treatment.

CASE I.—*Fracture of fibula. Immediate plaster of Paris bandage. Out of bed next day. Perfect recovery.*

P.H.,—slipping with his right foot under him, broke the right fibula two and a half inches above the lower end of its malleolus, but without injuring the tibia or the skin. 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. He left his bed the next day, and at the end of a week I made this note.—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 having become loose, opened, edges pared and closely re-adjusted with common bandage, after which the patient was again quite easy. When I finally removed the apparatus at the end of a month, the fibula was firmly consolidated, and the movements of the ankle perfect.

CASE II.—*Incised wound round the knuckle. Direct union under absorbent pad, rest, and pressure.*

Here is a pad of pure absorbent gauze and cotton, which has been removed from the left hand of a young person, whom I happened to see running down the street, to seek surgical aid at a neighbouring dispensary. Under a handkerchief soaked with blood, I found a clean-cut wound, extending an inch and a half from the dorsal aspect of the

first knuckle round into the palm. A little artery spouted. The edges of the skin admitted of easy approximation, which I maintained with the elastic pad and a few compressing turns of absorbent bandage. In a few hours, bloody serum had permeated the centre of the dressing, which was left to dry by evaporation. When, at the end of five days, I took off the bandage and pad, the fine linear cicatrix was barely visible, and the surrounding skin dry and painless.

All we did in the broken fibula, and in the cut finger, was accurately to adjust, and absolutely to immobilize, the divided parts, while they were glued together by the animal juice, which became consolidated and organised. In the one case, a pad and bandage was sufficient to maintain co-aptation; in the other, the bandage was impregnated with plaster of Paris to give greater strength. In the flesh wound, the severed edges were kept together under a softly compressing elastic pad, after the fashion of the elastic pressure which keeps together all the soft parts of the living frame. In the bone wound, we also imitated nature; for, pending the repair of the broken piece of endo-skeleton, we constructed an outer chalk shell, after the plan of the crustacea, and nutritive repair proceeded physiologically, to the entire prevention of pathological phenomena. In the flesh cut, union was perfect in five days; in the bone break it required nearly five weeks,—differences of detail for which my preliminary remarks will have prepared you, but, withal, differences not affecting the soundness of the analogy between wounds and fractures.

The parallel is still further illustrated, on physiological and surgical lines, by this man, who has just recovered from a wound and a fracture, more extensive than in the preceding cases, more serious because of the intensity of the first violence, and of the combined lesion through the soft and hard parts.

CASE III.—*Compound fracture of both bones of the leg. Out of bed third week. Direct union under dry dressing, pressure, and immobility.*

M. T., going backwards down a cellar stair with a cask of ale in front of him, slipped; the cask rolled on to his leg, breaking both bones and producing an extensive communicating wound in the soft parts. You perceive from the cicatrix, what a large flap of skin was turned down in front of the solution of continuity in the tibia. I saw the patient within half an hour from the occurrence, and found the trouser and stocking soaked with blood. I carefully uncovered the limb, reduced the fracture at once, and, after well drying the wound, fitted the skin-flap accurately into place, keeping it there by strips of dry lint, one of which was successively laid on the other as it became soaked with blood.* Softened mill-board splints, from the middle of the thigh down to embrace the foot, were the basis of the retentive apparatus; two similar splints being placed at the back, from the same point above, to within three inches of the heel-bone; a nicely-compressing circular bandage keeping the whole firmly together. A narrow sand bag on each side, from the foot to mid-thigh, afforded additional security for immobility. The patient had not a single bad symptom; pulse never above 80; no spasm, swelling, or discharge. He 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, and was out of bed within the third week. The shield of dry lint and blood was not disturbed for ten days, when the wound was wholly healed; —consolidation, of the then simple, fracture proceeding in the usual course. Before you is the limb, the broad

*Writing on Compound Fractures in 1779, Mr. Wilmer of Coventry taught that "in dressing the wound, whether it be small or large, no application seems in general so proper as dry lint." *Cases and Remarks in Surgery, by B. Wilmer, London*, 1779, p. 203.

-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. Here, repair of the wound in the soft parts and in the bone, occurred by one and the same natural process, aided by the same means,—exact co-aptation of the divided surfaces, and immobility, with dry and infrequent dressing, uniform and elastic pressure. Union by the first intention was perfect throughout the deep wound;—only differing in the length of time required, to accomplish consolidation of the soft parts and of the bones.

Reserving to succeeding lectures the complete justification, on scientific and practical grounds, of the parallel between wounds and fractures, it will be convenient at this stage to consider them separately.

Let us revert to the finger wound round the knuckle in Case II. It was so exposed as to offer no difficulty of exploration. In fulfilling an indication never to be lost sight of, as a preliminary to closing a wound, first make sure that it contains no foreign body. In determining this point, great assistance may generally be derived from an enquiry into the cause and manner of infliction of the wound. My patient had cut round the knuckle in using a long carving knife, and the lodgment of a foreign body was practically out of the question. With the finger, which, space allowing, is the best of probes, the wound was felt clear; a piece of dry lint, applied with steady pressure for a minute, stopped the bleeding; and, for prevention of its recurrence, I trusted to accurate apposition of the edges and immobility, under a compressing absorbent pad and bandage.

It was only after the cicatrix was perfect, that the bloody hand was washed. Under the absorbent, and compressing dressings, the part dried, shrank, and consolidated.

Drenching wounds with water during an operation, or after an accident, and washing them with it in subsequent dressings, are mistakes. (*) Water favours decomposition, which is the enemy of healing action. In the case of an incised wound, which has only partially healed, let anyone try the experiment of covering one part of the recent cicatrix with dry lint, and the other with water dressing. As a rule, liable to very rare exceptions, consolidation will be found to take place under the dry, and suppuration under the wet part.

Even in the case of a dirty wound I never wash with plain water; but, if any liquid be required for cleansing purposes, use equal parts of spirit and water, or a saturated solution of borax with the addition of about one-eighth of its bulk of glycerine. Camel hair pencils, and pledgets of absorbent gauze and cotton, are to be preferred as cleansing instruments, and to be burnt directly after use. Another good cleansing liquid may be prepared with equal parts of water, glycerine, and methylated spirit.

Mr. Bryant recommends† for the same purpose water, to which sufficient tincture of iodine has been added to make it a light sherry colour, and Dr. B. W. Richardson has suggested with the same object, proof spirit containing tannin and glycerine; all good. If much pain be unavoidable an anæsthetic should be administered, for, upon the accuracy of every step in the first dressing, the healing of a wound largely depends. Nothing is more important than to save pain, which is a cause, as well as a sign, of

*For most instructive observations on this point, and generally on the subject of wounds, the reader is referred to the article "On the Science and Art of Healing Wounds," by Benjamin W. Richardson, M.D., F.R.S., in the Transactions of the St. Andrews Medical Graduates' Association, edited by Leonard W. Sedgwick, M.D.—London: Churchill, 1872, p. 37—52.

† Article "Wounds" in The International Encyclopædia of Surgery, edited by John Ashhurst, London, 1882. Vol. II, p. 27.

physiological disturbance, and a very potent factor in the initiation and development of pathological changes.

On the presence of foreign bodies in wounds, cases are constantly occurring to teach valuable lessons. Here are a few by way of illustration.

CASE IV.—*Incised wound of temple and fissure of frontal bone. Direct union under absorbent pad and pressure.*

Sarah Madden was admitted to Ward 5 with a clean cut wound 1½ inch long, on the right upper angle of the forehead. The probe proved, that the cut penetrated into the frontal bone, and some rough material could be felt in its fissure. Enquiry elicited that the wound had been inflicted in falling over, and thereby smashing, an earthenware cup. This suggested the possible cause of the roughness, which proved to be due to fragments of earthenware which were dislodged from the bony fissure with the probe, by the resident dresser, Mr. Leslie Phillips. No liquid was applied to the wound, but its edges were brought together with a silver suture, and a dry absorbent pad secured over the seat of injury, with a lightly compressing bandage. No untoward symptom showed itself, and the dressing was not disturbed until the sixth day, when union by the first intention was perfect, and the suture removed. The absorbent pad was re-applied as a protection for a few days; and the patient, who had been the subject of a serious injury,—wound of the scalp and fissure of the skull,—was discharged the fourteenth day with a linear, pale, and painless cicatrix.

It is not always so easy to determine the presence of a foreign body in a comparatively superficial wound, as you may gather from a brief record of a case in my private practice.

CASE V.—*Clean-cut wound over and through, tibia, with eversion of bony edge. Dry dressing, application of sulphate of copper and turpentine ointment. Slight exfoliation. Complete recovery.*

I was called one Sunday morning to Mr. A. I., who, about an hour previously, had entered a railway carriage to go to Arley. He was sitting cross-legged just under the lamp, while it was being lifted out through the roof by a porter. The heavy glass bell fell into the carriage in a number of pieces, one of which struck the front of my patient's left leg three inches below the knee, cutting through the clothes, and inflicting a clean-cut wound right across the front of the tibia. As broken glass was the offending agent, I thought a portion of it might be in the wound. On lightly probing it, I felt a rough, prominent body, but it was immovable. Careful digital examination proved that there was no glass, but that the rough eminence was bony. Evidently one of the heavy pieces of glass had, with its sharp edge, cut into the tibia and turned up the lower edge of the fissure. The patient was in bed for some weeks; the wound suppurated slightly, but there was no surrounding inflammation. The limb was kept at perfect rest in a swing, and dry absorbent dressings applied to the wound. Its deficient reparative action was beneficially stimulated by touching it occasionally with sulphate of copper, and applying for a few days the Unguentum Terebinthinæ on the pad. Three small pieces of bone exfoliated, the last one some days after the wound appeared to have definitely healed. This fragment having made its way through the skin, the wound remained solid. My patient recovered substantial damages from the company, and has not suffered since.

If I had not examined the wound carefully at first, I should have been very much puzzled by subsequent events.

While relating this case, to prove the necessity of examining wounds attentively when you are first called to them, I cannot too strongly impress upon you the importance of conducting your explorations with the utmost possible gentleness. In every stage of wound treatment, light manipulation is of primary importance. As operators and dressers, cultivate light touching as an art;—probe without thrusting, cut without bruising, separate without tearing, manipulate without mauling.

Foreign bodies in the palm of the hand and the sole of the foot are often difficult of detection, and, if at all deeply situated, their extraction may be attended with considerable difficulty.

CASE VI.—*Removal of piece of wood from palm of hand. Direct union under absorbent pad, compound tincture of benzoin, rest, and pressure.*

A master carpenter at one of our principal theatres applied to me, with much pain and swelling in the inner half of the palm of his left hand. He said that a week previously it had been penetrated by a piece of wood; an ineffectual attempt at extraction had been made, and the part subsequently poulticed. Through a small aperture on the inner border of the hand pus exuded. Palpation in the centre of the palm caused great pain, and a foreign body was indistinctly felt there, but the hardness of the horny hand made the diagnosis difficult.

While my friend Mr. Cocks Johnston administered ether, I made an incision in the centre of the palm, and introduced the probe, but it failed to distinguish the piece of wood from the tendinous structures. The presence of the foreign body was, however, made clear by its becoming prominent at the palmar wound, when compression was exerted on the inner border of the hand. A transverse incision united the

two wounds, and through it a rough piece of wood nearly two inches long and a quarter of an inch in diameter was removed. Hæmorrhage was free. A pad of absorbent gauze, and cotton over which compound tincture of benzoin was freely sprinkled, was placed in the palm of the hand; a dry pad on the back of the hand, a compressing bandage with the fingers in a flexed position, and the elbow immobilized at an acute angle, completed the dressing. The next day the elbow was let down to a right angle, and the patient went about with his hand and forearm in a sling. The wound was not exposed until the fourth day, when it had healed without a drop of pus. Palmar pad and bandage continued for a week, as a precaution.

To have continued poulticing that hand, without extracting the foreign body, would have jeopardised both the injured limb and the patient's life. And after the operation nothing could have been more painless and rapid than the process of healing, by the aid of position, absolute rest, and pressure, although suppurative inflammation had been set up before the foreign body was extracted. The physiological after-treatment was unquestionably assisted by the application of the compound tincture of benzoin; but of this more hereafter.

The rule that before attempting the closure of a wound, any foreign body, that may have penetrated it, should be sought for and extracted, has its exceptions.

Experience proves that many extraneous substances, especially metallic ones, may remain in the body for years, without apparent evil consequences;—often indeed without the patient being aware of their presence. In the case of a bullet wound, whether attempt should be made to dislodge the missile, or whether it should be allowed to lodge, is often a nicely-balanced question, depending upon a variety of considerations and admitting of legitimate difference of

opinion. As a rule if you have direct physical evidence of the presence of the bullet, and its extraction be possible without adding materially to the life risk, extract; but if the probabilities are, that less harm will result from the lodgment of the foreign body, than from any attempt at its extraction, especially if there be any uncertainty as to its precise position, then leave it alone.

These reflections were forced upon me in a case which overwhelmed me with a sense of responsibility, not merely because a life was at stake, but because I had known the patient for years in an excellent social position; and the manner in which the wound was inflicted raised the question, whether he had not attempted to destroy another life besides his own. He was in full possession of all his faculties, assured me, in confidence, that he was quite innocent; and wished everything possible to be done to save his life, that he might have an opportunity of explaining the circumstances, which had already become the subject of much public comment.

CASE VII.—*Bullet wound through the ear. Extraction. Death.*

A few minutes before 1 A.M. on Wednesday, the 22nd September, 1880, I received an urgent note from Mr. Westwood Moore, our house-surgeon, reporting that a gentleman had just been admitted into the Queen's Hospital, after firing a revolver bullet into his right ear. Where the patient fell, a good deal of blood was found on the floor, and it poured distinctly from within the right ear, when he was brought to the hospital, and for some time afterwards. I proceeded to the institution at once, and found the patient in bed. He was sensible, with a fair pulse. A little blood was oozing from the right meatus, and the ear was most sensitive to touch, but only slightly

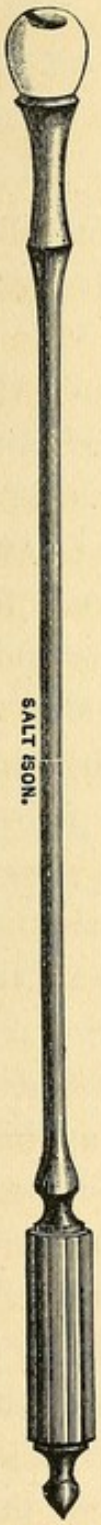
bruised at one point. On the left side of the neck, reaching below the larynx, and upwards on to the cheek, was a large, hot, brawny swelling, which, the patient informed me, had been in process of formation for about ten days. Everything had been done most judiciously and promptly for the patient's comfort by the resident hospital staff. Restoratives, ice, &c., were continued; and I resolved not to interfere, beyond removing a strong metal plate with artificial teeth from the upper jaw.

The patient continued for the next two days in much the same state, as denoted by the subjoined extracts from the temperature chart. For brevity I only quote the maximum numbers: —23rd, temperature 99·4°, pulse 96, respiration 16; 24th, temperature 99·4°, pulse 104, respiration 22; 25th, temperature 99·3°, pulse 96, respiration 24.

The swelling on the left side of the neck increased greatly, and on the 25th, I could feel an indistinct fluctuation in its centre. Through an incision, I gave exit to about one ounce and a half of very fetid pus.

Next morning the swelling just referred to, had so much diminished, and the patient was generally in such a favourable condition, that I determined on exploring the right ear, while Mr. Brett, our resident obstetric surgeon, administered ether. There had been a slight, but continuous, oozing of bloody serosity from the earhole.

With a narrow scalpel I made an incision in the roof and floor of the meatus, so as to admit the tip of my little finger, a metallic probe having previously detected a rough, hard substance within the passage. The inner ear was evidently blocked; but whether by bone or bullet, or both, I could not tell until I introduced a Nélaton porcelain probe. This soon solved the problem. On withdrawing it, I found on the white bulb this shiny



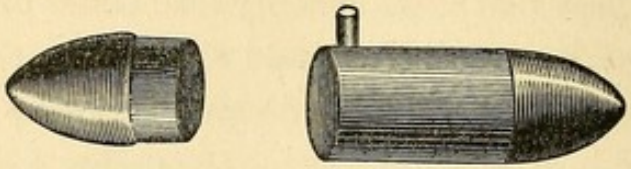
black mark, which only lead could produce. The mark was distinct and shining black, and I preserved it as a fixed diagnostic sign; determining to use another porcelain probe for subsequent exploration.

It was now clear to my mind that we had to deal with a compound fracture of the temporal bone, and an impacted bullet. The patient was calm, and wishful that an endeavour to save his life should be made. In his then state, death was inevitable; and if extraction could be effected without much violence there was a bare possibility of recovery.

My colleagues in consultation obtained an independent lead mark on the porcelain probe which they used, and unanimously approved my proposal to attempt the extraction. I seized the bullet with the fine long American forceps, but very firm traction made no impression. Having inserted the edge of my left index finger-nail between the outer edge of the bullet and the bone, I followed it with the point of a steel elevator, and gently prised the bullet out from what, as seen by these exact representations, was evidently the uneven bony bed in which the bullet had moulded itself.

The weight of the extracted bullet (126 grains) accurately corresponded with the weight of one of the bullets left in the revolver.





These figures show one of the bullets with, the other without, its metallic cartridge; all the illustrations being of natural size.

The extraction was effected without violence, once the elevator was placed under the foreign body and worked with my left hand, while the right index-finger acted as a fulcrum. Nothing was introduced into the ear, and little blood was lost. Free vent was afterwards allowed for discharge, which was collected in absorbent antiseptic pads. As the discharge was fetid, the pads acted agreeably as deodorisers, and their downy softness was so comfortable that the patient's repeated wish was for more pads. The patient quickly regained perfect consciousness, and took liquid nourishment. Next morning the temperature had risen to nearly 103°; pulse 144; respiration 24. The state in the evening was: temperature 101°; pulse 136; respiration 24. Perfect rest enjoined; ice internally and to the head, and attention to the bowels by enemata. At first ice was applied to the head by an ordinary ice-bag; but, as the temperature rose, a continuous current of iced-water cooled the head through one of Galante's syphon tube caps, which, fortunately, Mr. Salt had just previously brought over from Paris. The effect of this appliance was very speedily to reduce the temperature two degrees. Some refreshing sleeps were enjoyed. There was no sickness and no paralysis for the first thirty-six hours after the operation; but then coma rapidly supervened; the pupils became fixed; the body motionless; temperature 103·6°; pulse 168; respiration 17. Death occurred twenty minutes later, forty-two hours after the operation.

The post-mortem examination was conducted by Dr James Oliver, with the assistance of Mr. R. Fitch. There was a considerable amount of sero-purulent effusion in the cavity of the arachnoid, and its vessels were injected. A thin, purulent deposit covered the surface of the brain, especially of the right hemisphere. Much punctiform redness interspersed the cerebral substance. On removing the dura mater, a ragged fissure was visible through the roof of the right temporal bone. On laying open the interior of the petrous portion it proved to be tunnelled with an irregular dirty cavity with broken walls, demonstrably the place of lodgment of the bullet.

The question of bullet extraction recurred in the following case.

CASE VIII.—*Gun-shot wound of thigh. Direct union under compound tincture of benzoin, absorbent pad, millboard splints, pressure, and suspension.*

W. J., a gunmaker, called on me one evening, just after he had been testing an express rifle and conical bullet at a metal target. One of the bullets, in recoil, entered the right thigh ; bright red blood at once spurted out at some distance, but had been checked by tying a workman's apron round the limb. Uncovering it, I found an irregular circular opening on the inner side of the right thigh, immediately over the spot where the femoral artery enters Hunter's canal. The probe passed five inches outwards and upwards, in front of the femur, without meeting with any obstacle. I deemed it prudent not to explore further, in consideration of the position of the wound and the history of arterial hæmmorrhage. The bullet had evidently travelled beyond the point of danger, which was at the artery.

I placed an absorbent pad, soaked in the centre with compound tincture of benzoin over the wound, and bandaged

the limb with equable pressure. The patient was driven home to bed, and, as the absorbent dressings remained perfectly dry, I swung the limb, after immobilizing it in the extended position with a lattice work of strips of dextrined millboard and bandage. No pain or constitutional disturbance followed, and when the limb was exposed at the end of a week, it was pale and shrunken; the wound healed without a drop of pus. Only slight movement was allowed for the subsequent fortnight, when the patient resumed the direction of his business without any unfavourable result. He was perfectly well, and walking briskly, when I happened to meet him four months later.

Another violently contused wound, healed on the same principles by the first intention occurred in the next case.

CASE IX.—*Contused wound of foot. Direct union under compound tincture of benzoin, absorbent pad, rest, position and pressure.*

The dressing which I hold in my hand was removed from one of the workmen in an iron warehouse. He was moving some pigs of iron, when one, weighing a little over a hundredweight, fell on his right foot. I saw the man very shortly afterwards, and found his foot very much swollen, its bony outline obliterated, the skin bluish and shining, with a star-shaped wound on the centre of the instep. Having satisfied myself that no foreign body was present, I dried the wound, and placed over the dorsum of the foot this fold of lint, well soaked with compound tincture of benzoin; over it this large pad of absorbent gauze and cotton, and then a compressive bandage from the roots of the toes to the middle of the leg. I enjoined my patient to keep perfectly quiet, lying during the day with his head at the foot of a sofa and the injured foot over its head. I did not remove the dressing until the eighth day, when the wound

was healed, the outline of the limb perfect; and though the skin was mottled, as from a bruise, up to the middle of the leg, it was cool and painless.

You see how the blood had penetrated, though in small quantity, through the dressings, and dried on the outside. The tincture of benzoin had acted as a coagulant and anti-putrescent, and, drying into the lint, served the purposes of a mould. Its styptic property was assisted by pressure and position, under which the effusion was absorbed; the part shrank, and the wound healed without any further interference; not as a simple consequence of a dry application, but owing to a variety of causes which combined in controlling the circulation, and promoting reparative action in accordance with demonstrably true principles of animal physics.

In the cases hitherto passed in review, the wounded skin was healthy; but it may be inflamed and tender, and yet, when wounded, heal by the first intention.

CASE X.—*Removal of inflamed cystic tumour from scalp.—Direct union under dry lint, styptic colloid, and pressure.*

This little old gentleman, who has kindly attended in the theatre for your instruction, consulted me about two months previously for a cystic tumour, about as large as a hen's egg, in the right temporal region. The covering skin was very red, tense, and painful. After removing the cyst with the knife (transfixing through the base and enucleating the separate halves), I dried the interior of the wound with a fine sponge which had previously been well squeezed. The edges were then very accurately approximated, and kept so with a few strips of lint soaked in styptic colloid. A few turns of compressing bandage completed the dressing; when I removed it, at the end of five days, there was not a drop of discharge; adhesion was perfect, and afforded a simple but complete

illustration of the surgeon's first intention in treating wounds, —to secure direct union. All that is visible of the cicatrix is a very fine pinkish line, extending upwards about two inches from, and just in front of, the right ear.

This operation was performed contrary to the teaching of one of the leading scientific surgeons of the age, whom I do not name for two motives,—a deep regard for him personally, and a disinclination to enter into personal controversy on a matter which would be left unnoticed, were it not for the important surgical principles which it involves. The author referred to says—"Do not operate upon any small inflamed "parts . . . . A man will bear a little tumour, or a "small cyst, or a small pile, so long as it is not inflamed; "but when it inflames it teases him, and he asks to have "it removed with all speed. Don't do it. The risks of "operating on an inflamed part are manifold, and much "greater than the risks of operating upon one that is quiet."

There are doubtless many inflammatory states in surgical practice in which incisions have been practised unnecessarily; and I venture to think that no more useful lesson may be demonstrated in this clinique than the preventive and actively antiphlogistic influence of immobility, position, and pressure. But on the other hand, there are inflammatory states due to the presence of foreign bodies, or of tumours, or other pathological products, in which the use of the knife is imperatively demanded, and may be most safely practised, to relieve tension, make way for drainage, and otherwise render practicable the therapeutic axiom "*Sublata causa tollitur effectus.*"

In case *X.*, which has elicited these remarks, once the skin covering the cystic tumour of the scalp had become red and tender, there was practically no prospect, without the removal of the morbid growth, of reducing the inflammation, which was mainly due to tension, and consequent nerve and vascular irritation.

Take another case, of not infrequent occurrence in hospital out-patient rooms,--a wound into the joint over the knuckle, and inflammation of the hand, as the result of movement and wet applications. Redness, pain and tension under those circumstances are often extreme, resisting physiological treatment and threatening not only the finger, but the hand, and the life. By disarticulating the finger, at the inflamed and wounded joint, free exit is given to pathological products, and under absorbent and compressing dressings, and immobility in the flexed position, healing proceeds rapidly.

Yet another case in confirmation of the same principles and practice. There is no stronger reason for removal of enlarged tonsils, than that they are a frequent cause of inflamed throat. It is of course preferable to remove them when quiescent; but so far from inflammation being a bar to excision, I have at one sitting removed, with the guillotine, both tonsils so intensely inflamed and so enlarged, that they touched in the middle line, and threatened the suffocation of the patient. A copious discharge of bloody matter gave instant relief, and the patient has never had a recurrence of the attacks, which were previously frequent and most distressing.

It is a surgical axiom,—that no patient suffering from strangulated hernia should be allowed to die without relief of the stricture. The presence of inflammatory symptoms, far from being an objection to the use of the knife, is an additional reason for prompt resort to it; and in the truly wonderful achievements of modern abdominal surgery, none have been more brilliant and life-saving, than those in which the abdomen has been opened, for the removal of pathological products after inflammation has set in.

In substance, the first essential precept meant to be conveyed and illustrated in this introductory lecture may be

stated thus :—That, having ascertained that no foreign body is present, the surfaces of a wound should be placed and maintained in accurate apposition, as the condition precedent to their organic reunion.

In all the cases brought under review, the two commonest agencies for maintaining apposition have been sutures and adhesive plaster. On their value in every day practice, and on the manner of using them, surgeons have long been agreed, and the accepted knowledge in point may be gleaned from any surgical treatise or manual. There is still some question however, as to the material of sutures ; while some practical points, in the use of them and of adhesive plaster, are so important, that they cannot too often be repeated, especially not, in a practical course like this. Union may be secured, with proper precautions, irrespective of the material of which sutures are composed, as exemplified in.

Case XI.—*Removal of fatty tumour from the neck.—Direct union under dry pads, three silken and three silver sutures.*

A. F., aet 30, presented a tumour, characteristically fatty, extending from the right side of the cervical spine and occiput, downwards and forwards into the anterior triangle of the neck. The carotid sheath was exposed in the removal. The incision through the integuments was five inches in length, and, after carefully drying the interior of the wound, I brought its edges accurately together with three silver stitches in the upper half, and three silken ones in the lower half, subsequently exercising pressure by pads of dry lint and bandage. The wound, when inspected at the end of a week, was found to have healed directly and firmly, without a drop of discharge of any kind.

Silken and catgut sutures have the advantage of being more readily tied, and are best fitted for some special cases,

But for general surgical purposes, metallic sutures deserve the preference, for one reason above all others,—that they can be left a much longer time, with practically no risk of exciting suppuration.

The number of sutures must vary with circumstances, the great object being to secure the accurate contact of cut edges and surfaces, easily and without tension. The alternation of superficial and deep sutures is useful, and so long as they do not irritate, be not in a hurry to remove them. On this point, and very generally in surgical treatment, "*leave well alone*" is a golden rule.

The manner of withdrawing metallic sutures is not less important than that of introducing them. Care must be taken, that the end or wire drawn through is not bent or jagged, but flattened quite smooth to avoid bleeding, severance of the bond of union, and pain ; which, once set up, are fruitful sources of a chain of nervous and vascular disturbances opposed to wound healing.

In the absence of an assistant, hold the sides of the wound together with the left thumb and index finger, while the right hand withdraws the suture. In the event of several stitches having been inserted, remove them alternately, bridging each gap with a strip of non-irritating plaster. Drops of blood, serum, or pus, are to be taken up with a small pledget of absorbent gauze or cotton, or, in its absence, of dry lint, but no water must be used.

Adhesive plaster is of essential service in maintaining accurate co-aptation of divided parts. The elemi plaster (Southall's), which I have used for many years in preference to all other kinds of adhesive plaster, has many advantages. It needs no warming before application, is very pliant yet strong, unirritating and yet decidedly antiseptic in virtue of the terebinthinate resin which enters into its composition. Professor Gross speaks very highly (*) of Martin's plaster,

(*) Gross's System of Surgery, 6th edition. Philadelphia, 18 82, Vol, 1. p. 339

which consists of best Para rubber, Burgundy pitch and balsam of Tolu, spread upon strongly woven cloth thoroughly shrunken. The cheap adhesive plaster commonly sold is worse than useless.

Some practical points have to be borne in mind in applying and removing adhesive plaster. If the skin be hairy shave it, if moist dry it. The strips of plaster should be of sufficient length to secure good hold—for instance not less than nine inches in amputation of the breast. The soft parts near the wound are to be gently pressed together with the hands, from the deeper parts towards the surface, as the plaster is drawn with sufficient tightness to exercise equable pressure without constriction. By placing them diagonally instead of lengthways, the plaster strips hold much better. They should be applied between, and not over, points of suture, which, especially when metallic, are apt to cause pain under the plaster, or at any rate to interfere with the perfect comfort which is essential to absolute rest, and to nutritive repair without irritation. By leaving small gaps between the plaster strips, the accumulation of fluid beneath them is prevented, especially if absorbent pads be placed over them, to ensure drainage by capillary attraction. If there be tension in the neighbourhood of a wound—a condition powerfully conducive to nerve and vascular irritation—it may be relieved by cutting across one or more of the strips of plaster without removal. When it becomes necessary to change the dressing, the adhesive strips should be removed one at a time, the ends being raised simultaneously towards the wound, in the direction of, and not against, the advancing cicatrix; taking good care that the sides and lips of the wound are all the time kept in close contact, so that a tender bond of union be not broken or enfeebled. With these precautions, which cannot be too scrupulously attended to, an extensive wound

may be dressed with a minimum of mechanical displacement and nerve irritation, and with the least possible pain and discomfort to the patient. An important result of such painless procedure is, that the patient is relieved of all apprehension of suffering in subsequent dressings, which, as it will be one of my chief objects to demonstrate, should be as infrequent as possible.

LECTURE II.

CONTENTS.

Arrest of hæmorrhage. Physiological and physical principles of hæmostatics. — Styptics. — Torsion.— Ligature.—Acupressure.

To stop bleeding is one of the first indications in the treatment of wounds and fractures, and I shall briefly recall the means adopted for that purpose, in some of the cases which occupied our attention in the preceding lecture.

The little artery which spouted in the wound over the knuckle, (Case II), was controlled by bringing the edges together, applying the pressure of an elastic absorbent pad, and securing immobility. So, in the more formidable injury (Case III), in which both bones of the leg were broken by direct violence, and the soft parts wounded, the considerable hæmorrhage was checked by immediate and permanent co-aptation, under dry lint, equable compression, infrequent dressing, and absolute immobility.

Apart from the mechanical differences of the two cases, the physiological principles of treatment were substantially identical, as was, in both, the process of repair. The opened vessels were closed in the act of adjustment of the wound edges; the blood permeating and drying into the cotton pad and lint, formed an artificial scab; while rest, position, and pressure, moderated the afflux of blood, and gave time for effective consolidation.

Only the other day, I heard of more than an hour being spent in securing, by ligature, under the spray, the vessels in a rather extensive flesh wound, to promote direct union. The process of dressing caused great exhaustion, and proved nearly fatal. I should not have troubled to tie a single vessel in such a wound. A small pair of torsion forceps, and a camel-hair pencil touch, with some styptic solution, would have been quite sufficient as preliminaries to immediate and accurate co-aptation, elastic pressure, physiological position, and absolute immobility.

Allow me to read you a bit of very sound old surgery in point. I quote from p. 48 of Mr. R. Mynors' "Practical Thoughts on Amputations," published just a century ago. "We need not be too solicitous about the security of small arteries by ligature; for if the recently divided soft parts are gently brought together, and nicely retained in contact; if a passive state of the muscles surrounding them is duly attended to, and their own natural contraction properly assisted by the judicious, and artful application of bandage; a perfect security from future hæmorrhage will be insured, as well as the most likely means employed, to obtain a speedy, and easy cure of the wound by the first intention."

Styptics, already incidentally referred to, as aids to pressure and immobility in the arrest of hæmorrhage, merit careful consideration.

CASE X.—*Removal of sebaceous tumour from the scalp.—Direct union under absorbent pad, styptic colloid, and pressure.*

Here is a dressing I removed a few hours ago from the crown of the head of a private patient, on whom I had operated three days previously for the removal of a sebaceous tumour. As soon as I had turned it out, I adapted the edges accurately, and exerted pressure, for a few

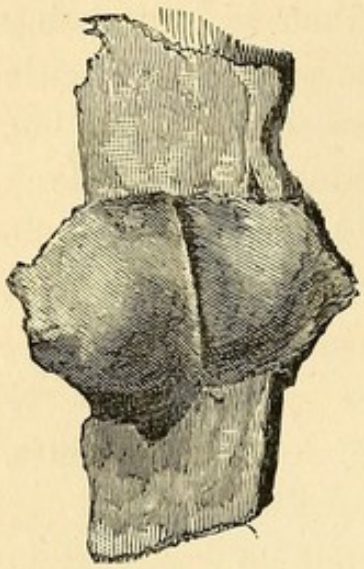


Fig. 1.

minutes, with the finger over a pledget of dry absorbent cotton; when this was stained with blood, I substituted for it a similar pledget soaked in styptic colloid, and over it a strip of dry lint. Under pressure for about three minutes longer, the dressing dried, and the patient left my consulting-room. When I saw him the next day, he was perfectly comfortable and attending to his business. It was not until the expiration of the third day, that I poured a little ether over the pad to soften it; this was the work of a few seconds. On removing the dressing, the clean and dry scalp presented a firm cicatrix, of which you see, and feel, a linear cast in the centre.

CASE XI.—*Removal of large lipoma from neck and shoulder. Styptic colloid, drainage, absorbent dressings, and compression. Rapid recovery.*

Mrs. E., aged 61, was admitted into the Queen's Hospital under my care, (*) with a swelling over the left shoulder and side of the neck; the tumour extended laterally from the arm-pit to the upper border of the larynx, covering the whole of the posterior triangle of the neck and the lower half of the anterior, the whole of the clavicle, and the upper part of the pectoralis major. The antero posterior axis of the swelling was the longest, and measured thirteen inches.

The tumour had been of slow growth for ten years, rapid for the last six months. It was elastic, and fairly movable; only troublesome from its size and weight. The covering skin dimpled on lateral pressure of the tumour, which on removal, proved, as diagnosed, characteristically fatty.

(*)For a full report of the case, here condensed, I am indebted to my friend and former dresser, Mr. Arthur Holdsworth.

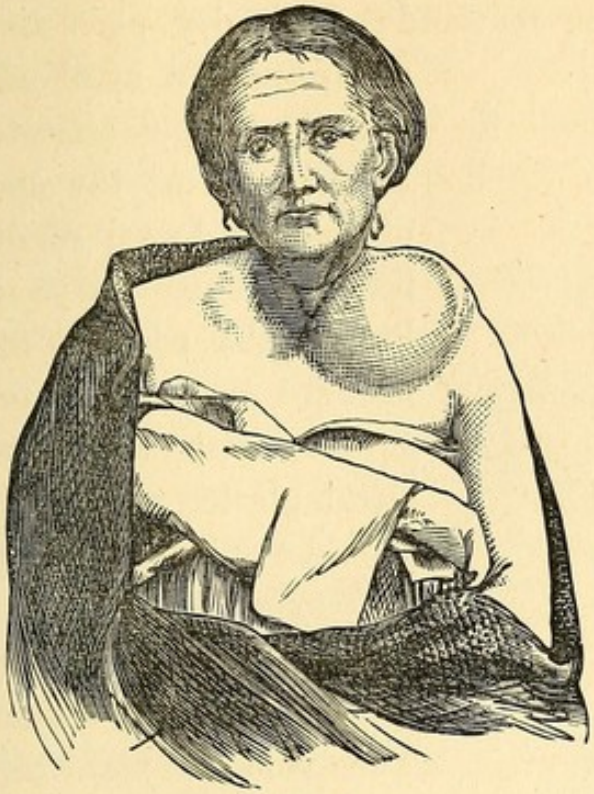


Fig. 2.

Enucleation was effected through an incision from a point one inch outside the episternal notch, over the middle of the tumour, to the centre of the spine of the scapula. The resulting wound measured, superficially, eight and a half by eight and a half inches; into its floor could be seen rising, with each inspiration, the apex of the left lung with its covering pleura. The great vessels and nerves to the head and arm were also exposed; but very little blood was lost. No vessel was tied or twisted. I brushed the wound out lightly with a camel-hair pencil previously dipped in styptic colloid, brought the edges together with seven silver sutures, inserted drainage tubes front and back, and compressed with a shoulder spica over oakum pads. It is important to note that the drainage tubes were left projecting, and separate pads placed over each of them, and lightly fixed with a turn of bandage. In this way absorbent pads could be changed without disturbing the greater part of the wound, which was thus kept perfectly drained, sweet, and dry, without violating the principle of infrequent dressing, so conducive to rest and painless repair. The patient passed a good night, and next morning the temperature was 101·5°, pulse 118, resp. 32.

The seventh day, pulse 94, resp. 24, temperature precisely normal; edges of wound united for nearly the whole length;

sutures and drainage tube removed; fresh dry pads and compression applied, and the patient allowed to get up. At the end of the second week, union had given way a little; the edges were brought accurately together with strips of elemi plaster, and a light shoulder spica applied, so as to exert light pressure through pads of absorbent gauze and cotton. The wound was not exposed for another week, and the cicatrix was then quite solid, as shown in the annexed wood-cut.



Fig. 3.

Admitting the hæmostatic value of pressure in these cases, the concurrent effect of the styptic colloid application was very apparent. It acted mainly, in all probability, by stimulating the contraction of the small vessels; but, to the coating which it leaves after evaporation, can scarcely be denied the influence of a rapidly-formed and efficient protective from the air. It was as a stimulant to the contraction of the small vessels that John Hunter (*) praised the hæmostatic action of "a dossil of lint dipped in oil of turpentine, after having first wiped the wound clean." He spoke of it as "the best, if not the only true styptic,"—rather too sweeping an assertion, if I may venture to say so, with all deference to such an authority.

(*) Op. cit., vol., 1, p. 538.

Styptic colloid was invented in 1867 (*) by my friend, Dr. B. W. Richardson, F.R.S. It is produced by saturating ether entirely with tannin and a colloidal substance, xyloidine or gun cotton, a little tincture of benzoin being finally admixed.

After a few days, styptic colloid dressing often peels off easily as a dry shell, leaving the parts beneath perfectly healthy. If the dressing be adherent, care must be taken to remove it so as not to disturb the subjacent parts, and not to give pain. This may be done by dropping on the dry colloid dressing, for a few minutes, a mixture of alcohol and ether, or equal parts of absolute alcohol and distilled water, warmed to a little above the heat of the body; when the dressing becomes moist almost directly, and can be taken off lightly without the patient feeling it. In the absence of alcohol and ether, brandy or whisky will serve to soften dry colloid dressing before removal.

In advocating the use of styptic colloid, as an excellent preparation for hæmostatic and retentive purposes, also valuable for its anti-putrescent properties, I do not attempt to define its merits as compared with other spirituous and resinous solutions—*e. g.*, collodion, tincture of the perchloride of iron, compound tincture of benzoin, the Friar's balsam or Balsamum Traumaticum of the old surgeons, which are one

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(*) *Vide* Dr. B. W. Richardson, in *Medical Times and Gazette*, 1867, Vol. I p. 383 *et seq.* "On a New Styptic and Adhesive Fluid—Styptic Colloid, and on Healing by the First Intention." Styptic colloid prepared after Dr. Richardson's instructions, by Messrs. Robbins & Co., Pharmaceutical Chemists, Oxford Street, London, is rather too costly for general use. To obviate this difficulty, Messrs. Southall Brothers and Barclay have, at my suggestion, instituted experiments in their pharmaceutical laboratory, with a view to secure a wound styptic at moderate price, combining the unquestionable advantages of the old Balsamum Traumaticum and the modern colloidal substances. The result has proved quite satisfactory. Southall's Styptic Colloid prepared with ether and spirit, tannic acid, gum benzoin, and gun cotton, is an efficient styptic and antiseptic.

and all excellent preparations. Any of them (*) may be used with great advantage in promoting the healing of wounds, as adjuvants to the great principles of rest, position, and pressure.

Styptic colloid has the advantage of drying very quickly; strips or pledgets of lint, or absorbent gauze and cotton, soaked in it, soon become so dry and firm as to act like splints in preventing motion. I have often treated injuries of the hand and fingers, with successful reliance on lint soaked in styptic colloid, with the two-fold object of closing the wounds and immobilizing the joints.

Torsion of the arteries, as another method of arresting hæmorrhage, was illustrated in

CASE XII.—*Strangulated inguinal hernia. Operation,—Torsion, sutures, dry and infrequent dressing, and pressure. Direct union.*

John Pardo, aet 21, with symptoms of strangulated inguinal hernia. I found it necessary to open the sac, (†) which contained some omentum and a knuckle of intestine, deeply congested, but otherwise in fair condition.

(*) The Friar's balsam and the Balsamum Traumaticum are practically identical in composition with the Tinctura Benzoini Composita of the British Pharmacopœia. The latter contains exactly the same quantity of Balsam of Tolu as the former, and rather more Benzoin, Storax, and Socotrine aloes. The compounds are excellent in surgical use. The appended formula is from the Pharmacopœia of the London College of Physicians for 1771 :—

BALSAMUM TRAUMATICUM.

℞ Benzoini P. uncias tres.
Styracis calamitæ colati P. uncias duas.
Balsami Tolutani P. unciam unam.
Aloës Socotrinæ P. unciam dimidiam.
Spiritûs vinosi rectificati M. libras duas.
DIGERE :—Ut gummi, quantum fieri poterit, solvantur, deinde cola.

(†) The extra-peritoneal operation is to be preferred whenever practicable. *Vide* Petit's Operation and Purgatives after Herniotomy, by J. Sampson Gamgee. London, Baillère, 1855.

Bleeding from two vessels was arrested by torsion. The wound was closed by three points of silver suture, and a pad of dry lint was applied over it, with a gently-compressing spica bandage. One grain of opium to be given every four hours. Milk diet.

The temperature, which on the day of operation was 101·2° with a pulse of 104, fell in forty-eight hours to 99·5° with a pulse of 76, and respiration 20. The opium was now discontinued, as the patient continued free from pain, and the thermometric chart denoted gradual return to the normal standard of health; the bandage was not interfered with, until the seventh day after the operation. The pulse was then 62, respiration 20, temperature 98·2°. I found the pad of lint quite dry; no tenderness or redness around the linear cicatrix, which was solid throughout. The sutures were now removed, another pad of lint applied, and a gruel enema ordered, the bowels not having yet acted.

The note on September 13th is:—The bowels acted 15 minutes after the enema; pulse 62, respiration 16, temperature 98·3°. The patient says he feels quite well; is allowed meat diet. He was discharged with a truss the eleventh day after the operation.

CASE XIII.—*Strangulated femoral hernia.—Direct union after operation, under dry pad and pressure.*

In this case of strangulated femoral hernia, in which I operated in consultation with Dr. Sawyer and Mr. Creswell, the wound healed perfectly in four days, under a pad of cotton wool and a lightly compressing bandage. The symptoms had existed some days before the operation, and, on opening the sac, a knuckle of deeply-congested intestine was found within it. The recently pared edges of a hare lip could not have healed more directly and soundly than this wound into the abdomen.

It is very many years since I tied a vessel in operating for strangulated hernia. In most cases a forceps-pinch of a spirting vessel, or a couple of twists, stop the bleeding very effectually; and the nicely adjusted wound, with provision for drainage at its dependent angle, is in the most favourable position for healing.

I do not recommend you to try torsion at first on large vessels; but practising it on small and medium ones, you will acquire such confidence from experience as will cause you to wonder, that so excellent a plan did not come more quickly into general use.

In 1850, while on a visit to the Clinique of Pavia, I saw Professor Luigi Porta twist all the vessels in an amputation of the leg near the knee. Torsion had then for some years been the method which Antonio Scarpa's successor had constantly employed in preference to the ligature, in all amputations; and the treatise (*) in which he advocated the practice in 1845, remains a monument of wide erudition, careful experiment, and sound clinical reasoning. But in this country, notwithstanding the experimental researches and demonstrations of W. B. Costello and Thomas Bryant, (†) torsion gained few disciples, until Mr. Syme adopted it, in opposition to Sir James Simpson's acupressure. It has since steadily gained ground.

In evidence of the confidence warranted by experiment, it may be stated that in his original communication on torsion, published in 1868, Mr. Bryant gave the results of numerous successful experiments in twisting the arteries of living animals, but he had only tried the practice once, and that on the brachial artery successfully, in the human

(*) Delle Alterazioni Patologiche delle Arterie per la Legatura e la Torsione. Esperienze e Osservazioni di Luigi Porta Prof. di Clinica Chirurgica Nell' I. R. Università di Pavia. Con Tredici Tavole in Rame. Milano, Tipografia di Giuseppe Bernardoni, di Gio, 1845.

(†) Med. Chir. Trans., Second Series, vol. 33, London, 1868, p. 199.

subject. Six years later he was able to publish this statement.* "Up to the end of 1874 we have had 200 consecutive cases of amputations of the thigh, leg, arm, and forearm, in which all the arteries had been twisted (110 of them having been of the femoral artery) and no case of secondary hemorrhage;—indeed, our house surgeons never expect to be called to cases of secondary hemorrhage now that torsion is the general practice of the hospital."

If increasing experience eventually establish that torsion, applied to large arteries as well as small, is as safe as the ligature, its adoption will proportionately become more general; but the first condition must be absolute safety against hæmorrhage. This is practically attained with the ligature. In thirty years' work as a hospital surgeon, I have never lost a patient from hæmorrhage in private practice, and only one amongst the thousands who have come under my care in hospital. That was a woman from whose right axilla I had dissected a deeply-seated tumour. The bleeding was checked at the time by ligature and pressure; but, in the course of a week, secondary hæmorrhage occurred in the middle of the night, and proved fatal, in spite of the best endeavours of our then house surgeon. As an instance of how successfully large vessels may be tied, let me read you a note which I had the honour of receiving from the late Professor Syme.

"No. 1, Shandwick Place, Edinburgh,

"My dear Sir, "January 19th, 1867.

"I lately tied the femoral artery of a gentleman, for popliteal "aneurism, with complete success, and this was the thirty-fifth time I had "performed the operation without any unfavourable result; except in one "case, where there had been an unsuccessful attempt by pressure.

"Yours very truly,

"Sampson Gamgee, Esq." "James Syme.

The next case may help to impress some of the preliminary lessons of wound treatment, which have occupied us so far,

* A Manual for the Practice of Surgery, by Thomas Bryant, London, 1879, 3rd Edition, vol. 2, p. 575.

and also to illustrate another method of arresting hæmorrhage.

CASE XIV.—*Extensive incised wound of wrist.—Acupressure, sutures, position, absorbent and infrequent dressings, pressure.—Direct union.*

I was in the hospital when the man now before you was brought in. A cloth soaked with blood surrounded the left hand and forearm, and we were told that the accident had happened a few minutes previously, while the man was grinding a matchet,* on a millstone weighing a ton, and revolving rapidly by steam-power. The steel blade flew into several pieces, one of which appeared at a first glance to have nearly cut off the hand. The gaping wound extended for two and a half inches across the front of the wrist. The superficial tendons were divided, and the ulnar artery bled freely. I passed an acupressure needle under the proximal end of the divided vessel, and after satisfying myself that the wound was free from a foreign body, brought the edges accurately together, by five points of silver suture. The hand and forearm were surrounded with absorbent gauze and cotton pads and compressing bandage, the elbow bent at an acute angle, the palm of the hand placed on the upper end of the sternum, and perfect

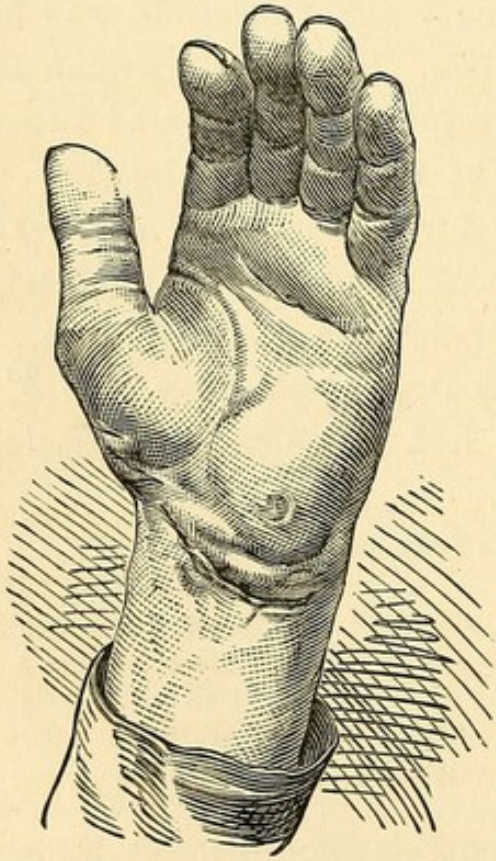


Fig. IV.

* A kind of slightly bent broadsword, used in the West Indian plantations for cutting down sugar-canes.

rest secured, by circular bandage round the trunk and the recumbent position. The acupressure needle was taken out on the fourth, the stitches on the fifth day, when the wound was nearly healed. On the eighth day the man was made an out-patient, and the same dressing was renewed every fourth day. This is the fortieth day since the accident, and you observe how fine and firm the scar is, without any subcutaneous matting, and with perfect freedom of the joint in every direction.

The means employed in this case for arresting bleeding, and for placing the formidable wound in the most favourable condition for healing, were—*a*, bending the artery at the elbow, which was bandaged to the side, with the palm of the hand resting on the upper end of the sternum; *b*, general elastic compression of the whole limb; *c*, acupressure of the wounded vessel.

A few words as to the rationale of these agencies.

Always bearing in mind the coagulability of the blood, and the physico vital forces of the circulation, the heart impulse under nervous control and the contractility of the vessels, it is important not to overlook the physico—hydraulic conditions under which the blood flows.

In your surgical dealings with the blood vessels, accustom yourselves to regard them as elastic tubes along which fluid is impelled at a rapid rate, by a powerful pump, in conformity to physical laws. The action of the many forms of tourniquet in mechanically checking the blood current has been utilized by surgeons for centuries; but the beneficial influence of position, in reducing the rate and amount of blood supply, is not held in sufficient importance for its direct application to surgical practice, alike in arresting hæmorrhage, and in preventing and reducing inflammation. If you watch an india-rubber pipe connected with a water tap, you will observe that you can influence the impetus service

of the jet by altering the level of the pipe and raising or lowering its outer end; you can still further check the outflow, in direct proportion as you bend the pipe at an acute angle. That is what we did in bending the man's elbow and raising the hand. How rapidly the blood-flow can thus be checked, admits of proof by a very simple experiment.

While your left hand is hanging down, feel its radial pulse with the right index-finger. Then, keeping the elbow close to the side, raise the left hand gradually, until the tips of the fingers touch the corresponding shoulder. In this movement the radial pulse can be felt progressively weakening, until it is at last nearly obliterated; hence the hæmostatic efficiency of the arterial flexion at the elbow and of the prone position of the hand.

With a given propelling force, other things being equal, the flow of blood in elastic tubes is in inverse ratio to the resistance; increase this, and the flow lessens. We compassed this end by general elastic compression of the limb, after bending the elbow at an acute angle, and by placing a needle under the artery, just above the wound, in accordance with the practice of acupressure.

Admitting that Sir James Simpson, who was the most powerful advocate, if not the inventor (*) of acupressure, extolled it too highly, it is beyond doubt a very simple and efficient method of arresting hæmorrhage. It is so especially, in wounds of the hand and wrist, the foot and ankle, where the vessels can be effectually compressed on a pin or needle, and where tendinous sheaths render it desirable to interfere as little as possible. In Sir James Simpson's own

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* At a recent meeting of the Roman Royal Academy of Medicine, Mazzoni claimed the discovery of acupressure for the late Professor Rizzoli, of Bologna, who is said to have practised it in 1850, and published a memoir in 1859, extolling the value of acupressure in the treatment of aneurisms. *Vide* Bullettino della Reale Accademia Medica di Roma, anno VI., n. 10, p. 50.

words (*) "The superiority of acupressure primarily depends "upon the merely temporary and removable nature of the "foreign occluding body; upon the relative slightness of "the physical compression which it produces upon the "tissues of the closed vessel, and upon . . . . . the "tolerance of metallic bodies by the living tissues of the "body." Supporting testimony by so sound a practical surgeon as the late Professor Pirrie, of Aberdeen, is worth quoting. "That acupressure is a practicable and trust- "worthy method of arresting surgical hæmorrhage is "uncontrovertibly proved by the fact that since March, "1864, with the exception of cases of excision of parts "situated where the pins might have interfered with "deglutition, in all my operations, both in hospital and "private practice, comprehending, among many others, "amputations in the thigh, leg, arm, and forearm, and at "the ankle joints; . . . . in all operations admitting "of the surface of the wound being brought together,—in "short, in almost every variety of operation, age, and sex, "I have invariably employed acupressure, and never in a "single instance failed in arresting the hæmorrhage." This passage occurs in the third edition of Professor Pirrie's "Principles and Practice of Surgery." (§) Four years later the Aberdeen professor wrote to me, "My decided "impressions after long experience of acupressure are those "stated in the last edition of my "Principles and Practice "of Surgery." I strongly incline to the opinion that, with increased experience, acupressure will grow in the estimation of surgeons as a hæmostatic process.

It is beyond question that in the case of severe wound of the wrist, which has called forth these remarks, and in

* ACUPRESSURE, a new method of arresting surgical hæmorrhage and of accelerating the healing of wounds, by James Y. Simpson, Edinburgh. Black; 1864; p. 46-7.

(§) London; Churchill, 1873, p. 589.

others to be commented on as we proceed, the success of acupressure was qualified, because it was only one amongst other powerful resources employed; to wit, styptics, position, immobility, and pressure. As surgeons, and generally as therapeutists, strive to have many strings to your bow; do not place too great reliance on any one resource; be wedded to no one system, but seek safety in well-chosen combinations of all means calculated to assist in attaining a desired object.

The cases of hæmorrhage hitherto noticed have been instances of primary bleeding, namely, of bleeding arising immediately or shortly after operation or injury.

Secondary or remote hæmorrhage is more formidable, and happily much more rare. Its usual causes are wet and needlessly frequent wound dressings; but the constitutional state of the patient exercises a powerful influence.

By careful attention to the principles of wound treatment carried out in this clinique, you will most rarely be troubled with secondary hæmorrhage; but when it presents itself, as in the cases which I am about to bring before you, a clear perception of the foundations of physiological surgery, and prompt, exact, and thorough, application of its practical resources are of vital importance.

CASE XV.—*Punctured wound in palm of hand.—Carbolic dressing.—Secondary hæmorrhage and inflammation.—Rapid recovery by position, iodised colloid, pressure, and immobility.*

I was asked to see a licensed victualler, who a week previously, while carving a joint, had thrust the point of a long knife into the centre of the palm of the left hand. He proceeded at once to a neighbouring hospital, where the hæmorrhage was arrested and a carbolic dressing applied.

Hæmorrhage recurred the third day, and the padded wooden splint, which I have here, was firmly applied with a calico roller to the hand, and the patient sent home with the request to attend in a few days. The arm swelled, pain was intense, and my attendance was requested. The splint you notice, is barely long enough to reach from the tips of the fingers to the wrist,—a useless contrivance for purposes of rest, a fulcrum for intolerable pressure under the strong calico roller firmly applied to check the bleeding. I found the palm of the swollen hand full of filth, which I lightly cleaned out with dry lint; blood issued rather freely from the wound, into which I lightly brushed iodized colloid with a camel-hair pencil. I put the man to bed, and raising the limb in the vertical position, padded it, and bandaged it, interlacing the spiral turns, every now and then, with a piece of moistened millboard. I left the man in bed, with the hand well raised, in perfect comfort. He had had no sleep for nights, but was never disturbed afterwards; with four changes of pads in a fortnight, swelling rapidly subsided, and healing was perfect without an untoward symptom. Pressure over a short, strong splint like this, is just the oppressive constriction which cannot be borne, and is a source of incalculable mischief. On the other hand, the equable elastic pressure subsequently employed, with absolute rest and position on sound principles of vital dynamics, was a most important factor in the successful result.

The iodized colloid is prepared by dissolving 20 grains of iodine in an ounce of styptic colloid, and is an application of special value to unhealthy wounds. (*)

More formidable secondary hæmorrhage occurred in,

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* Carbolic and zinc colloid may be prepared by dissolving carbolic acid and sulphate of zinc, in the above proportions, in styptic colloid.

CASE XVI.—*Wound through muscles of thumb. Acupressure, dry dressing.—Secondary hæmorrhage.—Styptic colloid and elastic compression, acupressure, flexed position, immobility.—Rapid and complete recovery.*

William Napp, aet 27, a butcher, was admitted as an in-patient, Dec. 17th. Seven days previously, whilst cutting meat, the knife slipped, entering the back of his hand between the metacarpal bones of thumb and of fore-finger, dividing the radial artery and making a wound of one inch in length. Patient arrested hæmorrhage with thumb of other hand, and at once came to hospital, when an attempt was made in the dressing-room to secure the vessel, but to no purpose, on account of its depth. A hare-lip pin was passed beneath the vessel, and a figure-of-eight ligature applied, which effectually controlled the bleeding; the wound was then dressed with dry lint and cotton wool, and bandaged on a splint. The following morning,—all appeared well. Next morning pin removed, having been in forty-eight hours. Dry lint applied as before. Patient feeling well, he did a little work in the afternoon, contrary to orders; hand commenced to bleed: controlled by pressure with pads of dry lint. From this date until he was admitted, patient lost a little blood at intervals; it was always stopped by pressure with graduated pads of dry lint. On the day of admission the hand was very big, tense, shiny, and painful. A graduated compress of dry lint was placed on wound, and the hand enveloped in cotton wool. Pads were laid over radial and ulnar arteries respectively, and forearm covered with wool, and bandaged. Forearm well elevated, flexed on arm, and carefully fixed to side with a liberal allowance of cotton wool. Morphia, gr. $\frac{1}{4}$ sub cute. All proceeded favourably until the twelfth day after admission, (the nineteenth from the accident), when blood was seen to permeate the dressings, while the patient was asleep. The

house-surgeon changed the dressings and re-applied dry pressure in the flexed position, but hæmorrhage recurred four days later. I was then summoned.

The patient was placed under chloroform, and I passed an acupressure needle under the artery at the wrist, about an inch and a half above the seat of injury. The wound looked dirty and sloughy; it was brushed out with a camel-hair pencil soaked in styptic colloid, and lightly stuffed with lint soaked in the same material, while the swollen hand was held in a vertical position from the shoulder. Pads of lint were now secured over the brachial, ulnar, and radial arteries; the elbow flexed at an acute angle, so that the tips of the fingers touched the point of the shoulder; the limb and chest well padded with cotton wool, a broad piece of moistened millboard securing the arm to the side, and the whole made fast with equably-compressing bandages. An ice-bag was placed over the hand and forearm so soon as the patient was removed to bed, where he was kept under the influence of morphia.

Everything going on well, and the patient being free from pain, it was not until three days afterwards that a small hole was made through the dressings on the outer part of the arm. As all looked well, the dressings were not removed until two days later,—the fifth day from application,—without, however, moving the hand or straightening the elbow. All swelling had disappeared, the bones were well-defined; the wound clean and granulating; the skin of hand and forearm dry and scaly. The acupressure needle removed, dry absorbent pads applied, and the limb bandaged in the same position. Dressings changed every fourth day. At the third dressing the elbow was extended, and the edges of the wound were approximated with adhesive plaster. The man was discharged at the end of a month, and when he presented

himself, about a fortnight later, the cicatrix was so solid that he could use the hand freely in his trade.

It has been noted that the man was treated at first as an out-patient, that all went well until, contrary to instructions, he used his hand. The repeated recurrence of secondary hæmorrhage, notwithstanding very great care from the house-surgeon, led me to adopt thorough measures. To cut down into a sloughy wound in the muscles of the thumb, with a view to find and secure a bleeding spot, is a tedious procedure, of very doubtful issue. Under such circumstances, I have known ligature of radial and ulnar fail, and a hand lost; but a combination, and very careful application, of the measures which I resorted to in the case, has never yet disappointed me.

CASE XVII.—*Amputation at the hip joint. Secondary hæmorrhage arrested by ice and pressure. Rapid recovery.*

The most imposing case of secondary hæmorrhage with which I have ever had to deal, occurred in the man whose thigh I amputated at the hip-joint 11th September, 1862 (*). After removal of the limb (which measured 48 inches in maximum circumference, and weighed 99 lbs, nearly two-thirds of the entire weight of the body), many vessels were tied, including the femoral vein. Everything proceeded favourably until the morning of the fourth day, when arterial blood gushed freely from the centre of the wound, which was nearly all healed. A nurse and dresser had been constantly at the patient's side, with instructions to apply the aortic tourniquet at once, if bleeding occurred; they obeyed, and I was summoned. On my arrival, in the course of a few minutes, the evidences that the loss of blood had been considerable, were unmistakable. To open up the

(*) History of a Successful Case of Amputation at the Hip-joint, by J. Sampson Gamgee, (with Photographs). London: Churchill, 1865.

flaps in search of the bleeding point, and then apply a ligature or the actual cautery, is a proceeding which I have more than once resorted to with success; but to attempt it, in the vast wound of this enfeebled man, menaced death. The tourniquet was retained, with slight pressure, nearly two hours; and a large ox bladder containing three pounds of pounded ice placed over the anterior flap, to be renewed as rapidly as the ice melted.

The bleeding did not recur; at the end of twenty-four hours the ice bag was discontinued. Pressure was kept up by means of a thick piece of sheet lead, weighing nearly one pound, cut and moulded to the shape of the anterior flap, on which it was placed; a piece of dry lint intervening. In the course of a few days the pressure was increased, and the man made a complete recovery.

Due importance must be attached to the effect of cold in preventing a recurrence of the bleeding, but the perfect state of repose of the part under the pressure, first of the 3 lb. ice-bag, and then of the lead, was most beneficial. To compress by bandage in this case would have been impossible, without violating the great principle of rest.

These records of experience, satisfactory so far as they go, leave open the general question of the relative merits of the ligature and torsion, of styptics and the cautery, and of vegetable, animal, and metallic substances for the purpose of securing bleeding vessels. (*) That is a wide field of enquiry, to which precise investigations on a uniform plan, and upon a large scale by a number of observers, may be most profitably directed. To be complete, these enquiries should embrace the value of acupressure and forcipressure.

(*) American surgeons, to whom Surgery is so greatly indebted in the matter of animal ligatures and metallic sutures, have also accumulated most interesting experience on the use of metallic ligatures for wounded arteries. *Vide* "A System of Surgery," by Samuel D. Gross. London and Philadelphia, 5th Ed., 1872, vol 1., p. 670, *et seq.*

(*) Never has the saying, that necessity is the mother of invention, been more completely justified, than by the discovery of means for the arrest of hæmorrhage. The available information on the subject is more complete and more nearly perfect, than on any other of the great surgical problems. There is the strongest reason for believing, that well-directed and sufficiently extensive experiments, and clinical enquiries, would soon raise our knowledge of hæmostatics to the rank of accurate scientific generalizations.

In estimating the relative value of the means employed for closing a divided artery, it must be borne in mind that their efficiency is greatly influenced by the general treatment of the wounded part. Any plan which favours rapid healing of cut surfaces, lessens in direct proportion the chances of recurrent bleeding. It is in this repect that the results of immobility, dry and infrequent dressing, and uniform compression are most conspicuous.

In direct proportion, as those influences conduce to sound wound healing, they contribute to the closure of blood vessels. Physiologically, and surgically, it cannot be too often repeated that repair is ONE process, and in dealing with hæmorrhage, especially, it is impossible to imitate too closely, and to utilize too diligently, the natural processes upon which the growth and restoration of parts depend.

The case of amputation at the hip-joint, incidentally referred to in this lecture, may not be deemed undeserving a few lines to record its issue, since the date of the monograph specially devoted to it.

(*) De la Forcipressure, ou de l'Application des Pinces à l'Hémostasie Chirurgicale, par G. Deny et Exchaquet, d'après les Leçons Profesées par M. le Docteur Péan. Paris : Germer Baillère, 1875. Remarks on Forcipressure and the use of Pressure Forceps in Surgery, by T. Spencer Wells. British Medical Journal, 1879, vol. 1., p. 928., vol. 2, p. 3.

On 13th December, 1874, I visited the patient at Whittington near Lichfield, in company with my friend, Mr. Herbert M. Morgan, to whom I had previously been much indebted for assistance in the case. I found that in the twelve years and three months which had elapsed since the operation, the man had increased in weight from about six and a half to twenty stones. The exostoses on the left tibia had not enlarged. By the same wife the man had had seven children before the operation, and six since. After the first seven, three were affected with multiple exostoses, for which I amputated the thigh of one son, and the finger of a daughter. Of the six children born after the operation, two were stillborn. Of the four born alive, three were affected with multiple exostoses. Joseph Bramwell died 9th May, 1876, fifteen years and eight months after the amputation of his enchondromatous thigh.

CASE XVIII.—*Hæmorrhage from stab through the ear-hole.—Wound of middle meningeal artery.—Traumatic aneurism—Ligature of left common carotid artery.—Death.*

William Lines, constable in the Birmingham police force, stabbed in a street row, was admitted into the Queen's Hospital, under my care, March 7th, 1875, faint and pulseless.

Bright red blood was flowing profusely from a clean incised wound through the tragus, along the anterior wall of the external auditory meatus, and through the tympanum of the left ear. After clearing out the clots, the patient was put to bed, with an ice bag over the left side of the head, a plug in the ear, and a compress around. Slight hæmorrhage recurring during the night, was stopped by the nurse

pressing on the pad. Next morning reaction had fully set in, and the patient suffered very little pain. Pulse 84; temperature 100°.

March 10th—Temperature 99·4 ; pulse 76; ear-plug changed; no hæmorrhage; ice to be continued.

March 13th (6th day)—No more hæmorrhage since the first night. The patient is so much better that the magisterial depositions are taken at the bedside.

March 16th—Pulse 76; asked for chicken for dinner.

March 17th—A swelling, which has gradually developed behind the ear, pulsates and is the seat of bruit. At 10.30 p.m., smart hæmorrhage from the ear stopped by re-plugging. Pressure by the nurse on the plug was sufficient to check subsequent slight bleeding. The application of ice continued without intermission.

March 19th—The pulsating swelling about the ear increasing, digital compression of the left common carotid resolved upon, and its application zealously undertaken and most accurately carried out by clinical students, Messrs. Butt, Creswell, Dennis, Dumbleton, Follows, Gascoigne, Godson, Hall, Johnston, Palmer, Perceval, Rhodes, and Tomkinson.

With the digital compression, pulsation and bruit in the traumatic aneurism very perceptibly lessened, with consolidation of the tumour, but the improvement was not persistent; digital pressure became unbearable, and slight bleedings recurred. I happened to be in the Hospital at 4.0 p.m. March 23rd (16th day), when bright blood spurted out of the ear with considerable force. I ligatured the common carotid artery at once. The aneurism became empty and silent, the hæmorrhage definitely ceased, and the patient quickly regaining perfect consciousness, asked for his wife and child. Four hours later he was delirious. Eight hours and a half after the operation the right side

became paralysed, and death occurred at noon on March 24th. (*)

The post-mortem examination showed the catgut ligature firmly embracing the left common carotid, just below the omo-hyoid ; in opening the artery, the inner coat was cleanly divided, and a firm adherent clot plugged the proximal extremity ; the distal side of the vessel was quite empty. The wound in the ear perforated the membrana tympani, and an irregular cavity, between and about the pterygoid muscles, was filled with semi-purulent decomposing clot. On removing the calvaria, the branches of the left middle meningeal vessels were quite empty, showing a marked contrast to their distended condition on the opposite side ; the dura mater and brain healthy. The internal carotid in the skull and petrous bone was laid bare, and found free from injury. The external carotid and its branches having been previously dissected, and found sound, the middle meningeal artery was traced from the internal maxillary through the foramen spinosum, and outwards, along the base of the skull, for about a quarter of an inch, where it was found to be torn, in consequence of the splintering of the thin lamina of bone at the junction of the squamous and petrous portion of the temporal. From the under surface of this part of the skull, an irregular sloughing canal passed down to a false aneurismal sac, between the pterygoid muscles, along which the blood, prevented from separating the dura mater by the close adhesion of that membrane in the base of the skull, had passed from the injured middle meningeal artery. All the other branches of the external carotid were healthy and free from injury.

* This abstract is from full clinical notes taken by our then house surgeon, Mr. F. G. Hamilton, whose ability and judgment were of the utmost value in the management of the case. For the notes of the autopsy, I am indebted to my friend and colleague Mr. William Thomas, then pathologist at the hospital.

A stab into the ear, followed by profuse hæmorrhage, would, under any circumstances, be attended with danger. Pressure, ice, and perfect rest, were the first means employed to arrest bleeding, and, for some days, with success. When the hæmorrhage recurred, and a pulsating tumour gradually developed in front and below the wounded ear, the question of further interference was increased in difficulty by the reflection that, the wound having been inflicted while the constable was in discharge of duty, a charge of wilful murder was impending, and two lives were involved in the issue. It was obviously impossible to say with precision what artery was wounded, and the position of the injury precluded resort to the practice of cutting down in search of the wounded vessel, and tying it *in situ*. The recurring hæmorrhage was slight in amount; pressure on the common carotid instantly checked it, and at the same time arrested the pulsation and bruit in the aneurism. Experience is steadily accumulating in favour of the treatment of aneurism by digital compression—a plan which in itself is singularly harmless. Ligature of the common carotid is attended with its own special risks. These considerations decided us in giving digital compression a thorough trial—a decision in which I was sustained by my colleagues in consultation. An appeal was no sooner made to our students for volunteers to practise digital compression, than a number came forward, and it is difficult to do justice to the gentle, faithful, and skilful care with which these gentlemen, over a period of seventy-two hours, remained at their post. For a time their endeavours promised the best results; the swelling grew solid, the pulsation and blood-murmur very perceptibly decreased; but, eventually, bright scarlet blood flowed again from the ear, and, to check it, it was necessary to exercise increasing pressure, which the patient was less able to bear.

Death from hæmorrhage now being imminent and certain, I resolved to tie the common carotid as the only means of prolonging life. Dr. Sawyer administered chloroform, and Mr. West and Mr. Wilders assisted me (*) while I cut down upon the common carotid, and secured it with a catgut ligature just below the omo-hyoid. For the immediate object for which it was performed—the arrest of hæmorrhage, which threatened instant death,—the operation was successful, although the supervention of hemiplegia and pulmonary congestion proved fatal in twenty hours.

The extraordinary nature of the wound in this case makes the recurrence of a parallel one highly improbable, and therefore the question of treatment is not likely to present itself under identical circumstances; yet principles were involved which underlie very important surgical questions and deserve careful study. The bleeding from the ear was completely controlled by ice and pressure, for a period of nine days. When hæmorrhage recurred, and a pulsating swelling was noticed below the left ear, the prominent question was, which vessel was wounded? It was impossible to say from the facts before us; and, with the information revealed *post mortem*, we now see how hopeless was the solution of the mystery. The rule of treatment in traumatic aneurism, to cut down, find the bleeding point, and tie above and below, was barred by the consideration, sustained by the autopsy, that the blood had descended into the neck, from the same wound within the head whence the blood spurted through the ear. Digital pressure was persisted in, so long as it could be borne, and controlled the hæmorrhage with increasing consolidation of the aneurism. So soon as the pressure became intolerable,

(*) My colleague, Mr. Furneaux Jordan, who had previously given me the full benefit of his opinion, was unavoidably absent at the moment of operation.

and the blood gushed out again, the only alternative was ligature of the common carotid. The case illustrates, forcibly, some of the difficulties which present themselves in surgical practice, and particularly in the treatment of hæmorrhage from an unknown source.

It is from no desire to lessen my own responsibility that I repeat, that I took counsel with my colleagues at every step, and that our consensus was throughout complete. The man who inflicted the wound was executed, as it was morally certain he would be, if the policeman died. The law is clear on the point, that if a man, wounded by another, dies in consequence of an operation which has been rendered necessary by the wound or its results, the aggressor is responsible for the death; provided always that the operation be performed with due skill and diligence. Most operating surgeons have been placed in similar positions of grave responsibility. Whenever that is your lot, give the patient first, then the supposed criminal, and lastly yourselves, the benefit of consultations with colleagues; for it cannot be doubted, that any two men whose lives depended upon one issue, would prefer that more than one man should try it. Courts of appeal for the trial of legal difficulties are always composed of more than one judge. It is the high, and very responsible privilege of members of our profession to be practically unfettered, in the treatment of patients who entrust their lives to our care. Yet prudence and experience teach, that it is humane and wise not to rely unduly on individual judgment, in the presence of exceptional difficulties involving life, but to seek the enlightenment and correction of others.

LECTURE III.

Sprains anatomically and therapeutically related to wounds, dislocations, and fractures. Treatment by leeches and fomentations, cold, movement, and friction, immobility and compression.

In our endeavour to illustrate the natural history and treatment of wounds and fractures, as solutions of continuity of soft and hard parts, the transition from simple to complicated cases, and a clear understanding of governing principles of pathology and therapeutics, may be assisted by the clinical study of sprains. Anatomically, sprains are a link between wounds, dislocations, and fractures, partaking of the character of each and all these injuries; therapeutically, they are amenable to the same principles and methods.

Though the skin, in a case of severe sprain, may be unbroken, it is often severely bruised, as are the soft parts beneath. The ligaments may be torn from their insertions, with bony spiculæ adherent to them, tendons dislocated or ruptured, varices and thromboses initiated by laceration or distention of vessels, and blood poured into a joint, to find its way into tendinous sheaths and inter-muscular septa. As the result of such extensive violence, swelling is rapid and pain intense; and recovery, in extreme cases, may be so slow as to justify the statement of John Hunter, "that the effects of a strain may continue "through life, (above fifty years,) always swelling, and "becoming painful on the least violence." (*)

(*) The works of John Hunter, edited by James F. Palmer. London: Longmans, 1837. Vol. I, p. 518.

Baudens has placed it on record (*) that of 78 amputations of feet or legs, sixty had been rendered necessary by alterations consecutive to sprains treated with poultices. Surgeons generally agree that those injuries are the most fruitful cause of articular disease. It is noteworthy that the joints which are least liable to dislocation are most prone to severe sprain ; to wit, the wrist, hip, knee, and ankle ; and these are precisely the joints which are also most frequently the seat of pathological change. The vertebral articulations are other illustrations in point.

The rapidity and completeness with which the effects of sprains disappear, depend in very great measure on the treatment employed. Its leading indication is to restore parts to their natural position, check the subcutaneous hæmorrhage, which is the cause of the rapid swelling, and promote the absorption of the blood already poured out, as soon as possible.

It is by coagulation and organization, that extravasated blood and lymph mat together the parts around a sprained joint, and seriously fetter its movements. Packing a sprained joint with ice, or pouring on it a constant stream of cold water, in the first stage of a sprain, is good practice. The cold constricts and numbs, checks hæmorrhage, and allays nerve irritation, while the weight of ice acts as an additional preventive of motion, and a stimulant to absorption. So do applications of collodion, which at first produces intense cold and vascular constriction, and then exercises uniform compression by its equable contraction. Shampooing or massage may replace dislocated tendons, and is opposed to blood stasis ; it also stimulates absorption in proportion to the activity which it imparts to the local circulation. Ribes, (†)

(*) Memoir on Sprains, read at the Academy of Sciences, the 14th May, 1852 ; quoted in Bonnet, Traité de Thérapeutique des Maladies Articulaires. Paris : 1853 ; p. 77.

(†) Mémoires et Observations d'Anatomie, de Physiologie, de Pathologie et de Chirurgie par le Docteur F. Ribes. Paris, 1841. Vol. II, p. 492- .

who was one of the most scientific surgeons of his time, quotes the popular practice of flexing and extending sprained joints, and states that he always adopted it when first called to a sprain. At the same time he exercised pressure with both hands around the joint, and, as a result, he repeatedly noted a diminution of pain and swelling. He subsequently kept the joint immersed in cold water for six or eight hours, and, in extreme cases, followed this up with bandage. Billroth (*) is another eminent advocate of massage in the first few hours after a sprain.

CASE XIX.—*Fall from a bicycle.—Sprains of nearly all the joints of the upper limbs.—Great relief after free movements under ether.*

A youth, in falling from his bicycle, so severely sprained the joints of the upper limbs, as to be unable to use them in any direction without great pain, which prevented thorough examination. For diagnostic purposes ether was administered. In the absence of fracture or dislocation, I freely moved in every direction the shoulders, elbows, and wrists, which the patient could use without pain on regaining consciousness, only excepting the left elbow, which was somewhat stiff for about a week.

The various spirituous and saline lotions in repute for sprains, probably only act in virtue of the cold they produce; and I very much doubt if arnica have any exceptional power, while it is liable to produce much irritation if applied too concentrated.

Some surgeons, on the contrary, pin their faith in sprain treatment to immersions in, or applications of, water as hot as it can be borne. The practice of applying leeches, when the sprained joint is much swollen, is only attended with

(*) Die allgemeine chirugissche Pathologie und Therapie von D. Theodor Billroth, achte auflage. Berlin : 1876 ; p. 257.

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. Not only is their action comparatively fruitless in reducing the bloody swelling, but their bites 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, keep up accurate and gentle compression. 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 which guided the treatment in the cases for present comment.

CASE XX.—*Supposed sprain of knee. Discovery of oblique fracture of femur the fourth day. Great inflammatory swelling. Application of pasteboard 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. The gentleman who first saw the patient considered that he was suffering from a 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; with a great deal of swelling, 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 the left.

Circumference over the middle of the patella,—

Right side, $14\frac{1}{2}$ inches; Left, $12\frac{3}{4}$ inches.

Circumference, $4\frac{1}{2}$ inches above patella,—

Right side, $15\frac{3}{4}$ inches; Left, 14 inches.

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

I effected reduction immediately, and immobilized with the millboard apparatus.

16th June.—Perfectly easy since last report. The pasteboard case is now loose on front of thigh;—opened, edges pared, and re-adjusted. Skin cool, swelling almost completely subsided.

27th June.—Apparatus re-opened,—re-adjusted and finally fixed. Patient 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. 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; no prudent effort should be spared to ensure its accuracy, for an error may entail consequences, scarcely less painful to the surgeon than to the patient.

An accurate diagnosis may only be possible after subsidence of swelling. A severe sprain may be complicated

with partial dislocation of a joint, or with fracture of one of the bones entering into its composition; and the cases are not rare in which, after injury to a joint and the neighbouring structures, rapid extravasation takes place to such an extent, pain is so intense and so ill borne, that attempts to determine the precise anatomical state are out of the question. Then give the patient, and take yourself, the benefit of the doubt. Treat the case as one of fracture. Do not wait for natural subsidence of the swelling: left alone it will increase in extent and density; whereas its disappearance under immobility, pressure, and physiological position, may be relied upon.

CASE XXI.—*Extensive injury to the left shoulder; great swelling; intense pain; precise diagnosis impossible. Immobilization and compression.—Rapid and complete recovery.*

I was summoned into the country, in consultation on a surgeon, past middle age, who had been thrown violently out of his phæton against a wall. He was a stout man. The left shoulder was immensely enlarged; the swelling extending over the back and chest, and to the root of the neck. Naturally irritable, he now could not bear to be touched. An anæsthetic was useless for diagnostic purposes, because no movement, even though painless, could be practised without fear of adding to subcutaneous mischief. I thickly padded the chest, back, and arm with layers of gauze and cotton wool, and applied a compressing bandage, over interlacing strips of moistened dextrined millboard, fixing the elbow to the side, with the palm of the hand against the chest. Opium administered.

Next morning the swelling had so much subsided, that the apparatus was comparatively loose. I re-bandaged with firmer pressure, and returned home, leaving our patient in

comfort. Our colleagues in attendance did not disturb the parts for some weeks. Swelling had then vanished, and the shoulder was comparatively stiff, but, with exercise, its use was completely regained. That case recovered undiagnosed; a result which I very much prefer to a less fortunate issue and a correct diagnosis. It was possible that my friend had suffered a fracture of the clavicle, of the anatomical neck of the humerus, or of the ribs; or the joints might be simply sprained, and the soft parts bruised. The treatment was good for all those conditions; and no better could have been done, had we possessed exact evidence of the lesion; while we ran the risk of doing a great deal of harm, in the endeavour to define it.

I am about to read you an abstract of notes of a case of very rare interest, because the same person presented severe sprain and fracture of corresponding limbs, and illustrated the comparative value of different methods of treatment.

CASE XXII.—*Severe sprain of left foot. Fracture of right os calcis.—Great swelling of both feet.—Comparative experiment of effects of compression and evaporating lotion.*

Ellen McGauley, admitted Nov. 26th, 1860, just after falling 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 normal, and sensation unimpaired. Still complains of great pain in lower lumbar region. On manipu-

lation I find distinct fracture across the middle of the right os calcis, without displacement. Applied pasteboard apparatus immediately, as far as the knee. No fracture in the swollen and severely sprained left foot, to which the application of evaporating lotion 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 (fractured side) is now perfect, whereas the swelling of the left one (sprained) is undiminished.

6th December.—Right foot quite easy; apparatus refitted to the shrunken member. The swelling of the left foot 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 sprained foot diminished.

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. An evaporating lotion was continuously applied to the left foot, whereas I immobilized and compressed the right one. The result was unmistakable; the application of pressure was attended with rapid relief of pain and subsidence of 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, though only sprained. 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.

CASE XXIII.—*Severe bruising and sprain of ankle. Hot fomentations; increase of pain and swelling.—Immobilization and compression attended with immediate relief.*

This patient, J. M———, a builder's foreman, came in to consult me from the country, the 20th of December. The day previously, while working on a scaffold, he was knocked down by a falling mass of brickwork, severely bruising the right ankle. The boot was removed with difficulty, and the joint was at once found to be a great deal swollen, and excessively painful on the slightest movement. He was removed home, and hot fomentations applied all through the night. The pain became more intense, and the swelling increased; sleep was impossible. When I saw the case, about twenty hours after the accident, the swelling of the lower part of the leg was so great that it was impossible to say if there were any fracture. Measurement round the point of the heel and ankle proved the injured side to be two inches more in circumference than the sound one. I covered the foot and lower half of the leg with cotton wool. On each side of the ankle I placed strips of moistened millboard, as represented in the annexed figure. This diagonal arrangement, on the principle of a carpenter's brace, gives great strength, and is applicable to any of the large joints, with trifling modifications of detail. As one strip is laid on, the compressing spiral bandage passes round two or three times, and moulds it into position; then another strip and more spiral bandage; so that when the application is complete, we have a kind of millboard and

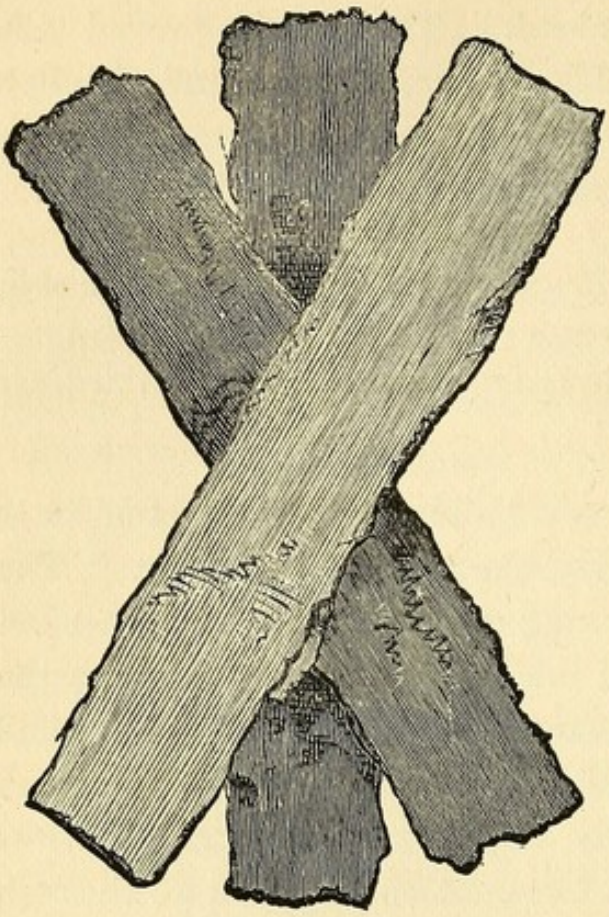


Fig. V.

bandage lattice-work, which cannot slip, and, with the subjacent cotton wool, makes a very firm and elastic mould. After adding two outside strips of dry paste-board, the man was removed, in comparative comfort, into the vehicle which had brought him in great pain. On returning home, he stated that he was soon easy and fell asleep. I did not touch the limb until the fourth day, when the looseness of the bandages denoted the great subsidence of swelling. On removing the apparatus, deeply mottled bruising, quite purple at the back, extended from the roots of the toes up nearly to the knee. The outline of the ankle was now quite distinct, and there was scarcely any pain. I again covered with cotton-wool, and firmly re-bandaged the splints which had just previously been re-moistened, so as to ensure their accurate fit under the moulding pressure. At the expiration of a week I moved the joint, and the man was able to inspect building operations; he has suffered nothing since.

Great as the importance is of rest in the early treatment of sprains, it must not be carried too far. To quote John Hunter, (*) "Sprains often remain very painful after the "original symptoms have been removed; this pain is often "removed by giving the part motion." Motion is the

(*) Op cit. Vol. 1, p. 518.

healthy function of joints, and if too long denied them, a pathological state is the result.(*) As soon as the swelling and acute pain of a sprained joint have well begun to subside, some movement should be commenced,—gradually at first, and then steadily increased. Alternate hot and cold douching, followed by friction, is of the greatest service in restoring natural function, by making the joints supple, and strengthening the muscles. The use of an oleaginous substance prevents the skin being irritated by friction, and that is the probable value of the popular lubricant—neat's foot oil; glycerine answers the same purpose, and so does oil of sweet almonds, to either of which a few drops of oil of cinnamon may be added, with increased probability of the friction injunctions being obeyed. The application should not be used lightly with the tips of the fingers, but with the palms of the hands, and decided pressure.

If the joint continue stiff, it may be necessary to employ very considerable force to break down adhesions, which can often be heard to crack very distinctly. A stiff joint so manipulated frequently regains healthy movement with remarkable rapidity. But it is important to pay attention to the sequences of long disablement of a joint. They often acquire so much importance, that if attention be concentrated exclusively on the joint originally injured, comparative failure will be the result. When months after a severe sprain of the wrist, the injured joint is stiff and painful, the fingers, elbow, and shoulder joints are also rigid from disuse. As the result of the same cause, the whole muscular system of the limb, including the shoulder, may be wasted. Under such circumstances all the joints of the extremity require forcible flexion and extension, and the general nutrition needs stimulation, by douching and friction.

(*) Lectures on Orthopedic Surgery and Diseases of the Joints, by Lewis A. Sayre. London : Churchill ; p. 12.

The nervous and nutritive excitation of electricity may, in extreme cases, be resorted to with great benefit.

How much force to apply, in cracking a stiffened joint, is a point which only experience can teach; but it is most remarkable how much is sometimes required, and may be used with perfect safety, especially if tenotomy be previously resorted to, as it should be when tendinous contraction is very marked.

CASE XXIV.—*Forcible extension of stiff knee after tenotomy. Immobility in plaster of Paris. Perfect recovery.*

In consultation with Mr. E. P. Turner, I was requested to visit a delicate youth, aged 15, whose left knee had been immovable for many months after injury. The leg was at a right angle with the thigh, and the head of the tibia slightly displaced backwards. The joint could not be moved in any direction. Two days afterwards, while the patient was under ether, I attempted forcible extension, with the only effect, at first, of making very tight all the tendinous structures about the joint. With a tenotome I successively divided all the hamstrings, including the ilio-tibial band, and, with the assistance of Mr. Turner, and my then dresser, Mr. Cocks Johnston, straightened the limb. To judge from the force employed, and from the successive loud cracks, the adhesions must have been in some part bony. The joint was wrapped in cotton-wool, and a plaster of Paris case applied. I did not interfere until the tenth day, when we found the wounds all healed, and the straightened knee cool and painless.

This plan of treatment, with the occasional addition of section of the rectus femoris, is one which I have repeatedly adopted in similar cases, since I first saw it practised at

Naples, in 1852, by my distinguished friend Senator Professor Palasciano.(*)

The term *passive* motion, as applied to stiff joints, is very misleading. It very often needs to be powerfully active; but it must always be steady, and not by jerks. In determining when it is safe to extend forcibly a stiff joint, bear in mind the rule laid down by Sir James Paget, for the treatment of old sprains. "Take the temperature of the part for your guidance. If the part be always over-warm, keep it quiet; if it be generally cold, or cool, it needs, and will bear, exercise. (§)

CASE XXV.—*Injury to left shoulder. Loss of power after protracted immobility. Forcible extension and rotation. Complete recovery.*

An Ayrshire farmer, of very powerful build, consulted me for loss of power of his left arm. He could not move the elbow more than two inches from the side, and informed me that four months previously he had broken the left collar bone, and severely sprained the corresponding shoulder. Absolute rest had been enjoined until within the last few weeks; when, permission having been given him to move the limb, he discovered that he could not do so, as the shoulder was "set."

The patient having uncovered the upper part of his body, I directed him to sit down, so that I might have more purchase in raising the arm from the side; I then grasped it with my two

(*) *Memorie ed Osservazioni di Chirurgia pratica sulle Anchilosi* del Dr. F. Palasciano. Un volume con dieci figure incise in rame. Napoli, Stabilimento Tipografico di G. Gioja. See also Rapporto sul Metodo di Cura delle Anchilosi del Ginocchio del Dottor Palasciano fatto da una Commissione dell' Accademia Medico-Chirurgica di Napoli. *Rendiconto dell' Accademia*, tom v. Febbrajo, 1851.

Lewis A. Sayre, op cit, p. 404.

(§) Clinical Lectures and Essays, by Sir James Paget. Second edition London: 1878. Page 97.

hands, just above the elbow, while I fixed the scapula by placing my bent knee on the top of the shoulder. By gradual, but considerable force, the adhesions were audibly cracked, as the arm was moved in every direction. After a short rest, the patient was able to dress himself, and put on a heavy great coat unaided, a task which he had been unable to accomplish since his accident.

The case is only a type of many I have met with in hospital and private practice, and I have invariably found the treatment of the chronic *cold* cases most satisfactory.

In the frequent cases of sprained joints, especially of the knee, which occur at football, there is great risk of the same joint being repeatedly injured; not a matter of unfortunate coincidence as some persons imagine, but the natural result of the joint once enfeebled by injury, being the one most likely to give way in a struggle. Under such circumstances there is no alternative but to interdict the game; and strengthen the joint and muscles by douching, friction, and moderate exercise. When some support to the joint is necessary, a Churton's bandage, spirally applied, or an india-rubber bandage, is very preferable to a knee-cap; because capable of being reapplied smoothly and accurately, with just the degree of support that is needed and comfortable from time to time.

Sprains of the vertebral column are a most important class of injury. In their treatment rest is the sheet-anchor in the early stages; friction, douching, and electricity in the later ones. In no painful cases is relief by immobility more rapid and decided than after sprains of the back. After well padding it, intersecting strips of millboard, or a plaster of Paris case, can be so applied as almost absolutely to immobilize the trunk. In minor cases of spinal and joint injury, sufficient support can be given by adhesive plaster, as originally recommended by Baynton,(*) and more recently

(*) Descriptive account of a new method of Treating old Ulcers of the Legs, by Thomas Baynton, surgeon, of Bristol. The second edition. Bristol: 1799, p. 46.

by Peter Hood.(*) Paraffine bandages first introduced by Lawson Tait, and much used by Macewen, are elegant and effective applications for a sprained wrist, or for strains of the fore-arm muscles, not very unfrequent in young persons playing tennis. India-rubber bandages are also very useful for the same purpose. Writing on sprains, in 1846, Liston (†) recommended, after the subsidence of swelling, "gentle friction, and the support of an elastic bandage (those of caoutchouc answer admirably) applied over a thin stocking." Dr. Martin, of Boston, U.S.A., has given a great and beneficial impetus to the practice of compression, by his india-rubber bandages.

Although it is only to chronic and cold sprains that I am disposed to recommend forcible movement, experience has satisfied me that compression acts with equal advantage, when the products of extravasation after sprains have undergone change through inflammatory action.

CASE XXVI.—*Severe ankle sprain. Inflammation of joint. Proposed incision. Rapid improvement after immobilization and compression.*

Here are the notes of a case in point, in which I was consulted by my colleague, Mr. John Clay. His patient, an elderly gentleman, recently sprained his right ankle in going over a ploughed field. As he had a policy in one of the accidental insurance companies, its medical officer saw the case; he advised an incision, for the purpose of giving vent to matter which he thought had formed in the centre of the swelling. In this advice he was sustained by a hospital surgeon of great experience, who was additionally called in

(*) On the Treatment of Sprained Ankle, by P. Hood, surgeon. London: Churchill, 1858.

(†) Practical Surgery. Fourth edition; p. 109.

on behalf of the company. Mr. Clay, dissenting, invited my attendance. I found the right ankle hot, and exquisitely painful. It was so much swollen, that its circumference over the heel exceeded that of the corresponding sound joint, by nearly an inch and a half. The skin on the outer side of the ankle was especially hot, red, tense, and shining; palpation in this situation communicated a feeling of elasticity closely simulating, but not amounting to, fluctuation. With Mr. Clay's concurrence and assistance, I enveloped the limb from the toes to the knee in fine cotton-wool, applied well-moulded pasteboard splints on each side, and bandaged with methodically uniform compression. A second consultation was held in the course of three days, when I found the patient very much easier. He had had good nights' rest, had been able to turn over in bed, and could bear the limb lifted and put down again without pain. On opening the apparatus in front, I found the swelling had considerably decreased; the previously red skin was yellowish and shrivelled, like the skin of a late russet apple; not looking, as at my first visit, like the red shining skin of a prime Blenheim. That shrivelled look is always a good sign, because a sure indication of lessened irritation and swelling, and of progressive interstitial consolidation and repair. I re-adjusted the apparatus with firmer pressure.

Three days later more shrinking was met by fresh paring of the edges of the apparatus, and still firmer bandaging. At a consultation held a fortnight after the first, the patient was perfectly easy. No one thought any more about puncturing in search of matter. The insurance company compromise by paying down a substantial sum of money. I substituted for the pasteboard apparatus, strapping the joint with emplastrum elemi spread on leather; a Churton's bandage being applied over it with smooth firmness. When I last saw the patient with Mr. Clay, he

was walking about his garden with a stick; the plaster had been very properly removed, and the swelling had subsided, the only difficulty to locomotion being stiffness of the joint. I cracked the adhesions by using the requisite amount of well-applied force, and we concurred in advising free use of the joint. In a note which I received from my colleague seven weeks after our first consultation, he wrote: "Our patient is progressing very satisfactorily; he comes to business every day, walks about a good deal, and does not require surgical supervision."

In considering the relative value of the therapeutic agencies in this case, full weight must be given to the perfect rest in which the joint was placed; but experience proves that rest, without methodical compression, would have been only imperfectly and slowly successful, in allaying the inflammatory action, and removing its products. Besides acting as the most powerful promoter of absorption, smooth circular compression ensures repose, by preventing muscular spasm, which, once excited, is an active cause of constitutional disturbance, and often the first link in a series of local troubles—disturbed union, hæmorrhage, nervous irritation, suppuration and its sequels.

Confirmatory therapeutic evidence is supplied by

CASE XXVII.—*Bruise of leg. Cooling lotions. Increasing swelling. Poultices. Proposed incision. Rapid recovery under elastic compression and suspension.*

Only the other day I was asked to see this case in consultation. A gentleman had bruised the front of his leg against the step of his carriage. The part injured was not the shin, as is usual, but the muscles outside it. Cooling lotions had been applied for two or three days: but, swelling and heat increasing, poultices were substituted, and an incision for the evacuation of matter was contemplated,

when I was called in. I found the part much swollen, red and tender, and have no doubt that an opening would have given exit to pus. But the patient being very averse to the knife, I consented to endeavour to avert it, while stating clearly that the surgeon was justified in recommending it. With his assistance I raised the limb vertically, padded it, and bandaged it, over interlacing strips of wet dextrined millboard from the toes to the knee. The patient was ordered to remain in bed with his leg in a swing, which in all similar cases gives great relief. In a few hours, the bandaging and millboard lattice-work were comparatively loose. Every twelve hours an outside bandage wa applied with equable pressure, until at the end of forty-eight hours the limb was exposed; we then found it pale, cool, shrunken, and painless.

The treatment by rest, position, and pressure, was only adopted tentatively. It proved successful, but it might have failed. Had it done so, nothing would have been lost, and the knife resorted to. Under analogous circumstances, the issue of the physiological treatment is determined almost immediately. The first test is pain, which is absent or steadily decreasing when rest, position, and pressure are winning. With decrease of pain tension diminishes, and compressive apparatus relaxes. Then re-bandage from time to time, so as to keep up the equable pressure on the shrinking limb. In due time expose it, and you will find it, as in our case, pale, cool, shrunken, and painless, and ready for commencing movement.

When the local issue is less favourable, the constitution presents consequential effects, and the sprained joint inflaming influences any prevailing diathesis, be it rheumatic, gouty, or scrofulous. Constitutional and local treatment must then go hand in hand. The title to John Abernethy's classical monograph, "Surgical Observations

on the Constitutional Origin and Treatment of Local Diseases," (*) embodied a great truth ; but it is no less to be borne in mind, as John Scott (†) demonstrated, that the reverse of Abernethy's proposition is also true,—that local diseases are potent causes of constitutional derangements. Everyday surgical practice proves the intimate relation of articular diseases and constitutional states, and as the origin of the former is largely traumatic, the cure of sprains becomes of the utmost constitutional importance.

(*) Seventh Ed. : London, 1824.

(†) "Surgical Observations on the Treatment of Chronic Inflammation . . . and Diseases of the Joints." London, 1828.

LECTURE IV.

The essentials of treatment in fractures of the limbs.—Care and difficulty in diagnosis.—Immediate reduction and immobilization.—Physiological repair of fractures.—Physico-vital causes of displacement.

GENTLEMEN,

Their close analogies conceded, fractures differ from wounds in that the latter, being visible, rarely present diagnostic difficulties, which are frequent and important in the former. In the majority of cases preternatural mobility, loss of power, pain, and grating leave no doubt that a bone is broken; in others, the diagnosis is one of extreme difficulty, *e.g.*, after injury to the shoulder or hip in a stout person, especially if the patient be the subject of chronic articular rheumatism or gout.

In case of doubt, be slow in pronouncing a negative; and give an anæsthetic as a preliminary to thorough examination. In circumstances of unusual difficulty, seek the benefit of another opinion, in the patient's interest and in your own. In the popular estimation, nothing is easier than to determine if a bone be broken or not. Great blame may attach to an error, which more than ordinary skill and experience may, sometimes, be powerless to avoid. When it falls to your lot to be called in to decide a doubtful diagnosis of fracture, be very considerate of the difficulties of others, and not over-confident of your own opinion.

Do not rest satisfied with examining the injured limb, but compare closely corresponding anatomical points on both sides of the body. Measurements should always be

taken most accurately and from various points; in the lower limb, for instance, it is not enough, in doubtful cases, to measure from the antero-superior spine of the ilium to the lower end of the inner malleolus; the distance from the former point to the upper edge of the great trochanter, to the upper border of the patella, and to the lower edge of the outer malleolus, should also be accurately noted. Though length measurements are the most generally important, those of circumference often afford material diagnostic aid. The comparative muscular condition of corresponding limbs is a material point for observation. A leg or arm wasted from previous injury or disease, may measure considerably less than its sound fellow, without fracture. The crackling of bursæ and tendinous sheaths which have suffered from old inflammation, is sometimes almost indistinguishable from bone grating under muscular masses, particularly at the shoulder and hip joints; and the muscles may lose all power after a blow, though it leave the bony framework of the limb intact.

Pain, especially when accurately localized, is a diagnostic of great value in the majority of cases, but most deceptive in others. I have found fracture of the humerus in a man who suffered no pain whatever, and was very much surprised when told that his arm was broken. On the other hand pain, after mere bruising is often intense.

Be careful of committing yourselves. In treatment err, if at all, on the side of safety, by adopting extreme precautions; and reserve your opinion, in doubtful cases, until the development of symptoms increases the probabilities of a correct diagnosis. The rule is a good one, that dislocations are characterized by preternatural fixity, and fractures by excessive mobility, under manipulation; but I have known very experienced surgeons differ on a diagnosis between dislocation and fracture,—conditions which not very

unfrequently co-exist. Given an ordinary case of fracture of a long bone, scarcely any question in surgical practice presents less diagnostic difficulty. Nothing, on the other hand, is more difficult to determine, than the nature and extent of injury which a bone may have sustained, and the diagnosis is sometimes impossible. (*)

Once it has been determined that a bone is broken, "it is demonstratively true that it cannot be too soon put to rights." (†) This principle of immediate reduction was re-affirmed and developed by Robert Liston in such apt words, that I make no apology for commending them to your recollection, as an authoritative statement of sound surgery, worthy of constant adoption in practice.

"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.

(*) "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 practise 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 vigilance and attention ; in a word none which requires a higher combination of surgical tact and power." A System of Surgery, by Samuel D. Gross. Philadelphia: 1859. Vol. II, p. 97.

(†) Pott's Chirurgical Works. Ed. 1783. Vol. I., p. 394.

(§) Liston ; Elements of Surgery. 2nd Edit. 1840. P. 687.

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 favourable 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." (*)

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.

In illustration let us examine a case of fractured arm bone.

CASE XXVIII.—*Transverse fracture of the humerus, without displacement.—Immobilized immediately in a pasteboard apparatus.—Recovery without pain or thickening.*

A. M., aged fifty, falling from some housemaids' steps on to her right side, complained of great pain in the corresponding arm, and of inability to move it. I saw the case within half an hour. The skin was uninjured, but on grasping the upper and lower parts of the arm, preternatural mobility and grating were very perceptible in the middle of the humerus,—it was broken directly across. No displacement, no shortening.

After surrounding the whole limb with cotton-wool pads, I immobilized with softened millboard splints and evenly-compressing bandage, from the tips of the fingers to the

(*) Practical Surgery. 4th Edit. London, 1846. P. 62.

shoulder; the hand in a semi-prone position; the elbow at a right angle, and efficiently supported in an arm sling.

The patient suffered no pain, and the arm was only looked at twice, when it was found to be in perfect condition. Union of the fragments was so direct, that there was no thickening, and the seat of injury was almost imperceptible at the end of two months, when the patient had regained the perfect use of the limb.

Very different was the state of things with the patient whose history I am about to condense.

CASE XXIX.—*Fracture of the thigh bone.—Deferred reduction. — Imperfect co-aptation. — Over-lapping of fragments.—Two inches shortening.—Redundant callus and great swelling. Extended and immobilized the twenty-fourth day.—Perfect recovery without shortening.*

W. C., æt 21, a carpenter from the country, admitted into Ward I, under my care, with fracture of the right thigh bone at the junction of the lower and middle third. The bone had been broken three weeks and three days before admission. Parts of the limb had never been bandaged, and the short wooden splints, applied at first, had been removed about twelve times.

I found an immense amount of callus thrown out round the broken ends of the femur, which overlapped each other and were movable. The lower fragment was drawn up beyond, and to the outer side of, the upper. The limb was so much swollen, as to be nearly a quarter as large again as the other, and it was two inches shorter.

The patient was placed under chloroform; one assistant, grasping the foot with both hands, gradually extended, while another exerted traction, in the opposite direction, with a jack-towel in the fork. Manipulating the seat of injury with both hands, I succeeded in moulding the

fragments into good position, then padded with cotton wool, and immobilized the whole limb with millboard splints, from the toes to the iliac crest, and starched the outside of the compressing bandage. The limbs were left of equal length.

The apparatus was cut up in three days, when an inch required to be taken out before re-adjustment, to compensate for the great reduction in swelling. Its still further decrease required two other re-adjustments, within the next week. Altogether five and a half inches of the apparatus required to be cut out to fit the shrunken limb, which was then finally immobilized. At the end of two months the fragments were solidly united, much of the thickening round the ends of the bones had been absorbed, and the two lower limbs were of exactly the same length.

What was the cause of the redundant callus in this case? Why was there none in the preceding one? 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.

According to the doctrine of Duhamel (*) and Dupuytren, (†) which long dominated the schools, and is still extensively believed in, fractures are repaired by two successive calli, the *provisional*, and the *definitive* callus. The former *(the tumour of the callus)* is a kind of ferrule surrounding and binding together the broken ends; its formation occupies between thirty and

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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. Depuytren sur le cal avec des Observations à l'appui, par M. L. J. Sanson.—*Journal Universel des Sciences Médicales*, Vol. xx.

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 experimental fractures in brutes, which cannot be immobilized during the process of repair, was supported by the results of faulty practice in human surgery. It has been productive of incalculable mischief, by teaching the surgeons of successive generations to regard, and to aim at attaining, as a healthy condition, essential to the repair of every fracture, that which is exceptional and abnormal.

Modern researches (*) have demonstrated that fractures in man often unite by direct deposit between the broken surfaces; and that when *provisional callus* does occur, it is owing to extensive injury to the soft parts, at the time of the accident, or to subsequent irritation by the fragments, when not kept perfectly at rest. In fact, the treatment of a fracture is perfect, in proportion as the thickening at the seat of injury is slight.

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 truth so clearly, that he 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 false analogy, of the provisional and definitive callus in man and animals, eclipse Pott's sound interpretation of the process of bone-repair; just as the latter's ingenious, but defective, reasoning on the flexed

(*) *Vötsch* die Heilung der Knochenbrüche per primam intentionem. Mit 5 Taf. Heidelburg, 1857. *Stanley.*—A Treatise on Diseases of the Bones. London, 1849. *Paget.*—Lectures on Surgical Pathology, revised and edited by W. Turner. London, 1863. P. 179, et seq. Lectures on Surgery, by James Spence. Edinburgh: 1882. Vol. I, p. 144.

position, obscured the truth of his teaching on immediate reduction, and on the length of splints.

On the repair of fractures, and on the causes of redundant callus, Percivall Pott's writing is as sound now as on the day it was penned, more than a century ago. "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 co-aptated, and proper methods have been used to keep them constantly and steadily in such state of co-aptation, 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 co-aptation, when such exact co-aptation 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 co-aptation 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 co-aptation, 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. It is likewise 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 that principle is adhered to.

This is well illustrated by the two cases brought before you at the commencement of this lecture. In the fracture of the humerus, in which the fragments were not displaced, and were immediately immobilized in an accurately fitting mould, union was direct, without irritation, and without thickening. On the contrary, a large amount of ossific deposit, provisional callus so-called, was thrown out around the displaced fragments of the broken femur, which were not adjusted and immobilized until twenty four days after the injury.

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

Here are notes of two other cases of fracture, illustrating direct union of the fragments after immediate reduction and immobilization.

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

Mary Birch, æt. 9 years, admitted 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. Pasteboard 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 XXXI.—*Oblique Fracture of femur; half-inch shortening.—Immediate reduction and immobilization.—Bed left the fourth day.—Perfect recovery.*

Joseph Sable, æt. 7 years, admitted 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 pasteboard 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.

To give effect to the cardinal principles of immediate reduction, and of accurate and immovable co-aptation of the fragments of a broken bone, it is important that you should have a clear idea of the causes of displacement,—a matter which has formed the subject of no little controversy.

Let us for a few moments contemplate a case of simple fracture of the shaft of the femur, which, from its length and position, presents exceptional opportunities for diagnostic and therapeutic observation.

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 ends 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 the arm of a lever.

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 irritating 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, paralysis, and 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. The limb is naturally over-balanced to the outer side, and this want of equilibrium produces its natural consequence, a fall outwards, whenever the controlling influence, the action of the muscles, is suspended, or rendered inoperative.

It has been a very prevalent error, initiated by Pott, to attach too much importance in the study of this subject to *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. Apart from the displacing physical agency of the bony fragments themselves, it is an error to assume that it is possible so to place a limb as to render its muscles powerless; the position most propitious to the inactivity of one set being consistent with, and as a rule favourable 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.

Transverse fracture of the patella, in which the upper fragment is drawn up by the powerful extensors of the thigh, is one of the purest examples of displacement from vital causes; of the mechanical ones, no better proof can be given than the displacement in a fracture of the clavicle about its middle; in this case, conceding the action of the pectorals, and of the deltoid, in drawing forward the outer fragment, the great cause of displacement is the drop of the arm so soon as its tie-beam is broken through.

Of both causes of displacement, the vital and the mechanical, one of the best illustrations is supplied by oblique fracture of the lower end of the femur, with the pointed upper fragment almost touching the patella, and the lower fragment drawn upwards and backwards into the ham.

CASE XXXII.—*Oblique Fracture of femur just above condyles. Shortening to an inch and a half. Immediate reduction and immobilization by pasteboard 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 Hospital, London, the evening of the 27th December, 1852. He had fallen over a bench a

(*) 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.

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 antero-posterior displacement. Co-aptation could only be effected by pressing on the upper fragment while extension was being made. There was no swelling; no bruise of the skin.

Having just previously returned from Brussels, where I had had the advantage of following the clinique of Baron Seutin, I closely imitated his plan in applying the immovable apparatus, and left the patient with two perfectly matched lower limbs, and free from pain. In order to maintain co-aptation, a sand bag, about six pounds in weight, was placed on the part corresponding to the upper fragment. Thirty-six hours after admission, I made the lad get out of bed, and walk up and down the ward on crutches. He did so with perfect ease, the foot being supported in a sling, so as not to touch the ground.

30th December.—It became necessary last evening to open the apparatus, in the middle line, to just above the ankle, 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 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, 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.

This case affords an example of one of the most formidable of simple 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.

In further illustration here are the notes of a recent case.

CASE XXXIII.—*Oblique fracture of the femur, great shortening and spasm.—Effusion into the knee joint.—Immediate reduction under ether, and application of pasteboard apparatus.—Rapid recovery.*

Joseph Barlow, æt. 50, a bricklayer, fell from a plank a distance of seven feet, an oak beam weighing 12cwt. falling at the same time across his left thigh. The femur was broken four inches above the knee joint, which was distended with fluid. The lower end of the upper fragment prominent under the skin at the outer side of the limb, the lower fragment being carried backwards, upwards, and inwards. Foot everted. Three inches shortening. Very severe spasm,

Under ether, the fracture was readily reduced, and a firm pasteboard apparatus applied from the toes to the brim of the pelvis, so as to keep the accurately adjusted fragments, and all the joints, immovable. The man suffered no pain, and the apparatus was not opened until the eighth day, The knee was then shrivelled and pale, the fragments in perfect apposition. In re-bandaging, additional pasteboard splints were used to give greater strength, and the man continuing in perfect comfort was made an out-patient within the month.

To what agencies were these results attributable? What was the *rationale* of the 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 the 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 patients were 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 exo-skeleton.

Fitting the limb as the 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, if the muscles had been able to act with their usual power. But the muscles were indisposed to, if not incapacitated for, action, by the constrained extended position of the limb, and 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 have no difficulty in understanding how the apparatus prevented 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 tendency to displacement, though the patient walked about from the second day after the accident. The cause of the antero-posterior displacement was probably twofold, firstly, and chiefly, I think, it was due to the falling backwards of the knee and lower fragment, and, secondly, 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 to gravitation and muscular action, 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, either as physiologists or as 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 approximating the fragments. Under similar circumstances of oblique fracture either of the lower end of the femur or of the tibia, bearing in mind the natural anterior convexity of the bones, 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, especially in the upper third of the femur. Oblique fracture in this situation, with tilting outwards and forwards of the upper fragment, is, all in all, perhaps the most difficult fracture in the body to treat without some permanent displacement. Once the limb has been immobilized, a large square sand-bag over the upper part of the thigh, weighing between fifteen and twenty pounds, has a great effect in tiring out and relaxing the very powerful displacing muscles—the external rotators and the psoas and iliacus. The latter muscles may, in this form of accident, be advantageously relaxed by inclining the patient's body forward in bed.

If the flexed position on the side be justifiable in any case of fractured femur, it is in an oblique one just below the trochanters, with cocking up of the superior fragment. But then Pott's precept, as to splints, should not be, as it

often is, forgotten. In his words, "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." In fracture of the thigh-bone, Pott recommended the limb and body to be placed on the outside and flexed, with a very broad deal splint from above the trochanter to below the knee. On the whole, the extended position is the most manageable in all fractures of the femur; but if the flexed position be tried with a splint, I should prefer that such splint be accurately moulded, and for that purpose millboard, plaster of Paris, or poro-plastic felt would be better than wood.

There can be no question that properly constructed moulds, accurately fitting the limb, and fixing the joints above and below the seat of injury, are very preferable to wood and iron splints. Yet 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.

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. A skilful and careful workman may, in spite of bad tools and a defective plan, achieve better results than a clumsy artificer acting under the best instructions; 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.

Cline's, Liston's, and McIntyre's, splints with their numberless wood and iron modifications, are more clumsy for the surgeon to handle, and far less comfortable for the patient to bear, than a millboard or a plaster case. Yet,

with the former appliances, and with substantially good results, thousands of fractures have been, and will be treated. Only have a clear perception of the great principles of immediate reduction, immobility, and a minimum of subsequent interference, pad comfortably and bandage smoothly, and your fractures will do well.

The efficiency of any splint may be greatly enhanced by first moulding to the seat of injury a couple of well-padded millboard, leather, or poro-plastic strips. The plan of applying the long splint with a sheet round the limb, is preferable to, because less liable to move, than bandage; and most fractures, but especially those of the lower limb, are greatly benefited by suspension.

The necessity of maintaining active extension and counter-extension is a vexed question. Strictly, the answer must be in the affirmative in principle, but the manner of carrying it out admits of very wide difference.

A millboard or plaster of Paris casing applied to a lower limb, which has been reduced to proper length after shortening from fracture, maintains extension by its close fitting into depressions and eminences, and passively resisting retraction. On the other hand, when a fracture of the thigh is treated with the weight and pulley, this exerts a constant and active influence in antagonism to the power of the muscles.

Wasting from inactivity and compression, the limb encased in a mould may shorten an inch or more, if the close fit of the apparatus be not maintained by timely re-adjustment. I have known a surgeon deceived by the apparent equal lengths of the lower limbs at the heel, when he has not made allowance for the thickness of the apparatus, which, becoming slack, has allowed of considerable retraction and ugly deformity. That is a mischance which cannot happen with the weight and pulley, which, all

circumstances considered, is probably the easiest and safest method of treating fracture of the femur under average conditions. Children bear the weight and pulley exceedingly well, but in advanced age, especially with fracture of the neck of the femur, too long confinement to bed is irksome and dangerous. Under those circumstances the advantages of millboard or plaster of Paris are conspicuous.

In the very frequent cases of fracture of the lower end of the radius, and of Potts' fracture, the pistol-shaped splint and Dupuytren's splint respectively, give results not to be exceeded by any other plan ; but, if millboard splints be first fitted to the limb, the wooden contrivances for leverage may be dispensed with, so soon as the case is dry and accurately and definitely fitted.

In the treatment of fractures, as in a multitude of other matters in the practice of medicine and surgery, the problem 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 ? In answering these questions the secret of practical success lies in the selection and combination of means rightly applied to carry out sound principles according to the exigencies of particular cases.

But however sound principles may be, however judicious the discrimination and accurate the manner of their application, failures occasionally and inevitably occur. That is so with the union of fractures. To say nothing of the extreme rarity of bony union in intra-capsular fracture of the neck of the femur, of its great rarity in fracture of the patella, and of its infrequency in fracture of the olecranon, failure of bony union does occur in fractures in situations where anatomical reasons do not explain the fact.

It is beyond doubt that some persons are very prone to fractures, as others are to bleeding; and it is equally certain, that no amount of surgical care can be at all times equal to supplementing defective constitutional powers of repair and growth. None the less I incline to the opinion, that in the majority of cases non-union of fractures is due to the imperfection of the means employed to immobilize the fragments. This was the conclusion arrived at by the late Mr. Joseph Amesbury, who devoted special attention to the subject, enjoyed large practical opportunities for its study, and thus expressed himself:—

"I have examined fifty six cases of non-union, exclusively of those which I have witnessed in the neck of the thigh-bone, olecranon and patella. The constitutions of three of the persons in whom these cases occurred, were decidedly bad; another had been much reduced by cholera during the recent state of the fracture. The remaining fifty two, apparently, possessed constitutions and enjoyed health equal to the most vigorous and healthy individuals that come under our observation. ..... In these cases, with the exception of two which occurred during pregnancy, I think the cause was purely local; and, for the most part, if the treatment had been such as to secure the fractured parts in proper apposition, and in a state of quietude, the fracture would have united at an early period." (*)

CASE XXXIV.—*Un-united fracture of the femur of six months date. Proposed resection-union by immobilization.*

I was consulted in a case of un-united fracture of the thigh, in a young man 25 years of age, six months after he had sustained the injury.

(*) Observations on the Nature and Treatment of Fractures of the upper third of the Thigh-bone, and of Fractures of long standing, by Joseph Amesbury. 2nd. Ed. London, 1829. P. 202-3.

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 the thigh-bone became perfectly solid.

In the succeeding case immobility was thoroughly tried, but its failure compelled resort to operative procedure.

CASE XXXV.—*Humerus fractured unconsciously. Failure of union in immovable apparatus.—Consolidation after re-section of ends of fragments.*

On August 7th, 1879, I re-sected the ends of an un-united fracture at the right humerus of T. P.——, a moulder, aged twenty-eight. He was healthy in youth, but since he was twenty-two has suffered greatly from chronic rheumatism, and has lost three stones in weight. When he first attended at the hospital as an out-patient for rheumatism of the right shoulder, he was not aware that his arm was broken, which, from the history, it had evidently been for some time, without the man being able to give any account of the occurrence. The limb was very efficiently put up in immovable apparatus by my then house-surgeon and present colleague, Mr. Jordan Lloyd. As there was no prospect of

union after six weeks, I operated. The fracture was above the insertion of the deltoid, the upper fragment displaced outwards, the lower upwards and inwards. I made an incision of three inches on the outer side over the fracture, detached the periosteum with a raspatory, and with strong bone pliers cut off an inch from each extremity of the denuded bone. A large drainage tube was inserted into the lower angle of the wound, which was closed above with three silver sutures. Dressing with dry gauze and oakum pad, limb absolutely immobilized in a pasteboard apparatus, in the position shown in the annexed wood-cut. The man slept well, and next morning complained of hunger. Temperature 99·6°; pulse 108; respiration 30.

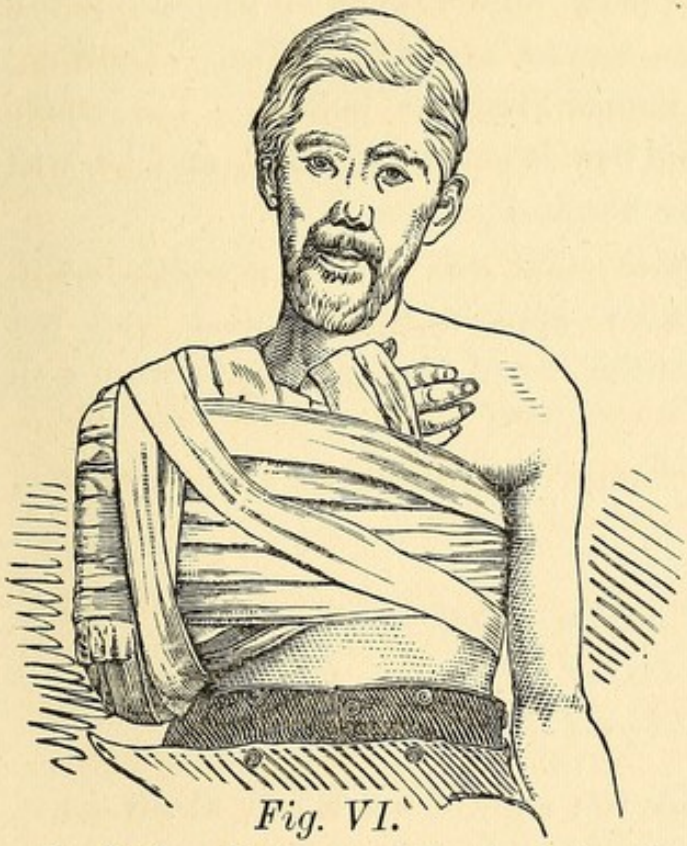


Fig. VI.

Aug. 12th (fifth day after operation)—Wound exposed by cutting through dressings, which were saturated with dirty, red, stinking discharge; the splints were mildewed. The outer end of the drainage-tube had inadvertently been left in the dressings, instead of being drawn through them to the outside. The wound was lightly wiped with pledgets of dry lint, and appeared solid, except at drainage-tube; surrounding skin pale; only a little redness at points of suture, all of which were removed; drainage-tube shortened one inch. Clean, dry oakum pads applied, with dry

pasteboard splints outside the old ones. The patient has had but little pain. Temperature 98°; pulse 112; respiration 28.

16th (second dressing).—As before. Temperature 98°; pulse 96; respiration 20. Patient to get up.

At the third dressing (Aug. 19th) the drainage tube was removed.

22nd (fifteenth day; fourth dressing).—On removal of the dressings there was scarcely any discharge; no odour; wound united deeply, and almost wholly on the surface; there were a few granulations, which were lightly touched with sulphate of copper; no discharge on pressure; the surrounding soft parts looked and felt perfectly healthy; limb dressed and immobilized as before. The man's appetite was good; his bowels acted regularly, and he was allowed to walk in the hospital garden.

28th.—Cicatrix quite dry and solid; general health improving. Immovable apparatus re-applied and not removed for two months, when the fragments were well united.

When practicable, change of air increases the chances of bony union.

CASE XXXVI.—*Fracture of both bones of the leg. Fragments movable at the end of six weeks. Perfect union in a plaster of Paris mould and change to the sea-side.*

I was consulted in the case of an officer about thirty years of age, of powerful build, and excellent constitution, who, six weeks previously, had sustained a fracture of both bones of the left leg, a little above the middle. The treatment had been conducted by a skilled surgeon, but the fragments still remained apart. I enclosed the limb to mid-thigh in a plaster of Paris case, and recommended the patient to go to Brighton, live well, and be out in the open

air as much as possible. The limb was not exposed for two months, when union was solid. In these cases it is especially important to immobilize the joints above and below the seat of fracture, and to abstain from interference for a sufficient length of time to give a chance of thorough repair.

Plaster of Paris moulds or splints are peculiarly adapted to the treatment of un-united fracture. The necessary solidity is thereby attained in a very complete manner, and the limb having already shrunk, in consequence of disuse, is not liable to decrease in size sufficiently to impair the fit of the apparatus.

In the comparatively rare cases in which operative interference is required, provided immobilization be subsequently secured, ivory pegs, wire sutures, and re-section present nearly equal chances of successful consolidation. Un-united fractures may consequently be looked upon as almost always preventible, and, when they do occur, as almost always curable.

LECTURE V.

Complications of fracture.—Abrasion of the skin, and Blebs. — Comminution. — Spasm. — Dislocation. — Ecchymotic and inflammatory swelling.

GENTLEMEN,

The possible complications of fractures are many, of various degrees of importance, and frequently co-existent,—to wit, abrasions of the skin and blebs, swelling from subcutaneous hæmorrhage, dislocation of the joint next to the fracture, comminution of the bone and muscular spasm, hæmorrhage and communicating wound. The two last are reserved for a subsequent lecture ; and, meanwhile, here are two cases of comparatively slight complication,—abrasion of skin and swelling from extravasation of blood.

CASE XXXVII.—*Fracture of the anatomical neck of the humerus, with great extravasation of blood.—Application of pasteboard apparatus; immediate relief; rapid absorption.*

Elizabeth Bull, æt. 48, was admitted the 26th May, with an injury to the right shoulder, occasioned by the woman being pushed violently against an iron post. I 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. I applied the pasteboard 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 make 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.

The injury from which this woman suffered,—fracture within the shoulder joint, with extensive swelling, the result of direct violence,—is attended with very great pain, which I have never failed in relieving by careful padding, complete immobilization, and methodical compression of the entire limb. The swelling subsides, as surely and rapidly as the pain.

In one case of the kind to which I was called, a young surgeon had applied the ordinary wooden splints two days previously. Pain was so severe, that the patient, a strong middle-aged man, was unable to lie down, and had sat up continuously in an arm chair. I was assured that he had fallen sound asleep before I could have been one hundred yards from the house, after immobilizing and compressing the limb in a well-padded pasteboard apparatus.

CASE XXXVIII.—*Oblique fracture of thigh in a lad, with abrasion of skin and swelling.—Immediate reduction, and application of pasteboard apparatus.—Out of bed the fifth day.—Perfect recovery.*

This boy, George Grey, æt. 12, was admitted 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 only a quarter of an inch of shortening. Preternatural mobility and grating very obvious. Abrasion of the skin on the outer side, and swelling from extravasation of blood. I applied the pasteboard 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, strengthening with additional inner splint to below knee, and binding the whole firmly but gently with roller; I then fitted an additional buttock splint, and fixed it according to my usual practice. 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 identical, and movement of joints perfectly free. It is only by way of precaution that I have ordered crutches to be used another week.

Comminution, or splintering of the bone, may occur to a considerable extent without lesion of the skin, and it is especially important as being the most potent cause of nerve irritation and muscular spasm.

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

Joseph Wood, a navvy, æt. 25, conveyed to the Queen's Hospital, July 22nd, in a Hansom cab, two miles from the seat of the 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 secured on a pillow, and the patient, covered with warm blankets, 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. Muscular spasm strong. I now proceeded with the application of the pasteboard apparatus, and starched the outside.

23rd July.—Has passed a good night, and is now quite easy. The swelling has in great measure subsided, as proved by the comparative looseness of the dried 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 understood, from one of his relatives, that he made an excellent recovery.

Incidentally let me remark, that the peculiarity of the treatment was 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 is a *starched bandage.* The starch is little more than an efficient substitute for the pins ordinarily employed in bandaging. The essentials are, 1stly, Immediate reduction, regardless of spasm, blebs, extravasation of blood, or inflammatory swelling; 2ndly, Circular compression; 3rdly, Immobilization in a mould constructed of several pieces, so as to admit of being opened, and re-adjusted to the limb as it alters in size.

The navvy's case presented several complications,—comminution, swelling from extensive extravasation of blood, and strong muscular spasm. It is to the latter, that I now wish to direct your attention.

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 source, the irritation of the muscles by the displaced fragments, indicates the remedy,—removal of the cause, by immediate reduction and the most accurate coaptation. But it has been said 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, which defeats its aim by the antagonism it provokes. 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 thigh, whose femur 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 relative 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 bone is broken, preparation should be made for the definite application of the most suitable apparatus; but much may be done, painlessly and at once, to prevent further mischief. The limb may be packed with pillows or straw, made firm with a sheet or towel closely pinned or tied round it. Sand bags are very useful for the same purpose; if they are not at hand, the limb may be packed with bags of chaff, or sawdust. Such soft packing may be converted into a firmly retentive apparatus by securing outside it a few pieces of stick or thin board, or strips made by tearing up a chip hat box. These materials, however slight, if placed diagonally, and interlaced with bandage or torn up sheeting, give great strength, while the pillow or chaff bag moulds itself to the limb and gives great comfort.

The principle of immediate reduction, sound as it is, must be put into practice with discrimination. In a case like that of our navvy, after a two miles ride in a cab, with a smashed thigh, artificial warmth by blankets and hot bottles, a little warm tea or other appropriate stimulant, will restore the vital powers and prepare for the serious operation of reduction, with or without an anæsthetic. Not unfrequently a man with such a local injury has sustained a much more serious internal one, which might be greatly aggravated by manipulations, however delicate. It is no use setting the thigh of a dying man; and nothing can be more painful than the reflection, that death has been hastened by attempts,

from which a little patience and reflection might have sufficed to dissuade.

When, in a case like the one under comment, reduction is determined on, and all necessary preparations made, pass a soft 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 bone, 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 effort, if spasm commence. Waiting patiently while the steady traction is kept up, you notice, after the lapse of a few moments, that relaxation commences; it is especially necessary to avoid the slightest jerk, which may act as a stimulus to fresh spasm. If required, the opposing 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 all cases of fracture, simple as well as compound, attended with much displacement and spasm, it is advisable to produce insensibility before applying the apparatus. When the muscular system is relaxed, and the patient perfectly quiet, the necessary surgical manipulations can be carried out with delicacy, and with the most perfect efficiency. 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 so prevent spasm and pain, when consciousness returns. If circumstances do not admit of the administration of an anæsthetic, 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 muscular effort.

When reduction has been effected, it is absolutely necessary to prevent all subsequent motion. The slightest disturbance is sufficient, by the irritation it produces, to excite muscular contraction, and this, once awakened, involves the danger of renewed spasm and displacement, with all their attendant evils. This is especially true in the not infrequent occurrence of patients with fracture being in a state of drunkenness and consequent delirium. Opium may then be of some service, as it proved in

CASE XL.—*Oblique fracture of tibia, and comminution of 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 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 was 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 and

applied pasteboard 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 effect 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, in spite of 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 was much struck with the occasional impotence of opium in delirium tremens in the next case, in which, though something like ten grains of solid opium were given in thirty-six hours, the excitement was only quelled by death.

CASE XLI.—*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 25th October, 1861. He was very drunk, and had injured the right ankle in wrestling. The joint was hot and puffy, and measured round the point of the heel $10\frac{3}{4}$ inches, while the left ankle, on the same level, was $8\frac{1}{2}$ 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 immobility 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 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 gentle compression.

Better than opium in controlling the delirium of drunken persons with fracture, I have found twenty grain doses of bromide of potassium and forty drops of tincture of digitalis, repeated as frequently as necessary, and as permitted by the general strength. Antimony is another very valuable drug, under similar circumstances, and it may be given in doses from half a grain to a grain every three or four hours.

The manner in which the patient, (Case XXXIX), 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 a 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, a door, or a hurdle answers the purpose perfectly well.

This is such an important point, as to deserve illustration by a case of fracture which has become classical in surgical history. The patient was no other than Mr. Percivall Pott, who, when riding in Kent Street, Southwark, was thrown from his horse, and suffered a compound fracture of the leg. Thoroughly aware how much such an injury may be increased by rough treatment or improper position, he would not suffer himself to be moved until he had sent to Westminster for two chairmen to bring their poles. He lay patiently on the cold pavement (it being the middle of January) till they arrived. In this situation he purchased a door, to which he made them nail their poles. When all was ready he caused himself to be laid on it, and

was carried to his home in Watling Street, near St. Paul's. (*)

In no fractures are the principles already enunciated to be more rigidly applied, than in those complicated with swelling, be it ecchymotic or inflammatory. 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 has been 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 interfered 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.

I beg you to dismiss such objections as the remnants of a faulty tradition, equally opposed to sound physiological principles and surgical practice.

CASE XLII.—*Fracture of both bones of the leg, with eversion, great swelling, and blebs. Application of pasteboard 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 the 24th December, in a state of intoxication, with injury to right leg inflicted in a fall,

(*) Mr. James Earle's short account of the life of Percivall Pott, prefixed to new edition of his works, London, 1790. The accident occurred in 1756, when Mr. Pott was forty-three years of age, and unknown as an author. During the leisure of his enforced confinement from the accident, he planned his treatise on ruptures, which proved the first of a long series of classical essays.

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 $11\frac{1}{2}$ inches,—of the right, same level, $13\frac{1}{4}$ 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 thirds. 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 character of the fracture.

The natural direction of the limb having been restored, I applied the pasteboard apparatus immediately, from the sole of the foot 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 of the fragments.

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, (8th. day). 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 XLIII.—*Fracture of fibula and inner malleolus. —Immense swelling.—Large tense blebs. Immediate application of pasteboard apparatus.—Instant relief.—Excellent recovery.*

W. J., admitted 30th June, with an alleged dislocation of the astragalus, to endeavour to reduce which, considerable force had been employed with the aid of a pulley. 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 pasteboard apparatus at once as far as the middle of the thigh, and the man pronounced himself immediately relieved.

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, 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 are examples of severe injury and serious complication,—the latter especially due to the powerful efforts which had been made to reduce a supposed dislocation of the astragalus: 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 same circumstances. 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.

When a bleb on a fractured limb breaks, a little absorbent gauze and cotton is the application most likely to form scabbing; and in the event, not frequent but possible, of superficial ulceration at the base of the bleb, it may be dressed with a little zinc, or elemi, or turpentine ointment. If it be deemed advisable to see the sore more frequently than the seat of fracture, a trap-door may be cut in the apparatus, but this is very rarely necessary.

CASE XLIV.——*Fracture of both bones of leg from direct violence.—Blebs, swelling, and slight ulceration.—Pasteboard apparatus.—Out of bed third day.—Perfect recovery.*

John Price, æt. 43, admitted I Ward, 2 a.m. October 13th, 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. 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. On opening the case along the front, I found that the swelling had almost subsided; the edges were then pared, and additional pasteboard splints fixed on each side of the knee.

October 16th.—Perfectly easy; says the only discomfort he suffers is from lying in bed. Allowed 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 sore which ensued; I made a trap-door for the purpose of dressing it, and it healed rapidly. At the expiration of eight weeks the injured limb was as strong and perfectly shaped as its fellow.

Dislocation is an important complication of fracture,—a cause of difficulty in diagnosis, and raising the therapeutic question as to which lesion shall have precedence in treatment. Reduce the dislocation, and then the fracture, afterwards immobilizing the limb. In this proceeding an anæsthetic is of the greatest service, as you have just seen in Ward 3, where I have experienced no difficulty in reducing the dislocated hip, aud adjusting the broken thigh, of the young man to whom chloroform was administered on admission. The accident had happened within an hour, and the soft parts were little altered. In similar cases swelling supervenes rapidly. Still the treatment should be the same, and the dislocation have precedence in reduction.

CASE XLV.—*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—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 follows;—

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 millboard, 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:

		DECREASE IN FIVE DAYS.
Middle of upper arm -	11½ inches.	1 inch.
Middle of forearm -	9½ „	3½ „
Point of elbow - -	13 „	2 „

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 throughout, had decreased at one point to no less than 3½ inches in circumference.

For the success of this treatment it is essential that the apparatus be adapted to the limb as it shrinks, thereby proving the combined efficiency of immobility and compression.

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

CASE XLVI.—*Fracture of fibula, with great swelling, heat and pain.—Fomentations for two days useless.—Third day pasteboard 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 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 6th from admission) 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. I reclosed the apparatus, bandaging with firm pressure, and the man left the hospital in perfect comfort.

The fact deserves notice, that perfect comfort followed bandaging with firm pressure, and that the man was treated as an out-patient, from the sixth day after fracture of the fibula, with great swelling and pain, which fomentation had failed to relieve. Many excellent surgeons disapprove such practice, under the circumstances stated, and in so doing they echo the teaching of the Macaulay of surgical literature, from whose classical work I am about to quote.

"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 ankle 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, 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 forearm 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 Principles of Surgery, by John Bell. Edinburgh: 1801. Vol. I, p. 617.

the authority of Mr. John Bell, the teaching, that rollers should not be applied directly to a broken limb, especially when swollen.

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.

Amongst the reviewers to whom I am indebted for instructive criticism, 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

(*) On the Advantages of the Starched Apparatus in the Treatment of Fractures and Diseases of Joints. Being the first part of an essay to which the Council of University College have awarded the Liston Clinical Medal. By Joseph Sampson Gamgee. London: H. K. Lewis, 1853.

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.

But our cases teach that 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 his protest against the application of *powerful constriction* to an inflamed limb?

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, 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?

It has fallen to my lot to see some terrible cases of deep sloughing, and some of mortification of entire limbs, after tight bandaging for fractures. I shudder at the thought of a stout wooden splint, with only a narrow pad being firmly bandaged to a limb, with a stout calico roller.

The patient, when complaining of pain, is often told that pain is inevitable in fractures, and must be borne. But the subsidence of pain may denote the torpor of local death, depicted in the cold mottled limb when at last exposed, leaving only one alternative,—the amputating knife through the living structures above.

Such a result, one of the most melancholy conceivable, is impossible, if you treat your fractures carefully. Pad the whole limb evenly, immobilize with accurately fitting moulds, apply these soft bandages, with lightness at each turn, and rely for firmness on equally distributed pressure and repeated intersecting spirals. Pay special attention to physiological position, and hold pain in reverential awe.

Never look upon pain as a sentimental evil, but as an expression of organic mischief. Patients with fractures when properly treated, are in comfort ; and if they are not it is your duty to find out the cause and remedy it. Amongst the remedial measures at your command, none safer and more beneficent than rest, position, and pressure, but beware lest any doctrinal generalizations should unduly bias you. Treat each case with patient watchfulness, and upon its own merits. Act on physiological principles with the accuracy, in minutest details, of skilled mechanicians. Err, if at all, on the side of excessive precaution.

LECTURE VI.

Compound fractures to be reduced to simple ones, and treated on the same principles,—immediate reduction, immobilization, and compression, with special attention to drainage.—Amputation in compound fracture.

GENTLEMEN,

The wound in the soft parts covering, and communicating with, the fragments, which 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, when the amount of injury is not so great as to demand amputation.

Wounds of the soft parts, as a complication of fracture, apart from constitutional peculiarities, derive their importance from the proximity of the fragments and the exposed medullary canal of the broken bone. If they be speedily adjusted, and immobility maintained, 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, as was done in the patient now before you,

CASE XLVII.—*Scalp wound.—Compound and comminuted fracture of forearm, healed by the first intention under dry dressing, immobility and pressure.*

C. H., aged 72 years, attended at the hospital on Dec. 7th, 1879. A short time previously she had fallen headforemost down a flight of stairs, and had sustained a wound on the

top of the head, two and a half inches long, not exposing the bone. There was also a fracture of both bones of the right forearm at the junction of the lower and middle thirds. That of the radius was a simple fracture, that of the ulna comminuted, and compound through two wounds situated on the inner side of the limb, two and a half inches from the wrist. Each of these wounds was three-quarters of an inch in length. They were covered with dry lint pads, as was also the scalp wound; the hand and forearm fixed, in a semi-prone position, in the ordinary wooden splints. Contrary to advice, the patient refused to remain in the hospital. She returned three days afterwards (Dec. 10th), when she was admitted as an in-patient. She complained of feeling ill, and there was considerable pain, redness, and swelling about the head. On removing the lint pad, however, the wound was found nearly healed. The head was covered with an oakum pad, and over it a layer of cotton-wool and gently compressing bandage. As there was no complaint of the forearm, it was not disturbed. The patient was put to bed, and a calomel-and-jalap purge administered. Feverishness passed off in a few hours, and the old lady continued to enjoy excellent health and spirits.

Dec. 17th (tenth day).—Splints removed for the first time. The lint over the wounds, which was hard and saturated with blood, not disturbed. No œdema or redness about the limb. A long slough of cellular tissue was drawn out from the scalp wound. Dry dressings, with compression as before, applied to the scalp, and the arm-splints re-adjusted.

21st.—Scalp wound firmly healed. Arm exposed, showing two firm linear cicatrices; not much bony union. Appetite and general health very good. Arm splints re-adjusted.

27th.—Scalp cicatrix sound and painless. Forearm firmer.

On January 1st, three weeks after admission, the old lady felt so well that she insisted on going home for the new

year. You now see her on the thirty-second day after the accident. The fracture of the forearm is consolidating satisfactorily, but there is slight discharge from the centre of the scalp wound. The scar has yielded a little since the patient went out, but the surrounding skin is pale and healthy; the scar itself is of normal pink hue and painless. The few drops of discharge are quite odourless, and the patient's health is excellent. The dry dressing and bandage re-applied, and changed twice in the succeeding fortnight, at the end of which period recovery was complete.

The patient's age, the nature of the accident, the co-existence of a considerable scalp wound and of a compound and comminuted fracture of the forearm, the refusal to remain an in-patient from the first, made the case a very serious one; nevertheless, the two wounds, over the broken ulna and near the wrist joint, healed by the first intention under dry lint.

The complication with the scalp wound need not detain us, as a special lecture will be devoted to injuries of the head; but it is significant that the erysipelas of the scalp, and the attendant feverishness, did not interfere with the rapid progress of the serious injury of the forearm. It has been noted that this was treated with pads of dry lint, and the ordinary wooden splints, with which I was careful not to interfere, as they had evidently been very carefully applied before my arrival, and the patient was perfectly comfortable.

Wounds of the fore-arm generally heal so satisfactorily, that the practice of completely closing them, which was adopted in this compound fracture, may be followed in similar cases, without risk. But, as a rule, provision should be made for drainage. In a measure this may be accomplished, by substituting absorbent gauze and cotton tissue for lint; but if the wound be considerable, a drainage-

tube should be inserted in its most dependent angle, after the edges have been approximated with sutures or strips of lint, soaked in styptic colloid or compound tincture of benzoin. The drainage-tube should be of sufficient length to be carried out from the deeper dressings, so that discharge may be collected near the surface into an absorbent pad, easily removable, without violating the fundamental principle of immobility.

It cannot be too often or too emphatically repeated, that after reduction and accurate co-aptation of fragments, immobility is the grand object to be secured in all fractures, in direct proportion to the complications attending them.

Irritation of the soft parts by the fragments is the potent cause of increased afflux of blood, effusion, and decomposition. If these developments be not checked, sealing of the wound may prove a mischievous practice; whereas its closure, with adequate provision for drainage and immobility, is safe and successful practice. (*)

(*) Mr. William Adams in his Principles and Practice of Subcutaneous Surgery (London, 1867. P. 15 et seq.), records that, "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 the 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 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."

Hæmorrhage, always a serious complication in fractures is 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. Our next case proves how speedily pressure arrests the flow, and the success which attended its employment in that instance 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 fragments be first and definitely adjusted; and thus you perceive, in the event of wound, hæmorrhage, and spasm, it is equally important to reduce and immobilize the fracture without delay.

CASE XLVII.—*Compound and comminuted fracture of the leg from direct violence;—great shortening,—violent spasm.—Immediate application of pasteboard apparatus.—Patient 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 3rd October, 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 $1\frac{3}{8}$ 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 distinctly 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

pasteboard 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 gradually lessened, 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 was conveyed from the hospital 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 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 protusion of fragment, copious hæmorrhage and violent spasm, constitutes one of the most serious cases to which you can be called.

The treatment adopted,—immediate reduction, immobility, dry dressing, and pressure,—could not have been more successful; freedom from pain and constitutional disturbance was complete, confinement to bed limited to twelve days, and union solid, with scarcely perceptible thickening, at the end of two months.

Further, and still more striking confirmation of the same therapeutic principles, is at hand.

CASE XLVIII.—*Compound and comminuted fracture of the fibula. Extensive contused wound of the ham and calf. Rapid recovery under dry and infrequent dressing, immobility, and pressure.*

J. T———, aged 19, admitted into Ward 3, Dec. 19th, 1878. A few minutes previously, while passing between a wall and a horizontal steam-engine in motion, the crank struck his right leg. The following particulars of the consequent injury were noted at the time. There was a large irregular contused and lacerated wound, at the outer and posterior surfaces of the upper part of the leg. The wound commenced at the centre of the posterior part of the knee, extending outwards to the external surface of the leg about two inches anteriorly to the head of the fibula; it then passed downwards along the whole upper half of the leg, measuring more than twelve inches, and dividing the soft structures down to the bones. The flesh flap was turned down the leg for five or six inches. The outer head of the

gastrocnemius was completely divided, the upper part hanging loose in the wound, and the lower being retracted for several inches. The outer head of the soleus muscle was completely torn through, as were also both peronei muscles. The external popliteal nerve was intact, stretching like a cord across the wound. The fascia covering the tibialis anticus was lacerated, and the muscle protruded through it for a considerable distance. The fibula was smashed about an inch and a half from its head, the lower fragment drawn inwards. Two spiculæ were removed, one of which was an inch in length. The wound could be felt to extend for some distance between the muscular planes of the calf, and nearly down to the tibia behind. There was rather free oozing, no distinct bleeding point. The knee-joint was not in any way implicated. The tibia was unbroken. The anterior and posterior tibial arteries pulsated, and there was no anæsthesia in the limb below the wound.

So soon as the patient was in bed, and the clothing removed, ether was administered by a qualified resident officer, who had had considerable hospital experience. In his opinion, so extensive was the injury that it was useless to attempt to save the limb.

Nevertheless the attempt was made, and with the most perfect success, by my friend and colleague Mr. Jordan Lloyd, then house surgeon at the Queen's Hospital. He brought the edges together with twelve silver sutures, inserted three drainage-tubes in varying directions for more than twenty-three inches, supported the lips of the wound by strips of lint soaked in styptic colloid, covered the part with muslin, tenax, and cotton wool, and immobilized the whole limb with pasteboard splints from toes to hip. The limb was then firmly bandaged, elevated on pillows, and supported by long, heavy sand-bags. On account of pain at

midnight, one-quarter of a grain of morphia was administered in a draught. The temperature, the evening after admission, was 97·3°. The next day there was not much pain, and slight bloody discharge had oozed through the dressings.

Dec. 21st.—Has passed a fair night. Not much pain; no fresh oozing; no tension about the apparatus; no odour. Temperature 100·2°, the highest reached throughout the progress of the case.

23rd (fourth day after admission).—On removing the bandages the dressings are found saturated with blood-clot undergoing decomposition, and stinking. On removing it lightly with pledgets of dry lint, the limb beneath is pale and not swollen; the wound is united in the greater part of its extent; no slough to be seen; strips of styptic lint not disturbed. Gauze and tenax-pad re-applied, with splints and equably-compressing bandage.

25th.—Feels all right; only a little watery and odourless discharge has permeated the dressings. Temperature 98·4°; pulse 96. To have meat diet.

27th (ninth day after admission, and second dressing).—All the apparatus completely removed. Tenax saturated with discharge, smelling offensively. Strips of styptic lint and eight stitches removed, also one foot of drainage-tube; wound healed for nearly ten inches of its length. No redness, œdema, pain, or bagging. Edges of wound supported with strips of elemi plaster. Dressing as before, with gauze and tenax pads, cotton-wool, pasteboard splints, and compressing bandage.

January 1st (third dressing, fourteenth day).—Pulse 100; respiration 22; temperature 98·4°. No oozing of discharge through dressings, but a disagreeable odour is perceptible outside the limb. On exposing it, a little stinking fluid in tenax; wound solid throughout; granulations flush with skin, except opposite head of fibula, where the wound is about one inch and a half deep, and three quarters of an inch in breadth.

The remaining stitches, and six inches of drainage-tube, removed; limb pale and shrivelled; no bagging, no pain; tongue clean; appetite good; feels quite well, and wants to get up. Fresh strapping to support wound, and same dressing as before.

4th (fourth dressing, seventeenth day).—Pulse 96; respiration 20; temperature 98·3°. On exposing the limb, it looks pale and shrivelled; healing proceeding rapidly. A very slight amount of fetid discharge. The last piece of drainage-tube removed. Dressing on the same plan reapplied.

15th (twenty-seventh day after admission).—The patient can lift the limb off the bed without discomfort, and bend the knee at an obtuse angle.

I have very rarely seen more extensive injury to a limb repaired with less constitutional disturbance, with more perfect freedom from pain, and less loss of tissue at the seat of mischief.

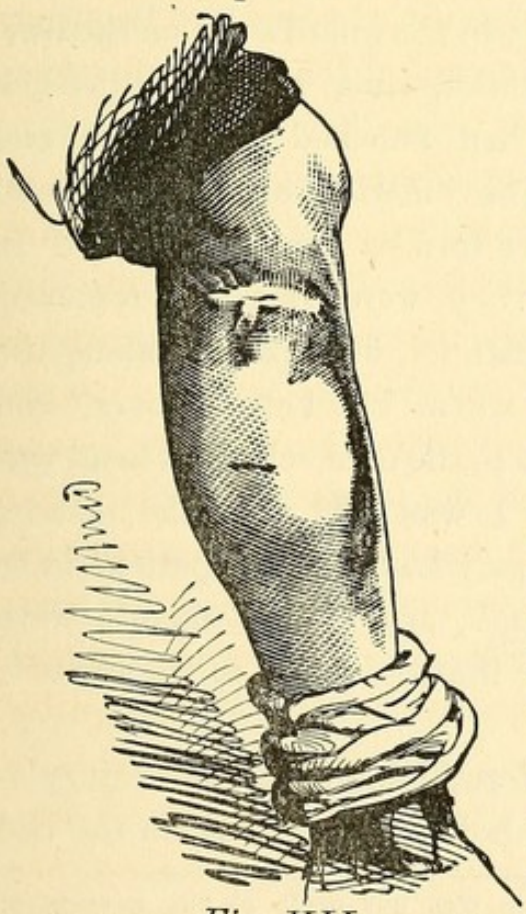


Fig. VII.

The wound was only disturbed three times in a fortnight, when union was almost perfect; pulse 100; respiration 22; temperature 98·4°. The annexed woodcut (from a photograph) shows the present state of the cicatrix, which extends across the popliteal space to the outer side of the leg, and down two-thirds of its length. Movements and sensation are perfect; and, in proof of good nutrition, here are the measurements round the two legs, taken four inches below the lower edge of the patella:—Right (the injured) leg, 13½in.; left leg, 13¼in.

Your attention is now requested to this Midland Railway porter, William Smith, who came in from Selly Oak for your inspection a few days ago. He walked with a slight limp, it is true, but briskly and without a stick, and could bend the knee on the injured side nearly to a right angle.

CASE XLIX.—*Compound comminuted fracture of the lower end of the femur.—Severe shock.—Three inches shortening.—Proposed amputation.—Immediate reduction and immobilization, dry and infrequent dressing, and equable pressure.—Uninterrupted recovery.*

I happened to be in the hospital when this man was brought in; he looked death-like, was nearly pulseless, and the surface of the body everywhere felt chilly to the hand.(*) The man had been carried up on a stretcher from New Street Station, whither he had travelled, partly in a cart on the common road, and partly in the guard's van on the line, a distance of some fifteen miles, since a laden coal-truck (weighing about eight tons) had knocked him down and passed over his left thigh, at the junction of its middle and lower thirds. His clothes were torn to rags and soaked in blood, at the seat of injury; they were carefully removed, while hot bottles, wrapped in flannel, were packed along the sound limb and the trunk, warm blankets to cover, and teaspoonfuls of warm tea given to the man, while his head was kept low on the mattress. I was told that the district surgeon of the Railway Company had sent the patient in to undergo amputation of the thigh, and the attendants were preparing the instruments for that operation in the theatre, when I intervened.

Nothing could look more formidable than the injury—short of actual crush of the whole limb. It lay on the bed

(*) Precise thermometric observation was not made at the moment of admission.

helplessly everted, the outer border of the foot flat on the mattress. About three inches above the knee, the thigh was distorted, the soft parts in front destroyed to an extent nearly as large as the palm of the hand; the bone was crushed into many pieces, which grated loosely on the least touch. The structures in the popliteal space and the knee-joint were sound; I could feel pulsation distinctly, though feebly, in the anterior and posterior tibial arteries, and I resolved upon an attempt to save the limb.

After gently straightening the limb (which was nearly three inches shorter than its fellow), I confided the foot to an assistant to make gentle extension, and applied myself to the seat of injury. Manipulating it, and the parts above and below, with both my hands spread out, so as to grasp smoothly and firmly, I moulded the parts into shape; no piece of bone was taken out; where the skin was least damaged and could be brought together, I secured the edges with points of silver suture, and strips of lint soaked in styptic colloid. Where the skin was much bruised I left it, and introduced a drainage tube, as thick as a goose-quill, into the seat of fracture through the opening (as large as half-a-crown), which was left in front, after the parts were approximated as much as possible without dragging upon them. I now packed the seat of injury with a layer of carded oakum carefully teazed out, over it cotton wool, which enveloped the whole limb, and millboard splints from the toes upwards, embracing the pelvis. In applying the outside compressing bandage, care was taken to allow the drainage tube to project externally. Long heavy sand-bags were then placed on both sides of the limb, and a narrow one, weighing about 3lbs., was placed in front, from the groin to just above the seat of injury.

The man rallied satisfactorily, was kept gently under the influence of opium, and the apparatus not touched for

ten days; after that every week. When it was changed, pledgets of lint or cotton wool were employed to remove any discharge from around the wound; but neither water nor lotion was ever allowed to approach it. Dry dressing was the same each time, with carded oakum and cotton wool, nice adjustment of compresses and equable pressure. Progress was uninterrupted, and the man could walk on crutches at the end of two months. There is barely an inch shortening, and only one small bit of bone has worked through the cicatrix, which is perfectly sound and painless. The man can bend his knee and walk long distances. Such a case needs little comment after the other cases which have occupied our attention this morning; it cannot fail to impress itself upon you, as a striking illustration of how satisfactorily surgery may be practised with simple methods and painstaking care. The first essentials for success are, a clear appreciation of physiological principles of treatment, and accuracy, gentleness, and thoroughness in carrying them out.

An important question in the treatment of compound and comminuted fractures, was involved in the cases on which we have been commenting,—are loose spiculæ to be removed? No, unless completely detached.

When, as in Case XLVIII, a piece of bone is lying loose and exposed in a large flesh wound, remove it; but when the fragments of a bone can be brought together, and the main blood-vessels and nerves are uninjured, the reparative powers are truly wonderful. In dealing with such injuries, as surgeons, you must bear in mind that their only unnatural conditions are breakage and bruising. Otherwise the tissues are in most cases healthy, and capable of physiological repair, which you can best promote by imitating the conditions of physiological nutrition.

It is sometimes difficult to replace a long bony fragment projecting through a wound; but anæsthetics and gentle

manipulations will enable you to achieve results, which, at first sight seem impracticable. Enlargement of the wound by a clear incision is to be preferred to removal of bone; and in the rare cases in which this is inevitable, preserve most jealously all the periosteum, which is a bone-producing, as well as a bone-investing membrane.

The cases of compound fracture which have hitherto engaged our attention were in the continuity of bones. Accidents of a similar nature through joints are still more serious, but amenable to the same treatment; subject, of course, occasionally, as our next case will show, to fatal result.

CASE L.—*Compound dislocation of the ankle.—Death from pyæmia.*

J. T., a plumber, aged 45, was admitted to Ward 1, Dec. 7th, 1878, suffering from the effects of drink, in which he had been indulging almost continuously the past three weeks. The lower end of the right tibia protruded through a wound, about two and a half inches long, in the normal situation of the internal malleolus. The projecting bone was stripped from all its surrounding structures, and the cartilage over its articular end was exposed and uninjured. The fibula was broken obliquely from before backwards, and downwards, about two inches above the malleolus. The astragalus was completely dislocated inwards, carrying the attached lower fragment of the fibula with it. The tendons were exposed for nearly two inches; there was no injury to vessels. Under chloroform the dislocation was reduced, the edges of the wound brought together with four silver points, a drainage-tube introduced into the wound, which was covered with strips of styptic colloid and cotton-wool; pasteboard splints from the roots of the toes to the middle of the thigh

a gently compressing bandage and long sand-bags on each side to immobilize lhe limb; the heel raised. The temperature, which was 97·1° on the evening of admission, rose to 101·1° in forty-eight hours; it never exceeded 102°. The report the next morning was that he had had a restless night, had vomited freely, muscular twitchings were general and almost constant, the abdomen very tympanitic, face dusky, breathing laboured, pulse irregularly intermittent. The man died on December the 23rd, the seventeenth day. With rare intervals delirium was continuous from the time of admission. Though a special night-nurse was allotted to the case, she had the greatest difficulty in keeping the man in bed. He several times jerked the heavy sand-bags aside, lifted the limb, and nearly got out of bed. On the fourth day the pulse was 120, breathing 34. On the sixth day, pulse 94, breathing 40; the laboured respiration continued. The leg, dressed on an average every two days, yielded profuse stinking discharge. I replaced the gauze and the tenax bags with lint, and over it gauze and pitch-pine sawdust bags, as introduced by the late Professor Porter, of Netley.

Examination, seventy hours after death, showed congestion and œdema of both lungs; the whole posterior part of the right lung was covered by recent lymph, and the right pleural cavity contained several ounces of turbid bloody fluid. No abscess in lung substance. The liver weighed ninety ounces; it and the kidneys were congested. In the subperitoneal tissue of the hypogastric region, adjacent to the bladder, was an abcess about two inches in diameter, which contained three or four ounces of thick yellow pus. Bladder and peritoneum quite healthy.

I transcribe our pathologist's notes of the state of the limb:—"There was no œdema, redness, or swelling in the leg; the wound was clean and healing; there was no

infiltration in the tissues of the foot. An abscess extended laterally on both sides of the limb, nearly as high as the knee-joint. The skin covering the whole anterior part of the middle third of the leg had disappeared, a large, irregular, clean sore remaining. The articular ends of the bones forming the ankle-joint appeared normal. No injection or erosion of the cartilages. The foot could be dislocated outwards quite readily. The fibula was broken transversely across, about one inch from the top of the malleolus, and there was a small piece of bone broken off from the malleolus. There was no suppuration, either in the sheaths of any of the tendons about the joint or between the muscular planes of the leg."

There is no doubt that this man died from pyæmic infection, directly due to the injury, indirectly to his broken constitution in consequence of drink. Would it have been possible to save the life by amputation? I object to remove a limb while a man is in a state of drunken delirium, and, as this patient was never out of it, I did not propose amputation. Compound dislocation of the ankle is one of those formidable injuries on the treatment of which authorities have differed widely, and are yet far from unanimous. That an attempt should be made to save the limb is the preponderating opinion, and on it I have always acted.

CASE LI.—*Compound dislocation and fracture of the ankle joint.—Malleoli and astragalus resected under chloroform after enlargement of external wound; this closed with sutures and dry lint, and compressing pasteboard apparatus applied.—Slight constitutional disturbance.—Infrequent dressing of the wound.—Use of drainage tube.—At the close of the ninth week, the wound healed and patient left the hospital.*

The man before you, who can walk five miles an hour without the slightest perceptible limp, was admitted into

the Queen's Hospital, under my care, sixteen years ago, with a most severe compound dislocation of the right ankle.

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, and inflicting a lacerated wound about four inches in length, immediately in front, 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 day after admission).—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, 100·2°; pulse 108; respirations, 18. Milk diet.

11th.—Slept all night, suffers no pain, shootings, or uneasiness in the limb. Pulse, 92; temperature, 100⅘; 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, 99·8°; 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, 101·2°. To take an ounce 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, 90; 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 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.

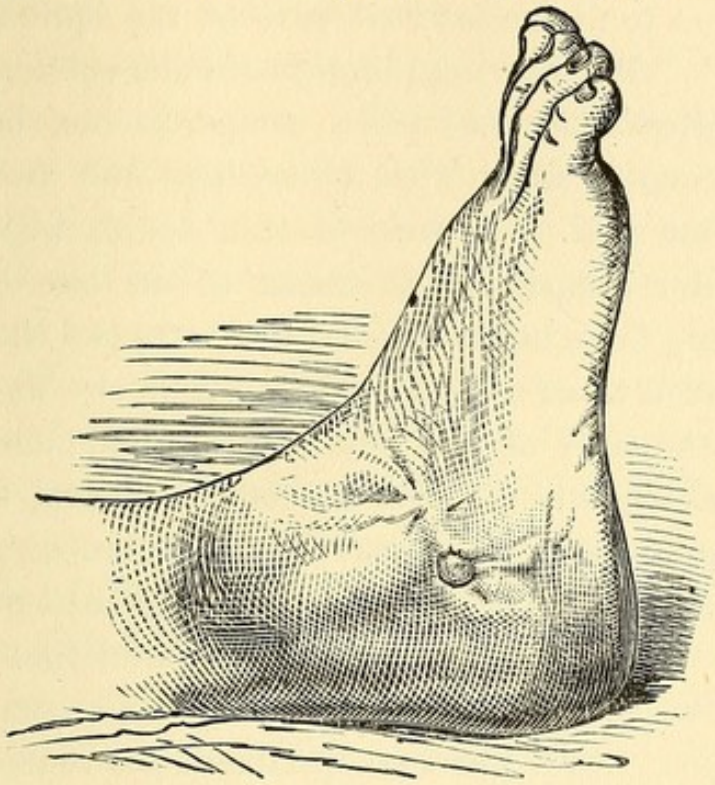


Fig. VIII.

In another month the man was able to walk with a stick, which he gradually discontinued, regaining useful motion in the ankle and a perfectly useful limb, only shortened to the extent of three-quarters of an inch. Sixteen years have elapsed since the accident, the man has worked hard, and the foot (of which an engraving from photograph is annexed), has never failed.

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

(*) London, 1849. Page 2.

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 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.

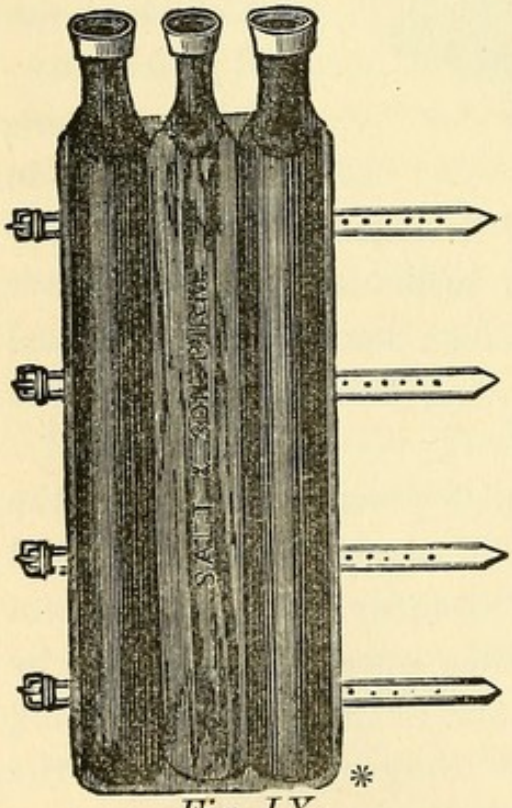


Fig. IX.

(*) 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 to the Salter's or any other swing in ordinary use.

The successful issue of the very formidable cases on which we have been commenting, must not lead you to underestimate the very grave importance of compound fractures, and the necessity of great caution in the prognosis, until the patient has quite recovered.

I was lately surprised by a fatal issue in a case of compound fracture of the leg. The patient, a healthy young man, had four weeks previously, sustained a compound fracture of the left leg. The wound was small, had scarcely suppurated at all, and had quite healed under cotton-wool and the pasteboard apparatus.

The patient had just previously enjoyed his breakfast, and was lying on his back in bed rolling a bandage. A sudden exclamation attracted the attention of the nurse, who was near. She found the patient pale and gasping for breath. He died within three minutes. The autopsy revealed embolism of the pulmonary artery. Within a few weeks I lost another case of compound fracture of the leg, in a gentleman sixty-five years of age. Everything was proceeding favourably when tetanus supervened, and very rapidly proved fatal, as it did in the succeeding case.

Case LII.—*Extensive laceration of the muscles of the leg, and compound fracture of the tibia. Favourable progress under dry dressing, immobility, and pressure.—Death from tetanus.*

F. H———, aged five, admitted under my care on Aug. 15th, by Mr. James Brett, house-surgeon, who had charge of the case, and has favoured me with his full notes, here abstracted.

The injury was a most formidable one, the child's right leg having been crushed between a passing cart and a large stone. The skin and soft parts down to the deep fascia were torn from over the popliteal space and calf of the leg;

the upper part of the flap was torn, the rest appeared to have been dissected off. The flap measured seven and a half inches in length, three inches broad. Marks of severe contusion down the front of the leg; great swelling about the foot and ankle; there was a compound fracture in the lower third of the tibia. The flap re-adjusted under chloroform, and fixed with six silver sutures; the limb surrounded with dry gauze and oakum pads, cotton-wool, moist pasteboard splints, and gently-compressing bandage. No drainage-tube was used. To ensure immobility, a sand-bag twenty-six inches long and fourteen pounds in weight was placed on the outer side of the limb; a similar bag, twenty inches long and fourteen pounds weight, on the inner side; a third sand-bag, measuring ten inches by six, and weighing four pounds, across the two preceding ones and the intervening leg. The next day the temperature was 100·4°; pulse 98; respiration 30. The third day, the thermometer stood at health, but it soon shot up.

At my second visit, on Aug. 19th (7.30 p m.), the temperature being 103°, the pulse 120, and the respiration 32, the wound was dressed under chloroform. On removing the apparatus, portions of the integument of the calf were sloughing. Three tense stitches were cut through. The foot and front of the leg looked well. The surface was wiped with pledgets of dry lint, and the limb put up precisely as before. Next morning the temperature had fallen to 99·2°.

Aug. 23rd (eighth day).—Second dressing under chloroform. Temperature 99°; pulse 96; respiration 26. Appetite good. The bowels acted regularly. On removal of the pads there was an entire absence of swelling. The skin on the front of the leg was pale and healthy-looking. Shreds of dead skin were detached from the back with scissors, and wiped off with dry lint. Wound granulating

healthily. Dry compressing and immovable apparatus re-applied.

So far nothing could well have been more satisfactory than the progress of the case: but on Aug. 27th (the twelfth day), symptoms of trismus appeared, and opisthotonos followed rapidly. The treatment consisted of local and constitutional quiet, with diet, occasional purgatives, and a mixture of five grains of chloral and ten grains of bromide of potassium every four hours. The patient continued to take milk freely, and slept very well; but on the 2nd of September (the nineteenth day after admission, and the sixth day of tetanus), general twitching culminated in two violent convulsions, which proved fatal. The wound continued clean and granulated healthily, without any swelling, heat, or pain of the adjacent parts. The local progress completely justified the attempt to save the limb, and the measures adopted for that purpose. Tetanus is one of the chief and well-known dangers attending extensive lacerated wounds, intervening not unfrequently when their cicatrization is most propitious.

A fatal issue, but from a different cause, attended,

CASE LIII.—*Compound fracture of leg, with extensive extravasation of blood and emphysema.—Application of pasteboard 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 pasteboard 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. It is very possible that injuries so severe, in constitutions so vitiated, may, in a considerable percentage of cases, have a similar termination, whatever the treatment employed.

The case just related occurred more than twenty years ago, when I still believed in the mischievous practice of poultices and incisions, for phlegmonous erysipelas Absorbent gauze and cotton-wool, digital compression of the femoral and glycerinum boracis, with elastic compression and infrequent dressing, would most probably have averted the fatal issue. The life might also have been preserved, if the patient had consented to amputation when advised.

The question of amputation in compound fractures is one of the most important in surgical practice. Most frequently it presents no difficulties, the case being obviously one in which an attempt should be made to save the limb, or one in which the crush is so complete as to offer no hope whatever. To the latter class belong these cases.

Case LIV. — *Amputation for crushed fore-arm.— Rapid recovery under dry and infrequent dressing, immobilization, and pressure.*

This youth's right fore-arm having been crushed in a cogged-wheel to within two inches of the elbow, I amputa-

ted just below that joint, utilizing some of the least damaged skin to cover the stump, which showed bruising of the muscles and effusion of blood into their substance. Two arteries were tied with silk, and some smaller ones twisted. Where the skin was quite sound, the edges were brought together with two points of suture; elsewhere the parts were approximated with strips of lint soaked in styptic colloid, a drainage tube being left in the lower part of the wound, and the ends of the ligature brought out at the angle with the tube. The stump was covered with a layer of cotton wool, and oakum over it. Rectangular pasteboard splints, extending from the end of the stump to the shoulder joint, were applied with gently compressing bandage, to ensure perfect immobility and prevent swelling.

When the apparatus was opened four days afterwards there was very slight sloughing of the margin of one flap; but the stump was of good colour and healthy temperature, without tension. I removed the drainage-tube, brought the edges closely together by adhesive strapping, and re-applied cotton wool and oakum as dry dressing, with pressure. The lad was discharged on the 17th June, a month within a day of his admission, the stump, then quite healed, having been dressed altogether seven times after the amputation. The sutures had been removed at the dressing on the tenth day, when the arterial ligatures came away with the dressing.

CASE LV.—*Thigh crushed by a wagon.—Ineffectual attempt to save the limb,—Amputation.—Recovery under dry and infrequent dressings.—Immobilization and pressure.*

The soft parts of the left lower limb of James B., æt. 6, had been extensively crushed by a wagon, and an attempt had been made to save the limb. Sloughing and profuse

suppuration had been followed by such exhaustion, that the lad might fairly be said to be moribund, when I was consulted. If the life was to be saved, it was quite clear that the limb must be removed at once. I accordingly amputated the thigh in the upper third. The structures in the stump were a good deal swollen, from the interstitial effusion which the severe contiguous inflammation had induced. I dressed with cotton-wool, oakum, and pasteboard splints, covering the hip-joint and extending upwards to the crest of the ilium; nicely compressing bandages completing the apparatus. In the forty-seven days which elapsed from the operation to the boy's leaving the hospital, in comparatively good health, the dressing was only renewed six times.

In these cases the question of amputation presents no difficulty; but it is a very nicely balanced one, in the treatment of many compound fractures.

You will bear in mind that in two preceding cases all the amputating instruments had been got ready before my arrival, but I did not think proper to use them, and saved the limbs, as I have done in many similar instances. I have scarcely ever had to regret profound reliance on the principles of physiological surgery in aiding the powers of nature; while I have seen many limbs and a few lives sacrificed by too hasty resort to the amputating knife.

I was very early impressed with Mr. James Earle's recital of Percival Pott's compound fracture, which teaches so instructive and memorable a lesson that I shall conclude this lecture by abstracting it.

Of the manner in which Mr. Pott was carried home you have already heard. At a consultation of surgeons, the case was thought so desperate as to require immediate amputation. Mr. Pott, convinced that no one could be a proper judge in his own case, submitted to their opinion, and the instruments were actually got ready, when Mr. Nourse, who had been

prevented from coming sooner, fortunately entered the room. After examining the limb, he conceived there was a possibility of preserving it; an attempt to save it was acquiesced in, no bad symptom ensued, but the wound healed, in some measure by the first intention.(*)

(*) Pott's Works, by Earle. Ed. cit. P. 15—16.

LECTURE VII.

Wounds Penetrating into Joints, to be healed by the first intention.—Cases illustrative of the successful application of the essential principles of immobilization, infrequent dressing, and compression.

GENTLEMEN,

Intimately connected with the subject of compound fractures is that of penetrating wounds of joints. Although these frequently occur without other violence to the bones than exposure of their articular surfaces, they are, by common admission, some of the most serious injuries which surgeons are called upon to treat, and they afford a critical test of the value of therapeutic measures.

A wound, either incised or the result of a heavy blow, may be situated immediately over a joint, without the evidence of penetration which is furnished by exposure of cartilage or escape of synovia. Excessive diagnostic inquisitiveness is to be deprecated. It may do harm ; and, even in the absence of direct evidence of penetration, a severe wound over a joint is to be treated as if the interior of the articulation were exposed. Its bruised coverings may slough and remotely cause penetration. Penetration of a joint caused by sloughing is more serious than a wound immediately opening into a joint, because it is attended with loss of substance, and also because it cannot be healed by the first intention, which, according to John Hunter's counsel, should be attempted in all wounds of the joints.(*)

(*) John Hunter's Works. Ed. Vol. I, p. 510.

CASE LVI.—*Incised wound over the knee-joint Immediate union.*

F. H———, a butcher, aged 30, admitted into the Queen's Hospital on October 31st, 1878. While sticking a sheep, shortly before admission, he inflicted a wound, over the inner side of the knee, nearly three inches long, and down to, but not penetrating, the joint. The edges were accurately brought together with four silver sutures, a gauze and oakum pad was placed over the wound, the limb enveloped in cotton-wool sufficiently to protect the bony prominences, and immobilized with lateral and posterior moistened pasteboard splints, from foot to hip. A gently-compressing bandage completed the dressing. Absolute rest was enjoined. The man felt nothing of the wound, and it was not looked at until the seventh day, when it was healed; the stitches were removed, and the same dry compressing apparatus applied until the fourteenth day, when the patient was discharged with a perfectly sound cicatrix.

CASE LVII.—*Punctured and contused wound over the knee-joint, from great direct violence.—Rapid healing under dry and infrequent dressing, immobilization, and pressure.*

D. B., a labourer, aged 21, was admitted to Ward 1, on Nov. 9th, with a punctured and contused wound just on the inner side of the upper margin of the right patella. The wound was round and jagged, capable of admitting the tip of the index-finger, and extending obliquely a little more than an inch in depth over the condyle. No hæmorrhage or synovia. The whole knee felt hot, and looked puffy. Accurate measurements, at the upper and lower margins of both patellæ, proved the circumference on the

injured side to be half an inch more than on the left. The man's statement was that, about an hour before admission, while breaking up a macadamized road, by driving into it with a sledge hammer a steel bar weighing about ten pounds, the latter recoiled, and struck him with the point (which had just before been tempered,) on the right knee. He walked half a mile to a cab, in which he rode to the hospital. A pledget of lint soaked in styptic colloid was placed on the wound, over it a dry gauze and tenax pad; and the limb, enveloped in cotton-wool, was immobilized from the toes to the hip with pasteboard splints and compressing bandage. The temperature, which on the evening of admission was 100°, rose in twenty-four hours to 102°. The evening of the second day it fell to 100·5°; the next day to normal, at which it remained with trivial deviation. When the temperature was at its highest (the second day), the man complained of some pain in the knee; it was not touched, but an ounce of castor oil prescribed, and a close watch kept. The temperature continuing normal, and the man becoming easier, it was not until the sixth day after admission that the apparatus was opened; the swelling had then all subsided; the skin was of natural colour, and about half a drachm of pus was, with a pledget of lint, wiped off the wound, which was contracted and granulating; dry gauze and oakum pad was placed over the wound, and the same immovable compressing apparatus reapplied. At the second dressing (November 21st, twelfth day after admission) the note is: "Only a trace of pus; wound nearly healed." At the third dressing on November 26th (seventeenth day), I made this note: "On opening apparatus, dressing perfectly dry, cicatrix solid and painless; no surrounding redness or swelling." I may incidentally remark that, apart from the wound, the swelling, which rapidly invaded the knee after the very violent blow, could

not have been treated so successfully by any other method as by perfect immobilisation and gentle uniform compression.

A steel bar, weighing ten pounds, rebounding against the knee after being struck with a sledge hammer, was likely to inflict a very severe injury. The jagged wound admitted the end of the little finger, and the knee became rapidly hot and swollen. No probing was practised, but the patient given the benefit of the doubt, and treatment adopted as if the joint were opened. The dressing was only changed three times in seventeen days. Before dismissing the case, let me call your attention on this, the twentieth day after the injury, to the soundness of the cicatrix, and to the healthy appearance, and free movement, of the joint.

CASE LVIII.—*Extensive wound penetrating the knee-joint. —Union by the first intention under dry and infrequent dressing, immobility, and pressure.*

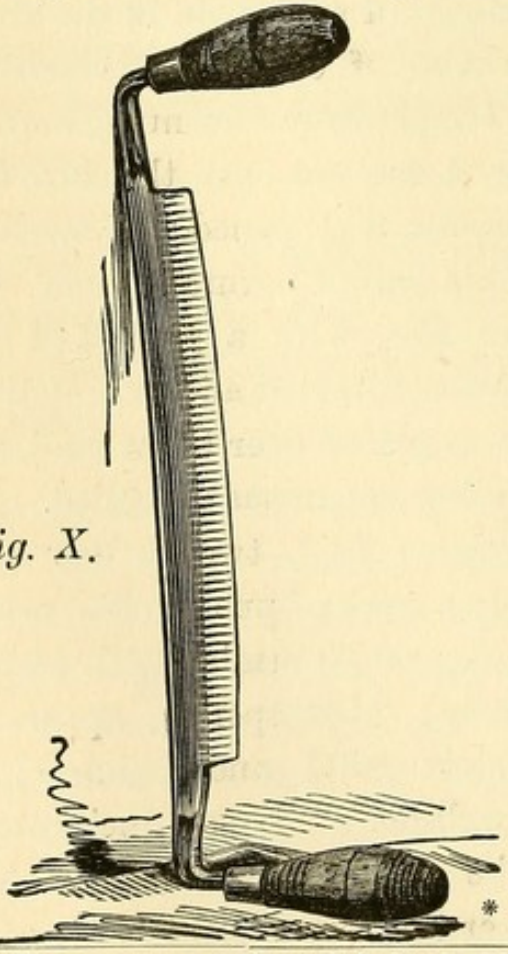


Fig. X.

This patient, George Thomas, aged 48, was admitted into the Queen's Hospital, under my care, 20th of July, 1877, with an extensive wound penetrating the left knee-joint. It was self-inflicted, while the patient—a foreman in one of our large factories—was trying the temper of a double-handled drawing-knife on a piece of ash.

His knee was bent at the time, and the knife, while being used with considerable force, slipped

(*) These representations of the tool with which the wound was inflicted, and of the joints after union, in this and the succeeding cases, were engraved on wood by Mr. R. Paterson, from photographs.

into the limb. On admission the patient was suffering from slight shock. The clean-cut wound extended three inches across the thigh, just above the upper border of the left patella; the tendon of the quadriceps extensor cruris was completely divided; so that the finger could be passed underneath the upper border of the patella into the knee-joint; the outline of the intercondyloid space could be made out; a thin currant-jelly-like clot was visible in the joint, and slight hæmorrhage was going on. I visited the hospital very shortly after I received notice of the patient's admission, and found that the assistants had prepared the spray and the requisite dressings, to treat the case on Mr. Lister's plan.

On hearing the account of the accident, satisfied that no foreign substance was in the joint, I took no heed of the blood clot, used neither sponge nor lint to the outside, but at once brought the lips of the wound very accurately together, and inserted three points of silver suture. Some strips of lint soaked in styptic colloid were placed lengthways, after the fashion of adhesive plasters, over the wound; over them a thin layer of picked oakum, and another of cotton-wool. The limb, being steadily held in the extended position, was immobilized by lateral and posterior pasteboard splints, which had been previously moistened; in bandaging them to the limb I used firm, smooth, compression. To give unity to the apparatus, the outside was starched, and long heavy sand-bags placed on each side of the limb.

July 27th (seventh day after admission).—Has been quite free from pain; temperature normal; the limb has not been touched. The upper part of the bandages was this morning cut down, in front in the middle line. The skin of the thigh looked so natural, there was such an entire absence of swelling about the knee, and the materials covering it were so dry, that the investing case was not further disturbed, but at once reclosed with compressing circular bandage.

July 29th (ninth day).—The case opened throughout in front; the adhesive strips, with the oakum and cotton wool, easily peeled off, leaving the skin pale and shrivelled; the outline of the knee perfect, and the patella movable; the wound quite healed and absolutely dry. I left the sutures, covered the seat of injury with a pad of cotton wool, and compressed and immobilized the limb in the same apparatus.

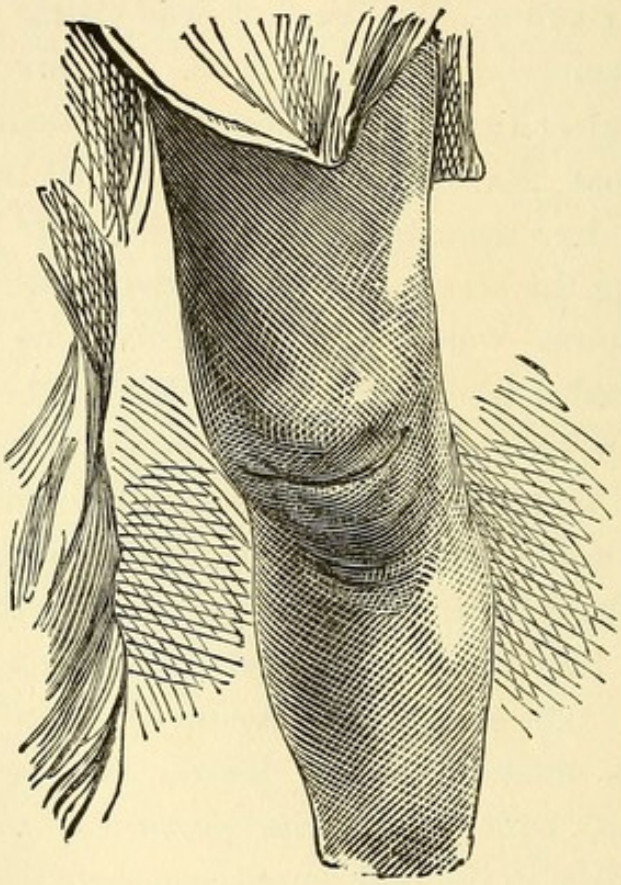


Fig. XI.

August 1st.—On exposing the limb everything looked healthy—no pain, swelling, redness, or moisture; sutures very carefully removed; apposition of edges supported by diagonal strips of elemi plaster, and compressing case re-adjusted.

August 6th.—The temperature and pulse have been normal throughout. The patient allowed to get up.

August 20th (thirtieth day).—Patient discharged, with a pale, dry, and painless, linear cicatrix.

I have seen this man from time to time since he left the hospital. The apparatus has been gradually reduced piece by piece. He has gone to business for the last six weeks; and now, barely three months and a half since the accident, he can walk with one stick; he can bend the knee nearly to

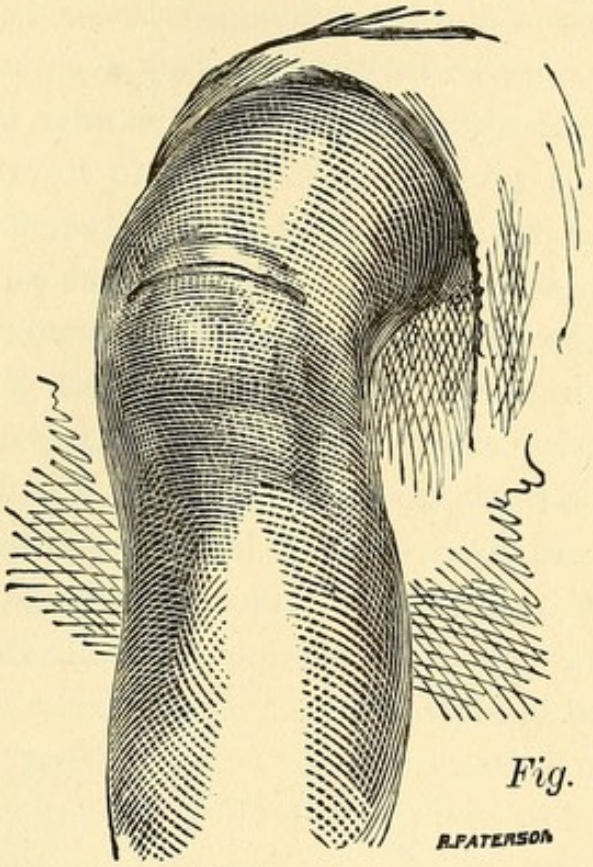


Fig. XII.

a right angle; when sitting, he can lift the heel from the ground without help, and when doing so you can feel the restored tendon, at its insertion in the knee-cap, of good average development and solidity. (*)

CASE LIX.—*Wound over the knee-joint, penetrating into the patella. Union by the first intention, under dry and infrequent dressing, immobilization, and pressure.*

William Bradley, aged 33, admitted under my care October 13th, 1877, with a clean-cut, transverse wound,

(*) Eighteen months after the accident, I saw this patient walking unaided and without a limp. He could then bend the injured knee to an acute angle, and the limb was as strong as its fellow.

over the centre of the right patella. The wound had been inflicted by a double-handle draw-knife, which slipped while the workman was shaping a spoke. The incision was two and a half inches in extent, and penetrated into the patella to the depth of one-third of an inch. The joint capsule was intact, and hæmorrhage had been slight. Our house surgeon, Mr. R. B. Wilkins, very accurately adjusted the edges of the wound, and fixed them with two points of silver suture; a piece of lint soaked in styptic colloid was applied to the front of the knee, and over it some picked oakum. The limb was then immobilized with lateral and posterior pasteboard splints, previously moistened so as to admit of accurate moulding under smoothly compressing bandage. Heavy lateral sand-bags were added.

October 18th (fifth day).—The wound was looked at for the first time; it was perfectly healed, the line of cicatrix scarcely visible, and quite dry, as was also the surrounding pale skin. The sutures were removed, and the limb fixed and compressed as before.

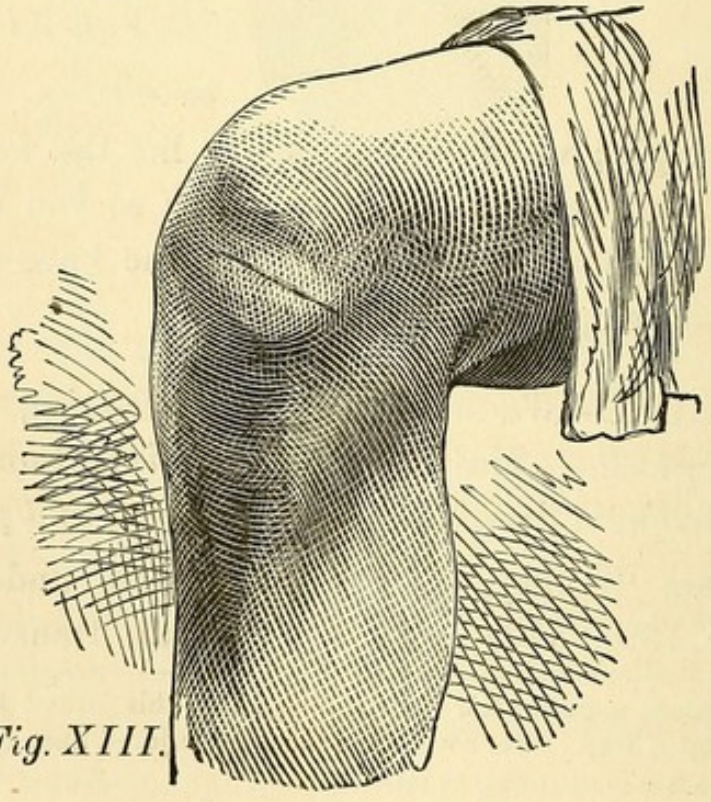


Fig. XIII.

October 26th.—There has been no rise of temperature or pulse throughout; the cicatrix, barely visible, is not adherent to the subjoined parts; there is no swelling of the knee, which can be bent at a right angle. The patient was discharged (a fortnight after admission), with a short back millboard splint and compressing bandage over cotton wool.

Just three weeks after the accident, the man, in ruddy health, could walk without a stick with barely perceptible limp.

You have here two very formidable injuries. In one, the knee joint was extensively laid open, and the quadriceps tendon completely divided; in the other, a wound across the front of the knee penetrated some distance into the substance of the patella. The result in both cases has been complete union by the first intention, without the slightest symptom of constitutional or local disturbance. The two cases were treated identically. No water was applied to the wounds, which were at once, and completely, closed; very efficient means were taken for immobilizing the limbs; and, keeping a close eye on the temperature chart, I waited, and did not interfere with the healing process, than which nothing could have been more simple, nothing more free from pain, nothing more satisfactory in the issue.

My general experience warrants me in saying, that in equally severe injuries the same plan of treatment, accurately carried out, will be attended with the same results, with exceedingly rare exceptions; although, of course, when the joint injury is very extensive, some complications must be expected, and it may be impossible to restore perfect freedom of movement.

CASE LX.—*Severely contused and opened knee-joint.—Recovery with some stiffness.*

Ernest Shield, æt. 15, admitted to Ward 3, May 21st, 1880, with a wound two inches long just on the outer side of the

left patella, which was exposed, as were also the external lateral ligament, the outer condyle of the femur, and the corresponding tuberosity of the tibia. There was free escape of synovia, and the joint was filled with blood, which was gently squeezed out; pressure with a dry pad of absorbent cotton being steadily maintained, to prevent further effusion.

The wound had been inflicted by the cogged-wheel of a steam-printing machine in motion, over which the patient (a nervous delicate lad) was kneeling. While Dr. James Oliver, resident physician, administered chloroform, Mr. E. M. Osborn, the acting house-surgeon, who admitted the patient, brought the edges of the wound together with three points of silver suture, covered the knee with dry pads of pure absorbent gauze and cotton, and with a compressing bandage immobilized the limb in the straight position by the aid of pasteboard splints. When I saw the case a few hours afterwards, the patient was so tranquil, and the apparatus in such good position, that I made no other alteration than to raise the lower end of the bed six inches, and place under the injured leg one of my sand-and-water pillows,(*) to ensure more perfect ease and immobility.

Everything proceeded most favourably, and the wound was not looked at until the sixth day after admission, when I dictated this note at the bedside :—

"May 27th, 11 a. m.—Has had a good night, but has felt a little pain since morning. Temperature, 99° ; pulse, 108; respiration, 16; tongue clean and moist. Ether having been administered, I proceed with the first dressing. The outer bandages, pasteboard splints, and pads lining them perfectly clean. Absorbent bandages and pads over the knee-joint quite dry, but stained with what has evidently

(*) See Fig. IX. P 142.

been reddish fluid. The knee-joint, on exposure, is quite shrunken, and all its bony limits are clearly defined. Two drops of creamy pus exude at the point of lower suture, none from the upper and middle sutures; on removing the middle suture, a couple of drops of blood issue, but none on removing the two others. No exudation on gently pressing the sides of the wound, which are kept together by diagonal strips of elemi plaster. Fresh absorbent pads applied round the knee, with some pasteboard splints, in addition to the previous ones, to ensure absolute immobility. The dressing completed by bandaging with smooth but considerable pressure; the limb again placed on the sand-and-water pillow, and the lower end of the bed raised."

The copious notes record the happy progress of the patient after his formidable injury. The wound into the knee-joint closed thoroughly by the first intention, although a purely superficial sore resulted from the sloughing of the contused skin. The temperature has been high on several occasions, but there has never been the slightest redness of the skin or puffiness of the joint. The patella has been throughout well defined and movable. On an average, the compressing cotton pads have been changed every five days, and on various occasions a little glycerine has been poured on them, previous to their application to the wound. When the wound was nearly closed, it remained inactive for a few days, and was then beneficially stimulated by adding sulphate of zinc to the glycerine, in the proportion of two grains to the ounce.

The patient was not discharged until the fourth of September, just three months and a half from the date of admission. The prolonged sojourn in the hospital was occasioned by recurring pain in the knee, the patient being very averse to exercise the limb by daily move-

ment. The cicatrix kept quite sound, but the limb was not perfectly straight when the lad left. I saw him twelve months afterwards walking at a brisk pace, but with a decided limp. The result, though not perfect, was satisfactory, considering the great extent to which the knee had been laid open, by the rapidly revolving cogged-wheel of the steam printing machine, when the joint was bent over it in the patient's kneeling attitude.

If you study this case in conjunction with the others which I have brought under your notice, you will be assisted in forming a just estimate of essentials in wound treatment. They are—accurate co-aptation and immobilization, to which position, infrequent dressing, and pressure are powerfully conducive.

In confirmation of the soundness of the therapeutic principles in question, here is a clinical record from the work of one of the Masters of Surgery,—a record no less valuable because the case occurred upwards of ninety years ago. I read from Mr. William Hey's "Practical Observations in Surgery." (*)

"In 1784 a stout young man was brought into the Infirmary at Leeds, with a transverse wound penetrating the knee-joint just above the patella. The patient had been working in the woods, and a woodman's bill had fallen from a bough above him, and, striking the lowest part of the thigh, had made a transverse wound about two inches in length, dividing the tendon of the rectus femoris close to the patella. A wound was made through the capsular ligament, so large that I could easily introduce my finger into the joint.

"After examining the interior parts of the joint with my finger, that no extraneous body might be left there, I united

(*) Second edition, London, 1810, page 359. The quotation is a transcript, with only the omission of immaterial details.

the lips of the wound by three stitches of the interrupted suture, taking care to lay hold of nothing with the needle but the integuments. I could not remove all the blood from the inside of the joint, for that continued to flow as long as my finger remained in the wound. Neither could I favour the discharge of that blood which remained in the joint, by any method of placing the limb which would answer my principal intention. But I hoped that, if inflammation could be avoided, the extravasated blood would be absorbed without danger.

"That I might keep the knee quite steady, and the injured parts in a state of relaxation, I placed the man in a supine posture, with his leg upon a pillow in a heavy fracture-box, and covered the wound with ceratum saponis, spread upon a pledget of tow. This method kept the anterior parts of the knee, with the rectus femoris, in a state of the greatest relaxation, and the external air was excluded without making any pressure upon the injured parts. I gave directions that all possible care should be taken to prevent the motion of the joint upon any occasion. The patient complained of smarting in the wound for about half an hour after the dressing, but had afterwards no return of pain. The same treatment was continued, and the ligatures cut out upon the tenth day after the accident. The patient recovered so well, that in the space of four weeks he became able to move about in the ward upon crutches. He regained the perfect use of his limb."

Be good enough to note that in this case, as in mine of George Thomas, the knee-joint was extensively opened, and the great tendon completely divided close to the knee-cap. Mr. Hey, like myself, trusted to the extravasated blood being absorbed, and was fully alive to the paramount necessity of immobility, though he adopted different means to secure it; in both cases the wounds were accurately closed and the

air excluded, the sutures and dressings were not touched for many days, and recovery in both was rapid and complete. One material point of difference in the treatment calls for remark. Mr. Hey observes that he made no pressure upon the injured parts. I steadily and uniformly compressed the injured joint with a circular bandage, over an intervening pad of picked oakum and cotton-wool, and applied smooth pressure from the toes to the groin.

In the Surgical Clinique of the elder Larrey, are recorded great and brilliant advances in many departments of surgery, in none more so than in the treatment of wounds into the larger joints.(*) He clearly understood, and impressively taught, the value of gentle pressure, immobilization, and of infrequent dressings. In keeping parts at rest he employed, besides adhesive plasters, a retentive apparatus composed of compresses and pledgets of tow soaked in a mixture of Goulard's extract, camphorated spirit, and white of eggs; bandages externally. He specially counsels that, apart from accident, such as hæmorrhage or unforeseen displacement, the apparatus is not to be removed before the twenty-first day. He adds, that it is even beneficial to leave it until the cure is completed.

Let me translate the main facts of one of Larrey's cases :–

"At the combat of Salahiez, in Egypt, one of our dragoons received, from one of Ibrahim Bey's Mamelukes, a sabre wound on the shoulder, extending obliquely from the acromion to the anterior border of the axilla. The inner part of the deltoid was divided in almost its whole depth, the edge of the acromion was notched, the anterior and internal wall of the joint capsule was wounded to the extent of four or five lines, and the head of the humerus was slightly cut. I

(*) Clinique Chirurgicale exercée particulièrement dans les Camps et les Hôpitaux Militaires depuis 1792, jusq' au 1829. Par le Baron D. J. Larrey. Paris, 1829. Tome Troisième, 371, *et seq.*

proceeded immediately after the combat to dress the patient. . . . We placed a pad surrounded with tow in the axilla, so as to press outwards against the posterior part of the joint. A circular bandage was then applied to the whole limb with light uniform compression. We united the edges of the wound by means of adhesive straps and an appropriate bandage; the fore-arm was placed in a sling, and the wounded man was sent to the hospital at Cairo, where we saw him some days afterwards. According to my instructions, the apparatus had not been touched. . . . . I removed it myself for the first time on the ninth day. The wound was almost entirely healed without swelling or inflammation of the limb. After some weeks of care and rest, the soldier went back to duty."

Let me direct your attention especially to the fact that Baron Larrey himself, chief surgeon to Napoleon's army in Egypt, stooped down in the ambulance to dress the wounded dragoon, and followed him to Cairo, to dress him again the ninth day after he received his sabre wound;—one of many lessons in which the great surgeon gave proof of his conviction, that surgical success is a question of gentleness and accuracy in surgical dressing, worthy exercise for a master of his art.

I must ask you to listen to another abstract from the Baron's clinique:—"The coachman of the Marchioness de Grouchy, falling from a height on to the edge of a footpath with his leg bent, had cut through the quadriceps tendon at its insertion into the patella, as well as the integuments covering it. We placed the extended limb in an immovable apparatus, and it remained in it for ninety days; during this time the dressing had only been renewed ten times. The man returned to his employment as a coachman. We have similarly treated with success, in several of our soldiers, wounds of the knee with transverse or oblique division of the patella. These patients having been dressed by us imme-

diately after the accident, the bony fragments have been accurately consolidated, and the movements of the joint have been preserved."

To pass from old to modern times, from the historic battle fields of Egypt, to the virgin forests of far West America, here is another case of most severe and extensive wound of the knee-joint treated on what I have taught you to regard as principles of sound surgery :—

Dr. A. P. Knowlton, of Olmstead Falls, Ohio, records (*) that he was called, December 5th, 1872, to see a lad, aged eleven years, who had received a severe wound of the knee. The boy was in the forest with his father, where the latter was chopping wood. The boy had climbed a sapling close by; the sapling bent over, and the boy slipped and fell, coming down in front of the father just as he was bringing down his axe. The axe struck the left knee of the boy, severing the patella, cutting down on the outside of the knee-joint, penetrating the joint with a cut through the synovial membrane about one inch long. After arresting the hæmorrhage and brushing over the cut surfaces with a solution of perchloride of iron, they were carefully placed in apposition and secured with silver pin sutures. A figure-of-eight bandage was applied to hold the fragments of the patella in apposition; a long splint was then applied from the axilla down to about six inches below the foot; an inside splint reaching from the lower part of the upper third of the thigh to six inches below the foot; cross-piece below the foot, another one just below the knee, and one just above; a rack was framed around the joint, leaving a chamber from the integument to the inside of the rack about one inch in diameter, and this rack was covered with relays of ice-bags. The boy was ordered a one-grain opium pill

(*) *American Journal of the Medical Sciences.* Philadelphia, 1876, Vol. I., p. 413.

every four hours; gentle extension and counter-extension was kept up. This treatment was continued for eight days, when the ice-bags were discontinued and the wound dressed with dilute alcohol and carbolic acid. At the end of three weeks the splint was removed each day, and passive motion practised. The lad made a good recovery, and now has complete use of the leg with perfect motion of the knee-joint."

The opium pill every four hours was a wise prescription; the sedative influence of the drug is of great service in keeping patients quiet, after severe injuries and operations; but discrimination must of course be exercised, as to dose and repetition.

Nothing could have been more effective than Dr. Knowlton's appliances for securing the immobility of the limb. The long wooden cradle, with the bags of ice, precluded all possibility of motion.

I look upon the dilute alcohol and carbolic acid employed, as surplusage; for it is expressly stated that the apparatus and ice-bags were continued for eight days, when primary union had been obtained. The perchloride of iron solution which was brushed over the cut surfaces, acted in principle like the balsamum traumaticum, the styptic colloid, and the allied agents to which we have already referred; and of its good qualities I once had accidental, but impressive, proof. Having removed a very large cancerous breast, after twisting some vessels, I proceeded to brush over the surface with a thick camel-hair pencil dipped in what I believed to be styptic colloid, which is very similar in appearance to the tincture of the perchloride of iron. Noticing the peculiar stain of the latter on my fingers, I instituted inquiry after the operation, and it was proved that an assistant had by mistake poured out for my use the preparation of iron, instead of the colloid styptic. I never had a case heal more

rapidly and solidly, and with less pain and suppuration than the one in which this incident occurred.

All the instances of penetrating wounds of joints on which we have been commenting, have been primary, and the opening into articulations having been diagnosed from the first, appropriate treatment has been instituted, before serious complications have arisen.

Here are notes of a case of a different kind, of which most of the essentials have been already published, with one important omission,—the chief cause of the complication. The young gentleman who first saw the case (now several years ago), in the out-patient room, failed to appreciate its importance, and only called my attention to it, when extensive inflammation had made such progress, as to threaten the limb and the patient's life. What made the matter more serious was the fact, that the wound was inflicted with alleged criminal intent; and, in the not improbably fatal issue, another life might have been involved.

CASE LXI.—*Compound fracture into the elbow joint. Inflammation and suppuration. Recovery under immobilization, position, absorbent dressings, and compression.*

S. M., æt. 32, was admitted into hospital under my care 4th March. Pulse 120; resp. 26; temp. 102°. The left upper limb generally—but especially at and near the elbow—was red, hot, swollen, and very tender. A transverse irregular suppurating wound, 1½ inches by ½ inch, extended from the olecranon to the outer condyle. On wiping off the pus with a pledget of lint, the bottom of the wound was grey.

The circular measurements of the two elbows were—

	Right.	Left.
At point of olecranon -	$9\frac{1}{2}$ inches.	12 inches.
3 inches above - -	$8\frac{5}{8}$ „	$11\frac{3}{8}$ „
3 inches below - -	$8\frac{3}{8}$ „	$9\frac{3}{4}$ „

The injury, I was informed, had been inflicted four days previously, by throwing a glass bottle at the elbow. When first seen, the contused wound contained some bits of glass, and a small fragment of the olecranon, which was bare and fissured.

Considering the facts reported, and those before me, it was clear that we had to deal with a compound fracture of the olecranon, the wound penetrating through the bone into the elbow-joint, which, with the whole limb, was intensely inflamed. There was at the same time high constitutional fever. Having satisfied myself that no foreign body remained in the wound, I prepared moist pasteboard splints to immobilize the arm in the extended position. Whilst the patient was lying in bed, I raised the arm vertically to empty it of blood so far as practicable, covered the limb with absorbent gauze and cotton pads, and with a soft absorbent bandage and even pressure moulded the splints, one on the anterior and the other on the inner aspect. In this application the wound and surrounding parts, for about two inches, were left exposed, and afterwards covered with a separate absorbent pad and compressing bandage, so that these could be changed without disturbing the general apparatus. I secured the arm on pillows with the hand well raised. Seven hours later, the arm quite easy; discharge through dressings at elbow; the bowels not having been opened for two days, an ounce of castor-oil prescribed.

March 6th (48 hours after admission).—Temp. 103°; pulse 120; resp. 24. Bowels have acted freely. Arm easy. Apparatus loose from subsidence of swelling. On removal

of absorbent pad from elbow (for the first time) it is found soaked with pus, which is quite odourless; wound cleaning at edges. Arm, so far as can be seen, softer and paler. Another absorbent gauze and cotton pad bandaged over wound, with increased pressure. On asking the patient immediately afterwards how the arm felt, her reply, noted down, was—"*Beautiful, as if in a glove.*"

March 7th.—Temp. 101°; pulse 108; resp. 26. Discharge has permeated pad at elbow; on removing the pad it is found soaked in the centre with odourless pus; bottom of wound clean; surrounding parts much paler and shrunken. Another absorbent pad and compressing bandage applied at elbow.

The next day the woman was delirious, and for a fortnight she continued violently maniacal, requiring the attendance of special nurses day and night. The same dressing continued to the arm throughout, and nothing could be more satisfactory than the local progess. The patient's general state is now (April 7th) quite satisfactory; she is rational, eats well, and gets up daily. The wound is quite clean and superficial, the discharge very much decreased, and the absorbent pad is only changed every fourth day. The limb is of natural shape and colour. The dimensions at the elbow which can be moved with comparatively little pain, are now:—

		Decrease since admission.
At point of olecranon -	$9\frac{5}{8}$ inches.	$2\frac{3}{8}$
3 inches above - - -	$8\frac{7}{8}$ „	$2\frac{1}{2}$
3 inches below - - -	$8\frac{5}{8}$ „	$1\frac{1}{8}$

The patient having a comfortable home was allowed to leave the hospital. The wound healed in the course of a week, and at the end of a month the elbow had regained considerable freedom of movement, but I then lost sight of the case.

CASE LXII.—*Wound into the knee-joint overlooked for a fortnight. Extension, inflammation, and suppuration. Recovery after drainage, immobilization, and compression.*

A. B., æt. 30, sent in from the country to be under my care. A fortnight previously he had accidentally wounded the outer part of the left knee with a long knife ; a good deal of blood and glairy fluid had escaped. Strips of adhesive plaster and a bandage were applied, and the man attended to his business, until disabled by great pain and swelling. I found a greyish-red gaping wound, about an inch long, on the outer side of the left patella, which floated on a swollen knee full of matter. The limb was so swollen, that the bony eminences were obliterated. I introduced a drainage-tube through the wound into the joint, packed the whole limb with cotton-wool, immobilized and compressed with pasteboard splints and bandage, laid long heavy sand-bags on each side, and raised the lower end of the bed six inches on blocks of wood. Progress was rapid and unchecked ; a fresh compressing bandage was applied ; the apparatus was not changed until the end of the week. At the second dressing, a week later, the drainage-tube was removed, and the wound was healed at the end of the month, with fair prospect of a movable joint.

CASE LXIII.—*Suppuration of the knee-joint. Proposed amputation. Recovery after drainage, compression, and suspension.*

Mr. ——— called on me one evening to see his wife, who was to undergo amputation of the thigh the next day, by the urgent advice of the family attendant and of a hospital surgeon. When I met those gentlemen in consultation, I found the right knee-joint full of pus, in a delicate woman who had been ill some weeks. She had a clean tongue and cool skin, and was taking a fair amount of nourishment

The first consultant was for amputation at once. I counselled at least twenty-four hours' delay, to watch the effect of an attempt to save the limb. This advice having been accepted, I passed a drainage-tube. the size of a goose quill, from side to side, through the knee, packed the joint with carded oakum, immobilized the limb with millboard splints and gently-compressing bandage, and suspended it in a swing cradle. Improvement was immediate ; there was no need for re-opening the question of amputation at the end of the first twenty-four hours ; the joint gradually emptied itself of a large collection of pus, and the skin covering it changed, from a red and shining appearance, to a pale and withered look. Pressure was gradually increased, the drainage-tube was withdrawn at the end of three weeks, and not a single untoward symptom occurred. The patient can now walk,—with a limp it is true, but without the aid of a stick, and has continued to enjoy excellent health.

LECTURE VIII.

Physiological explanation and surgical applications of infrequent dressing and compression.

Abstract of Professor Vanzetti's Memoir on the Treatment of Inflammation by Digital Compression.

GENTLEMEN,

The necessarily fragmentary character of clinical instruction based on cases as they occur, is attended with no small difficulty in carrying out one of the chief objects of this course, in demonstrating that sound surgical practice is based on scientific principles, which are physiologically and surgically continuous; of this truth you have had considerable evidence, which, however, is very far from having exhausted the complex subject. In supplementing the deficiency we have the compensating advantages of clinical experience. Cases are constantly occurring, which are rich in opportunity for studying the same facts from different standpoints, and testing the accuracy of principles, by a method nearly as sure as that employed by the arithmetician in proving his calculations. From the study to the bedside, then to the operating theatre and the laboratory, and back to the clinical note-books and the classics of physiology and surgery, is a process which some might think tedious. Certainly it is laborious, and involves a good deal of recapitulation; but it is the only method of attaining the certainty which results from observation and induction.

In the study of organic life you are constantly reminded of the intricate co-operation of numerous, and seemingly conflicting, influences, in bringing about results apparently

simple. Vital, physical, and chemical causes combine, and it is only by taking them all into consideration, that animal functions can be understood. If that be so in the natural state, how much more is it the case when the complications of traumatism and disease come into operation? The truth cannot be ascertained by partial examination; but comprehensive enquiry, and strenuous efforts to exclude error, are necessary, if we are to arrive at what we want to know,—the truth, the whole truth, and nothing but the truth, concerning the recovery from injuries, and the best, the least painful, and the safest method of securing their repair.

Repair, as cannot too often be repeated, is an extension, a development, of nutrition; a complex process due to many influences. In the simplest conceivable flesh-wound, the parts once brought together appear to coalesce at once, by a process of what might be called vital agglutination, apparently as simple, and certainly quite as rapid and effectual, as that by which a carpenter, with the contents of his glue-pot, unites two pieces of wood. But if we next contemplate one of the many serious cases which have come before us, the healing, even if happily free from complications, can only be secured by the minutest attention to a great variety of details, and by conserving and utilizing many natural processes.

The great scheme of nature is characterized by unity of aims and variety of means,—to wit, the vital mechanism of the circulation of the blood and of articular movements; and the processes of secretion and absorption, with all of which, as surgeons, we are intimately concerned. Their physiological results are apparently simple, but their factors are many, and their combinations multiple. So in surgery; given a gash into the knee-joint, laying it widely open, dividing the main tendon, and turning down the patella, the process of healing the formidable lesion, and the result,

may be relied upon with almost mathematical certainty; but, to achieve it, many physical agencies have to be set in motion, with due regard to their relative importance.

Accurate and immovable co-aptation of divided surfaces, we have uniformly dwelt upon as essential to their re-union. Infrequent dressing is a corollary of that fundamental principle of absolute rest. A great truth was embodied in the title of Cesare Magati's 17th century essay, "De rara medicatione vulnerum;" and Belloste was inspired by sound surgical instinct when he thus expressed himself:—"I only dress a wound infrequently, convinced that we must give nature leisure to act, in re-establishing wounded parts in their former state."(*) To quote Sir Astley Cooper, "Union by adhesion is often frustrated by the surgeon's impatience; he is anxious to see if union be effected or not, and most absurdly and mischievously raises the dressings, disturbing, and often breaking, the adhesions, and thus rendering the process of granulation necessary, when it might have been avoided." (†)

No surgeon ever practised in wider fields, or achieved more brilliant surgical victories, than did the elder Larrey. 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 Moscow, in 1812, at my request, set out immediately on his journey homewards,

(*) Le Chirurgien d'Hôpital. Amsterdam: 1707. Chap. XI, p. 195.

†) The Lectures of Sir Astley Cooper on the Principles and Practice of Surgery, with additional notes and cases, by F. Tyrrell. London, 1827. Vol. 3, p. 159.

(‡) Rélation médicale de Campagnes et Voyages de 1815 à 1840. Paris, 1841. Page 268.

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."

It is quite true that in his first dressings Larrey used camphorated spirit and acetate of lead,—a class of agents of unquestionable potency, to which we shall have to refer hereafter; but it is no less a fact, that the cardinal principles, on which the illustrious Frenchman relied, were, immobility, infrequent dressing, and compression. It is with these that we are now more especially concerned.

To meddle is to irritate, and irritation is opposed to healthy nutrition, which is essential to the safe, painless, and rapid repair of wounded structures, so powerfully promoted by infrequent dressing and compression. These are the two great factors in successful wound treatment, to which your attention is now specially invited.

CASE LXIV.—*Removal of enchondromatous tumour from the face.—Dressings not touched for a week.—Cicatrix solid.*

Mrs. Bradshaw, Ward 5, had an enchondromatous tumour, the size of a pigeon's egg, beneath the right zygomatic arch. On removing it, I found the covering skin loose, but the deep parts required careful dissection, to separate the adhesions without injuring the contiguous nerve. After bringing the edges in close apposition, and securing them with three points of silver suture, our house surgeon, Mr.

R. B. Wilkins, covered the part with a pledget of lint soaked in styptic colloid, dry oakum, and a compressing bandage. There was not the slighest pain or constitutional irritation, and the dressings were not touched for a week. They were quite dry, and the surrounding skin of natural colour. The sutures were then taken out, leaving the linear cicatrix firm, and the patient quite well.

CASE LXV.—*Wound (three inches) over and exposing lower jaw.—Cicatrix solid the tenth day, after two dressings.*

Just before admission E. H. ——— had fallen forward on the edge of a barrel, which inflicted a wound nearly three inches long a little to the left of the chin, exposing a considerable portion of the lower jaw and its depressor muscles. The edges of the wound were at once accurately adjusted with five points of silver suture, a fine drainage-tube was secured in the lower angle, and smooth pressure exerted with a fine soft bandage over a pad of pure absorbent gauze



Fig. XIV.

and cotton. The first dressing, with two sutures and the drainage-tube, was removed the third day, when the absorbent pad was found to have taken up some sanguineous discharge, and the greater part of the wound was healed. The three remaining sutures were removed the eighth day. On the tenth day, the wound was solid and the cicatrix linear, with the exception of the lower angle, which presented a slight pucker, at the point where the drainage-tube was introduced.

CASE LXVI.—*Large popliteal aneurism.—Ligature of femoral artery with common catgut in Scarpa's triangle.—Recovery after five changes of dressings.*

Abraham Whitehouse, æt. 32, a brush maker, formerly a foot soldier, admitted April 24th, 1879. In March, 1877, after heavy work, had rheumatic pains at the back of the right knee. Three weeks later felt a beating swelling in that situation, as large as a pigeon's egg. In July he was sent into hospital at Colchester, where it was considered the aneurism had been cured by pressure. But pulsation returned, the swelling grew, and the patient was discharged from the army, in April 1878. During the following twelve months he disregarded his condition, and worked for his living until disabled by pain.

On admission, a swelling nearly seven inches in length, occupied the right popliteal space. It was soft and pulsating. The covering skin distinctly bluish. A loud bruit in the tumour was silenced by pressure on the femoral artery. The circumference of the right lower limb, on a level with the patella, exceeded the left, by four inches and one-eighth.

I tied the femoral artery with plain catgut, May 3rd; and closed the wound, with five silver sutures, except at the lower edge, where I inserted a drainage-tube; dry lint pad

dressing, with cotton-wool over the limb and light pressure. Two days afterwards the temperature rose to 100°, its highest point throughout the treatment. It fell to 99° on the fourth day, with pulse 70; resp. 14. I now removed dressings, and found faintest blush near edge of wound, which was united throughout, except at the drainage-tube, through which a little pus issued. All sutures removed; dressing with narrow strips of plaster, dry pads and gently compressing bandage. The solid tumour gradually shrank, and the patient was discharged at the end of five weeks after five dressings.

CASE LXVII.—*Operation for strangulated femoral hernia.—Two dressings in seven days.—Wound healed.*

Eliza Taylor, aged 75, admitted January 30th, in a state of very great prostration, having suffered for five days from all the symptoms of strangulated hernia. When I saw her, very shortly after admission, the drawn countenance betokened great suffering, vomiting was frequent, the pulse 104 and very feeble, the body emaciated to an extent rarely witnessed. On the left side, in the region of femoral hernia, was a small tumour, on which the taxis had been attempted in vain by the parish surgeon, who had sent the case into the hospital. It was not a case for debate. I directed ether to be administered, and at once cut down upon the tumour. It was necessary to open the sac, before the constricting band could be divided. That done, and the gut restored to the abdominal cavity, I brought the edges of the wound together with two points of silver suture, and over it applied, with gentle pressure, an absorbent cotton-wool and gauze pad, with an absorbent spica bandage.

The report next morning was, "Has slept well, has no pain, pulse 100, resp. 24, temp. 98·3°." February 2nd (third

day after operation), pulse 90, resp. 24, temp. 98·2°; the wound dressed for the first time. A slight amount of discharge had soaked through the bandage and pad. The parts around the wound looked of natural colour and quite healthy. On removal of the sutures the deep parts of wound quite healed. The edges were brought together by strips of plaster, and the dressing completed with an absorbent pad and bandage as before.

February 5th was the date of the second dressing, February 8th of the third. The note this day was, "Pulse 74, resp. 20, temp. 98·4°. Only one or two drops of odourless discharge dried on the pad; wound healed."

The next day, the eleventh since the operation, the patient was allowed to get up. She did so every day since, rapidly improving in general health. You saw her, still of course a very feeble old woman; but, so far as the operation was concerned, the scar was only visible on close inspection, and looked as solid as if it dated from months instead of days.

The four cases just related could not have had a more uneventful course, and a more satisfactory issue. The enchondromatous tumour on the cheek, and the wound exposing the jaw, were not very grave matters; it was otherwise with the strangulated hernia in the very feeble old woman of seventy-five, and with the soldier's large aneurism distended nearly to bursting. In the treatment of all the cases, an essential and leading feature was infrequent dressing, which has the great advantage of allowing the patient to forget the wound, and to enjoy bodily repose, free from nervous apprehension.

It was Sir Henry Holland who remarked, that "the strong and continued direction of the attention to a part, in all probability affects either its innervation or its circulation, or both," and, I would add, its nutrition, too.

If immobility—material rest—be essential to organic consolidation, a no less potent factor in perfecting it, is unquestionably nervous rest. One of the points on which the consensus of surgeons is happily becoming every day more pronounced, is, that once co-aptation is effected, in wound and fracture treatment, there should be a minimum of irritation and interference. But, with all its advantages, the practice of infrequent dressing is attended with one difficulty, more especially felt with private patients. They are anxious that the surgeon should see how matters are getting on, and cannot reconcile themselves to their injuries not being looked at. The practitioner's tact must minimise this obstacle. The removal of an outer bandage may give satisfaction without doing any harm; and most people become reconciled to a line of treatment, which practically relieves them of all pain.

The principle of infrequent dressing decided, the practical question arises, how often should a wound be dressed? In reply, no definite rule can be laid down. The surgeon's chief guides must be the patient's countenance, attitude, and feelings; the condition of the tongue, skin, bowels, and kidneys; the pulse and respiration ratio, and the thermometer.

I attach very great importance to facial expression and manner of lying, as denoting ease or discomfort; and always take into serious account complaints of pain. A fracture, or an amputation, through the thigh, fracture of several ribs, a large wound in the chest from removal of a tumour, and, in fact, the majority of solutions of continuity after operation or accident, admit of being treated with very little pain indeed. If there be much pain, especially if the pulse, respiration, and temperature be much above the normal standard, something is amiss; the seat of injury should then be inspected, and the constitutional state carefully

enquired into. Constipation is a frequent cause of rise of temperature, and I have repeatedly known the thermometer fall two, and even three, degrees within twelve hours, after an evacuation of the bowels. Rise of temperature may be accidental, and of no importance if only persistent for a few hours. The close watching, which is of the very essence of success, will either remove or confirm apprehension.

After all important operations, pulse, respiration, and temperature should be noted morning and evening; but, in the case of intelligent patients, it is important that they should not see the chart. Alarm and the tension of expectancy, are quite enough to send up the pulse and the thermometer. Mental and bodily rest or unrest go together, and what the surgical patients require is *absolute and complete rest.* (*)

If the signs of constitutional tranquility be altogether satisfactory, I attach very little, indeed scarcely any, importance to the permeation of discharge. If it be reddish, soon after an injury or operation, we know that bloody serosity soon dries by evaporation through our absorbent dressings, which then form a shield-like artificial scab of two-fold potency, by air exclusion and immobilization.

The dressings thus dried after permeation may be left for days, if the thermometric and other signs permit. When at last renewal is effected, the parts under the original dressings are found dry clean and sweet, and the cicatrix in all probability solid, or very nearly so. If, instead of being permeated by sanguineous serum, the dressings be stained by a purulent fluid, the time for change will come

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(*) Some very interesting thermometric observations in relation to wound dressing, are contained in a Note on Wound Treatment, by Mr. William Berry, Hon. Surgeon to the Royal Albert Edward Infirmary, Wigan. Liverpool Medico-Chirurgical Journal. January, 1883. P. 43,

sooner; but must not even then be hastened unduly, beyond the necessity indicated by the signs already referred to.

Pressure, as a therapeutic agency in the general practice of surgery, has not yet attained that position in the estimation of surgeons to which it is entitled on scientific and practical grounds; and we shall now pass some cases in review with the special object of enquiring into the power, and the rationale, of physiological compression in its surgical applications.

CASE LXVIII.—*Amputation of the little finger.—Union by the first intention.*

From the right hand of the man now before you, I amputated the little finger ten days ago, being careful to save enough skin to admit of easy closure of the wound without tension. One bleeding vessel was stopped by torsion. The edges were united by three points of silver suture, and the wound was covered with a pledget of picked oakum; a moist pasteboard splint was now bandaged with equable pressure over cotton-wool padding, to the palmar aspect of the limb, from the tips of the fingers to the elbow, and the forearm suspended in a sling at an acute angle with the arm. At the end of the week the sutures were removed, the dry pad and compressing bandage renewed. On this, the tenth day, you see the linear cicatrix dry and solid, in the midst of parts as healthy as you ever see in the most successful case of hare-lip operation. The after treatment could not have been attended with less pain to the patient, or with less trouble to the surgeon; neither could the process of healing have well been more rapid and solid. Amongst the agencies

which contributed to this result, no single one was more potent than the equable pressure.

CASE LXIX.—*Contused and inflamed wound of the thumb.—Healing under infrequent dressing, position, and pressure.*

This youth is the son of one of our principal ivory and bone turners, who, while practising the other day with a fine circular saw, nearly cut off the soft pad at the end of his right thumb. He did not consult me until the third day, when the little flap was swollen, the wound dirty, the whole thumb throbbing and very painful. On compressing the radial artery with the finger just above the wrist, the throbbing and pain ceased, and I taught my patient how to obtain the relief, by effecting the digital compression himself, with the thumb and index finger of his left hand. I then brought the edges of the wound together with narrow strips of emplastrum elemi, leaving slight intervals for the escape of matter; covered the end of the thumb with a little fine picked oakum, bandaged it so as to effect gentle uniform compression, and supported the hand at an acute angle with the arm. The sling used for the purpose enclosed the elbow, as every arm-sling should do, to be efficient.(*)

Relief was immediate; the dressing was not touched for four days, and only twice afterwards, at intervals of three days. You see the thumb very nearly a match for its fellow, and a linear cicatrix is all that is left of a very ugly wound.

(*) To make such a sling for the right arm of an adult, take a piece of black alpaca or other suitable material about 28 inches wide, and a yard long; fold it cornerwise 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 may be 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 long extremities are carried upwards, on the dorsal and palmar aspect of the forearm respectively, and secured by safety pin.

This case illustrates, like the preceding one, the advantages of dry and infrequent dressings in the treatment of wounds, whether contused or incised. The succeeding case furnishes additional evidence of the benefits to be derived from position and compression in the treatment of inflammation of the limbs.

CASE LXX.—*Inflamed leg-stump; adherent cicatrix; proposed inicision in search of dead bone. Rapid decrease of all symptoms under pressure, immobilization, and suspension.*

A farmer lately came in from the country to consult me under the following circumstances:—His left leg had been amputated, a year previously, for compound fracture in the lower third. Free incisions had subsequently been made below the knee, for phlegmonous erysipelas, and the scars resulting from them, as well as the cicatrix on the face of the stump, were adherent to the subjacent tissues. An attempt had been made to wear an artificial support, but it produced great irritation. The stump swelled, became red and exquisitely tender. The pain was greatest in a long cicatrix on the fibular side, and here it was proposed to make an incision down to the bone.

I recommended that the patient should remain in bed for a few days, and after enveloping the stump and the lower half of the thigh in absorbent gauze and cotton-wool tissue, I applied a smoothly-compressing bandage over a millboard lattice-work, with the knee straight. The limb was swung. The patient was at once comfortable, and had the best night he had passed for months. Two days afterwards, the apparatus being quite loose, I removed it. The parts beneath were pale, shrunken, soft, and painless. There was no more question of incisions. I renewed the compressing apparatus and suspension for a week, when the stump was in as good a condition as it ever can be.

A clear understanding of the value of compression, as distinguished from constriction, is of the very first importance to the successful treatment of wounds, and of surgical injuries generally.

Of all surgical agencies none more beneficent than compression, none requiring more delicate manipulation, none so inadequately appreciated. Under a smooth and uniformly, while lightly compressing, bandage applied to the head, the trunk, or the limbs, extravasations of blood are absorbed, the healing action is promoted, and a soothing influence is exercised. There must be no constriction—only equable adaptation of surface to surface, with the light pressure which always comforts. There must be no squeezing like that of an old college friend's hand, when seen after a long absence; such pressure as that, on tender parts, is intolerable constriction. The soothing surgical pressure is like that which you interchange with the hand of a lady, when the pleasure of meeting her is tempered by a respectful regard. Your hand adapts itself to hers, and gently presses it wherever it can touch it, but nowhere squeezes it for fear of offending.

Doubtless a very great deal depends upon how, and with what materials, pressure is applied. If you bandage a limb firmly with a strong calico roller over ordinary fracture pads or dense common wadding, against wood or iron splints, the risk is unquestionable; but if you use the softest materials, such as you are in the habit of seeing employed in this clinique, especially if you use this beautifully elastic and absorbent gauze and cotton tissue, and soft bandages, you will have reason to congratulate yourselves upon admirable results.

How such pressure, when employed by the surgeon in the treatment of injuries, soothes and heals, is illustrated in,

CASE LXXI.—*Extensive inflammation and acute sensitiveness of leg, rapidly subdued by elastic pressure.*

On the 18th September, 1879, a bloated, middle-aged man came before me in the out-patient room, with his right leg big, tense, purple, and exquisitely tender.

From the full notes taken by my dresser, Mr. W. R. Awdry, I condense the previous history, state on admission, and progress under treatment.

The man had earned his living as a hawker, and been a hard drinker. On admission, the right leg was of greatly increased size, and of deep purple colour; the skin tense and shining, and intensely sensitive to the slightest touch. Circular measurement of the two legs gave the following result:—

	Right.	Left.
At the middle of the patella	18½ inches.	17 inches.
Six inches below - -	18 „	17 „
Round the malleoli - -	14 „	11¼ „

Eight p.m.—Placing the man on his back and raising the foot, I enveloped the limb in a layer of cotton-wool, over which I constructed a compressing millboard and bandage lattice-work.

September 19th, nine a.m.—After the lapse of 13 hours, bandages very loose from the considerable subsidence of swelling, which has taken place in the twelve hours since they were applied. I applied another bandage with firmer pressure, and suspended the limb. The patient had passed a comfortable night, with the exception of some pain between midnight and five a.m. He is now perfectly comfortable.

8.15 p.m.—Has been very easy all day. On removing the apparatus the limb is much paler and softer, and scarcely tender on pressure. The patient's spontaneous expression is, —"It is wonderful how I can bear it handled now, and I

could not stand a feather touching it last night." The following are the circular measurements of the right leg :—

		Decrease in 24 hours.
Mid patella - -	17 inches.	$1\frac{1}{2}$ inches.
Six inches below -	$15\frac{7}{8}$ „	$2\frac{1}{8}$ „
Round the malleoli -	12 „	2 „

The strips of pasteboard were now remoistened, to fit the shrunken limb, and bandaged to it, lattice-work fashion, over cotton-wool with increased pressure. The application last night, though conducted most gently, caused occasional exclamations of intense suffering, but the patient bore it to-night, though executed comparatively roughly, without the least pain. The same process was repeated daily, to follow up the decreasing limb with equable pressure; and, at the end of a week, the two legs were of equal size.

Admitting the beneficial influence of the horizontal position of the body, and of the suspension of the limb in the flexed position, there can be no question that the immediate relief of pain and the rapid subsidence of swelling were chiefly due to smooth elastic pressure. You have had the opportunity of observing in this clinique numerous cases, accurately measured, proving that a similar plan of treatment employed in cases of severe sprain, and after other injuries attended with great tension, heat, and pain, is followed by equally satisfactory results—almost immediate ease, and rapid subsidence of swelling. What is the physiological explanation of the action of pressure in these cases? Are the effects due to hydraulic or vital, to vascular or to nervous influences? In other words, when a limb is greatly distended by the extravasation of fluid within its substance, is the condition due to filtration from disturbance in the balance of pressure, to disordered innervation of the blood vessels, or to a combination of those influences?

In quest of a solution let us revert briefly to case LXXI. (p. 187)

In that big, tense, shining, purple leg, the extreme sensitiveness admits of explanation, by the irritation to which the nerves were subjected in the inflamed, swollen, and solid limb. The irritation of the nerve-filaments, carried along their trunks to the respective vaso-motor centres, became a cause of still further vascular excitement; and so a circular chain of intensifying cause and effect was established,—more blood and extravasation in the limb, more nerve-fibre irritation, greater vaso-motor excitement, and proportionately greater determination of blood and its inevitable results,—corpuscular migration and exudation of plasma.

The condition of a distended limb may presumably be held to pervade all the tissues, but especially the blood-vessels. I am greatly impressed by the bearing on this point, of a passage in a recent paper by my friend and colleague Dr. Robert Saundby. Writing on obliterative endarteritis, and the inflammatory changes in the coats of the small vessels, the author sets out with this generalization, as the result of his microscopic investigations. "The changes in the vessels agree very closely in character with the changes in the surrounding tissues. Where the inflamed parts are swollen and infiltrated, swelling and infiltration will be found in the vessels; and where the inflammation gives way to organisation, however low in type, this is repeated in the vascular walls." (*) If so, one explanation of the influence of rest, position, and pressure, in reducing a swollen limb, may be their direct action on the swelling and infiltration in the vessels.

The mere act of laying our patient on his back and raising the foot had a tendency to empty the leg of some of its redundant blood; and the elastic pressure of the millboard

(*) The Journal of Anatomy and Physiology, Normal and Pathological, Vol. 17, p. 180, part 2. January, 1883. Macmillan & Co.

and bandage lattice-work over cotton-wool rapidly and powerfully contributed to the same result. The experiment of raising one hand vertically above the head, while the other is held dependent by the side, proves the rapid influence of position in emptying a limb of its blood, for in a very few seconds the raised hand is pale and comparatively exsanguine.

Charles Bell (†) had a clear conception of the ease with which a limb can be emptied of much of its blood by bandaging, when he advised rolling a limb before amputation, to empty the veins into the general system and save blood. This is the expulsive principle which Esmarch has carried out, with so much thoroughness and usefulness, in his apparatus for bloodless operations, and which, in a minor degree, operates in our compressive apparatus.

In the big, purple, tender limb, on which we are commenting, the balance of arterial and venous pressure which had been disturbed, beyond the possibility of natural readjustment, was restored by position and external elastic pressure. So soon as the normal hydraulic condition of the local circulation was re-established, the man was at ease, and the limb quickly softened and shrank.

When considering the means at our disposal for the arrest of hæmorrhage, I dwelt (*) on the importance of taking into account the physical, as well as the vital forces and conditions, of the circulation. It is especially important to do so when studying the influence of gravitation and pressure on congestion, which is the preliminary stage of inflammation.

If you turn on its side a human corpse, which has been lying on its back some hours, you note that while the anterior parts of the body are pale, the posterior are congested, but not uniformly so. The skin covering the shoulders, the backs of the elbows, the sacrum and buttocks, and the calves

(†) Illustrations of the Great Operations of Surgery. London : 1821, p. 5 .

(*) Lecture II, p. 34—38.

of the legs, is comparatively, often quite, pale. Those are the points on which pressure is exerted. In the hollow of the loins, and, as a rule, in all parts at the back which are not compressed by the weight of the body on the table, the gravitated blood has imparted the damson stain of ongestion.

If a limb, affected with erysipelas or congestion, be allowed to lie flat on the bed, you will find that the posterior part, if not quite pale, is yet much paler than that which is not compressed. When dressings with elastic pressure are applied to an inflamed or congested part, discoloration remains most perceptible in the parts least compressed, and especially in those beyond the limit of pressure.

Gravitation influences the circulation as an accessory, when the vital forces are in full vigour. Whenever these fail, the effects of gravity and consequent expansion of the walls of the vessels, and effusion through them become manifest.

It is also a noteworthy fact that absorption is the "less rapid, the fuller and tenser the blood-vessels are;" (*) so that it is reasonable to assume, that vascular distention being reduced in a swollen limb by rest,eposition, and pressure, these influences, in direct ratio, accelerate the resorption of the products of extravasation.

If anyone reflects on the powerful hydraulic engine contained within us, on the velocity of the blood current, on the close elastic packing of all the tissues and organs of the body, on the elasticity and strength of the integumental covering, it cannot be matter of wonder that a solution of continuity, such as a wound or a fracture, is attended with serious results. In so far as they are due, as they are in fact to a considerable degree, to a disturbance in the balance of

(*) Kirkes' Hand-Book of Physiology, by W Morrant Baker, F.R.C.S. Tenth edition. London, 1880. P. 375.

pressure, it is intelligible that equable elastic compression, must powerfully aid in restoring the physiological condition, of which it is a close imitation.

Gravitation is the chief physical cause of the greater tendency of the lower, than the upper limbs, to swelling and ulceration; and it suggests the explanation of the therapeutic power of elastic pressure, in promoting the healing of ulcers of the legs.

The analogy between dead and living organic matter is a fruitful source of fallacy carefully to be guarded against; but the case I am about to quote illustrates the application of the observations made a short time since, as to the colour at the back of a corpse.

CASE LXXII.—*Comminuted fracture of radius and ulna, extensive brusing in the perineum. Skin pale on parts compressed.*

William Carpenter, age 19 years, was admitted June 20th, 1879.

Shortly before admission, the scaffolding on which the patient was working gave way, and he fell a distance of thirty feet; a pair of pulley blocks, about one cwt., falling at the same time upon the upper end of his right arm.

Note on admission.—" Patient is suffering from severe shock; the right forearm is tense, swollen, discoloured, and deformed; there is comminution of radius and ulna at the junction of middle and upper third. There is some swelling about right buttock, with pain and tenderness."

The limb was rolled with cotton wadding, and plaster of Paris bandages applied, from centre of arm to end of metacarpus.

June 25th.—Arm comfortable; case rather loose; patient free from pain; a large hæmatoma has formed in front of right tube ischii, surrounded by ecchymosis, which

extends forwards along the perineum to the scrotum, and upwards beyond the iliac crest; the skin posteriorly is normal in colour throughout the region of pressure consequent upon dorsal decubitus. The contrast is most marked between the pale skin, where compressed by lying upon, and the dark blue ecchymosis just beyond that limit.

It is also reasonable to assume, though not so easy to prove, that just as pressure applied externally prevents blood stasis, it is opposed to the stasis of lymph. I expect that the more closely the matter is enquired into by physiologists, the more clearly it will be seen, that the surgical effects of pressure are based on demonstrable scientific principles.(*)

In passing from physiological explanation to surgical practice, it is scarcely possible to dwell too frequently, or too emphatically, on the distinction between compression and

(*) I have much pleasure in acknowledging the obligations under which I have been placed, by discussing the physiological action of surgical pressure with my friend and colleague, Dr. A. H. Carter, with my brother, Professor Arthur Gamgee, F.R.S., and with Professor D. J. Hamilton, of Aberdeen. The article by the latter on the Process of Healing (Journal of Anatomy and Physiology, London: Macmillan & Co., July, 1879. P. 319.), written from an independent scientific stand-point, is full of suggestions for the practical surgeon, who will also find much valuable information on the history and value of surgical compression, in:—M. Lombard, Opuscules de Chirurgie, sur l'utilité et l'abus de la Compression, et propriétés de l'eau froide et chaude dans la cure des maladies chirurgicales, Strasbourg, 1786; Neue Bermerkungen und Erfahrungen zur Bereicherung der Wundarzneykunst und Arzneygelahrheit von Christian Johann Anthon Theden. Berlin und Stettin, 1782–95; P. Brétonneau de l'utilité de la Compression, et en particulier de l'efficacité du bandage de Thêden dans l'inflammation idiopathique de la peau. Thèse présentée et soutenue à la Faculté de Médecine de Paris, le 7 Janvier, 1815, in Collection des Thèses soutenues à la Faculté de Médecine de Paris, t. 1er.; Marjolin, article Compression, in Dictionnaire de Médecine, Paris, 1822, Vol. 5, p. 51; A, Velpeau, Memoire sur l'emploi du Bandage Compressif dans le Traitement de l'Érysipèle Phlegmoneux, de la Brûlure, et de plusieurs autres Inflammations Aigues des Membres. Archives Générales de Médecine, t. 11, p.p. 192 et 395. Paris, 1826; L. J. Sanson, article Compression, in Dictionnaire de Médecine et de Chirurgie Pratiques. Paris, 1830. T. 5, p. 387; J. L. Ogilvie Will, on Some of the Surgical Uses of Elastic Compression. Edinburgh Medical Journal, March, 1879; Ch. Sarazin, article Compression, in Nouveau Dictionnaire de Médecine et de Chirurgie Pratiques. Paris, Baillère: 1872. T. 8e., p. 779 et seq. The writings of Mynors, Baynton, John Scott, Seutin, Burggraeve, Martin of Boston, Bryant, and Esmarch, quoted in other parts of this volume, are also rich in evidence proving the surgical value of pressure.

constriction; this strangles and destroys, that comforts and repairs. Constriction is hard and sharp, violent and painful; compression is elastic and soft, gradual and comforting. Nothing more soothing to an injured part, nothing more powerfully conducive to the balance of innervation and circulation, to the prevention of sanguineous and inflammatory effusion, and to its removal when it has taken place, than gentle, equable, elastic compression. Its application is greatly facilitated by bandaging evenly, with a rapid spiral and without reverses, over absorbent gauze and cotton tissue, the elasticity of which is practically indestructible.

By this method and with these materials, it is possible to apply very considerable pressure with comfort and safety; but, where it is necessary to do so, I always immobilize the part; and, whenever practicable, also suspend it, so as to reduce functional and nutritive activity to the minimum consistent with life.

It is of the first importance to have a clear conception of the very considerable effect speedily produced by light compression. This is abundantly proved in experiments, and in surgical practice for the arrest of hæmorrhage. It is conceded by authorities (*) that compression is one of the most powerful therapeutic agencies in counteracting the effects of chronic inflammation, but the effect of light surface pressure, in preventing and treating acute inflammation, is not so generally known. Hang the hand down in a basin of hot water, and, when you take it out, compress the reddened skin lightly; at first with the tip of a finger, then with some of our elastic tissue. On removing the pressure abruptly, you will soon become convinced how rapidly, and under what slight elastic pressure, the artificially inflamed skin becomes deathly pale;

(*) Die Allgemeine Chirurgische Pathologie und Therapie von Theodor Billroth. Achte Vermehrte Auflage. Berlin, 1876. P. 182.

all the more of course, if you raise the hand vertically, then bend the elbow at an acute angle, immobilize the limb, and simultaneously compress the inflamed surface. The experiment will demonstrate how immobility, position, and compression assist each other, and how, jointly, they attain a potency unrivalled by any other triple combination in surgical therapeutics. Clinical experience supplies abundant confirmatory evidence.

CASE LXXIII.—*Severe onychia and inflammation of the great toe.—Cured by immobilization and pressure.*

I was consulted in the case of a middle-aged gentleman, of full habit, but without gouty history. Two months previously, while cutting the big toe-nail of his right foot he injured the end of the toe. It swelled and became painful. He had the advantage of attendance by two very able practitioners, who applied a variety of lotions, fomentations, and poultices, partially excised the nail, and had, in fact, as I was assured, done almost everything. The patient, in robust health, was confined to his bed, wholly disabled by the exquisitely painful toe. When I visited him, in consultation, I found a bread poultice secured on the end of the toe, by means of a handkerchief crossed over the ankle. So timid was the patient, that it was only after some little persuasion that he would allow me to remove the poultice. This done, and all its particles gently wiped off with a piece of dry soft lint, I exposed a big, tense, shiny red toe, exquisitely tender to the slightest touch. In the place of the nail was a dirty, reddish-grey sore. This I covered with a thin layer of muslin soaked in a solution of borax and glycerine. I enveloped the foot and ankle in a layer of fine cotton-wool, applied a piece of moistened pasteboard to the sole of the foot, extending from a little beyond the heel to half an inch in front of the great

toe, and broad enough to embrace the tread of the foot. Across the ankle I placed two diagonal strips of moistened pasteboard; and over the whole a smoothly, but decidedly compressing bandage. The dressing was completed by fixing with a few turns of bandage a dry pasteboard splint to the sole of the foot, and securing the lower part of the limb in the hollow of a pillow, tied round it with a couple of pieces of bandage.

The patient was immediately comfortable, and continued so. He passed a good night, and when I saw him next day was quite easy. On removing the dressing after twenty-four hours, the toe was comparatively pale and shrunken, and could be handled comfortably. I reapplied the same dressing, but with firmer pressure. Forty-eight hours later, improvement continued without interruption. I found the toe still further reduced; and as the sore, though healthier, was not quite clean, I brushed over it, and into the crevices, at its root and sides, with a fine camel-hair pencil dipped in the following lotion:—borax, half a drachm; compound tincture of lavender, a drachm and a half; glycerine, an ounce and a half; water, six ounces. This application did not cause the least pain, and when I had once more immobilized and compressed the foot, I was able to drop it, from the height of a couple of feet, on to the couch without the least discomfort. Within a week, the patient went out for a drive; a few days later he was able to walk well, and left for a tour on the continent.

The lotion applied to the sore was unquestionably of value in promoting its healing; but it was not applied, until after very marked improvement had attended immobilization and pressure. This treatment was attended with immediate relief. Well do I remember the patient and his wife assuring me, after I had very gently taken off the bread poultice, that the toe was so sensitive it could not bear

touching. I have heard such statements of many inflamed joints and limbs; but equable compression, physiological position, and immobilization, soothe them like charms. I know nothing in surgery more noteworthy than the considerable elastic pressure which can be borne with the most perfect comfort, by a part just previously so sensitive that the slighest touch may have been intolerable.

In-growing toe nail is a good illustration in point. Given an extreme case, with the inner edge of the nail curled into the sore flesh, out of which dirty red granulations spring, the fleshy pad on the inner side of the toe rising to overlap the incurved nail. The toe itself is at the same time swollen, red and tender. In such a case, while the patient is sitting before me, I place his foot between my knees, and drawing aside the pad of the toe pass a fine probe gently under the nail, with enough cotton-wool to raise its inner edge a little, and prevent its cutting into the sore. I touch the granulations with solid sulphate of copper, and place, over them and the flesh pad on the inner side of the toe, a pad of lint, which I fix with decided pressure, by a long spiral strip of adhesive plaster, commencing on the inner side of the foot well above the ball of the toe, and winding round it and the lint pad. As a rule, with the rarest exceptions, the patient, who previously might only be able to stand uneasily, can now stamp his foot down and walk away with comfort. For a completion of the cure, the dressing may have to be renewed a few times, at four or five days interval. Wide boots with easy tread must be worn; otherwise the naturally defective conformation of the foot, which is a prime factor in these cases, is very likely to lead to recurrence. But the patient can soon be taught the reason of his suffering and of his cure, in which well adjusted pressure is the chief agency.

Well adjusted elastic pressure is also of great value in the treatment of bubo, burns, and carbuncles, (*) and some surgeons have recommended that it be applied by means of sponges. (†) Independently of other considerations, absorbent gauze and cotton-wool dressings have these advantages:—the same process which renders them absorbent, deprives them of all impurity; their elasticity cannot be surpassed; and they are so inexpensive that there is no inducement to preserve them. Their destruction by burning after change of dressing, ensures a perfectly pure renewal.

In the injury to the boy's thumb (Case LXIX, p. 184), which occupied our attention a little while ago, it was noted that in addition to the application of smooth elastic pressure to the surface, the radial artery was compressed with the finger just above the wrist, and the pain and throbbing then ceased.

It is many 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 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

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(*) Clinical lecture on the Treatment of Anthrax, delivered at St. Vincent's Hospital, by Dr. O'Farrall. Re-printed from the *Dublin Hospital Gazette.* Dublin: Browne and Nolan, 1858.

(†) Cases in Surgery, with Remarks. Part I. By Charles White, F.R.S., Surgeon to the Manchester Infirmary. London, 1770. P. 151, et seq. An Appendix to an Enquiry into the Present State of Medical Surgery, by the late Thomas Kirkland, M.D. With Preface, Notes, &c., by James Kirkland. London, 1813. Contributions to the Pathology and Practice of Surgery. By James Syme. Edinburgh, 1848. Pp. 77—8. Sept. 3rd, 1881, pp. 423—5. The Constantly-moist Antiseptic Sponge Dressing in Surgical Enquiries, by Furneaux Jordan, F.R.C.S. London. 2nd edition, p. 126. On the Use of Sponge Pressure as a Surgical Dressing, by James Hardie. Lancet, vol. 2, 1881, p 658.

arterial trunks, in the treatment of injuries and diseased conditions of the limbs other than aneurism.

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 lessening the blood supply, checking spasm, and promoting absorption of bloody or inflammatory effusion. Unquestionably, digital compression is in the front rank amongst the resources of conservative surgery ; for it is harmless, when not actively beneficial, and a very short time suffices to determine its real value in doubtful cases. Physiologically, the principle of treatment is a sound one ; clinically, it is of real efficiency.

Every practitioner has ample opportunity for proving, by a perfectly safe and easy method, 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 principle, and conservative in its object. Digital compression gives relief, though often only auxiliary to other remedial measures, alike in whitlow and phlegmonous erysipelas, in arthritis and compound fracture.

From the combination of equable elastic compression of the surface, and digital compression of the main artery of a limb, the most beneficial effects may be anticipated in removing pathological products, and restoring the physiological state.

Professor Vanzetti's Memoir (*) on "The Treatment of Inflammation by Digital Compression," is so little known, and is so difficult of access, that a condensed translation of

(*) Observations on the Treatment of Inflammation by Digital Compression, by Dr. Tito Vanzetti, Professor of Clinical Surgery in the University of Padua. Giornale Veneto di Scienze Mediche, Vol. 10, Serie 2.

it may, I trust, prove an acceptable and useful appendix to this lecture.

"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.

"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.

"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 may learn how to compress an artery, as shown in this 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 caster, of light build, admitted 28th March, 1858.

"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 into 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 limb affected with acute arthritis than in the sound one.

"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, arterial 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.

"Padua, 1st April, 1858."

LECTURE IX.

Dry and absorbent dressings generally applicable.—Modifications necessary in special cases.

GENTLEMEN,

Dry and absorbent dressings, to which it is my present purpose to direct your attention, are so intimately associated, physiologically and mechanically, with infrequency and compression, as factors in wound treatment, that we may be compelled again to travel over ground already trodden. On the other hand, the principles and physical action of absorbent dressings, are so closely allied to those of drainage and antiseptics, that we may, to some extent, trench on the matter of succeeding lectures. Sharp distinctions are impossible in a subject, the underlying principles of which are essentially continuous, and practically indivisible. The course is so arranged, that recapitulation may be as brief as possible; where it is inevitable, I hope to make it profitably subservient to general principles and daily work.

In general terms it may be said that repair and consolidation, decay and liquefaction of animal structures proceed together,—and that healing is rapid, in direct ratio to dryness and compactness of tissue, in inverse ratio to effusion and laxity. The inference that surgical dressings are perfect in proportion as they contain less water, and are more active in carrying off discharges, finds abundant support in practice. But it would be a great mistake to argue from this generalization, in favour of the universal applicability of dry and absorbent dressings, pure and

simple, to wound treatment. The modifications which are necessitated by constitutional and local pecularities are numerous.

CASE LXXIV.—*Ulcer and great swelling of leg, of seven years standing.—Cured in three weeks, under absorbent dressings, pressure, and suspension.*

T. H., æt. 33, presented himself in the out-patient room, on the 17th May, 1880. I transcribe the notes taken at the time by Mr. Aubrey Finch, acting house surgeon. This patient is a well-built, healthy man, by occupation a wood-turner, standing all day at his work. Seven years ago a piece of lignum vitæ grazed his right leg, and produced inflammation followed by ulcers, which have never since entirely healed, though treated by a variety of surgeons. When I first saw the leg (May 17th) it was covered with varicose veins; the skin, especially in the middle third, was thickened, purple, shining, and very tense and tender. On the inner side was a sore three inches in length, one inch and a half wide, with dirty greyish-yellow surface, and a few weak-looking, flabby granulations; the edges of the sore were uneven. The measurements round the two calves, six inches below the patellæ, were—right, $14\frac{1}{2}$ inches; left, $12\frac{3}{4}$ inches. Placing the man on his back on a couch, and raising the leg vertically, it became almost immediately pale, the veins empty, and the tissues of the calf, previously so tense, flabby. At the expiration of sixty seconds, from the time that an assistant held the right foot vertically above the pelvis, I measured the right calf at the same spot previously tested. The decrease proved to be exactly one inch in one minute. A piece of lint soaked in glycerine was placed over the sore, the limb was covered with dry pads of pure absorbent gauze and cotton, bandaged with light pressure, and suspended. The patient was at once easy, and two

days afterwards the limb was pale and shrunken, the sore clean, healing, and much diminished in size. The same treatment was continued, and the note on the eighth day is to the effect, that the sore had nearly healed, and that the calf measured at the point previously tested, 12⅞ inches;—a decrease of 1⅝ inches. On the twentieth day, from the commencement of our treatment, the large sore, which had proved so rebellious for seven years, was firmly healed, and the surrounding tissues were pale, supple, and painless.

Rest, position, and pressure were doubtless the great factors in this healing process,—the glycerine acting as a soothing application to the sore and skin, which we had found so exquisitely tender. The cotton pads absorbed whatever discharge was poured out; but their great elasticity, as a medium of smooth pressure, was their chief value. The scantiness of the discharge was a noteworthy feature in the case, and that admits of ready explanation. One effect of immobilization, suspension, and pressure, is to lessen the afflux of blood to a limb so considerably, that there is only enough for nourishment,—none, or scarcely any, for effusion and cell proliferation; so shrinkage, dryness, sweetness, and reparative consolidation, proceed abreast.

The fact deserves to be recalled, that when the man was placed on his back on a couch, and his big red leg held up, with the foot in a perpendicular line from the buttock, the limb rapidly became pale and flabby, and decreased one inch in circumference in sixty seconds. This result was repeatedly tested, by making the man get up and walk about to re-distend the leg, which was again raised when the man was on his back, and measured by several of the lookers on,—one placing the tape, and another looking at the numbers; the results being silently noted by a third observer, and the successive measurements being subsequently compared. All tallied. The decrease in circumference was, as stated, one inch in one minute.

The skin of the leg, let me remind you, was purple and shining. That appearance, coupled with the fact of the rapid decrease in size from mere position, proved that the swelling was in great part due to engorgement of the over-distended blood-vessels. This condition, and the weak looking, flabby granulations, suggested the line of treatment, which was followed out with such rapid and complete success. But here is a case of a very different kind, though, like the preceding one, an ulcer on an enlarged leg.

Case LXXV.—*Great and solid enlargement of the leg. Old ulcer with callous edges. Application of nitrate of silver, bread poultice, and subsequent pressure and exercise. Complete recovery.*

A. B., æt. 50, very stout and florid, has had an ulcer on the right leg for some years. The limb is much larger than its fellow, the œdema very solid. The ulcer, just below the middle of the leg, on the inner side, is almost perfectly circular; its floor concave, grey, and quite smooth. The edge raised, white, and solid; the surrounding skin bluish. I rubbed a stick of solid nitrate of silver freely over the ulcer, its edge, and the surrounding skin for a couple of inches; prescribed a purgative, rest in bed, and a cold bread poultice to the part, to be changed morning and evening. At the end of three days a good deal of the surface tissue had broken down, the edge was flat, and the sore red. I cleaned it, and the surrounding skin, with a pledget of soft dry lint, strapped and bandaged the limb with considerable pressure, and allowed the patient to walk about. For the first fortnight the strapping was removed every fourth day; after that, once a week; and at the end of two months the sore was solidly healed, and the patient more active than he had been for years.

This success was obtained in following a well established method for the treatment of old ulcers. We violated for the

nonce the precept which enjoins absence from irritation, and from influences calculated to promote putrefaction. Our aim was to kill and remove the inert surface of the sore, and stimulate fresh action. After the first two days we also violated the principle of rest, for the man was ordered to walk about. The fact is, stoutness, over distension of the vascular system, is one of the causes of ulcers of the leg. They indispose to exercise,—all the functions become sluggish—the belly bigger and the ulcer hardened. Stimulate its nutritive activity, support the local circulation by compression; improve the general nutrition by exercise, moderate diet, and aperients when necessary, and the ulcer heals, *pari passu* with the recovery of general activity and strength.

CASE LXXVI.—*Great swelling, heat, and pain of leg, after contused wound.—Cure in seven days under absorbent dressings, millboard lattice-work, compression, and suspension.*

John Careless, æt. 48, from Ridge Top, Wollaston, Stourbridge, admitted into Ward 3, Queen's Hospital, 11 30 a.m. December 30th, 1880.

History and state on admission.—Three months ago, an iron casting fell on the front of the patient's right leg, knocking off a piece of skin. The cicatrix, a little larger than a sixpence, is adherent to the subjacent tissues. Right leg generally reddish, shining and hot to above the knee.

Circumference of the two limbs:—	Right.	Left.
Round malleoli - -	11 inches.	$9\frac{3}{4}$ inches.
Seven inches above inner malleolus	$15\frac{1}{2}$ „	$11\frac{1}{2}$ „
Mid patella - -	18 „	13 „
Four inches above upper edge of patella	18 „	$14\frac{3}{8}$ „

The enlargement below the right knee is very solid,—but is softer above. The patient suffers considerable pain in the limb, with burning sensation in the skin.

Treatment:—Absorbent gauze and cotton pads, from the sole of the foot to mid-thigh; dextrined millboard lattice-work; compressing bandages and suspension.

5.30 p.m. (six hours later).—Perfectly easy. Apparatus feels loose, from subsidence of swelling. The three outer bandages removed, and reapplied with firmer pressure.

December 31st, 8.0 a.m. (twenty hours and a half from admission).—The patient continues perfectly easy. Apparatus lax; the three outer bandages removed and reapplied with firmer pressure.

December 31st, 11.50 a.m. (twenty-four hours from admission).—On removing apparatus, limb much shrunken and soft, quite painless, and comparatively pale. Pads puffed by warming, splints re-moistened, whole apparatus re-adjusted with firm pressure (seven rollers, of six yards each, used), and the limb suspended. The patient says he is perfectly comfortable.

December 31st, 8.0 p.m.—Apparatus lax. The three outer bandages removed. When I re-applied them very firmly, the patient said, "*it feels very beautiful.*"

January 1st, 11.30 a.m. (forty-eight hours from admission).—On exposing the limb, it is much paler and softer, the joints can be moved with ease. Skin puckered from shrinkage. Compressing apparatus and suspension renewed.

From this date to the 6th of January, four notes were taken, and the apparatus renewed once; each report is the same; looseness from progressive shrinkage, removal of slack outer bandages, and re-application with firm pressure. The patient was discharged cured January 6th, 1881, at the end of a week from admission; and here is a table shewing the measurements taken during that period.

Circular measurement in inches at 11.30 a.m. each day.	December.			January.				Decrease of swollen limb in six days.
	30th	31st	1st	2nd	4th	6th		
	Left	Right	Right	Right	Right	Right	Right	
At malleoli	$9\frac{3}{4}$	11	$10\frac{1}{8}$	10	$9\frac{7}{8}$	$9\frac{3}{4}$	$9\frac{3}{4}$	$1\frac{1}{4}$ inches.
7 inch. above	$11\frac{1}{2}$	$15\frac{1}{2}$	$14\frac{1}{8}$	14	$13\frac{3}{8}$	$13\frac{1}{8}$	12	$2\frac{1}{2}$ „
Mid patella	13	18	17	$16\frac{3}{4}$	$15\frac{7}{8}$	$15\frac{1}{2}$	15	3 „
4 inch. above	$14\frac{3}{8}$	18	17	16	$15\frac{5}{8}$	$15\frac{1}{2}$	$14\frac{1}{2}$	$3\frac{1}{2}$ „

It is, I think, superfluous to comment at any length on this rapid recovery. If you compare it with the numerous cases which I have brought before you, and bear in mind the accuracy with which they have been measured and noted, you will, I think, accord them the credit due to facts rigidly observed.

In T. H.'s limb (Case LXXIV, p. 205), a little glycerine was applied to the sore, but to John Careless's inflamed and very tender leg (Case LXXVI, p. 208), the compressing elastic dressing was applied quite dry, as it was in,

CASE LXXVII.—*Almost complete detachment of the right ear, by a contused, jagged wound. Healing by the first intention with one dry dressing, compression, and drainage.*

S. B———, aged fifteen, was admitted to Ward 3 on the 21st of November, 1878. The following note was made at the time by our house-surgeon, Mr. Jordan Lloyd, to whom I take this opportunity of expressing my indebtedness for his very intelligent and painstaking assistance. Shortly before admission "S. B——— was knocked down by a cart, the wheel of which struck him on the right side of the head. On admission there was some shock; a contused ragged wound, full of grit, began about three-eighths of an inch in front of the right tragus, and extended from just below the lobule to a little above the upper margin of the pinna; it passed backwards, so as nearly to sever the ear from the head, completely dividing the external auditory

meatus about half an inch from its orifice. There was considerable contusion in the temporal region about the jaws and around the eye." After lightly wiping clean the wounded surface with dry pledgets of lint, the lips of the wound were brought together by three silver sutures; a drainage-tube was passed into the lower angle of the wound, and a soft gauze and stypium pad placed round the back of the ear, so as to give the pinna true and sufficient support. Over the ear, the wound, and the right temporal region, was placed a pad of gauze and dry stypium, covered by a layer of cotton-wool; the whole firmly secured by a gently compressing bandage.—Nov. 22nd (day after admission): After a comfortable night, has vomited, and complains of headache. Temperature 102°; pulse 120; respiration 34. To have an ounce of castor oil; milk diet. No tension felt through the dressings, which remain untouched. The temperature fell two degrees in twenty-four hours, and stood at health on the morning of Nov. 25th (fourth day), with pulse 104, respiration 24. In two days more, the pulse was 84, respiration 22.—28th (seventh day): Wound dressed for the first time. The dry gauze pad peels off very readily, showing pale skin and an united wound. A few drops of matter, collected in the concha, wiped out with dry lint. Drainage-tube and sutures removed. The pad behind the ear not interfered with. The edges of the wound supported with a couple of strips of elemi plaster, and the dressing completed with dry stypium pad, cotton-wool, and compressing bandage.—Dec. 1st (tenth day): Has been up in the ward for several hours. Says he feels quite well. Meat diet.—The patient was discharged on Dec. 18th, and the appearance of the cicatrix on Dec. 13th (the twenty-second day after the accident), is faithfully represented by this engraving, from a photograph.

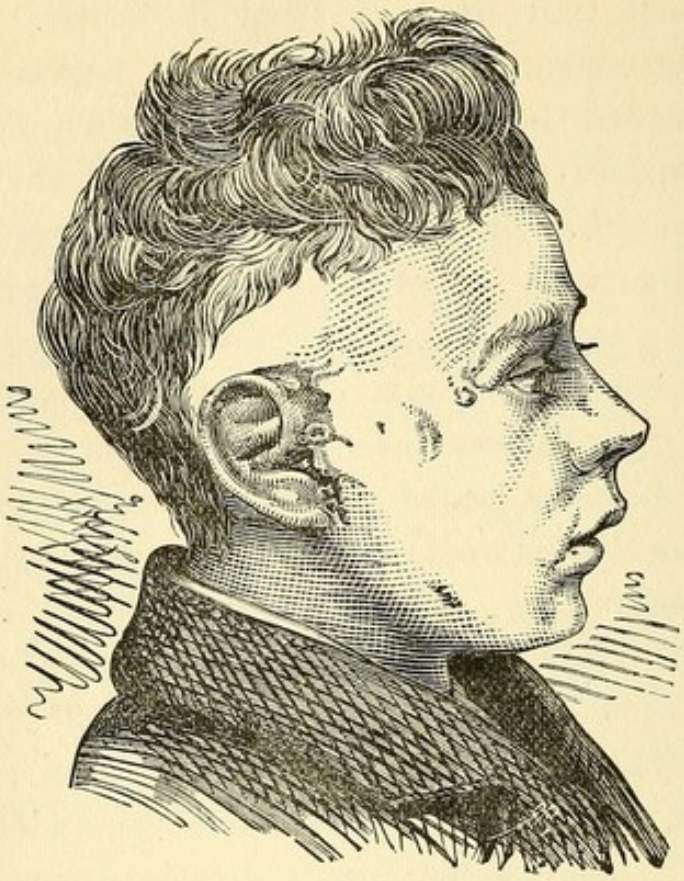


Fig. XV.

The absence of water from the dressings characterized this case, as it did the succeeding one, which I shall relate as a prelude to observations on the subject of dry dressing.

CASE LXXVIII.—*Strangulated inguinal hernia.—Operation.—Recovery the tenth day.*

I was called to John Marriott, at two a.m., Sunday, February 1st, 1880. He had a large, tense, and very tender swelling in the right inguinal region, with all the symptoms of acute strangulation. Warm baths and taxis having been tried in vain before my arrival, I directed ether to be administered, and divided the structures over the neck of the tumour. Reduction could only be effected after opening the sac. The protruding intestine, which was very considerable in amount, was carefully restored to the abdomen. The wound was closed with four points of silver

suture, and on it absorbent cotton-wool and gauze pads applied, with lightly compressing spica bandage. The patient slept a few hours, and on waking said he was comfortable; but in the evening the temperature rose to 104° ; and, as the urine could not be passed naturally, it was drawn with a catheter. The next day the temperature had fallen to 100°.

February 3rd.—Some diffused redness of the skin being visible in the right loin, above the bandage, I removed the dressing. The pad and bandage were moist over the wound, its edges reddish, but united almost throughout. I removed the sutures, kept the edges together with strips of plaster and slight pressure, and, with a spiral movement, introduced a small piece of drainage-tube into the lower angle of the wound, giving exit to nearly an ounce of pus. I covered the wound and the whole extent of redness, with a large absorbent cotton and gauze pad, with smoke and elastic pressure. As the bowels had not acted since the operation, and for two or three days previously, I ordered a gruel enema, and five grains of the pil. aloes socot. Soon afterwards the patient had a rigor, and the temperature rose to 105·2°. Another gruel enema was administered, the bowels acted very copiously, and the man was at once comfortable.

February 6th (sixth day after operation).—Pulse 88, resp. 24, temp. 98·2°. The patient says "he is very comfortable." On exposing the wound, the redness all gone, very few drops of discharge in the pad, tube removed, fresh pad and bandage applied. The next day the man was allowed to get up, and to have meat diet. I presented the patient at the Midland Medical Society the tenth day after the operation, and the cicatrix was then quite solid. The man left the hospital the twelfth day.

If, according to my usual practice, I had inserted an elastic drainage-tube at the lower angle of the wound, at the time of operation, it is probable that the fluid which produced the irritation would have been carried off at once, and the subsequent tension and its effects would have been averted. As it was, the incident afforded valuable experience; for the perfectly linear cicatrix, and the soft and healthy look of the surrounding skin, testified to the readiness with which the effects of the diffuse inflammation disappeared when the silver stitches were removed, the fluid drained off, and the elastic pressure applied, with a soft absorbent bandage over the dry absorbent gauze and cotton-wool pad.

I remember the day when, according to prevalent practice, I should have applied a poultice over the inflamed part; and the probability is, that diffuse suppuration in the connective tissue would have been the result, with possible indirect consequences of more serious import. The recovery under our treatment was due to a co-operation of causes,—relief of tension, drainage, pressure, and dry dressing; but the last was not the least important.

But the value of dry dressings, and the possible mischief of wet ones must not be exaggerated. Experience has proved that cold water irrigation is consistent with rapid and sound wound healing, in virtue of its repressive and sedative action on the local circulation and innervation, and of the perfect drainage which it secures. It is stagnant water, which with warmth, favours putrefaction, and is opposed to primary wound healing. On the other hand, a dry dressing may be a source of irritation and mischief, if instead of absorbing discharge, it imprisons it. Dry dressing, without immobility, physiological position, and elastic compression, is not to be relied on; but their combination is powerful for good.

Burns are a class of cases which very well illustrate an exception to the suitability of dry dressings, while affording evidence of the value of infrequency and compression. When the cuticle is broken, our absorbent gauze and cotton tissue should first be covered lightly with glycerinum boracis, with a mixture of terebene and equal part of olive oil, or with carron oil. The glycerinum amyli is also a very good application.

The value of dry dressing, as opposed to putrefaction, is not difficult to explain.

Everyone who has attempted the preservation of meat for domestic purposes, knows the importance of keeping it cool and dry, in a current of air, wiping off any moisture that exudes on the surface, or taking it up by sprinkling with flour or other absorbent material. Moistening and putrefaction, drying and preservation, go together.

I have read a letter from a surgeon to one of Her Majesty's ships stationed on the coast of Peru, during the late war with Chili, who recalled visits to battle-fields in the Bulgarian swamps, where he had seen dead bodies, exposed in a warm and humid atmosphere, rapidly swell and decompose. But when after the recent feats of arms in South America, he traversed the arid plains, often going many miles without a sight of water, the cadavers exposed in the dry, burning air, were dry and shrunken.

Take two pieces of fresh meat, of equal thickness and weight, and place one between two pads of absorbent gauze and cotton, and wrap the other in lint soaked in water, with a covering of oiled silk or gutta-percha. The first piece, as I have often proved by experiment, will continue dry and sweet, long after the meat in water dressing has become a rotten stinking mass.

Reasoning, *à priori*, from the operation of physical causes on dead organic matter, to their influence on living tissues,

has been productive of so many fallacies and so much mischievous practice, that I wish the illustrations just adduced, only to be taken as proof, other things being equal, of the effect of moisture and dryness on the decomposition of the animal tissues.

Under the microscope, as my brother, Professor Arthur Gamgee, first pointed out to me, the effect of water on the muscular fibres is seen to be rapidly destructive. Admitting that such a physical change may be resisted, for a time at any rate, in the condition of active life, every one knows, to quote Demarquay,(*) that "washing wounds with water predisposes them to atony and retards recovery."

Certainly no more rapid instances of healing can be produced than after operations for hare-lip, or under a blood crust or scab, and those are typically dry.

By rest, position, and pressure, our aim is to reduce muscular and nutritive activity to the minimum, and thereby prevent effusion. When effusion does occur, we aim at keeping the part dry, by carrying off the fluid as rapidly as it is poured out. This we do, in great part, by absorbent dressings.

Let me detain you for a few moments with an experimental demonstration of the action of the materials employed. Here is a piece of the finest cotton-wool, such as is ordinarily used by jewellers. You see it floats on water, and rises to the surface any number of times after being pushed to the bottom of the glass. It will float for weeks, as I have proved by repeated trials. I drop into a tumbler of water this pledget of cotton-wool, made absorbent by the removal of oily matter and other impurities, and you see it sinks to the bottom in a very few seconds. I now envelop a pledget of absorbent cotton in a piece of

(*) De la Glycérine de ses applications à la Chirurgie et à la Médecine par M. Demarquay. Troisième édition. Paris, 1867, p. 115.

unbleached gauze, such as commonly used in surgical practice. In spite of the proved absorbing power of the contained cotton, so impermeable is the gauze that the pledget floats and resists forcible immersion. I have had a little pad, so made, floating on a tumbler of water in my consulting room for thirty-five days. If, however, you make a little pad with the absorbent cotton, and the same kind of gauze rendered absorbent by bleaching, you find the substance sucks up the water with avidity, and sinks at once. So with the bandages. Here is a piece of ordinary calico bandage; it floats in the basin like a plank on a pond. Here is a piece of open wove absorbent bandage; it sinks the instant it is dropped on the water.

Once I had ascertained these facts, no time was lost in putting them to the test of clinical experience, which has demonstrated the great therapeutic value of these absorbent materials; discharges drain through them so readily, that wounds are kept clean and the surrounding parts dry. Union rapidly and painlessly consolidates under the elastic pressure. So great is the elasticity of the material that the pad I hold in my hand is scarcely flattened, though it has been firmly bandaged on a man's instep for five days. On holding the pad before the fire you see it puff up at once, and quickly regain its original fulness and downy softness.

Here is a pad, soft and elastic, though for a week it has been firmly bandaged to the sole of a man's foot, inside a millboard moulded splint. Here is another pad which is beautifully soft, though it has been tightly screwed down in my copying press for upwards of nine hours.

Experiments which my friend and colleague, Professor Bostock Hill, was good enough to institute at my suggestion, proved that the absorbent materials lose none of their physical properties, when treated with borax, iodine, tannin

and similar substances. Those trials have been continued and largely extended, with a view to practical application, by Messrs. Southall Brothers and Barclay, and I gladly take this opportunity of acknowledging the assistance they have rendered in the prosecution of this research, by placing at my disposal the resources of their pharmaceutical laboratory. Besides the substances named, benzoic, boracic, carbolic, and salicylic acids, iodoform and tar have been employed; and before you are gauze and cotton-wool tissue, pads and bandages, perfectly absorbent and elastic, and powerfully styptic and antiseptic.

It is foreign to my present purpose to detain you with any theoretical speculations. It may be argued that the cotton wool acts as a germ filter, as well as an aspirator and an elastic medium of equable compression. Let us get at the facts before we speculate. Certain it is, that the perfect softness and elasticity of these absorbent materials are of the utmost value and comfort. Those qualities render possible, with the most perfect safety, the application of that elastic compression which, with rest and position, is so potent in relieving local congestion and inflammation, and they make it practicable to keep wounds clean, sweet, and dry, in the majority of cases; but not always; where they fail, matters are going wrong; for a wound producing wet, dirt, and stench indicates local decomposition, the forerunner, if not arrested, of constitutional danger.

Case LXXIX.—*Operation for strangulated inguinal hernia.—Death the fourth day.*

Thomas Appleton, a very stout man, æt. 66, admitted to Ward I, Feb. 28th 1880, with symptoms of strangulated right inguinal hernia of twenty hours' duration. I could only reduce by opening the sac. The abdomen was much distended, and a considerable quantity of serum escaped through the wound, which was dressed with two silver

sutures, drainage-tube, absorbent pad, and lightly compressing spica.

Some flatus was passed after the operation, but the patient passed a very restless night, and the next day the temperature was 100·3° ; pulse 116 ; resp. 26.

March 1st (forty-eight hours after operation).—Has passed some flatus but has had no sleep, and has vomited freely. Temp. 100·2°; pulse 120; resp. 32. Dressing, soaked with discharge, removed ; sutures taken out, no healing in wound ; its interior explored with the finger proves that there has been no protrusion. Fresh dressing with large pad of absorbent tissue—an enema of soap and water, prescribed. Milk diet. Tympanites increased, the pulse rose to 132, the temperature fell rapidly to 98°, and death occurred four days after the operation.

The autopsy revealed pulmonary congestion, peritonitis with great distention of the intestines, no evidence of the strangulation perceptible. Wound dirty, and without trace of healing.

From the first, the case bore a most unfavourable aspect, and the relief of the intestine from strangulation did not check the downward course. In strangulated hernia, almost more than in any other operation, obesity is a serious complication ; and when, as in the case just related, the constitution exhibits no rallying power, and the intestine after constriction remains paralyzed, wounds into the abdomen are attended with exceptional danger.

Here is another fatal case, which recalls some of those in Sir James Paget's deeply instructive lecture on the calamities of surgery, (*) and which I relate because the issue was unforeseen and unpreventible. Dwelling, as I do, on the importance of physiological wound treatment, and on

(*) Clinical Lectures and Essays, by Sir James Paget, F.R.S. Edited by Howard Marsh, F.R.C.S. 2nd edition. London, 1879. P. 54.

the safety with which operations may be performed, it is important to guard against the erroneous impression that, in surgical practice, wound dressing and healing are everything. Over and above them, have to be considered constitutional states, and organic changes in vital organs

CASE LXXX.—*Removal of scirrhous mamma.—Uninterrupted progress.—Death the fourteenth day, from embolism of the middle meningeal artery.*

A lady placed herself under my care for removal of the left breast for cancer,—the operation having been advised by several surgeons. All the symptoms seemed favourable; and the social circumstances of the patient admitted of the best arrangements being made for nursing and assistance.

Nothing could have been more propitious than the progress of the case. I dressed the wound according to my usual practice, and it was so very nearly healed, without suppuration or redness, at my visit on the twelfth day, that arrangements were discussed for a visit to Brighton. I left my patient this day at noon, enjoying a sponge cake and a small glass of champagne for luncheon, and on reaching home, an hour and a half later, received a telegram announcing that the lady was dying. I found her insensible, speechless, and paralyzed on the left side. She survived thirty-six hours. The examination revealed embolism of the middle meningeal artery, and softening of surrounding brain substance. The adhesion of the perfectly clean wound was singularly firm. The patient's age proved to be ten years older than stated, a fact which would have greatly weighed with me against the operation. It could only be under very exceptional circumstances, that I should advise an operation for scirrhus of the breast after sixty years of age.

In open cancer, primary or recurrent, absorbent dressings are most comforting.

CASE LXXXI.—*Recurrent cancer of the breast.—Intense pain after frequent dressings with carbolic oil.—Great relief from infrequent dressings with absorbent materials.*

I was consulted in the case of a lady residing in London, whose left breast had been removed for cancer. Recurrence and ulceration were very rapid. The dressing of the sore, morning and evening, alternately with carbolic oil and a zinc preparation, was most painful. Discharge was fetid, and so abundant that the most attentive nursing failed, in keeping personal and bed linen clean. These difficulties were aggravated by the lady's unwieldy stoutness. I dressed the large sore with absorbent gauze and cotton, supporting the lax parts with a broad body bandage of absorbent material; outside it and within the night-dress I placed a large pad of pitch pine sawdust in absorbent muslin. This could be changed as frequently as it became damp without removing the deeper dressings, and it kept the patient dry and sweet. She was comparatively comfortable at once. Death was inevitable, but the unirritating absorbent dressings were a great improvement on those previously applied.

I believe the credit of introducing pine sawdust as a surgical dressing belongs to the late Surgeon-Major J. H. Porter, but for whose lamented death in the Afghan campaign, we should doubtless have had more abundant evidence of his plan of treatment. In the paper in which he recommended sawdust from one of the pine species as a surgical dressing, Professor Porter wrote: "It has now been in use for some time, and I believe, when applied as suggested, has been found a good absorbent and deodoriser, as well as suitable material for making extemporised pads for fractures.

"My chief object in referring to it at present is, that some of my medical friends, merely hearing of it as a dressing, do not quite understand how to apply it. The process is simple. Obtain a fresh supply of the dust, of a fine description, enclose it in gauze or muslin bags a little larger in superficial area than the part to which it is to be applied, see that any splinters of wood or impurities have been removed from the dust, and that the stiffening has been washed out of the muslin or gauze. Do not fill the bags too full, or they become hard; and, if it is desired, place a piece of oiled lint, with several holes cut in it, between the wound and the pads. If the pads are very large, put two or three stitches in them, so as to keep the sawdust evenly distributed.

"Since these pads have been introduced, it has been suggested to use the sawdust taken from the wood of the eucalyptus, it having in itself powerful remedial properties, or to steep the ordinary pads in a solution of the eucalyptus or terebene, and then dry them, which would increase their antiseptic and deodorising properties. The addition of both these powerful antiseptics and deodorants is, no doubt, excellent, but the modification quite does away with my prime object—simplicity."(*)

When the parts are very tender, glycerine is very preferable to oil as an application between absorbent dressing and wounds. The former is a powerful anti-putrescent, and has so great an affinity for water, that it increases the absorbent properties of sawdust, gauze, cotton, or other materials of a like nature to which it may be added.

If you take two square pieces of our absorbent tissue of equal dimensions, and drop them flat into a large bath full

(*) Remarks on some New Forms of Surgical Dressings and Applications, read before the Southampton Medical Society, October, 1878, by Surgeon-Major J. H. Porter, Assistant Professor of Military Surgery, Army Medical School, Netley. Dublin Medical Journal, 1878, p. 386.

of water, after pouring some glycerine on one of the pieces, you will find that the latter becomes more quickly saturated, and sinks to the bottom first. Allowing for the weight of the glycerine, the experiment can be so varied as to illustrate beyond doubt its well-known powerful affinity for water.

The application of glycerine to a wound on absorbent tissue assists in carrying off discharge, keeps the interior clear from accumulated effusions, and, by excluding stagnant water, does away with one of the chief elements of putrefaction. Glycerine possesses the additional advantage, in wounds attended with much loss of substance, of preventing the absorbent dressings adhering too closely to parts unprotected by skin.

Addressing my class in 1867, I stated that I had "discarded water dressing after recent operations, as acting something like a poultice,"(*) and ten years later, Mr. Robert Hamilton, of the Royal Southern Hospital, Liverpool, writing in the *Lancet* (†) on "The Anhydrous Dressing of Wounds," characterised "the action of water as the same as that of a poultice, only in a minor degree." The correctness of the comparison must, I think, impress anyone who will treat a few cases alternately, with water dressing and with dry absorbent dressing. The comparison is still more strikingly against water dressing as feeding suppuration, if it be applied to one half of a long wound, while the other half is dressed dry.

(*) Clinical lecture on the Treatment of Wounds, by Sampson Gamgee Brit. Med. Jour. 1867, p. 562.

(†) *Lancet*, 1877, vol. I, p. 605.

CASE LXXXII.—*A boil on the forearm, succeeded by a crop of boils under linseed meal poultices.—Rapid recovery under dry absorbent dressings and pressure.*

Mr. L., a powerfully-built young man, came in to consult me from Rugby. His right forearm was enveloped in a poultice, on removing which I found the limb red, much swollen, exquisitely tender, and studded with twenty or more boils, in all stages of development, from small nodules to suppurative centres as large as hazel nuts. The first boil was said to have commenced about the centre of the forearm. It broke under linseed meal poultice, which was continuously applied, and of increasing size to cover the wider region in which boils kept on forming. I lightly wiped the forearm dry, enveloped it with absorbent gauze and cotton tissue, bandaged with smooth but considerable pressure, and suspended the limb in a sling, with the elbow at an acute angle. The patient was at ease immediately, and continued so. Three days later, on removing the absorbent dressing, a good deal of pus was found dried into it; the forearm was pale and shrivelling, and the boils in rapid process of healing. Two more similar dressings in the course of another week, and the patient was well. Compression and physiological position had a good deal to do with the result, but one of the chief factors was the dry, absorbent dressing, in lieu of the linseed meal poultice.

CASE LXXXIII.—*Wound of thumb.—Erysipelas of the arm. Collection of pus at the thumb, elbow, and axilla. Rapid recovery under immobility, position, and pressure, after evacuating pus.*

Mary Heard, æt. 50, admitted February 27th, 1880, with her right thumb swollen, red, and extremely painful. A white spot on its palmar surface indicated the presence of pus. The fore-arm was œdematous. The arm, very much

enlarged from the elbow to the axilla, was red, very hot, and painful. The swelling was most prominent on the inner side of the arm, close to the axilla. The face was flushed, the tongue furred. The patient said she felt very ill, and four days previously had grazed her right thumb while scouring a floor. This injury was followed in two days by swelling, and, on the third day, by a lump in the arm pit.

The patient was put to bed, and a small incision made in the thumb; it gave exit to a drachm of pus. From another incision close to the axilla, nearly an ounce of pus issued. A dry pad of absorbent tissue was placed round the thumb, another in the axilla; the whole limb was surrounded with cotton-wool, and a narrow compressing bandage applied from the fingers to the shoulder. The limb was then raised, by means of pillows, to an angle of about forty degrees from the bed. Four hours afterwards the patient was much easier, the bandage quite loose. A dose of castor oil prescribed.

February 29th (forty-eight hours after admission).—Dressings removed; œdema of fore-arm quite gone; swelling of arm diminished; the axillary pad coated with a large quantity of pus. The pad on the thumb appeared to have absorbed all the discharge from it. Dressings as before, excepting that glycerine on lint was applied to the thumb.

March 2nd (fourth day).—Dressed for the second time; the thumb had almost ceased to discharge; hand quite dry; fore-arm dry, and normal in size. No redness. The axillary pad had absorbed a fair amount of discharge, but the opening in the axilla was nearly dry. Entire absence of pain; able to sleep and eat well. Five days later, a small collection of pus was opened in front of the elbow, and dressed with absorbent pad and pressure. The patient progressed without an unfavourable symptom, and was dis-

charged, cured, March 15th, seventeen days after admission. (*)

Looking at the case from its origin, with the rapid spread of inflammation from the thumb to the axilla, and suppuration in both those centres, there was strong reason to suspect blood poisoning. Those who have seen such cases treated by fomentations and poultices, can form a just estimate of our patient's rapid progress under elastic compression, position, and absorbent dressings.

(*) I am indebted to our former house surgeon, Mr. J. Westwood Moore, for notes of the case, and great attention to the patient.

LECTURE X.

History, principles, and uses of surgical drainage.—Treatment of mammary abscess.—The principle and practice of suspension in general surgery.—A note on swings and pulleys.

GENTLEMEN,

One of the first essentials to the healing of wounds is, that effused fluids should not accumulate within them, but be carried off as rapidly as they are poured out, and with the minimum of local disturbance. This object is promoted in operation wounds, by so contriving their direction, as to favour easy outflow, in the most natural and comfortable position for the patient. We have on a former occasion explained how pressure, with immobility and position, prevents effusion; and when fluid is poured out, its diffusion in deep and loose tissue can be checked by a nice adjustment of pressure pads. They can be made to act as banks to the current, so as to direct it towards the surface, there to be taken up by absorbent dressings.

As an illustration of the manner in which the surgeons of the preceding generation strove to compass these ends, let me read you a passage from Hennen's Chapter on the Treatment of Compound Fractures. "When the position of the wound did not favour the flow of matter, I have effectually obviated its stagnation by placing a soft sponge over the limb, which absorbed the pus almost as soon as formed, and by drawing a woollen thread through it, and connecting it with a proper dish below, *it has performed the part of a syphon.* (*)

(*) John Hennen, Principles of Military Surgery. Third edition. London, 1829. P. 118.

You have here the idea of an absorbent dressing, and the syphon action of the drainage-tube, ingeniously and very simply utilized. Drainage was the intention of the old practice of counter-openings, tents, and setons; but it was reserved for Chassaignac, in 1855, to establish drainage as a general principle and practice of surgical therapeutics. (*) The instrument which he introduced for the purpose. and which you see in constant use in our clinique, is an india-rubber tube, made of different sizes, from that of a probe to the diameter of the little finger, with holes in its walls in different directions, at intervals of half an inch, more or less.

The essential facts in Chassaignac's system of drainage are that india-rubber tubes may be made to traverse the muscular or bony structures of the limbs, the large joints, or the great visceral cavities, without producing any irritation; and that filling with discharge by capillary attraction, they do not give admission to air from without.

CASE LXXXIV.—*Proposed amputation of leg for necrosis.—Limb saved by removal of sequestra, drainage, dry and infrequent dressing, and suspension of the limb.*

I was requested, some years since, to amputate the left leg of a youth, who had had the benefit of experienced professional advice. A number of openings led down to dead bone in all directions, and the patient was much exhausted by long-continued suppuration; but, as he was of healthy parentage, had sound lungs, and the knee and ankle were not yet involved, I could not conscientiously amputate; consultation resulted in making an incision along the front of the tibia, to within half an inch of the knee and ankle respectively. Uniting the cloacæ with a few strokes of the

(*) Traité Pratique de la Suppuration et du Drainage Chirurgical, par E. Chassaignac. 2 vols. Paris, 1859.

mallet and chisel, an ample channel was made for clearing out a large amount of imprisoned dead bone. A long drainage-tube was placed along the bottom of the wound, with its ends depending. With dry and infrequent dressings, and suspension of the limb, convalescence was rapid, and recovery complete.

I know no more trying position, than that of being impelled by a sense of duty to decline to perform an operation previously resolved upon. But I have always declined to use the knife when my judgment has not approved of it; and, in the saving of limbs, I have never regretted that line of action.

Of the advantages of drainage, in the treatment of effusions into the pleural cavities, there is no lack of proof, and the case to which I am about to refer is a striking instance in point.

CASE LXXXV.—*Drainage of the chest for empyema in a man in a moribund condition.—Survivorship for eighteen months.*

I was urgently summoned one morning to G. Madge, aged 25, recently admitted under my care to Ward 3. I found him propped up in bed, with sunken cheeks, open mouth, and widely staring eyes, a leaden hue, big drops of cold sweat on the forehead, breathing forty times in the minute, and with barely perceptible pulse. He had a history of phthisis of two years' standing. Some weeks previously he had been carried into the operating theatre of a hospital, with a view to tapping the thorax ; but the operation was not performed, as I subsequently learned, on account of diffused pulsation over the left chest. I found this side much enlarged, the intercostal spaces bulging, percussion-dulness absolute. The heart's apex beat under the right nipple. Pulsation could be felt over a great part of the left

chest wall; presuming that it was due to a recoil wave—seeing that the man was actually moribund—I passed a long silver probe, carrying at its end a medium-sized drainage-tube, through the chest, from front to back, in the sixth intercostal space, and a little outside the line of the left nipple. Creamy pus came out freely from both ends of the tube. The left chest was lightly packed with oakum, and a circular flannel bandage applied loosely. The pulse rallied, the face became animated, the man was able to lie on his back in a few hours, took food well, and lived 18 months,—more than half the time with the tube in his chest.

CASE LXXXVI.—*Mammary abscess discharging through several openings.—Rapid recovery after drainage, suspension, and compression.*

Such cases as this of abscess in the breast also illustrate, in a very marked manner, the advantages of Chassaignac's drainage tubes. When this woman was before you last week, her pale drawn face betokened suffering and exhaustion; the big, pendulous, and exquisitely tender left breast discharged matter through half a dozen openings, the result of *post partum* mammary abscesses and linseed poultices. I passed a long probe from the lower aperture on the outer side, under the mammary gland obliquely upwards and inwards, and out at the uppermost aperture near the sternum. A ligature, secured to the eye of the probe, enabled me to carry a good-sized drainage-tube along the track of the sinus, and I left it there, with both ends depending, covering the breast with a thick pad of carded oakum, and suspending it with a smoothly-compressing bandage. The poor woman was easy at once, her appetite improved, and she slept well. When the dressing was removed after a lapse of four days, the breast was soft and much diminished in size, the openings other than those traversed

by the drainage tube were healing rapidly, and the woman is now cheerful and in advanced convalescence. The drainage tube was a chief cause of the improvement in this case, draining the dependent and soddened breast, on much the same principle as a farmer drains a piece of boggy land with an earthenware pipe. It was this very agricultural practice which, according to Brochin,(*) suggested to Chassaignac his great surgical reform.

CASE LXXXVII.—*Supposed scirrhus of breast, proved to be chronic abscess.—Rapidly cured by drainage and dry dressing, compression, and suspension.*

Mrs. T., aged 42, from Evesham, lately consulted me with a view to removal, from the right breast, of a tumour which was supposed to be scirrhous. From the history and physical signs, I suspected deep-seated chronic abscess, and an incision with a straight narrow bistoury revealed the presence of pus. I introduced a drainage tube the size of a crow quill into the aperture, and passed it along to the bottom, by a gentle spiral, or corkscrew, movement. A layer of gauze over the breast, a soft pad of carded oakum, and a bandage carefully applied, so as to compress the breast and suspend it, completed the dressing. The patient returned into the country at once. When I saw her at the end of five days the discharge had permeated the bandages, but these and the oakum were quite dry. The tube was lying against the cicatrized opening, the breast having shrunk away from it. There was no pain and no discomfort, and I have since heard that the patient has perfectly recovered.

In these breast cases the india-rubber tube was not the single beneficent agent; suspension and compression of the breast had greatly contributed to the result in which the drainage tube was an important factor. The great value of

(*) Gazette des Hôpitaux, 29 Septembre, 1855.

surgical drainage is, that it admits of compression, rest, and infrequent dressing, while carrying off matter as rapidly as it is formed, and thus preventing tension, decomposition, and consequent irritation.

Once an inflammatory nodule has formed in a mamma, especially during the period of lactation, the application of a poultice will, with practical certainty, result in suppuration. Very often the inflamed breast acquires a great size, and if poulticing be continued, after the matter has been evacuated, more pus forms and burrows. If, on the contrary, the breast be well suspended by a broad bandage passing round the opposite shoulder, and bandaged with smooth pressure, over a good padding of elastic tissue, great comfort will result. If pus do form, it will be in a circumscribed area, whence it can be evacuated and drained.

When the inflammatory nodule is first perceived in the mamma it is a good plan to foment it with very hot water, and apply friction over the whole gland, with the out-spread hand smeared with almond oil or glycerine; then pad, suspend, and compress. The effect of the hot douching and friction, appears to be to produce a rapid determination of blood to the part, and probably to move obstruction in the congested small vessels, by flushing them with an increased current. The subsequent action of suspension and compression is explicable on general principles. If the inflammatory nodule have passed the stage of possible resolution, and the breast be so tender that friction cannot be borne, very hot fomentation gives relief. It should then be followed by a light hot linseed meal poultice on the centre of mischief; over it a piece of oiled silk or gutta percha, to retain heat and moisture; and over all, elastic compression, and efficient suspension from the shoulder. Early evacuation of pus is desirable; then introduce a fine india-rubber drainage tube, carefully

securing its outer end to prevent it slipping in, suspend and compress,(*) and you will drain the gorged gland of blood and interstitial deposit, which under the weight and heat of continued poultices would break down into corruption.

Abscesses forming in the ischio-rectal fossa, do not bear compression. In these cases hot hip baths and linseed-meal poultices hasten the desirable formation of matter, which should be evacuated by free opening, so soon as formed. That done, absorbent pads answer admirably, as they do if the result be fistula in ano, necessitating division of the sphincter.

Drainage tubes, like most other good things, are liable to abuse. Do without them when you can, and, when necessary, let them be neither too small for efficiency, nor so thick and long that they may act as foreign bodies, and prevent the contact of surfaces which it is desirable to unite. For the same reason, drainage tubes should be removed when they cease to be absolutely necessary. That is a point which it is often difficult to determine, and the tube is apt to be left in to avoid the danger of the track closing, and having to be re-opened. A wire or thread left in it will avoid this difficulty, as it can be used in drawing through another drainage tube if it become necessary. Meanwhile, the wound can be allowed to consolidate under pressure and absorbent dressings, which are always the complement, often the substitute, of drainage tubes. To prevent the tubes from slipping completely into the wound, a not infrequent and rather troublesome occurrence, the outer end of the tube should be left of good length, or be secured by one or two loops threaded through its side, and fixed by adhesive plaster or bandage.

(*) A very interesting paper on Cases of Mammary Abscess Treated by Compression, was published by Mr. Joseph Bell, in the London Medical Gazette, so far back as 1842, p. 170.

Catgut and horse-hair are often used as minor drains ; but absorbent pads and gentle pressure will dispense with their necessity, in the great majority of cases.

To secure the combined efficiency of position, pressure, and drainage-tubes, in carrying off discharges, it is important to have the outer end of the tube sufficiently free. This may be done by passing the tube through a hole in the absorbent pad next the body, or between the edges of two pads,—the bandage exercising pressure around the tube, so as to direct fluid through it.

To complete the dressing, another pad may be secured lightly, by bandage or a couple of safety pins, over the outer end of the drain-pipe. This outer pad is independent of the deeper, compressing, and more permanent dressing ; it acts as the receptacle of the drained products, and may be changed as often as deemed necessary, without prejudice to the great principle of rest. It thus becomes possible to combine, frequent removal of discharge with infrequency of dressing.

It is easy to understand how drainage is assisted by position, which can be readily altered in a variety of ways, but especially by the use of the swing. Suspension has been employed in many of our cases for the two-fold purposes of immobilization and physiological position. It is a therapeutic method of great value, alike in wound and fracture treatment, and merits careful consideration.

Suspension in a swing, is elevation, and something more. A limb suspended to a fracture cradle by two or three loops of bandage, is certainly raised on an inclined plane, but is not swung on the hammock principle. To explain the *rationale* of surgical suspension, let us compare 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 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; very little of the impetus is consequently 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 mechanical appliances, so far as fixity;—the one 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 render impossible a jerk in any part of its length. Experience proves that the same principle, is at stake in suspending a limb with an open joint or a broken bone. The accurate fitting of an outer mould, and the perfect undulation of the suspending medium, though apparently so dissimilar mechanically, co-operate harmoniously in securing absolute rest, preventing irritation, congestion, and their sequelæ.

While visiting the hospital at Lausanne, many years ago, I was struck with the simplicity and efficiency with which the suspension principle was carried out in Mayor's clinique, as shewn in this sketch of one of his swings. (p. 236)

The materials used in the construction of this apparatus may be found in any cottage. Variations in detail will readily suggest themselves to suit particular cases of the upper or the lower limb. Instead of a board, a hammock may be improvised with a pillow and a few pieces of

wooden stake, or cane, or twigs, outside it, secured by cord or string. The suspending cord may be fastened to the head of the bed, or to the ceiling; the longer the cord, the freer the undulation, and the more perfect the swing for

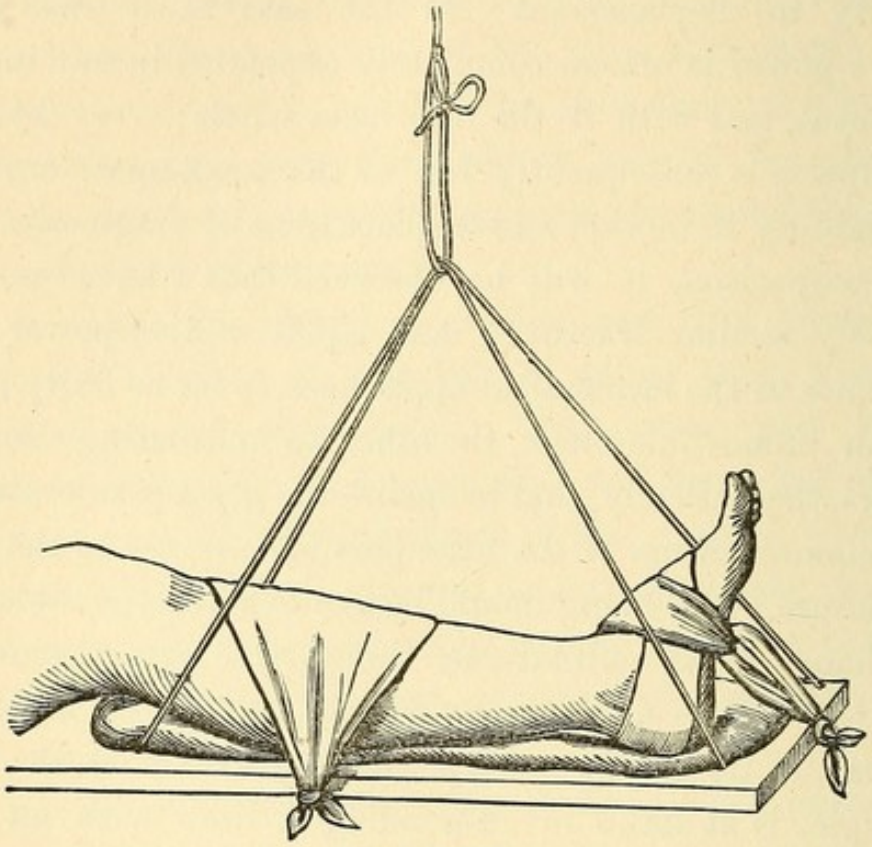


Fig XVI.

surgical purposes. In the swinging machines commonly used, the suspending chain is so stiff and short, that provision for undulation is very imperfect.

The principle of suspension 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 to other methods, when wounds, sprains, and other affections of the limb, independently of fractures, have to be treated. 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. When a limb is swung, nothing is easier than to

pack it with earth, sand, or shot-bags, so as to exercise very soothing and healing compression, although the most efficacious method is by spiral bandaging over a smooth elastic padding. But however it is applied, providing it be smooth and judiciously graduated, compression, with suspension, is a safe, painless, and most efficacious method of treating inflammation of the limbs.

Suspension may be utilized with great advantage in operative surgery, as I found just twenty years ago, when removing at the hip-joint a limb weighing nearly two-thirds of the entire bulk of the body. As it would have been very difficult for the assistants to support the limb, and move it in consonance with the amputating knife, I caused a pulley to be fixed to the ceiling, and suspension effected by the aid of a cord and a jack-towel as shewn in this sketch.

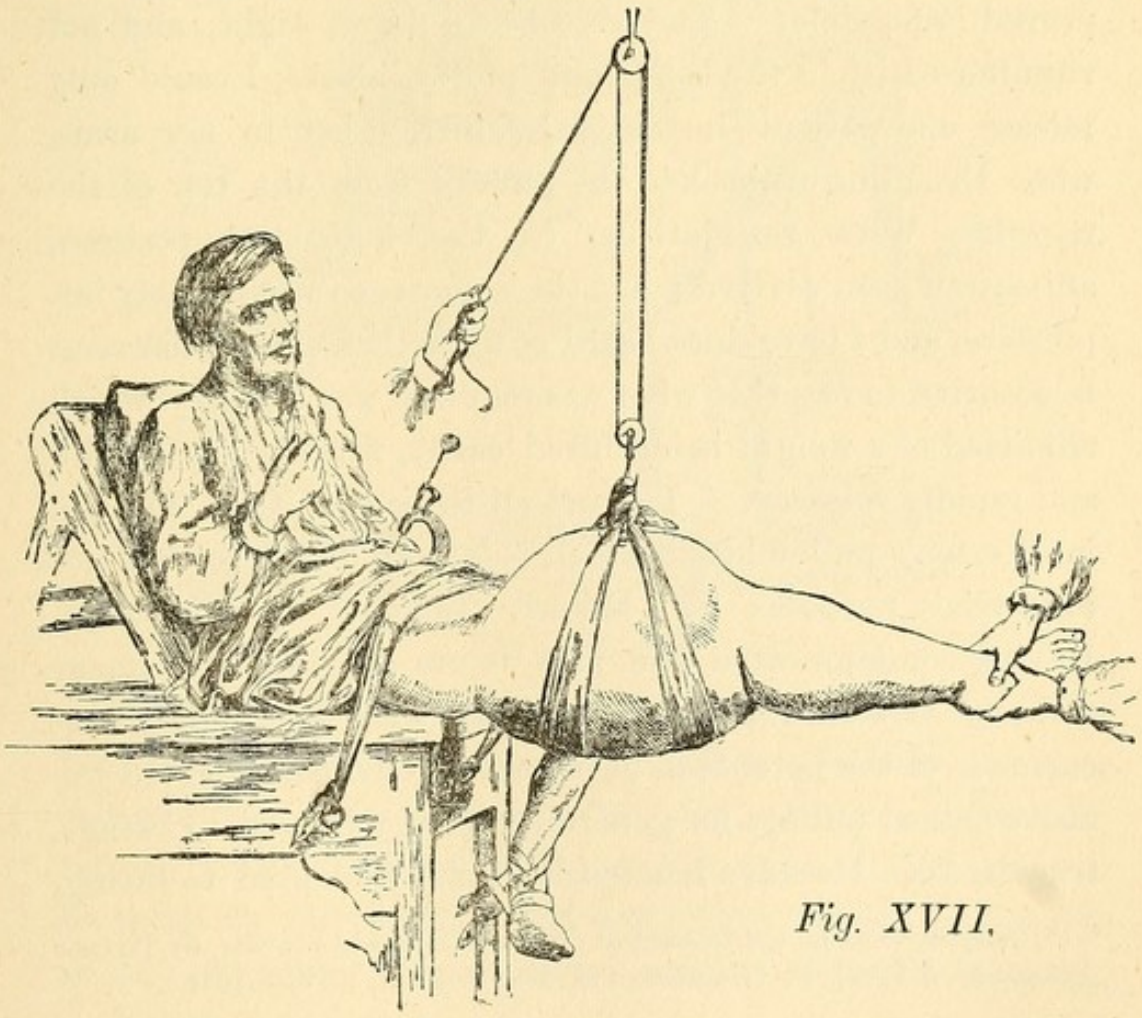


Fig. XVII.

The contrivance greatly facilitated the performance of the operation, and more recently Professor Annandale has directed attention to the subject,(*) which is of practical interest, and well deserves the attention of surgeons.

While on the subject of surgical swings and pulleys, as aids to rest and motion in the treatment of injuries, I may refer to an improvement in suspension pulleys suggested by an accidental occurrence, which very nearly proved fatal.

In consultation with my friend Dr. Flinn, of Brownhills, and with the assistance of my then house surgeon, Mr. R. B. Wilkins, I was applying a plaster jacket to a young lady, suspended with the well-known tripod, when we noticed her suddenly looking pale and unconscious. The pulse at the wrist was at the same time barely perceptible. I directed the patient to be let down at once, but this proved impossible. The cord being drawn tight, and not running easily in the compound pulley blocks, I could only release our patient instantly by lifting her in my arms, while Dr. Flinn unhooked the pulleys from the top of the tripod. With restoratives, in the horizontal position, animation soon revived ; but the experience was terribly impressive, and I have since heard of more than one similar case. It occurred to me, that what was required was a pulley which admitted of a weight being lifted easily, fixed at any height, and rapidly released. I found all these conditions fulfilled in Weston's pulley block, which is largely manufactured for industrial purposes by Messrs. Tangye, of this town. Having communicated the idea to our surgical instrument makers, Messrs. Salt and Son, they, with the friendly concurrence of the patentees, have very ingeniously adapted the above named pulleys for general surgical purposes, to swings, tripods, &c. Here is a hammock specially adapted to lifting,

(*) Suspension as an aid to surgical demonstrations and practice, by Thomas Annandale, F.R.C.S.E. Edinburgh Medical Journal, 1879, p. 1001.

with the minimum disturbance, a patient suffering from severe injuries to the trunk, such as a fracture of the spine.

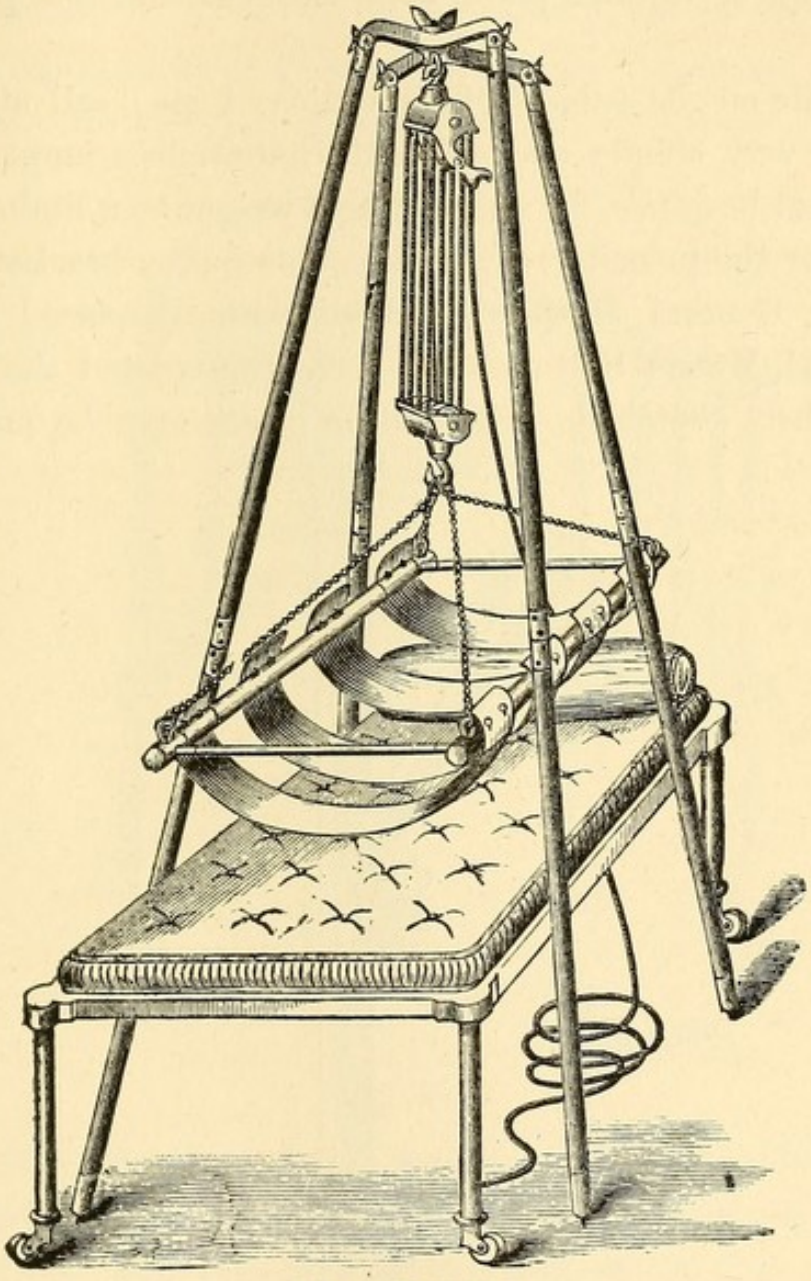


Fig. XVIII.

When the patient is raised, a very slight deflection of the cord to the right or left causes the pulley to become instantly self-retentive; that is to say, the body, whatever its weight, cannot possibly descend, although the force which raised it be suddenly withdrawn. But immediate release is possible at any moment. A pull in a downward direction instantly

releases the catch, and allows the patient to descend without jerk; a fact which may be of great utility in combining immobility of injured parts with locomotion of the patient's body.

While on the subject of suspension, I may call attention to two very simple and efficient contrivances employed in our local hospitals, for suspending a weight to a limb.

After the principle of an adjustable pulley-bracket in use at the General Hospital, and very kindly placed at our disposal, Messrs. Salt and Son have constructed the instrument here sketched. The sliding pieces may be moved to

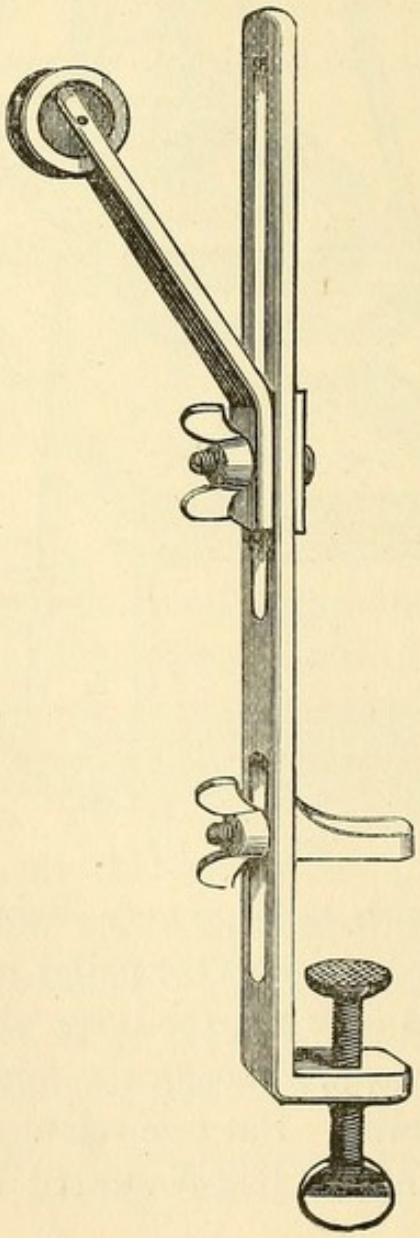


Fig. XIX.

fit any bed, and the cord attached to the limb passes over the pulley to support the weight. This may be in the shape of a sand bag, or a piece of iron, varying from three to six pounds for children, and double that for adults.

This representation of a cot from the Children's Ward in the Queen's Hospital, shows its lower end raised on two

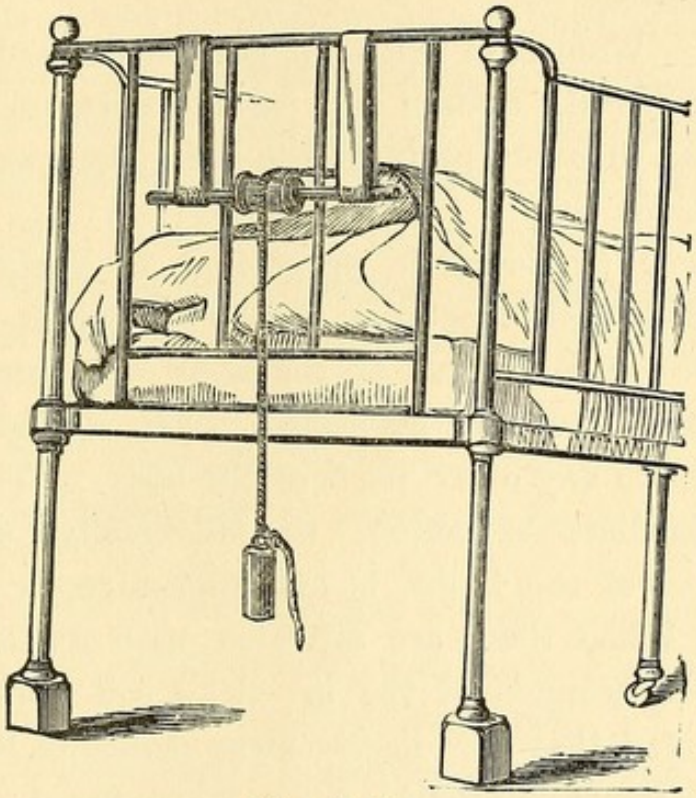


Fig. XX.

blocks of wood or stone, five inches deep. A small rod of iron, passed through a large cotton reel, is suspended by two strips of bandage, from the top bar at the foot of the bed, and over the reel passes the cord attached to the patient's limb above, and to the weight below.

LECTURE XI.

Wounds of the scalp, and fractures of the vault of the skull.

GENTLEMEN,

Wounds of the scalp, and fractures of the vault of the skull, fully sustain the parallel between wounds and fractures in other parts of the body; but, with important distinctions.

A very considerable proportion of scalp wounds is associated with fractures of the subjacent bones; and fractures of the vault of the skull are more frequently compound, that is, associated with wounds, than are fractures in any other parts of the body. The grand rule of immediate reduction, so universally applicable in fractures of the limbs, is not applicable to those of the skull. When these are attended with displacement, but not with wounds of the investing soft parts, authorities are agreed that the displacement should be left, with only a very few exceptions. Even when the fracture of the vault attended with displacement is compound, the propriety of mechanical interference is limited to a comparatively small number of cases.

Another, and greater distinctive feature of fractures of the cranial vault, is inseparable from the vital importance of its contents. A compound and comminuted fracture of one of the long bones of the limbs, though serious, is only fatal in a minority of cases; but, only a small minority recover, when the splinters of a cranial bone are driven through the subjacent membranes into the nerve centre.

The necessity for accuracy in diagnosis, for caution in prognosis, for sound judgment in determining the line of treatment to be followed in particular cases, is incomparably greater in wounds and fractures of the skull, than in similar lesions in any other parts of the body.

Do not judge the importance of a scalp wound according to its extent. A very small wound through the integument, without any signs of constitutional disturbance, may lead down to that most formidable lesion, a punctured fracture of the skull, with fissures radiating through the vault, just as you often see them starring a plate-glass window from a little central hole. Additionally, the inner table of the skull may be splintered more extensively than the outer, and the pieces driven through the dura mater. Here are two such cases from the note books of my student days.

CASE LXXXVIII.—*Slight scalp wound rapidly healed.—Meningitis.—Trephining for punctured fracture.—Death.*

I was a visitor to the clinique of Professor Regnoli, in Florence, in 1851, when a man was brought in insensible, from a cottage on the neighbouring hills. A fortnight previously, while he was working in a field, a small piece of rock struck him on the head, inflicting a very small wound, of which no notice was taken. It healed, and the man went on with his work. Ten days later his head ached, he was feverish, became drowsy, and then speechless. On admission into the clinique, Regnoli found the site of the wound hot and puffy, a drop of pus issuing from the centre. He made an incision at once through the swelling down to the bone, which was punctured, starred, and depressed. He now resolved to trephine. He did so, raised the depression, and removed several splinters of bone. The dura mater had been perforated. The man

never recovered his senses, and died in three days from diffuse suppurative meningitis, as proved at the autopsy.

CASE LXXXIX.—*Slight wound over orbital ridge, rapidly healed.—Death, at the end of a month, from meningitis and extensive fracture of the skull.*

While I was house-surgeon to Mr. Erichsen, at University College Hospital, in 1853, a man was admitted with a small contused wound, just over the centre of the left orbital ridge. He was partially insensible, and a companion stated that the blow had been inflicted by the pole of a carriage. The wound led down to bone, in which a slight fissure was felt; but there was no depression. The man was put to bed, and kept perfectly quiet, with cold applications to the head. Consciousness was rapidly restored, the wound healed, and within three days the patient was helping in the work of the ward. He was not discharged, because the left pupil, dilated from the first, continued so, and was insensible to light. No change occurred until the end of the fourth week, when the man complained of severe headache, became very feverish, violently delirious, and died in three days. At the autopsy the soft parts at the seat of injury were sound; but the bone was punctured very slightly, and from the central spot two fissures radiated; one passed upwards, vertically for an inch and a half, into the frontal bone; the other went backwards through the orbital plate, across the sphenoid to the right side of the middle line, across the petrous temporal bone and into the occiput, to within half an inch of the foramen magnum.

Two injuries of smaller extent, to external appearance, cannot well be conceived, than those which occurred in these two patients. Neither, however, can you imagine deep mischief more extensive, or fraught with greater danger.

CASE XC.—*Fall on the head, very slight scalp wound.—Death, in fifty-four hours, from extensive brain laceration.*

Here is another fatal result after an injury, which was at first deemed very trivial. I happened to call at the hospital one afternoon when a man walked in, stating that he had just previously fallen on to the top of his head, in getting down from an omnibus. A little blood issued from a small wound on the vertex, but it did not penetrate to the bone. The man smelt of beer, but was not drunk, and spoke correctly. The assistant on duty was telling him to go home, and attend as an out-patient next day, when I advised that he should be admitted as a precautionary measure. He walked into the ward, and retired to bed. He took a little food and was very quiet, until, eighteen hours afterwards, the nurse noticed that he was in strong convulsions. These recurred at frequent intervals; consciousness was lost and never regained, and death occurred at the expiration of fifty-fours hours from the time of injury. The examination revealed no damage at the site of the superficial wound, but the under surface of both anterior lobes of the brain was broken up, to the depth of half an inch, into blood clot and brain matter.

The books abound in cases as terrible as these, and in all essential respects analogous. It would, I think, be superfluous to adduce more evidence, to impress caution in the diagnosis and prognosis of head injuries.

Here are some cases to prove how unimportant some extensive scalp wounds may be, judging from the rapidity with which they heal, and the absence of complications.

CASE XCI.—*Wound of the scalp (six and a half inches), healed by the first intention under dry dressing and pressure.*

Ann Hand, in Ward 5, æt. 55, but looking much older, had fallen down some steps, on to her head, into the

cellar, when she was brought into the hospital. Her scalp presented a wound 6½ inches in length, a little to the right of the middle line. The wound was gaping, and the bone was exposed in one small spot. There had been considerable hæmorrhage, and the patient was suffering from slight concussion. The edges of the wound were accurately brought together by Mr. Wilkins, and secured by five points of silver suture. A large pad of dry lint, supported by carefully applied bandage, with considerable pressure, completed the dressing. The patient rallied in the course of a few hours, took milk and ice plentifully, and was quite free from pain. The wound was not looked at, until the completion of the seventh day. It was then perfectly healed throughout; the cicatrix appearing as a fine brownish line, movable on the subjacent parts, as was also the healthy looking and feeling skin in the neighbourhood. Not the slightest irritation was visible at the points of suture, of which four were now removed; the middle one being left as a precaution. The lint pad and bandage were re-applied. The eleventh day after admission the fifth suture was removed; it had not produced any irritation. A bandage was lightly applied, and the patient (in perfect health) discharged.

A more formidable wound than the preceding, but treated on substantially the same principles and with equal success, was that of the patient now before you, with this extensive cicatrix on the right side of his head.

CASE XCII.—*Large flap of scalp turned down by beam of steam engine in motion.—Rapid recovery under absorbent dressings and pressure.*

Thomas Weaver, admitted April 29th, 1880, after being struck on the head by the beam of a steam-engine in motion. The wound commenced just behind and above the

right ear, and extended upwards and backwards for a distance of three and three-quarter inches; then, forwards at right angles, for four inches. The triangular flap was turned down, and the bone exposed corresponding to its whole extent. Hæmorrhage profuse. The flap was replaced, and secured with four silver sutures, a large dry pad of absorbent gauze and cotton, and a smoothly compressing bandage. Three days afterwards, the temperature being 102·4°, the dressings were removed. The pad was soaked with a considerable amount of red serous discharge,

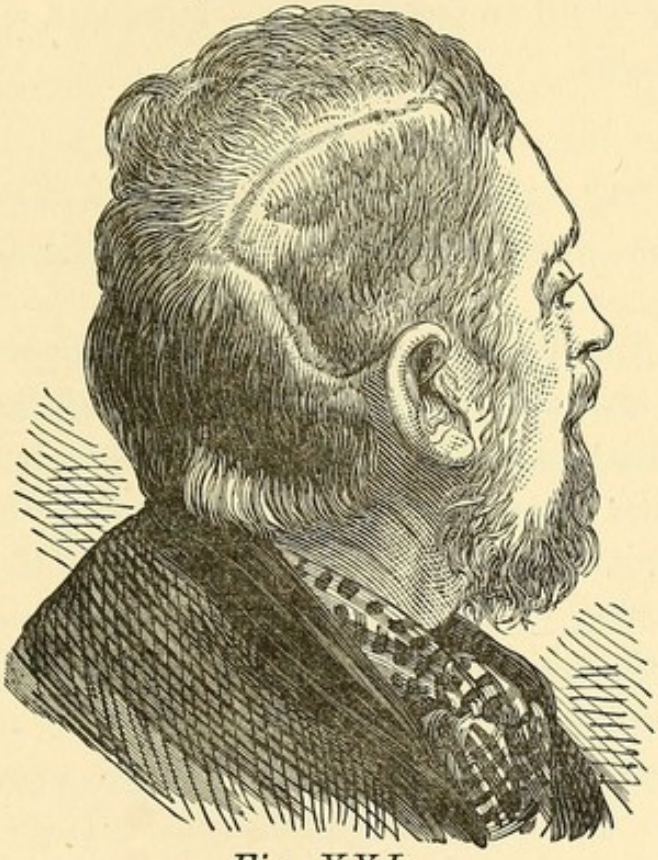


Fig. XXI.

but there was no redness of the skin, and the flap looked healthy and in good position; two sutures removed and fresh dry gauze and cotton pads applied, with increased pressure. The temperature fell steadily, and was normal at the third dressing, on the seventh day after admission. There was altogether very little suppuration, and the man left the hospital (May 9th) at the end of three weeks, with

the cicatrix sound throughout. During the whole period, the dressing with dry absorbent pads had been renewed six times. I saw the man between two and three months afterwards, and he continued perfectly well.

The two last cases illustrate how readily extensive scalp wounds may heal, after accurate co-aptation, under pressure and dry dressing infrequently changed. The bone was exposed in both instances; but that neither affected the treatment nor the result.

Progress is sometimes equally uneventful, though the vault of the skull be fractured and depressed, as well as the scalp wounded.

CASE XCIII.—*Compound depressed fracture of skull.—Union by the first intention under one dry dressing.*

Thomas Timmins, æt. 4 years, admitted September 14th, 1878. A few minutes previously he had been knocked down by a cab, and received a wound about one-and-a-half inches long, extending vertically upwards, and slightly inwards, from the centre of the right orbital ridge of the frontal bone. The bone was bared, fractured, and depressed, through the whole extent of the wound. The child had no brain symptoms.

The edges of the wound were brought together by two deep silver sutures, and dressed with a large dry pad of lint and roller. As there was no complaint from the child, and no indication of matter formation, the dressings were not touched for a week, when the lint was removed, and the stitches withdrawn. Only a linear cicatrix remained to mark the injury.

CASE XCIV.—*Compound and depressed fracture of skull.—Wound healed under dry dressing and ice.—Rapid and complete recovery.*

Thomas Moran, a bricklayer's labourer, æt. 55, was admitted to Ward 3, on September 15th, 1875. While he was at work just previously, a brick fell from a considerable height upon his head, making a Y-shaped scalp-wound, about two inches and a half in length, situated rather above the middle of the left parietal bone. The flap of the wound being turned back, a Y-shaped fracture became visible, with its centre depressed to one-third of an inch; the sides of the fracture sloped evenly towards the central and most depressed point. The man seemed little affected by the accident, and had no idea of its serious nature. The edges of the wound, admitting of easy approximation, were brought together and dressed with dry lint; and for the first fortnight the patient was kept perfectly quiet in bed, on milk diet, with an ice-bag on his head. No signs of constitutional disturbance appeared, and the man was discharged at the end of seven weeks, to use his own words, "in as good health as ever he was in his life." The wound was then quite healed, and the area of the depressed bone measured one inch and a half longitudinally, and seven-eighths of an inch transversely; the depth of the depression was three-eighths of an inch in the centre.

I took no notice of the fracture, beyond reducing it to the condition of a simple one, by promoting healing of the wound. The local and constitutional progress could not have been more favourable. When I saw the patient some months after the accident he continued in perfect health.

CASE XCV..—*Compound depressed fracture of skull, with partial paralysis.—Rapid recovery under dry dressing and ice.*

On the 22nd November, 1875, Edward Armitt was admitted into the Queen's Hospital under my care. He had a transverse wound, about an inch and a half in extent, at the back of the head, a little to the left of the middle line, and just below the suture between the occipital and the left parietal bone. The wound, which had been inflicted with a cabman's metal badge, led directly down to the skull; this was fissured, and the edges of the bony cleft were distinctly felt to have been driven in. The man was perfectly sensible, but the right pupil was dilated, the corresponding eyelid drooped, and partial paralysis of motion in the right arm was well marked. The treatment prescribed was absolute rest in bed, low diet, close attention to the bowels, dry dressing of the wound, and application of ice-bag to the head. At the end of nine days the wound had healed, and the symptoms of compression, after steady decrease, had completely disappeared. The patient was discharged on the 10th December, and resumed work six weeks after the accident. I saw him several times in the course of the following year, in perfect health. The depression in the skull was quite perceptible, but the man had not lost an hour's work and had shown no symptons traceable to the injury.

A still more serious state of things occured in

CASE XCVI.—*Compound, punctured, and depressed fracture of temporal bone, with considerable hæmorrhage. Gradual healing of wound under dry dressings; complete recovery.*

Henry Haddon, a machinist, æt. 25, admitted to Ward 1, at 11.20 p.m., on the 25th September, 1875. A few minutes

previously, in a street row, a brick had been thrown at his head, producing a wound an inch in length, over the left temporal ridge, in a line above, and in front of, the ear. The hæmorrhage was considerable. The probe passed into a very abruptly punctured fracture of the skull; the amount of depression being half an inch, and the edges of the bone, on one side at least, being quite perpendicular. Mr. C. R. Keetley, our house-surgeon at the time, to whom I am indebted for the notes of the case, made a memorandum on the spot to the effect that, in Haddon's fracture, a small piece of bone appeared to have been driven in. The man was quite sensible, though faint from loss of blood. He was put to bed, with an ice-bag on his head. At 8.30 next morning, a little headache was complained of; the pupils were even; temperature 101°. A magistrate took the patient's depositions at his bedside in the afternoon.

September 27th (morning).—Pulse 80; temperature 98° There was a thin drab fur on the dorsum of the tongue. The bowels were confined. He had slept well, and was very hungry. The wound was healthy. Eyelids slightly swollen.

The bowels acted the next day. The wound gradually healed, under dry lint dressing. On October 9th (a fortnight after admission) the ice-bag was left off, a flannel cap ordered to be worn, and the man allowed to get up. At the end of another fortnight he was discharged, in perfect health; the cicatrix was quite sound, and the depression at the seat of fracture admitted the end of the little finger, which did not seem to touch bone at the bottom. I saw this man, some months after the accident, in perfect health.

CASE XCVII.—*Compound depressed fracture of the skull.—Complete recovery under dry dressing, ice-bag, and milk diet.*

T. Smith, a joiner's labourer, æt. 25, was stooping at his work, when a brick fell on his head from a height of thirty feet. When admitted to Ward 1 (4.15 p.m., October 15th, 1875), half an hour after the accident, he was quite sensible. A wound on the left side of the head was bleeding freely; corresponding to it was a depressed fracture of the skull, the displaced piece of bone being horse-shoe shaped, and situated near the middle of the lambdoidal suture. The depressed surface was about one-eighth of an inch below the surrounding bony level. No head symptoms. Pulse 80; temperature 99°; respirations 24. The edges of the wound were approximated, and dressed with dry lint. An ice-bag was ordered to be kept on the head constantly.

October 16th.—Temperature 99°; pulse 72; respirations 20. Patient perfectly sensible, and had taken plenty of milk. He was ordered to have an ounce of castor oil.

October 17th.—Has slept four or five hours in the night. The bowels have acted. Temperature 101°; pulse 104; respirations 22.

October 18th.—Temperature 101·6°; pulse 76; respirations 25.

November 19th (morning).—Temperature 99·2°; pulse 84; respirations 22. There were still no symptoms of nervous lesion or constitutional disturbance. Seven p.m.—temperature 104·4°; pulse 104; respirations 32. He had a rigor half an hour ago. The bowels not having acted for some days, a full dose of castor oil was administered; the bowels were then freely relieved. The temperature rapidly fell to the normal standard, and no other untoward symptom occurred.

December 8th.—The patient had continued perfectly well, and for the last month had acted as assistant porter in the

hospital. He was now discharged, and I made the following note :—"The length of the cicatrix is one inch and three-quarters. The depressed portion of bone measures one inch and one-eighth, by seven-eighths of an inch. The depression is deepest in the centre, where no bone can be felt. The man looks perfectly well, and says that he is so."

I saw this patient upwards of twelve months after the accident. He continued quite well, and had never missed a day's work. Three small pieces of bone had worked through the cicatrix, which was quite solid, pale, and painless, over the depressed portion of the skull.

The four last cases have several characters in common. In each, the scalp was wounded and the skull broken; in each, the fractured bone was depressed. In all the cases, the offending cause was a powerful one, presumably sufficient to cause considerable intra-cranial extravasation. Two of the men had each had a brick fall on his head from a considerable height; in a third a brick had been flung at the temporal region in a street row. In neither of the cases were brain symptoms present. In treating them, I dismissed the fracture from consideration, closed and dry-dressed the wounds, kept the patients at perfect rest with large ice-bags on the head, fed them on iced milk, and watched the thermometer chart closely. Recovery was practically uninterrupted in each case, and was proved to have continued so, for many months after the patients were discharged from the hospital.

Case XCVIII.—*Extensive wound of scalp, and denudation of periosteum.—Double depressed (one punctured) fracture of frontal and parietal bones.—Impaired sensibility and motor power.—Complete recovery under ice-bag and dry dressing.*

On May 11th, 1877, John Curtis, æt. 46, was admitted under my care in our accident ward. He had been thrown

out of a cart, in rapid motion, on to some stones. The greater part of the right half of the scalp was turned back, and much periosteum had been stripped from the frontal and left parietal bones, in each of which was a fracture with depression: one fracture, immediately above the parietal ridge, was characteristically punctured and depressed—a circular piece of bone, about the size of a split pea, having been firmly driven in to the depth of one-eighth of an inch. The man was barely conscious, and could only give a very imperfect account of the accident. When I saw him at 11.10 p.m., about two hours after admission, the pulse was 76; respirations 22; temperature 99·8°. After carefully cleansing the wound, its edges were brought into contact, except at a small dependent point, with eight points of silver suture; an oakum dressing and a gently compressing bandage were applied, and a large ice-bag all over.

On the following day (May 12th), 9.30 a.m., pulse 84; respirations 22; temperature 101·2°. Nine p.m.—pulse 108; respirations 28; temperature 103°. After this visit, I noted numbness and impaired motor power in the left hand, with complaint of headache. Ice-bag to be persistently continued, and an aperient draught prescribed.

May 14th, (3rd day).—Dry and compressing dressing renewed; discharge considerable, but wound looking very well; the lower half of it healing by the first intention. Pulse 80; respirations 20; temperature 101·2°. Pain in head, and numbness in hand, gradually decreasing; absolute quiet, and ice-bag to be continued.

From this date, the progress to recovery was uninterrupted. The man was discharged June 21st, barely six weeks after the accident. He resumed his regular work as a carter in another fortnight, and three months later (September 28th), he was in vigorous health. Two splinters of bone were extracted shortly afterwards, from the cicatrix, which

throughout continued pale and painless, the points where the sutures were inserted being scarcely perceptible. *

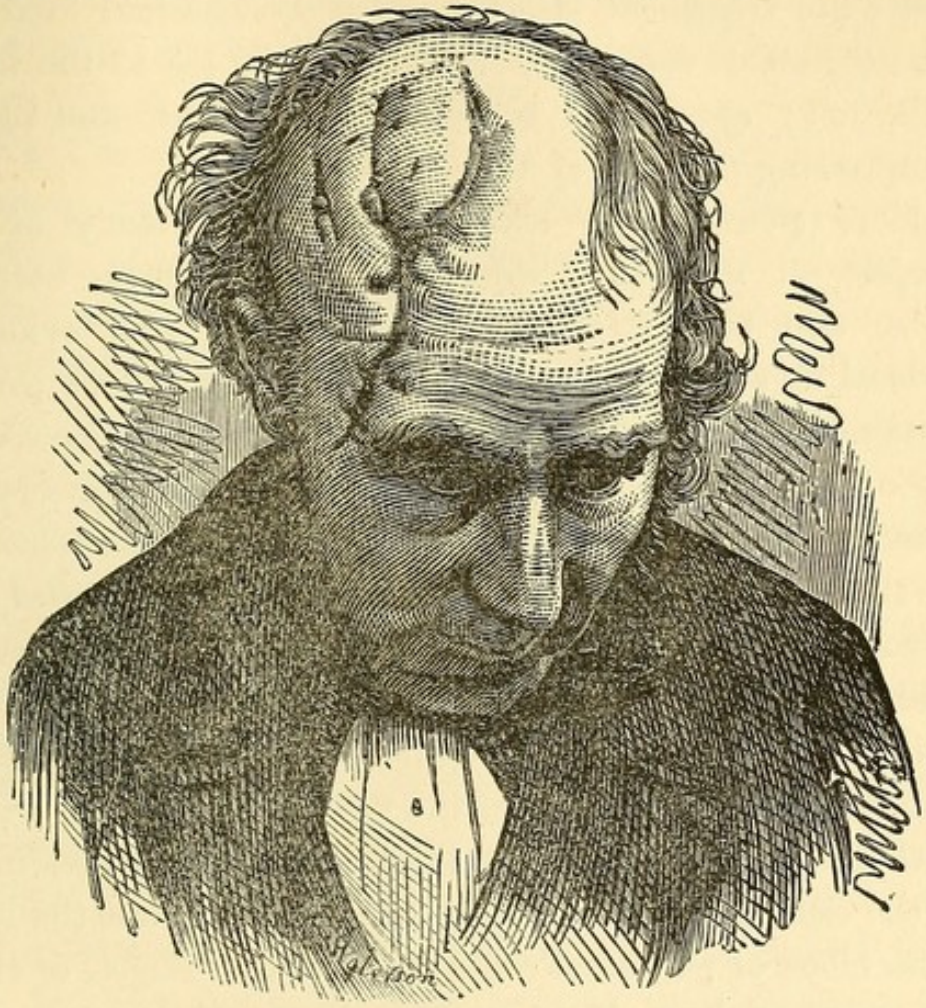


Fig. XXII.

Many surgeons would have trephined in this case; the majority probably would have done so in Henry Haddon's, in whom a brick thrown at the temporal region had abruptly punctured the bone, and driven a small piece of it right into the skull.

Why did I not trephine?

Because the injuries to the scalp and to the vault of the skull were either not associated with brain symptoms,

* While revising this proof-sheet (2nd May, 1883), this patient has called on me. The cicatrix is less perceptible, but the bone depressions are very well marked. The man has continued in excellent health, in the same situation, and has not lost a day's work since the accident.

or, in the cases in which such signs did appear, they quickly subsided, as denoted by the closest observation, under the treatment steadily pursued,—absolute local and constitutional rest; the application of ice to the head; milk diet; aperients; absorbent, infrequent, and lightly compressing dressing of the wound.

More precise and extensive statistical study of this subject is necessary, especially with accurate notes of pulse and respiration ratio, temperature, and evidences of local organic and functional disturbance. In the present state of knowledge, I beg you to accept the expression, of my opinion on this complex question with much reservation. I incline to the opinion which guided me in the treatment of the cases related, and which their results justified, that in compound and depressed fractures of the skull, without brain symptoms, the trephine should not, as a rule, be used. But that rule has its exceptions. I am furthermore of opinion that, in fractures of the vault of the skull, with or without wound, the use of the trephine may be justifiable, if the constitutional and local symptoms warrant the belief, that blood or pus is collected under the meninges, or that a fragment of bone is pressing upon the brain at the seat of injury.

The cases which I have brought before you are too few for any definite conclusion to be drawn from them; I might treble the number from my own practice. They vary in details, but are alike in essentials, and lead to the same conclusion. Yet that inference is not an adequate foundation for a rule of practice, because a large number of cases can be quoted from the books leading to an opposite conclusion. Some of the greatest surgeons of all time have been, and are, ranged on two sides on the question of trephining for fractures of the skull; and the subject is pre-eminently one in which disinclination to dogmatism

grows with experience. Sharp lines of distinction and systematic generalizations are, in the present state of knowledge, impossible, in the diagnosis, prognosis, and treatment of injuries of the head.

What does history teach ?

A century ago, operative interference was the rule in all fractures of the skull. It was Quesnay, himself an advocate of the practice of interference, who gave force to the opinions of dissentients, by the very title of one of those masterpieces of clinical study embodied in the memoirs of the old Academy of Surgery. * It fell to the lot of another of the academicians to substitute, for traditional empiricism, rules of practice, as prudent and safe in their application, as their conception was enlightened and their demonstration closely, and carefully, reasoned. With few reservations, Desault was opposed to the use of the trephine in fractures of the skull. † It was otherwise with his great rival on this side of the Channel, Percivall Pott. The elevator and trephine were his favourite instruments; and so great was his ascendancy in the surgical world, so much more fascinating for the multitude, then as now, were boldness and complication than prudence and simplicity, that his heroic action had many imitators.‡ Foremost amongst them was his most illustrious pupil, John Hunter, who went so far as to advocate the trepan in some doubtful cases, "as the operation can do no harm." § The impending French Revolution, and its attendant slaughter on the battle-fields

* Précis de Diverses Observations sur le Trépan dans les Cas Douteux, par M. Quesnay. Mémoires de l'Academie Royale de Chirurgie, 8vo edition, tome i, p. 311, et seq. Paris : 1774.

† Œuvres Chirurgicales de P. J. Desault, par Xavier Bichât. Paris, an. ix 1801. Mémoires sur les Plaies de la Tête, vol. ii, p. 1, et seq.

‡ Fractures of the Cranium with Depression, in the Chirurgical Works of Percivall Pott, vol. i, p. 213, et seq. London : 1783.

§ The Works of John Hunter, F.R.S., with notes, edited by James F. Palmer, vol. i, p. 424. London : 1867.

of Europe, was soon to furnish those lessons which, in surgical as in other experience, make men judicious.

When, after the battle of Talavera de la Reyna, the order was given for all the wounded, who could leave the town, to march, Surgeon Rose found himself in charge of a large number of the disabled Guardsmen. Twelve or fourteen of them had compound fractures of the skull, some with depression. In none of these was the trephine employed. The retreat, in the burning sun, lasted sixteen days, and yet every one of those who were wounded in the head recovered.*

Hennen relates the case of Corporal Cockeyne, wounded by a musket-ball in the head, at Waterloo. The fractured portion of bone was driven into the brain (being exactly an inch and one-fourth from the surface of the scalp). No operation was performed, and yet the man was discharged, cured, in a few weeks. After quoting a similar case, Hennen sums up: "We have here sufficient proof that there is no absolute necessity for trepanning, merely for depressed bones from gunshot, ¶ —an opinion strengthened by the cumulative experience of military surgeons; many of them now entirely discard the trephine, while almost all are agreed that its use should be restricted to exceptional cases. †

Desault's conservatism told directly on the civil practice, not merely of his own countrymen, ‡ but of British surgeons. John Bell, § with his true surgical instinct, with his

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* Quoted in Ballingall's Outlines of Military Surgery, fourth edition, pp. 288-9. Edinburgh: 1852.

¶ Principles of Military Surgery, by John Hennen, third edition, p. 290. London: 1829.

† Vide Professor Longmore on the Treatment of Gunshot-Wounds of the Head, in Holmes's System of Surgery. Third edition, vol. i, p. 506. 1883.

‡ Dupuytren, Leçons Orales de Clinique Chirurgicale, tome vi. Paris: 1839. Blessures de la Tête, p. 128, et seq.

§ On Fractures of the Skull, with Depression, in John Bell's Principles of Surgery, vol. ii, part ii, p. 764, et seq. London: 1806.

impetuous energy, and with the furbished eloquence of his ripe culture, threw in his lot against the trepan. "After the expiration of my apprenticeship at these hospitals," Astley Cooper has placed on record, * "I went over to Paris, to see the practice of Desault at the Hôtel de Dieu; and there I found that scarcely ever under any circumstances did he trephine; and he was more successful than the English surgeons." Abernethy, ¶ and Lawrence, ‖ too, were in this matter disciples of Desault; and on the same side must be mentioned one of the most enterprising surgeons of the century,—a master who combined, in a very rare degree, fearlessness and judgment, power of brain and skill of hands,—I allude to Robert Liston. In his *Practical Surgery* † he thus writes: "When fracture of the skull is complicated with wound of the scalp, the surgeon will not in general mend matters by trephining, as has been advised, merely because there is a wound; if the depression is pretty extensive, and unless he has a better reason to give for the proceeding than the mere circumstance of the fracture being compound, as it is called, he will often thus add as much to the injury and to the risk which the patient is subjected to by it, as he would by dividing the scalp in simple fractures."

This warning is of special significance, emanating, as it does, from one who had had abundant opportunities of witnessing the effects of the trephine and elevator; and who possessed operative skill and courage in so high a degree, that he never felt the temptation to inaction as a refuge from responsibility.

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* Lectures by Sir Astley Cooper on the Principles and Practice of Surgery with Notes and Cases, by F. Tyrrell, vol. i, p. 279. London: 1824.

¶ The Surgical Works of John Abernethy, a new edition, vol. ii, pp. 24-5. London: 1827.

‖ Quoted in Guthrie, on Injuries of the Head affecting the Brain, p. 118, et seq. London: 1842.

† London, 1846, fourth edition, p. 45.

Samuel Cooper * was equally conservative; but it is due to you to state that three of his contemporaries—Guthrie, † Brodie, ‡ and Velpeau, §—in the very front rank of surgical authorities, rather inclined to the heroic practice of Pott, than to the physiological observations and the gentle measures of Desault. Italian surgery ‖ has gradually come round to non-interference, as the rule of practice in fractures of the skull; while the German school has traditionally been opposed to the trephine. ¶ Neudörfer writing after the Franco-German war, sums up directly against it. ** Mac Cormac †† reflected the combined experience of the French and German surgeons on the battle-field of Sedan, in the statement that, "as a general rule, the largest proportion of good results (in gun-shot fractures of the skull) obtain amongst those cases where the amount of operative surgery has been at a minimum."

Jules Rochard ‡‡ has contributed an interesting summary of the international position of the question. Speaking of

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* Article "Trephine" in Dictionary of Practical Surgery, by Samuel Cooper, seventh edition. London: 1838.

† On Injuries of the Head affecting the Brain, by G. J. Guthrie, p. 92 and 17. London: 1842.

‡ Pathological and Surgical Observations relating to Injuries of the Brain, by B. C. Brodie, F.R.S., in Medico-Chirurgical Transactions, vol. xiv. London: 1828, and in the Works of Sir Benjamin Collins Brodie, collected and arranged by Charles Hawkins. London: 1865. Vol. iii, pp. 21-85.

§ Velpeau, De l'Operation du Trépan dans les Plaies de Tête. Paris: 1834.

‖ Lezioni di Medicina Operatoria e di Patalogia Chirurgica, di Regnoli e Ranzi, volume quarto, p. 47, et seq. Firenze, 1850.—Istituzioni di Patologia Chirurgica, scritte da Felice de Rensis e Antonio Ciccone, terza edizione, volume primo, p, 178, et seq. Napoli, 1852.

¶ Vide Durchborung des Schädels in Die Chirurgischen Krankheiten nud Verletzungen des Gehirn und seiner Umhüllungen, von Victor Bruns, p, 1037, et seq. Tübingen: 1854.

** "Die Trepanation niemals eine Heil-Operation sein Kann." Neudörfer, Handbuch der Kriegschirurgie und der Operationslehre. Zweite Heft. Specielle Theil. Leipzig, 1872. Erste Abtheilung, p. 82.

†† Notes and Experiences of an Ambulance Surgeon, by William Mac Cormac, p. 65. London: 1871.

‡‡ Histoire de la Chirurgie Française au xixe Siecle, p. 862. Paris: 1875.

trephining, he says: "The spirit of reserve distinguishes French surgery. It holds a position between the practice of the Germans, who scarcely ever trephine, and that of the English and of the Americans, who, though resting on the same rules as ourselves, have much more frequently recourse to this operation. Léon le Fort has analysed the trephine operations on the two sides of the Channel, from 1855 to 1866. He has found one hundred and fifty-seven of them in England, and only four in France, in that period."

The results of the operation amongst the most distinguished contemporary British surgeons show a very large mortality. Mr. Erichsen tells us "that of 17 cases in which the trephine proper was used at University College Hospital by Cooper, Liston, and himself, six patients recovered." (*)

We learn from Mr. Bryant, that "at Guy's Hospital trephining and elevation of bone for head injuries, have been performed in 51 cases during seven years, and of these only 12 recovered." He adds, on the authority of Mr. Callender, that in 1867, at St. Bartholomew's Hospital, the operation had not been performed for six years.(†)

This is a very remarkable statement for Mr. Callender, practising in a hospital in which the succession was lineal and unbroken, between Percivall Pott and himself, through John Abernethy, Sir William Lawrence, and Sir James Paget. We have already noted what Pott thought of the trephine, and how he practised it. If, under the favourable conditions in which surgery has always been practised at St. Bartholomew's, the successors of John Hunter's surgical teacher had come to regard the operation with so much distrust as not to practise it for six years, I leave you to form your

(*) Science and Art of Surgery, by John Eric Erichsen. London: 1872. Sixth edition. Vol. I, page 444.

(†) Manual for the Practice of Surgery, by Thomas Bryant. London: 1879 Third edition. Vol. I, page 232.

own conclusion, as to the estimate in which they held it, in the treatment of the large number of head injuries which, from its position and repute, have always sought relief in their great Hospital.

And yet Pott's practice is not everywhere abandoned even in this country. Dr. Robert S. Hudson, of Redruth, (*) has recorded that the Cornwall surgeons, lineal descendants of Pott's personal pupils, still trephine for fractures of the skull so frequently, that a Redruth practitioner could show 64 specimens of trephine bones, each in its little box, with name and date of operation. A surgeon now living rarely knew a week pass during his pupilage, without one or two trephine operations. A very large percentage of these cases are said to have recovered; and the latest writer from St. Bartholomew's Hospital, Mr. W. J. Walsham, answers the question. Is trephining the skull a dangerous operation *per se*, in these words; "I think we may safely reply that the operation of trephining is attended in itself with but slight risk."(‖)

Further evidence of reaction in favour of trephining is furnished by two of the most recent surgical publications amongst the English speaking race. Dr. Lewis A. Stimpson, Professor of Surgical Pathology in the Medical Faculty of the University of the city of New York, writes,(†) "So far as my own observation and experience go, the practice of early active interference yields good results; that is, the percentage of success is not only very much greater than that furnished by the tardy use of the trephine, but is actually high, especially when the wound is treated anti-

(*) On the use of the trephine in depressed fractures of the skull, by Robert S. Hudson, British Medical Journal, 1877. Volume II, page 75.

(‖) St. Bartholomew's Hospital Reports. London : 1882. Volume XVIII, page 223.

(†) A Treatise on Fractures, by Lewis A. Stimpson. London : 1883, page 247, &c.

septically. During the last year, 1880-1, thirteen compound fractures of the skull have been treated at Belle Vue Hospital by trephining, and under this term I include the use of the bone-pliers, to remove a portion of bone so as to elevate or remove the depressed portions. One case was a gun-shot fracture, the bullet was buried in the brain, and the patient died in 24 hours. In another, the fracture was overlooked for nearly a fortnight; then severe brain symptoms set in, the wound was enlarged, a slight depression found, and the trephine applied; pus was found between the dura mater and the bone; the patient died soon afterwards, and the autopsy disclosed a circumscribed suppurative meningitis. Of the remaining, two died, eight recovered, and one is still under treatment with hernia cerebri. Seven of these presented no brain symptoms beyond stunning, and were operated upon immediately after the accident; they all recovered, and in two of them the amount of bone removed was about three square inches, one of them being further complicated by a wound of the longitudinal sinus. The remaining four cases presented brain symptoms, they were operated upon immediately; two died, one recovered, and the fourth is the one with hernia cerebri just mentioned. Within the same period I have operated at the Presbyterian Hospital upon two cases of compound fracture, one with extensive depression, the other with double linear fracture; both operations were done within two hours after the accident, and both patients recovered without a bad symptom. In contrast to these, I may mention two cases that have recently come under my observation, one of the tardy use of the trephine, the other of non-interference; both terminated fatally, the first with suppurative meningitis, the second with abscess of the brain. Both fractures were compound and small, both patients walked to the hospital, and neither presented brain symptoms until after a week had passed. Both, I think, might have been saved by an early operation."

No less authorities than Mr. Prescott Hewett and Mr. J. W. Hulke, have quite recently expressed themselves in these terms: (*) "With a wound leading down to the bone, we ought to operate at once. If the symptoms are slight, the operation may be successful; but if the symptoms are urgent—if compression of the brain is decided and strongly marked—there is every probability that all our efforts will be unavailing; for in such cases it very rarely happens that the brain symptoms are dependent upon the depressed bone. The severe symptoms in fracture with depression arise, for the most part, from extensive extravasations of blood, or some serious lesion of the brain substance itself, and hence the reason of an operation being so seldom of any use. Still, notwithstanding all this, it is our duty to operate, as the symptoms may, after all, be wholly dependent upon the bone."

Reconsidering my own experience of nearly thirty years as a hospital surgeon, with the light shed upon it by the authorities quoted, by many others which time and space prevent my referring to, by the practice of many surgeons which I have been privileged to witness, by the opinions of many able men whom I have met in consultation, my present opinion on the question is this.

There is good reason to believe that a large number of patients have died after being trephined, who ought not to have been operated upon, because moribund at the time. A few hours watching of the thermometer and the pulse and respiration ratio, might have proved conclusively that the stream of life was fast ebbing,—in many cases from internal injuries, independent of the fracture of the skull. Lives have been lost that might have been saved, if the golden maxim, "leave well alone," had been respected; if

(*) System of Surgery, edited by T. Holmes and J. W. Hulke. London: 1883. Third adition, vol I, page 584.

local and constitutional rest had been strictly enforced; and if mechanical interference had been abstained from, when there was no urgent need for it. On the other hand, some patients, with head injuries, have died, who would probably have recovered had they been trephined. No general and fixed rule can be laid down. Each case must be considered, physiologically and surgically, on its merits, without preoccupation from theory or tradition, and only after judgment formed on facts accurately noted and comprehensively considered.

I commenced this lecture by relating cases of compound depressed fracture of the skull which had recovered without operative interference. Here are notes of others, in which a different practice was pursued.

CASE XCIX.—*Compound depressed fracture of frontal bone.—Removal of two small pieces of bone.—Perfect recovery within a month.*

Charles Phillips, æt. 12, admitted December 4th, 1880, with a lacerated and contused wound, two inches in length, on the frontal bone, which was depressed, to the depth of three-quarters of an inch, on to the brain. Two fragments of bone were comparatively loose, and were removed with great care at once. Hæmorrhage was slight. No brain symptoms. The edges of the wound were approximated with two fine silver sutures. A drainage tube was introduced into the lower angle, the outer end of the tube being passed through a hole in the absorbent pad, which was secured over the head with lightly compressing bandage. A small absorbent pad was lightly fixed over the outer end of the tube.

Dec. 5th (next day).—Is very restless. A considerable amount of bloody fluid has drained and dried into the pad,

Pulse 112; resp. 24; temp. 99°,—the highest registered throughout the progress of the case. The patient gradually became calm, took light food and rested well, and the pulse steadily fell to 84, the seventh day after admission, when the wound was dressed for the first time. Pads and bandages saturated with dried blood; in centre of pad over wound purulent discharge had come through. Skin, around wound, pale and dry to the very edge. Wound granulating from the bottom. Absorbent pad and lightly compressing bandage re-applied.

December 17th (14th day, second dressing).—Constitutionally quite well. Wound healing, sutures removed; drainage-tube withdrawn, and a smaller one substituted; its end, as before, brought through absorbent pad.

The lad was made an out-patient January 27th, when this note was dictated;—"wound very small, bone completely covered by a depressed adherent cicatrix; in the centre is a small portion about the size of a pea, which has not yet healed. Only slight discharge. Patient to come up once a week to be dressed. General health perfect." At the end of another fortnight, the lad, being quite well, discontinued attendance.

In this case two small pieces of the depressed frontal bone were lightly picked out, by the aid of a pair of forceps, without any difficulty. The next depressed compound fracture was of a much more formidable kind, and the treatment necessarily bolder, but the result equally successful.

CASE C.—*Compound comminuted and depressed fracture of skull.—Trephining.—Recovery.*

Mary McIvan, æt. 44, admitted July 19th.

History.—Whilst walking in Smallbrook Street a short time before admission, a brick fell from a house-top, striking

her on the head, and knocking her down, but she was not rendered unconscious.

On admission, patient being quite sensible, a wound three and a half inches in length was found on the anterior part of the vertex. On the finger being introduced, a longitudinal depressed fracture, to the extent of two and a half inches, was detected, a little to the right side of the superior longitudinal sinus. Shortly after admission chloroform was administered, and I enlarged the original wound to the extent necessary for removal of a circle of bone, by means of the trephine. I then elevated the depressed portion, and removed nine fragments, besides the circular piece in the crown of the trephine. Three of the fragments placed side by side on the sheet of paper before me, make one piece, which measures superficially two inches by one inch.

The wound was dressed with dry lint, the head shaved, and dry cold applied. Milk diet.

July 20th.—Slept well, and passed a quiet night. Complains of a little frontal headache, otherwise comfortable.

July 22nd.—Is quite free from pain, progressing favourably in every respect. Tongue clean; bowels open.

July 26th.—Wound discharging freely, but patient is easy and comfortable.

July 31st.—Continues to improve; wound healing nicely, scarcely any discharge. Pulse has never been above 80.

August 10th.—Still improving; very little discharge.

August 17th.—Patient has been out of bed once or twice since last report, and feels much better in every respect.

August 31st.—There is still a little discharge, patient is otherwise quite well.

Sept. 15th.—Wound is now perfectly healed, patient is walking about as usual, and has been out of hospital several times. Oct. 4th.—Went home to-day.

Oct. 12th.—Visited patient at her own house, and found her quite well; examined depression and found that it measured two and a half inches in length, and nearly half an inch in depth.

I am now about to read you the notes taken by the then house surgeon, and my present colleague, Mr. Jordan Lloyd, of a case full of scientific interest, and of the most important practical bearing on the question of trephining under certain circumstances.

CASE CI.—*Wound of scalp and injury of skull.—Coma.—Trephining.—Evacuation of pus in moribund state from abscess in substance of brain.—Survivorship for six days.*

Charles Squires, æt. 11 years, a schoolboy, attended as an out-patient at Queen's Hospital, Birmingham, on Oct. 28th, 1879.

A week before he had been struck on the forehead with a stone. He was not rendered insensible, and felt very little of it. The wound was dressed, until his attendance here, by his mother. It was about half an inch in length, situated a little to the right of the median line, and immediately below the line of juncture of the hair with the forehead. It appeared healthy and granulating. The bone was denuded, but there was no fracture discoverable. It was dressed with a pad of dry lint, and the boy treated as an out-patient, as he made no complaints of feeling ill in any way.

He attended as an out-patient until Nov. 28th, feeling quite well during the whole of this time; the wound only healing slowly. On this day, a small thin irregularly triangular exfoliation of bone, about three-eighths of an inch in its longest diameter, came away. There was slight pulsation in deepest part of wound. A probe detected no

more bare bone, and could be felt to pass into a "cleft" in the skull. He made no complaint of any kind, but was taken into hospital and put to bed. Temperature 99·2°; pulse 100; respirations 18.

Dec. 6th.—No symptoms since admission. To-day, when patient coughs, there is an escape of about one-third of a drachm of thick laudable pus, from the deeper part of the wound, evidently from within the cranial cavity. Face, hands, and feet are cold and bluish. Pulse so small and feeble as scarcely to be perceptible. Temp. 98°; pulse 84; resp. 18.

Dec. 15th.—Has been doing well since last report. No symptoms. There is a little accumulation of pus at each dressing, wound continues to pulsate. His evening temperature during the last four nights has between 100° and 102°, falling to normal in the mornings. On the 12th he had a flushed face. To-day he complained, for the first time, of headache. Temperature 98·6°; pulse 118; respirations 30.

Dec. 25th.—Headache passed away on the 17th. Temperature has not risen since 15th. He has had no symptoms, and feels quite well. Discharge from wound has been gradually diminishing; wound is healing. There is no pulsation, and scarcely any pus; ordered to sit up. Temp. 98·4°; pulse 98; resp. 18.

January 1st, 1879.—Has been up and about since last report. He feels pretty well. Wound is covered by a small firm scab. No complaints of any kind; he was, therefore, discharged as cured.

January 15th.—Patient was re-admitted to-day. Since his discharge his mother says, "he has kept very quiet, and seemed to be going on well until the last three or four days, when he appeared to fall off again, and complained of headache and sickness."

On admission, the boy is pale and weak. He complains of constant headache, and frequent vomiting. Wound a little moist, not pulsating. Temp. 98·4°; pulse 78; resp. 22. He was put to bed, and ordered an ice-bag locally, and free purgatives.

January 18th.—No amelioration of symptoms; nothing fresh to note. Temp. 98·2°; pulse 76; resp. 20.

January 23rd.—Since last report, sickness has been a little better. To-day, it has returned, with headache, referred to forehead and occiput. Emaciating rapidly, has tendency to obstinate constipation. Is unable to bear the ice-bag longer, as it increases the pain. Temperature 98·4°, with an evening fall of nearly one degree.

January 28th.—No improvement in symptoms. During last two or three days has frequently shrieked loudly, has also been wandering at night. No paralysis of any kind. Pupils equally dilated under atropine. There is double optic neuritis, margins of discs blurred, veins engorged. Wound is practically healed, no swelling or redness about its edges. Constipation. Temp. 98·4°; pulse 66; resp. 18.

January 31st.—Boy still growing worse. Temp. 98·4°; pulse 60; resp. 18. Tongue foul, breath fetid. He is quite conscious, and answers questions rationally. He desires, however, to be left quiet. To-day, under anesthetics, I trephined under the carbolic spray, removing a circle of bone from the upper and outer part of wound. The bone was slightly eroded on its inner surface; there was no pus found; the dura mater was healthy, and did not bulge into trephine hole. The wound was dressed, and the boy returned to his bed. At night, all the symptoms were still present, his temperature had fallen to 95·1°; pulse 66; respiration 16. He was quite conscious and answered questions.

February 1st (nine a.m.).—Wound dressed; little oozing only, no pus. No vomiting since early morning. Has not slept, but constantly shrieking through night. Involuntary micturition. Bladder not distended. Temp. 96·2°; pulse 66; resp. 18.

At 11.45 a.m. to-day, he was lying quiet, and was not taking food, when he quite suddenly ceased to breathe. The house surgeon, Mr. Jordan Lloyd, was summoned from a distant part of the hospital, and on his arrival, the nurse told him the boy was dead; he had not breathed for three or four minutes. Face was livid, eyelids drooping, and eyes fixed and insensitive; jaw had fallen, and there was frothing from the mouth; pupils dilated and insensitive; limbs and trunk flaccid; pulse small and fast, only just perceptible. Artificial respiration (Silvester's method) for 15 minutes, was followed by one or two feeble respiratory efforts, which quickly died away again; pulse still perceptible. At a few minutes after twelve o'clock, the patient being apparently moribund, Mr. Jordan Lloyd divided the membranes in the line of the external wound, and, to quote the words of his report, which is accurate and graphic as his surgical action was sound, "there was an escape of about half an ounce of serous fluid, but no pus; I then plunged a bistoury into the brain matter vertically downwards, and when nearly an inch from the surface, a stream of pus oozed out. I had some difficulty in introducing a drainage-tube, which I had to do along a director inserted after the knife was withdrawn; during my manipulations, I felt the point of the director impinge on the base of the skull; it was clear, therefore, that I had penetrated completely through the anterior lobe of the brain. I exercised the slightest possible pressure in inserting the drainage-tube (a thin india-rubber one), which passed inwards for seven or eight inches, doubtless having curled itself up in the abscess cavity. By this time all

respiration had ceased, pulse imperceptible at wrist; there was occasional pulsation at precordia. Artificial respiration had been kept up at intervals during the operation, and was then re-commenced. Ordered friction and hot water bottles to extremities, and cleared a large quantity of frothy mucus from the upper part of the larynx, the tongue being drawn forwards, and the neck well arched over a pillow; in ten or twelve minutes more, he made voluntary efforts at respiration; slow and shallow pulse, still imperceptible at wrist; complete anesthesia. A few minutes afterwards conjunctivæ became sensitive, and respiration responded to cold flacking of chest."

At 12.45 p.m. pulse could not be taken; patient, breathing eighteen shallow respirations per minute, was quite unconscious and could not be roused.

At 1.15, patient's respirations slowed; and he seemed to be relapsing. After a wet, cold sponge had been "dabbed" on the chest every five or six minutes, he again rallied at 1.30, respirations 18, pulse 136. At 2.40 p.m., he opened his eyes, asked for milk, and recognised persons around.

At 4 p.m., he drank some beef tea, says "he feels better," headache has disappeared. He asked for a bottle, and passed water.

At 12 p.m., sleeping, temp. 102°; pulse 126; resp. 18. The wound dressed under the carbolic spray.

Feb. 2nd.—Has passed a good night, slept nearly the whole time. This morning is quite conscious, but drowsy. Says "he feels better." neither headache nor vomiting, pupils normal, no paralysis. No urine since 4 p.m. yesterday; catheterism yielded only eleven ounces. He has no remembrance of anything which has happened since yesterday morning. Wound dressed; free bloody discharge in dressings; pus in drainage tube; temp. 92°; pulse 108; resp. 21.

Feb. 4th.—Yesterday complained of a "twinge" of headache occasionally, moaned and threw his arms about once or twice during the night; with these exceptions, he has been quite comfortable; complains of hunger, and takes nourishment freely. There is slight loss of expression on left side of face,—no paralysis; slight headache, in front and behind; pains about body, especially in neck and back; throws his arms about occasionally; perspires rather freely; involuntary micturition; bladder not distended.

Morning temperature 104°, having risen during last night from 100°; pulse 156; resp. 38.

Evening temperature 102°; pulse 160; resp. 38.

Feb. 6th.—Wound dressed daily; not much discharge. Severe headache, which is relieved for a short time after dressing. Drainage tube removed,—a strand of catgut substituted. Has "wandered" through night. Involuntary defaecation and micturition. Restlessness; slight twitchings of face and limbs. Persists in pulling off dressings; answers questions quite readily; no paralysis. Appetite good.

Temp. 100°; pulse 118; resp. 30.

Feb. 8th.—Restlessness, headache, and moaning have been worse since last report. Temperature has fallen gradually to 98·4°. At 7.10 a.m. he was attacked in a manner similar to that of a week ago; a few minutes previously he seemed "fairly well," when he suddenly, and finally, ceased to breathe.

Examination twenty-four hours after death. The pia mater, over the right frontal lobe, both at its lateral aspect, and base, was covered with a thick layer of purulent lymph; this did not extend forwards, as far as the wound through the skull; but, at the base, a thin strip ran along the base of the frontal lobe, as far forwards as the right olfactory bulb. The convolutions were flattened generally, and the sulci obliterated.

At the anterior part of right frontal lobe, occupying the position of the white matter of the brain, and immediately underlying the grey convolutions, was an abscess cavity, nearly two inches in its longitudinal axis, containing about one ounce of reddish-brown purulent fluid, with ragged brain debris. Its roof and sides were regular, its floor irregular with diverticula, one of which could be traced through the base to the front of the right olfactory bulb. This cavity was lined with a brownish-grey membrane, nearly a line in thickness. The brain-matter, for a space of more than an inch around this cavity, was softened, semi-diffluent, and of a mottled, pale grey colour.

All the other viscera were healthy.

This clinical history well deserves careful consideration. Note, in the first place, that the original injury on the forehead was so slight that the mother dressed it herself for a week. When she brought her son to the hospital, he was treated for some time as an out-patient; and the house surgeon deemed the case so unimportant, that he did not call my attention to it. When the symptoms suggested the advisability of admission into the wards, the patient progressed so well, that he was soon discharged "cured,"—the wound being covered by a small scab, and no complaints made of any kind.

After fourteen days, the patient was re-admitted on January 15th, pale, weak, and drowsy, and the wound moist. The entries from that date to the 31st, are most instructive. Looking back, with the light shed by subsequent events, it is clear that an earlier application of the trephine might have given a better chance. I think, also, that when I did remove the piece of bone, though it is specially noted that the dura mater was healthy, so strong were the

indications of intra-cranial suppuration, that an incision into the brain substance at once would have been justifiable. As events developed, it is clear that such an incision would have given a chance of life.

These reflections, so far as the individual case is concerned, possess the defect inseparable from being wise after the event; but I am trying to fulfil the most useful mission of a clinical teacher, when I am criticizing the results of treatment in a fatal case, with the sole object of arriving at the truth, in order that you may learn lessons of experience, for your guidance in similar difficulties.

LECTURE XII.

History and real value of antiseptics.—Fallacious application of the germ theory as the basis of a surgical system.

GENTLEMEN,

It has been my object throughout these lectures, to demonstrate, by typical cases, the fundamental principles and simple methods, by which wounds may be successfully treated. When touching on some disputed point, reference to dissentient opinions has been inevitable; but controversial matters have, so far as practicable, been avoided. It is impossible, however, to eliminate them, in discussing the history and merits of the antiseptic treatment, which has been advocated, on special scientific grounds, as an innovation on surgical practice.

When visiting Paris in 1867, I found Professor Maisonneuve, at the head of the clinical wards in the old Hôtel Dieu, enthusiastic on the beneficial effects of what he called his anti-putrescent lotion, composed of one part of carbolic acid to one hundred of water. It was said to cleanse wounds, promote healing, and prevent pyæmia. The matter was not treated as a novelty, but as the outcome of theoretical studies and practical investigations, of six years' standing. It was in March of that year, that Professor Lister published the first of his series of papers on a new method of treating compound fracture, abscess, &c., with observations on the condition of suppuration.(*) The treatment advocated was the free use of

(*) *Lancet*, 1867, vol. I, p. 326, *et seq.*

carbolic acid; and M. Pasteur's germ theory was advanced as the key to the explanation of the antiseptic effects. Visiting Professor Lister's clinique, I enjoyed the fullest opportunity of examining his cases, and was uniformly struck with the admirable precision of the dressings, which were daily superintended, and in great part carried out, by the Professor himself.

Amongst the cases of which I took notes, at the bedside, in Mr. Lister's wards at the Edinburgh Royal Infirmary, December, 1873, was the following, than which it is scarcely possible to conceive a more satisfactory result.

William T———, aged thirty-one, a farm-servant, and a powerful man, was admitted November 19th, 1873. Two years and a half ago he began to suffer the inconvenient symptoms, in the right elbow, for which he now sought relief. Both flexion and extension were very imperfect. When the elbow was bent to about a right angle, a sudden check was experienced, and when extension was attempted, great pain was felt in the joint. So long as he kept his hand in his pocket he was perfectly easy, but, when he let it hang by his side intolerable uneasiness ensued; so much so that he had been off work for twelve months, and had been subjected to various treatment without any arrest of the complaint.

On examination of the limb, nothing was found wrong with the posterior aspect of the elbow, where the bony prominences had their natural appearance, unaffected by any thickening of the soft parts. But, anteriorly, on careful manipulation, there was felt a distinct abnormal projection from the humerus, on a level with the external condyle, and therefore in the region of the joint. That the growth, of whatever nature, did extend into the articulation, was further indicated by the great pain on extension, which could not be accounted for by mere stretching of fibres of

the brachialis anticus, but was readily to be understood if the anterior ligament of the joint was put on the stretch over it.

Knowing that pedunculated exostoses occasionally grow from the humerus in the immediate vicinity of the elbow, Mr. Lister was inclined to think that the present case was of that nature. Two alternatives presented themselves in the way of operative procedure—viz., excision of the joint, and removal of the tumour alone. The latter, necessarily involving opening the articulation, would have been, in Mr. Lister's opinion, altogether unjustifiable without reliable antiseptic measures; but, with these, it was believed to be perfectly safe, and likely to leave a stronger and more useful limb than excision.

Accordingly, on November 25th, the skin having been purified with 1 to 20 carbolic-acid solution, and a spray of 1 to 40 lotion playing over the part, an incision was made about five inches long over the outer condyle and supra-condyloid ridge, and the external aspect of the joint. The supinator longus and the neighbouring extensors being then detached from the inter-muscular septum and from the condyle, and the external lateral ligament exposed, the muscles were drawn aside with a spatula from the front of the joint, and, on introduction of the finger into the wound, the prominence before detected through the soft parts was distinctly felt. On the joint being opened however, instead of an exostosis, a large number of loose cartilages were discovered, most of them, about 200 in number, being about an eighth of an inch in diameter or less, while six were larger, varying from one fourth of an inch to an inch and a half in greatest diameter. They were very irregular in form, the larger appearing at first sight like aggregations of the smaller ones; but in reality, as seen on section, consisting in the interior of true bone and medul-

lary tissue, with a cartilaginous external layer and synovial investment, to which small cartilaginous bodies were attached by narrow peduncles. The larger of these bodies were most of them still connected by synovial bands to a prominent ridge of bone, across the front of the humerus; but the smaller ones were generally free in the articulation. In order to extract the larger ones it was necessary to divide the anterior ligament with a probe-pointed knife, to the extent of about an inch and a half, after which, the ridge from which they sprang was removed with the gouge. The very numerous small ones were successively brought into view by free alternate flexion and extension of the joint; and as they continued to appear, time after time, when these movements were executed, and as it seemed right to endeavour to extract them all, the joint was laid open, and exposed to the spray and sponging, for full half an hour. The operation was performed in the bloodless manner, which had been practised by Mr. Lister for several years, by freely elevating the limb, and then screwing up the common tourniquet as rapidly as possible, so as entirely to arrest circulation. Some small arterial branches having been secured, two drainage-tubes, each about one fourth of an inch in diameter, were introduced fairly down to the open joint, their outer extremities being kept on a level with the cutaneous margins of the wound, which were elsewhere accurately stitched; after which the usual dressing of antiseptic gauze was applied, a piece of protective tissue being interposed between it and the wound.

The patient experienced no symptoms of irritation of the joint, nor any constitutional disturbance as the result of this procedure. For the first three days the dressing was changed daily, as the discharge of serum was still considerable; but after this, as the serous oozing diminished in amount, the intervals between the dressings were extended

to three days, four days, five days, and six days, respectively. Of the two drainage-tubes, one was removed the second day after the operation, and the other eight days later, when, the wound elsewhere being entirely healed, the stitches were extracted. On the 17th December, when I witnessed the dressing after an interval of six days, and just three weeks after the operation, the place where the two drainage-tubes had originally been was contracted to a very small size, and all that remained to heal was a grey patch, about one eighth of an inch in diameter, of the original blood-clot altered by organization; the neighbouring parts looked pale and healthy, having cicatrized, I was informed, not only without the appearance of a particle of pus, but without the occurrence of granulation. Meanwhile the object of the operation had been so far attained, that the elbow could be extended to almost the full degree without occasioning uneasiness.

Pasteur's germ theory was credited with the result, and it has never varied, as the basis and explanation of Mr. Lister's practice. In evidence of the importance which he attached to the maleficent potency of atmospheric dust, I shall read you an extract from the *British Medical Journal*,(‡) in which an account is given of an operation for psoas abscess at King's College Hospital. "All the instruments to be used had been placed in carbolic acid lotion an hour before the time of operation; the dressing forceps had a little grease in the teeth, so that when drawn over a towel they soiled it; but, as they had been well soaked, Mr. Lister considered them perfectly antiseptic, and used them without fear. Clean and dry towels were placed around the patient, the pubes being carefully covered up, and the clothes drawn out of the way. A continuous cloud of carbolic spray was produced by a hand steam-spray producer, and directed

(‡) October 27, 1877, p. 572.

over the seat of operation; carbolic lotion (1-20) was placed in the bottle of the apparatus, and, by dilution with the steam, it was reduced to about 1-30, before it fell upon the skin. The bistoury to be used had been soaked in carbolic lotion, but, when taken out, "the blade was no longer antiseptic, as dust might fall upon it, together with septic particles. To keep it antiseptic, the knife must be freely exposed on both sides to the carbolic spray, and kept there till the conclusion of the operation."

Without for a moment calling in question Professor Lister's belief in the novelty of his teaching, there can be no doubt that, as phenic acid, carbolic acid was first introduced to the profession as a parasiticide for the treatment of foul wounds, by Lemaire and Déclat. A claim of priority has been contested between these two gentlemen, but, without engaging in it, I shall translate and condense from Déclat's work.(*)

"On the 30th of November, 1861, M. Déclat was summoned by Count Paul Demidoff to a gentleman who was thrown from his horse against a tree while hunting. Paralysis ensued, and, in spite of the utmost care, the soft parts, over a number of the bony eminences, by-and-by became gangrenous. The smell was so offensive that the bedroom became uninhabitable, though spacious and well ventilated. In this state the gangrenous parts were *tanned*, by being brushed over with a solution of one part of carbolic acid to ten of common oil. The smell disappeared, the soft parts ceased to mortify, and the patient rapidly recovered; a carbolic lotion was injected into some purulent tracks along the muscular sheaths.

"From this date (1861), M. Maisonneuve, having witnessed the surprising result in this patient, has not

(*) Nouvelles Applications de l' Acide Phénique en Médecine et en Chirurgie. Par le Docteur G. Déclat. Paris: Adrien Delahaye. Octobre, 1865. P. 21, *et seq.*

ceased to employ carbolic acid at the Hôtel Dieu as a common dressing. Accordingly his wards are made healthy, and the results are most satisfactory and remarkable. Alcohol and camphor, like carbolic acid, act as parasiticides, and in some way as poison antidotes. It is by an analogous action that they prevent purulent infection, hospital gangrene, &c.

"The fine researches of M. Pasteur clearly explain these unexpected phenomena. Everywhere where there is decomposition of an organic liquid or substance, such decomposition is caused by the physiological action of living beings, the germs of which pullulate in the air. Everywhere, where a wound is made, air penetrates, and with the air, germs, which have the power of developing themselves, even in the interior of the blood-vessels where the circulation carries them. Hence result inflammations of the lymphatics and of the veins, erysipelas, gangrene, &c. The more cutting the instrument with which the operations are performed, the more freely are the vessels divided, the better do the germs penetrate, the more easily do microphytes and microzoa cause complications, especially in loose and vascular tissues . . . . It is to-day well proven that carbolic acid and its compounds prevent the development of, and even partially destroy, the germs in the air. One can thus easily understand the favourable action of that acid in wounds of all kinds, in burns, and even in midwifery practice."

This public teaching of Déclat, in 1865, founded on experiments conducted in 1861, is unmistakably Pasteur's germ theory applied to surgical practice with carbolic acid as the parasiticide. But, curiously enough, in Pasteur's own country, and with his countrymen generally, the theory found very little favour. It probably would have been forgotten, but for its enthusiastic adoption and untiring advocacy by a distinguished British surgeon, and but for

the admiring approval of Volkmann, von Nussbaum, König, and others of our German confrères, who have added the term Listerism to surgical language and history.

At the onset, and through the discussion, one fundamental truth must be held steadily in view: the majority of wounds have an almost irresistible natural tendency to heal. Amongst the glorious results achieved by contemporary surgeons, we have none to surpass, very few to equal, the success of Alanson of Liverpool, * with thirty-five amputations and no death; of Martineau of Norwich, † eighty-four lithotomies, and only two deaths; of Syme of Edinburgh,‡ with only one fatal result in thirty-five ligatures of the femoral artery for popliteal aneurism; of the elder Larrey, with twelve recoveries out of fourteen amputations at the shoulder-joint, on the field of battle. Of the two who died, one committed suicide, the other sank under shock within twenty-four hours.§

If a comparison be instituted between the statistical results of surgical practice under the lamented Callender and Mr. Lister; in the Edinburgh Infirmary under Spence; at Glasgow under Cameron and M'Ewen; and at Kilmarnock under Borland and M'Vail, the very small difference in the percentage of deaths is a prominent and incontrovertible fact. As those all but uniform results have been attained under very various methods of wound-treatment, the thought suggests itself, that local appliances have less influence on the process of wound-healing, than has the manner in which they are employed, the judgment of the surgeon, and his manipulative dexterity and precision.

* Practical Observations on Amputation and its after-treatment, by Edward Alanson, surgeon to the Liverpool Infirmary. Second edition. London, 1782, p. 15.

† Medico-Chirurgical Transactions of London, vol. xi, p. 402, et seq.

‡ Mr. Syme's autograph letter, at p. 33 of this volume.

§ Mémoires de Chirurgie Militaire et Campagnes, de D. J. Larrey. Paris, 1812. Tome iii, p. 361.

When, in 1867, Sir James Simpson was working out his acupressure, he applied to me for some information, suggested on reading my papers on "The Present State of Surgery in Paris," just previously published in *The Lancet*. To illustrate one point, I requested my then house-surgeon, Mr. Robert Jolly, to tabulate all the operations of any moment which I had performed during his tenure of office, a period of about two years and nine months, during which I had discarded poultices, water dressings as little better, and dressed wounds mainly by rest, position, and pressure, with pads of dry lint. Excluding a large number of minor operations, all of which were successful, the total reached 107 operations, amongst which were three of lithotomy, ovariotomy two, fistula in ano twelve, trephining skull one, removal of bony sequestra six, ligature and division of varicose veins two, removal of female breasts twelve, removals of tumours sixteen, excision of elbow four, amputations of arm, wrist, thigh, leg, and ankle twelve, partial amputations of hand and foot twenty-five, with the result of three deaths in 107 operations; and that is a fair average of my general surgical experience.

Comprehensively considering these with the statistical results already quoted, of successful wound-treatment under a variety of methods, one thing is quite clear. The atmosphere, with its pervading particles, was practically the same in all; but it had little influence, if we are to judge from the result. Spray or no spray, the wounds healed.

With the most sincere deference, I cannot but think that the intrusion of the germ-theory, into this discussion, has been a very unfortunate one. From a strictly scientific point of view, the expression "antiseptic surgery," professedly based on the germ-theory, seems scarcely more defensible than "homœopathic medicine," which claims the doctrine of similars for its foundation.

Assuming the truth of the former, and the utter falsity of the latter, the terms remain objectionable. Surgery and medicine are sciences of observation, in which pathological states should be noted, their causes enquired into, and their remedies experimentally tested, by a strictly inductive process. If the practice be once recognized of prefixing to them designations, according to *à priori* theoretical generalizations, which extended experience may prove to be fallacious, the nomenclature of the sciences will vary with succeeding ages and opposing schools.

In questioning the wisdom of endeavouring to base a new system of surgery on the germ-theory, let it not be supposed that I confound with it the value of antiseptics, which the omnipresent germs are said to require for their extermination. But what may be considered matter for regret, is the attempt to explain the action of antiseptics by a new theory, and on it to base a professedly new system of surgery. In doing so, a three-fold error has been committed: first, in raising accessories to the position of essentials; secondly, in predicating from experiments on dead matter the behaviour of living tissues; thirdly, in ignoring, or underrating, the difference between physiological and pathological states. An incision into healthy tissues through the scalp to turn out a cystic tumour, and an opening, of similar dimensions, in Scarpa's triangle, to evacuate a collection of pus which has travelled down from a centre of decaying bone in the spine, differ so widely as to preclude comparison, without violence to the first principles of scientific reasoning.

Life and putrefaction are not correlative, but antagonistic; and in proportion as the surgeon utilises and economises the attributes of life, he will find himself independent of those changes which are inherent to decaying organic matter; whether it be in bagging wounds or boggy lands. Life is

the great antiseptic. Preserve it, restore healthy function, control by rest, position, and pressure, nervous, vascular, and muscular action, so as to minimise the material for, and the causes of discharge, carry this off as it is produced, by drainage-tubes and absorbent dressings, and the repair of injuries proceeds like healthy nutrition, uninterruptedly and painlessly.

That infection is always floating in the atmosphere, ready to settle, in the shape of impalpable and implacable germs, into any breach which may be made in the surface of a living body, is an idea which has never troubled me. The prescription, inspired by that idea, to rub strong carbolic acid into the innermost recesses of a compound fracture, to pursue and kill the germs; the warning that an antiseptic dressing may lose all its potency, through a hole, no bigger than a pin's point, in the investing mackintosh, admitting countless germs; that a dressing must be changed as soon as a little discharge permeates it, lest a septic channel be established for the ubiquitous and maleficent vibrios; that these will settle down, as a swarm from the air, on a granulating sore, if the spray be not kept in action while it is dressed, are,—I say it with the sincerest respect—questionable propositions.

That, as powerful accessories to wound treatment, antiseptics possess real value, is an old truth, for insisting on which the world will ever be indebted to those from whom I have felt compelled to express qualified, but material, dissen Lesne tells us, in his posthumous edition of the works of Jean Louis Petit,(‡‡) that the great surgeon knew that tepid water and poultices were of no use in arresting sloughing and caries; against them he employed the most powerful antiseptics. Belloste, in his *Chirurgien d'*

(‡‡) *Traité des Maladies Chirurgicales et des Opérations qui leur conviennent.* Ouvrage posthume de J. L. Petit mis au jour par M. Lesne. Nouvelle édition. Paris, 1790. Discours préliminaire, p. xxi.

Hôpital, (§) one of the brightest gems of our seventeenth century literature, employed antiseptics largely; and G. B. Monteggia, writing in 1828, on balsamic preparations in the treatment of wounds, recognised their "antiseptic virtue, in retarding putrefaction and facilitating infrequent dressing."

It would be tedious and profitless to go on quoting instances of the old and wide repute in which turpentine and resinous gums, alcohol, bark, and acids have been held as aids to wound-treatment, for their anti-putrescent properties. In appropriate conditions, their value is indisputable,—always remembering that no local treatment can dispense with attention to constitutional states.

The absorbent dressings, drainage tubes, elemi plaster, styptic colloid, compound tincture of benzoin, and many other preparations which we are constantly using in wound treatment, are each and all powerfully antiseptic. So are rest, position, and pressure, for by controlling the dynamics of the circulation, they are potent conservators of life, and, in direct ratio, prevent the development of pathological states.

To pass from historical evidence and scientific reasoning, to clinical tests, let me recall

CASES CII. AND CIII.—*Excisions of two right elbow-joints.—One treated throughout under the carbolic spray, the other by dry and infrequent dressing, rest, position, and pressure.*

In Nov. 1878, I excised the right elbow joints of two men, treating the one strictly on Prof. Lister's plan, the other by dry dressing, gentle pressure, and absolute rest. I had at first intended to draw lots as to which case should be treated on one plan rather than the other; but, as in one case the skin

§ Belloste, *Le Chirurgien d' Hôpital*, Amsterdam, 1707.

was unbroken, and in the other a sinus led down to a suppurating joint, I took this case for the dry dressing, because its condition is not looked upon as a favourable one for the antiseptic method. The suppurating case was in another particular the more unfavourable one of the two, as its subject was altogether a weaker man. This patient's temperature stood at 98° the evening before the operation; of the pulse and respiration at the same time, I regret that we had no record. The stronger man, who was afterwards treated with the carbolic spray, had a temperature on the eve of the operation of 98·4°, the pulse at the same time being 84, and the respiration 20. On the morning of Nov. 23rd, I excised both elbows, making in each case one longitudinal incision. The state of the parts admitted of my removing, as nearly as possible, a similar amount of the three bones in both cases. In the dry case, I carefully abstained from wetting the wound, and lightly brushed its surface with styptic colloid, after twisting one vessel. Five points of silver suture accurately approximated the edges, except in the centre, where a gap was left for a loop of drainage-tube, which passed through it and the opening on the radial side, which had led into the joint before operation. The dressing consisted of strips of lint, soaked in styptic colloid, applied so as to assist the stitches; a gauze and oakum pad outside the joint; a covering of cotton-wool, half an inch thick, over the whole limb, which was immobilized, in the straight position, by means of moist pasteboard splints, extending from the tips of the fingers to the shoulder, and moulded to the limb under a gently compressing bandage; dry pasteboard splints were then lightly fixed externally.(*)

* On examination of the parts removed the following were the appearances, as dictated at the time. From the dry rest case :—The bones are acutely inflamed. They are light, soft, and spongy, and at the time of removal were intensely red. The articular surfaces are roughened and completely denuded of cartilage, except the tip of the inner surface of the olecranon, a small patch of the anterior border of the great sigmoid cavity of the ulna, and a small patch on the anterior part of the capitellum of the humerus. The ligaments,

In the case treated according to Professor Lister's plan, the utmost care had been taken to carry out his teaching. The limb was well cleansed with carbolic water before, and after, the application of Esmarch's bandage; the assistants and myself thoroughly washed our hands with soap, and then with carbolic water; the latter was freely used in cleansing the sponges and soaking the instruments;* the steam spray acted well; the protective gauze dressings and bandages were all perfectly carbolised and applied with the utmost care. In this case four vessels were secured with carbolised catgut; five silver sutures were used to approximate the edges, except in the centre, where a gap was left for a carbolised drainage-tube, the same thickness as that employed in the dry case, but shorter, as there was no sinus on the outer aspect of this joint. The carbolic case was dressed, whenever permeation was observed through the dressings, which was daily for the first few days. The dry case was dressed the first time at the commencement of the fourth day after the operation, when four-fifths of the wound were found healed and four sutures removed. Two days afterwards, the patient had some bleeding from the nose, and some venous oozing through the dressings over the seat of operation. On removing the apparatus I found the wound looked well, and the bleeding could not have

parts of which remain attached to the bones, are pulpy, soft, and thickened. From the antiseptic case:—The articular ends of all the bones entering into the formation of this elbow joint are enlarged—especially the humerus and the olecranon process of the ulna. They are unusually dense and firm in consistency and increased in weight. The trochlear surface of the humerus is deprived almost entirely of its cartilage, the underlying bone being slightly encrusted. The cartilage over the capitellum is roughened and softened. The lesser sigmoid notch of the ulna is covered by fibrous-looking material—probably inflammatory product. Its greater sigmoid notch is almost eroded, there being but a small patch of cartilage remaining. The cartilage on the head of the radius is irregularly pitted, and covered by old inflammatory products.

(*) The carbolised water in the bowls, for hand and sponge washing, was of the strength of 1 in 50; in the spray, 1 in 25.

exceeded two ounces. The same kind of dressing was reapplied. Three days later (Dec. 23rd, tenth day after operation), some bright red blood was seen to have permeated the dressings, which the house surgeon removed. Finding that the wound looked well, and the hæmorrhage had ceased, he surrounded the elbow with pads of dry lint, and bandaged the same splints over cotton-wool, with somewhat firmer pressure than before. After the previous attack of venous oozing, the limb had been placed on an inclined plane with the hand raised. When the second hæmorrhage occurred, the hand was still further raised. Please to bear in mind that this patient was from the first the weaker of the two; his elbow-joint had suppurated; and since the operation, not only had the bleeding occurred, once from the nose and twice from the arm, but he had been troubled with obstinate constipation; yet his temperature and pulse were throughout lower than in the carbolic spray case. Only last evening did the temperature of both stand exactly at the same level—98·4°. The pulses, however, differed: that of the dry rest case was 76; that of the carbolic spray case 106. Seven hours after the completion of the tenth day from the time of operation, the record of the temperature, pulse, and respiration in the two cases was—

		Nov. 24.	Nov. 27.	Nov. 30.	Dec. 3.
Dry rest case	Temp.	102·5°	98·5°	98·4°	98·4°
	Pulse	96	80	84	76
	Resp.	34	24	24	26
Carbolic spray case.	Temp.	103°	102	99·5°	98·4°
	Pulse	120	108	88	106
	Resp.	30	24	22	22

At 11.30 a.m., December 15th (the commencement of the twenty-second day after operation), I made this note:—

	Temp.	Pulse	Resp.
Dry case - -	98·2°	76	19
Spray case - -	98·8°	87	20

On dressing both cases at the same time, we find in the carbolic case about thirty drops of perfectly odourless pus next the wound, which is granulating throughout. The protective is not at all discoloured. A slight opening, through which a drop of pus exudes, has formed on the outer side of the elbow, which admits of motion with very little pain. On removing the dressings from the dry case, they are quite dry, emitting a faint odour, as of half-cured fish. The old sinus, opening on the outer side of the elbow, is all but closed, and the cicatrix is quite solid for about three-fourths of its length. The elbow can be flexed and extended without any pain. This man has had no recurrence of bleeding, and both patients have walked about for some days with the elbows at right angles, supported in efficient slings.

Although the dry rest man was nervous and comparatively feeble, he was in comfort by day, and had good sleeps at night; while his more plucky companion suffered a great deal of pain in the arm, greatly intensified at each dressing. The hand and forearm of the former were all along pale, cool, and shrivelled; of the latter puffy, pink, and shining, during several days.

Both patients recovered with useful limbs; but, as they lay in adjoining beds, their spontaneous testimony to the relative comfort of the two methods of treatment was very explicit. The testimony of the respective dressers was no less emphatic, as to the simplicity and economy of time in treating the dry case compared to the spray one.

Instructive corroborative evidence was furnished by a patient with severe compound fracture, under my colleague Professor Wilders, by whose permission I transcribe this note. Immediately after the accident the fracture was reduced, and the wound dressed under the carbolic spray; this was also used at subsequent dressings, which were renewed whenever discharge permeated. The local and

constitutional irritation being very great, dry pads, pressure, and infrequent dressings were substituted; with the immediate effect of relief of pain, fall of temperature, and most satisfactory progress of a formidable injury.

Another illustration of the irritating effect of carbolic lotion, and of the soothing influence of physiological treatment is supplied by

CASE CIV.—*Wound of forearm from direct violence. Carbolic dressing followed by inflammation, which rapidly subsided under absorbent, compressing, and infrequent dressings.*

My attendance was requested by Mr. P., who has kindly attended this morning for the class inspection. A fortnight previously a heavy piece of timber had inflicted a deep oblique wound in front of the right forearm, just above the wrist. It was dressed with carbolic lotion, and, when inflammation supervened, with poultices. I found the man suffering intensely, the hand and forearm red and greatly swollen, wound measuring four inches by three-quarters of an inch, the bottom dirty grey, and the edges everted. I wiped the limb dry with a pledget of absorbent cotton, raised the hand vertically above the head, and surrounded it, and the forearm as far as the elbow, with dry pads of pure absorbent gauze and cotton. A softened millboard splint was placed on the dorsal, another on the palmar aspect of the limb, and a soft bandage applied with even pressure. The hand was now lowered and fixed on the chest, the tips of the fingers touching the opposite shoulder. A bandage round the trunk maintained immobility. The patient was at once easy, slept well the same night, and has not had a single bad symptom. He is engaged in an important patent manufacture, and has not lost an hour in superintending it since I first saw him. The apparatus soon became loose from

subsidence of the swelling; fresh cotton pads were applied with increasing pressure, and at the end of a week the wound was clean and half its former size, the surrounding skin pale, dry, and shrunken. In the course of a few days the healing advanced more slowly, and I dressed the wound with a lotion containing two grains of sulphate of zinc, a drachm of glycerine, and twenty drops of compound tincture of lavender, to the ounce of water, continuing the elastic absorbent pads and increased pressure. The stimulating effect was very apparent; the blue line of new skin advanced rapidly from the edge. I then omitted the lotion, and in another week the cicatrix was solid under a dry compressing pad, and every movement of the limb was perfect.

The position of the wound in this case,—on the anterior part of the forearm—was eminently favourable to physiological treatment by position, compression, and drainage; but the circumstances were altogether different in the succeeding case, in which Mr. Lister's practice with the carbolic spray achieved a very important success.

CASE CV.—*Stinking abscess in the upper dorsal region producing constitutional irritation and spinal compression,—opened under the spray. Rapid improvement.*

W. C———, aged eleven, a pale, weakly, strumous lad (mother died consumptive), was admitted into the Queen's Hospital, under the care of my friend and colleague, Dr. Sawyer, on 13th June. He had had difficulty in walking for the last three months. On admission, the temperature was 101°; pulse 104; there was loss of power over both lower extremities; a projection, tender on pressure, existed in the upper dorsal spine, which was rigid. Dr. Sawyer diagnosed strumous disease of the dorsal vertebræ and paraplegia, prescribed cod-liver oil and iron, and transferred the case to my care, while himself continuing to watch

it, and giving me the benefit of his advice in consultation. A plaster-of-Paris jacket was applied, with marked benefit; the lad regained the power of flexing and extending the legs, but continued unable to bear his weight on them. A swelling formed over the upper dorsal vertebræ, on a level with the highest part of the spine of the scapula, and it gradually developed into an abscess, with renewed and more severe paraplegia.

August 18th (noon). (*)—Patient lying on his right side, being unable to lie on his back. Skin hot and dry, lips parched, breath offensive, tongue furred. From the root of the neck to within an inch and a half of the inferior angle of the scapula, is a fluctuating swelling, seven inches long, and six across. The covering skin is red, hot, and very tender. The neck is thrust forwards, so that the head forms an angle (about 45°) with the trunk. Cutaneous sensibility impaired in the lower limbs, which cannot be moved. Complete loss of power over the rectum, and to some extent over the bladder. There could be no doubt that we had to deal with an acute abscess, producing great constitutional irritation and spinal compression. I resolved on opening it at once, under the carbolic spray, adhering most closely (myself and assistants), to all the instructions laid down by Mr. Lister. Through the incision, little more than half an inch in length, issued nine ounces of reddish-yellow matter, stinking abominably. Large-sized drainage-tube introduced, protective applied with swabs of muslin soaked in carbolic lotion, gauze dressings, mackintosh, and bandages. Improvement was immediate and rapid. At 7.30 the same evening, seven hours after operation, the temperature had fallen 3·4 degrees, the pulse 28 beats, and the respiration

(*) I am indebted for these notes, and for the utmost care of the patient at the most critical stage, to Dr. Sawyer's house-physician, Dr. Wood, assisted by Mr. John Whitehouse, acting house-surgeon.

2. This note will make clear the rapidity and extent of the improvement within seven and a half hours :—

12.15 noon. temp. 101·4° ; pulse 128; resp. 28.
7.30 p.m.: „ 98·0°; „ 100; „ 26.

At the latter visit the patient took milk freely, and was quite easy; could flex and extend his legs, and hold his motions; dressings changed under the spray, as the discharge had already made its way through those first applied.

19th.—Has passed a good night. Takes food well. Dressings changed because permeated with discharge, which is much less in quantity, and free from offensive odour.

23rd.—Dressed each day, and the drainage-tube shortened. Discharge now trifling in quantity, and quite sweet. Power over legs steadily improving. Eats and sleeps well. Temperature 97·5° ; pulse 92 ; respiration 26.

The Sayre's case having been removed, as irksome and inefficient, I directed the application of a plaster case, extending from the top of the shoulders to below the hips, and so constructed as to admit readily of removal and re-adjustment. The patient continued to improve ; he ate and slept well ; his temperature was barely above normal ; he was quite free from pain ; had a good appetite and regular action of the bowels, could roll over in bed, and walk in the ward with slight assistance from a nurse ; he was discharged at the end of three weeks in comparatively good health.

A more brilliant therapeutic result than this cannot well be conceived, and I characterise it as such, all the more freely, because the merit of saving the patient's life was not mine, but Mr. Lister's. When a large collection of pus has formed, in a case like the one now under comment, or in a psoas abscess, drainage is so difficult, if not impossible, the control of the circulation by position and compression, so

entirely out of the question, the danger of constitutional poisoning from the local centre of infection so great, that I should not think of opening such a collection of matter and subsequently treating it, except by strictly following the lines of Mr. Lister's practice. But that admission only concerns the treatment of exceptional pathological states. In the general practice of operative and traumatic surgery, the physiological principles, and the simple practices we have endeavoured to illustrate, will insure the most satisfactory results.

If so, it may be asked, how can the very general acceptance of Mr. Lister's teaching be explained ?

As already incidentally mentioned, there seems every reason to believe, that the substantially identical teaching of his predecessors, Lemaire and Déclat, would long since have been forgotten, but for the influence of Mr Syme's successor. The historic renown of the Edinburgh University and Infirmary, their almost matchless intellectual resources, the moral support of Sir Robert Christison against local detractors, Mr. Lister's single-minded enthusiasm, the exceedingly rare combination of his accomplishments as a chemist and naturalist, a microscopist and surgeon, the exceptional circumstances which permitted his almost exclusive devotion to hospital work, the fascination of a theory and a system, professedly novel and of universal application, the attractive elegance and ingenuity of the spray apparatus and its accessories, was an overpowering combination of influences in establishing a school of surgical dressing. But notwithstanding all the advantages referred to,it is doubtful if the germ-theory would have made such way as it did in the surgical world, had it not captivated the imagination of continental surgeons, especially of the Germans, who in surgical, as in general science, have

exercised such a powerful influence on contemporary thought.

Anyone who remembers the filthy condition of continental hospitals, a quarter of a century ago, will have no difficulty in understanding, how and why Mr. Lister's minute prescriptions for the most scrupulous cleanliness must have worked a life-saving reform. Their power for good must obviously have been all the greater when, from over-crowding or any other cause, a hospital had become unhealthy; and it is not improbable that to the success of the system under exceptional pathological conditions, may be attributable the blind adhesion of some of its admirers.

Mr. Lister himself has done much to explain away exaggerations for which he cannot be held responsible.

By the courtesy of the Council of the Midland Medical Society, the students of this school were privileged to hear the deeply thoughtful and richly instructive address which Professor Lister delivered here. His title, you will remember, was "On the Healing of Wounds without the Antiseptic Treatment." I shall only recall to you one passage which I took down *verbatim*, as my distinguished friend and old fellow-student was endeavouring to explain some of the published results of my practice. He did not question the reported recoveries after wounds into joints, and amputations under dry and infrequent dressing, rest, and pressure. Here is the pith of his explanation—"that the healthy living tissues have the power of preventing the development of bacteria in their vicinity." This admission goes a very long way towards solving the question at issue. Since the great majority of wounds, whether inflicted by accident or by the surgeon's knife, are in healthy living tissues, the development of bacteria need not be feared. Life

resists putrefaction. Administer economically, preserve and utilise the resources of life, and you will have the benefit of its power in your surgical work. You will secure nutrition and repair, and, under the circumstances mentioned, have very little need to wage a war of extermination against atmospheric dust. But all wounds are not into healthy tissues—to wit, an incision into a joint filled with pus, an opening into a psoas abscess, or an empyema. It is in these cases that the argument of the germ-theory is full of suggestiveness; it is in these cases, not improbably, that a special triumph will be reserved for Professor Lister's treatment. If so, the triumph will be a grand and glorious one.

Concurrently with, and largely owing to the spread of Listerism, operating surgeons have ceased to delegate the all-important matter of dressing to comparatively unskilled assistants, and have devoted themselves to it, with the painstaking care which it deserves. Thought, diligence, and experience, patience, precision, and untiring effort have once more borne their unfailing fruit,—success. Hence diminished surgical mortality has attended injuries and operations, largely in consequence of the manner in which the patients have been attended to.

But, in a great number of the successes which have followed the use of the carbolic spray, it may be questioned if it have been a potent factor in the therapeutic result. Here are one or two illustrations to prove how very necessary it is, in the wide and complex question of wound treatment, to distinguish between essentials and accessories in the chain of therapeutic causation.

I have seen a case, the type of a large class, in which a surgeon prided himself on the antiseptic treatment of an excision of the knee. The carbolic spray had certainly

been used; but a good deal of constitutional disturbance, and not a little suppuration had followed. When I saw the patient, matters were progressing favourably; but for some weeks the limb had been immobilized in plaster of Paris, and suspended in a Salter's swing; very considerable pressure being at the same time employed, with gauze bandages, in applying the dressings to the knee. A success under such circumstances is perfectly explicable, in accordance with the proved principles of scientific surgery, without importing any hypothesis about germs.

Having accepted the invitation of a great partisan of Listerism to visit his wards, he triumphantly pointed to a case of compound fracture of the leg. The accident had happened a week before, from indirect violence. Both bones were broken, and the wound was a small one. Reduction was effected immediately after admission, the wound was dressed under the carbolic spray, with all the prescribed accessories, and the limb was put up in well padded lateral splints, and suspended in a Salter's swing. There had been no pain, and no constitutional disturbance, and my colleague had very wisely not meddled further. He doubtless would find the wound healed when he did expose it. But what does such a case as that prove beyond the soundness of established principles of surgical science and practice? My friend remarked that he cared nothing for the *rationale* of the cure; he was quite satisfied with the plan if such were its results.

But I submit that it is a very important matter not to encumber surgery with an erroneous doctrine. No less important is it to discard all complications of operative procedure, unless absolutely essential to saving pain or life. Scientifically considered, the truth or error of the germ theory, in its surgical application, is a question of the greatest interest; practically, no less so. A surgeon

exceptionally placed in public and private circumstances, with the resources of a great hospital at his command, and a class of enthusiastic students to do his bidding, may be able to carry out, with comparative ease, a complicated course of treatment; but on the field of battle, or at the mouth of a coal mine, in a parish infirmary, or on a twenty-mile round in a country practice, hand and steam sprays, gauze and protective, with the minute injunctions for their successful use on the antiseptic theory, become serious complications, if not absolute impossibilities.

It has been urged that, for the perfect success of the antiseptic system, its conditions must be accurately fulfilled, and that it is owing to their violation that failure occurs. Professor Lister has repeatedly shown his class a number of long flasks, containing a variety of organic fluids, and having their mouths well plugged with cotton wool. The vessels have been filled with special precautions, and exposed to great heat; their contents have remained clear for months. Admit air to one of those flasks, inoculate it with a ferment, and troubled action, turbidity, and stink soon follow. In the laboratories of scientific men these experiments have been the matter of much contention, not merely as to their theory, but as to the facts themselves. Conceding the facts of the flasks and their clear and turbid contents, just as they may be stated by the most ardent advocate of the germ theory, what do they amount to in their surgical application? Is not the whole history of physiology and surgery full of examples, to prove the fallacy of arguing from the demeanour of organic parts removed from the body, to what occurs in the living system?

Here are ten operations—1, hare-lip; 2, perineoraphy; 3, rhinoplasty; 4, ligature of femoral; 5 amputation of fore-arm; 6, Syme's amputation at the ankle; 7, excision of the

elbow; 8, excision of the knee; 9, excision of the lower jaw; 10, removal of cystic tumours from the scalp. The selection is made as an average representation of so-called major surgery. Most of those operations I have performed many times, some only occasionally. I have never lost any one of the cases. Other surgeons can, doubtless, say the same. Wherever the maleficent germs were, the powers of life proved an insurmountable barrier to their penetration and fertility.

Far from me to attempt to disparage the indirect advantages which have resulted from the discussion of the germ-theory and the advocacy of antiseptics, exaggerated and exclusive though they have often been. I well remember the day when one of the most kindly natured men I have ever known, and probably one of the most brilliant operators who ever took a knife in hand, performed one after the other such operations as a lithotomy, a ligature of the femoral, an excision of the lower jaw, and an amputation of the thigh. Well can I see him dipping his knife into the fat of the ischio-rectal fossa, with as much freedom, and as little concern, as a butter-taster would dive into a tub of Dutch butter. The forceps followed into the large opening, and brought out a stone, as easily as a boy takes a marble out of his pocket. Some rather free bleeding was little heeded, and the patient was carried to bed, to make way for a young woman whose jaw was to be excised. To save time, she was already under chloroform when brought into the theatre, and it was a matter of a very few minutes to turn up the cheek and divide the symphysis, lever out the condyloid process, and send the patient back to bed with a fold of wet lint in the vast wound, and the blandly-expressed assurance that the oozing of blood would soon cease. Such surgery, as brilliant, and nearly as fatal, as the charge of Balaklava, might be magnificent as a feat of physical

dexterity, but withal it was not surgery. Less blood would have been spilt , more lives saved, by a far less dexterous and showy operator, who had thought a little more of the evils of traumatism, and of the advantages of careful dressing based on sound physiological principles. To amputate a fleshy thigh, ligature two or three vessels, flood the flaps with iced water, send the patient to bed with a fold of wet lint in the wound, and dress it after a few hours, when glazed, is a proceeding which was once called scientific, but which I shall abstain from characterising as it deserves, through respect and sympathy for the mistaken men who practised it,—myself, five and twenty years ago, amongst the number.

In heading the practical protest against such a state of things, and in exemplifying, by the most magnificent patience, the value of attention to details, which had come to be treated almost habitually with neglect, Professor Lister established claims to admiration and gratitude, which will survive, long after the eccentricities of the germ-theory shall have been forgotten.

I venture to think that his dressing materials will prove one of the most enduring and beneficent results of his labours. The substitution of gauze for calico bandages, the discouragement of poultices and water dressings, the impetus to the system of drainage, and the unconscious generalization of immobilization and compression, in admirably adapted dressings for the purpose of excluding germs, have been most beneficial reforms. Countless vibrious have, it is true, been found under the mos perfect antiseptic dressings ; but the fact remains tha[t] pressure has been used to exclude them, and has produced the beneficial effects which always attend it. That elastic pressure, immobility, and its corollary infrequent dressings are jointly the most potent factors in successful wound

treatment, is a proposition to which opinions are rapidly converging. If to that, be added the universally conceded importance of cleanliness and drainage, it will be found that on the essentials of wound treatment, substantial agreement has been practically attained. On the relative value of various antiseptics, and on the best means of employing them, differences of opinion still prevail.(*)

But no one can recall the proceedings of the last International Medical Congress, and study the monographs of Sir William MacCormac, Mr. Watson Cheyne, and Lucas-Championnière, without being deeply and gratefully impressed by the cumulating evidences of the beneficent change in progress. Wounds are now treated so painlessly, with so little constitutional disturbance, and with so little risk to life, that surgery is losing almost all its terrors, since half those which seemed inseparable from its practice were banished by the introduction of anæsthetics.

Looking back to the successive classes of students to whom the matter of these lectures has been familiar through a number of addresses, here re-arranged and condensed, I would say to each: Study scientific principles, and search untiringly after causes; be a slave to no master and to no system; aim at judicially combining remedial measures to meet the exigencies of particular cases; cultivate gentleness and precision; you will then expedite and attain most safely, that which, as practical surgeons, must be your first and constant aim,—your patient's recovery.

(*) Germs and the Spray, by John Duncan, *Edinburgh Medical Journal*, March 1883, p. 778. Les dernières évolutions des Pansements Antiseptiques, par le Dr. L. de Santi, archives générales de médcine. Paris, Mars 1883, p, 302. Le Germe Ferment le germe contage par le Professeur Léon le Fort, Paris, 1882.

In your studies beware of narrowness.

It is in this, as in many other departments of knowledge, abstract and applied. The very concentration, which is of the essence of success to complete mastery of principles and detail, is apt to cramp the powers, and to beget prejudice. Enquirers, with steady gaze on the objects immediately before and around them, are very liable to mistake for the horizon the boundary lines of their restricted vision, and to be attracted into newly discovered by-ways as if these could dispense with the old highway of truth, to which they are but auxiliary.

All that is needed to dispel the illusion and sober the judgment, is wide observation of nature from an independent standpoint, and a patient study of the masters of our science and art, irrespective of age and country. Such a study will minimise obstacles to reconciliation of differences, often more apparent than real. It will strengthen a reasonable faith in the powers of living nature, which will be found all sufficient to promote the healing of wounds and fractures in the hands of surgeons who, guided by the demonstrable truths of experimental physiology and pathology, combine unprejudiced, clear, and painstaking observation, with light-handed, clean, and painless manipulation.

Practical Directions on Materials and Apparatus, and on Fractures in Particular Situations.

Only those practical directions on materials and apparatus are here noted, which I have found from experience to be of special use, or which are not so widely known as they deserve. In illustrating this section, I have reproduced several of the wood cuts from my Liston Prize Thesis (1853), "On the advantages of the starched apparatus in the Treatment of Fractures and Diseases of Joints," and I have much pleasure in acknowledging the liberality, then and now, of Mr. H. K. Lewis who published my student Thesis.

I.

PAPER SPLINTS.

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.

Half a sheet of ordinary-sized note paper makes a very good finger splint: gum it on one side, and fold to the width of a finger, over and over, until the half sheet is exhausted; then place it under the finger, and mould it accurately. If the splint, thus moulded, be taken off carefully, and dried before the fire, or placed in the kitchen oven, on a plate, for a few minutes, the mould becomes hard and

strong, and can be bandaged to the finger over lint or cotton wool. In the same way, of course, dorsal and palmar finger splints can be made. The bandage should not be wider than three-quarters of an inch, and the finger not stretched out to unnatural straightness, but held so as to preserve the slight natural curve. As the layers of bandage are applied, brush them over with ordinary gum, care being taken that the paper does not overlap or quite meet at the sides; narrow spaces are thus 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.

When a 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 bandaging alternate layers of gummed paper on the dorsal and palmar aspects, with intervening cotton-wool, to a few inches up the fore-arm.

Millboard Apparatus.

The materials requisite for the construction of a millboard apparatus are

a.—Absorbent cotton-wool tissue.

b.—Bandages.

c.—Millboard.

d.—Starch, gum, or dextrine.

Absorbent Cotton-wool Tissue.

For all purposes of surgical dressing and padding, I use the absorbent cotton-wool tissue prepared by Messrs. Robinson and Son, at the Wheat Bridge Mills, Chesterfield. It consists of absorbent cotton between two layers of absorbent gauze; and it possesses the special advantages of perfect smoothness, great absorbent power, and almost indestructible elasticity. It may be obtained from any surgical instrument maker, or chemist, in layers or rolls, at about the price of good lint, and may be cut into pieces for the smallest wound-dressing, folded into pads for splints of any length, or rolled round the body. It is admirably adapted to the dressing of blisters, burns, and bed sores, and for general surgical purposes is very superior to even the finest jeweller's cotton wool. Mr. W. Bradbury Robinson has given me great assistance in preparing the new dressing, the idea of which was suggested to me by Mayor's article, (De la mousseline avec ou sans le coton (*)

My friend and colleague, Dr. Sawyer, to whom I take this opportunity of expressing my deep sense of obligation for much valuable counsel in the revision of this volume, writes, "I can imagine nothing more perfect as a light, non-conducting, and absorbent external application in many medical cases, than the new gauze and cotton-wool tissue. I have found it a valuable material for making a kind of chest jacket, to place over pneumonic lung, after discontinuance of poultices."

For those who prefer it, Messrs. Southall Brothers and Barclay prepare the absorbent gauze and cotton tissue, with any of the well-known antiseptics, in prescribed proportion.

Bandages.

I have, for some years, invariably used bandages made of soft, bleached, and absorbent material. Two inches width is

(*) La Chirurgie Simplifiée Bruxelles, 1842. P 104.

the most generally useful; but for the trunk, and especially for fractured ribs, bandages of the same material are made four-and-a-half inches wide. As a general rule, a layer of the elastic cotton tissue should be smoothly adapted to any part, before it is bandaged.

Good bandaging is the very essence of an efficient and comfortable fracture apparatus, or wound-dressing. 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 material to prominences and depressions, without constriction or inequality. This can only be done by training of the fingers, and refinement of the sense of touch, by careful and persistent experience.

Every surgical student should practise the application of the roller, frequently and accurately, so that he may attain perfection in a procedure which, for universal applicability and beneficent power, has no equal in surgical practice.

Reverses are objectionable in bandaging. If made at all, they are preferable 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 intersecting spirals, or figures of 8. This plan not only has the advantage of ensuring more perfect equality of pressure, but of proportionately increasing strength, by lessening the chance of the turns of the bandage slipping.

To bandage a left leg and foot, by way of illustration, begin just above the malleoli with a couple of circular turns then over the instep, obliquely from left to right; make a circular turn at the roots of the toes, and wind obliquely upwards from the inner side of the foot, in front of the ankle, to the back, and thence to the front, of the leg, with a long spiral to reach the knee-joint; below this make a couple of

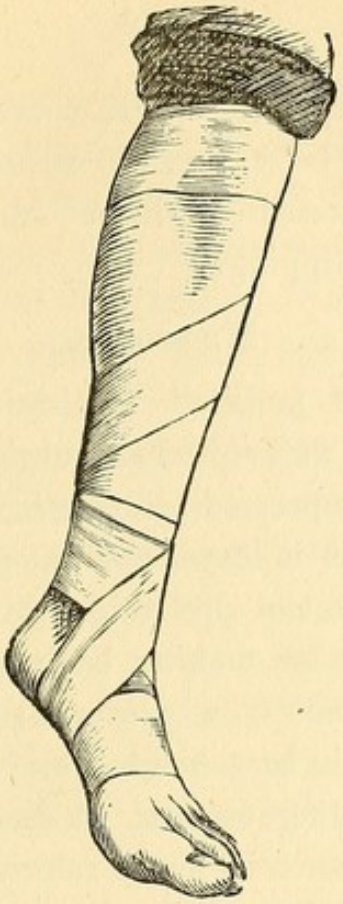


Fig. XXIII.

circular turns; thence downwards and upwards, by long, intersecting spirals or figures of 8, until every part, the heel included, is smoothly covered.

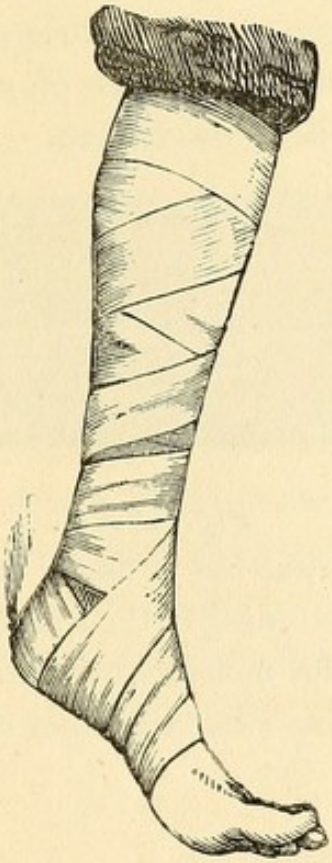


Fig. XXIV.

This method is applicable, with trifling varieties of detail, to all parts of the body, so as to exercise the most equable and comfortable pressure, without ruck or reverse, and without danger of slipping.

Millboard.

The pressed and polished millboard, usually sold by stationers, is not so well suited for surgical purposes as rough unglazed and uncompressed millboard, in the early stage of manufacture, just as it leaves the vat ; one-eighth, or one-sixth 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 strength 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 millboard ; but 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.

In preparing angle pieces, however, a knife is useful to make a notch at opposite ends of a rectangular piece, which can then be bent and broken.

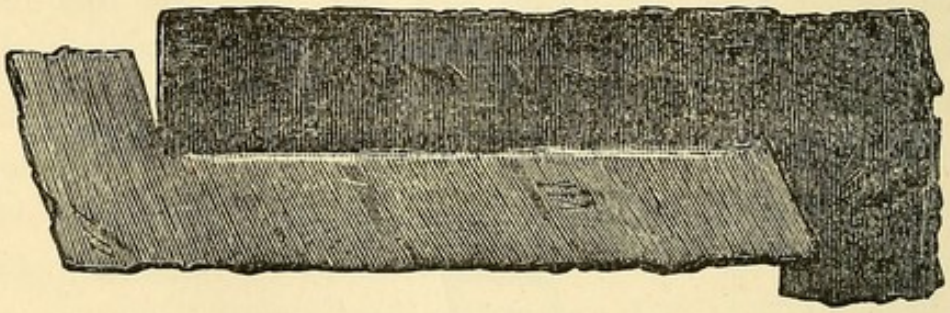


Fig. XXV.

The ragged edge thus left is useful in absorbing moisture, and hastening the softening of the splints ; and is 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 millboard splints may be well moistened in two 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 millboard.

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 millboard be moulded during the process of bandaging.

The shape and length of the millboard splints may require to be varied, according to the size of the limb to be encased. Long strips are apt to break, and so are angle ones. This may be prevented by putting two thicknesses of millboard, together with an intervening layer of bandage and starch, or gum, or common flour paste.

For general use I prefer millboard strips, between two and three inches wide, and eighteen inches long. They can be broken shorter; or, by overlapping them, and intersecting

with bandage, any length may be covered, and great strength secured.

The dextrined millboard, which Messrs. Southall Brothers and Barclay have made, at my suggestion, is a very useful material. It takes up water readily, dries quickly, and with great strength. Right angle pieces of the material are prepared, and they can be used to immobilize shoulder, elbow, or ankle:—straight strips being used for any necessary lengthening.

To avoid the breakage of angle splints, I prefer this plan, when it is necessary to immobilize a joint at a right angle

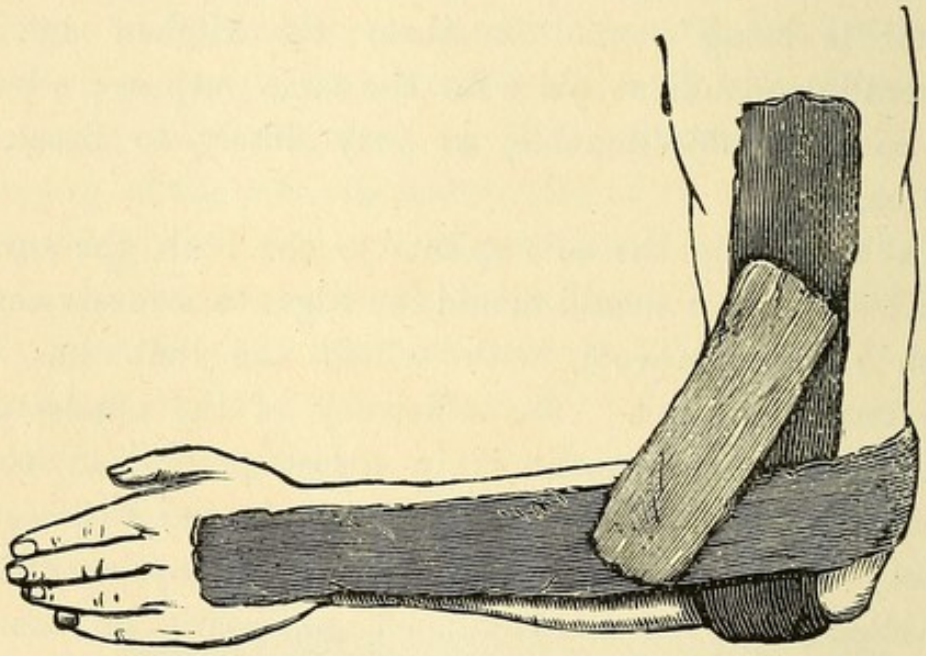


Fig. XXVI.

Narrow straight strips of moistened millboard answer the purpose. To fix the elbow, let a horizontal splint surround the joint at the back, and be secured by bandage; a vertical splint across the former, surrounds the joint below; fix by bandage, and then place a strip of the same material across the angle. If the same arrangement be repeated on both sides of the limb, over good padding, and with careful bandaging, a very strong and comfortable apparatus will be the result. With insignificant modifications of detail, the

shoulder and ankle can be immobilized after the same fashion.

Millboard and Bandage Lattice-work.

A very ready and efficient plan for immobilizing a joint or a limb, is to envelope it in cotton-wool, and over this, in various directions, to place strips of moistened millboard.

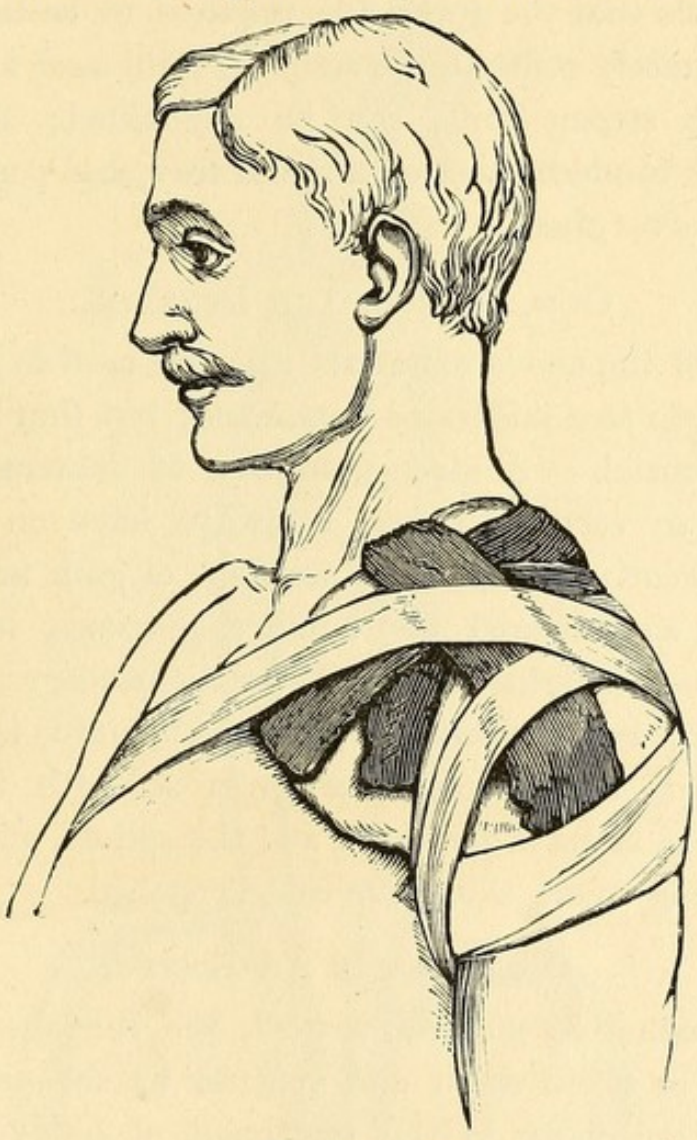


Fig. XXVII.

As each strip is laid on, it is fixed by bandage, then another strip diagonally placed, and more bandage, without reverses and with smooth pressure. This arrangement is applicable to the trunk, when several ribs are broken, or when the spine or pelvis is injured. It is also very efficient

when applied to an acutely swollen joint or limb. Under firm, elastic pressure, especially if combined with suspension, the enlargement rapidly decreases; and without disturbing the apparatus, while it is still moist, fresh compressing bandage can be applied externally, twice, or oftener, in the twenty-four hours. When the shrinkage of the limb is so considerable that the apparatus requires to be taken down to be accurately refitted, the strips of millboard which have dried into strong coils, can be remoulded; all that is required is to place them on a metal tray, and pour a little hot water over them.

Gum, Starch, and Dextrine.

Either of the above materials may be used to give unity and strength to a millboard apparatus; but they are by no means essential. A strong solution of dextrine answers the purpose very well, but I always have on hand and most frequently use the B. P. mucilage of gum acacia.

Starch, as prepared for laundry purposes, but a little thicker, may be lightly smeared over the bandage in course of application, and externally when the apparatus is complete. Any one of these substances gives strength in holding together the turns of the roller and the splints, and prevents them falling apart when the case is opened.

Opening the Apparatus.

When no adhesive material is used, the bandage and millboard can be taken down and refitted by moistening; but as a rule, especially in the treatment of fractures by the millboard apparatus, it is desirable to give it unity and solidity, with gum or starch. 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

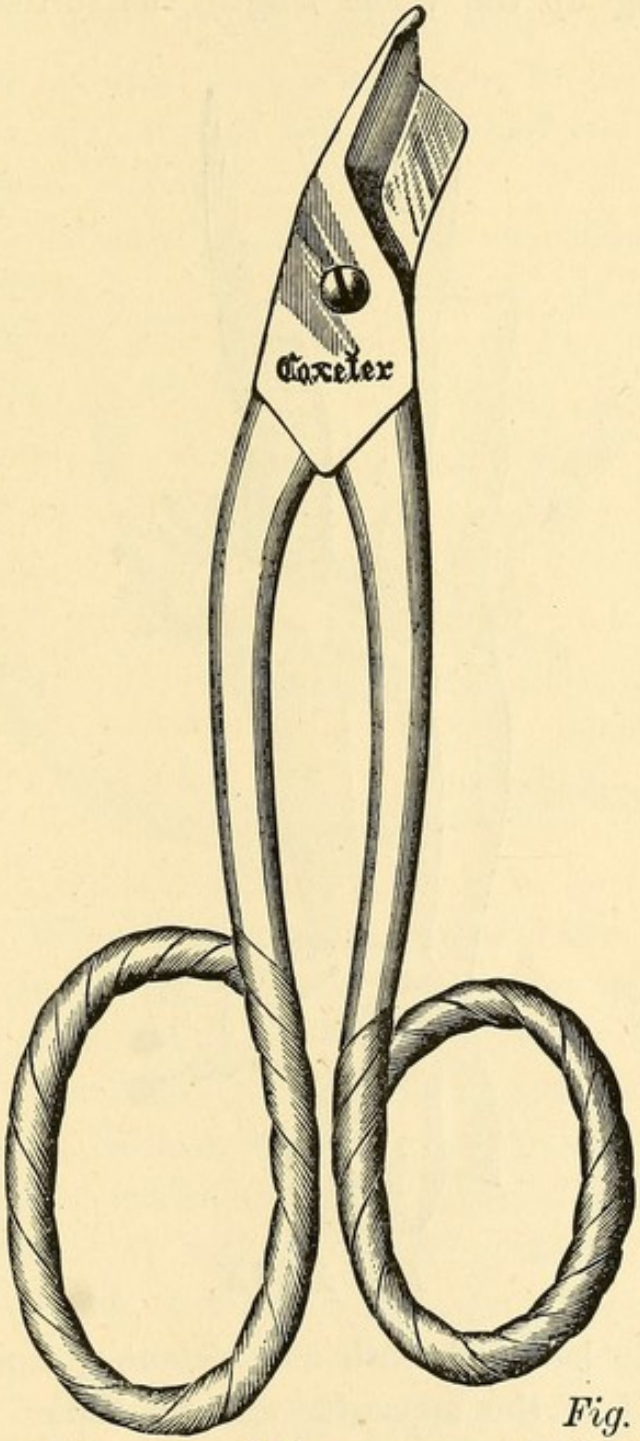


Fig. XXVIII.

and re-adjusted. For this purpose decidedly the best instruments are these scissors, manufactured by Messrs.

Coxeter and Son, of London, after the late 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

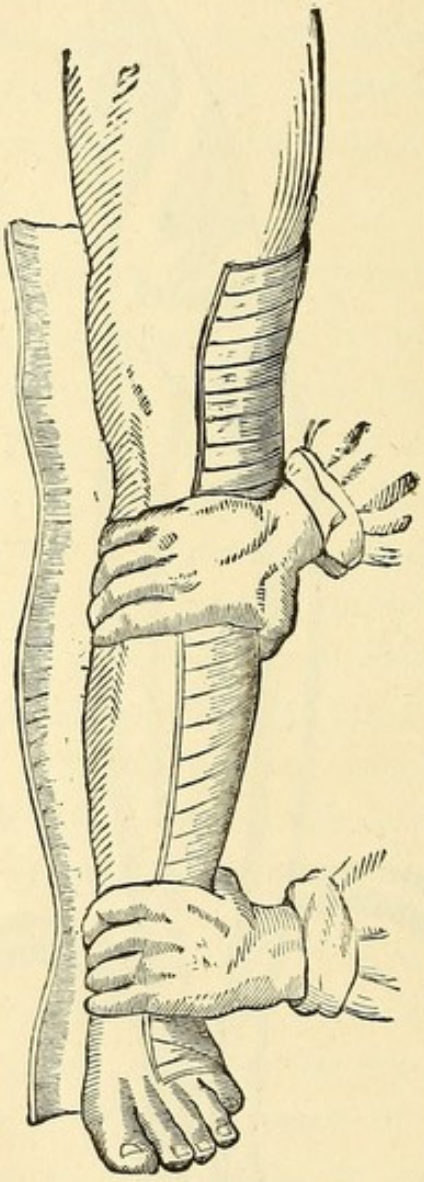


Fig. XXIX.

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.

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 roller passes round.

The examination of the upper limb is conducted on the

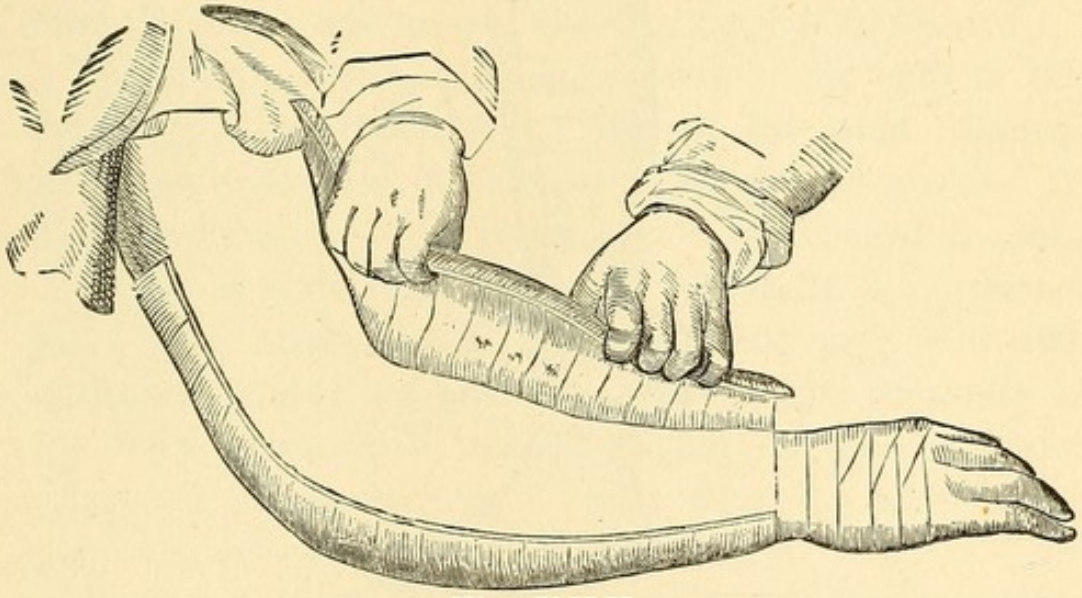


Fig XXX.

same plan. When the apparatus has been once opened and reclosed, I rarely gum 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 here shewn, to allow the wound to

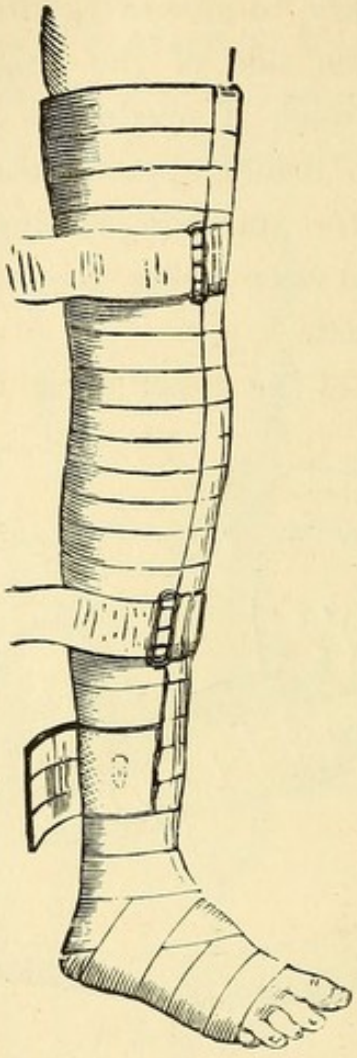


Fig. XXXI.

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 proves 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 be taken in cases of abundant suppuration, of introducing a drainage tube into the wound, and carrying it out through a perforation in the apparatus.

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 millboard 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. In fractures near the elbow and shoulder, the joint must be completely immobilized, and when the clavicle is broken, the chief indications are, to raise the elbow, and prevent the shoulder falling forward.

The splints should, as a rule, 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 millboard 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. Reduction effected, and the upper arm and axilla well protected with cotton wool, millboard splints are fitted to the shoulder on any of the plans previously described. 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; the elbow is to be first fixed at right angles with the forearm in the semi-prone position, by means of millboard splints; a few circular rolls of bandage, securing the limb to the trunk, add materially to steadiness.

Fractures of the Lower Limbs.

Fractures of the toes and of the metatarsal bones are commonly the result of direct violence, and 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 millboard 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 foot, and to do that effectually, the pasteboard splints must embrace

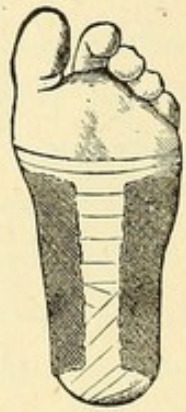


Fig. XXXII.

the sides of the foot, 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.

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 millboard 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 is an admirable contrivance for the

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

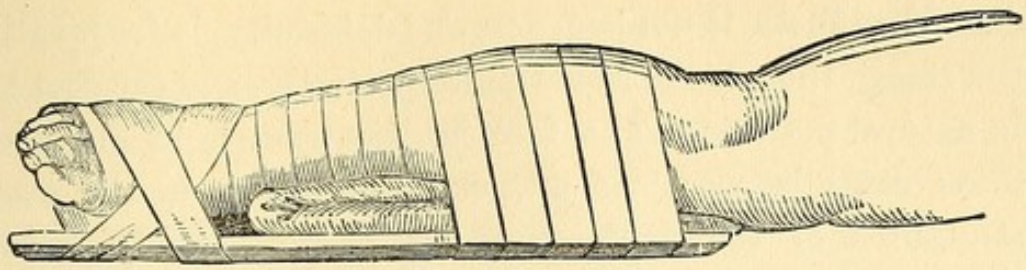


Fig. XXXIII.

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 gummed or 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 millboard apparatus while it is drying, adds security, and can be productive of no mischief.

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

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 106).

To prevent loss of mobility, it is essential to begin to flex and extend the ankle not later than the fourth week. A week later, move the ankle freely, apply alternate hot and cold douches and friction, 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, millboard splints from the sides of the foot to the knee are sufficient for the maintenance of

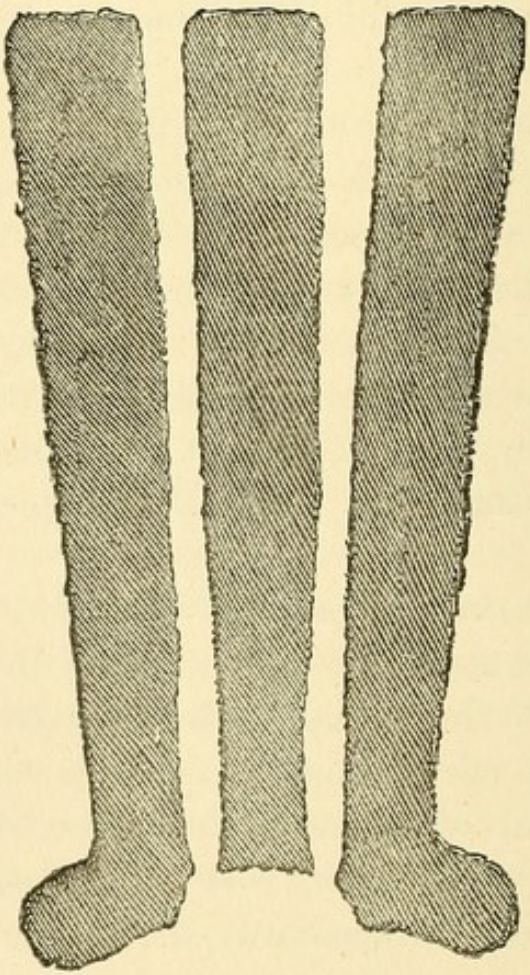


Fig. XXXIV.

cc-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.

Fracture of both bones of the leg is 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.

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 the foot, to fit which, each splint requires to be made with a foot-piece.

Each of these splints may be made in two lengths, which are joined by overlapping and bandaging, while the apparatus is being constructed. 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 been effected, the whole limb, from the roots of the toes to mid thigh, is to be padded with gauze and cotton-wool tissue. Special care must also be taken to pad well over 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 the tissue 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 neither overlap laterally, nor 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

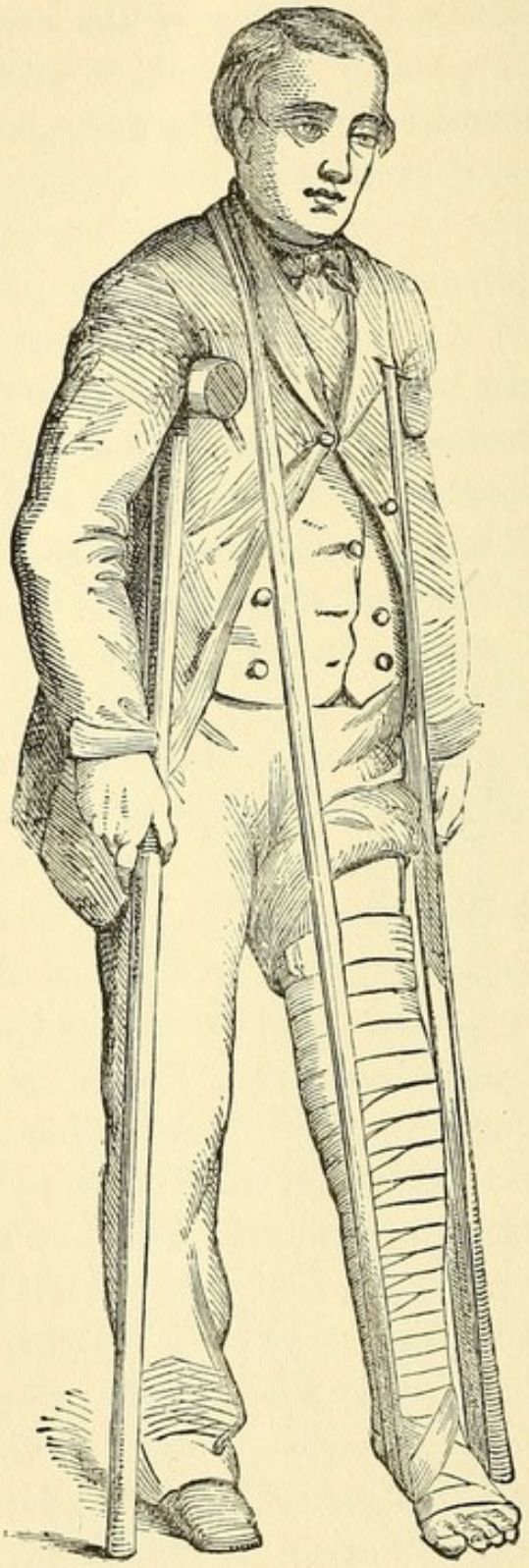


Fig. XXXV.

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 most improbable occurrence under the influence of pressure, the edges must not be brought into too close apposition. The examination completed, the

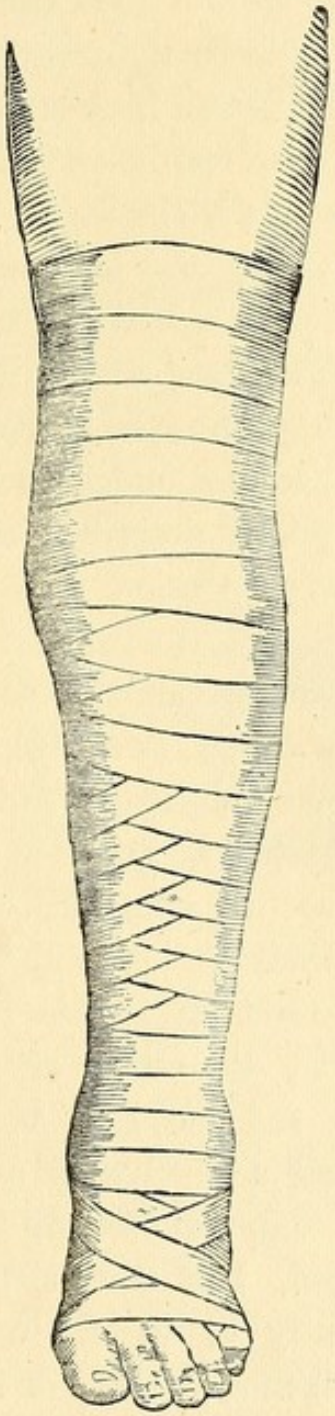


Fig. XXXVI.

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 does 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 is 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; it is to be tightened, above as much as is necessary to draw the lower limb efficiently, forwards and upwards, but not uncomfortably so. (Fig. XXXV. p. 324,)

In double fractures in the small part of the leg associated with great displacement, one or more extra millboard 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 142, 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 millboard 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 immobilized, 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; the blebs 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 mischief. 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.

Compound Fractures of the Leg.

In transferring the patient from the seat of accident to his residence, Pirogoff's field splint will be found a very useful one.

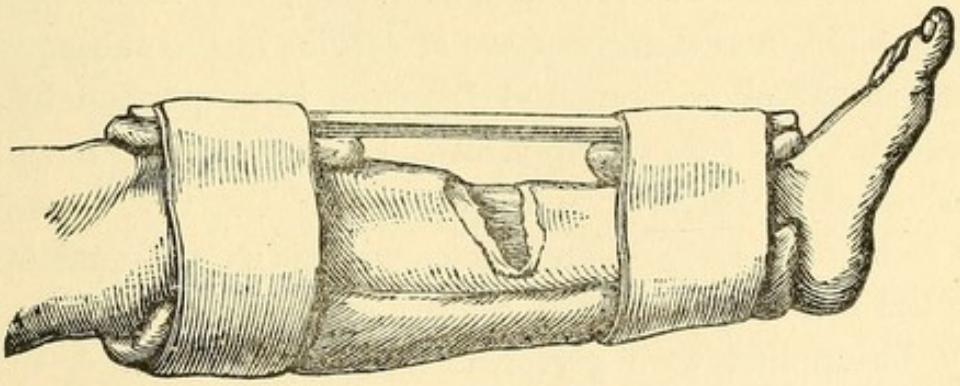


Fig. XXXVII.

In treating a compound fracture, 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 enlarging the wound

or 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 any possibility can be. It is especially important to sacrifice no periosteum. The wound must be lightly but effectually cleaned, and the edges accurately brought together, by one or more points of metallic suture; strips of lint or absorbent cotton tissue, 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 into 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 absorbent tissue, and compressed and immobilized, as recommended for simple fractures of the leg.

The sand and water pillow, or sand bags, suspension, digital compression, and sedatives, are of service in the subsequent management of a compound fracture, in proportion to its severity. As a rule the apparatus does not require touching for four or five days, or more; and after the first opening and re-adjustment, dressing once a week is usually sufficient.

If the state of the wound require it, the absorbent tissue may be applied with glycerine and borax, or other mild and efficient antiseptic; but 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, absorbent dressings, and immobilization of the joints are the great agencies, while abundance of pure air to breathe is the sovereign antiseptic.

Fracture of the Patella.

The millboard 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 leans 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. The surgeon now pads with elastic tissue the upper half of the spine of the tibia, the bony eminences

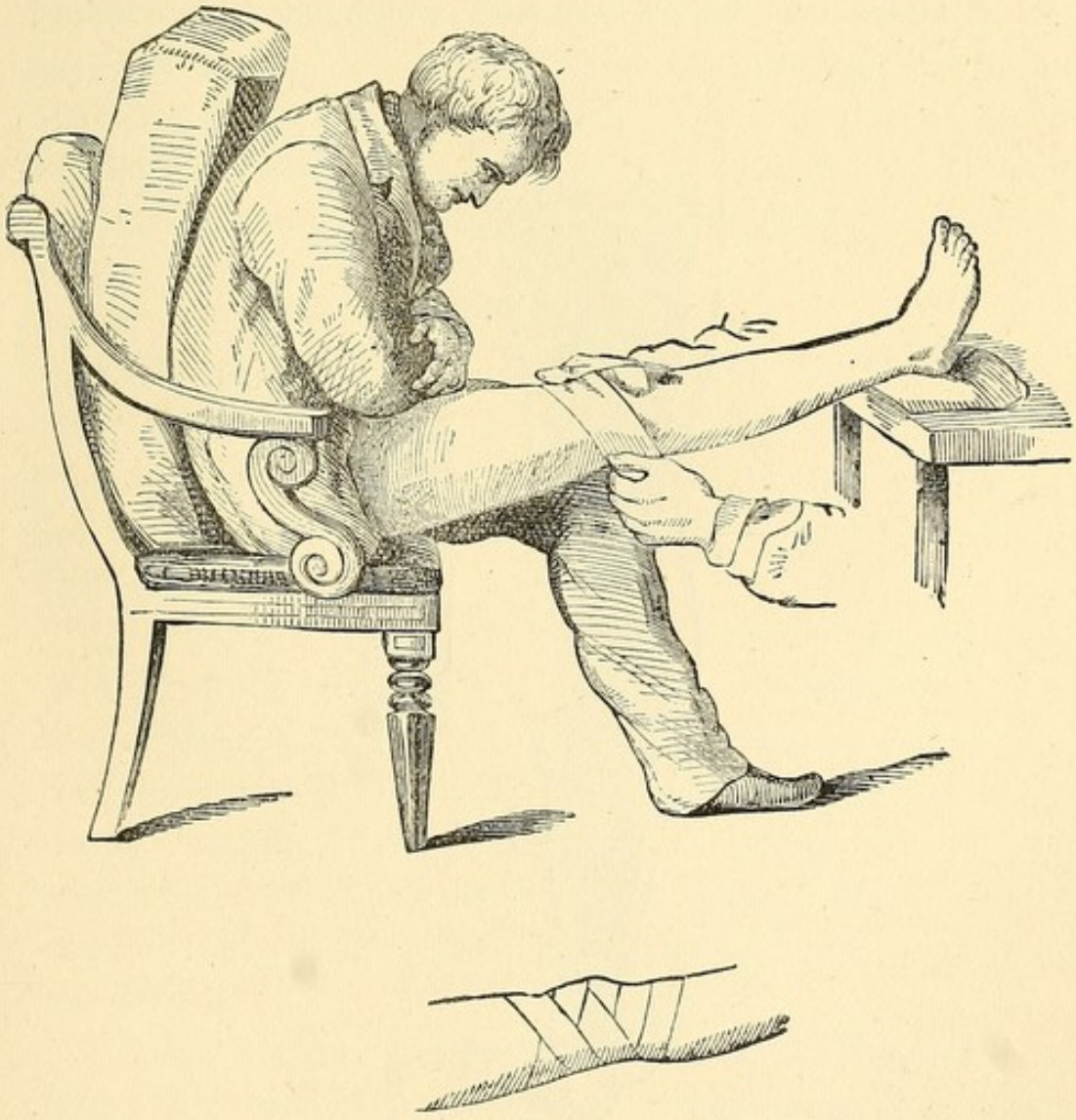


Fig. XXXVIII.

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 gummed or starched, and a short millboard splint 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; 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

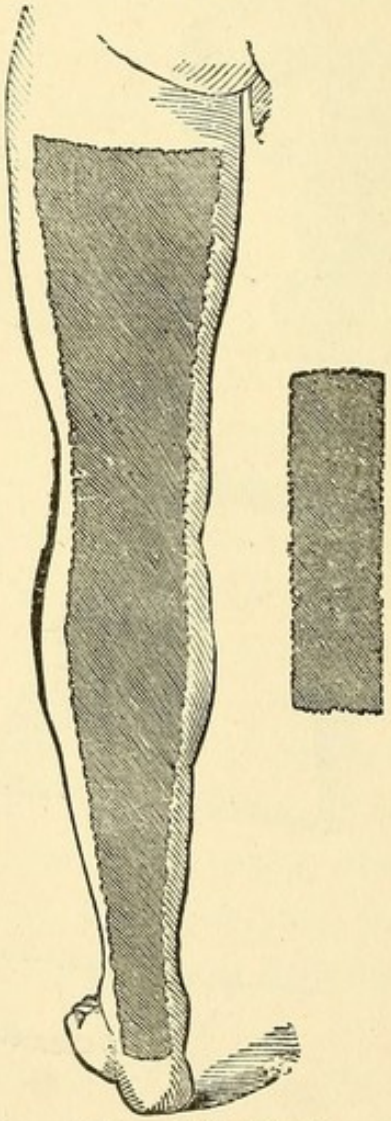


Fig. XXXIX

bandaged. It is important to place a thick pad of wool between the tendo Achillis and the lower end of the splint; and to adopt a similar precaution to prevent the upper edge of the splint from chafing the thigh. Finally, a dry bandage is applied from the toes, over the heel, to the upper part of the thigh, and then gummed. 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, with 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 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.

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 millboard 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 anæsthesia 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 ischium and pubes, the outer, and the posterior, one to the iliac crest. The outer 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 well padded 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

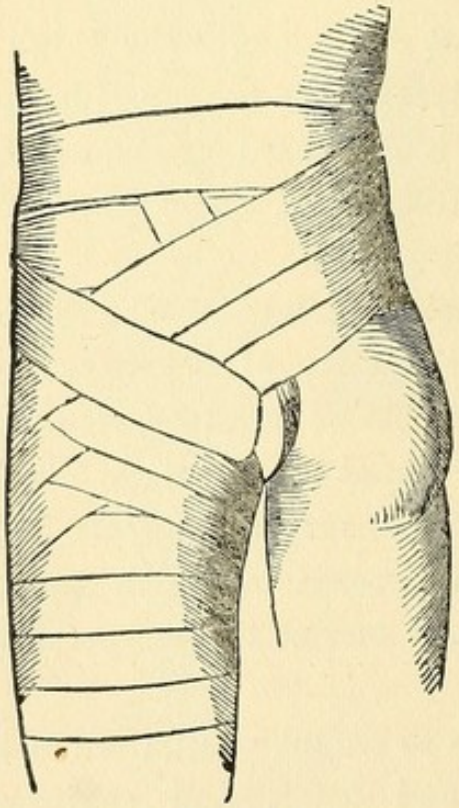


Fig. XL.

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. He now opposes resistance to the extending force, by passing his arms round the patient's trunk, or standing at the upper end of the bed placing one hand in each axilla, and holding back with just sufficient force to prevent the patient slipping, in obedience to the extending 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. The points to be especially attended to are, to spread out the bandage posteriorly, so as to cover the buttock.

By making several figures of eight round the pelvis, and passing the bandage alternately above and below the antero-superior spines, it is effectually prevented slipping over the iliac crests on to the sides of the abdomen. (Fig. XLI. p. 334).

The leg is now to be encased in millboard apparatus, extending from the sides of the foot upwards, as already described (page 323), 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. An outer coating of gum or starch completes the apparatus.

If the thigh be very muscular, it is advisable, as a precaution during the drying stage, to add dry pasteboard splints 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

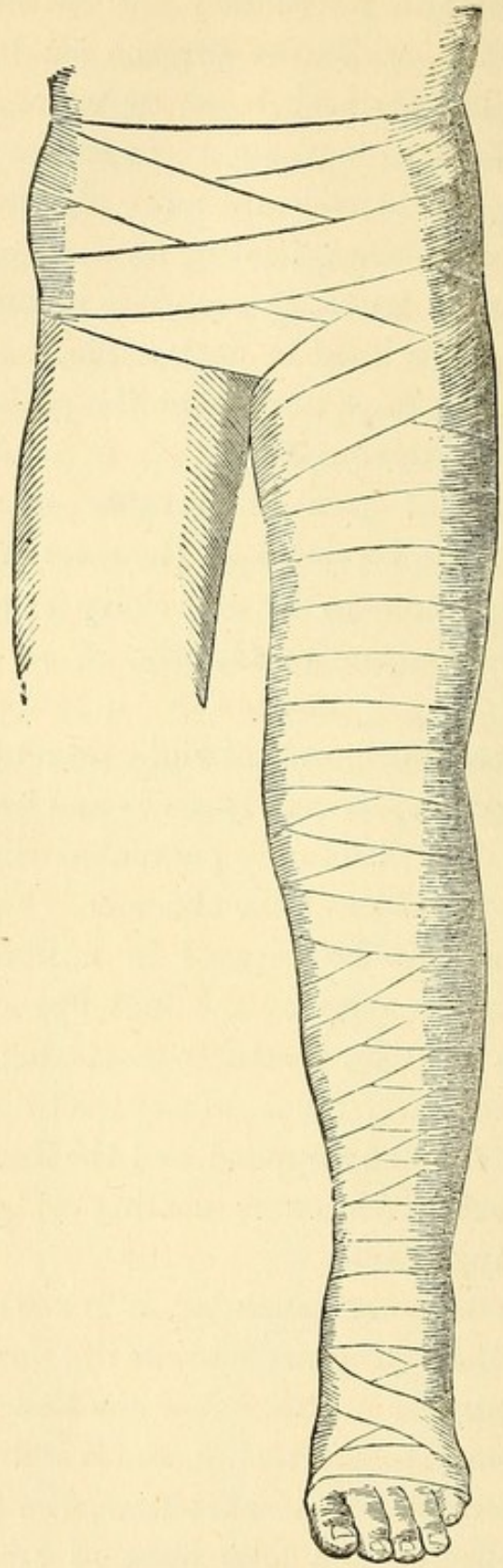


Fig. XLI.

weight is 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. If the lower end of the bed be raised a few inches, a weight at the foot is sufficient, the backward weight of the body being an adequate counter-extending force.

Lateral and transverse sand-bags are very useful, in steadying the limb during the drying process.

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.

Fractures of the neck of the femur inside the capsule are especially well suited to treatment by the millboard or plaster of Paris apparatus. Occurring as that injury does, almost invariably in old people, who are frequent subjects of pulmonary or cardiac 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 the 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 millboard apparatus from the sides of the foot to the iliac crest; the hip joint requires to be thoroughly fixed by double layers of millboard, over the outer-side, and over the whole buttock, closely moulded to the limb by double spica bandage, applied with great care, before and behind, as directed at Page 333. 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 through, or just 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.

The most powerful of the displacing muscles, the psoas and the 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 millboard mould. When the apparatus has been opened with all due care, and definitely adjusted, I am in the habit of applying an extra broad millboard 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.

Oblique fracture of the lower end of the femur is a formidable injury, requiring skilful and very diligent treatment. 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 millboard splints, as directed at Page 334-6; the apparatus must have additional strength at the knee, and it will be found convenient to apply the back 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 millboard splint of that length, and about $3\frac{1}{2}$ inches wide, is placed at the back, and fixed there by a gently-compressing bandage; the whole thigh is then encased as described at Page 335, and finally the apparatus is applied to the leg and foot. While the millboard splints are moist, immobility may be secured with the utmost certainty by placing a sand-bag, or 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.

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. 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 counteracted 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.

Plaster of Paris Apparatus.

Plaster of Paris possesses one unquestionable advantage over millboard in the construction of surgical moulds. It solidifies almost immediately. It is inferior in other respects. It is not favourable to the application of elastic pressure, and comparatively difficult to adapt to varying changes of size. Constant practice minimizes these difficulties, and beyond question plaster of Paris is a most valuable agent in the hands of a surgical dresser. Many ways of using it have been recommended. (*)

(*) Muttray, De cruribus fractis gypso liquefacto curandis (Dissert. Inaug., Berlin, 1831); On the Composition of Moulding Tablets for Fractures, by Alfred Smee, Dresser at St. Bartholomew's Hospital. London: 1838-39. Vol. I, p. 833-35; Du Bandage Plâtré et de son Application dans le Traitement des Fractures, par A. Mathysen. Liege: 1854. Pp. 89, avec 11 figures; Die reposition und der verband der Fractur, in Handbuch der Lehre von den Knochenbrüchen, von Dr. E. Gurlt, Berlin, 1862, Erster oder Allegemeiner Theil, s 403—519; Le Bandage Platré, amovo-inamovible d'emblée et Tricot plâtré, 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 described his plan in the Association Medical

I shall limit myself to describing briefly three simple and efficient plans.

Good dry plaster of Paris is an essential requisite. After exposure to the air it quickly loses its cohesive property. It may be rubbed dry into bandages, or prepared in a semi-liquid state, by sprinkling dry plaster of Paris into water, until it has acquired the consistence of good cream. By the addition of some gum mucilage, the solidification of the plaster cream is conveniently delayed. Gum has the further advantage of rendering the plaster less brittle on drying. In the plaster cream, so prepared, pieces of flannel, lint, gauze, or bandage, may be dipped, then wrung out and placed on any part of the body, previously padded and bandaged. Two, three, or more folds of absorbent bandage after having been dipped in the plaster cream, may be placed anywhere, lengthways or diagonally; they soon dry into a firm, well-fitting, and most useful splint. To hold the pieces together, an absorbent bandage may be used without preparation, or previously impregnated with dry plaster of Paris. When so prepared, the bandage must be rolled loosely, so that it may take up water just before use. The water may be poured into either end of the bandage roll, in sufficient quantity to wet it, but not to wash through it. Another plan of wetting the dried plaster bandages is to place them endways, in just sufficient water to cover them, and allow them to remain in it so long as bubbles of gas come to the surface. The bandages are then squeezed lightly, to remove superfluous water, and rolled on. Where special strength is

Journal, September, 1853. "On the Treatment of Simple Fractures and Dislocations of the Bones of the Leg and Foot by the Immediate Application of Plaster of Paris Splints," by John Croft, F.R.C.S., Med. Chir. Trans. Vol. LXIV, p. 295; Treatment of Fractures by Plaster of Paris Splint, by Professor Coskery, Baltimore, U.S A. Lancet, 1879. Vol. II, p. 185.; Treatise on Fractures by Lewis A. Stimson. London: 1883, p. 170; T. Smith and R. Lyell, in System of Surgery, edited by T. Holmes and J. W. Hulke. Third edition, vol. III, p. 632.

required, some plaster cream may be added to the surface. By a little exercise of ingenuity, the plaster mould can be constructed in sections of varying strength, the lines of support corresponding to the direction of the bones, with extra strength for immobilizing joints. At the sides and in front, the plastered bandage may be left so thin as to form a hinge when the mould is opened, or so as to be readily cut. For this purpose the scissors figured at page 315 are perfectly efficient. The one pair, which I have had in constant use for twenty years, are now equal to opening a gum and millboard, or a plaster of Paris case, and to cutting the pattern of a splint out of a sheet of tissue paper.

For the knowledge of another and excellent plan of using plaster of Paris, I am indirectly indebted to my friend, Dr. Fifield, surgeon to the City Hospital, Boston, U.S.A. One of the late house-surgeons to that Institution, Dr. Rufus A. Kingman, lately brought the plan to my knowledge, when he favoured me with a visit, on Dr. Fifield's introduction.

Dr. Kingman has been good enough to accede to my request by writing from Brooklyn, Mass., a description of his method, for publication in this volume.

"This method of applying plaster of Paris splints has been in extensive use in the Boston City Hospital for about two years, during which time it has almost entirely superseded the older plaster of Paris bandages, in the treatment of fractures, and has, to a very large extent, filled the place of the fracture box and carved splints.

"Among the chief advantages presented by the plaster splint, are,

"1st.—Greater ease of application,

"2nd.—The possession of a strong and accurately fitting splint, which cannot in any way produce constriction and consequent interference with circulation,

"3rd.—The readiness with which the position and condition of the fracture can be noted without disturbing the limb, and

"4th.—The fact that the splint can be easily removed and reapplied at will.

"As the principle finds its most important adaptation in the antero-posterior splint for fractures of the lower leg, a brief explanation of the process of its application may be sufficient to enable the practical surgeon to find, in his plaster barrel, a suitable splint for almost any fracture that may call for his attention.

"The materials required do not differ from those ordinarily used in applying the plaster bandage, or jacket, viz.,—stiff muslin gauze (commonly known as crinoline), cotton wadding, and a good sample of plaster of Paris.

"The leg being bared, a piece of the gauze is placed beneath it, long enough to reach from the knee to a point

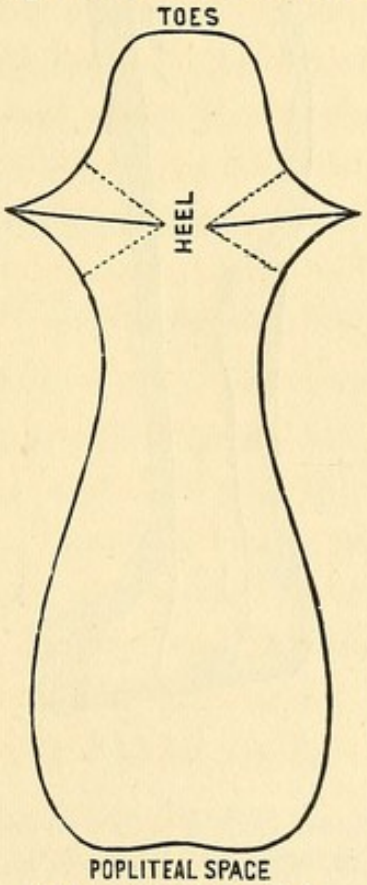


Fig. XLII. (*)

(*) The fold at the heel beiug made along the horizontal lines shewn n the figure, a fold on each side along the dotted lines allows the projecting piece to be folded upwards on to the leg, or downwards towards the sole of the foot, thereby very effectively immobilizing the joint.

about ten inches below the heel, and wide enough to encircle the calf.

Upon this gauze, mark out with a lead pencil a pattern similar to the outline of the (Fig. XLII., p. 341) sketch, of such size that it shall cover the posterior two-thirds of the limb. Place the pattern upon six or eight layers of the same material, and with a pair of shears cut them altogether.

"Now, having bandaged the limb evenly and thickly with the cotton wadding, proceed to mix the plaster with warm water into a smooth and tolerably thick cream or paste, and with the hand spread upon the pieces of gauze, layer by layer, until they are all incorporated into one soft and



Fig. XLIII. (*)

(*) This drawing is taken from a splint moulded on my son's leg. The pattern was cut out in lint, after Dr. Kingman's design (p. 341). The lint having been soaked in plaster cream and lightly squeezed, was placed under the previously-bandaged leg, and fitted to it by folding as previously directed. To strengthen the joint, a double fold of bandage, previously soaked in plaster cream, was placed vertically on each side. Making and fitting the splint was the work of a very few minutes.

flexible mass. Place this under the limb, fold and fix firmly with one or two roller bandages. If care be now taken to secure the fragments in position for ten minutes, the splint will have become quite hard, and no further displacement can occur.

"In a few hours the cotton bandage may be removed, the wadding opened with scissors, and thus the leg exposed to view for purpose of inspection, or for the application of soothing lotions.

"The anterior splint is seldom required. It consists of a half-dozen straight strips of gauze, spread with plaster as before, and applied over the cotton bandage, from which it can be easily detached when dry.

"If greater nicety be desired, the under layer of gauze may be cut larger than the others, the projecting portion being used to bind the edge after the plaster has been spread.

"A very valuable splint for fracture of the lower jaw may be made in the same way, the gauze being cut according to the pattern used for the gutta-percha or tin splint."

Plaster Stocking Apparatus.

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.

Parafine Bandages and Splints.

Parafine bandages are elegant and not cumbersome. I recently applied them to the sprained thumb of a mathematical instrument maker, and to the forearm of a young lady who had sprained it at tennis. The comfort and appearance in both were entirely satisfactury. The limb is first to be covered with a soft bandage. Into the parafine, which may be melted in a bowl immersed in boiling water, or in the cup of a large food warmer, dip a loosely-rolled absorbent bandage, in yard lengths. The process will be most agreable, if the parafine be allowed to cool somewhat after melting. The bandage, soaked in it, adapts itself very nicely to the part and soon hardens. This process may be hastened by sponging with cold water. If one or two layers of the parafine bandage be placed lengthways, intersecting circular and spiral turns, a singularly firm lattice-work, may be rapidly constructed. It has the further advantage of being very light, easily cut open, and adaptable to the shrinkage of the part.

Parafine splints may be prepared by dipping strips of rough millboard or felt in melted parafine. They soon acquire hardness, and soften on brief exposure to the fire. In this state they can be readily moulded and bandaged to any part. Their rigidity relaxes somewhat under the heat of the body, but they are none the less very handy and useful in many cases.

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

(*) 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.

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 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 elastic tissue, with extra thickness of protective material over bony prominences.

To soften the gutta percha it must be immersed in water as hot as can be comfortably borne; 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 elastic tissue, 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 fitted 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 millboard, 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, one-eighth 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 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. These directions will be found sufficient for the construction of a gutta percha apparatus to treat any fracture. The same rules for special fractures apply, as already given for treatment with the millboard moulds.

For fractures of the nasal bones, gutta-percha is very useful in constructing a compressing mould. The flattening and widening of the organ is the chief cause of deformity, and is only imperfectly remedied by plugging. A piece of gutta-percha cut to the shape of the nose, and sufficiently broad to rest laterally on the malar bones, is to be moulded to the part with good side pressure. With a director inside the nostrils, the septum can at the same time be straightened, and accurately adjusted plugs are useful accessories. In keeping the gutta-percha mould in position, its edge may be enveloped with absorbent cotton soaked in collodion. This material may be used to form the whole nasal mould; the decided compression which results from its contraction on drying, is very serviceable in checking hæmorrhage, preventing inflammation, and securing immobility.

Much may be done before the period of complete consolidation, in perfecting the shape of a nose distorted after fracture. In a case of the kind, in which I was consulted, so much benefit resulted from the use of an ingenious

instrument constructed by Messrs. T. P. Salt and Son, of Birmingham, that no one, now seeing the perfectly-shaped nose, could imagine the extent of the deformity which had been corrected. (*)

The instrument consists of three parts: viz., a spectacle-

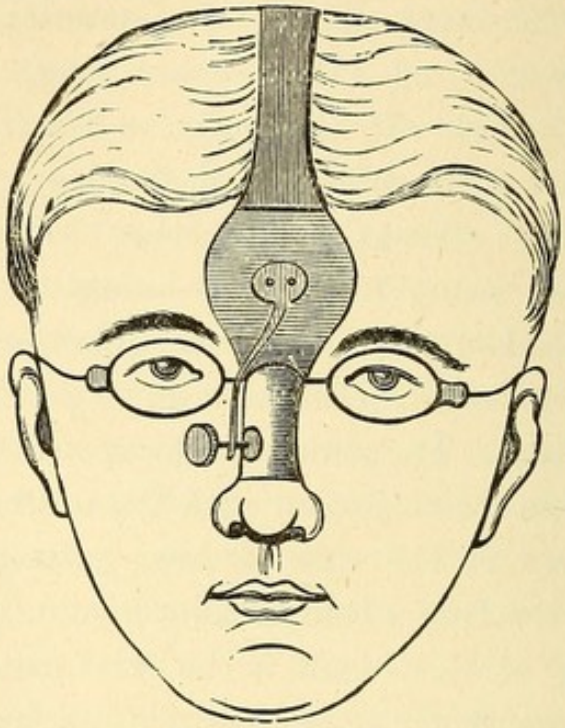


Fig. XLIV.

frame, from which the glasses have been removed; a nose-saddle, with forehead piece made of gutta-percha, accurately modelled to the contour of the parts; and a screw, with cushion. The spectacle-frame is attached to the saddle by a metal loop, in which it moves freely in a horizontal plane, the free ends of the spectacle-frame being fastened at the occiput by a piece of ribbon; from the forehead piece, which is a continuation of the saddle, proceeds a padded band, passing over the head, and fixed to the ribbon aforesaid, so as to prevent, in conjunction with the spectacle-frame, both lateral and vertical movement. An oval aperture is cut in the saddle, as shown in the engraving; and a

(*) On Fracture of the Nasal Bones, a Clinical Note, by Sampson Gamgee, British Medical Journal, October 23rd, 1875.

steel spring is fastened to the forehead piece or mask, passing in a direction nearly parallel with the nose, and exerting its force in a line opposite to that which the distortion has taken; through the spring, a screw works, having at its extremity a small padded cushion, so disposed as to press on the fractured bones with any degree of force which the surgeon may think desirable. The whole arrangement allows the pressure to be nicely graduated, and at the same time, prevents the instrument from being displaced—an accident which may, under other conditions, easily happen.

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In the preparation of this Index I am indebted to my valued friend and former dresser, Mr. E. Cocks Johnston ; and to Mr. Thomas G. Johnson, the Sub-Librarian of the Birmingham Medical Institute, whose literary aid has on other occasions been welcome and useful to me.

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E. C. OSBORNE AND SON, PRINTERS, 84, NEW STREET, BIRMINGHAM.

ADDENDUM.

ON ABSORBENT COTTON-WOOL TISSUE, AS A BASIS FOR MOULDS AND SPLINTS, FOR THE TREATMENT OF SURGICAL DISEASES AND INJURIES.

Experience has strengthened my conviction that the absorbent cotton-wool tissue (*ante p.* 307), which Messrs. Robinson and Sons, of the Wheat Bridge Mills, Chesterfield, have manufactured under my instructions, is calculated to prove of very great service in medical and surgical practice. Its perfect smoothness and elasticity specially fit it for application to inflamed parts; while its perfectly even surface specially adapts it to be a medium for equable pressure. It never becomes knotty or lumpy like ordinary cotton-wool, and its powerful absorbing and antiseptic properties prevent the retention and decomposition of skin and wound secretions.

While experimenting with a variety of porous substances and coagulable fluids, I ascertained the readiness with which the absorbent wool tissue becomes impregnated with a liquid mixture of plaster of Paris, on being dipped into it. With this fact as a basis, I surrounded a hand with a layer of absorbent wool tissue, and, outside this, moulded another layer of the same tissue, previously soaked in plaster of Paris cream.

This cream is made by sprinkling in water perfectly fresh and powdered plaster of Paris. Stir with a metal spoon, and continue sprinkling the powder until the liquid acquires the consistence of rich cream, or thin batter. The tissue, on being pressed into the liquid, very quickly becomes completely saturated. It requires to be lightly squeezed, to expel redundant cream, and is then fit to be smoothly applied over the layer of dry tissue, with which the part has previ-

ously been covered. Bandaging with a white, soft, absorbent roller, the plaster covering is moulded accurately and without constriction. It rapidly dries and hardens, but this process may be hastened by unrolling the bandage, carefully removing the mould, and holding it for a few minutes before the fire. It can then be re-applied, and it will be found that, while the outer shell is hard, the inner lining retains all the softness and elasticity of the original tissue. In this way splints may be cut any shape, adapted to any surfaces, and almost instantly solidified. Given a case of fracture of the pelvis, spine, or ribs, a layer of the dry absorbent tissue having been rolled round the patient, one or two more layers bandaged outside it, after having been previously soaked in plaster cream, result in the construction of a solid shell, within which fragments are held motionless and harmless.

By cutting strips of the tissue, and soaking them in plaster cream, any joint may be immobilized by a plaster and bandage brace, or lattice work, after the plans sketched on pages 312 and 313.

If desired, gum arabic, starch, or dextrine may be added to the plaster cream; while for parafine moulds and splints, the absorbent gauze and cotton tissue is a perfect basis.

Skill in making the moulds may be readily acquired by anyone cutting pieces of the tissue, soaking them in plaster cream, and moulding them with the hands round a tumbler or a tea-pot, a fancy jug or a large shell. However unequal the surface, a perfect mould can be taken; it quickly solidifies, and can be readily taken off. One effect resulting from impregnation of the gauze and cotton fibre with plaster is, that the resulting mould is not brittle, but on the contrary so tough, that it is almost impossible to break or tear it. Since the moulds and splints can be made and removed in sections, the usual difficulty in opening and

removing a plaster of Paris case is entirely obviated.

With the absorbent gauze and cotton-wool tissue as a base, parafine-splint sheeting may be kept on hand, to be cut into any shape according to the case to be treated,—a sprained joint, a fractured limb, or an enfeebled spine to be immobilized.

Strips of thin deal veneer, in parallel lines or intersecting lattice-work fashion, between two layers of parafined absorbent tissue, make an exceedingly strong splintage. This material can be cut to any size with an ordinary pair of scissors, moulded to any shape after exposure to slight heat, and rapidly solidified on being sponged with cold water. Incorporated, as the parafine is, with the cotton and gauze, the resulting tissue is not in the least brittle; moulds made with it may be kicked about without risk of fracture. So indeed may be the moulds made with the plaster of Paris cream. The latter are the cheapest; but the price of those made with parafine is greatly reduced by melting down old splints. This may be readily accomplished by pouring over them boiling water. The parafine rises to the surface and, on cooling, is taken off as a solid cake for future use. This process may be repeated, indefinitely, with very slight loss of parafine, at each operation.

The parafine and plaster splintage may be perforated to facilitate drainage, and that made with parafine has the further advantage of being especially well adapted for the application of pressure.

In process of these researches I have had occasion to visit the Wheat Bridge Mills at Chesterfield, where the absorbent tissue is prepared. The raw cotton is rendered absorbent by an elaborate process of chemical depuration, which goes far to explain how it is that our absorbent materials are

so powerfully antiseptic, beyond their anti-putrescent physical action in carrying off discharges, and minimising their evil influence, through the drying which results from evaporation. Such evaporation is rapid, just in the same proportion as the absorbent tissue gives free passage to water, in or out.

Besides its well known, intrinsic, antiseptic properties, parafine readily takes up borax and other anti-putrescent agents. With medicated parafine and veneered, or ribbed, absorbent tissue, we can construct firm moulds and splints for all surgical purposes, so as to give effect to the cardinal principles, on which rests the successful treatment of the vast majority of surgical injuries and diseases. Those principles are IMMOBILITY, POSITION, PRESSURE, DRAINAGE, and ANTISEPSIS.

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Pardon & Sons, Printers,] [*Paternoster Row, London.*

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