Dr Radcliffe Chester

with the author's sincere regards,

Aug 21st 1891.

Presented to.

Robt. M. Lewis.

April 14th 1907

with. ——

from. his friend

Radcliffe Chester

*

MINOR SURGERY

AND

BANDAGING

INCLUDING THE

TREATMENT OF FRACTURES AND DISLOCATIONS, TRACHEOTOMY, INTUBATION OF THE LARYNX, LIGATIONS OF ARTERIES AND AMPUTATIONS.

BY

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WITH FOUR HUNDRED AND THREE ILLUSTRATIONS.

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PREFACE.

The author has, in this work, endeavored to present, in as concise a manner as possible, a description of the various bandages, surgical dressings, and minor surgical procedures which are employed in the practice of surgery at the present time. The preparation and application of the antiseptic dressings now most commonly used have also received full consideration. The article upon Bandaging is fully illustrated with cuts, mostly new and taken from photographs, which, it is hoped, will prove of value as furnishing an accurate representation of the most important bandages used in surgical practice; the same is in a measure true of the article upon the dressing of Fractures and Dislocations, in which many new cuts of the same kind appear.

The work also contains short articles upon Tracheotomy, Intubation of the Larynx, Ligations of Arteries, and Amputations, and, although these procedures are scarcely to be included with those of Minor Surgery, it is hoped that their description will increase the value of the work to medical students, for whose use it has been prepared. The author's thanks are due to Dr. Walter D. Green for his kind assistance in revising the proof-sheets, and to Mr. James Wood for the skilful photographic work used in illustrating several of the articles.

112 South Eighteenth St.,
Philadelphia, August, 1891.

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PART I.

BANDAGING.

Bandages constitute one of the most widely used and important surgical dressings; they are employed to hold dressings in contact with the surface of the body, to make pressure, to hold splints in place in the treatment of fractures and dislocations, and to restore to their natural position parts which may have become displaced.

Bandages may be prepared of various materials, such as linen, crinoline, flannel, cheese or tobacco cloth, rubber sheeting, or muslin, bleached or unbleached; the latter material is the most commonly employed, by reason of the ease with which it is obtained and its cheapness; flannel, from its elasticity, is sometimes used, but its employment for bandages is now generally limited to its use in dressings for operative work in connection with the eye, and for a primary roller in the application of the plaster-of-Paris dressings.

Bandages are either *simple*, when composed of one piece of material such as the ordinary roller bandage, or *compound* when prepared of one or more pieces, adapted by size and shape to peculiar objects.

Bandages are also described as uniting, dividing, compressing, expelling or retaining bandages, according to the purposes they serve by their application.

The importance of being perfectly familiar with the general rules of bandaging and proficient in the application of the roller bandage cannot be over-estimated, and both the student and general practitioner will never have cause to regret the time occupied in learning to apply neatly this form of surgical dressing.

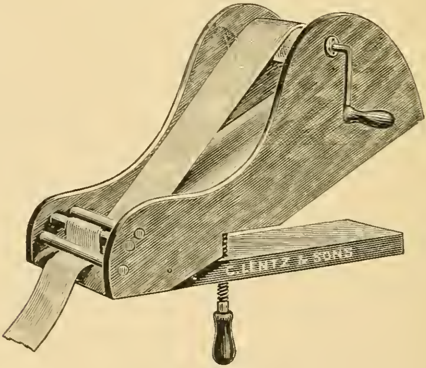
A well-applied bandage adds to the comfort of the patient, and the method of its application often secures for the physician the confidence both of the patient and of his friends, while, on the other hand, a badly applied bandage is apt to be uncomfortable and insecure, and to meet with their adverse criticism.

The Roller Bandage.

The roller bandage consists of a strip of woven material, prepared from some of the materials previously mentioned, of variable length and width according to the portion of the body to which it is to be applied; this, for ease of application, is rolled into a cylindrical form.

The material commonly employed for the roller bandage is unbleached muslin, although, for special purposes, linen,

Fig 1.



Bandage winder.

flannel, rubber sheeting, crinoline or cheese-cloth may be used. It is important that the roller bandage should consist of one piece, free from seams and selvage, for if made of a number of pieces sewed together, or if it contains creases or selvage it cannot be so neatly applied, and it is not so comfortable to the patient, as it is apt to leave creases upon the skin.

In preparing the ordinary muslin bandage the material is torn in strips varying in length and width according to the part of the body to which it is to be applied, and it is then rolled into a cylinder, either by the hand or by a machine constructed for the purpose. (Fig. 1.)

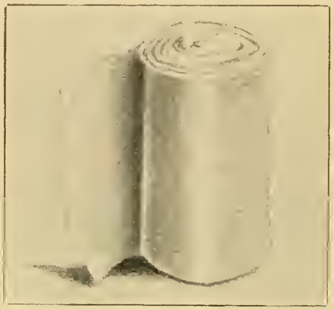
It is important that every student and practitioner should be able to roll a bandage by hand, for in practice the medical

Fig. 2.

Rolling a bandage by hand.

attendant may at any moment be called upon to roll a bandage, in order to apply a dressing, and as the art of preparing a bandage is acquired by a little practice, it should be familiar to every student and physician. To roll a bandage by hand the strip should be folded at one extremity several times until a small cylinder is formed; this is then grasped by its extremities by the thumb and index finger of the left hand; the free extremity of the strip is then grasped between the thumb and index finger of the right hand, and by alternate pronation and supination of the right hand the cylinder is revolved and the roller is formed; the firmness of the roller will depend upon the amount of tension which is kept upon the free extremity of the strip during the revolution of the cylinder. (Fig. 2.)

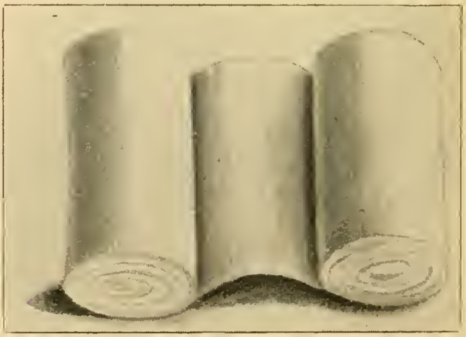
Fig. 3.



Single roller.

A bandage rolled in the form of a cylinder is called a *single* or *single-headed* roller (Fig. 3); if rolled from each

Fig. 4.



Double roller.

extremity toward the centre so that two cylinders are formed joined by the central portion of the strip, the *double* or *double-headed* roller is formed. (Fig. 4.) Double rollers are not much used, and in practice the single roller will be found to be amply sufficient for the application of almost all the bandages employed in surgical dressings.

The free end of the roller bandage is called the *initial extremity;* the end which is enclosed in the centre of the cylinder is its *terminal extremity;* and the portion between the extremities *the body;* a roller has also two surfaces, *external* and *internal.*

Dimensions of Bandages.

Bandages vary in length and width according to the purposes for which they are employed, and in practice it will be found that a small variety of bandages will be amply sufficient for the application of the ordinary surgical dressings.

The following list comprises those most frequently used and will show their dimensions:

Bandage one inch wide, three yards in length, for bandages for the hand, fingers, and toes.

Bandage two inches wide, six yards in length, for head bandages and for the extremities in children.

Bandage two and a half inches wide, seven yards in length, for bandages of the extremities in adults; a roller of this size is the one most generally used.

Bandage three inches wide, nine yards in length, for bandages of the thigh, groin, and trunk.

Bandages four inches wide, ten yards in length, for bandages of the trunk.

General Rules for Bandaging.

In applying a roller bandage the operator should place the external surface of the free extremity of the roller upon the part, holding it in position with the fingers of the left hand until fixed by a few turns of the roller, the cylinder being held in the right hand by the thumb and fingers; for thus as the bandage is unwound it rolls into the operator's hand, thereby giving him more control of it; care should also be taken that the turns are applied smoothly to the surface, and that the pressure exerted by each turn is uniform.

If a bandage be applied to a limb the surgeon should see that the part is in the position it is to occupy as regards flexion and extension when the dressing is completed, for a bandage applied when the limb is flexed will exert too much pressure when the limb is extended, and then may, by the pressure it exerts, become a matter of discomfort or even of danger to the patient, or if applied to an extended limb will become uncomfortable upon flexion.

My experience has been that, as a rule, those who have had little experience with the application of the roller bandage are apt to apply their bandages too tightly, and this

Fig. 5.

Bandage scissors.

may lead to disastrous consequences, especially in the dressing of fractures. Professor Ashhurst, in his clinical teaching, advises students to make use of a larger number of turns of a bandage in securing fracture dressings rather than to depend upon a few turns too firmly applied; advice which certainly conduces to the safety and comfort of the patient. When the bandage has been applied the terminal extremity should be secured by a pin or safety-pin applied transversely to the bandage, and if a pin be used its point should be buried in the folds of the bandage; if the bandage is a narrow one, the end may be split and the two tails resulting may be secured around the part by tying. In removing a bandage the folds should be carefully gathered up in a loose mass as the bandage is unwound, the mass being transferred rapidly from one hand to the other, thus facilitating its removal and preventing the part from becoming entangled in its loops. If it is desirable to cut the bandage to remove it, the use of scissors made for this purpose will be found most satisfactory. (Fig. 5.)

VARIETIES OF BANDAGES.

The Circular Bandage.

This bandage consists of a few circular turns around a part, each turn covering accurately the preceding turn. This variety of bandage may be used to retain a dressing to a limited portion of the head, neck, or limbs, to make compression upon the veins of the arm before performing venesection. (Fig. 9, *b*.)

The Oblique Bandage.

In this form of bandage the turns are carried obliquely over the part, leaving uncovered spaces between the suc-

FIG. 6.

Oblique bandage.

cessive turns. (Fig. 6.) Its principal use is for the application of temporary dressings.

The Spiral Bandage.

In this bandage the turns are carried around the part in a spiral direction, each turn overlapping a portion of the preceding one, usually one-third or one-half. (Fig. 7.) This bandage may be used to cover a part which does not increase too rapidly in diameter, for instance the abdomen, chest, or arm.

Fig 7.

Spiral bandage.

The Spiral Reversed Bandage.

This bandage is a spiral bandage, but differs from the ordinary spiral bandage in having its turns folded back or

Fig. 8.

Method of making reverses.

reversed as it ascends a part, the diameter of which gradually increases. By its use it is possible to cover by spiral turns a part conical in shape, so as to make equable pressure upon all parts of the surface. The reverses are made as follows: After fixing the initial extremity of the roller, as the part increases in diameter the bandage is carried off a little obliquely to the axis of the limb for from four to six inches; the index finger or thumb of the disengaged hand is placed upon the body of the bandage to keep it securely in place upon the limb, the hand holding the roller is carried a little toward the limb to slacken the unwound portion of the bandage, and by changing the position of the hand holding the bandage from extreme supination to pronation the reverse is made. (Fig. 8.) Care should be taken not to attempt to make the reverse while the bandage is tense, for by so doing the bandage is twisted into a cord which is unsightly and uncomfortable to the patient, instead of forming a closely fitting reverse.

The reverse should be completed before the bandage is carried around the limb, and when it has been completed the bandage may be slightly tightened so as to conform to the part accurately.

The reverses should be in line to have the bandage present a good appearance, and care should be taken that the reverses should not be made over salient parts of the skeleton, for if they occupy such positions they cause creases in the skin and become uncomfortable to the patient.

To make reverses neatly and to have them in line requires skill and practice; a well applied spiral reversed bandage is a test of a competent bandager.

Spica Bandages.

When the turns of the roller cross each other in the form of the Greek letter lambda, leaving the previous turn about one-third uncovered, the bandage is known as a spica bandage. (Fig. 9, *a*.) These spica bandages are especially serviceable as a means of retaining surgical dressings upon particular portions of the surface of the body, such as to the shoulder, groin, or foot.

2*

Fig. 9.

a — Spica bandage. b — Circular bandage.

Figure-of-eight Bandage.

This bandage receives its name from the turns being applied so as to form a figure-of-eight. This method of application is made use of in the Barton's bandage, the bandages of the knee and elbow, and many other bandages.

Fig. 10.

Recurrent bandage.

Recurrent Bandage.

This bandage derives its name from the fact that the roller after covering a certain part of the surface is reflected and brought back to the point of starting; it is then reversed and carried toward the opposite point, and this manipulation is continued until the part is covered by these recurrent turns, which are then secured by a few circular turns. (Fig. 10.) This is the bandage usually employed in the dressing of stumps.

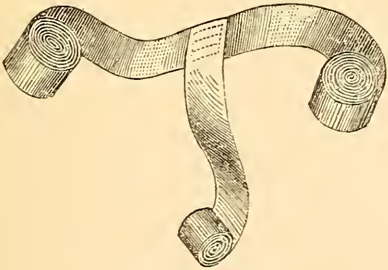
Compound Bandages.

These bandages are usually formed of several pieces of muslin or other material, and are employed to fulfil some special indication in the application of dressings to particular parts of the body. The most useful of the compound bandages are the T-bandages and the many-tailed bandages.

T-bandages.

The single T-bandage consists of a horizontal band to which is attached, about its middle, another having a vertical direction; the horizontal piece should be about twice the

Fig. 11.



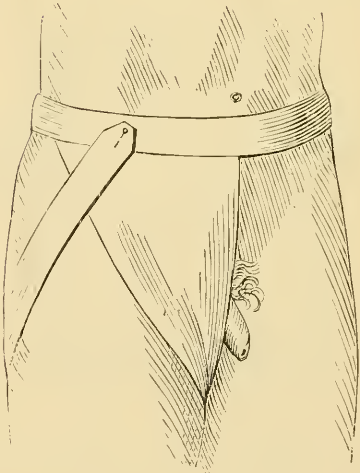
Single T-bandage.

length of the vertical piece. (Fig. 11.) The single T-bandage may be used to retain dressings to the head, the horizontal piece being passed around the head from the occiput to the forehead, the vertical piece being passed over the head and secured to the horizontal piece; the shape and width of the two pieces being varied according to the indications. In applying dressings to the anal region, or perineum, or in securing a catheter in a perineal wound, the single

FIG. 12.

Single T-bandage for chest.

FIG. 13.

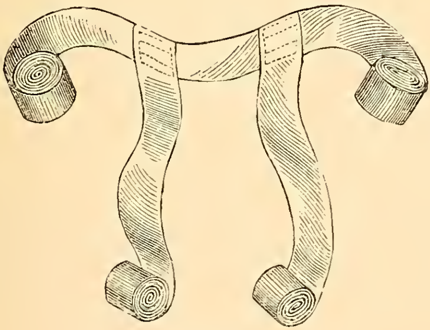


T-bandage of groin.

T-bandage will be found most useful. In applying a T-bandage for this purpose the body of the bandage is placed over the spine, just above the pelvis, and the horizontal portion is tied around the abdomen. The free extremity is split into two tails for about two-thirds of its length, and is carried over the anal region and brought up between the thighs, the terminal strips passing one on each side of the scrotum and being secured to the horizontal strip in front. The single T-bandage may be variously modified according to the indications which are to be met; for instance, in applying a dressing to the breasts the horizontal strip passing around the chest may be made ten or twelve inches in width, the vertical strip, two inches in width, passes from the back over the shoulder and is secured to the horizontal strip in front. (Fig. 12.) The single T-bandage may be variously modified, according to the ideas of the surgeon, so as to meet the indications presented in special cases. For the groin a piece of muslin six inches wide at its base and thirty inches long is sewed to a horizontal strip of muslin one and a half yards long and two inches in width. It may be applied as in Fig. 13 to hold a dressing to this part.

Double T-bandage.

FIG. 14.



Double T-bandage.

The double T-bandage differs from the single bandage in having two vertical strips attached to the horizontal strip, and it may be used for much the same purposes as the single T-bandage. (Fig. 14.) It may be conveniently used for retaining dressings to the chest, breasts or abdomen; when used for this purpose the horizontal portion should be from eight to twelve inches wide and long enough to pass one and a quarter times about the chest; two vertical strips, two inches wide and twenty inches long, should be attached to the horizontal strip a short distance apart near its middle. In applying this bandage to the chest, the horizontal strip is placed around the chest so that the vertical strips occupy a position on either side of the spine; the overlapping end of the horizontal portion is secured by pins or safety-pins, and the vertical strips are next carried one over either shoulder and secured to other portions of the bandage in front of the chest. (Fig. 15.)

FIG. 15.

Double T-bandage of chest.

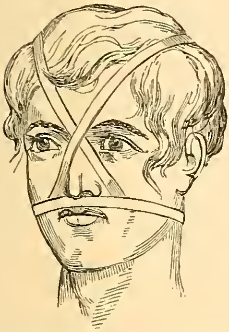
The double T-bandage may also be used to secure dressings to the nose, in which event the strips should be quite narrow, about one inch in width, and should be applied as shown in Fig. 16.

Many-tailed Bandages or Slings.

These bandages are prepared from pieces of muslin of various lengths and breadths, which are split at each extremity into two, three, or more tails up to within a few inches of their centres, their width and length being regulated by the part of the body to which they are applied.

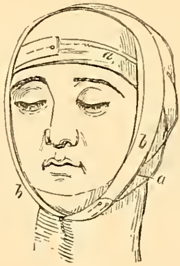
The *four-tailed* bandage may be found useful as a temporary dressing in cases of fracture of the jaw, or to hold

Fig. 16.



Double T-bandage of nose.

Fig. 17.



Four-tailed bandage of chin.

dressings to the chin. It may be prepared by taking a portion of a roller bandage three inches wide and one yard in length, and splitting each extremity up to within two inches of the centre; it is then applied as seen in Fig. 17.

The four-tailed bandage may also be used to retain dressings to the scalp, and can be prepared by taking a piece of muslin one yard and a quarter long and six or eight inches in width, splitting it at each extremity into two tails within three inches of the centre; it may then be applied as seen in Fig. 18.

Fig. 18.

Four-tailed bandage of head.

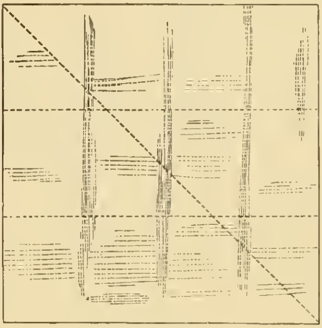
The four-tailed bandage may also be used in the temporary dressing of fractures of the clavicle—the body of the bandage being placed upon the elbow of the injured side, two tails passing around the body, fixing the arm to the side, and two tails passing over the sound shoulder.

The many-tailed bandage may also be used for holding dressings in contact with the abdomen or trunk, and is the bandage which many surgeons employ to hold the dressings to a laparotomy wound, and to give support to the abdominal walls after this operation. In preparing this bandage, a strip of muslin, one and a half yards in length and eighteen to twenty inches in width, is required, and the extremities may be split so as to form an eight-tailed bandage. In applying this bandage to the abdomen the body is placed upon the patient's back and the tails are brought around the abdomen and overlap each other, and when sufficiently firmly drawn to make the desired amount of pressure they are secured by means of safety-pins.

Handkerchief Bandages.

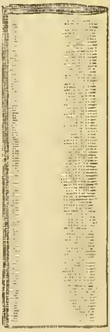
The use of handkerchiefs or square pieces of muslin for the temporary or permanent dressing of wounds, fractures,

Fig. 19.



The square.

Fig. 20.



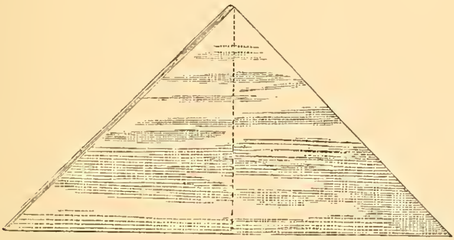
The oblong.

or dislocations was advocated many years ago by M. Mayor, a Swiss surgeon, who wrote an extensive work upon this subject, in which he reduced their application to a system.

He employed a handkerchief or square piece of muslin, and by various modifications in the application of these developed a number of very ingenious bandages.

The various forms which the handkerchief or *square* (Fig. 19) is made to assume are as follows: The *oblong*, made by folding the square once or twice on itself (Fig. 20). The *triangle*, made by bringing together the diagonal angles of the square (Fig. 21). The line of folding is known as

FIG. 21.



The triangle.

the base, the angle opposite the base the apex, and the other angles the extremities.

The *cravat* is prepared from the triangle by bringing the apex to its base, and folding it a number of times upon itself until the desired width is obtained. (Fig. 22.)

FIG. 22.

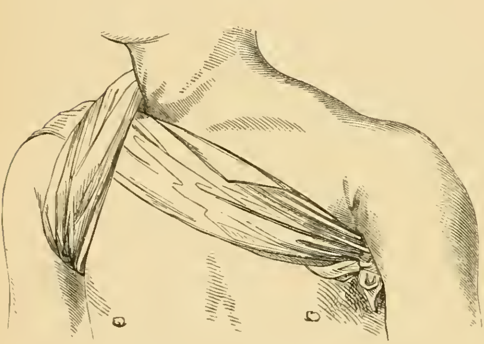
The cravat.

FIG. 23.

The cord.

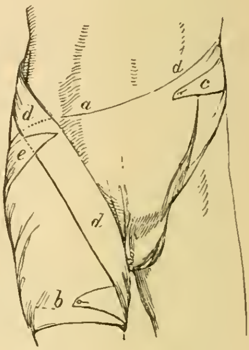
The *cord* is formed from the cravat twisted upon itself (Fig. 23). The names of the various handkerchief bandages are derived from the shape of the handkerchiefs used and the parts to which they are applied; the names serve as guides in their application. It is to be remembered that the base of the triangle or the body of the cravat is to be placed upon the portion the designation of which forms the final portion of the name of the bandage; thus, in the *fronto-occipital triangle*, the shape of the handkerchief is given, and we know that the base of the triangle is to be applied to the forehead and then pass to the occiput. In using the cravats the same rule applies; thus, in the *bis-axillary*

Fig. 24.



Bis-axillary cravat.

Fig. 25.



Cruro-pelvic triangle.

cravat, the body of the cravat is to be placed in the axilla of the affected side, the extremities crossed over the corresponding shoulder and carried over the chest, one before, the other behind, to the axilla of the opposite side, where they are secured. To apply the *bis-axillary cravat* (Fig. 24), a piece of muslin a yard and a quarter long and eighteen inches in width folded into a cravat is required; this bandage may be used to hold dressing to the axilla.

The Cruro-pelvic Triangle.

This bandage may be applied with a piece of muslin folded into a triangle a yard and a half long and two feet deep. It is applied by placing the base of the triangle obliquely across the right groin and conducting the superior extremity around the left side, across the loins to the right groin, when it is secured. The inferior end should be carried around the upper part of the right thigh between it and the scrotum, to a point near the superior extremity, and fastened with a pin (Fig. 25); this bandage may be employed to secure dressings to the groin, hip, and upper portion of the thigh.

Barton's Handkerchief.

This dressing may be employed to make extension in cases of fracture of the leg or thigh. It is applied by taking a handkerchief folded into a narrow cravat and placing the body of it on the extremity of the os calcis below the insertion of the tendo Achillis, so that two-thirds of the cravat comes around under the outer malleolus, and the other third remains on the inside. The inside portion remaining parallel with the sole of the foot, the outside piece is carried over the instep and passed around it so as to form a knot, and also passed under the sole of the foot to be turned around the first turn and to form another knot at the metatarsal articulation, when both ends are carried off perpendicularly from the foot.

I have described a few of the many very ingenious bandages devised by Mayor to substitute the use of the roller bandage, which will give the student some idea of their design and application. It is well to bear in mind this system of dressing, for the occasion might occur in which the other means of bandaging could not be obtained, and the use of handkerchiefs might answer a useful purpose as temporary dressings. I think their principal use is for temporary dressings, and I do not think they will ever take the place of the roller bandage, which can be applied with much greater nicety and exactness, and certainly presents a much neater appearance.

REGIONAL BANDAGING.

Bandages for the Head and Neck.

Barton's Bandage.

Roller Two Inches in Width, Six Yards in Length.

Application.—The initial extremity of the roller should be placed on the head just behind the mastoid process and the bandage should then be carried under the occipital protuberance obliquely upward under and in front of the parietal eminence across the vertex of the skull, then downward over the zygomatic arch, under the chin, thence upward over the opposite zygomatic arch and over the top of

Fig. 26.

Barton's bandage.

the head, crossing the first turn, which was made as nearly as possible in the median line of the skull, carrying the turns of the roller under the parietal eminence to the point of commencement. The bandage is then passed obliquely around under the occipital protuberance and forward under the ear to the front of the chin, thence back to the point from which the roller started. These figure-of-eight turns over the head and the circular turns from the occiput to the chin should be repeated, each turn exactly overlapping the preceding one until the bandage is exhausted (Fig. 26.) The extremity should then be secured by a pin ; and pins should be introduced at the points where the turns cross each other to give additional fixation to the bandage. In applying the bandage care should be taken to see that the turns overlap each other exactly and that the turns passing over the vertex cross as near as possible in the median line of the skull.

Modified Barton's Bandage.

To obtain additional security in the application of the Barton's bandage a turn of the bandage passing from the occiput to the forehead may be made, this turn being interposed between the turns of the bandage as ordinarily applied.

Fig. 27.

Modified Barton's bandage.

(Fig. 27.) In applying this bandage after the first set of turns has been completed, that is after the bandage has been brought back to the occiput, the bandage is carried forward upon the head just over the ear, around the forehead and backward above the ear on the opposite side to the occiput;

this being done, the ordinary figure-of-eight and circular turns are made, and when these have been completed another occipito-frontal turn may be made as described above, and this may be repeated as often as is desired until the bandage is exhausted, when the extremity is fastened with a pin, and pins are also introduced at all points at which the turns cross.

Use.—This bandage is one of the most useful of the bandages of the head, being employed to secure fixation of the jaw in cases of fracture or dislocation, and for the application of dressings to the chin. I have also employed it in place of the head-gear in slinging patients for the application of the plaster-of-Paris bandage in cases of disease of the spine, a stout cord or a piece of bandage about three inches wide and one yard long being passed under the turns crossing over the vertex; this cord is then secured to the cross-bar of the extension apparatus; this will be found quite as comfortable to the patient as the ordinary head-gear employed and much less likely to slip out of place and interfere with the breathing of the patient.

A firmly applied Barton bandage holds the jaws so closely together that care should be taken in applying it to patients who are under the influence of an anæsthetic, for if vomiting occurs the material may not be able to escape from the mouth and suffocation might occur unless the bandage were promptly removed. This accident I once saw occur and the patient's condition was alarming until the bandage was cut, allowing the jaw to be opened and the contents of the mouth to escape.

Gibson's Bandage.

Roller Two Inches in Width, Six Yards in Length.

Application.—The initial extremity of the roller should be placed upon the vertex of the skull in a line with the anterior portion of the ear; the bandage is then carried downward in front of the ear to the chin, and passed under the chin, and is carried upward on the same line until it reaches the point of starting. The same turns are repeated until three complete turns have been made; the bandage is then continued until it reaches a point just above the ear, when it is reversed and is carried backward around the occiput, and is continued around the head and forehead until it reaches its point of origin; these circular turns are continued until three turns have been made. When the bandage reaches the occiput, having completed the third turn,

Fig. 28.

Gibson's bandage.

it is allowed to drop down to the base of the skull, and it is then carried forward below the ear and around the chin, being brought back upon the opposite side of the head and neck to the point of origin; these turns are repeated until three complete turns have been made, and upon the completion of the third turn the bandage is reversed and carried forward over the occiput and vertex to the forehead, and its extremity is here secured with a pin. Pins should also be applied at the points where the turns of the bandage cross each other. (Fig. 28.)

Use.—This bandage may be used to fix the lower jaw in cases of fracture or dislocation of the jaw, but is more apt to change its position, and is therefore not so satisfactory as the Barton's bandage for this purpose.

Oblique Bandage of Angle of the Jaw.

Roller Two Inches in Width, Six Yards in Length.

Application.—The initial extremity of the roller is placed just in front of and above the left ear, and if the left angle of the lower jaw is to be covered in, the bandage is to be carried from left to right, making two complete turns around the cranium from the occiput to the forehead. If the right angle of the lower jaw is to be covered in, the turns should be made in the opposite direction.

Having made two turns from the occiput to the forehead, the bandage is allowed to drop down upon the neck, and is carried forward under the ear and under the chin to the angle

Fig. 29.

Oblique bandage of angle of the jaw.

of the jaw; it is now carried upward close to the edge of the orbit, and obliquely over the vertex of the skull, then down behind the right ear, continuing this oblique turn under the chin to the angle of the left jaw, where it ascends in the same direction as the previous turn. Three or four of these oblique turns are made, each turn overlapping the preceding one and passing from the edge of the orbit toward the ear until the space is covered in; the bandage is then carried to a point just above the ear on the opposite side, is reversed, and finished with one or two circular turns from the occiput to the forehead, the extremity being secured by a pin. (Fig. 29.)

Use.—This will be found to be one of the most useful of the head bandages; it may be used with a compress in treating fractures of the angle of the lower jaw, for holding dressings to the lower part of the chin and to the vault of the cranium, and is especially useful in retaining dressings to the sides of the face and the parotid region. As before stated, it may be applied to cover either the right or left side of the face, and, by reason of the oblique turns, holds its position most securely, having little tendency to become displaced.

Recurrent Bandage of the Head.

Roller Two Inches in Width, Eight Yards in Length.

Application.—The initial extremity of the roller is placed upon the lower part of the forehead and the bandage is carried twice around the head from the forehead to the occiput to secure it. When the bandage is brought back to the median line of the forehead it is reversed and the reversed turn is held by the finger of the left hand while the roller is carried over the top of the head along the sagittal suture to a point just below the occipital protuberance; here it is reversed again and the reverse is held by an assistant while the roller is carried back to the forehead in an elliptical course, each turn covering in two-thirds of the preceding turn. These turns are repeated with successive reverses at the forehead and occiput until one side of the head is completely covered in, and when this is accomplished a circular turn is made from the forehead to the occiput to hold the reverses in place.

The opposite side of the head is next covered in by elliptical reversed turns made in the same manner, and when this has been accomplished two or three circular turns are carried around the head from the forehead to the occiput to fix the previous turns. Pins should be applied at the forehead and occiput at the points where the reversed turns concentrate. (Fig. 30.)

FIG. 30.

Recurrent bandage of the head.

Use.—This bandage when well applied is one of the neatest of the head bandages, and it will be found useful to retain dressings to the vault of the cranium in the treatment of wounds of the scalp in this region. It will also be found of service in holding dressings to fractures of the cranium and to wounds after the operation of trephining. In restless patients it will sometimes become displaced, and it may be rendered more secure by pinning a strip of bandage to the circular turn in front of the ear and carrying it down under the chin and up to a corresponding point on the opposite side, where it is pinned to the circular turn; or one or two oblique turns passing from the circular turn over the vertex of the skull downward behind the ear, under the chin and up to the circular turn in front of the ear may be applied. The course of these turns is the same as those employed in the *oblique bandage of the angle of the jaw*, the extremity being secured by a pin.

V-bandage of the Head.

Roller Two Inches in Width, Four Yards in Length.

Application.—The initial extremity of the roller is secured by two turns of the bandage around the cranium from the forehead to the occiput, and when the roller reaches the occipital protuberance it is allowed to drop slightly a little below this and is carried forward below the ear around the

Fig. 31.

V-bandage of the head.

front of the chin and lower lip, then backward to the point of starting. These turns passing from the occiput to the forehead and from the occiput to the chin are alternately made until a sufficient number have been applied, and the extremity is secured by a pin over the occiput. (Fig. 31.)

This bandage may be modified by carrying the turns from the occiput forward under the ear and around the upper lip and back to the occiput and alternating these turns with the occipito-frontal turns; if employed in this way a bandage of one and one-half inches in width should be used.

Use.—This bandage may be employed to hold dressings to the front of the chin, to the upper and lower lips in cases of wounds, or to give support to these parts after plastic operations.

Head and Neck Bandage.

Roller Two Inches in Width, Four Yards in Length.

Application.—The initial extremity of the roller is placed upon the forehead and carried backward just above the ear to the occiput and is then brought forward around the opposite side of the head to the point of starting. Two

Fig. 32.

Head and neck bandage.

of these circular turns are made to fix the bandage, and when it is carried back to the occiput it is allowed to drop down slightly upon the neck and is then carried around the neck, the turns around the head alternating with the neck turns until a sufficient number of these have been applied, when the extremity of the bandage is secured by a pin at the point of crossing of the turns at the back of the head. (Fig. 32.)

Use.—This bandage may be found useful in securing dressings to the anterior or posterior portion of the neck or to the region of the occiput.

Care should be taken to apply it in such a manner that too much pressure is not made by the turns around the neck, which would be uncomfortable to the patient, and might seriously interfere with respiration.

Crossed Bandage of One Eye.

Roller Two Inches in Width, Four Yards in Length.

Application.—The initial extremity of the bandage is placed upon the forehead and fixed by two circular turns passing around the head from the occiput to the forehead;

Fig. 33.

Crossed bandage of one eye.

the roller is then carried back to the occiput and passed around this and brought forward below the ear, and passing over the outer portion of the cheek is carried upward to the junction of the nose with the forehead, and is then conducted over the parietal protuberance downward to the occiput; a circular fronto-occipital turn is next made, and when the bandage is brought back to the occiput it is brought forward again to the cheek and ascends to the forehead, covering in two-thirds of the previous turn, and is again conducted back to the occiput; these turns are repeated, the oblique turns covering the eye alternating with circular turns around the head until the eye is completely enclosed (Fig. 33), and the bandage is finished by making a circular turn about the head and introducing a pin to secure its extremity. It will be found more comfortable to the patient to include the ear on the same side on which the eye is covered in the turns of the bandage.

Use.—This bandage will be found useful in retaining dressings to one eye. It will be more comfortable to the patient if a flannel roller be used to apply this bandage, as well as the bandage which includes both eyes.

Crossed Bandage of Both Eyes.

Roller Two Inches in Width, Six Yards in Length.

Application.—The initial extremity of the roller is placed upon the forehead and secured by two circular turns of the bandage, passing around the head from the forehead to the occiput; the roller is then carried downward behind the occiput and brought forward below the ear to the upper portion of the cheek; it is then carried upward to the junction of the nose with the forehead and conducted over the parietal protuberance to the occiput; a circular turn is now made around the head from the occiput to the forehead, and the roller is carried from the occiput over the parietal protuberance of the opposite side forward to the junction of the nose with the forehead, then downward over the eye and outer portion of the cheek below the ear and back to the occiput; a circular turn around the head is next made, and this is followed by a repetition of the previous turns, ascending over one eye, descending over the other eye, each turn alternating with a circular turn around the head. These turns are repeated until both eyes are covered in, and the bandage is finished by making a circular turn around the head, the extremity being secured by a pin. (Fig. 34.) In this bandage both ears may be covered in, or left uncovered.

Fig. 34.

Crossed bandage of both eyes.

Use.—This bandage may be used to apply dressings to both eyes, and both of these bandages covering the eyes are used where it is desired to make pressure; but, for the simple application of a light dressing or of a bandage for the exclusion of light, the Liebreich's bandage (Fig. 68) will be found more comfortable to the patient.

Occipito-facial Bandage.

Roller Two Inches in Width, Four Yards in Length.

The initial extremity of the roller is placed upon the vertex of the head, and the bandage is carried downward in front of the ear and under the jaw, and upward upon the opposite side in the same line to the vertex; two or three of these turns are made, one turn accurately covering in the other, and a reverse is made just above and in front of the ear, and two or three turns are made around the head from the occiput to the forehead, which completes the bandage. (Fig. 35.) Pins should be inserted at the points where the turns of the bandage cross each other.

Fig. 35.

Occipito-facial bandage.

Use.—This bandage is employed to secure dressings to the vertex, temporal, occipital, or frontal regions.

Oblique Bandage of the Head.

Roller Two Inches in Width, Four Yards in Length.

The initial extremity of the bandage is placed upon the forehead, and is secured by two circular turns passing around the head from the forehead to the occiput. From the occiput the bandage is carried obliquely over the highest part of the lateral aspect of the head, which is to be covered in, and is passed over the forehead and back to the occiput, and is then carried to the forehead by a circular turn, then conducted obliquely over the other side of the head and back to the occiput. These turns are repeated, so that each succeeding turn covers in three-fourths of the preceding turn until the sides of the head are covered in by descending turns, and the bandage is completed by a circular turn passing around the head from the forehead to the occiput. (Fig. 36.) This bandage may be applied with descending or ascending turns.

FIG. 36.

Oblique bandage of the head.

Use.—This bandage is employed to make pressure upon or to hold dressings to the lateral aspects of the head.

Bandages of the Upper Extremity.

SPIRAL BANDAGE OF THE FINGER.

Roller One Inch in Width, One and a Half Yards in Length.

APPLICATION.—The initial extremity of the roller is secured by two or three turns around the wrist; the bandage is then carried obliquely across the back of the hand to the base of the finger to be covered in, then to its tip by oblique turns; a circular turn is then made and the finger is covered by ascending spiral or spiral reversed turns until its base is reached; the bandage is then carried obliquely across the back of the hand and finished by one or two circular turns around the wrist; the extremity may be pinned or may be split into two tails, which are tied around the wrist. (Fig. 37.)

FIG. 37.

Spiral bandage of the finger.

Use.—This bandage is employed to retain dressings upon the finger and to secure splints in the treatment of fractures or dislocations of the phalanges.

GAUNTLET BANDAGE.

Roller One Inch in Width, Three Yards in Length.

APPLICATION.—The initial extremity of the roller is fixed at the wrist by one or two circular turns of the bandage; it is then carried down to the tip of the thumb by an oblique turn of the roller, and this is covered in by spiral or spiral reversed turns to the metacarpo-phalangeal articulations; the roller is then carried back to the wrist and a circular turn is made around it, and the bandage is now carried down to the tip of the next finger by an oblique turn, which is covered-in in the same manner. When all the fingers have been covered in, the bandage is finished by circular turns around the hand and wrist. (Fig. 38.)

Fig. 38.

Gauntlet bandage.

Use.—This bandage may be employed to apply dressings to the fingers and hand in case of wounds or fractures. It was formerly much employed in the treatment of burns of the fingers to prevent the opposed ulcerated surfaces from adhering, but its use for this purpose has been supplanted by wrapping each finger in a separate dressing and applying a dressing over the whole with a few recurrent and spiral turns of a wide roller, the application of this dressing being much less painful to the patient, and being at the same time equally satisfactory.

Demi-gauntlet Bandage.

Roller One Inch in Width, Four Yards in Length.

Application.—The initial extremity of the bandage should be placed upon the wrist and fixed by two circular turns passing from the ulnar to the radial side; then carry the roller obliquely across the back of the hand to the base

Fig. 39.

Demi-gauntlet bandage.

of the index finger, pass the bandage around this and carry the roller back to the wrist, making a circular turn; it should then be carried obliquely across the hand to the base of the next finger, and so successively until the base of each of the fingers and of the thumb has been included; the bandage is then completed by a circular turn around the wrist. (Fig. 39.)

The demi-gauntlet bandage may be also applied in such a manner as to cover the palm of the hand and leave the back of the hand uncovered.

Use.—This bandage may be employed to retain light dressings to the dorsal or palmar surface of the hand.

Spica Bandage of the Thumb.

Roller One Inch in Width, Three Yards in Length.

Application.—The initial extremity of the roller is placed upon the wrist and fixed by two circular turns; then carry the roller obliquely over the dorsal surface of the thumb to its distal extremity; next make a circular or spiral turn around the thumb, and carry the bandage upward over the back of the thumb to the wrist, around which a circular turn should be made. The roller is next carried around the thumb and wrist, making figure-of-eight turns, each turn overlapping the previous one two-thirds as it ascends the thumb, and each figure-of-eight turn alternating with a circular turn about the wrist. These turns are repeated until the thumb is completely covered in with spica turns, and the bandage is finished by a circular turn around the wrist. (Fig. 40.)

Fig. 40.

Spica bandage of the thumb.

Use.—This bandage is employed to apply dressings to the dorsal surface of the thumb, and for the retention of splints in the dressing of fractures or dislocations of the bones of the thumb.

Spiral Reversed Bandage of the Upper Extremity.

Roller Two and a Half Inches in Width, Seven Yards in Length.

Application.—The initial extremity of the roller is placed upon the wrist, and secured by two turns around the wrist; the bandage is then carried obliquely across the back of the hand to the second joint of the fingers, where a circular turn should be made; the hand is covered in by two or three ascending spiral or spiral reversed turns. When the thumb has been reached, its base and the wrist are covered in by

Fig. 41.

Spiral reversed bandage of the upper extremity.

two figure-of-eight turns; the bandage is then carried up the forearm by spiral and spiral reversed turns until the elbow is reached; this may be covered in with spiral reversed turns, and the bandage is next carried up the arm with spiral reversed turns to the axilla. (Fig. 41.) If, on reaching the elbow, the arm is bent or is to be flexed in the subsequent dressing, the elbow should be covered in with figure-of-eight turns, and when this has been done the arm above may be covered in with spiral reversed turns. When properly applied, the reverses should be in line, and should not be made over the prominent ridge of the ulna.

Use.—This is one of the most generally employed of all the roller bandages; it constitutes the primary roller which is applied in the dressing of fractures of the humerus, and is also the bandage employed in holding dressings to the arm and forearm, and in securing splints to these parts in the treatment of fractures and dislocations.

Figure-of-eight Bandage of the Elbow.

Roller Two Inches in Width, Four Yards in Length.

Application.—The initial extremity of the bandage is placed upon the forearm a short distance below the elbow-joint, and fixed by one or two circular turns, the arm being

Fig. 42.

Figure-of-eight bandage of the elbow.

flexed. The bandage is then carried by an oblique turn across the flexure of the elbow-joint, and passed around the arm a few inches above the elbow; a circular turn is then made, and the roller is next carried across the flexure of the elbow and passed around the forearm. These turns are repeated, the turns from the forearm ascending and those from the arm descending, each set of turns crossing in the flexure of the elbow until it is covered in, and a final turn is passed circularly around the elbow-joint. (Fig. 42.)

Use.—This bandage is often employed as a part of the spiral reversed bandage of the upper extremity when the arm is to be flexed, and is also used to hold dressings to the region of the elbow-joint. It was formerly much used to hold the compress upon the wound resulting from venesection at the elbow.

Spica Bandage of the Shoulder (Ascending).

Roller Two and a Half Inches in Width, Seven Yards in Length.

Application.—The initial extremity of the roller is placed obliquely upon the outer surface of the arm opposite the axillary fold, and fixed by one or two circular turns. If

Fig. 43.

Spica bandage of the shoulder (ascending).

Fig. 44.

Spica bandage of the shoulder (descending).

the right shoulder is to be covered, the bandage is next carried across the front of the chest to the axilla of the opposite side, then around the back of the chest to the point of starting upon the arm; then conduct the roller around the arm of this side up over the shoulder, across the front of the chest, through the opposite axilla and back over the posterior surface of the chest to the point of starting; continue to make these ascending turns, each turn overlapping the preceding turn about two-thirds until the shoulder is covered in (Fig. 43), when the extremity of the bandage may be secured by a pin at the point of ending, or the last turn may be carried from the shoulder around the back of the neck and brought forward over the opposite shoulder and pinned to the turns which pass around the axilla It should be remembered that the turns of the roller overlap each other exactly in the opposite axilla, and it will be found more comfortable to the patient to apply a little cotton wadding in the axilla to prevent the bandage from excoriating the skin of this part. Care should be taken to see that the turns are made in such a manner that the spica turns occupy, as nearly as possible, the median line of the shoulder. When this bandage is applied to the left shoulder, after fixing the initial extremity by circular turns around the arm, the roller should be carried over the back of the chest to the axilla of the opposite side and then brought back to the point of starting; the succeeding turns are then applied in the same manner.

Spica Bandage of the Shoulder (Descending).

Roller Two and a Half Inches in Width, Seven Yards in Length.

Application.—The initial extremity of the roller should be fixed upon the arm as near as possible to the axillary line by one or two circular turns, and if it is applied to the right shoulder the bandage should be passed under the axilla and carried obliquely over the shoulder to the base of the neck, then downward across the front of the chest to the axilla of the opposite side; from the axilla the roller is carried over the back of the chest to the base of the neck so as to cross the first turn at this point; it is then carried to the axilla and through this, then back to the neck, the turns descending toward the shoulder. These turns, taking the same course are repeated, each turn overlapping two-thirds of the previous one until the shoulder is covered in and the circular turn around the arm is reached, at which point the extremity is secured by a pin. (Fig. 44.)

Use.—The spica bandages of the shoulder are employed to hold dressings to the shoulder, to hold compresses over the acromial end of the clavicle in case of dislocation of that portion of the bone, to retain the shoulder-cap used in the treatment of fractures of the upper portion of the humerus, and to retain dressings to the axilla.

Figure-of-eight Bandage of the Neck and Axilla.

Roller Two Inches in Width, Five Yards in Length.

Application.—The initial extremity of the roller is fixed upon the side of the neck and secured by one or two loosely applied circular turns; if applied to the right axilla carry the bandage from left to right over the right shoulder to the posterior part of the axilla under which it passes, to ascend in front over the same shoulder to the back of the neck; these figure-of-eight turns around the neck and axilla, each turn overlapping two-thirds of the previous turn, are repeated until the desired space is covered, and the bandage is completed by a circular turn around the neck. (Fig. 45.)

Fig 45.

Figure-of-eight bandage of the neck and axilla.

Use.—This will be found a useful bandage to secure dressings to the base of the neck, the upper part of the shoulder, and to the axilla, as it does not restrict the motions of the arm unless drawn too tight.

Velpeau's Bandage.

Two Rollers Two and a Half Inches in Width, Seven Yards in Length.

Application.—The patient should place the fingers of the hand of the affected side on the opposite shoulder; the initial end of the roller should be placed on the body of the scapula of the sound side and secured by a turn made by

Fig. 46.

Velpeau's bandage.

carrying the bandage over the shoulder of the affected side, near its outer portion, then conducting it downward over the outer and posterior surface of the arm of the same side, behind the point of the elbow, and obliquely across the front of the chest to the axilla of the opposite side, thence to the point of starting. This turn should be repeated, to fix the initial extremity of the bandage. Having completed the second turn, carry the roller transversely around the thorax, passing over the flexed elbow of the affected side, from this point to the axilla, and through this to the back. From this point the roller is carried over the shoulder and down the outer and posterior surface of the arm behind the elbow and obliquely across the front of the chest through the axilla to the back, and continuing, passes transversely across the back of the chest to the elbow, which it encircles, then passing to the axilla. These alternating turns are repeated until the arm and forearm are bound firmly to the side and chest. The vertical turns over the shoulder, each turn covering in two-thirds of the previous turn and ascending from the point of the shoulder toward the neck and from the posterior surface of the arm toward the elbow, are applied until the point of the elbow is reached. The transverse turns passing around the chest and arm are so applied that they ascend from the point of the elbow toward the shoulder, each turn covering in one-third of the previous one, and the last turn should pass transversely around the shoulder and chest, covering the wrist. (Fig. 46.)

The extremity of the bandage should be secured by a pin where it ends, and additional fixation will be secured by introducing a number of pins at the points where the turns of the bandage cross each other.

Use.—This bandage is employed to fix the arm in the treatment of certain fractures of the clavicle and scapula, also to secure fixation of the humerus after the reduction of dislocations of the shoulder-joint.

Desault's Bandage.

Three Rollers Two and a Half Inches in Width, Seven Yards in Length.

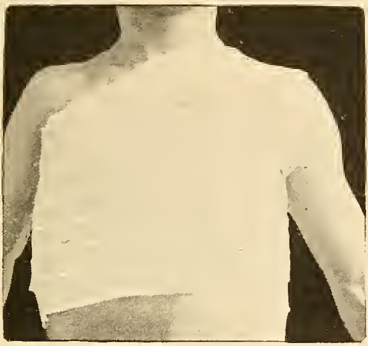
A wedge-shaped pad to fit in the axilla is also required.

These rollers are known as the *first*, *second* and *third* rollers.

First Roller of Desault's Bandage.

Application.—Before applying the first roller the arm of the patient on the injured side should be elevated and carried off at right angles to the body; the wedge-shaped pad with its base in the axilla should next be applied to the side of the chest, and the initial extremity of the roller is placed upon the middle of the pad and fixed by two or three circular turns around the chest; the bandage is then carried obliquely across the front of the chest to the sound

FIG. 47.



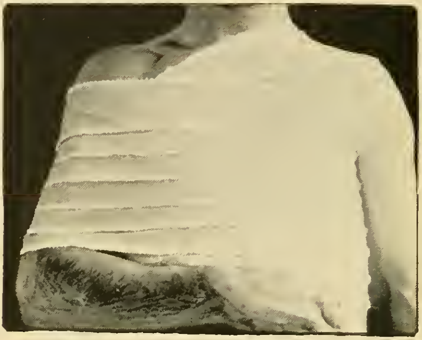
First roller of Desault's bandage.

shoulder and passed under the axilla, brought over the shoulder and conducted around the chest to pass over the pad, and it is next carried obliquely down to the lower portion of the chest to a point opposite the lower end of the pad; it is now made to ascend the chest by spiral turns until the top of the pad is reached, where it is secured. (Fig. 47.)

Second Roller of Desault's Bandage.

APPLICATION.—The arm should be brought down against the side so as to press upon the pad previously applied, and the forearm should be flexed upon the arm and brought across the lower portion of the chest. The initial extremity of the roller is placed in the axilla of the sound side, and the bandage is carried around the chest and over the arm of the injured side, making a circular turn around the chest to fix it; then spiral turns are made around the chest from above downward until the elbow is reached, the turns being more

Fig. 48.



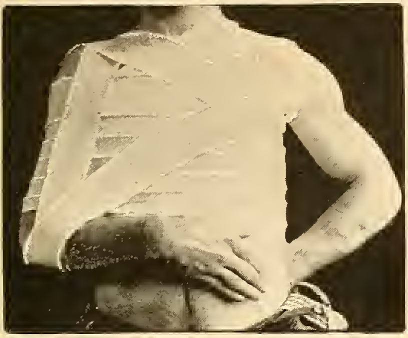
Second roller of Desault's bandage.

firmly applied as they descend, and when this point is reached the end of the bandage is secured. (Fig. 48.)

Third Roller of Desault's Bandage.

Application.—The initial extremity of the roller is placed in the axilla of the sound side, and the bandage is carried obliquely over the front of the chest to the shoulder of the injured side, passed over this, and conducted down the back of the arm to the elbow, thence obliquely upward over the upper fifth of the forearm to the axilla of the sound side. From this point it is carried backward obliquely over the back of the chest to the shoulder; crossing the previous shoulder-turn it is conducted down the front of the arm to the elbow, then around this and backward obliquely over the back of the chest to the axilla of the sound side. These turns are repeated until three sets of turns have been applied, and the turns should overlie each other exactly. (Fig. 49.) The course of the turns of the third roller is considered the most difficult to remember, and the student may be assisted in its correct application by remembering that all the turns start at the axilla, pass to the shoulder, and then to the elbow, and from the elbow always return to

FIG. 49.



Third roller of Desault's bandage.

the starting-point—the axilla. The turns of the third roller make two triangles, one on the anterior surface of the chest, the other upon the back.

After the application of the three rollers the hand and uncovered portion of the forearm should be supported in a sling suspended from the neck.

Use.—This bandage, applied completely, or some one of its various rollers, is employed in the treatment of fractures of the clavicle.

Bandages of the Trunk.

SPIRAL BANDAGE OF THE CHEST.

Roller Three Inches in Width, Nine Yards in Length.

APPLICATION.—The initial extremity of the roller is applied to the anterior portion of the waist, and fixed by one or two circular turns; the bandage is then carried upward, encircling the chest by ascending spiral turns, each turn covering in one-half of the previous turn until the axillary line is reached; the roller is next carried around the axilla to the back, and obliquely over this to the base of the neck of the opposite side, and then it may be passed down over the chest and pinned to the spiral turns at several points; a pin should also be inserted at the point where the last turn of the roller leaves the spiral turn upon the back of the chest. (Fig. 50.)

Fig. 50.

Spiral bandage of the chest.

Use.—This bandage is employed to hold dressings to the chest, and may be used as a temporary dressing in fractures of the ribs or sternum. Care should be taken that the bandage be not so tightly applied as to interfere with respiration.

Anterior Figure-of-eight Bandage of the Chest.

Roller Two and a Half Inches in Width, Seven Yards in Length.

Application.—The initial extremity of the roller should be placed in the axilla of one side, and fixed by two or three circular turns around the chest; the bandage is then carried through the axilla and passed upward over the shoulder of the same side, and obliquely across the anterior portion of the chest to the axilla of the opposite side, then through this to the shoulder of the same side, and obliquely downward to the opposite axilla. These turns should be repeated, ascending from the shoulder toward the neck, each turn overlapping three-fourths of the preceding one, until five or six turns have been applied, the end of the

Fig. 51.

Anterior figure-of-eight bandage of the chest.

bandage being secured by a pin (Fig. 51), or it may be completed by a circular turn around the chest.

Use.—This bandage may be employed to bring the shoulders forward, and to hold dressings to the anterior portion of the chest.

Posterior Figure-of-eight Bandage of the Chest.

Roller Two and a Half Inches in Width, Seven Yards in Length.

Application.—The initial extremity of the roller should be placed upon the outer portion of the left shoulder, and the bandage is carried obliquely backward and downward to the axilla of the opposite side; it is then passed through this and conducted over the shoulder of the same side and passed obliquely downward to the axilla of the opposite side and carried through this and brought up over the shoulder to fix the initial extremity of the roller. These turns are repeated five or six times, the same precautions being observed in

Fig. 52.

Posterior figure-of-eight bandage of the chest.

covering the turns and in ascending from the shoulder toward the neck (Fig. 52). In applying both of these bandages the crosses of the bandage, either anterior or posterior, should be made in the median line of the chest.

Use.—This bandage may be employed to hold dressings to the posterior portion of the chest and to draw the shoulders backward.

Suspensory and Compressor Bandage of the Breast.

Roller Two and a Half Inches in Width, Seven Yards in Length.

Application.—The initial extremity of the roller should be placed upon the scapula of the affected side, and secured by two oblique turns carried over the opposite shoulder and conducted downward under the mamma to be covered in, and then carried to the axilla of the same side. Next carry the roller transversely around the chest, covering in the lowest portion of the affected mamma. These turns should be repeated, the oblique turns from the axilla over the shoulder

Fig 53.

Suspensory and compressor bandage of the breast.

alternating with the transverse turns around the chest until the breast is covered in, each series of turns ascending, and covering two-thirds of the preceding turn. (Fig. 53.)

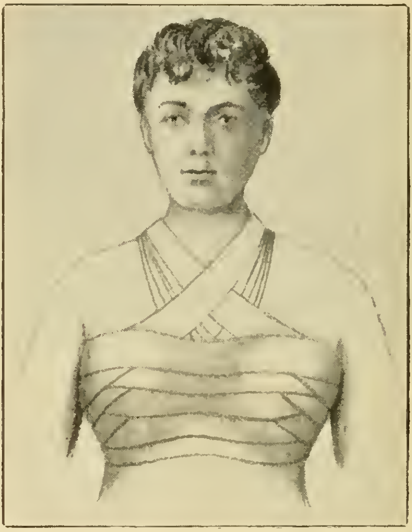
Use.—This bandage is employed to support the breast and to make compression at the same time; it may also be employed to hold dressings to the breast.

Suspensory and Compressor Bandage of Both Breasts.

Two Rollers Two and a Half Inches in Width, Seven Yards in Length.

Application.—The initial extremity of the bandage should be secured by oblique turns of the axilla and shoulder as in the preceding bandage; the bandage should next be carried transversely around the back to the breast, then under the breast and upward over the opposite shoulder, then obliquely downward around the chest to the other side, being carried transversely over the lower portion of both breasts to the point of starting upon the back. Repeat these oblique turns from the shoulder to the axilla and from the axilla to the shoulder, and alternate these turns with a

FIG. 54.



Suspensory and compressor bandage of both breasts.

transverse turn around the chest and over both breasts. Both series of turns should ascend, and each turn should overlap two-thirds of the preceding turn. (Fig. 54.)

Use.—This bandage is employed to support and compress both breasts and to retain dressings to the breasts.

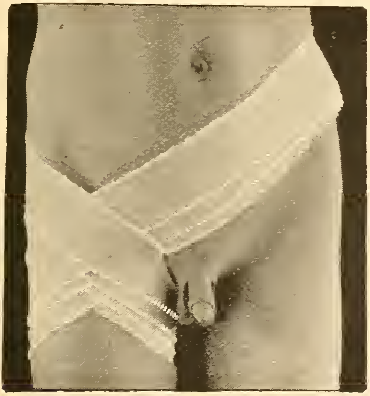
Bandages of the Lower Extremity.

Single Spica Bandage of the Groin (Ascending).

Roller Two and a Half Inches in Width, Seven Yards in Length.

Application.—Place the initial extremity of the bandage upon the anterior portion of the right thigh just below the groin and secure it by one or two circular turns around the thigh, or place the initial extremity of the roller obliquely upon the upper part of the thigh and carry it behind the

Fig. 55.



Ascending spica bandage of the groin.

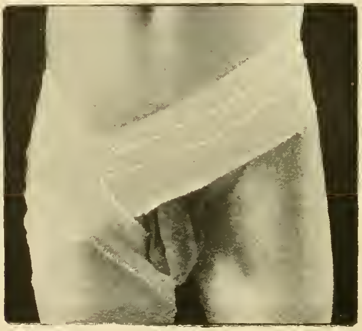
thigh and upward around the outer side of the thigh to the abdomen, omitting the circular turns; then carry the bandage obliquely across the lower part of the abdomen to a point just below the crest of the left ilium and conduct it transversely around the back of the pelvis to a corresponding point on the opposite side; then bring it obliquely downward to the groin over to the inner portion of the thigh, carrying it around the thigh, crossing the starting-turn in the middle line of the thigh. These turns are repeated, each turn ascending and covering in two-thirds of the previous turn, until six or eight complete turns have been made, and the bandage is secured at any point where it ends. (Fig. 55.)

Single Spica Bandage of the Groin (Descending).

Roller Two and a Half Inches in Width, Seven Yards in Length.

Application.—Place the initial extremity of the roller obliquely upon the anterior surface of the right thigh and secure it by one or two circular turns around the thigh, or

Fig. 56.



Descending spica bandage of the groin·

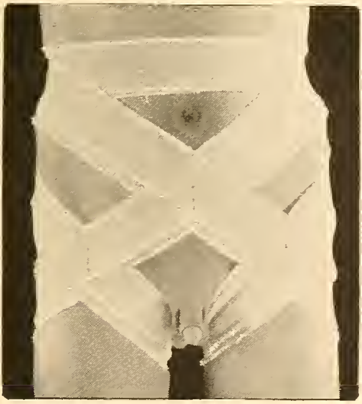
start the bandage with an oblique turn, as previously described; then carry the bandage obliquely across the abdomen to a point just below the crest of the ilium, and conduct it transversely around the back of the pelvis to a corresponding point on the opposite side; then bring it obliquely down over the lower portion of the abdomen, crossing the first turn, to the junction of the thigh with the scrotum, pass it under the thigh and bring it up over the lower part of the abdomen, and let it follow the course of the first turn. These turns are repeated, each turn descending and overlapping two-thirds of the previous turn until the groin is covered (Fig. 56). When either of these bandages is applied to the left groin, after the initial extremity of the roller is fixed, it is carried first to the crest of the ilium of the same side, then around the back of the pelvis to a corresponding point on the opposite side, then obliquely across the lower part of the abdomen to the outer aspect of the thigh, being conveyed under this and brought up between the thigh and the scrotum, passing obliquely over the groin to follow the course of the original turn. The turns may be made either to ascend or descend as the bandage is applied.

Double Spica Bandage of the Groins.

Roller Three Inches in Width, Nine Yards in Length.

Application.—The initial extremity of the roller is placed upon the abdomen just above the iliac crests and

Fig. 57.



Double spica bandage of the groins.

secured by one or two circular turns; the bandage is then carried from a point just below the crest of the right ilium obliquely across the lower portion of the abdomen to the outer portion of the thigh, and is carried around this and brought up between the scrotum and the thigh, and is passed obliquely over the groin, crossing the previous turn in the median line, and is conducted to a point just below the crest of the ilium on the same side. The bandage is then continued around the pelvis to the same point on the opposite side, and from this point is made to pass obliquely over the groin to the inner side of the thigh, passing around this and coming up on its outer side, crossing the previous turn at the middle line of the groin, to be carried obliquely across the groin and lower part of the abdomen to the crest of the ilium on the opposite side. These turns are repeated, each turn covering in two-thirds of the previous turn, until both groins have been covered (Fig. 57). The turns may be so applied as to ascend or descend, forming the ascending or descending double spica bandage of the groin. When properly applied, this bandage presents three sets of crossing turns, one in each groin and one in the median line of the abdomen.

Use.—The spica bandages of the groin, either single or double, are employed to hold dressings to wounds in the inguinal region—for instance, those resulting from herniotomy, or from operation upon the glands of the groin. They are also employed to make pressure upon this region, and will often prove of use in the securing of compresses applied for the temporary retention of herniæ.

Figure-of-eight Bandage of the Knee.

Roller Two and a Half Inches in Width, Five Yards in Length.

Application.—The initial extremity of the roller is placed upon the thigh three inches above the patella and secured by two or three circular turns; then conduct the bandage over the outer condyle of the femur across the popliteal space to the inner border of the tibia and around the anterior surface below the tubercle and head of the fibula and make one circular turn; the roller should then be carried obliquely across the poplitcal space to the inner condyle of the femur, crossing the previous turn; then carry it around the front of the thigh to the outer condyle; repeat these

Fig 58.

Figure-of-eight bandage of the knee.

turns, ascending toward the knee from the leg and descending from the thigh toward the knee, and finish the bandage by a circular turn over the patella (Fig. 58).

Use.—This bandage is employed to hold dressings to the knee-joint either anteriorly or posteriorly. These figure-of-eight turns are often employed in covering the knee in applying the spiral reversed bandage of the lower extremity when it is desired that the patient be allowed to bend the knee.

Figure-of-eight Bandage of Both Knees.

Roller Two and a Half Inches in Width, Seven Yards in Length.

Application.—Place the knees of the patient together with a compress between them; then place the initial extremity of the roller upon one thigh, about three inches above the patella, and secure it by one or two circular turns around both thighs; then conduct the roller from the outer condyle of the femur obliquely across the popliteal spaces of both legs to the head of the fibula on the opposite side,

Fig. 59.

Figure-of-eight bandage of both knees.

making a circular turn around both legs; pass the roller from the head of the fibula on the opposite side across the popliteal space to the external condyle opposite the point of starting.

Repeat these turns, descending from the thighs and ascending from the legs, until the knees are covered, and finish the bandage by carrying a turn of the bandage at right angles to the previous turns between the thighs and the legs. (Fig. 58.)

Use.—This bandage is employed to secure fixation of the limbs after operation upon the perineum, and may also be employed to obtain temporary fixation of the limbs in transporting cases of fracture of the neck of the femur, and after the reduction of dislocations of the head of the femur.

Spica Bandage of the Foot.

Roller Two and a Half Inches in Width, Five Yards in Length.

Application.—Fix the initial extremity of the roller upon the ankle and secure it by two circular turns; then carry the bandage obliquely over the dorsum of the foot to the metatarso-phalangeal articulation and make a circular turn around the foot at this point: then continue it upward over the metatarsus by making two or three spiral reversed turns; next carry the bandage parallel with the inner or outer margin of the sole of the foot, according to whether it is applied to the right or left foot, directly across the posterior surface of the heel; thence along the opposite border

Fig. 60.

Spica bandage of the foot.

of the foot and over the dorsum, crossing the original turn in the median line of the foot. This completes the first spica turn. These spica turns are repeated, gradually ascending by allowing each turn to cover in three-fourths of the preceding turn, until the foot is covered in with the exception of the posterior portion of the sole of the heel. (Fig. 60.) Care should be taken to see that the turns cross each other in the median line of the foot, and that the turns are kept parallel to each other throughout their course.

Use.—This bandage will be found very useful when it is desired to make firm compression upon the foot or to retain dressings to it; it is especially useful in the treatment of sprains of the ankle or anterior tarsus.

Bandage of Foot Covering the Heel (American).

Roller Two and a Half Inches in Width, Seven Yards in Length.

Application.—The initial extremity of the roller is placed upon the leg just above the malleoli and fixed by two circular turns around the leg; the bandage is then carried obliquely across the dorsum of the foot to the metatarso-phalangeal articulation, at which point a circular turn is made; two or three spiral or spiral reversed turns are then made ascending the foot; the roller is next carried directly

Fig. 61.

Bandage of foot covering the heel.

over the point of the heel and continued back to the dorsum of the foot; thence beneath the instep around one side of the heel and up over the instep; from this point it is carried beneath the instep around the other side of the heel and up in front of the ankle, from which point it may be continued up the leg. (Fig. 61.)

Use.—This bandage is employed to cover in the foot and retain dressings to the foot and heel.

Bandage of Foot not Covering the Heel (French).

Roller Two and a Half Inches in Width, Seven Yards in Length.

Application.—Fix the initial extremity of the roller upon the leg just above the malleoli and secure it by two circular turns around the leg; the bandage is then carried obliquely across the dorsum of the foot to the metatarso-phalangeal articulation and at this point a circular turn

Fig. 62.

Bandage of foot not covering the heel.

around the foot is made. The roller is now carried up the foot, covering it in with two or three spiral reversed turns, and at this point a figure-of-eight turn is made around the ankle and instep; this should be repeated once, which will cover in the foot with the exception of the heel; the bandage may then be continued up the leg with spiral reversed turns. (Fig. 62.)

Use.—This bandage may be employed to secure dressings to the foot and is the one generally used to cover the foot in applying the spiral reversed bandage of the lower extremity.

Spiral Reversed Bandage of the Lower Extremity.

Roller Two and a Half Inches in Width, Seven Yards in Length.

Application.—The initial extremity of the roller is placed upon the leg just above the malleoli and secured by two circular turns, then carried obliquely over the foot to the metatarso-phalangeal articulation and here a circular turn is made around the foot; the foot is next covered in with two or three spiral reversed turns and two figure-of-eight turns of the ankle and instep, and just above the ankle one or two circular or spiral turns are made around the leg, and as the bandage is carried up the leg, as it increases in diameter, spiral reversed turns are made until it approaches the knee; at this point, if the limb is to be kept straight, the spiral reversed turns may be continued over this region and

Fig. 63.

Spiral reversed bandage of the lower extremity.

up upon the thigh. If the knee is to be bent, figure-of-eight turns may be applied until the knee is covered, and then the thigh may be covered with spiral reversed turns. (Fig. 63.) To cover in the thigh as well as the leg, two bandages of the dimensions before given will be required.

Care should be taken to keep the reverses in a line and not to make them over the spine of the tibia, as they may thus become painful to the patient.

Use.—This is one of the most frequently employed of the roller bandages; it is used to apply pressure to the lower extremity, to retain dressings, and to secure splints in the treatment of fractures and dislocations.

Figure-of-eight Bandage of the Leg.

Roller Two and a Half Inches in Width, Seven Yards in Length.

Application.—This bandage differs from the spiral reversed bandage of the lower extremity only in the fact that

Fig. 64.

Figure-of-eight bandage of the leg.

when the swell of the calf is reached, figure-of-eight turns are made around the leg instead of spiral reversed turns. In applying the roller, when the calf of the leg is reached, the bandage is carried obliquely around the leg and brought in front of the leg and made to cross the starting-turn in the median line; these turns are repeated until the calf of the leg has been covered in, and the bandage is finished with one or two circular turns just below the knee. (Fig. 64.)

Use.—This bandage holds its place more firmly than the ordinary spiral reversed bandage of the leg, and may be employed in the treatment of ulcers of the leg in conjunction with strapping, where it is desirable to change the dressings at infrequent intervals and to allow the patient to walk about during the course of treatment.

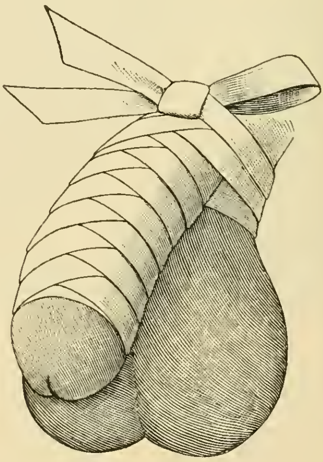
SPECIAL BANDAGES.

Spiral Reversed Bandage of the Penis.

Roller Three-quarters of an Inch in Width, Thirty Inches in Length.

Application.—Fix the initial extremity of the roller by two circular turns around the penis close to the pubis; then

Fig. 65.



Spiral reversed bandage of the penis.

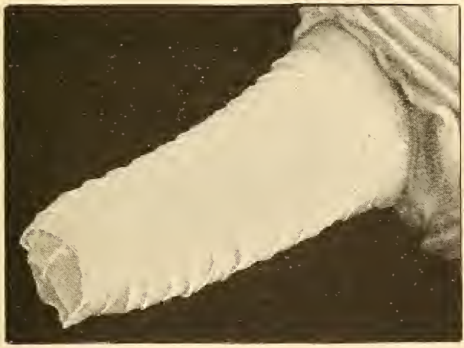
carry the bandage obliquely down to the corona glandis; from this point ascend the body of the penis by spiral reversed turns to the pubis and finish the bandage by two figure-of-eight turns around the neck of the scrotum and root of the penis; split the end of the bandage so as to form two tails and secure it by tying these around the root of the penis. (Fig. 65.)

Recurrent Bandage of Stump.

Roller Two and a Half Inches in Width, Five to Seven Yards in Length.

Application.—Place the initial extremity of the roller upon the anterior or posterior surface of the limb a few inches above the extremity of the stump, and carry the

Fig. 66.



Recurrent bandage of stump.

bandage to the end of the stump, and then conduct it upward or downward on the limb, as the case may be, to a point directly opposite to the point of starting; then bring the bandage back over the face of the stump to the point of starting and continue these recurrent turns, each turn overlapping two-thirds of the previous one, until the face of the stump is covered; then reverse the bandage and secure the recurrent turns at their points of origin by two or three circular turns. The roller should next be carried obliquely down to the end of the stump and a circular turn should be made around this, and the bandage should next be carried up the limb by spiral or spiral reversed turns beyond the point at which the recurrent turns terminated, and secured by one or two circular turns. (Fig. 66.)

In applying this bandage in very short stumps resulting from amputations at or near the shoulder or hip-joints, after making the recurrent and spiral turns, it will be found necessary to carry the bandage, in the case of the shoulder, across the chest to the opposite axilla and back, and apply several of these turns; so in case of the hip amputations it will be found best to finish the bandage with a few turns about the pelvis.

Bandage for Securing the Hands and Feet in the Lithotomy Position.

Roller Two and a Half Inches in Width, Three Yards in Length.

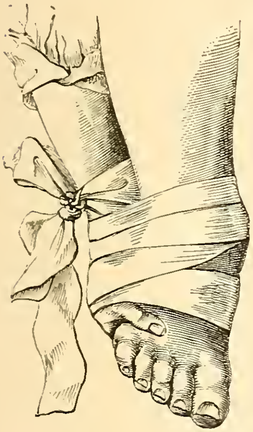
Application.—The hand of the patient should be brought down and made to grasp the outer side of the foot; the initial extremity of the roller is fixed by two circular turns around the wrist and ankle, and the bandage is then passed around the foot and hand, and these turns are alternated with turns around the wrist and ankle, until the hand and foot are firmly secured. The same procedure is adopted with the hand and foot of the opposite side. (Fig. 67.)

Use.—This bandage is useful in securing the hands and feet while the patient is put in the lithotomy position for that operation, or for perineal section.

Liebreich's Eye Bandage.

This bandage consists of a strip of flannel two and a half inches in width and from six to ten inches in length, to the extremities of which are sewed tapes. It may be applied transversely so as to cover both eyes, or obliquely so as to cover one eye only, and is secured by the tapes carried around the head and tied over the forehead. (Fig. 68.)

Fig. 67.



Bandage for securing hands and feet for lithotomy.

Fig. 68.

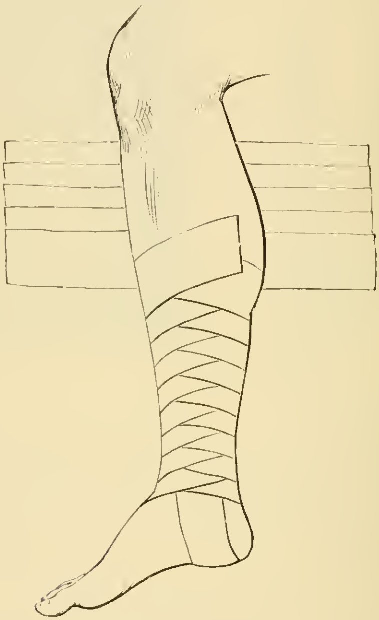
Liebreich's eye bandage.

Use.—This bandage is used to hold compresses or dressings to the eye or eyes, and the elasticity of the flannel permits of its being applied so as to make a variable amount of pressure.

Bandage of Scultetus.

This is a compound bandage, consisting of a number of pieces of muslin, and may be prepared from a two and a half or three-inch roller by cutting off strips long enough to encircle the part about one and one-third times. These strips are placed under the part in such a manner that the first piece shall be overlapped by the second, the second by the third, and so on from below upward; the pieces are then brought around the limb, and the extremities of the last piece are secured by pins. (Fig. 69.) This bandage was formerly much employed in the treatment of compound fractures to secure dressings to the wound, and possessed the advantage that single strips which became soiled could be removed without disturbing the whole dressing, the new strip to be introduced being pinned to the extremity of the

Fig. 69.



Bandage of Scultetus.

soiled piece to be removed, and then being drawn through by its removal. This bandage will often be found convenient in applying dressings to cases of excision of the joints, where as little disturbance of the parts as possible is important in dressing the wounds. When the strips are attached to each other by a thread passed through each strip in the centre, the bandage is known as *Pott's bandage.*

This bandage is applied and secured in the same manner, but it possesses no advantages over the bandage of Scultetus.

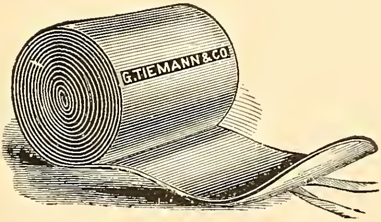
The Rubber Bandage.

This bandage is made from a strip of rubber sheeting, from one inch to four inches in width and from three to five yards in length, which, for convenience of application, is rolled into a cylinder.

Its use was introduced to the profession by Dr. Martin, of Boston, and it will be found a useful form of dressing where it is considered desirable to apply elastic pressure to a part.

It may be employed in the treatment of varicose veins of the legs, in chronic ulcers of those parts where pressure is

Fig. 70.



Martin's rubber bandage.

an important element in the treatment, and may be used as a substitute for strapping to secure this object. Its application has also been recommended in the treatment of swelled testicle in that stage of the affection in which pressure is indicated.

Application.—For application to the leg a rubber bandage two and a half inches in width and three yards in length is required.

The initial extremity of the roller is fixed upon the foot near the toes and secured by a circular turn; the foot is then covered in by spiral turns overlapping each other about two-thirds, and a figure-of-eight turn is made from the ankle to the instep, and the bandage is then carried up the limb to the knee with spiral turns, where it is secured by two tapes sewed to the terminal extremity of the bandage, which are passed around the leg and tied. The bandage need not be reversed, as its elasticity allows it to conform to the shape of the limb. Care should be taken not to apply these turns with too much firmness; the bandage should be stretched very slightly; if this precaution is not taken, it soon becomes uncomfortable to the patient. A patient using one of these bandages will soon learn to apply it himself, making just the requisite amount of tension to secure its holding its place and to insure a comfortable amount of pressure upon the part. A well-fitting stocking may be placed upon the limb before the bandage is applied, or it may be applied directly to the skin.

The bandage should be removed at night when the patient goes to bed and hung up to dry, as its inner surface becomes moist from the secretions from the skin; it should be reapplied as soon as the patient rises in the morning.

In using it in the treatment of ulcers of the leg no ointments should be applied to the ulcer, as oily dressings soon destroy the rubber; dressings may be made to the ulcer by means of dry powders, such as oxide of zinc, iodoform, or aristol, before the bandage is applied.

In the treatment of swelled testicle the bandage is applied to the testicle by means of recurrent turns not too firmly made, and secured in place by spiral turns, until the whole surface of the organ is covered in; the end of the bandage is secured with tapes tied around the root of the scrotum. The same precaution to apply the bandage so as to make only moderate pressure should here also be observed.

Fixed Dressings or Hardening Bandages.

For the application of these dressings a variety of substances are used which are incorporated in the meshes of some fabric, such as crinoline or cheese-cloth, or painted over its surface to give fixity or solidity to the bandage.

The materials most commonly used in the preparation of fixed dressings are plaster-of-Paris, starch, silicate of sodium or potassium, paraffine, or a mixture of chalk and gum or of oxide of zinc and glue.

The Plaster-of-Paris Bandage.

The plaster-of-Paris used for the application of surgical dressings should be of the same quality as that which the dental surgeons employ in taking casts for teeth—that is, the extra-calcined variety. If moist or of inferior quality, it will not set rapidly or firmly, and will fail to give sufficient fixation to the dressing.

The plaster-of-Paris dressing may be applied in several ways, either by covering the part to be enclosed with some loose fabric, and rubbing the moist plaster into it, alternating the layers of the fabric with layers of moist plaster, or it may be applied by means of a roller which has been prepared with plaster-of-Paris and is moistened and applied to the part.

To apply a plaster-of-Paris dressing according to the first method, the part to be enclosed—the leg, for instance—should first be covered by a neatly applied flannel bandage or a muslin bandage, which has been shrunken by being washed; new muslin is not satisfactory as a primary application to a limb in applying a plaster-of-Paris dressing, as the moisture from the plaster wets it and causes it to shrink, so that it may exert injurious pressure after the bandage becomes dry.

The limb having been covered by the bandage, and any bony prominences such as the malleoli having been padded with small wads of cotton to prevent undue pressure upon them, the part is next covered by a layer of turns of a crinoline bandage or by strips of cheese-cloth or any other loose material. A small quantity of plaster-of-Paris is next mixed with water until it has the consistence of thick cream, when it is smeared evenly over the whole surface of the previously applied bandage. Another layer of the bandage or of strips is next applied, and the plaster is smeared over this in the same manner, and so alternate layers of plaster-of-Paris and bandage are applied until a casing of the desired thickness is obtained. If the plaster-of-Paris of the quality previously described be used, it will set or become hard in a few minutes.

The most convenient method of applying the plaster-of-Paris dressing is that employed by Prof. Sayre, which consists in the use of bandages which have been previously prepared with plaster-of-Paris; these are moistened and applied while moist to the part to be encased.

Preparation of the Plaster-of-Paris Bandage.

These bandages are prepared by taking cheese-cloth, mosquito-netting, or crinoline, which latter is by far the best fabric, and cutting or tearing it into strips two and a half to three inches in width and five yards in length. These are laid on a table, and plaster-of-Paris of the quality before mentioned is dusted over them and rubbed into the meshes of the fabric; the material when impregnated with plaster is loosely rolled into a cylinder, and these bandages when prepared should be placed in air-tight jars or tin cans until required.

Bandages thus prepared, which have been exposed to the air or have been kept for a long time, are not apt to set well when applied; but if such bandages are placed in a hot oven and baked for half an hour before being used, they will be found to set as satisfactorily as those freshly prepared.

These bandages may be prepared by a machine made for this purpose, but I do not think that they are apt to have the plaster as evenly distributed through them, and therefore are not as satisfactory, as those prepared by hand.

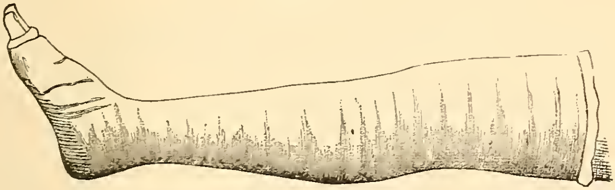
Application of the Plaster-of-Paris Bandage.

Before applying this dressing, the part to be encased—the leg, for instance—should be covered by a flannel roller, the bony prominences being protected by pads of cotton, or a closely fitting stocking may be applied to the part.

The bandage should be dipped in warm water and kept covered by water for a few moments; it may be squeezed with the hand, and as soon as bubbles of air cease to escape it is a sign that it is thoroughly soaked and is ready for application.

On removing it from the water the excess of water should be squeezed out by the hand and the bandage should then be evenly applied to the limb with just enough firmness to make it fit the part nicely, and as few reverses as possible should be made. A sufficient number of bandages are applied to make a dressing as firm as may be required; three rollers of the above dimensions are usually quite ample for a dressing for the leg, and when the last roller has been applied some dry plaster should be moistened with water until it has the consistence of thick cream, and it should be rubbed evenly over the surface of the bandage to give it a finish (Fig. 71). If a good quality of plaster has

Fig. 71.



Leg encased in plaster-of-Paris dressing.

been used, the bandage should be quite firm in from ten to fifteen minutes, but the patient should not for a few hours be allowed to put any weight upon the bandage.

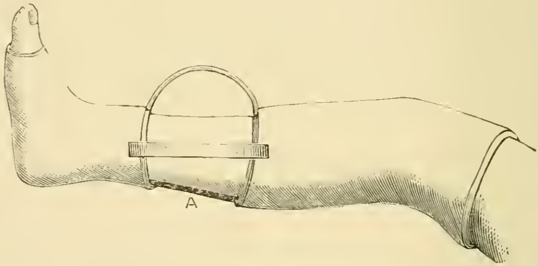
An equally firm bandage may be applied with the use of a less number of bandages, if the surgeon rubs over the surface of each layer of bandage applied a little moist plaster, then applying another layer and repeating the same procedure; finishing the dressing by an external coating of moist plaster, as above described.

In applying these dressings a fewer number of bandages will be required if narrow strips of tin, zinc, or binder's board are incorporated in the layers of the bandage, which also increase the strength of the dressing.

Interrupted Plaster-of-Paris Dressing.

This form of plaster-of-Paris dressing is applied by first placing a short iron rod under the extremity some distance above and below the point at which the dressing is to be interrupted; this is fixed by a few turns of the plaster bandage above and below the portion of the limb which is to be left exposed; stout wire is next bent into loops, the

Fig. 72



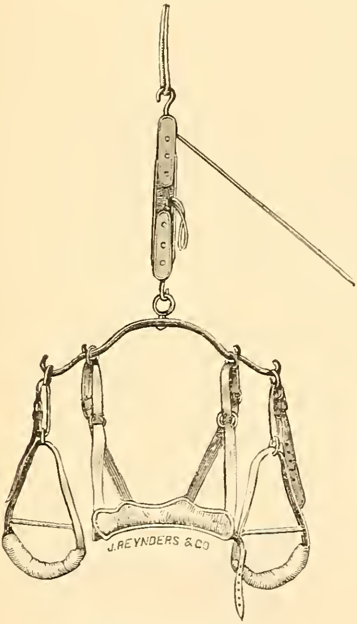
Interrupted plaster-of-Paris dressing.

extremities of which are incorporated in the subsequent turns of the plaster bandage; three loops thus placed in addition to the posterior iron bar will usually make the dressing sufficiently firm (Fig. 72). A number of turns of the bandage are applied to firmly fix the loops, and the limb is held in the desired position until the plaster has set.

Application of the Plaster-of-Paris Jacket.

The patient's body should be covered with a soft, closely fitting woven shirt without arms, but with shoulder-straps to hold it in position, or an ordinary woven undershirt may be employed; one or two folded towels, or a pad of cotton folded in a towel, are next placed over the abdomen between the shirt and the skin—this is called, by Prof. Sayre, the dinner pad, and is intended to leave space for the distention of the abdomen after eating. Small pads of raw cotton may

FIG. 73.

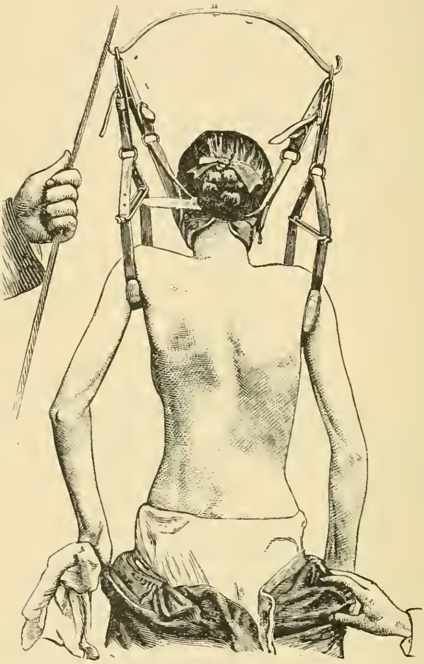


Suspensory apparatus.

also be placed over the anterior iliac spines, and, in the case of females, a pad of cotton wrapped in a handkerchief may be placed over each mammary gland.

The patient should next be suspended by the apparatus consisting of a collar and arm-pieces attached to a cross-bar (Fig. 73), which is attached by a cord and pulley to a tripod. If this apparatus is not at hand, a very satisfactory substitute may be made by folding two towels into cravats and tying together the ends, so as to make two loops, one of which is placed in each axilla; a bar of wood two and a half feet in length is next taken and the loops are secured to the ends of this by stout cords or handkerchiefs; a Barton's bandage

Fig. 74.



Patient suspended for application of plaster jacket.

is next applied to the head, and a strip of bandage is passed under the turns which cross the vertex and is secured to the middle of the cross-bar. The bar is next suspended by a cord passed through a pulley or ring which may be attached to the sill of a door if the ordinary tripod is not to be obtained.

The patient should be slowly raised by the apparatus until the toes only are in contact with the floor, and the extension should not be carried to the point which makes it uncomfortable to the patient. (Fig. 74.) The shirt should be drawn downward over the hips by an assistant and held in place until a few turns of the bandage have been applied.

The plaster bandage having been soaked and squeezed, a turn should be made around the body above the pelvis, and it should then be carried downward below the iliac spines, and from this point should be made to ascend gradually by spiral turns until it reaches the axillary line. The turns should be applied smoothly and not too tightly. After one or two layers of turns have been applied, the surgeon may rub some moist plaster upon their surface if he desires to use fewer bandages. These turns are repeated until a bandage of the desired thickness is applied, and the surface of the dressing may be finished by rubbing it over with moistened plaster. This jacket for a child will generally require the use of four bandages of the dimensions given; for an adult, six to eight bandages.

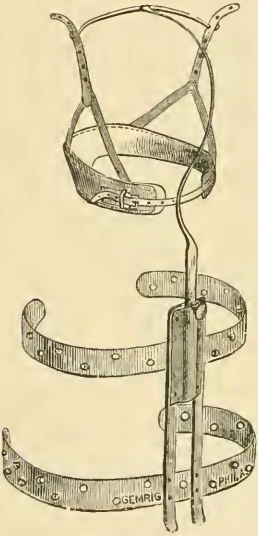
The patient should be kept suspended until the bandage has set, usually from ten to fifteen minutes, and then should be carefully lifted so as not to bend the spine, and placed upon his back upon a mattress, until the dressing becomes perfectly hardened. The dinner pad, and mammary pads, if they have been used, should next be removed. In applying this dressing, strips of zinc or tin may be placed between the layers of bandage if it is desired to give more strength to the dressing.

Application of the Jury-mast by Means of Plaster-of-Paris.

In disease of the spine involving the cervical or upper dorsal region the ordinary plaster-of-Paris jacket is not satisfactory, and in such cases the "jury-mast" is employed in connection with the plaster jacket. In applying the "jury-mast" the same steps are taken in the preparation of the patient as in applying the plaster-of-Paris jacket, with the exception of extension, which need not be used.

After three or four layers of the plaster bandage have been applied to the body, an apparatus made of two bars of metal having two perforated strips of zinc attached to them a few inches apart, which partly encircle the body, is applied and held in position by turns of the plaster bandage. The perpendicular bars have at their upper part a slot, into which the lower end (Fig. 75) of the "jury-mast" fits, and is secured by a screw; to the upper part of this is attached a movable cross-bar, to which are fastened the straps of the collar from which the head is suspended.

Fig. 75.



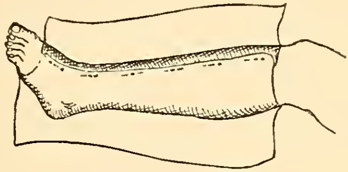
Head-support and jury-mast.

The Bavarian Dressing.

To apply this dressing, which is sometimes employed in the treatment of fractures, take two pieces of Canton flannel the length of the part to be enclosed, and more than wide enough to envelope its circumference. In applying it to the leg these pieces should be cut so as to correspond to the outline of the leg and posterior portion of the foot.

These pieces should be placed one over the other and sewed together in the middle line, the seam corresponding to the back of the leg. The leg and foot are then placed upon this, and the inner layer of flannel is brought up in front of the leg and over the dorsum of the foot and made fast with pins. (Fig. 76.) Plaster-of-Paris is next mixed with water and made into a paste, which is rubbed thickly and evenly over the flannel next to the limb until a sufficient thickness is obtained; the outer layer of flannel is then brought up about the leg and moulded to its surface by the hands. A loosely applied roller may now be used to hold the dressing in place until the plaster has set.

FIG. 76.



Bavarian dressing.

When it is necessary to inspect the parts, the turns of the roller are cut, and upon separating the layers of flannel the two halves can be turned aside, the seam at the back acting as a hinge. Upon reapplying the splints to the leg they may be retained in position by a roller or by one or two strips of bandage.

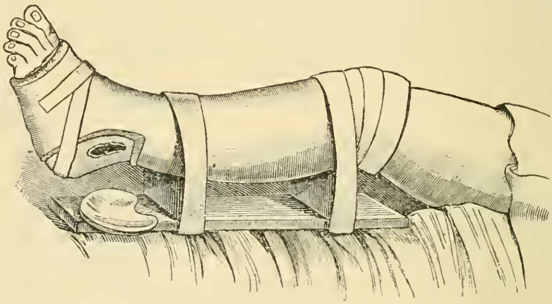
MOULDED PLASTER SPLINTS.

It is sometimes found difficult to apply the ordinary plaster dressings to parts irregular in their shape, and at the same time to have a splint which can be removed with ease. To accomplish this purpose moulded splints of plaster may be made by cutting a paper pattern of the part to be covered in, and then cutting pieces of crinoline to conform to this pattern; eight or ten pieces will usually form a splint of sufficient thickness. One of these pieces of crinoline is laid upon a table and dry plaster is rubbed into its meshes; another is laid upon this and plaster is applied to it in the same way, and so on until all the pieces have been placed in position, one over the other, with plaster rubbed well into the meshes. The dressing is then folded up and dipped into water, squeezed out, and moulded to the part and held in position, until it sets, by the turns of a bandage. The edges should overlap slightly, and in applying it a strip of waxed paper may be placed under the overlapping edge to prevent its adhesion to the dressing below, and thus facilitate its removal. Splints prepared in this way can be removed with ease, and are often of service in cases where it is desirable to inspect the parts frequently; I have employed with advantage such splints in making fixation of the hip-joint in cases of coxalgia, and also for the same purpose in affections of other joints. The splints upon being reapplied are secured by a few strips of bandage, or by a roller bandage.

Trapping Plaster Bandages.

In applying the plaster-of-Paris dressing to a part where there is a wound which is covered by the plaster bandage, it is well to make some provision whereby the plaster dressing over the site of the wound may be cut away, making a trap or window through which the wound may be inspected or dressed, if necessary. (Fig. 77.) To accomplish this, before applying the plaster bandage, a compress of lint or gauze should be placed over the wound, which, when the dressing is completed, forms a projection on its surface, indicating the position of the wound, and also allows the surgeon to cut away the dressing without injuring the skin below. These traps may be cut out after the bandage has partially set, or after it has become hard. In applying the plaster-of-Paris dressing in cases of compound fracture and

Fig. 77.



Plaster-of-Paris bandage trapped. (Esmarch.)

after osteotomy, I always make provision for trapping of the bandage if it should become necessary, although in the vast majority of cases it does not have to be done.

Removing Plaster-of-Paris from the Hands.

One objection to the use of plaster-of-Paris dressings is the difficulty of removing it from the hands of the surgeon, and the harsh condition in which the skin of the hands is left after its removal. If, however, the hands are washed in a solution of carbonate of sodium—a tablespoonful to a basin of water—the plaster will be readily removed and the skin will be left in a soft and comfortable condition.

Removing the Plaster-of-Paris Bandage.

The removal of the plaster bandage is sometimes a matter of difficulty, particularly if it has to be removed before the parts below it are consolidated, as it may disarrange them and cause the patient pain if it is not accomplished without much force.

When the bandage is applied to get a cast of the part, a strip of sheet-lead one inch in width is first placed over the flannel bandage, and is allowed to project at each end beyond the dressing; the plaster can then be readily cut through upon this strip with a knife without injury to the parts below.

It may also be removed by means of a saw devised for this purpose (Fig. 78), or by strong cutting shears of various

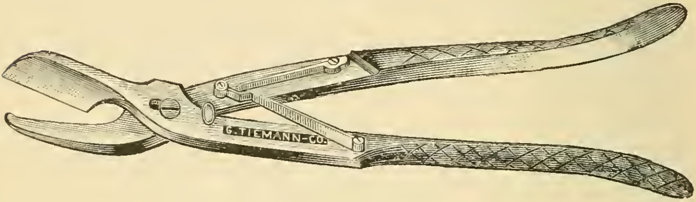
Fig. 78.

Hunter's saw for removing plaster bandages.

kinds (Fig. 79); or a line may be painted over the dressing with hydrochloric acid or vinegar, which softens the plaster so that it can readily be cut through with a knife. Dr. William

B. Hopkins has devised a vertebrated metal chain which is applied to the part before the plaster is applied and removed when the bandage has set, leaving a hollow longitudinal

FIG. 79.



Shears for cutting plaster bandages.

ridge which can be cut through or divided with a rasp. The saw is, I think, the most satisfactory means of removing these dressings; the only caution to be exercised is to use it carefully, as the final layers of the bandage are divided, to avoid wounding the skin.

USES OF PLASTER-OF-PARIS DRESSINGS.

These dressings are employed to secure fixation, as primary or secondary dressings in the treatment of fractures, and for a like purpose in injuries and diseases of the joints. They are also largely used in the treatment of diseases and deformities of the spinal column, and will also be found most satisfactory applications after osteotomy and tenotomy, to secure immobility and hold the parts in their corrected positions; when employed in dressing cases after tenotomy, they are generally used for a few weeks until the proper mechanical apparatus is applied.

THE STARCHED BANDAGE.

To apply this bandage starch is first mixed with cold water until a thick creamy mixture results; to this is added boiling water until a clear mucilaginous liquid is produced; if too thin it can be made thicker by heating it upon a stove. The part to be dressed is first covered with a flannel roller, and over this a few layers of a cheese-cloth or crinoline bandage, which has been shrunken, are applied; the starch is then smeared or rubbed with the hand evenly into the meshes of the material, and the part is again covered with a layer of turns of the bandage, and the starch is again applied; this manipulation is continued until a dressing of the desired thickness is produced. Strips of pasteboard may be applied between the layers of the bandage to give additional strength to the dressing, if desired.

It requires from twenty-four to thirty-six hours for the starched bandage to become dry and thoroughly set, and it may be removed in the same way in which the plaster-of-Paris dressing is removed.

Use.—Before the introduction of the plaster-of-Paris dressing it was formerly much employed in the treatment of fractures and in injuries of the joints. It may be used in such cases, but possesses no advantage over the former dressing and has the disadvantage of setting much less promptly.

Gum and Chalk Bandage.

In applying this dressing equal parts of powdered gum arabic and precipitated chalk are mixed with boiling water until a mass of the consistence of cream results. This is applied to the cheese cloth or crinoline bandage in the same manner as is the starch in the application of the starched bandage; it has the advantage over the latter dressing of setting more promptly, five or six hours only being required for it to become hard. It may be employed for the same purposes as the starched or plaster-of-Paris bandage.

Silicate of Potassium or Sodium Bandage.

In applying this bandage after a flannel roller and several layers of a cheese-cloth or crinoline bandage have been applied to the part, the surface of the latter is coated with silicate of sodium or potassium applied by means of a brush, then a second layer of bandage is applied and treated in the same manner, and this manipulation is continued until a bandage of the desired thickness is produced. It requires twenty-four hours for this dressing to become firm. In removing the silicate bandage it may be first softened by soaking it in warm water and then it can be readily cut with scissors.

In applying either the starched bandage or the silicate of potassium bandage care should be taken to use cheese-cloth or crinoline which has been shrunken by being moistened and allowed to dry before being employed; otherwise dangerous compression of the part may occur if the bandage has been firmly applied and shrinks after its application.

The Paraffine Bandage.

Paraffine, which melts at from 105° to 120° F., is used in the application of this bandage. The limb being covered by a flannel roller, a vessel containing paraffine is placed in a basin of boiling water. As the roller, which may be either of flannel, cheese-cloth, or crinoline, is unwound it is passed through the melted paraffine and applied to the part, and the turns are repeated until a dressing of sufficient thickness results, and the surface may be brushed over with melted paraffine. This dressing sets very rapidly, being quite firm in from five to ten minutes.

It possesses the advantage of the other fixed dressings in that it does not absorb discharges and become offensive, and for this reason it was formerly recommended in the treatment of compound fractures.

Glue or Glue and Oxide of Zinc Bandage.

Glue or glue combined with oxide of zinc has been employed in the preparation of fixed dressings, but possesses no advantages over those previously mentioned.

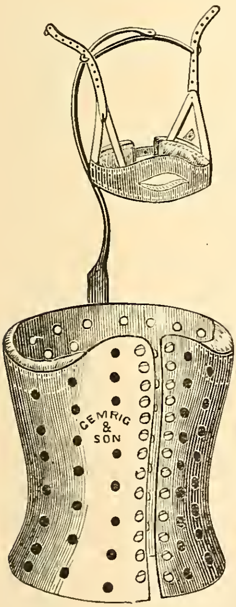
Raw-hide or Leather Splints or Dressings.

In moulding raw-hide or leather splints it is necessary, first, to apply a plaster-of-Paris bandage to the part to which the raw-hide splint is to be fitted; as soon as the plaster has set it is removed, and a solid plaster cast is next made by pouring liquid plaster-of-Paris into this mould. When this has become dry a piece of raw-hide, which has been soaked for a time in warm water, is moulded to the cast and held firmly in contact with it by a bandage until it has become perfectly dry. It is then removed, and its surface is covered with several coats of shellac, to prevent its absorbing moisture from the skin when applied, and changing its shape. Eyelets or hooks are fastened to the edges of the splint, through which strings are passed to secure the splint in place.

Made in this manner raw-hide splints fit the part very accurately, and constitute a very satisfactory dressing for cases of joint-disease, and in the form of leather jackets are often employed in the treatment of disease of the spine in place of the plaster-of-Paris jacket. (Fig. 80.)

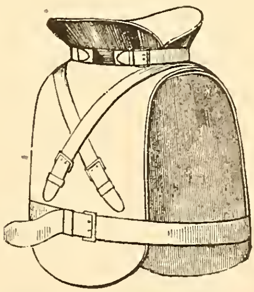
In the treatment of high dorsal

Fig. 80.



Leather jacket with jury-mast.

Fig. 81.



Leather splint for cervical caries (Owen.)

or cervical caries a leather splint in two sections, which rests upon the shoulders and supports the head, is often used with good results. (Fig. 81.)

Binder's Board or Pasteboard Splints.

This material, which can be obtained in sheets of different thickness, is frequently employed for the manufacture of splints. In moulding these splints a portion of the board of the requisite size and thickness is dipped in boiling water for a short time, and when it has become softened it is removed and allowed to cool; a thick layer of cotton batting is next applied over it, and it is then moulded to the part and held firmly in place by the turns of a roller bandage; in a few hours it becomes dry and hard.

This material, from its cheapness and the ease with which it is obtained, is frequently employed to mould splints for the treatment of fractures, especially in children, and for the fixation of joints in the treatment of acute and chronic joint affections. A moulded pasteboard splint is also often employed to fix the ends of the bones after the excision of a joint.

Porous Felt Splints.

This material is also employed for the manufacture of splints, and is applied by dipping the material in hot water and then moulding it to the part; as it dries it becomes hard.

Hatter's Felt Splints.

Hatter's felt is also frequently employed for the manufacture of splints or dressings. It is softened by dipping it in boiling water or heating it in the flame of an alcohol lamp, and when soft and pliable it is moulded to the part, and as it cools it again becomes hard.

These splints are employed for the same purposes as those made of plaster-of-Paris, leather, or pasteboard.

PART II.

MINOR SURGERY.

Theory of Asepsis and Antisepsis in Wound Treatment.

The term *Asepsis*, applied to wounds, implies that there is in the wound an absence of those vegetable parasites or microörganisms whose presence sets up fermentative changes, accompanied by suppuration and constitutional disturbance.

Antisepsis, on the other hand, has reference to the means employed to bring about the destruction of microörganisms which may be present in the wound or upon the instruments, dressings, or hands of the surgeon, and which, if not destroyed or rendered inert, will set up fermentative changes in the wound.

It has long been a well-recognized fact that albuminoid substances, such as dead animal tissue, blood, or blood-serum, will, when exposed to moisture, warmth, and the presence of certain living organisms or fungi, bacteria and micrococci, develop putrefactive changes; and if these changes take place in the living body there result certain constitutional disturbances known as symptomatic, inflammatory, or septic fever.

It was also recognized that these putrefactive changes in albuminoid substances could be avoided by their exposure to heat, cold, or by drying—any of these conditions being sufficient to destroy or arrest the development of the micrococci. The microörganisms which set up fermentative and putrefactive changes in animal tissues exist in great variety, but those which are of most interest to the surgeon belong to the *cocci* and *bacilli.*

Rosenbach's investigations have shown that the most common cause of suppuration in living human tissue is a minute globular micrococcus, to which the name *staphylococcus pyogenes aureus* has been given. This coccus is found in almost all varieties of acute suppuration.

Another form of coccus which may exist alone or in connection with the previously mentioned fungus is the *staphylococcus pyogenes albus.* Both of these varieties of cocci, from the agminated arrangement of the single coccus, are known as grape cocci, and have the peculiarity of causing well-localized foci of inflammation.

The *streptococcus pyogenes*, a pus-generating chain coccus, which extends rapidly along the lymph spaces and lymphatics, and by rapid infiltration of the tissues causes spreading gangrene, is also of especial interest to the surgeon.

Decomposition in tissues, accompanied by the presence of foul odors, is said always to be due to the action of rod-like bodies called bacilli or bacteria, such as the *bacillus pyogenes fœtidus* and *bacillus pyocyaneus.*

In wounds the result of accident or made by the surgeon, we have present conditions most favorable for the entrance and development of these organisms, such as the serum and blood, and the dead or partially devitalized cells of the various tissues which are exposed. We have present also warmth and moisture, and in the air coming in contact with the wound we have vast quantities of dust laden with spores, which under these favoring conditions develop into the organisms before mentioned, which rapidly set up fermentative processes known as decomposition.

The products of this decomposition, carried into the circulation by the lymphatics and veins, set up local changes in the shape of inflammation and at the same time give rise to systemic disturbances which we recognize as septic fever.

Modern wound treatment aims at the prevention of decomposition and suppuration, and accomplishes this purpose by having the wound kept aseptic, by perfect cleanliness of the region of the wound, the hands and instruments of the surgeon, and by not exposing the wound to an atmosphere which contains dust; as the latter condition is difficult to obtain we secure the destruction of the microörganisms which may be present by heat, as seen in the use of the actual cautery, and by chemical sterilization, which is accomplished by the use of germicides.

Methods and Dressings Employed in Wounds to Secure Asepsis.

To prevent infection of wounds the various chemical sterilizers and dressings are employed in different ways, and the principal types of dressings are as follows:

Method by Simple Drying.

This method is employed in small and not very deep wounds. The edges having been brought together by sutures the surface of the wound is dusted with powdered iodoform, the serum and blood forming with this, as it dries, a scab, which protects the wound from infection from without, and repair takes place promptly under this scab. Iodoform collodion may be employed instead of powdered iodoform in this method of dressing.

Method by Drying and Chemical Sterilization.

The object of this method of dressing is to provide a means of sterilizing the blood or serum which escapes from the wound, and at the same time to insure the sterilization of the air coming in contact with the discharges or the wound.

It is employed in large or deep wounds, where there is always more or less escape of blood or serum, and is accom plished by applying a number of layers of sublimate or iodoform gauze and sublimated cotton over the wound. Evaporation not being interfered with, the whole dressing becomes hardened, and the wound is surrounded by a large antiseptic crust made up of the dressing and serum or blood.

This method of dressing is the one most generally employed at the present time.

Moist Dressings.

In this method of dressing, the wound is covered by moist gauze dressings and these are kept moist and evaporation is prevented by applying over them some impervious material such as mackintosh or rubber tissue.

Modified Moist Dressing.

In this method of dressing, the wound itself is covered by a piece of protective or rubber tissue; over this is placed the sublimated or iodoform gauze dressing and some layers of bichloride cotton. By this method of dressing, the wound itself is kept in a moist condition favoring particularly the organization of blood clots: the external dressings become dry as the discharges which have escaped into them evaporate, forming an antiseptic crust or covering over the wound.

Surgical Cleanliness.

In the practice of aseptic surgery it is a matter of the first importance that anything coming in contact with a wound should be absolutely clean, such as the hands of the operator, instruments, sponges, towels, ligatures, sutures and dressings.

Antiseptic Substances Employed.

A great variety of substances possessing more or less germicidal properties have been at different times employed in the practice of aseptic or antiseptic surgery; those most employed at the present time are bichloride of mercury, carbolic acid, iodoform, beta-naphthol, chloride of zinc, peroxide of hydrogen, creolin, permanganate of potassium, pyoktanin and boric acid, the double cyanide of mercury and zinc, and aristol.

Bichloride of Mercury.

This is employed as an antiseptic in watery solution, varying in strength from 1 : 500 to 1 : 5000.

The solution 1 : 500 to 1 : 1000 is used only for the irrigation and disinfection of the hands and skin; for the irrigation of wounds, a solution of 1 : 2000 is generally employed. In using the bichloride solution in operations upon children, I am in the habit of using a solution of 1 in 4000, and I find that it produces less irritation of the skin and is equally efficient as a germicide. Where continuous irrigation is kept up or where it is employed in large cavities, a still weaker solution, 1 : 5000 to 1 : 10,000, should be employed.

In using these solutions the surgeon should watch the patient carefully for symptoms of poisoning due to the absorption of the bichloride of mercury; the symptoms denoting this are vomiting, fetid breath, salivation, inflammation of the gums, diarrhœa, blood-stained stools, and bleeding from the mouth and nose.

In preparing the solutions of bichloride of mercury for use, it will be found convenient to have a concentrated solution of the salt in alcohol, one part of the bichloride of mercury to ten parts of alcohol; this can be kept in a well-stoppered bottle, and to this should be added one teaspoonful of common salt, which prevents the disintegration of the mercuric compound. One teaspoonful of this solution added to one quart of water makes a 1:1500 solution.

A 10 per cent. bichloride solution may be made as follows:

Bichloride of mercury	2 parts.
Sodium chloride	1 part.
Dilute acetic acid	1 "
Water	16 parts.

By adding water in an appropriate quantity, 1 : 1000 or 1 : 2000 solution can be made.

Or the solution may be prepared with tartaric acid in the proportion of five parts of the acid to one part of the bichloride of mercury, the following formula being employed:

Hydrarg. chlor. corrosiv.	grs. xv.
Ac. tartaric.	grs. lxxv.
Aquæ dest.	Oij.

Pellets containing a definite amount of bichloride of mercury compounded with a few grains of common salt or muriate of ammonia, which, when dissolved in a definite quantity of water, make a solution of 1 : 1000 or 1 : 2000, will also be found very convenient for the preparation of solutions.

These bichloride or sublimate solutions are also employed to sterilize the gauze and cotton which are largely employed in antiseptic dressings.

Carbolic Acid.

This drug is employed in solutions of 1 : 20 or 1 : 40. The stronger solution, 1 ; 20, is usually employed to sterilize the instruments, the latter being allowed to remain in this solution for thirty minutes before being used. As a carbolic solution of this strength benumbs and cracks the hands of the operator, it should be diluted just before the instruments are required, by adding an equal quantity of water, making it a 1 : 40 solution.

The 1 : 40 solution is used for the irrigation of wounds and the washing of sponges. Carbolic acid is also employed in the preparation of gauze. A ready method of making a 5 per cent. carbolic solution is to add one tablespoonful of carbolic acid to one quart of water.

In using carbolic acid solutions the surgeon should be on the watch for the symptoms of poisoning, which will show itself by dark-colored urine, headache, dizziness, vomiting, and in severe cases bloody diarrhœa, hæmoglobinuria, and death from collapse. Carbolic acid solutions should be used with great caution in young children, as they seem to be more susceptible than adults to the constitutional effects of this drug. I have seen the use of quite dilute solutions produce the characteristic symptoms of poisoning in such patients.

Iodoform.

Iodoform has been shown by experimental research to possess little germicidal action, but in spite of this fact clinical experience has proved that it possesses powerful antiseptic properties, due not to the destruction of germs, but to its undergoing a decomposition in their presence, and thus rendering the ptomaines which have resulted from the germ-growth inert. Iodoform may be rendered absolutely sterile by washing it in a 1 : 1000 bichloride solution, which destroys all microörganisms; it should then be dried, and kept for use in closely stoppered bottles.

Iodoform is very extensively employed as an application to wounds; it is especially useful as a dressing to infected wounds, and to tubercular or syphilitic ulcers. It is also employed in the preparation of iodoform gauze, and may be combined with collodion to form *iodoform collodion*, which is a useful dressing in superficial wounds:

Iodoform	grs. xlviij.
Collodion	℥j.

An ethereal solution of iodoform (iodoform grs. xv, ether ʒj) is also used as an application to chronic ulcers.

An *emulsion of iodoform* in glycerin (iodoform ʒj, glycerin ʒx) is much employed at the present time as an injection in the treatment of chronic or tubercular abscesses.

Elderly persons are more prone to the toxic action of iodoform than young persons. These symptoms are manifested by sleeplessness, debility, headache, delirium, and death may result from meningitis or cardiac depression.

Beta-naphthol.

Beta-naphthol, in a 1 : 2500 solution, is employed for much the same purposes as the bichloride of mercury solution; it is not, however, so powerful a germicide. It is employed in irrigating large cavities because it is not a poisonous agent, but is especially useful as a bath for instruments, as it does not corrode them, as does the sublimate solution. It also possesses the advantage over a carbolic acid solution of not irritating the skin of the surgeon's hands.

Chloride of Zinc.

Chloride of zinc, in a solution of 30 to 40 grains to water f℥j, is a very powerful antiseptic. When employed upon raw surfaces it produces marked blanching of the tissues; it is especially useful in wounds which are infected or which have been exposed to infection. I have found it by all means the best application to the poisoned wounds which are received in dissecting dead bodies and in operating. In such cases the whole cavity or surface of the wound should be washed with a 30-grain solution of the chloride of zinc, and then the wound should be dressed with a bichloride dressing.

Sulpho-carbolate of Zinc.

This drug has been found to possess more decided antiseptic properties than the chloride of zinc, and is much less irritating. It may be used in the same strength and for the same purposes as the former drug.

Peroxide of Hydrogen.

This drug is employed in what is known as a 15-volume solution, which may be diluted from 10 per cent. upward or used in full strength. It is employed in the sterilization of sinuses or suppurating cavities, such, for instance, as often result from diseases of or operations upon bone. It seems to have a direct action upon pus generation by destroying the microörganisms of pus. It is injected into sinuses and cavities by means of a syringe, or may be applied to open wounds in the form of a spray; its action is shown by the escape of bubbles of air, and it should be used as long as these continue to escape.

Kreolin or Creolin.

This substance is obtained from English coal by dry distillation, and has been found to possess powerful germicidal properties; it is non-irritating and practically non-toxic. It is insoluble in water, but forms an emulsion with it which possesses marked germicidal properties. It is employed for the same purposes as carbolic acid, and has the advantage over the latter drug that it is not irritating to the skin, and is almost devoid of toxic properties.

It is used in an emulsion, in strength from two to five per cent., and is employed in the irrigation of large wounds or cavities of the body, and has been most favorably recommended in gynecological practice. As a bath for instruments to render them sterile during operations it is useful, but the opacity of the emulsion makes it difficult to find the instruments and interferes with its efficiency.

Boric Acid.

This drug has not very marked antiseptic qualities, but is unirritating even in saturated solutions. It is frequently employed in a 5 to 30 per cent. solution to cleanse and disinfect mucous surfaces and large cavities. It is often employed to wash out the bladder before the operation for the removal of calculi or growths from that organ.

In the dressing of superficial wounds, or in wounds in which the bichloride or carbolic acid dressings produce irritation, an ointment of boric acid, made by taking boric acid 1 part, vaseline 5 parts, will be found very satisfactory.

Boro-salicylic Lotion.

This lotion is prepared by adding 2 parts of salicylic acid and 12 parts of boric acid to 1000 parts of hot water. This forms a very bland solution, which can be used where there is danger in using bichloride or carbolic solutions—as, for instance, in the bladder or peritoneal cavity.

Permanganate of Potassium.

This drug, owing to its rapid absorption of oxygen, acts as an antiseptic, and is often employed for the disinfection of foul wounds and ulcers. It is also employed in solution for washing the operator's hands, and for the washing of sponges. It is pratically non-irritating, and may be used in quite concentrated solutions, but is usually employed in the following solution: Permanganate of potash ʒj, water f℥j. One fluid drachm of this solution to a pint of water makes a 1 : 1000 solution.

Pyoktanin.

Methyl-violet, known in commerce under the name of pyoktanin, has been recommended as a drug possessing marked antiseptic powers. It is said to prevent suppuration by destroying the organisms which are active in its production, which are said to have an affinity for and are killed by aniline colors. It has been claimed that it sterilizes the pus of suppurating wounds and ulcers, and it is recommended as an injection in the treatment of large suppurating cavities for this purpose, as it is practically non-poisonous.

It is employed in a solution of a strength of 1 : 1000 or 1 : 2000, and for the sterilization of surgical instruments a 1 : 10,000 solution may be employed. When employed as a means of irrigating wounds, it should be used until the tissues are of a deep-blue color. Recent investigations have shown that it is, as a germicide, much less reliable than bichloride of mercury.

Aristol.

Aristol, which is a compound of iodine and thymol, possesses germicidal properties and has been introduced as a substitute for iodoform. It has the advantage over iodoform of not being poisonous and is also without disagreeable odor. It may be employed for the same purposes as iodoform and it seems to be particularly useful as a dressing to chronic and specific ulcers.

Double Cyanide of Mercury and Zinc.

Cyanide of potassium, cyanide of mercury, and sulphate of zinc are mixed together in solution, in quantities proportioned to the atomic weights of $2KCy$, $HgCy_2$ and $ZnSO_4 + 7H_2O$; the cyanide of potassium and cyanide of mercury being dissolved together in one and a half ounces of water for every 100 grains of potassium cyanide, are added to the sulphate of zinc dissolved in three times that amount of water. The precipitate is collected and washed in two successive portions of water equal in quantity to that used for the solutions, that is six ounces of water for every 100 grains of the potassium cyanide, to free the precipitate from the irritating salts associated with it in its formation. The precipitate being well washed, is next mixed with distilled water containing one part of hæmatoxylin for every 100 parts of the cyanide salt; this, when it precipitates the cyanide salt, changes its color to a pale bluish tint.

Ammonia is next added in such a proportion to the mixture that one fluidrachm of the ammoniacal liquid shall correspond with one grain of hæmatoxylin, and the ammoniacal mixture is allowed to stand for three or four hours, when it is filtered and the dyed salt is drained and dried at a moderate heat, is next levigated and may then be kept for any length of time for use. When employed for charging gauze it is mixed with a 1 : 4000 bichloride solution in the proportion of four pints of the solution to 100 grains of the salt.

Preparation of Materials Used in Aseptic Surgery and Dressings.

Sponges.

Sponges, while dry, should be beaten to free them from calcareous matter, then placed in a 15 per cent. solution of hydrochloric acid for thirty minutes to dissolve any lime which may remain in them; they should then be removed from this solution and washed, and should next be well washed with green or castile soap and warm water for a few minutes and then thoroughly rinsed and placed in a 1 : 1000 bichloride solution or in a 5 per cent. carbolic solution in closely covered jars until required for use.

Or, after beating the sponges to remove any sandy matter, they may be placed for twenty-four hours in a solution of hydrochloric acid—hydrochloric acid ℥iv, water four pints—then removed and washed until free from acid, then steeped for half an hour in a solution of permanganate of potassium, 180 grains to six pints of water. Next wash them and place them in the following solution: hyposulphite of sodium, ℥x; hydrochloric acid, f℥v; water, f℥lxviij; and allow them to remain in this solution for four hours; remove them from this and place them in running water for six hours; they should then be placed in jars and covered either by a 5 per cent. carbolic acid solution or a 1 : 1000 bichloride solution. The carbolic acid solution is better for keeping the sponges than the sublimate solution, as it does not decompose.

They may be prepared also by beating and washing them, and then soaking them for twelve hours in a solution of chlorinated soda — chlorinated soda 1 part, water 5 parts. They are then removed and well rinsed and placed in a 5 per cent. carbolic solution, or they may be placed in a moderately warm oven until thoroughly dry, and then placed in air-tight jars, if it is desired to keep them dry.

It is better to use a cheaper grade of sponges, and to use them only once, but if the same sponges are to be used again, they should be well washed in a solution of carbonate of soda, 1 ounce to the quart, and then placed in a 1 : 1000 bichloride solution.

Silk.

Silk for sutures or ligatures should be sterilized by boiling for thirty minutes in a 5 per cent. solution of carbolic acid or water, then placed in stoppered bottles and covered with a 5 per cent. solution of carbolic acid or with absolute alcohol.

Silkworm-gut.

Silkworm-gut is an excellent material for sutures, and is much easier to thread than the silk or catgut. It may be kept dry in glass jars, or preserved in alcohol, and should be placed in a 5 per cent. carbolic solution for a few minutes before being used, as this renders it more supple.

·Catgut Ligatures or Sutures.

Juniper Catgut.

Catgut, varying in size from No. 0, which is very fine, to No. 4, which is quite thick, is placed in oil of juniper berries for one week, and is then transferred to absolute alcohol, in which it should be kept until required for use.

No. 1 catgut is the size usually employed for ligatures and sutures.

Alcohol is the best material in which to preserve the catgut, as it keeps it firm, and does not interfere with its flexibility, while both carbolic acid and bichloride solutions render it brittle and weak.

Chromic Acid Catgut.

The catgut is first washed in alcohol and placed in 1 quart of a 5 per cent. solution of carbolic acid, containing 30 grains of bichromate of potassium, and is allowed to remain for forty-eight hours. This immersion should be longer when large-sized varieties of catgut are used; but for the sizes of catgut which are ordinarily used, this time of immersion will prepare the gut to resist the action of the living tissues for a week or more. Catgut thus prepared may be dried and placed in closely stoppered jars, or may be kept in alcohol.

Catgut may also be prepared by soaking it in alcohol for a short time, and then placing it in the following solution for forty-eight hours: Chromic acid, 1 grain; carbolic acid, 200 grains; alcohol, 2 drachms; water, $2\frac{1}{2}$ ounces. It is then removed and placed in glass jars for use.

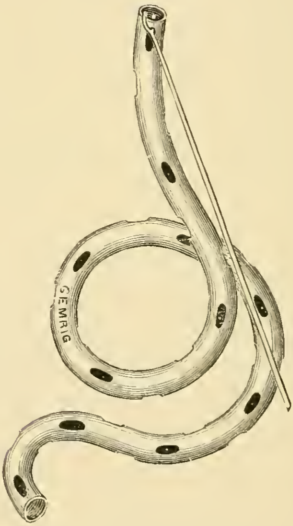
Before being used it should be soaked for thirty minutes in a 5 per cent. carbolic acid solution, or in a 1 : 1000 bichloride solution.

The chromic acid catgut is by far the best variety of gut to use for sutures and for the ligation of the larger vessels in their continuity.

Drainage-tubes.

The drainage-tubes usually employed are prepared from rubber tubing of different sizes perforated at short intervals;

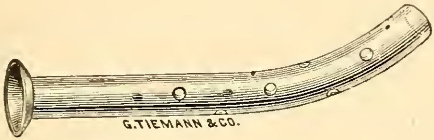
Fig. 82.



Rubber drainage-tube.

the black rubber tubes are softer and more pliable than the red or white rubber tubes, and should be preferred. (Fig. 82.) Drainage-tubes are also made of glass (Fig. 83), which are almost exclusively used in abdominal surgery, and also of decalcified bone. Drainage-tubes should be kept in a 5 per cent. solution of carbolic acid, or, if kept dry, they

Fig. 83.



Glass drainage-tube.

should be well washed and placed in a carbolic or bichloride solution for thirty minutes before being used.

Horse-hair and Catgut for Drainage.

Catgut as ordinarily prepared for ligatures may be used to secure drainage in small and superficial wounds; a number of strands of catgut are placed in the bottom of the wound, and the end or ends are allowed to project from one or both extremities of the wound.

Horsehair may be employed for the same purpose, a number of strands of the hair being placed in the wound in the same manner. Before being used it should be well washed with soap and water and then soaked in a 5 per cent. carbolic solution or 1 : 1000 bichloride solution for thirty minutes.

Protective.

Protective is employed to prevent the wound from being irritated by the antiseptic substances with which the gauze is impregnated or by its irregular surface.

Various materials are employed as protectives, the principal requirement being that it is some tissue which can be readily rendered aseptic, and does not absorb any irritating materials from the dressings.

The protective first employed by Mr. Lister, which is still generally employed, is prepared by coating oiled silk with copal varnish, and when this is dry a mixture of 1 part of dextrine, 2 parts of powdered starch, and 16 parts of a 1 : 20 carbolic acid solution is brushed over its surface.

Rubber tissue may be employed very satisfactorily as a substitute for this protective.

Before applying the protective to the wound, it is dipped into a solution of bichloride of mercury or carbolic acid.

Mackintosh.

This consists of cotton cloth, with a thin layer of India-rubber spread on one side. It is employed in antiseptic dressings as a layer of dressing outside of the gauze, and should be applied with the rubber surface toward the wound, to prevent the discharge from the wound from soaking directly through the dressing.

The mackintosh cloth is not at the present time as much employed as formerly, unless the moist method of dressing is adopted.

Rubber Tissue.

This consists of a very thin sheet of India-rubber with glazed surfaces, which can be obtained from the rubber manufacturers; it is employed for the same purposes as the mackintosh, is much less expensive, and, as previously stated, may be used instead of protective for covering the wound.

Parchment Paper.

This consists of a very tough paper material which can be soaked in a watery solution of corrosive sublimate or carbolic acid without becoming so much softened as to tear upon handling. It is prepared by the manufacturers of surgical dressings, and is employed for the same purposes as mackintosh.

Gauze Dressings.

The most convenient and cheapest material for wound-dressing is a sheer material known in the trade as cheese or tobacco cloth. By reason of having a very open mesh it absorbs well either the materials with which it is prepared or the discharges from the wound when applied as a dressing. It can be readily obtained anywhere, is inexpensive, and is soft and pliable, so that it is a comfortable form of dressing to the patient. The gauze is impregnated with different materials to render it antiseptic, and its preparation is a matter of little difficulty.

Preparation of Gauze Dressing.

Bichloride of Mercury or Corrosive Sublimate Gauze.

In preparing bichloride or corrosive sublimate gauze, thirty yards of cheese-cloth are placed in a wash-kettle and covered with water, to which is added two pounds of washing soda or a pint of lye, and boiled for an hour; the soda or lye is added to remove any oily matters which the cheese-cloth contains, and thus make it more absorbent. The gauze is next removed from the water and washed in clear water, and passed through a clothes-wringer, and then immersed in a 1 : 1000 bichloride of mercury solution for twenty-four hours. It is then dried and cut into pieces several yards in length, and packed in closely covered glass jars or tin boxes and put away for use. Or it may be preserved as moist gauze by packing it in air-tight jars. If gauze has been prepared for some time, it is well to soak it for a short time in a 1 : 1000 bichloride of mercury solution before using it.

In using the sublimate gauze on delicate skins there will sometimes result a dermatitis which is known as mercurial eczema; this is particularly apt to occur if the gauze is moistened or covered with rubber tissue or mackintosh. If this condition develops, the parts covered by the gauze should be rubbed over with boric acid ointment or vaseline before it is reapplied, or another variety of dressing may have to be substituted, such as the iodoform or carbolized gauze.

Iodoform Gauze.

Iodoform gauze may be prepared by sprinkling cheese-cloth, which has been boiled in soda solution, with powdered iodoform and rubbing it well into its meshes; it should then be dried and packed in glass jars for use.

It may also be prepared by rubbing an emulsion of iodoform, made by adding 3 drachms of iodoform to 6 ounces of Castile soap-suds, into 18 ounces of moist gauze; this should be dried and packed in glass jars for use.

Double Cyanide of Mercury and Zinc Gauze.

The preparation of this gauze is much more difficult than that of the other varieties of gauze, requiring the following:

Potass. cyanide	130	grains.
Mercuric cyanide	251.7	"
Zinc sulphate	268.9	"
Hæmatoxylin	1.3	"
Sal ammonia (gas NH_3 1 per cent.)	6	minims.
Gauze (previously boiled and dried)	10	ounces.
Bichloride of mercury solution	7.6	pints.
Distilled water	q. s.	

In charging gauze with this substance, 100 grains of the salt are dissolved in 4 pints of a 1 : 4000 bichloride solution, which will give from 2 to 3 per cent. of the cyanide to the dry gauze. The gauze should be freshly prepared and used moist, or if allowed to become dry it should be moistened again with a weak bichloride solution before being used. The advantages claimed for this gauze are that it is not irritating to the skin, and as the antiseptic is not soluble it is not washed out by the discharges from the wound.

Prof. J. William White, who has used it extensively in his practice, considers that it possesses decided advantages over the bichloride gauze.

Carbolized Gauze.

The carbolized gauze which is used in the University Hospital is prepared in the following manner: Cheese-cloth, which has been previously boiled and dried, is soaked for a few hours in the following solution:

Resin	1 pound.
Alcohol	5 pints.
Castor oil	24 ounces.
Carbolic acid	12 "

The gauze is next removed from this solution and passed through a clothes-wringer, and is then cut in pieces four to six yards in length, which are folded and packed in air-tight tin boxes for use.

Sawdust Dressing.

Sawdust is impregnated with a 1 : 1000 bichloride of mercury solution for twenty-four hours, and then spread out to dry; after it has become sufficiently dry it is enclosed in bags made of cheese-cloth of various sizes. This will be found to be a satisfactory substitute for the ordinary gauze. In using this dressing the wound should be covered with a piece of protective or a few layers of gauze, and the bags are then packed over this and held in place by a bandage.

Moss Dressing.

Different species of *sphagnum* or moss, on account of their cheapness, elasticity, and great absorbing power, have been found a very satisfactory material with which to make dressing bags.

Clean moss is soaked for twenty-four hours in a 1 : 1000 bichloride of mercury solution and then dried; cheese-cloth bags are filled with this material and may be used dry or may be moistened with 1 : 3000 bichloride solution before being applied in the dressing of wounds. They are much employed in the hospitals of Germany, and have largely superseded the gauze dressings.

Improvised Antiseptic Dressings.

In cases of emergency, when the ordinary gauze dressings cannot be obtained, it is well to remember that old muslin or linen, which can usually be obtained, will serve for a temporary dressing if properly sterilized, until a more elaborate dressing can be applied. Old sheets either of muslin or linen should be torn into pieces half a yard square and thrown into boiling water; after remaining for a few minutes in this they should be removed and soaked for a few minutes in a 1 : 1000 or 1 : 2000 bichloride solution, or a 5 per cent. carbolic solution, and applied to the wound, a number of layers of this material being applied and held in position by a bandage. This dressing will keep the wound aseptic until a more elaborate dressing is obtained.

Antiseptic Bandages.

These bandages are prepared by tearing or cutting bichloride or carbolized gauze into strips two to three inches in width and five yards in length, and forming the strips into rollers and packing them in air-tight vessels.

The bandages may also be prepared from boiled dry gauze in the same manner, and are kept in air-tight boxes or jars until required for use, when they are soaked for a few minutes in a 1 : 1000 bichloride or 5 per cent. carbolic solution.

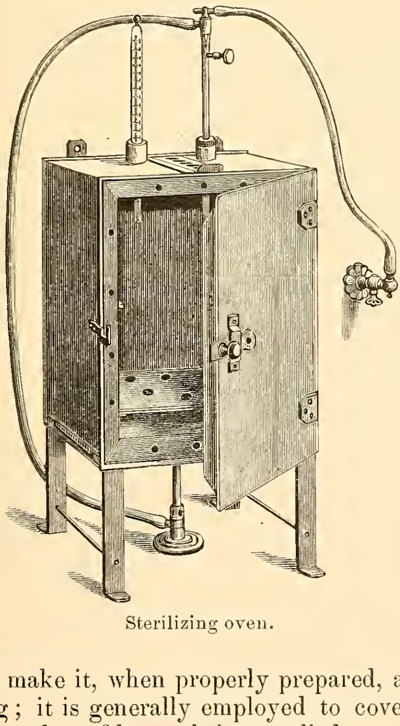
They may also be prepared from crinoline, the same material which is used for the plaster-of-Paris bandage; as this material is quite stiff, the bandage should be soaked in a bichloride or carbolic solution before being applied, and as the material contains a certain amount of starchy matter, it becomes firm as it dries and makes a very secure dressing.

For this reason it is often applied over the ordinary antiseptic bandage.

Bichloride Cotton.

This material, which is an important part of most antiseptic dressings, is prepared by soaking absorbent cotton in a 1 : 1000 bichloride of mercury solution for twenty-four hours, and then allowing it to dry. When dry, it is packed in jars or air-tight boxes. Its great absorbing power and

Fig. 84.



Sterilizing oven.

its elasticity make it, when properly prepared, a most valuable dressing; it is generally employed to cover the gauze dressing, a number of layers being applied.

Borated, carbolized, and salicylated cotton, prepared in the same manner, are also frequently employed for a similar purpose.

Dry Sterilized Dressings.

These dressings are prepared by sterilizing ordinary gauze with steam. Gauze cut into proper lengths is placed in wire cases and exposed to super-heated steam in an oven for a few hours, and is then dried in another oven, removed, and placed in air-tight jars or boxes The apparatus required for perfect sterilization of dressings is expensive, and is not likely to be employed by practitioners, but is used in hospitals where a large number of dressings are constantly required. A convenient form of sterilizing oven is shown in Fig. 84. Unless the sterilization is perfect, these dressings should not be employed; the same method is employed in the sterilization of instruments.

Preparation for Aseptic Operation.

Surgical Cleanliness.

The Hands.

The hands and forearms of the surgeon and of his assistants should be well washed in hot water with soap for a few minutes, and a nail-brush should be used to cleanse the region of the finger-nails; rings with irregular surfaces which might retain filth should be removed. After the hands and forearms have been thoroughly cleansed, they should be immersed in 1 : 1000 bichloride solution for a short time.

The same precautions should be taken with the hands and forearms of nurses who handle the instruments and dressings. If in any manner the hands of the surgeon or of his assistants come in contact, during the operation, with any objects which have not been disinfected, such as the clothing of the patient, the operating-table, etc., it is a matter of the first importance that they should be thoroughly washed and disinfected before again being brought in contact with the wound.

Sterilizing of Instruments.

The instruments should be carefully scrubbed with warm water and soap, care being taken to see that all joints and roughened surfaces are freed from any dry matter which may adhere to them; after being thoroughly cleansed in this manner, they should be placed in a metal or porcelain tray and covered by a 5 per cent. carbolic solution for fifteen minutes before being used.

The instruments which are now constructed with metal handles may be sterilized by placing them in boiling water, or by boiling them; where instruments are employed which have wooden handles this method of sterilization cannot be employed, and here it will be found necessary to resort to the first method of sterilization.

Instruments which fall upon the floor or come in contact with the clothing of the surgeon or the patient during the operation, should be washed and placed in the carbolic solution before again being brought in contact with the wound.

Preparation of the Patient for Operation.

The patient having been prepared for the operation by whatever constitutional treatment the surgeon considers necessary, the region of the proposed wound is first rubbed over with cotton saturated with spirits of turpentine, and next is thoroughly washed with soap and water; if hairs are present in the region they should be shaved off; after a careful washing with soap and water, the skin is carefully washed with a 1 : 1000 bichloride or 5 per cent. carbolic solution, and is then covered with a towel wrung out in a 1 : 2000 bichloride solution until the surgeon is ready to begin the operation.

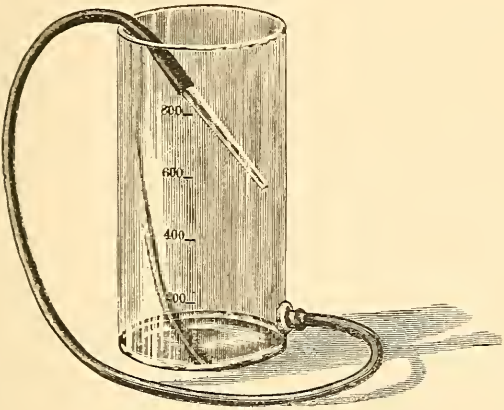
This cleansing of the region of the proposed wound in hospital practice is generally made a few hours before the operation, but in private practice it has to be done just before the operation is undertaken; but if carefully done the results will be in no wise less satisfactory. In private practice the operation may have to be performed while the patient is in his bed, or, if an ordinary kitchen-table is at hand, it will be found more convenient to place him upon this; this should be prepared by placing upon it a folded quilt or blanket, and over this a sheet of rubber cloth, and upon this is laid a clean, folded, linen or muslin sheet. The surgeon should carry with him a sheet of this rubber cloth, three by four feet, which he will find most useful in preparing the table for the operation, or in protecting the bed of the patient if he is not placed upon the table; a rubber cloth of this size takes up little space if carefully folded, and can be easily packed in the instrument-bag.

Details of an Aseptic Operation.

The patient being anæsthetized and placed upon the table, the clothing is so arranged as to expose freely the part to be operated upon; the clothing or the skin surrounding this region is next covered with towels wet with a 1 : 1000 bichloride solution. If any considerable surface of the patient's body is covered by these towels, to avoid chilling the surface and adding to the shock which naturally follows the operation, they should be wrung out in a hot bichloride or carbolic solution, and should be replaced as they become cold by hot towels prepared in the same manner. The patient being ready for operation, the surgeon should assign the assistants and nurses their duties, and having again immersed their hands and forearms in the bichloride solution the operation is begun.

During the operation the wound is irrigated frequently with a 1 : 2000 or 1 : 3000 bichloride solution, which may be allowed to run over the wound, or be applied by means of a syringe or irrigating apparatus (Fig. 85), and the hands of the surgeon and assistants should also be washed in this solution at not too long intervals. In prolonged operations, or in those in which a large wound is made, I think it is especially important that the irrigating solutions should be used as warm as can be comfortably borne by the hands of the surgeon; warm solutions, it has been shown by recent

FIG. 85.



Irrigating apparatus. (ESMARCH.)

investigations, possess a greater germicidal power than those of the same strength when used cold, and they also possess the advantage of preventing the chilling of the patient, and thus diminish the shock of the operation.

Hemorrhage during the operation is controlled by the use of hæmostatic forceps, which are applied to the bleeding vessels, or the vessels may be ligatured as they are divided. After the operation has been completed, and all hemorrhage has been controlled, the wound is thoroughly irrigated with a 1 : 2000 or 1 : 3000 bichloride solution.

The next step is to provide for drainage; this may be disregarded in small or superficial wounds, but in a wound of any considerable size or depth it is safer to provide free drainage. This is accomplished by the use of perforated rubber drainage-tubes, or a number of strands of catgut or horsehair, or by decalcified bone or glass drainage-tubes.

The rubber tube in large wounds will be found most comfortable to the patient and satisfactory as regards drainage; it may be laid in the wound, the ends being allowed to extend from the extremities of the wound, or it may be so introduced that one end of the tube rests in the deepest part of the wound and the other extremity is brought out of the wound at its most dependent portion; in large or irregularly shaped wounds a number of tubes may be required to secure free drainage. The ends of the drainage-tubes are transfixed with safety pins which have been sterilized and allowed to remain in a 5 per cent. carbolic solution until required, and the ends of the tube should next be cut off close to the pins so as to be as nearly as possible flush with the skin.

The wound is next closed by the introduction of sutures, which may be of silkworm-gut, chromicized catgut, silk, or silver wire; the needles and sutures should be soaked in a 5 per cent. carbolic solution for thirty minutes before being used. The wound being closed, a final irrigation of its deepest parts should be made, by injecting a stream of bichloride solution, 1 : 2000 or 1 : 3000, into the end of the drainage-tube; if through-and-through drainage has been employed, one end of the tube should be closed and the solution should be injected into the wound through the other end of the tube by means of a syringe or irrigating-tube, until the wound is slightly distended with the solution, which allows the latter to find its way to all parts of the cavity of the wound. The external surface of the wound and the skin for some distance surrounding it should next be washed with a 1 : 2000 bichloride solution, and a piece of protective, a little longer and wider than the wound, is next dipped in a bichloride or carbolic solution and placed over it, and over this is laid the deep dressing, which consists of a pad of bichloride gauze from eight to sixteen layers in thickness and large enough to overlap the wound two or three inches in all directions. This should be dipped in a 1 : 2000 bichloride solution, and wrung out as dry as possible before being applied. The superficial gauze dressing is next applied, and consists of sixteen layers of gauze, which should be large enough to extend from three to six inches beyond the wound in all directions; this gauze is applied dry. Over the superficial gauze dressing there is next applied a number of layers of bichloride cotton, so arranged as to extend a little beyond the margin of the superficial gauze dressing. These dressings are now secured in position by the application of a gauze bandage, which is prevented from slipping by the introduction of a few safety-pins.

The dressing being completed, the patient is moved from the operating-table to his bed, and care should be exercised to see that the dressings do not become soiled if the patient vomits upon coming up from the anæsthetic.

In this method of dressing no mackintosh or rubber tissue is employed, outside of the superficial gauze dressing; the discharges from the wound are disseminated through the dressing and become dry by evaporation, and the dressing forms an antiseptic scab which covers and surrounds the wound.

Moist Method of Dressing.

If, for any reason, it is desired to adopt the moist method of dressing, a piece of mackintosh or rubber tissue larger than the superficial gauze dressing is placed over it, and over this is placed a few layers of bichloride cotton, care being taken to see that the layers of cotton overlap the mackintosh or rubber tissue by a few inches; the application of an antiseptic gauze bandage then completes the dressing. On the removal of this dressing the gauze will be generally found to be soaked with the discharges from the wound, and in a moist condition. The disadvantage of this variety of dressing is that there is apt to be more irritation of the skin set up by the bichloride gauze when kept moist than when applied in the manner of a dry dressing.

Reapplication of Dressings.

The re-dressing of a wound which remains aseptic need not be made for some days; if the temperature remains normal or a little above this point, and the patient exhibits no unfavorable constitutional symptoms, and the dressing is comfortable to the patient, it need not be disturbed for a week or ten days; at the expiration of this time it is well to examine the wound and to remove the drainage-tube if a drainage-tube has been used, and to remove a portion or all of the sutures if the superficial parts of the wound are firmly healed.

In re-dressing an aseptic wound at the end of a week or ten days, to prevent any possible infection, as much care should be exercised as in the original dressing of the wound. The patient's clothes should be removed so as to freely expose the dressing, and a rubber cloth should be placed under the patient so as to protect the bed, and the clothing and skin in the region of the wound should be protected by towels wrung out in a 1 : 1000 bichloride solution. The surgeon should wash his hands and immerse them in a 1 : 1000 bichloride solution before removing the dressings. The bandage retaining the dressing should be divided with bandage scissors and the dressings should be removed layer by layer, and when the deep dressing is removed care should be taken to see that the drainage-tubes are not pulled upon if they are adherent to the dressing; the protective should next be removed, and the surface of the wound should be irrigated with a 1 : 2000 bichloride solution; the drainage-tubes should next be inspected to see that they are free, and a stream of bichloride solution may be passed through them by means of a syringe. If the wound is found aseptic the drainage-tube may be removed, and the wound should next be irrigated through its track by a stream of bichloride solution. If the wound is healed the sutures may be removed at this dressing; but if the wound has been an extensive or deep one it may be well to remove only a portion of the sutures; if animal sutures have been employed, they need not be removed. The surface of the wound is next washed with a 1 : 2000 bichloride solution and a piece of protective is placed over the line of incision, and the deep and superficial dressings are applied as previously described and covered with layers of bichloride cotton, and the whole dressing is secured by the application of an antiseptic bandage. If the wound remains aseptic after this dressing, the dressings need not be changed for a week or ten days, and at this time the wound will usually be found healed, so that further dressings are not required.

If, however, the wound is not running the typical course of an aseptic wound, constitutional symptoms will be developed, as evidenced by a rise in the temperature and pulse-rate and other constitutional disturbances. In this event the wound should be re-dressed as soon as possible, and if the cause of the disturbance can be found it should be removed; for instance, hemorrhage may have taken place into the wound, and the blood not being able to escape through the drainage-tubes may have caused so much distention of the wound that the vitality of the skin covering the wound is threatened, or the sutures may be found to be causing irritation, or suppuration may be found to be present.

If, on exposure of the wound, it is found that it is distended with blood-clots, and blood is escaping from the wound, the sutures should be removed, the clots should be turned out, and the bleeding vessel or vessels should be sought for and ligatured, and the wound, after a thorough irrigation with 1 : 2000 bichloride solution, should be drained and closed with sutures, and dressed as previously described.

If, however, on exposure of the wound, and upon the removal of a portion or all of the sutures, the wound is found distended with a blood-clot, and no evidence of hemorrhage at the time exists, or of suppuration in the wound, the clot may be allowed to remain in place, and the wound should be re-dressed as in the original dressing, trusting to the organization of the blood-clot if it has remained aseptic. If the patient's condition improves after the dressing, and the temperature and pulse-rate become normal, it is an indication that the wound is still aseptic, and it need not be re-dressed for some days.

If, on the other hand, examination of the wound shows that the drainage is insufficient, or that the drainage-tubes are occluded by blood-clots, these should be removed by washing out the tubes with a 1 : 2000 bichloride solution by means of a syringe, and introducing additional drainage-tubes, if it is deemed necessary; the wound should then be re-dressed.

When it is found on examination of the wound that suppuration is present, the surgeon may adopt one of two methods of treatment: he may thoroughly wash out the wound through the drainage-tubes with a 1 : 2000 bichloride solution, and after thorough irrigation of the wound re-dress it, and, if the patient's constitutional symptoms improve, he may be assured that the wound has been rendered aseptic, and is running an aseptic course.

If he does not feel that this method of treatment is sufficient, he may open the wound and wash it thoroughly with a 1 : 2000 bichloride solution, and next apply to its surface a 15-volume solution of the peroxide of hydrogen, which may be diluted with water one-third or one-half, or a 30-grain solution of chloride of zinc may be used; and after this application a final irrigation with the 1 : 2000 bichloride solution shall be made, and it should then be drained, closed, and dressed, as previously described.

If the treatment instituted to render the wound aseptic has been successful, the patient's constitutional condition will improve, and it will heal as an aseptic wound.

Dressing of Septic Wounds.

It often happens that patients suffering from wounds which have been improperly treated, or have had no treatment, come under the care of the surgeon; such wounds are already infected, and to render them aseptic, if possible, the following treatment should be adopted: The skin surrounding the wound should be carefully washed with spirits of turpentine, and then with soap and water, and finally with a 1 : 2000 bichloride solution. The wound itself should be next exposed as fully as possible, and any foreign bodies which are found in it, or dirt, should be removed with forceps and a stream of water; it should next be thoroughly irrigated with a 1 : 2000 bichloride solution, and then should be drained, closed, and dressed as an operation wound.

If suppuration is already present, after cleansing the region of the wound it should be irrigated with a 1 : 2000 bichloride solution, and should next be washed with a 30-grain solution of chloride of zinc, or a 15-volume solution of the peroxide of hydrogen diluted with water one-half, one-third, or used in its full strength; and finally thoroughly irrigated with a 1 : 2000 bichloride solution.

The introduction of drainage-tubes and sutures will depend upon the character of the wound. Sutures cannot often be used with advantage if much retraction of the skin has occurred, and a drainage-tube is not required if the wound is left open. A piece of protective is next applied over the surface of the wound, and the deep gauze dressing, wrung out in a 1 : 2000 bichloride solution, is applied over this, and the superficial gauze dressing and bichloride cotton are next applied and secured by a bandage.

Infected wounds which are treated in this manner will often be rendered aseptic, and in their subsequent course will be perfectly satisfactory, both to the patient and to the surgeon.

Materials Used in Surgical Dressings—*Continued.*

Lint.

This material is employed in surgical dressings, and is of two varieties; the domestic lint, which consists of pieces of old linen or muslin which have been thoroughly washed or boiled and then dried, or the surgical lint which is manufactured by machinery, and resembles Canton flannel in appearance; the latter is the best material, as it has a greater absorbing capacity.

Lint is used as a material on which unctuous preparations are spread in the dressing of wounds, and is also employed as a material for saturating with the various solutions which are used in wet dressings, such as lead-water and laudanum, or dilute alcohol; the lint, after being saturated with these solutions, is covered with rubber tissue or oiled silk when applied, to prevent too rapid evaporation of the solution. It is also one of the best materials from which to construct compresses employed in the treatment of fractures, to control hemorrhage, or to make pressure for any purpose

Paper-lint, made from old rags or wood pulp, has great absorbing power for fluids, and may be used as a substitute for surgical lint in the application of wet dressings to surfaces when the skin is unbroken.

Oakum.

This material, made from old tarred rope, was formerly much employed in the dressing of wounds before the introduction of the antiseptic method of wound-treatment; it was supposed to possess some antiseptic properties due to the tar with which it was impregnated. From its elasticity it is found to be an excellent material for padding splints or other surgical appliances. It is also employed in the form of pads to place under patients to relieve portions of the body from pressure, or to absorb discharges which soak through the dressings. A mass of oakum which has been well teased out and wrapped in a towel forms an excellent pillow on which to support a stump. The *oakum seton* is highly recommended by Dr. Sayre as a means of making a direct application of ointments to sinuses of bone; the oakum is loosely twisted into a cord and covered with any ointment desired and is passed through the sinuses in the bone; the position of the seton is changed from time to time, fresh ointment being applied before it is drawn through; resin cerate is a favorite application to these sinuses made in this manner.

Cotton.

Cotton is now employed in surgical dressings principally as a material to pad splints or to relieve salient parts of the skeleton from pressure in the application of splints or bandages; for instance, in the application of the plaster-of-Paris bandages, the bony prominences are generally covered by small masses of cotton; it possesses but little absorbent power unless used in the form of absorbent cotton, and is not much employed in surgical dressings, except for the purposes mentioned above.

Absorbent Cotton.

This material is prepared from ordinary cotton, which is boiled with a strong alkali to remove the oily matter which it contains. When so prepared it absorbs liquids freely, and by reason of its great absorbing capacity it is largely employed in surgical dressings. A small mass of absorbent cotton wrapped upon the end of a probe or stick is now generally employed to make applications to wounds, and has taken the place of the sponge or brush which was formerly employed for this purpose. From its cheapness, after one application it can be thrown away and a new piece can be used, and thus the danger of carrying infection from one wound to another by the applicator is abolished. It is largely employed in gynecological practice for making applications to the female genital organs.

It is impregnated with various antiseptic substances, such as the bichloride of mercury, carbolic acid, boric acid, and salicylic acid, and, when thus treated, forms the *bichloride*, *carbolized*, *borated*, and *salicylated cotton* so much employed in antiseptic dressings.

Jute.

This substance is made from the fibre of the *Corchorus capsularis*, which, on account of the character of its fibre, possesses both elasticity and absorbing qualities; it has been employed for much the same purposes as oakum and cotton, such as the padding of splints, and is also used as an external absorbing dressing.

Oiled Silk or Muslin.

These materials are employed as an external cover for moist dressings to prevent rapid evaporation from the dressings; they form excellent materials for this purpose, but as they are quite expensive their use is limited.

Waxed or Paraffine Paper.

This dressing is prepared by passing sheets of tissue-paper through melted wax or paraffine, and then allowing them to dry for a few minutes. Paper thus treated forms an excellent and cheap substitute for oiled silk or muslin, and may be employed for the same purpose for which the latter materials are used.

Rubber Tissue.

This material, which is prepared by rubber manufacturers, consists of rubber run out into very thin sheets; it has a glazed surface, is very pliable and strong at the same time, and forms a cheap and satisfactory substitute for oiled silk, and is employed for the same purposes. In the moist method of antiseptic dressing it may be used in place of the mackintosh, and indeed I prefer it to the latter in this method of dressing.

Parchment Paper.

This paper is prepared so as to render it water-proof; it is employed in surgical dressings for the same purposes as oiled silk and rubber tissue.

Compresses.

Compresses are prepared by folding pieces of lint, muslin, linen, or flannel upon themselves so as to form firm masses of variable sizes; oakum or cotton may also be used to form compresses. Compresses are employed to make pressure over localized portions of the body, as in the treatment of fractures, or to make pressure upon vessels for the control of hemorrhage.

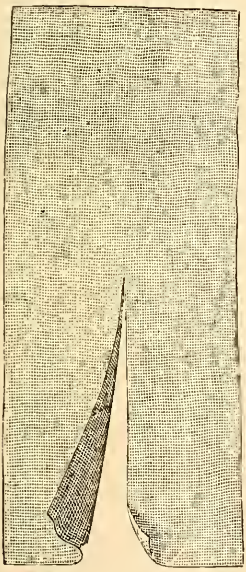
Tent.

This consists of a small portion of lint, oakum, or muslin rolled in a conical shape, which is employed to keep wounds open and facilitate discharges. This dressing is not much employed at the present time, its use being largely superseded by the drainage-tube.

Retractors.

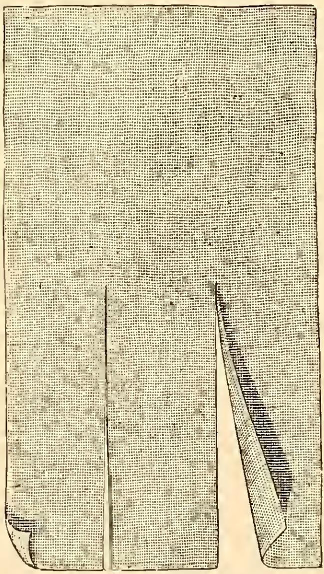
Retractors are made by taking a piece of muslin four inches wide and twelve to eighteen inches in length and

Fig. 86.



Two-tailed retractor.

Fig. 87.



Three-tailed retractor.

splitting it as far as the centre, thus making a *two-tailed retractor*. (Fig. 86.) A *three-tailed retractor* is made in the same way, except that the muslin is slit twice instead of once. (Fig. 87.) Retractors are used to retract the soft parts in amputation, to prevent their injury by the saw in the division of the bones. When one bone is sawed a two-tailed retractor is used, and when two bones are sawed a three-tailed retractor is employed.

Plasters.

The varieties of plaster which are most commonly employed in surgical dressings are *adhesive* or *resin plaster*, *isinglass plaster* and *rubber adhesive plaster.*

Resin Plaster.—This plaster, which is machine-spread, is one of the most widely employed plasters in surgical dressings; the spread surface is covered with a layer of tissue-paper, which should be removed before it is used; it is cut into strips of the required width and length, and the strips should be cut lengthwise from the roll of plaster, as the cloth upon which it is spread stretches more transversely than in a longitudinal direction. When heated and applied to the surface it holds firmly; it is prepared for application by applying the unspread side to a vessel containing hot water, or it may be passed rapidly through the flame of an alcohol lamp.

This is the variety of plaster which is generally used in making the extension apparatus for the treatment of fractures, for strapping the chest in fractures of the ribs and sternum, for strapping the pelvis in cases of fractures of the pelvic bones, or for strapping the breast, the testicle, ulcers, or joints.

Rubber Adhesive Plaster is made by spreading a preparation of India-rubber on muslin, and has the advantage over the ordinary resin plaster that it adheres without the application of heat. It is employed for the same purposes as resin plaster, but when applied directly to the skin it is apt to produce a certain amount of irritation, and for this reason when it is to be continuously applied for some time, as in the case of an extension apparatus, it is not so comfortable a dressing as that made from resin plaster.

Isinglass Plaster, which is made by spreading a solution of isinglass upon silk or muslin, will be found to be a most useful dressing in the treatment of superficial wounds. It is made to adhere to the surface by moistening it, and when used in the treatment of wounds it should be moistened with an antiseptic solution; it is in this way rendered antiseptic and may be used with safety in connection with other antiseptic dressings. The best form of this plaster is spread on muslin, and when properly applied adheres as firmly and possesses as much strength as the ordinary resin plaster.

Before using any of these plasters, if the part to which they are to be applied contains hairs, these should be shaved off, otherwise traction upon these, if the plaster is used for the purpose of extension, or in its removal, will cause the patient discomfort or pain.

Soap Plaster. — Soap plaster for surgical purposes is prepared by spreading *emplastrum saponis* upon kid or chamois. It is not employed for the same purposes as the resin or rubber plaster, as it has little adhesive power, and is used simply to give support to parts or to protect salient portions of the skeleton from pressure. It is found a most useful dressing when applied over the sacrum in cases of threatened bedsores, and may be applied for the same purpose to other parts of the body where pressure sores are apt to occur.

In the treatment of sprains of joints a well-moulded soap-plaster splint secured by a bandage will often be found a most efficient dressing, and in the treatment of fractures the comfort of the patient is often materially increased by applying small pieces of soap plaster over the bony prominences, upon which the splints, even when well padded, are apt to make an undue amount of pressure.

Strapping, or applying pressure to parts by means of strips of plaster firmly applied, is a procedure often employed in surgical practice.

Strapping the Testicle.

In strapping the testicle strips of resin plaster are usually employed; a dozen or more strips one-half an inch wide and twelve inches in length will be required.

The scrotum should be first washed and shaved, and the surgeon next draws the skin over the affected organ tense by passing the thumb and finger around the scrotum at its upper portion, making circular constriction; a strip of plaster which has been heated is passed in a circular manner around the skin of the scrotum above the organ, and is tightly drawn and secured; this isolates the part and prevents the other strips from slipping. Strips are now applied in a longitudinal direction, the first strip being fastened to

Fig. 88.

Strapping the testicle. (Smith.)

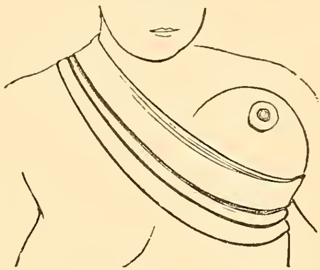
the circular strip and carried over the most prominent part of the testicle, and is then carried back to the circular strip and fastened. A number of these strips are applied in an imbricated manner until the skin is covered (Fig. 88), and the dressing is completed by passing transverse strips around the testicle from its lowest portion to the circular strip; care should be taken to see that no portion of the skin is left uncovered.

Strapping the testicle is employed with advantage in the subacute stage of orchitis or epididymitis, and it will be found a useful means of applying pressure to the scrotum after the injection treatment of hydrocele. As the swelling of the testicle diminishes the strips become loose, and the part will require re-strapping.

Strapping of the Breast.

To strap the breast, strips of resin plaster two inches wide and long enough to pass from the opposite shoulder under the breast to the point of starting are required. In applying the strips the end of the strip is placed on the spine of the scapula of the side opposite the diseased breast and is carried forward over the shoulder and obliquely downward under the breast and axilla, and then over the back to the point of starting; the first strip being applied in this manner, the next one is applied in the same direction, overlapping about one-third of the previous strip (Fig. 89). These oblique strips are applied in an imbricated manner until a sufficient number have been used to cover in the breast, or the oblique strips may be alternated with circular strips passing from the sternum over the breast to the spine. A sufficient number of strips are used to cover the breast and to make firm compression upon it. Strapping of the breast in this manner will be found a satisfactory method of treatment in chronic inflammatory conditions of the breast, where it is of advantage to support the breast and make compression at the same time; it has the advantage over the use of a bandage to support and compress the breast, that it does not interfere with the chest motions upon the opposite side of the body.

Fig 89.

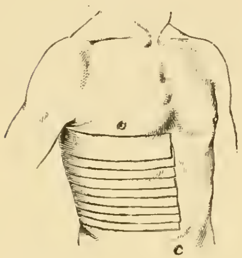


Strapping the breast. (Smith.)

Strapping of the Chest.

To strap one-half of the chest, strips of resin plaster two and a half inches wide, and long enough to extend from the spine to the median line of the sternum are required—eighteen to twenty inches in length. The first strip is heated and one extremity is placed upon the spine opposite the lower portion of the chest; it is then carried over the chest and its other extremity is fixed upon the skin in the median line of the sternum. Strips are next applied from below upward in the same manner, each strip overlapping one-third of the preceding one, until the axillary fold is reached (Fig. 90); a second layer of strips may be applied over the first, if additional fixation is desired, or a few oblique strips may be employed.

Fig. 90.



Strapping of the chest.

Adhesive straps applied in this manner very materially limit the motion of the chest-wall upon the affected side, and are frequently employed in the treatment of fractures and dislocations of the ribs, in contusions of the chest, and in cases of plastic pleurisy when the motions of the chest-walls are extremely painful to the patient.

Strapping of Ulcers.

To strap ulcers of the leg, strips of resin plaster one and a half inches wide, and long enough to extend two-thirds around the limb, are required. The ulcer should be thoroughly cleansed, and the skin surrounding it should be well dried; the first strip, being heated, is applied obliquely to the long axis of the leg about two inches below the ulcer, and is carried two-thirds around the limb: another strip is applied to a corresponding point of the skin on the opposite side of the limb, and is carried obliquely over the limb, crossing the first strip in the median line, and is carried two-thirds of the way around the limb; alternate strips are thus applied until the ulcer is covered in, and the strips are carried several inches above the ulcer (Fig. 91). Care should be taken to see that the strips are so applied as not to meet or cover the entire circumference of the limb, as by so doing injurious circular compression may result. Chronic ulcers upon other portions of the body may be strapped in the same manner.

Strapping of leg ulcers is usually reinforced by the application of a firmly applied spiral reversed or spica bandage of the lower extremity.

FIG. 91.

Strapping of ulcer of leg. (LISTOR.)

Strapping of ulcers of the leg applied in the manner described will be found a most satisfactory method of treating chronic ulcers in this location in patients who have to work during the course of treatment; the strips need only be removed at intervals of a week, and, if well applied, the dressing is generally a comfortable one to the patient.

STRAPPING OF JOINTS.

Strips of resin plaster two inches in width and long enough to extend two-thirds around the joint are required. The first strip is applied a few inches below the joint, and strips are then applied over this, each strip covering in two-thirds of the preceding one until the joint is covered in and the strips extend a few inches above the joint.

The ankle-joint is strapped by taking strips of resin plaster one inch in width; the first strip is placed over the heel, and its ends are brought forward until they meet over the dorsum of the foot; a second strip encircles the foot and secures the ends of the first strip. These strips are alternately applied, each strip covering in one-half of the previous strip until the foot and ankle are covered in.

Strapping of joints will be found a satisfactory dressing in the treatment of sprains of joints in their chronic state.

Strapping of a Carbuncle.

To strap a carbuncle strips of resin plaster one to one and a half inches in width are required; these strips are applied at the margin of the swelling and are laid on concentrically until all except the central portion is covered. If a number of openings exist, the strips are so placed as not to cover these. Strapping applied in this manner in the treatment of carbuncle is often a comfortable dressing for the patient, and at the same time the concentric pressure favors the extrusion of the slough.

Poultices.

This form of dressing was formerly much employed in the treatment of inflammatory conditions and injuries as a means of applying heat and moisture to the part at the same time, and although the use of poultices is now very much restricted since the introduction of the antiseptic method of wound treatment, yet I think there are still conditions in which their employment is both useful and judicious.

They are often employed with advantage in inflammatory affections of the chest and of the abdominal organs, and in inflammatory affections of the joints and of bone, combined with rest, their action is often most satisfactory; in cases of gangrene their employment hastens the separation of the sloughs.

They constitute a form of dressing which conduces much to the comfort of the patient in cases of deep suppuration by their relaxing effect upon the tissues, and their previous use does not prevent the surgeon from using all antiseptic precautions in the opening and drainage of these abscesses and the employment of antiseptic dressing in their subsequent treatment.

Flaxseed Poultice.

This poultice is prepared by adding first a little cold water to ground flaxseed and then adding boiling water, and stirring it in until the resulting mixture is of the consistency of thick mush. A piece of muslin is next taken which is a little larger than the intended poultice, and this is laid upon the surface of a table and the poultice mass is spread evenly upon it with a spatula or knife from one-quarter to one-half an inch in thickness; a margin of the muslin of one or one and a half inches is left, which is turned over after the poultice is spread, and serves to prevent it from escaping around the edges when applied. The surface of the poultice may be thinly spread over with a little olive oil, or may be covered with a layer of thin gauze to prevent the mass from adhering to the skin.

It is now applied to the surface of the skin and is covered with a piece of oiled silk, rubber tissue, or waxed paper, and held in position by a bandage or a binder.

Bread Poultice.

This poultice is prepared from stale wheaten bread, the crusts being discarded and the crumb only being used; this is moistened with boiling water and allowed to soak for a few minutes, when the excess of water is poured off and the mass is spread upon a piece of muslin or linen, as before described.

Charcoal Poultice.

In preparing this poultice flaxseed-meal and powdered charcoal in equal parts are mixed together, and by adding boiling water a poultice mass is produced, which is spread upon muslin, as previously detailed. It is better to use animal charcoal in making this poultice, as it possesses greater disinfecting power than vegetable charcoal. This poultice is used as an application to gangrenous parts, as it possesses marked disinfecting properties.

Fermenting Poultice.

This poultice may be prepared by adding yeast, two tablespoonfuls, to a mixture of flaxseed with hot water, making a thin poultice mass, and allowing it to stand for a few hours in a warm place; it rises and becomes light, and is then spread upon muslin and applied as required. A few ounces of porter or a piece of yeast cake may be used as a substitute for the yeast in preparing this poultice; charcoal may also be added to it to increase its disinfectant power. This poultice was formerly and is still used as an application to gangrenous parts to hasten their separation and to diminish the odor arising from the necrotic tissues.

Oakum Poultice.

This is prepared by soaking a mass of loosely picked oakum in hot water, wringing it out and covering it with a layer of cheese-cloth or antiseptic gauze. It is next applied to the part and covered with oiled silk or rubber tissue, and held in place by a bandage; it has a large capacity for the absorption of discharges.

It may be wrung out in a warm bichloride solution, or carbolic solution, and thus form an *antiseptic* poultice.

Hot Fomentations.

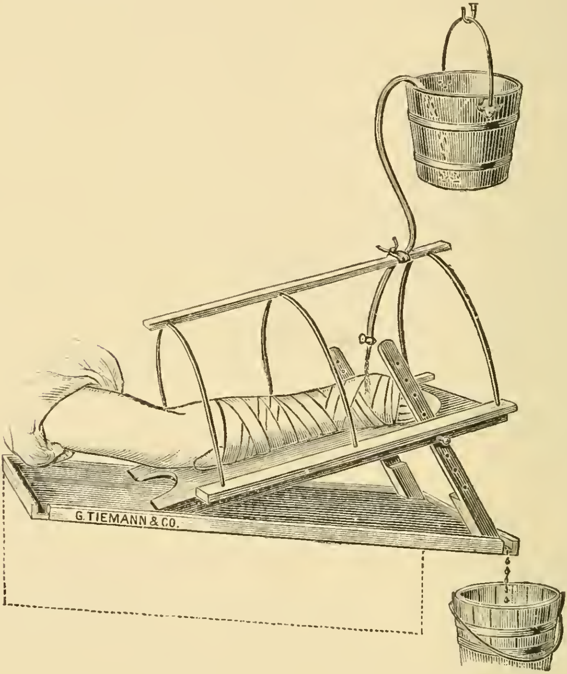
Hot fomentations are employed to keep up the vitality of parts which have been subjected to injury, as seen in severe contusions resulting from railway or machinery accidents; also to combat inflammatory action. Flannel cloths, several layers in thickness, or surgical lint should be soaked in water having a temperature of 120°; these are wrung out and placed over the part and covered with waxed paper or rubber tissue; a second cloth should be in the hot water, ready to apply as soon as the first-applied cloth begins to cool, and so by continuously reapplying them the part is kept constantly covered by a hot dressing. The use of these hot fomentations may in many cases have to be continued for hours before the desired result is obtained. *Hot compresses* applied in this manner are frequently employed in treating inflammatory conditions of the eye, and are also of the greatest service in keeping up the vitality of parts which have been subjected to severe injury interfering with their blood-supply. I have seen contused limbs, which were cold and seemed to be doomed to gangrene by reason of diminished blood-supply, have their temperature and circulation restored by the patient and persistent use of this dressing. After the vitality of such a part is restored it should be covered with cotton and a flannel bandage and surrounded by hot-water bags or hot-water cans.

Irrigation.

This may be accomplished by allowing the irrigating fluid to come in contact with the wound or inflamed part, or by allowing the cold or warm fluids to pass through rubber tubes which are in contact with or surround the part; the latter method is known as *mediate irrigation*.

In employing irrigation in the treatment of wounds or in inflammatory conditions, a funnel-shaped can with a stop-cock at the bottom, or a bucket is suspended over the part at a distance of a few inches (Fig. 92), or a jar with a skein of thread or lamp-wick arranged to act as a siphon may be employed. (Fig. 93.) The can or jar is filled with water, and this is allowed to fall drop by drop upon the part to be irrigated, which should be placed upon a piece of rubber sheeting so arranged as to allow the water to run off into a receptacle so as to prevent the wetting of the patient's bed. The water employed may be either cold or warm, and this is decided by the indications in special cases, and if it is

Fig. 92.

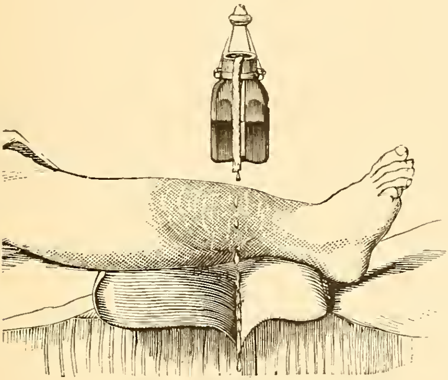


Apparatus for continuous irrigation. (Esmarch.)

desired to make use of antiseptic irrigation the water is impregnated with carbolic acid or bichloride of mercury; a 1 : 5000 to 1 : 10,000 bichloride solution, or a 1 : 60 carbolic acid solution, is frequently employed with good results.

Antiseptic irrigation employed in this manner will be found a most useful method of treating lacerated and contused wounds of the extremities in which the vitality of the tissues is much impaired; and in such cases the warm water should be preferred to cool water, the temperature being from 100° to 110°.

Fig. 93.



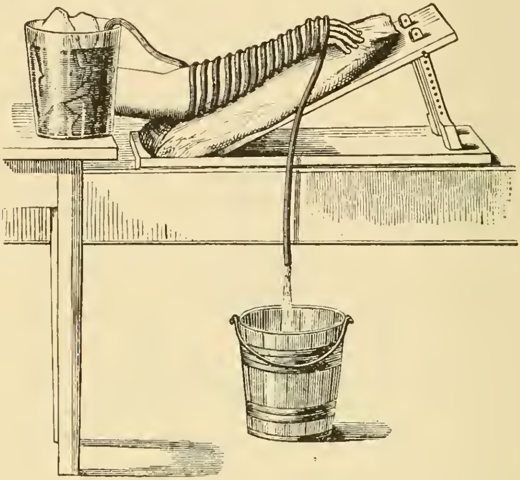
Irrigating apparatus. (Erichsen.)

Under the use of warm irrigation it is surprising to see how tissues apparently devitalized regain their vitality; the absence of tension from the non-introduction of sutures and firm dressings, and the warmth and moisture kept constantly in contact with the wound by this method of irrigation, are the important factors in the attainment of this favorable result.

Mediate Irrigation.

In this method cold or warm irrigation is applied to the part by means of cold or warm water passing through a rubber tube in contact with the part. A flexible tube of India-rubber half an inch in diameter, with thin walls, and sixteen or twenty feet in length, is applied to the limb like a spiral bandage, or is applied in a coil to the head, breast, or joints and held in place by a few turns of a bandage; the end of the tube is attached to a reservoir filled with cold or warm water above the level of the patient's body, and the water is allowed to flow constantly through the tubing and escape into a receptacle arranged to receive it. (Fig. 94.)

FIG. 94.



Cold coil applied to arm. (ESMARCH.)

COLD WATER DRESSINGS.

These dressings are applied by bringing the cold water either directly in contact with the part or by applying it by means of a rubber bag or bladder.

The temperature of the water may vary from cool water to that of ice-water.

These dressings are employed in local inflammatory conditions; a favorite method of employment of this dressing is by means of *cold compresses*, which are made of a few layers of surgical lint, dipped in water of the desired temperature and applied to the part; they are renewed as soon as they become warm. When it is desirable to have the compresses very cold, they may be laid upon a block of ice or in a basin with broken ice; to obtain the best results from their employment they should be renewed at very short intervals.

A convenient method of applying cold without moisture is by the use of the *ice-bag*. This is either a rubber bag or bladder, which is filled with broken ice and applied to the part. In using an ice-bag it is better to cover the part first with a towel or a few layers of lint or muslin, which prevents the surface from becoming wet by absorbing the moisture which condenses upon the surface of the bag or bladder, and thus renders the dressing more comfortable to the patient. The ice-bag is often employed as an application to the head in inflammatory conditions of the brain or membranes, and is also used upon the surface of the body to control internal hemorrhage.

Counter-irritation.

Counter-irritants are substances employed to excite external irritation, and the extent of their action varies according to the material used and duration of its application; superficial redness or complete destruction of the vitality of the parts to which they are applied may result.

The use of counter-irritants under favorable circumstances is found to have a decided effect in modifying morbid processes, and they are widely employed as local revulsants in cases of congestion or inflammation, and in cases of collapse for their stimulating effect.

Rubefacients.

These agents, by reason of their irritating properties when applied to the skin, produce intense redness and congestion.

Hot Water.—When it is desired to make a quick impression upon the skin, the application of muslin or flannel cloths wrung out in hot water and renewed as rapidly as they become cool will soon produce a superficial redness of the integuments.

Spirits of Turpentine.—This drug applied to the skin is a very active counter-irritant; it may be rubbed upon the surface of the skin until redness results. When used in patients whose skin is very delicate, its action may be modified by mixing it with equal parts of olive oil before applying it; this will be found a useful precaution in applying it as a rubefacient to the tender skins of young children.

When redness of the skin has resulted from the application, the skin should be wiped dry by means of a soft towel or absorbent cotton to remove any turpentine from the surface, which by its continued contact may cause vesication.

Turpentine is often employed as a rubefacient in the form of the *turpentine stupe*, which is prepared by sprinkling spirits of turpentine over flannel cloths which have been wrung out in hot water, or by dipping hot flannel in warm spirits of turpentine; prepared in either way the stupe should be squeezed as dry as possible to remove the excess of turpentine before being applied to the surface of the body. A turpentine stupe may cause vesication if allowed to remain for too long a time in contact with the skin; its application for from five to ten minutes will usually produce the desired effect; it should be removed after this time, and it can be reapplied if desired.

If the patient complains of severe burning of the skin after the use of turpentine, the painful surface should be freely smeared with vaseline or lard, which will relieve the uncomfortable symptom.

Chloroform.—A few drops of chloroform applied to the surface of the body by means of a piece of lint, muslin, or flannel, and covered by oiled silk or rubber tissue, will excite a rapid rubefacient effect.

Mustard.—Ground mustard or mustard flour prepared from either *Sinapis alba* or *Sinapis nigra* is one of the most commonly used substances to produre rubefacient action. It is generally employed in the form of the *mustard plaster* or *sinapism*, which is prepared by mixing equal parts of mustard flour with wheat flour or flaxseed meal, and adding to this enough warm water to make a thick paste; this is spread upon a piece of old muslin, and the surface of the paste should be covered with some thin material, such as gauze, to prevent the paste from adhering to the skin. In making a mustard plaster for application to the tender skin of a child, 1 part of mustard flour should be mixed with 3 parts of wheat flour or flaxseed meal.

A mustard plaster or sinapism may be allowed to remain in contact with the skin for a period varying from fifteen to thirty minutes, the time being governed by the sensations of the patient; if it is allowed to remain longer it may cause vesication, which is to be avoided, as ulcers produced by mustard are very painful and extremely slow in healing. After removing a sinapism the irritated surface of the skin should be dressed with a piece of muslin or lint spread with vaseline, boric acid or oxide of zinc ointment.

To excite a rapid revulsive action the *mustard foot-bath* is often employed; it is prepared by adding two tablespoonfuls of mustard flour to a bucket or foot-tub of water at a temperature of 100° to 110°; in this the patient is allowed to soak his feet for a few minutes.

Mustard Papers—Charta Sinapis, which can be obtained in the shops ready for use, are a convenient means of obtaining the rubefacient action of mustard. They are dipped in warm water, and as they are generally very strong, it is well to place a layer of muslin between the surface of the plaster and the skin before applying it to the surface.

Capsicum or *Cayenne pepper* is also sometimes employed as a rubefacient, but it is generally employed in combination with spices, forming the well-known *spice plaster*; this is prepared by taking equal parts of ground ginger, cloves, cinnamon, and allspice, and adding to them one-fourth part of Cayenne pepper; these are thoroughly mixed, enclosed in a flannel bag, and evenly distributed; a few stitches should be passed through the bag at different points, to prevent the powder from shifting its position; before applying it, one side of the bag should be wet with warm whiskey or alcohol. Capsine plasters are also employed to obtain the rubefacient effect of Cayenne pepper.

Aqua ammonia may also be employed for its rubefacient action. A piece of lint saturated with the stronger water of ammonia, placed upon the skin and covered with waxed paper, and allowed to remain for one or two minutes, will produce a marked rubefacient effect.

Caution should be exercised in applying counter-irritants to patients who are comatose or under the influence of a narcotic, for here the sensations of a patient cannot be used as a guide to their removal, and their too long continued application when the vitality of the tissues is impaired may result in serious consequences.

VESICANTS.

Where it is desirable to make a more permanent counter-irritant effect than that produced by rubefacients, substances are employed which by their action on the skin cause an effusion of serum, or of serum and lymph, beneath the cuticle, thus giving rise to vesicles or blisters; they are known as vesicants.

The substance most commonly employed to produce vesication is *Cantharis*, or Spanish fly, and the preparation commonly used is the *Ceratum cantharidis*, which is spread upon adhesive plaster, leaving a margin one-half an inch in width uncovered, which will adhere to the skin and hold the blister in position. The time required for a fly blister to produce vesication is from four to six hours; it should then be removed and the surface should be covered with a flax-seed-meal poultice, or with a warm water dressing. When the blister or vesicle is well developed, it may be punctured at its most dependent part, to allow the serum to escape, and it should be dressed with vaseline or boric ointment. If, for any reason it is desired to keep up continued irritation, after allowing the serum to escape, the cuticle should be cut away and the raw surface should be dressed with some stimulating material, such as the compound resin cerate.

Cantharidal Collodion may also be employed to produce vesication; it is applied by painting several layers upon the skin with a brush over the part on which the blister is to be produced. It is a convenient preparation to use when the patient would disturb the ordinary blister, as in the case of an insane patient, or where the surface is so irregular that the ordinary blister cannot be well applied. The after-treatment of blisters produced by cantharidal collodion is similar to that previously described.

In the treatment of chronic inflammation it is often better to apply a number of small blisters at intervals than one large blister producing an extensive vesication of the surface. Caution should be observed in using blisters upon the tender skins of children; if employed, they should be allowed to remain in contact with the skin for a short time only. They are contra-indicated in patients in whom the vitality of the tissues is depressed by adynamic diseases, and in aged persons.

A complication which sometimes occurs from the use of cantharidal preparations as blisters is *strangury*, which is shown by frequent and painful micturition, the urine often containing blood. This accident should be treated by the use of opium and belladonna by suppository, demulcent drinks, and warm sitz-baths, and by leeches to the perineum if the symptoms are very severe.

To avoid the development of strangury small blisters should be employed, and should not be allowed to remain too long in contact with the surface, and cantharidal preparations should not be employed in cases where renal or vesical irritation has existed or is present. It is said that strangury may also be avoided by incorporating opium and camphor with the cantharidal cerate.

Aqua ammonia fortior and *chloroform* may be employed to produce rapid vesication, a few drops being placed upon the surface of the body and covered by an inverted watch-glass for a few minutes, or lint saturated with aqua ammonia or chloroform may be placed upon the skin and covered with waxed paper or oiled silk. Either of these agents applied in this manner, and allowed to remain in contact with the skin for fifteen minutes, will produce marked vesication. The blisters resulting from these agents are painful, and they are only used where a rapid result is desired.

Nitrate of silver, in a strong solution or in the form of the solid stick, may be applied to the surface of the skin to produce a counter-irritant effect. Nitrate of silver, applied by drawing the moist stick across the skin of the scrotum at a number of points, was formerly a popular form of treatment for acute epididymitis.

Acupuncture.

Counter-irritation is effected by this method by thrusting steel needles deeply into the subcutaneous tissues. The needles employed should be of steel, from two to four inches in length, strong, highly polished, and sharp-pointed, and should have round metallic heads or be fixed in handles. (Fig. 95.) Before being used they should be allowed to remain for a few minutes in boiling water or in a carbolized solution to thoroughly sterilize them. In performing the operation of acupuncture, localities containing important organs, large bloodvessels, the joints, and viscera, should be avoided. When introduced the needles should be passed through the skin with a rotary motion, the skin being rendered tense between the thumb and fingers, and pushed into the deep-seated structures. They are allowed to remain in position for a few moments and are then withdrawn, the skin being supported by the thumb and fingers.

Fig. 95.

Acupuncture needles.

Acupuncture has been found of service in cases of deep-seated neuralgia, obstinate rheumatic affections, and sciatica.

Issues.

Issues are ulcers made intentionally by the application of caustics, the moxa, or the knife. They are not often employed at the present time, but were formerly a popular means of causing long-continued counter-irritation. In making an issue, a region was selected where the subcutaneous cellular tissue was abundant, and which was free from large bloodvessels and nerves, and not near the joints. The plan usually adopted was to apply over the surface of the skin a piece of adhesive plaster perforated in the centre. A small piece of caustic potash or Vienna caustic, mixed with water to make it a paste, was placed in the hole in the adhesive plaster, and held in position by a strip of adhesive plaster. In one or two hours the plaster should be removed and the part should be washed with dilute acid to prevent further action of the caustic; a poultice of flaxseed should next be applied, to hasten the separation of the slough. The ulcer remaining after the removal of the slough may be kept from healing by introducing into it a small wooden ball known as an *issue pea*, or a glass bead or pebble held in place by a compress and adhesive strap.

The Moxa was formerly used to make an issue; it consisted of a small mass of some combustible material, such as punk, cotton, or lint, rolled into pyramidal shape, which was placed upon the surface of the body and ignited so as to produce an eschar upon the skin. To facilitate the application of the moxa an instrument called the porte-moxa (Fig. 96) is employed. The treatment of the eschar resulting from the moxa is the same as that resulting from the use of caustic potash.

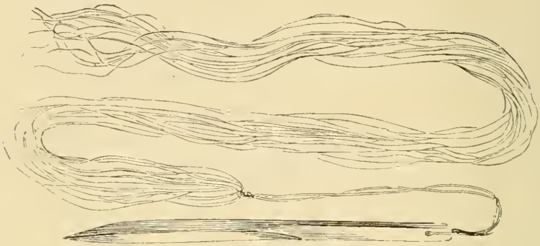
FIG. 96.

Porte-moxa.

The knife was also employed to establish an issue, a crucial incision being made through the skin and cellular tissues into the deep tissues; the objection to the use of the knife in forming an issue was the difficulty in preventing the wound from healing.

The Seton.—A seton is a subcutaneous sinus, or an issue with two openings upon the surface, which is prevented from healing by the introduction of a foreign body. It is established by introducing a few strands of silk, a narrow strip of linen, or a rubber ligature, by means of a seton-needle (Fig. 97), or by means of a sharp-pointed bistoury and an eyed probe. The seton-

FIG. 97.

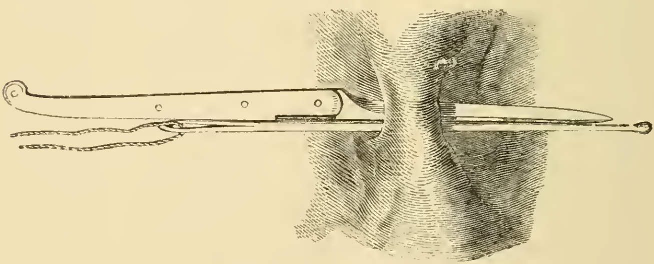


Seton-needle.

needle should be passed deeply into the superficial fascia, care being taken to avoid important veins and nerves.

A seton may also be established by pinching up a fold of skin and transfixing its base with a narrow, sharp-pointed bistoury (Fig. 98), and passing through the wound thus

FIG. 98.



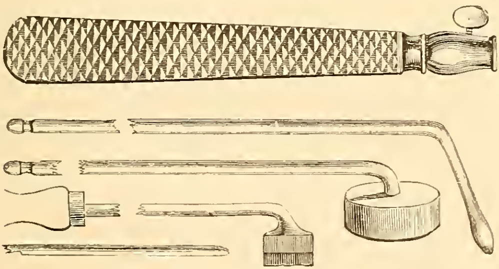
Method of forming a seton.

made an eyed probe armed with a few strands of silk, a strip of muslin, or an elastic ligature; the probe is then removed and the ends loosely tied together. The wound should be dressed, and at each change of the dressing the strip should be removed, or it may be smeared with some stimulating ointment, which can thus be brought in contact with the granulating surface by drawing it through the wound.

Actual Cautery.

This method of counter-irritation is accomplished by bringing in contact with the skin some metallic substance brought to a high degree of temperature. This constitutes one of the most powerful means of counter-irritation and revulsion ; it is rapid in its action, and is not more painful than some of the slower methods. The cauteries generally employed are made of iron, and are fixed in handles of wood or other non-conducting material, and have their extremities fashioned in a variety of shapes (Fig. 99). The irons are

Fig. 99.



Cautery irons.

heated by placing their extremities in an ordinary fire, or by holding them in the flame of a spirit-lamp until they are heated to the desired point, either white or dull-red heat. They are then applied to the surface of the skin at one point, or drawn over the skin in lines either parallel to or crossing one another. The intense burning which follows the use of the cautery may be allayed by placing upon the cautery-marks compresses wrung out in ice-water or saturated with equal parts of lime-water and sweet oil.

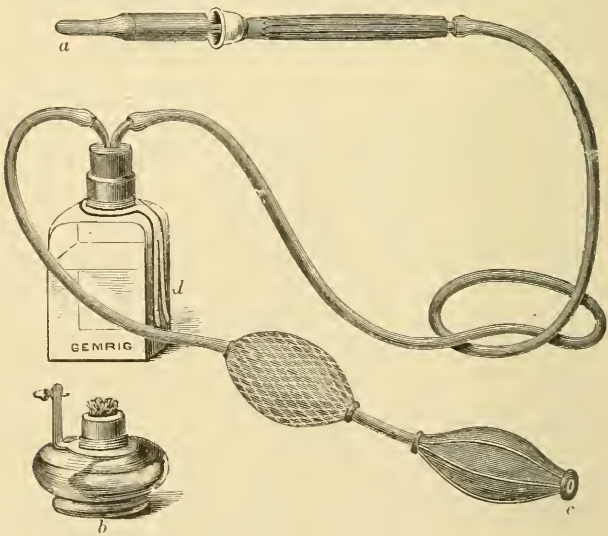
Where the ordinary cautery irons are not at hand, a steel knitting-needle or iron poker heated in the flame of a spirit-lamp or in a fire may be employed with equally satisfactory results. Where the cautery iron is held in contact with the surface for some time to make a deep burn, the pain of its application may be allayed by placing a mixture of salt and cracked ice upon the spot to be cauterized for a few minutes immediately before its application. The cautery iron should not be placed over the skin covering salient parts of the skeleton or over important organs.

Actual cautery thus applied, in addition to its use in producing counter-irritation and revulsion, is often employed to control hemorrhage and to destroy morbid growths.

Paquelin's Thermo-cautery.

A very convenient and efficient means of using thermo-cautery is the apparatus of Paquelin, which utilizes the property of heated platinum-sponge to become incandescent when

Fig. 100.



Paquelin's cautery.

exposed to the action of the vapor of benzole or rhigolene. (Fig. 100.) The cautery is prepared for use by attaching the gum tube to the receiver containing benzole and heating the platinum knife or button, which is also attached to the benzole receiver by a rubber tube, in the flame of the alcohol lamp for a few moments, and then passing the vapor of benzole through the platinum-sponge, which is enclosed in the knife or button, by compressing the rubber bulb. The points may be brought to a high degree of heat, or may be brought only to a dull-red heat.

This form of cautery may be employed for the same purposes as that previously mentioned; its great advantage consists in the ease with which it can be prepared for use. The knives heated to a dull-red heat will be found of great service in operating upon vascular tumors, where the use of an ordinary knife would be accompanied by profuse or even dangerous hemorrhage. Wounds made by the actual cautery are aseptic wounds, and when dusted with iodoform will generally heal promptly under the scab without suppuration.

Bloodletting.

This procedure is often resorted-to to obtain both the local and the general effects following the withdrawal of blood from the circulation. Local depletion is accomplished by means of some one of the following procedures: *scarification*, *puncturation*, *cupping* and *leeching*, and general depletion is effected by means of *venesection* or *arteriotomy*.

Scarification.

Scarification is performed by making small and not too deep incisions into an inflamed or congested part with a sharp-pointed bistoury: the incisions should be in parallel lines and should be made to correspond to the long axis of the part, and care should be taken in making them to avoid wounding superficial veins and nerves. Incisions thus made relieve tension by allowing blood and serum to escape from the engorged capillaries of the infiltrated tissue of the part. Warm fomentations applied over the incisions will increase and keep up the flow of blood and serum. Scarification is employed with advantage in inflammatory conditions of the skin and subcutaneous cellular tissue and in acute inflammatory swelling or œdema of the mucous membrane; for instance, of the conjunctiva, and in acute inflammation of the tonsils, tongue, and epiglottis it is an especially valuable procedure. A modification of scarification known as *deep incisions* is practised in urinary infiltration to establish drainage and relieve the tissues of the contained urine and to prevent sloughing; in threatened gangrene and phlegmonous erysipelas the same procedure is adopted to relieve tension by permitting of the escape of blood and serum, and its employment is often followed by most satisfactory results.

Puncturation.

This procedure consists in making punctures, which should not extend deeper than the subcutaneous tissue, into inflamed tissues with the point of a sharp-pointed bistoury; it is an operation similar in character to that just described, its object being to relieve tension and bring about depletion. It is employed in cases similar to those in which scarification is indicated, and is resorted to in cases of diffuse areolar inflammation or erysipelas.

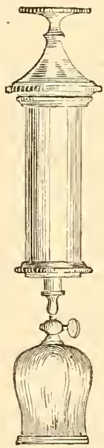
Cupping.

Cupping is a convenient method of employing local depletion by inviting the blood from the deeper parts to the surface of the skin. Cupping is accomplished by the use of *wet* or *dry* cups. When the former are used, no blood is abstracted and the derivative action only is obtained; when wet cups are employed there is an actual abstraction of blood or local depletion as well as the derivative action.

Dry Cupping.

Dry cups as ordinarily applied consist of small cup-shaped glasses, which have a valve and stop-cock at their summit; these are placed upon the skin and an air-pump is attached, and as the air is exhausted in the cup the congested integument is seen to bulge into the cavity of the cup. When the exhaustion is complete the stop-cock is turned and the air-pump is removed, the cup being allowed to remain in position for a few minutes, and is then removed by turning the stop-cock and allowing the air again to enter the cup. This procedure is repeated until a sufficient number of cups have been applied.

Fig. 101.



Cupping-glass and air-pump.

In cases of emergency, when the ordinary cupping-glasses and air-pump cannot be obtained, a very satisfactory substitute may be obtained by taking a wineglass and burning in it a little roll of paper, or a small piece of lint or paper wet with alcohol, and before the flame is extinguished rapidly inverting it upon the skin, or the air may be exhausted by the introduction, for a moment or two, of the flame of a spirit-lamp into the cup. Applied in this manner cups will draw as well as when the more complicated apparatus is used, and when they are removed it is only necessary to press the finger on the skin close to the edge of the cup until air enters the cup, when it will fall off. Although dry cups do not remove blood there is often an escape of blood from the capillaries into the skin and cellular tissue, as evidenced by the ecchymosis which frequently remains at the seat of the cup-marks for some days.

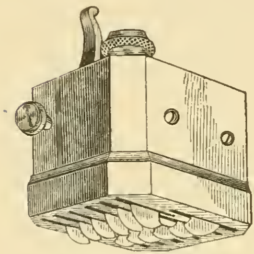
Dry cups, as previously stated, are employed for their derivative action in cases in which depletion is not indicated.

Wet Cupping.

When the abstraction of blood as well as the derivative action is desired wet cups are resorted to, and here it is necessary to have a scarificator as well as the cups and air-pump. (Fig. 102.)

Before applying wet cups the skin should be washed carefully with a carbolic solution, and the scarificator should also be dipped in a carbolic solution. A cup is first applied to produce superficial congestion of the skin; this is removed and the scarificator is applied, and the skin is cut by springing the blades, and the cups are immediately applied and exhausted, and they are kept in place as long as blood continues to flow. When the vacuum is exhausted and blood ceases to flow, they should be removed and emptied, and can be reapplied if it is desirable to remove more blood. A sharp-pointed bistoury which has been sterilized may be employed to make a few incisions into the skin instead of the scarificator, and the improvised cups may be employed if the ordinary cupping apparatus cannot be obtained.

Fig 102.



Scarificator.

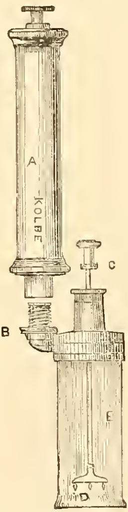
After the removal of wet cups the skin should be washed carefully with a bichloride or carbolic solution, and an antiseptic dressing should be placed over the wounds and held in place by a roller bandage.

Leeching.

In the abstraction of blood by leeching two varieties of leeches are used—the *American* leech, which draws about a teaspoonful of blood, and the *Swedish* leech, which draws three or four teaspoonfuls.

Before applying leeches the skin should be carefully washed, and the leech should be placed upon the part from which the blood is to be drawn, and confined to this place by inverting a tumbler or glass jar over him; if he does not bite or take hold, a little milk or blood should be smeared upon the surface, which will generally secure the desired result. As soon as the leech has ceased to draw blood he is apt to let go his hold and fall off; if, however, it is desired to remove leeches, they may be made to let go their hold by sprinkling them with a little salt. After the removal of leeches bleeding from the bites may be encouraged if desirable by the application of warm fomentations. Leech-bites should be washed with a bichloride or carbolic solution, and a compress of bichloride or iodoform gauze should be placed over them and secured by a bandage.

Fig. 103.



Mechanical leech.

It sometimes happens that free bleeding continues from the leech-bite after the removal of the leeches; in this event, if a compress does not control the hemorrhage, the bleeding-point should be touched with a stick of nitrate of silver or with the point of a steel knitting needle heated to a dull-red heat, and if this fails to control the bleeding a delicate harelip pin should be passed through the skin under the bite and a twisted suture should be thrown around this; the wound should then be washed and dressed as previously described.

In applying leeches in or near mucous cavities, care should be taken to see that they do not escape into the cavities and pass out of reach. Leeches should not be employed directly over inflamed tissue, but should be applied to the parts surrounding it; they should not be allowed to take hold directly over a superficial artery, vein, or nerve, and should never be applied to a part where there is delicate skin and a large amount of loose cellular tissue, as in the eyelid or scrotum, as unsightly ecchymoses will result, which will persist for some time. Leeches should not be used a second time.

Mechanical Leech.

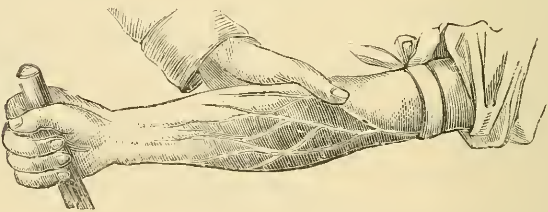
The mechanical leech is an apparatus which has been constructed to take the place of the leech; it consists of a scarificator, cup, and exhausting syringe or air-pump. (Fig. 103.) In using this apparatus, after the scarificator has been used the piston of the exhausting instrument should be drawn out slowly, which secures a better flow of blood than if a sudden vacuum is made.

The mechanical leech may be employed when the natural leech cannot be obtained, but possesses no advantages over the latter, and is apt to get out of order if not in constant use.

VENESECTION.

Venesection, as its name implies, consists in the division of a vein, and it is the ordinary operation by which general depletion or bleeding is accomplished. Venesection at the bend of the elbow is the operation which is now usually resorted to for general bloodletting; the vein selected is the median cephalic, which is further from the line of the brachial artery than the median basilic vein.

FIG. 104.



Venesection. (HEATH.)

To perform venesection the surgeon requires a bistoury or lancet—the spring lancet was formerly much used, but it is not employed at the present time—several bandages, a small antiseptic dressing, and a basin to receive the blood.

The patient's arm should be carefully cleansed, washed over with a bichloride solution, and a few turns of a roller bandage should be placed around the middle of the arm, being applied tightly enough to obstruct the venous circulation and make the veins below become prominent, but not to obstruct the arterial circulation. The patient at the same time should be instructed to grasp a stick or a roller bandage and work his finger upon it. The surgeon should next assure himself that there is no abnormal artery beneath the skin, and having selected the vein, the median cephalic by preference, he then steadies the vein with his thumb and passes the point of the bistoury or lancet beneath it and cuts quickly outward, making a free skin opening. The blood usually escapes freely, and the amount withdrawn is regulated by the condition of the pulse and the appearance of the patient. For this reason it is better to have the patient sitting up or semi-reclining when venesection is performed, as the surgeon can judge better as to the constitutional effects of the loss of blood while the patient is in this position.

When a sufficient quantity of blood has been removed, the thumb is placed over the wounded vein and the bandage is removed from the arm above. The wound is next washed with a bichloride solution, and a compress of antiseptic gauze is applied over the wound and held in position by a bandage, which should be so applied as to envelop the limb from the fingers to the axilla. The dressing need not be disturbed for five or six days, at which time the wound is usually found to be healed.

Wounds of the brachial artery have occurred in opening the vein at the bend of the elbow, but if care is taken this accident should not take place.

Venesection may be practised on the *external jugular vein* when, from excess of fat or in the case of children, the veins at the bend of the elbow cannot be easily found. The vein is rendered prominent by placing the thumb or a pad over the vein at the outer edge of the sterno-cleido-mastoid muscle just above the clavicle. The vein is next opened over this muscle by an incision parallel to its fibres. After a sufficient quantity of blood has escaped, the wound is washed with an antiseptic solution and closed by a compress of antiseptic gauze held in position by a bandage carried around the neck.

Bleeding from this vein has been advocated in cases of apoplexy and cerebral inflammation, but it is questionable whether any advantage is gained by opening the external jugular vein over the vein at the bend of the elbow.

The *internal saphena vein* is also sometimes selected for venesection, and here care should be taken not to wound the accompanying nerve which lies directly behind the vein.

Arteriotomy.

This operation is now scarcely ever performed, but if done the vessel generally selected is the anterior branch of the temporal artery. The position of the vessel is fixed by the finger and thumb, and it is opened by a transverse incision with a bistoury. After a sufficient quantity of blood has escaped the wound is inspected, and if the vessel is not completely divided, its division is completed; the wound should be washed out with an antiseptic solution and a gauze compress should next be applied and held in position by a firmly applied bandage.

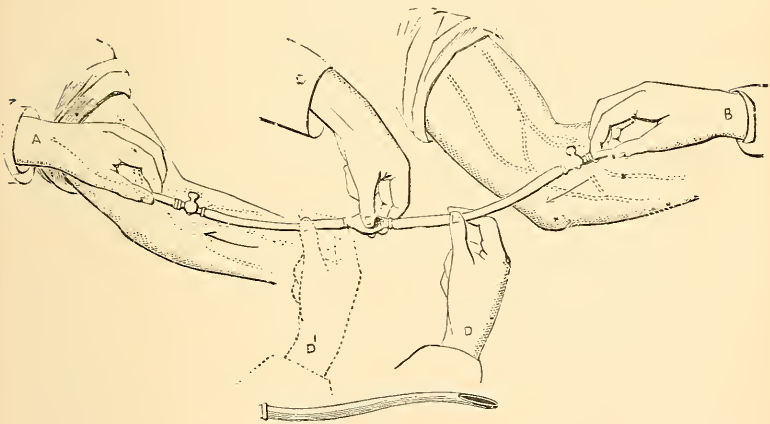
Transfusion of Blood.

This operation may be employed to introduce a certain quantity of blood into the circulation of a patient who has suffered from profuse hemorrhage. There are two methods by which transfusion may be effected: the *direct*, by which the blood is conveyed directly and without exposure to the air from the vessel of one person to that of another, and the *indirect*, in which the blood is first drawn from one person and is then injected into the vein of another, being first deprived of its fibrin before being injected.

Direct Transfusion of Blood.

This is best accomplished by using Aveling's apparatus, which consists of a rubber tube, about eighteen inches in length, with a small bulb in the centre, having metallic extremities provided with stop-cocks, and two bevel-pointed metallic canulæ to be used to connect the tube with the bloodvessels. In performing the operation of direct transfusion the bulb and tube are first placed in a shallow basin containing warm normal saline solution (0.7 per cent.), and the bulb and tube are filled with this solution to displace any air which they contain. The person supplying the

Fig. 105.



Apparatus for the direct transfusion of blood.

blood places his arm near the arm of the patient, and the operator exposes a prominent vein on the patient's arm at the bend of the elbow and opens it, and inserts into it one of the canulæ filled with saline solution, with the point directed toward the body, and at the same time an assistant should introduce the other canula into a vein at the bend of the elbow of the party who supplies the blood.

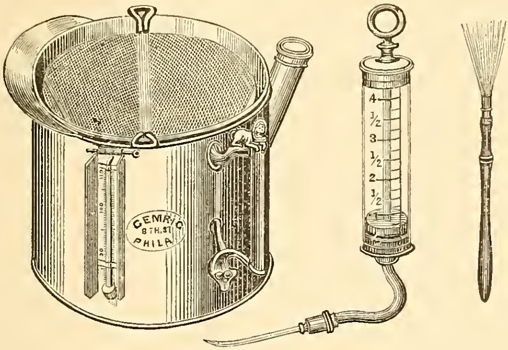
The canulæ are held in position by assistants, and the tube is quickly connected with them, the stop-cocks being closed before it is taken out of the saline solution, to prevent the entrance of air; then upon opening the stop-cocks a direct communication is established between the circulation of the patient and the donor. (Fig. 105.) The introduction of the contents of the bulb into the vein of the patient is effected by the operator slowly compressing the bulb with one hand, while he keeps the tube closed on the side of the donor with the finger and thumb of the other hand. By relaxing the pressure on the tube on the donor's side of the bulb and closing it on the patient's side, blood will flow from the donor's vein into the bulb as it slowly expands, and when filled the communication with the patient's circulation is again made, and the manipulation is repeated until a sufficient quantity of blood has been introduced as indicated by the condition of the patient's pulse. The quantity of blood or saline solution introduced can be calculated by remembering that at each emptying of the bulb two drachms of fluid are introduced into the circulation. When a sufficient quantity has been introduced the canulæ are removed and the wounds are dressed as ordinary venesection wounds.

Indirect Transfusion of Blood.

Indirect transfusion of blood is accomplished by withdrawing from a vein of the donor by venesection about ten ounces of blood, which is received in a clean glass or porcelain vessel, which is placed in water at a temperature of 110°. The blood thus kept warm is next defibrinated by whipping it with a bundle of broom straws or a wire brush, and after being filtered through a fine linen cloth or wire strainer, it is injected by means of an ordinary syringe attached to a canula which has previously been inserted into a vein of the patient; care should be taken that no air is introduced with the blood. When a sufficient quantity of blood has been introduced, the canula is removed and the wound is dressed in the usual manner. The success of this operation largely depends upon the expedition with which it is performed; to prevent the coagulation of the blood not more than two minutes should be allowed to intervene between the reception of the blood in the syringe and its introduction into the patient's vein.

Various forms of apparatus have been devised for the operation of indirect transfusion of blood, and of these one

Fig. 106.



Apparatus for the indirect transfusion of blood.

of the best is that devised by Dr. J. G. Allen and modified by the late Dr. C. T. Hunter. (Fig. 106.)

Arterial Transfusion.

This procedure, which consists in injecting defibrinated venous blood into an artery, is occasionally practised. An artery, usually the radial at the wrist or the posterior tibial behind the inner malleolus, is exposed and secured by a ligature; it is then opened on the distal side of the ligature and the point of a canula or the nozzle of a syringe is introduced, directed toward the distal extremity of the limb, and blood, which has been previously defibrinated, is slowly injected. When a sufficient quantity has been introduced the canula is removed, and the division of the artery is completed and its extremities are secured by ligatures, and the wound is closed and dressed.

Auto-transfusion.

This procedure is recommended in cases of excessive hemorrhage to support a moribund patient until other means of resuscitation can be adopted. It consists in the application of rubber bandages or of muslin bandages to the extremities for the purpose of forcing the blood toward the vascular and nervous centres.

Intra-venous Injection of Saline Solution.

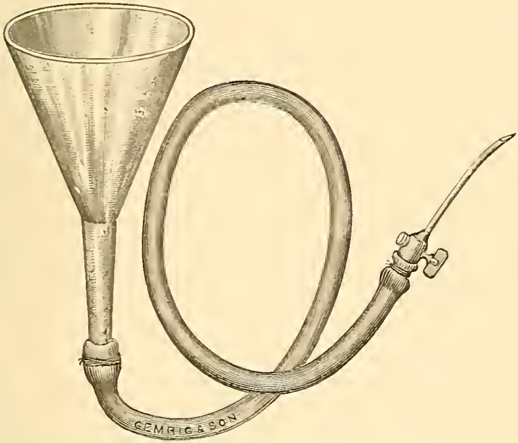
It has been proved by experiments and by clinical experience that human blood is not more efficacious in supplying volume to and restoring a rapidly failing circulation than normal salt solution, and as the latter can be obtained with much more ease than blood, its use has largely superseded the latter. The saline solution which is found most satisfactory to employ for this purpose is known as normal saline solution (0.7 per cent.).

The solution should be prepared with water which has been boiled to sterilize it, and should be of a temperature of about 100° when used.

A vein of the patient, at the elbow, should be exposed and should have placed under it, about one-half inch apart, two catgut ligatures; the distal ligature is then tied and an opening is made into the vein between the ligatures; a canula is next inserted into the opening into the vein, and is secured in position by tying the proximal ligature. The canula is first filled with the saline solution, and is then connected with a funnel by means of a rubber tube (Fig. 107), which is filled with saline solution to displace the air, and upon raising the funnel above the part the solution enters the vein; care should be taken to see that the funnel is kept well supplied with solution until a sufficient quantity has been introduced. The quantity introduced is regulated by the condition of the patient's pulse.

Saline solution may also be introduced by means of a syringe when the apparatus described cannot be obtained.

Fig. 107.



Funnel and tube for intra-venous injection.

Intra-venous Injection of Milk.

The intra-venous injection of cow's or goat's milk has also been employed as a substitute for transfusion of blood in patients who have suffered from excessive hemorrhage or from diseases which greatly deteriorate the quality of the blood, such as pernicious anæmia, typhoid fever, and in carbolic acid poisoning. In making one of these injections the milk should be fresh and should be warmed and strained through a fine wire or linen strainer, and it should be introduced by means of a canula inserted into a vein and secured in position by a ligature; to this canula is attached the rubber tubing and funnel, such as is employed in the intra-venous injection of saline solutions. The funnel and tube are next filled with milk prepared as above described, and it is made to enter the vein of the patient by turning the stop-cock and raising the funnel above the patient's body. This injection has been employed in the class of cases mentioned above with apparently beneficial results.

Artificial Respiration.

This procedure is resorted to in cases of threatened death from apnœa consequent upon drowning, profound anæsthetization or the inhalation of irrespirable gases, or any cause which checks or interferes with the function of breathing. Before resorting to artificial respiration care should be taken to see that nothing is present in the mouth or air-passages which will obstruct the entrance of air into the lungs, such as mucus, foreign bodies or liquids, and also that all tight clothing should be removed from the chest which will interfere with the free expansion of the chest walls.

When artificial respiration is resorted to the operator should persevere with it for some time, even when no apparent spontaneous respiratory movements are excited; for resuscitation has been accomplished in seemingly hopeless cases by patient perseverance with the manipulations.

When the first natural respiratory movement is detected the operator should not cease making artificial respiration, but should continue these movements in such a way as to coincide with the spontaneous inspiratory and expiratory movements until the breathing has assumed its regular character.

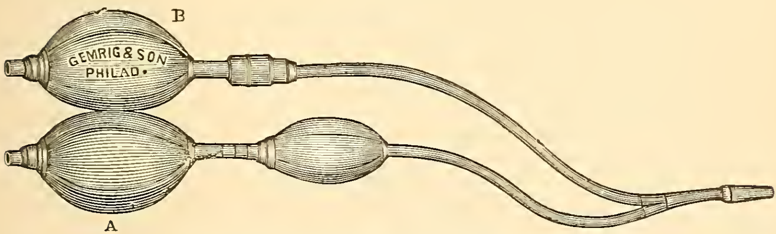
The temperature of the body should also be restored by frictions to the surface of the body by the hands or by rough towels and hot-water bottles, and warm coverings should be applied for the same object.

Mouth-to-Mouth Inflation.

This method of artificial respiration has been resorted to in cases of great emergency, especially in very young children. The operator draws the tongue forward, closes the nostrils, and applies his mouth directly to the mouth of the patient, and by a deep expiratory effort endeavors to force air into the chest; when this is accomplished the air can be expelled from the lungs by pressure upon the walls of the chest, and the procedure should be repeated about sixteen times in a minute. The same object may be accomplished by passing a flexible catheter into the trachea through the mouth, or by passing an intubation-tube, to the upper part of which a rubber tube is attached, into the larynx; this can be passed with the fingers without difficulty, and the lungs can then be inflated by the operator blowing into the catheter or tube, or by attaching to it a pair of bellows.

Inflation of the lungs through the nostrils has been employed by Dr. Richardson, of London, who has devised a pocket-bellows for this object. The apparatus consists of two elastic bulbs, to which two rubber tubes are attached, which terminate in a single tube. In using this bellows the terminal tube is introduced into one nostril, the other nostril

Fig. 108.



Richardson's bellows for artificial respiration.

and mouth being closed; air is forced into the lungs by compressing one bulb, and withdrawn by compressing the other bulb.

This bellows may also be attached to a catheter or intubation-tube passed into the larynx, which would prevent the possibility of air escaping into the œsophagus, which is a complication which is liable to occur in mouth-to-mouth inflation or inflation through the nose.

Direct Method of Artificial Respiration (Howard's).

This method of artificial respiration is at the present time considered the most efficacious, and is the one adopted by the United States Life Saving Service, and although the rules given are for the resuscitation of cases of apparent drowning, the same procedures may be adopted in cases of apnœa arising from other causes.

The rules laid down by Dr. Howard are as follows:

Rule I.—"To expel water from the stomach and lungs, strip the patient to the waist, and if the jaws are clenched separate them and keep them apart by placing between the teeth a cork or a small piece of wood. Place the patient face downward, the pit of the stomach being raised above the level of the mouth by a large roll of clothing placed beneath it. (Fig. 109.) Throw your weight forcibly two or three times upon the patient's back over the roll of

FIG. 109.

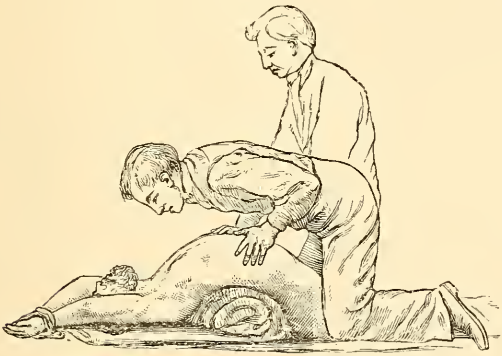
First manipulation in Howard's method.

clothing so as to press all fluids in the stomach out of the mouth."

The first rule applies only to cases of drowning, and in using Howard's method in apnœa from other causes it is to be omitted.

Rule II.—"To perform artificial respiration, quickly turn the patient upon his back, placing the roll of clothing beneath it so as to make the breast-bone the highest point of the body. Kneel beside or astride of the patient's hips. Grasp the front part of the chest on either side of the pit of the stomach, resting the fingers along the spaces between the short ribs. Brace your elbows against your sides, and steadily grasping and pressing forward and upward throw your whole weight upon the chest, gradually increasing the pressure while you count one—two—three. Then suddenly let go with a final push which springs you back to your first position. (Fig. 110.) Rest erect upon your knees while you count one—two; then make pressure again as before, repeating the entire motions at first about four or five times a minute, gradually increasing to about ten or

Fig. 110.



Direct method of artificial respiration.

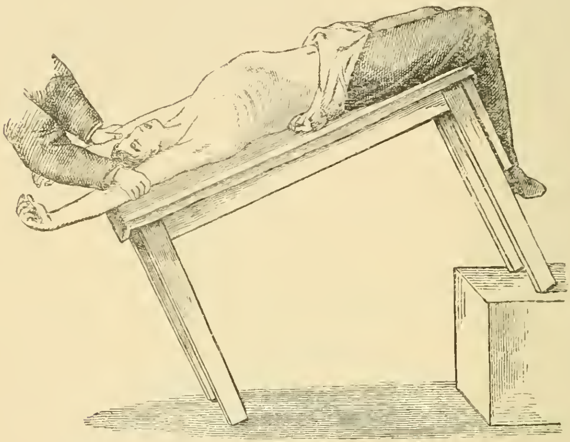
twelve times. Use the same regularity as in blowing bellows and as seen in the natural breathing which you are imitating. If another person is present let him with one hand, by means of a dry piece of linen, hold the tip of the tongue out of one corner of the mouth, and with the other hand grasp both wrists and pin them to the ground above the patient's head."

This method may be employed in cases of still-birth or in young children, the operator holding the chest of the child in his left hand and compressing it with the right hand.

Sylvester's Method of Artificial Respiration.

In employing this method of artificial respiration the patient should be placed on his back upon a firm flat surface; a cushion of clothing is placed under the shoulders,

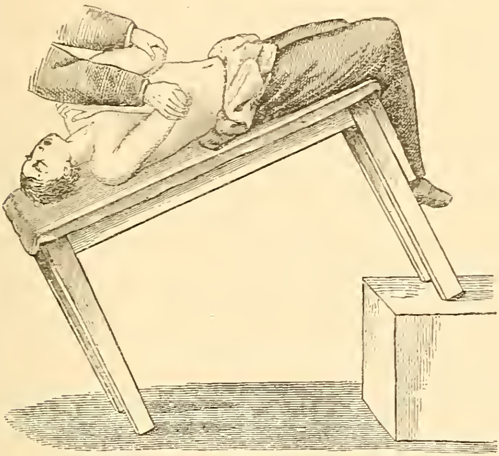
Fig. 111.



Sylvester's method—Inspiration. (Esmarch.)

and the head should be dropped lower than the body by tilting the surface on which he is laid. The mouth being cleared of mucus or foreign substances, the tongue is drawn forward and secured to the chin by a piece of tape tied around it and the lower jaw, or may be pulled out of the mouth and held by an assistant. The operator, standing at the patient's head, grasps the arms at the elbows and carries them first outward and then upward until the hands are brought together above the head; they should be kept in this position for two seconds, after which time they are brought slowly back to the sides of the thorax and pressed against it for two seconds. These movements are repeated fifteen times in a minute until the breathing is restored, or until it is evident that the case is a hopeless one.

FIG. 112.



Sylvester's method—Expiration. (ESMARCH.)

Marshall Hall's Ready Method of Artificial Respiration.

In this method the mouth should first be freed from mucus or foreign bodies, and the patient is turned upon his face with one wrist under his forehead, and a roll of clothing is placed beneath his chest. By turning the body briskly on the side and a little beyond, and then on the face, alternately, respiration is imitated. As the body is brought in the prone position, compression is to be made upon the posterior aspect of the chest. These manipulations should be made fifteen times in a minute.

In using any of these methods of artificial respiration the operator should persevere with them for an hour at least before abandoning the case as a hopeless one.

In cases where the apnœa is due to the presence of a foreign body in the larynx or trachea, it is evident that no efforts at respiration can be successful until the air-passages are freed from the occluding body, and in such cases tracheotomy should be performed before artificial respiration is attempted; the tracheal wound should be held open by retractors, which in a case of emergency can be made from bent hairpins, or by a tracheotomy-tube if one be at hand.

Forced Respiration.

This is that method of artificial respiration by which air is forcibly passed into the lungs. This procedure is strongly advocated by Dr. George E. Fell, who has devised an apparatus by which it may be satisfactorily accomplished. Prof. H. C. Wood has also made use of forced respiration in the resuscitation of animals with an apparatus somewhat similar to that devised by Dr. Fell with good results, but has never applied it practically in the case of the human subject. Wood's apparatus consists of a pair of bellows, a few feet of rubber tubing and a face mask of rubber, and one or two intubation-tubes; the mask or intubation-tube is attached to one end of the rubber tube and the bellows to the other end of the tube. The mask is applied over the mouth, or if this is not used the intubation-tube is introduced into the larynx, and air is forced into the lungs by working the bellows. He also advises that in the tubing a double metal tube be introduced, with openings so placed that their size can be so regulated by turning the outer tube, that the operator can allow any excess of air thrown by the bellows to escape.

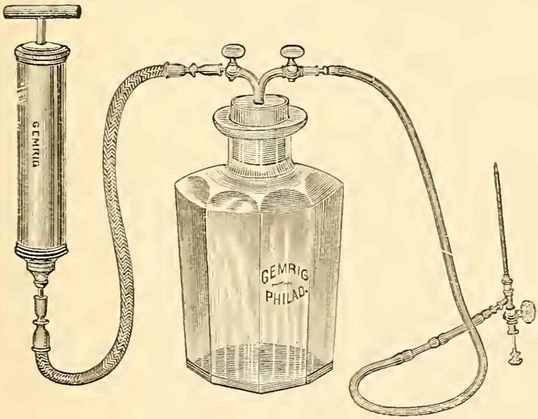
The apparatus of Fell, which he has used in a number of cases with good results, consists of a tracheotomy-tube, a tube connected with the air-control valve, which is attached to an air-warming apparatus, which in turn is connected with a bellows by another tube. In this apparatus air is forced into the lungs and allowed to escape when the lungs have been expanded by the elasticity of the lung tissue and the chest walls.

Forced respiration will prove of value in cases of narcotic poisoning and other accidents in which death is produced by paralysis of the respiratory centres. Dr. Fell has reported a number of cases of narcotic poisoning in which he has used his apparatus with the most satisfactory results.

Aspiration.

This procedure is adopted to remove fluid from a closed cavity without the admission of air, and the instrument which is employed to accomplish this object is known as an aspirator. The two forms of aspirator most generally employed are those of Dieulafoy and Potain. (Fig. 113.)

Fig. 113.



Aspirator.

Potain's aspirator consists of a glass bottle, into the stopper of which is introduced a metallic tube, which is connected with two rubber tubes, one of which is connected with an exhausting pump, and the other with a delicate canula carrying a fine trocar; the apparatus is provided with stopcocks to prevent the admission of air. In using this aspirator the bottle is exhausted of air by using the air-pump; the canula enclosing the trocar is next pushed through the tissues into the cavity containing the fluid to be removed; the trocar is next removed, and upon opening the stop-cock the fluid is forced out of the cavity by atmospheric pressure and passes into the bottle or receiver. If the fluid contains masses of lymph or clots which block the canula, interrupting the flow of fluid, a stylet is passed through the canula to free it of the obstruction.

To diminish the pain produced in introducing the trocar and canula, the skin at the point to be punctured may be rendered less sensitive by holding in contact with it for a few minutes a piece of ice wrapped in a towel, or a towel containing broken ice and salt. Care should also be taken to see that the trocar and canula are perfectly clean; to accomplish this it should be carefully washed and placed in boiling water or a 5 per cent. carbolic solution before being used.

In introducing the trocar and canula the operator should be careful to avoid injuring any important veins, arteries, or nerves.

After removing the canula the small puncture should be dressed with a compress of antiseptic or iodoform gauze held in place by a bandage or adhesive straps.

The aspirator is frequently employed in cases of hydrothorax, empyema and ascites, to evacuate the contents of cold abscesses in diseases of the hip and spine, and to remove the contents of a distended bladder until a more radical operation can be performed. It is also a valuable instrument for diagnostic purposes, being frequently used to ascertain the character of the contents of deep-seated tumors containing fluid.

The Stomach-tube.

This consists of a tube about twenty-eight inches in length and three-eighths of an inch in diameter, which is introduced while the patient is in the sitting posture, the head being thrown backward so as to bring the mouth and gullet as nearly as possible in the same line. The tube being warmed and oiled, the surgeon standing in front of the patient passes it directly back to the pharynx, at the same time introducing the index finger of the left hand to guide its point over the epiglottis; it is then passed gently downward into the stomach. If any obstruction is met with in its passage it should be withdrawn a little way and then pushed gently downward; all manipulations should be made without much force to prevent perforation of the wall of the œsophagus.

The introduction of the stomach-tube may be required for the evacuation of poisons from the stomach, or to wash out the cavity of this viscus, and it may also be used to introduce liquid nourishment into the stomachs of patients who are unable or unwilling to swallow food. In the recently introduced method of treating disorders of the stomach and intestines by washing them out, *lavage*, the introduction of a stomach-tube is required; the tube here employed is from twenty-four to thirty inches in length (Fig. 114), and the fluid is introduced by means of a funnel

FIG. 114.

The Stomach-tube.

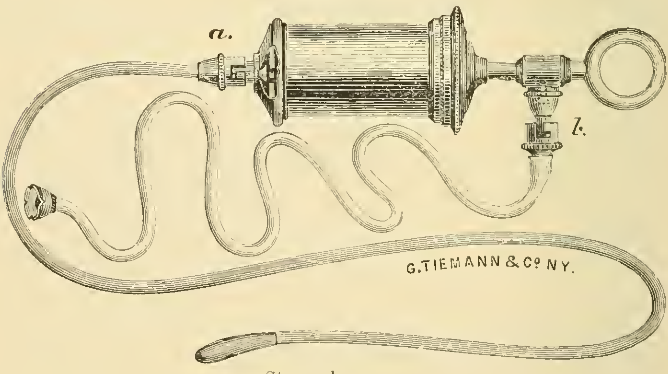
attached to its free extremity, or it may be attached to a stomach-pump. In introducing liquid nourishment a syringe or funnel is fitted to the exposed end of the tube which has been passed into the stomach; the syringe or funnel having been filled with milk or beef-tea or broth, the contents are injected gently or allowed to run into the stomach.

In cases of poisoning, where it is desirable to withdraw the contents of the stomach and to wash out the organ, a stomach-tube and syringe may be employed; several syringefuls of warm water are first thrown into the stomach and then withdrawn by suction, but in such cases the use of the stomach-pump will be found more satisfactory.

The Stomach-pump.

This consists of a brass syringe, the nozzle of which is connected with two tubes, one at the end, the other at the side. The passage through the nozzle is regulated by a valve controlled by a lever. The nozzle of the pump is attached to the stomach-tube, and the end of the lateral tube is placed in a pan of warm water. By raising the piston and opening the valve, water may be drawn from the basin, and by closing the valve and depressing the piston it is passed through the stomach-tube into the stomach; when a sufficient quantity has been injected in this manner, by reversing the action of the valve the fluid is drawn out of the stomach and discharged through the lateral tube into a basin. This manipulation is continued until the water returns clear and the stomach has been completely washed out. A less complicated instrument will often serve as well as that just described (Fig. 115).

Fig. 115.



Stomach-pump.

Œsophageal Bougie.—This instrument—which may be passed through the œsophagus into the stomach for the purposes of diagnosis, or for the purpose of dilating strictures of the œsophagus—is passed in exactly the same manner as the stomach-tube, and, as in the case of the latter instrument, it should be introduced without the use of much force, as perforations of the œsophagus have followed the forcible introduction of such bougies.

Vaccination.

This is a minor surgical procedure which every physician is called upon to perform. The surface may be prepared for the reception of the lymph by abrading the surface of the skin at one or two points with a dull lancet, or by making several superficial incisions with a knife, or by scratching the surface of the skin with the ivory-point charged with lymph, in lines with crossing lines, *cross-scratch*, until a little serum exudes. It is not advisable to draw blood, which washes away the lymph, and for this reason I prefer the abraded surface made by the dull knife or the ivory-point.

The lymph used may be the *humanized* or the *bovine*. The *humanized lymph* may be the viscid fluid taken from the vaccine vesicle on the eighth or ninth day, or the dried scab which separates when the wound is about healed; if the latter is used, a small portion of it is rubbed up with water until it forms a mixture of creamy consistence; this is rubbed into the abraded surface or the punctures. In using humanized lymph care should be taken to see that it is procured from a healthy subject.

Bovine lymph or *virus*, which is now most generally employed, is taken from the vaccine vesicles upon the udders and teats of heifers; ivory-points or quills are dipped into this lymph and allowed to dry, and in using them they are dipped in water for a moment, to moisten the lymph, before being applied to the abraded surface. The ivory-point is one of the most convenient means of vaccinating, as the surface may be abraded with it before the lymph is applied.

It has recently been advised that antiseptic precautions be exercised in performing vaccination, and although all of the details cannot be carried out, I have found that the exercise of care as regards cleanliness of the surface has been followed by much fewer inflammatory complications in vaccination wounds. In an institution in which I vaccinate yearly a large number of cases, since I have adopted the following precautions I have had fewer bad arms.

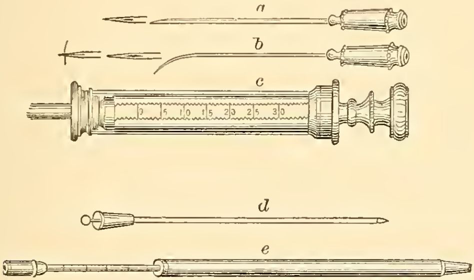
The surface to be abraded, usually the left arm below the deltoid, is first washed with soap and water, and then with a 1 : 2000 bichloride solution. Two points of this surface, an inch apart, are then abraded by using a knife which has been washed or dipped in boiling water, or by using the ivory-point which has been dipped in water which has been boiled and cooled down. When the surface has been prepared in the manner described, the moistened virus is rubbed upon it and allowed to dry. Vaccination upon the leg, which is practised by some physicians to prevent the scar from showing, I think is not to be recommended, and I never practise it in this situation, as it is more difficult to keep this part at rest, and I have seen some very severe cases of cellulitis and phlebitis follow leg vaccination.

Hypodermic Injections.

The syringe used to make hypodermic injections is provided with a perforated needle, which is passed into the cellular tissue. (Fig. 116.) Care should be taken to see that the instrument and needle are perfectly clean before being used; if a metallic syringe is employed it should be rendered aseptic by soaking it for a few minutes in boiling water, or in a five per cent. carbolic solution. Hypodermic injections are generally made into parts in which the cellular tissue is abundant, and great care should be observed to avoid introducing the needle into a large vein or artery, as by neglect of this precaution serious symptoms have resulted, from the drug being thrown rapidly into the circulation instead of being slowly absorbed from the subcutaneous cellular tissue; the injury of superficial nerves should also be avoided. Care should also be taken to see that the solutions employed are sterilized if possible, and freshly made solutions should be preferred.

An unclean syringe or a solution which has not been sterilized may give rise to a troublesome abscess at the site of the injection.

Fig. 116.

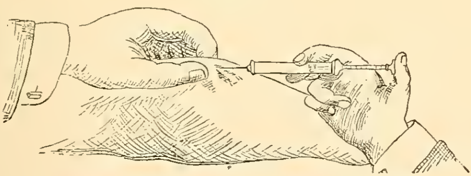


Hypodermic syringe and needles.

To avoid using solutions for hypodermic use which undergo change from being kept, it will be found convenient to use the compressed pellets which are prepared by the manufacturing chemists, the alkaloids being compressed with a little sulphate of sodium, which increases their solubility, the solution being prepared with boiled water just before being used.

The portions of the body usually selected for hypodermic injection are the outer surface of the thighs or arms and

Fig. 117.



Method of giving a hypodermic injection.

the anterior surface of the forearm. In making a hypodermic injection the syringe is charged and the needle is fastened to the nozzle of the syringe; the skin is next pinched up and the needle is quickly thrust through this into the cellular tissue; the syringe is then emptied by pressing down the piston, and when the cylinder is empty the needle is withdrawn; the small puncture in the skin resulting seldom bleeds and usually heals without difficulty. (Fig. 117.) In patients who have suffered from profuse hemorrhage, where transfusion of blood is not considered advisable, large injections of normal salt solution may be introduced into the cellular tissue by means of hypodermic injections, or the needle may be introduced into the cellular tissue and connected by a piece of rubber tubing, with an irrigator containing normal salt solution held above the part, and the solution gradually finds its way into the subcutaneous cellular tissue. A large quantity of fluid may be introduced in this way.

Exploring Needle.

This consists of a fine-grooved needle fitted into a handle (Fig. 118), which is introduced into tumors or swellings to

Fig. 118.

Exploring needle.

ascertain the nature of their contents, and its use is often of service for purposes of diagnosis. The exploring trocar (Fig. 119) is employed for the same purpose, or the needle

Fig. 119.

Exploring trocar.

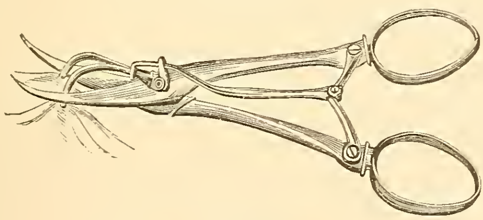
of the hypodermic syringe or a fine needle attached to an aspirator may be used for a like purpose. When either the exploring needle or trocar is employed care should be taken to see that it is rendered perfectly aseptic before being used; otherwise its employment is not without danger, for I have seen the introduction of an exploring needle into an effusion in a joint for diagnostic purposes followed by suppuration and destruction of the joint, which subsequently necessitated its excision.

Skin-grafting.

This is a minor surgical procedure which may be employed to hasten cicatrization where large granulating surfaces are exposed, such as result from extensive operations and from burns.

The operation consists in applying shavings of the epidermis or of the epidermis and cutis together, to the grannlating surface and holding them in contact with it for a few days; the grafts often seem to disappear, but at the end of a few days, if the part is closely inspected, bluish-white points will be seen to occupy the positions at which the grafts were applied, which become converted into isolated cicatrices from which the healing process rapidly extends. To have a successful result following the use of skin-grafts the surface of the ulcer should be healthy, and the grafts should be applied at a number of points.

Fig. 120.



Scissors for skin-grafting.

The skin is removed by scissors made for this purpose (Fig. 120), or by raising the epidermis with a needle or with forceps and cutting out a small portion of it with a sharp scalpel. The graft is next applied to the granulating surface with its raw surface in contact with the granulations; after a sufficient number of grafts have been applied, a piece of sterilized protective is laid over them and held in place by means of a few strips of isinglass plaster. An ordinary antiseptic gauze dressing is next applied, and the dressing is not disturbed for a week or ten days, at which time, if the grafts have taken, isolated cicatrices at the points where the grafts were applied will be found to exist.

Electrolysis.

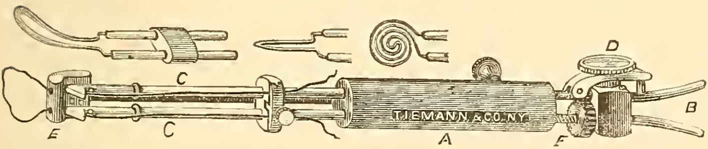
Electrolysis, or the chemical decomposition induced by electricity, is employed in surgery to destroy morbid products, tumors, or exudations. For this procedure a galvanic or continuous-current battery is required, which is provided with electrodes and needles of suitable shapes. In applying electrolysis to a tumor, for instance, the needle connected with one of the poles of the battery is inserted into the tumor and the other rheophore is applied to the surface of the body, or two fine needles, carefully insulated nearly to their extremities, are connected with both poles of the battery by conducting cords; these are introduced into the tumor and a weak current is allowed to pass, and its strength is gradually increased as the operation advances; the current is passed for fifteen or twenty minutes, and the procedure is repeated at intervals of several days, until some decided change occurs in the tumor.

Electrolysis has been applied with success in the treatment of aneurism inaccessible to other operative procedures, in malignant growths, in nævi, goitres, cysts, hydatids, and is at the present time the most satisfactory method of removing superfluous hairs from those portions of the body in which their presence causes disfigurement.

Galvano-cautery.

Galvano-cautery batteries are constructed with plates of large size, placed closely together, so that the internal resistance is reduced and a current is quickly obtained which will keep a metallic electrode at a white heat. The advantage in the use of this form of cautery is that the electrode can be introduced into the various cavities of the body while cold and quickly heated to the desired temperature. The electrodes are made of various shapes and sizes, according to the object desired (Fig. 121). Galvano-cautery is applied

Fig. 121.



Electrodes for galvano-cautery.

for the same purposes as the actual cautery, but, as previously stated, its use is more convenient in the various cavities of the body, its action can be more easily localized, and by its use hemorrhage is avoided. It is frequently employed to destroy morbid growths in the nasal passages, the throat, vagina, or uterus, and also may be employed in the treatment of superficial external growths; in using it for the removal of growths from the mucous membrane, its application may be rendered practically painless by previously thoroughly cocainizing the parts.

Faradization.

The application of electricity in this form is often employed in surgical affections; in cases of wasting of the muscles following fractures or sprains, in some forms of club-foot, and in lateral curvature of the spine the judicious use of the faradic current will often be found to be followed by the most satisfactory results. The current is applied in such a manner as to bring about contraction of the affected or wasted muscles, and thus improve their nutrition.

Massage.

Massage consists in a variety of manipulations, such as pinching up the integuments and muscles, and rolling them between the thumb and fingers, in stroking or rubbing the surface with the palm of the hand from the periphery toward the centre, to empty the distended veins and lymphatics; rubbing the parts circularly with the extremities of the fingers and thumb or the palm of the hand, or kneading of the parts is another method of practising massage. Massage may also be practised by tapping the surface of the affected part with more or less force with the tips of the fingers held in a row, or with the ulnar border of the hand or with the palm of the hand. Before applying massage to an affected part, if there be a heavy growth of hair, it should be carefully shaved off; otherwise the manipulation may give the patient pain, and irritation of the hair follicles resulting in abscesses will be apt to occur. The part should also be rubbed over with olive oil, vaseline, or cocoa-butter before and during the manipulations.

Massage is often employed with advantage in the treatment of sprains and strains in their subacute and chronic states, and it will be found of great service in the later treatment of fractures involving the joints or their vicinity, in regaining the motion of the parts as well as in improving the nutrition of the muscles which have become wasted from disuse.

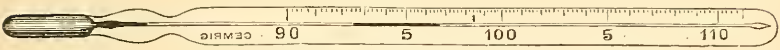
Passive Motion.

This manipulation consists in alternately flexing and extending or rotating the limb to imitate the normal joint movements. The motions should be carefully practised, and in cases of fracture they should not be undertaken until there is quite firm union at the seat of fracture, or if for any reason passive motion is made use of before this time the fragments should be firmly supported while it is being employed. Other forms of massage, such as stroking and kneading, may be employed in conjunction with passive motion in the treatment of the troublesome stiffness of the joints resulting from fractures, dislocations, and sprains; passive motion applied in this manner will often restore the function of a stiff joint more satisfactorily and with less pain to the patient than the forcible manipulations of the joint which are practised under an anæsthetic.

The Clinical Thermometer.

For clinical observations two thermometer scales are in general use, the Centigrade and Fahrenheit; the latter is the one commonly employed in America and England. This scale has a limited range above and below the normal bodily temperature, which is $98\frac{2}{5}°$ Fahrenheit or 36° Centigrade. Thermometers are now made with a convex surface,

Fig. 122.

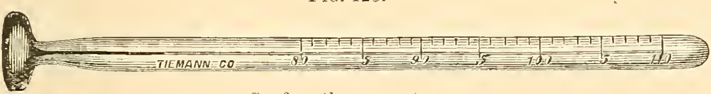


Clinical thermometer.

which serves to magnify the column of mercury, and thus enables the observer without difficulty to note the position of the index. (Fig. 122.)

The temperature of the body may be taken in the mouth, axilla, vagina, or rectum; the two former positions are those generally employed. When taken in the axilla care should be exercised to see that no clothing is interposed between the skin and the instrument, and when the mouth is used for thermometric observations the patient should be instructed to keep his lips tightly closed and breathe through

Fig. 123.



Surface thermometer.

his nose. The thermometer should be kept in place for from three to five minutes.

Surface thermometers are sometimes employed, the instruments for this purpose having bulbs of a discoid shape, or are drawn out in the form of a spiral or coil. (Fig. 123.) In using this form of thermometer to determine the amount of variation of the surface temperature, the temperature of corresponding parts of the body on the opposite side and the general temperature of the body should be taken at the same time.

The Rectal Tube.

The introduction of the rectal tube is best accomplished by placing the patient upon his left side, and the surgeon should introduce his index finger well oiled into the rectum and guide the tube upon this through the anus, and by gentle pressure it is gradually passed into the rectum; if a stricture exists in the rectum within reach of the finger, the latter should be used to guide the tube through the opening in this; if the tube becomes caught in a transverse fold of the mucous membrane, and becomes doubled upon itself, it should be withdrawn and a fresh attempt should be made to pass it; in passing a rectal tube all manipulations should be made with extreme gentleness, as it has been shown that its passage is not without danger, perforations of the intestine having followed its use in some cases. In cases of stricture of the rectum high up, the operator has to depend upon the sense of resistance experienced in passing the tube, and in such cases the manipulations should be most carefully made. When the rectal tube is employed to introduce fluids into the large intestine, the fluids may be introduced by means of a syringe, or by pouring them into a funnel attached to the free end of the tube, or by attaching the tube to a fountain syringe, thus allowing the liquid to pass slowly into the intestine.

The rectal tube is often employed with good results in relieving the intestine of excessive flatus, and in introducing water or oil into the intestine in cases of intestinal obstruction, and in those cases where the obstruction results from intussusception or fecal accumulations its use will often prove most satisfactory.

Rectal Bougies.

These instruments are made of the same material as the English flexible catheter, and are of various sizes. They should first be oiled, and carefully introduced in the same manner as the rectal tube. They are generally employed in cases of stricture of the rectum, and they should be used with great care to avoid perforating the wall of the rectum. A very satisfactory substitute for a rectal bougie is a tallow candle, one end of which is melted or rubbed down to a conical shape.

Enemata.

These may be administered by means of the ordinary syringe, or by means of a gravity or fountain syringe: the precautions which should be observed are to introduce the nozzle of the syringe gently and in the right direction, as perforation of the lower portion of the rectum has taken place from the careless and forcible introduction of the nozzle of the enema-syringe; the fluid should also be injected slowly, as by so doing there is less resistance and less tendency for the patient to pass the fluid before the desired quantity has been introduced.

The enema most commonly employed to empty the lower bowel is made by adding a tablespoonful of sweet oil and two teaspoonfuls of spirits of turpentine to one or two pints of warm water in which a little Castile soap has been dissolved; warm water and sweet oil are also frequently used for the same purpose.

Glycerin Enema.—One or two teaspoonfuls of glycerin injected into the rectum, or a suppository made of glycerin, will often be found an efficient substitute for the larger enemata of water.

Nutritious Enemata.

When it is found necessary to resort to feeding by the rectum, the substances employed should be injected into the rectum by means of a syringe, and care should be taken to see that the quantity is not too large, and that it is of such a nature as not to cause any irritation of the walls of the rectum, or it will not be retained; two ounces in the case of an adult is generally a sufficient quantity to inject at one time.

Peptonized milk or beef juice, or the yolk of an egg beaten up with milk, are often employed, and any unirritating drugs may be mixed with the enema and administered at the same time.

Anæsthetics.

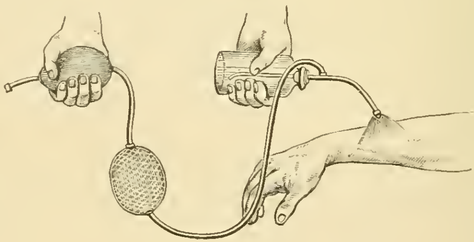
The substances which are employed at the present time to produce either local or general anæsthesia are ice, cocaine, rhigolene, nitrous oxide, chloroform, and ether.

Local Anæsthesia.

Cold.

Local anæsthesia may be produced by the application of cold, either by a piece of ice or a mixture of ice and salt

Fig. 124.



Application of rhigolene spray.

held in contact with the part for one or two minutes, or by directing a spray of rhigolene upon the surface of the part whose sensibility is to be obtunded. (Fig. 124) This form of local anæsthesia is made use of in minor surgical procedures, such as aspiration, the opening of abscesses, and the removal of superficial tumors.

Rapid Respiration.

Rapidly repeated deep inspirations kept up for a few minutes will produce insensibility to pain, but sensibility to contact is not obliterated. This form of anæsthesia may be made use of in slight operations, such as the opening of abscesses.

Cocaine.

Local anæsthesia produced by the employment of an aqueous solution of the hydrochlorate of cocaine, in strength from 2 to 12 per cent., is often made use of in minor surgical procedures, where the mucous membrane is to be operated upon or growths removed from it. Analgesia is produced by brushing the surface over with the solution of cocaine, or by applying a compress of absorbent cotton saturated with the solution to the part for a few minutes; in mucous cavities the latter method of application will be found most convenient. In using a solution of cocaine to produce anæsthesia in operations upon the eye a 2 or 4 per cent. solution is dropped into the eye, and the application is repeated until the analgesia is complete.

In applying cocaine to the urethra a 4 to 10 per cent. solution is injected into the urethra, and is allowed to remain for two or three minutes; more than one or two grains should not be injected at one time.

When it is desired to produce local anæsthesia of the skin or deeper tissues the application of the solution of cocaine to the surface is not satisfactory, and it should in such cases be injected hypodermically into the deeper layers of the skin and into the cellular tissue of the parts to be operated upon; to avoid mutiple puncture the needle is not completely withdrawn from the wound, but its direction is changed and the solution is thrown into different portions of the tissues. It is well, in situations where it can be accomplished, to cut off the circulation from the part to be operated upon by placing around it a rubber strap or tube, which prevents its rapid absorption into the general blood current. It is well not to inject more than one grain of the drug in this way, for fatal results have followed the injection of larger quantities; this is especially the case in using cocaine in the urethra and rectum, and in these situations great caution should be exercised in its use.

Some persons also have an idiosyncrasy for cocaine, and children seem more susceptible to its constitutional effects than adults. I have seen several cases in children in which marked symptoms of cocaine poisoning resulted from the application of a 4 per cent. solution to the nasal mucous membrane.

In minor surgical operations, such as amputations of the finger, circumcision, opening of abscesses, and removal of superficial tumors, cocaine-anæsthesia may be employed with advantage, but its utility is most marked in operations upon the eye and those upon the mucous membranes of the nose, throat, rectum, vagina, and urethra. Applied to the surface of an ulcer for a few minutes, which is to be cauterized, it will render the operation almost painless to the patient.

Nitrous Oxide Gas.

This gas is administered for the purpose of producing anæsthesia, and the apparatus best suited for its administration consists of a cylinder of metal in which the gas is compressed; this is attached to a rubber bag which has a mouthpiece fastened to it; this is provided with a double valve, which prevents the expired air from passing back into the bag. The mouthpiece is adjusted over the mouth, and after removing any false teeth, or foreign bodies, from the mouth, the patient is instructed to take deep, full breaths, and in from one-half to one minute the face becomes congested and dusky, and the breathing becomes stertorous, indicating that the patient is fully under the influence of the gas. The anæsthesia from nitrous oxide cannot be prolonged for more than a few minutes, so that it can only be employed in operations which take a short time for their performance, such as the extraction of teeth, opening of abscesses, and reduction of dislocations or fractures. In England nitrous oxide is frequently used to produce anæsthesia, and when this result is accomplished the anæsthesia is kept up by the administration of ether by the employment of a special apparatus devised for this purpose. Nitrous oxide gas is most commonly employed in dental surgery to produce anæsthesia for the removal of teeth, but is also occasionally employed in minor surgical operations; but from the fact that the apparatus for its administration is a bulky one, its use is not as convenient as ether or chloroform, and in this country it is not much employed in general surgery.

Ether.

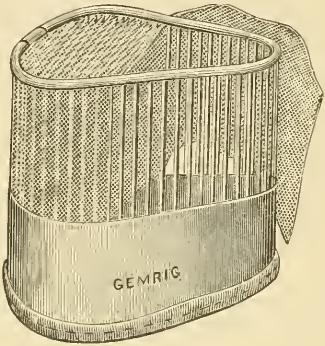
Sulphuric ether is one of the most widely employed substances in surgery to produce anæsthesia; it is probably the safest of all anæsthetics, and for this reason should be given the preference over all others.

A patient should be prepared for the administration of ether by not allowing him to have any solid food for at least six hours before its inhalation: he should be in the recumbent posture, and any garments about the chest or neck should be loosened so that the respiratory movements are not interfered with. The surgeon should also see that any false teeth or foreign bodies which may be present in the mouth are removed before the administration of the drug is begun. As the vapor of ether often causes irritation of the mucus membrane of the lips and nasal passages, it is well to anoint these parts with a little vaseline or cold-cream before administering the ether.

It should also be borne in mind that the vapor of ether is very inflammable, and that it is heavier than the air, so that lights brought near the patient while being etherized should be held at a higher level than the ether can or inhaler.

In administering ether a towel folded into a cone or one of the various ether inhalers may be employed. The best of these is Allis's inhaler (Fig. 125), which consists of a metallic framework covered with leather, which carries a number of folds of a roller bandage, giving a large surface for the rapid evaporation of the drug.

Fig. 125.



Allis's ether inhaler.

If a towel folded into a cone is used, a few layers of stiff paper interposed between the outer layers of the towel will keep the cone in shape and will prevent the evaporation of the ether from its external surface.

In debilitated patients or those who are weak from the loss of blood the administration of half an ounce to an ounce of whiskey from fifteen to thirty minutes before the anæsthetic is given is often advisable.

Half an ounce of ether is next poured over the inner surface of the towel or inhaler and it is brought near the mouth of the patient, and he is requested to take deep breaths or to blow the ether away, and as soon as he has become accustomed to the irritating qualities of the ether vapor, the cone or inhaler is held firmly over the mouth and nose, and the vapor is administered in as concentrated a form as possible; if the respiration and circulation are good there is no disadvantage in pushing the ether. When the conjunctiva is insensible to the touch of the finger, and the muscular relaxation is complete and the breathing tends to become stertorous, the stage of complete anæthesia has been reached, and the ether should be withdrawn for a time or should be given only in such quantities as suffice to keep the patient in this condition.

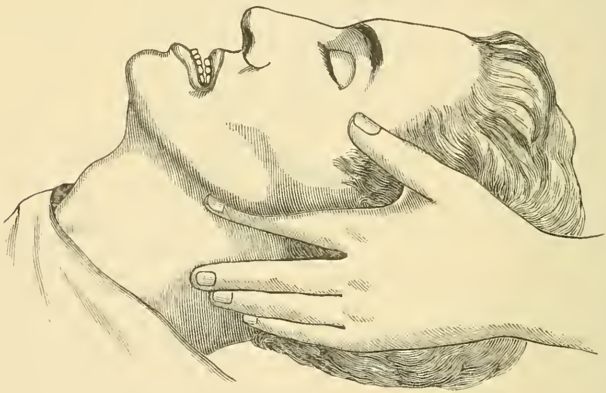
The first effect from the inhalation of ether is to produce acceleration of the pulse and respiration; the mucous membrane of the air-passages is irritated and coughing often occurs; there is also in this stage a disposition to muscular movements, and it is frequently necessary to restrain the patient; the brain is also excited and the patient is apt to cry out. These symptoms call for a continuance of the administration of the ether and not for its withdrawal. Succeeding this stage, if the ether is pushed, profound anæsthesia takes place, as is evidenced by loss of consciousness, relaxation of the muscular system, moistened skin, loss of the special senses, contracted pupils, and slow and deep respiration tending to become stertorous.

Under the name of *first insensibility from ether* there exists early in the course of the administration of ether a primary anæsthesia, which lasts for a minute or so, and which may be taken advantage of to perform such minor surgical operations as the opening of an abscess or the reduction of a dislocation or the drawing of a tooth. The recovery from this condition is usually very prompt, and it is not followed by nausea and the after-effects which attend the prolonged administration of ether. During the administration of ether, particularly in the early stage, the patient may stop breathing, the face at the same time becoming cyanosed; this condition calls for the withdrawal of the ether, and if a deep inspiration does not quickly follow, pressure should be made upon the front of the chest, and when this is relaxed a deep inspiration usually takes place and no further difficulty is experienced.

If the patient has eaten solid food shortly before the etherization, vomiting is apt to occur; when this takes place the ether inhaler should be removed and the head should be turned to one side, or the patient should be rolled upon his side, the mouth being kept open to facilitate the escape of the vomited matters. The breathing also sometimes becomes obstructed by the accumulation of mucus in the fauces; this should be removed by small sponges securely fastened to sponge-holders.

When the anæsthesia is profound it sometimes happens that the muscular relaxation is so complete that the tongue falls backward and the glottis is closed, the face becomes cyanosed and the pulse frequent and irregular, and death is threatened from asphyxia; in this event the head should be extended and the lower jaw should be pressed forward by the fingers placed beneath the ramus of the submaxillary bone. (Fig. 126.) This manipulation is usually sufficient

Fig. 126.



Pushing the lower jaw forward. (Esmarch.)

to reëstablish the respiratory movements, but if so fortunate a result does not take place artificial respiration should be practised—Sylvester's or Howard's methods being given the preference—the patient's head being placed upon a lower level than the body, the tongue brought forward, and the fauces being cleared of mucus. The respiratory action should also be stimulated by the use of electricity—one sponge-electrode being placed over the sternum, the other being applied to the epigastrium during an inspiratory effort.

If artificial respiration is not satisfactorily applied in this way, forced respiration applied by means of a mask with tube and bellows attached (Fell's apparatus, see page 176), or an intubation-tube with a rubber tube attached, which is connected with a bellows, may be slipped into the larynx, and air may thus be directly forced into the lungs, or the trachea should be opened. This is especially to be recommended if the asphyxia has resulted from blood or vomited matters having entered the larynx. After opening the trachea and introducing a tracheal canula, a rubber tube and bellows is connected with this and respiratory movements are simulated by forcing air directly into the trachea.

The hypodermic injection of strychnia, atropia, or digitalis is also recommended, and the intravenous injection of ammonia is said to have been followed by good results.

Efforts at resuscitation in these cases should be persevered in for at least half an hour, as apparently hopeless cases have been saved by persistent use of these means.

The person intrusted with the administration of the anæsthetic should watch the patient closely and should not have his attention diverted by the operation; he should carefully watch the pulse, respiration, and the color of the patient's face, and be ready to withdraw the ether upon the development of any symptom of danger, and to meet such symptoms, should they arise, by the use of some of the means previously mentioned.

The administration of ether vapor by the rectum was a few years ago employed in many cases, and although anæsthesia was quickly produced, dangerous symptoms sometimes followed its employment, so that this method of administration has been abandoned.

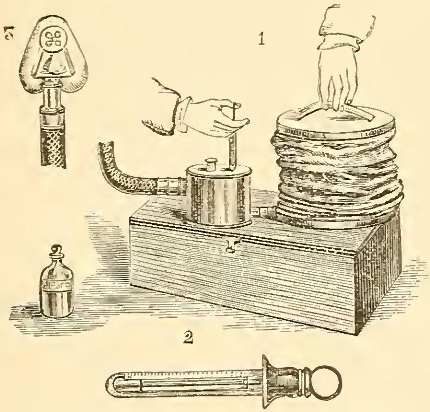
An anæsthetic should never be given to a woman without the presence of a third person, as in some cases these agents give rise to erotic dreams, and it may be difficult to disabuse the patient's mind of the idea that an assault has been committed unless the evidence of eye-witnesses at the time of the anæsthetization can be brought forward to prove that such was not the case.

Chloroform.

A patient is prepared for the administration of chloroform as in the case of ether, the same precautions being taken as regards the removal of false teeth or foreign bodies from the mouth, and to see that the clothing about the chest and neck does not restrict the circulation or respiratory movements. Chloroform is certainly a much more dangerous anæsthetic than ether, and although it is widely used in the British Islands and upon the Continent, it is not used in this country except in certain districts—as in the southern and southwestern districts of the United States, and here its use is followed by fewer fatalities than in the northern districts, so that it is possible that its use is safer in warm climates. Clinical experience has demonstrated the fact that chloroform can be used in aged and very young subjects and in puerperal patients with comparative safety; it is also to be preferred to ether in patients suffering from emphysema of the lungs, bronchitis, and vascular degeneration of the kidneys. It is also employed instead of ether in operations upon the mouth when the actual cautery is employed, on account of its less inflammable character.

Chloroform is administered by pouring a drachm of the drug upon a folded towel, which is first held a few inches from the mouth and nose and gradually brought nearer, but is not allowed to come in contact with the face, as from its local irritating action it will blister the surface; the anæsthetizer should remember that one of the dangers in the administration of chloroform is the risk of too great concentration of its vapor, so that he should see that a sufficient admixture of atmospheric air takes place. Profound anæsthesia is evidenced by insensibility of the conjunctiva to the touch, by complete muscular relaxation, and by the absence of reflexes; the pupils in chloroform-anæsthesia are usually contracted. Various inhalers have been devised to regulate the amount of chloroform administered and to secure the proper admixture of atmospheric air, and the best of these is probably Mr. Clover's apparatus. (Fig. 127.) This consists of a bag holding 8000 cubic inches of air connected with a face-piece by a flexible tube. The bag is charged by means of a bellows (Fig. 127, 1) measuring 100 cubic inches; and the air is passed through a box warmed with hot water, into which is introduced at each filling of the

Fig. 127.



Clover's chloroform apparatus. (Erichsen.)

bellows as much chloroform as is required for 1000 cubic inches of air. This is done with a syringe (Fig. 127, 2); the amount of chloroform required is usually from 30 to 40 minims. When the bag is full the tube is removed from the evaporator and the mouthpiece (Fig. 127, 3) is fitted to it. Additional air may be admitted by regulating the size of the opening in the mouthpiece: the patient, however, cannot receive a larger proportion of chloroform than the air in the bag is charged with.

Death from the administration of chloroform results from cardiac syncope or from respiratory arrest, and the dangerous symptoms develop so rapidly that the greatest promptness is required to meet them. The person administering chloroform should be constantly on the watch, and should not for a moment have his attention diverted from the patient; great vigilance is here, if possible, more important than during the administration of ether.

When dangerous symptoms arise they are to be treated by lowering the patient's head, and if respiratory arrest has occurred the same means to bring about respiratory action should be employed as for a similar condition during ether narcosis. Cardiac syncope is treated by the use of electricity, the electrodes with a rapidly interrupted current being swept over the chest; hypodermics of digitalis and strychnine and atropia may be employed to stimulate the heart and respiration, and as in ether narcosis the efforts should not be desisted from for some time, as by the persistent employment of these means apparently hopeless cases have been resuscitated.

The A. C. E. Mixture.

This mixture, which consists of 3 parts of chloroform, 1 part of ether, and 1 part of alcohol, has been employed by some surgeons in the place of ether or chloroform, with the idea that the dangers of chloroform are diminished by the combination of it with ether and alcohol. Clinical experience, however, has not proved this view to be correct, and I see no advantage in the use of this combination over that of ether or chloroform. If administered with as much care as chloroform, its administration is accompanied with the same safety. It should be administered upon a towel in the same manner as chloroform, and the patient should be watched as carefully during its inhalation as during the administration of the latter drug, and complications occurring should be treated in the same manner as those arising during the use of chloroform.

Trusses.

A truss for the palliative treatment of hernia is a mechanical contrivance with one or more pads and a strap; these are held in position by a spring to which they are attached, which holds the pad in contact with the skin over the hernial ring.

They are applied in all cases of reducible hernia, and are used in the treatment of hernia at all ages; in infants and young children the continued use of a properly fitting truss is often followed by a radical cure of the hernia.

Trusses are made with steel or rubber springs and with pads of wood, rubber, celluloid, or horsehair, covered with chamois, and their shape and the pressure which they exert varies with the kind of hernia for which they are applied.

A firm compress applied over the inguinal canal or crural ring, secured in position by a firmly applied spica-of-the-groin bandage, forms a very satisfactory temporary means of controlling either of these varieties of hernia.

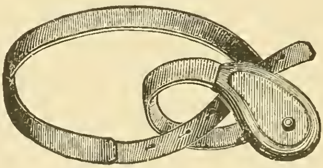
A properly fitting truss should be worn without discomfort to the patient—that is, should not make too much pressure upon the skin at the points where the pads are applied—and should absolutely prevent the descent of the hernia. In testing the adequacy of a truss, after application, to prevent the escape of the hernia, the patient should be instructed to separate his legs, bend forward over the back of a chair, and cough or strain deeply; if this does not bring the hernia down, its control of the rupture may be considered satisfactory.

Trusses should be applied after the complete reduction of the hernia, while the patient is in the recumbent posture. When first applied the truss should be worn both during the night and day, and if the skin becomes tender at the points of pressure it should be sponged with alcohol and alum, then dried and dusted with powdered starch or lycopodium. Patients at first sometimes complain of discomfort in wearing a truss, but they soon become accustomed to its presence. After a truss has been worn for some time its use at night while the patient is in bed may be dispensed with, but the patient should not remove it until he is in bed in the recumbent posture, and he should reapply it before he rises in the morning. In children it is better to have the truss worn continuously, and if it is removed for bathing the nurse should be instructed to place her finger over the ring to prevent the descent of the hernia until the truss is reapplied. In applying trusses to male children care should be taken not to make pressure upon an undescended testicle.

Trusses for Inguinal Hernia.

In measuring a patient for this form of truss the circumference of the body midway between the crest of the ilium and the great trochanter should be taken, and the distance from the symphysis pubis to the anterior superior spinous process of the ilium may also be given, as half of this distance corresponds to the position of the internal abdominal ring. In reducible inguinal hernia the truss-pressure should be exerted upon the inguinal canal and directly backward.

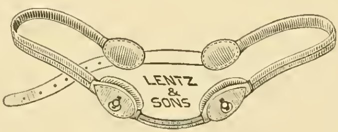
Fig. 128.



Truss for inguinal hernia.

To control this variety of hernia a single-spring truss (Fig. 128) may be employed, or the use of a truss having a double spring with flat pads on each side of the spine attached to the springs, and a smaller pad over the inguinal canal on the unaffected side, with a full pad on the side of

Fig. 129.



Hood's truss.

the hernia, will often be found most satisfactory. This, which is known as a Hood's truss, is one which will be found a very satisfactory instrument both in inguinal and femoral hernia. (Fig. 129.)

Trusses for Femoral Hernia.

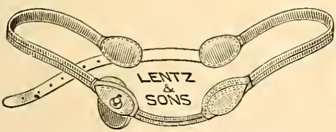
In measuring a patient for this variety of truss, the circumference of the body midway between the crest of the ilium and the great trochanter should be taken; the distance of the saphenous opening from the symphysis pubis, as well as from the anterior iliac spine, should also be taken. In reducible femoral hernia the truss-pressure should be directed backward against the femoral canal, and the pad should be large enough to make pressure upon the adjacent tissues through which the hernia passes, as well as upon the relaxed tissues covering the femoral canal. As in inguinal hernia, either a single or a double spring truss may be employed (Fig. 130).

In applying a truss for femoral hernia, care should be taken to see that the pad does not rest upon the pubis, and thus remove the pressure from the crural ring and adjacent tissues and prevent the proper control of the hernia.

Trusses for Umbilical Hernia.

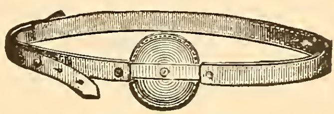
In measuring a patient for this variety of truss, the circumference of the body over the umbilicus should be taken.

Fig. 130.



Hood's truss for femoral hernia.

Fig. 131.



Truss for umbilical hernia.

In reducible umbilical hernia the truss-pressure should be directed backward, and the pad should bear rather on the tendinous margins of the ring than on the hernial opening. A truss for this variety of hernia should have a flat or slightly convex pad, which is held in position over the umbilical ring by means of springs having counter-pads on either side of the spine attached to their extremities; these are fastened together by a strap (Fig. 131).

A simple and satisfactory truss for umbilical hernia in infants consists of a penny covered by adhesive plaster, held over the umbilical ring by one or two strips of adhesive plaster about two inches in width, which should be applied so as to cover in about the anterior two-thirds of the body. A penny, or a small, flat compress of linen, will be found much more satisfactory than the conical rubber or cork pad which is often recommended.

Trusses for Irreducible Hernia.

The application of a truss to this variety of hernia secures the hernia from injury and prevents the further protrusion of the hernia; such trusses are secured in the same way as those for reducible hernia, but the pads are made concave or cup-shaped, or may have an air-cushion attached to the pad.

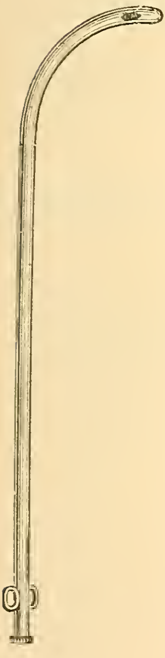
Use of Catheters and Bougies.

Catheters are hollow tubes, made either of metal, India-rubber, or other flexible substances.

Metallic catheters are made of silver, or, if constructed of other metals, they should be plated with silver or nickel, to give them a smooth, bright surface which can easily be kept perfectly clean; and their shape should conform to that of the normal urethra (Fig. 132). The shape of the metallic catheter is sometimes changed to meet certain indications; for instance the metallic catheter for use in cases of enlarged prostate is longer and has a longer curve than the ordinary instrument (Fig. 133). The metallic female catheter is shorter and has a much smaller curve than the instrument used for the male urethra.

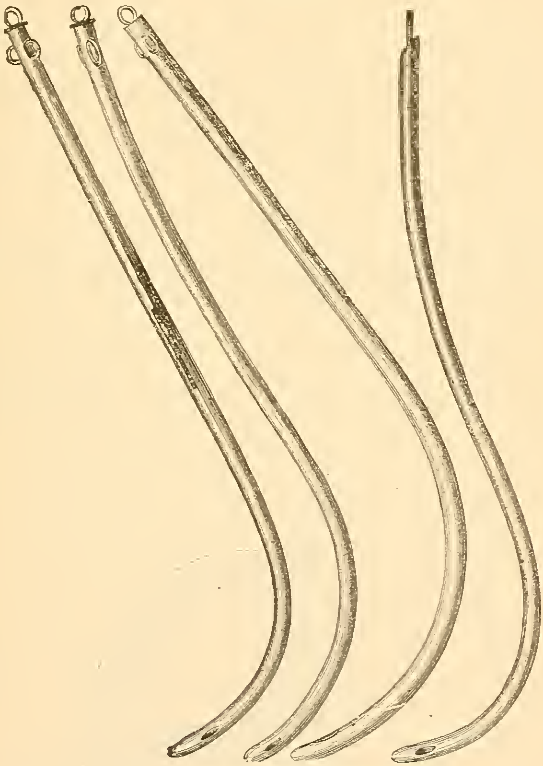
Flexible Catheters.—The most commonly used variety of flexible catheter is that known as the English catheter, which is made of linen and shellac, and is provided with a stylet; it can be moulded into any shape desired by dipping

Fig. 132.



Metallic catheter.

Fig. 133.

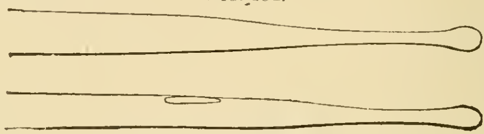


Prostatic catheters.

it into hot water, which renders it very flexible, and, after moulding it to the proper curve, this can be fixed by immersing it in cold water, which hardens it again.

The French flexible catheters are made of India-rubber, or a combination of this material with other substances. These instruments are conical toward their extremities, and terminate in an olive-shaped point; they are provided with one or two smoothly finished eyes near their vesical extremities (Fig. 134).

FIG. 134.



French flexible bougie and catheter.

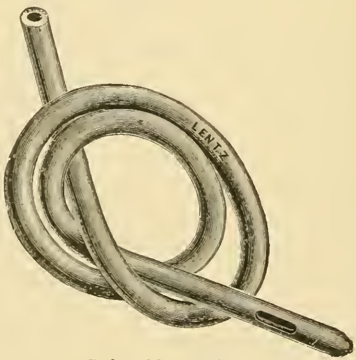
Another form of flexible catheter, known as the elbow-catheter or Mercier's catheter (Fig. 135), has an angle or

FIG. 135.

Mercier's elbowed catheter.

elbow near its vesical extremity; this is often found a satisfactory instrument to use in cases of enlarged prostate. A

FIG. 136.



Soft rubber catheter.

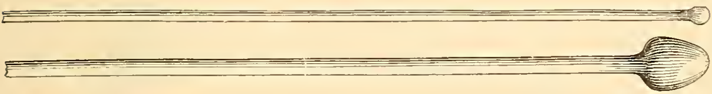
variety of flexible catheter made of soft India-rubber is also sometimes employed. (Fig. 136.)

Catheters and bougies are made according to a certain scale. The English scale runs from 1 to 12; the American from 1 to 20; and the French from 1 to 30.

Bougies and Sounds.

Bougies are flexible instruments which correspond in size and shape to the English and French catheters, and besides these is the acorn-pointed bougie (Fig. 137) and the filiform bougie, which is made of whalebone or of the same material

Fig. 137.



Bulbous or acorn-pointed bougies.

as the ordinary French bougie and catheter. These instruments are of very small size and can often be passed through strictures which will admit no other form of instrument. (Fig. 138.)

Sounds.—These are solid instruments usually made of steel with a smooth surface and plated with nickel; they correspond in size and have the same curve as the metallic catheter; the handle is flattened to allow the operator to grasp them firmly; they are employed in the treatment of strictures by dilatation. (Fig. 139.) The sound used in dilating strictures of the meatus is straight and is shorter than the sound employed in the treatment of urethral strictures. (Fig. 140.)

Introduction of a Catheter.

The passing of a catheter is a minor surgical procedure which every practitioner is at times called upon to employ, and its passage through a healthy urethra is a matter of little difficulty. For the introduction of a catheter the patient may be in the standing, sitting, or recumbent posture, and the latter is the best in most cases ; he should rest squarely on his back and have the thighs a little flexed and separated.

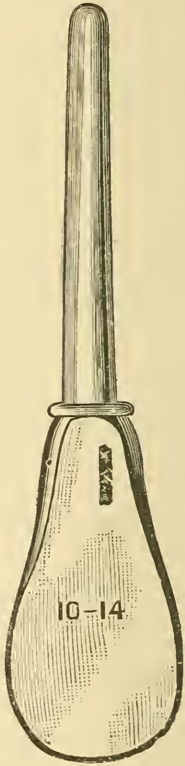
Fig. 138.

Filiform bougies.

Fig. 139.

Steel sound.

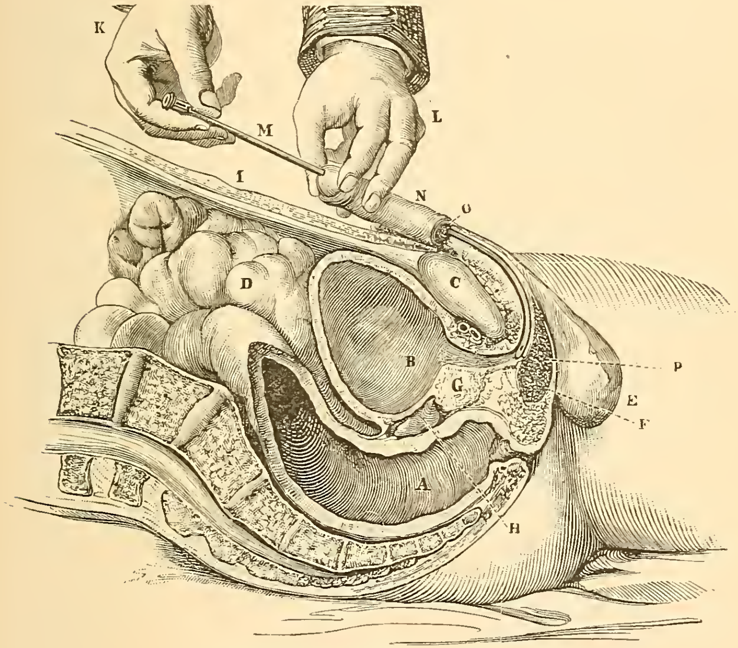
Fig 140.



Sound for dilating meatus.

Before passing a metallic catheter the surgeon should see that it is perfectly clean, and after warming and oiling it he stands upon the left side of the patient and grasps the penis with the left hand, and turns it over the pubis and introduces the beak of the catheter into the meatus, and gently passes it along the urethra until its point passes beneath the symphysis pubis; at this point the handle is elevated and gently depressed between the thighs, and the beak will pass into the bladder. (Fig. 141.)

FIG. 141.



Introduction of catheter. (VOILLEMIER.)

When the prostatic region is reached difficulty is sometimes experienced in passing the catheter; this may be overcome by introducing the finger into the rectum and guiding the catheter through this, or if the prostate is found much enlarged the catheter should be withdrawn, and a prostatic catheter (Fig. 133) should be substituted for it.

The same manipulation is made use of in passing metallic sounds.

Flexible catheters and bougies are passed by grasping the penis and holding it in such a position that it is at a right angle to the axis of the body, and the catheter or bougie is passed into the meatus and carried through the urethra into the bladder by gently pushing the instrument downward.

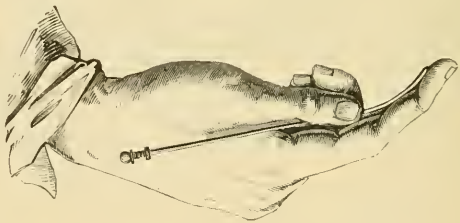
In this variety of catheter, which has no curve, the surgeon has no means of guiding the point of the instrument, and if an obstruction is met he should withdraw the instrument slightly and make another attempt; all manipulations should be extremely gentle.

The same manipulations are employed in passing bougies through the urethra.

Passing the Female Catheter.

This should be introduced without exposure of the patient, she being in bed with the thighs slightly flexed and separated from each other. The surgeon introduces the fore-

Fig. 142.



Method of holding female catheter.

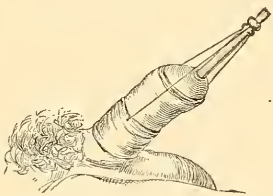
finger of the left hand between the nymphæ, bringing it from behind forward until he touches the space between the entrance of the vagina and the orifice of the urethra; the catheter is then introduced with the right hand held as shown in Fig. 142, and guided by the left forefinger is passed through the orifice of the urethra into the bladder.

Tying Male Catheter in the Bladder.

When it is desirable to retain a catheter for some time in the male bladder, it is necessary to secure it to prevent its slipping out. Either a metallic or flexible catheter may be employed, but, as a rule, the flexible instrument is to be preferred; there are several methods of securing it in the bladder.

By one method two narrow strips of tape, or two or three strong silk ligatures are attached to the rings at the end of a metallic catheter, or are securely fastened around the end of the flexible instrument; these are next brought backward, one on each side of the penis, and the skin is drawn forward and a strap of adhesive plaster half an inch in width is passed over the strings or tapes and carried three or four times around the body of the penis just behind the position of the glans penis. If the skin has been brought well forward before the straps have been applied, the ligatures are tightened as it slips back, and the catheter has not too much play (Fig. 143).

Fig. 143.



Tying in catheter. (Bryant.)

Another method consists in fastening a strong silk ligature around the catheter just in advance of the meatus; the two ends are next brought backward and tied in a knot behind the corona glandis; the ends are then carried around behind the corona and tied on one side of the frænum; the foreskin is slipped forward and covers the ligatures.

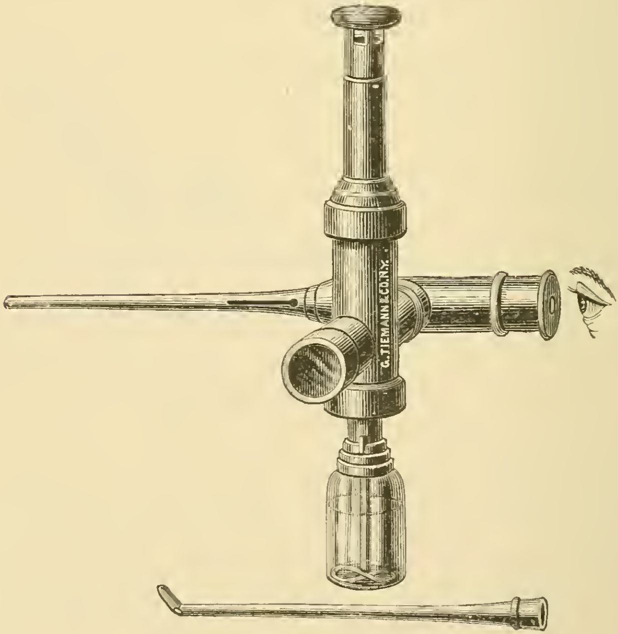
A simpler method of securing the catheter is to perforate the free end with a needle armed with a double ligature of silk or hemp; the needle being removed, two loops are made of the proper length, and these are passed through the ends of a T-bandage, which is secured around the waist, the tails being brought up on either side of the scrotum and secured to the body of the bandage passing around the waist.

In the female bladder, when it is desirable to keep the bladder empty, the self-retaining catheter is usually employed, which consists of a catheter with a bulb at its vesical extremity, or an ordinary catheter with silk loops and a T-bandage may be employed in the same manner as in securing a male catheter.

The Endoscope.

This instrument is employed to explore the internal cavities of the body. When used to obtain a view of the

Fig. 144.



Endoscope of Desormeaux.

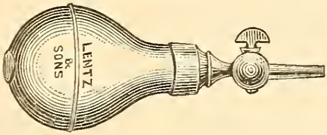
urethra, it consists of a straight conical metallic tube for the urethra, and for the bladder one which is somewhat curved like a vesical sound; there is also an eye-piece, an illuminating apparatus, and an arrangement of mirrors by which a strong light can be thrown upon whatever touches the end of the tube (Fig. 144). By the use of this instrument the urethra and inner surface of the bladder can be examined by the eye.

A view of the urethra may also be obtained by the use of the *urethroscope*, which consists of a straight, hard rubber tube provided with a rounded obturator which projects somewhat beyond the end of the tube. The instrument is introduced into the urethra until the bladder is reached, when it is slightly withdrawn and the obturator is removed and a strong light is thrown into the tube from a head mirror or from an electric lamp, and as the tube is withdrawn various portions of the urethra are exposed to the view of the surgeon.

Washing out the Bladder.

This procedure may be required in the treatment of cystitis, and it is accomplished by passing a flexible catheter with a large eye into the bladder, or a double catheter may be employed. A syringe, or better a rubber bulb holding about a pint, having a nozzle and stopcock (Fig. 145), is

Fig. 145.



Rubber bag with stopcock, for washing out the bladder.

filled with warm water, or with any medicated solution which is desired, and it is then attached to the free end of the catheter and the contents are gently injected into the bladder; care should be taken that the bladder is not too much distended. When the desired amount of fluid has been injected, it is allowed to run out of the catheter, and the procedure may be repeated until the solution comes away perfectly clear.

Care should be taken to see that the bladder is perfectly emptied of the solution, and in cases of paralysis of the bladder gentle pressure should be made upon the abdomen over the pubis to accomplish this object. Solutions of boric acid, permanganate of potassium, and weak solutions of carbolic acid and of nitrate of silver are often employed in washing out the bladder in cases of chronic cystitis.

Urethral Injections.

In the treatment of urethral inflammations the injection of medicated solutions is generally made use of, and as these injections are usually made by the patient himself, he should be shown or instructed how to employ them. A rubber syringe having a conical nozzle and holding about two or three drachms is the best instrument to employ for this purpose. (Fig. 146.) The syringe having been filled with the solution, and the patient sitting upon the edge of a hard chair, with the thighs separated, grasps the syringe between the thumb and middle finger of the right hand, the tip of the index finger resting upon the end of the piston, and inserts its conical end from a quarter to half an inch within the meatus, which is held open by the thumb and finger of the left hand, and after its introduction it should be drawn tightly around it, the pressure being made laterally so as to narrow the aperture instead of broadening it, as is the case when the compression is in an antero-posterior direction. After the fluid has been thrown into the urethra in this manner the syringe is removed, and the patient is instructed to hold the lips of the meatus together for one or two minutes to prevent the escape of the fluid.

Fig. 146.

Shape of nozzle of urethral syringe.

Sutures.

A variety of materials are employed for sutures, such as silk, catgut, silver or iron wire, silkworm-gut, and horse-hair; the material most frequently employed at the present time is either catgut, silk, or silkworm-gut, although some surgeons still prefer silver wire. Catgut is practically the only substance employed as a suture which is absorbable; the other varieties of suture require removal after their application, although some sutures, such as the silk, when employed in subcutaneous wounds may be cut short, as they are apt to become encysted and produce no trouble. It matters little what variety of material be employed for suture if the surgeon is careful to see that it is rendered thoroughly sterile before being brought in contact with the wound.

Sutures of Relaxation are those which are entered and brought out at some distance from the edges of the wound, and are employed to prevent dangerous tension upon the sutures which close skin wounds. This form of suture is employed by the use of the quilled, button, or plate suture.

Sutures of Coaptation.—These are superficial sutures applied closely together and include only the skin; they are employed to secure accurate apposition of the cutaneous surface of wounds.

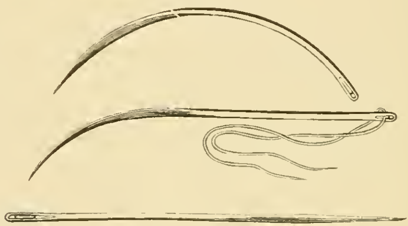
Sutures of Approximation are those which are applied deeply into the tissues to secure approximation of the deep portions of a wound; this object is accomplished by the use of the quilled, button, or plate suture.

Secondary Sutures.—These sutures are applied when the surfaces of the wound are covered by granulations, when the primary sutures have failed to secure apposition of the edges of the wound, or in cases of secondary hemorrhage where the opening of the wound has been necessitated to turn out the blood-clot and secure the bleeding vessel, or in plastic operations where the primary sutures have failed to secure adhesions of the edges of the flaps. They are also employed with advantage in cases in which it is necessary to pack a wound with antiseptic gauze, or to allow hæmostatic forceps to remain clamped upon bleeding tissues in a wound at the time of operation. The sutures should in such a case be introduced and loosely tied at this time, and when the packing or forceps are removed at the end of two or three days the sutures are tightened so as to secure apposition of the edges of the wound.

Surgical Needles.

Needles for surgical use are of different sizes and shapes (Fig. 147): straight needles are the ones most commonly

Fig. 147.



Surgical needles.

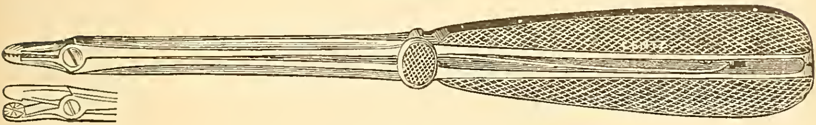
employed, but curved needles will be found most convenient for the introduction of sutures in wounds of certain

Fig. 148.

Mounted needle.

locations. Tubular needles are often employed in introducing sutures in wounds in which the use of an ordinary needle is difficult: for instance, in the operation for cleft palate, and for the introduction of sutures in deep wounds, a mounted needle will often be found very useful (Fig. 148). Needles should be sharp and clean and should be rendered thoroughly aseptic before being used. A needle-holder is often required for the satisfactory introduction of needles in wounds of certain localities (Fig. 149); if

Fig. 149.



Needle-holder.

this is not at hand the needle may be held by a pair of dressing forceps or a pair of hæmostatic forceps.

Method of Securing Sutures and Ligatures.

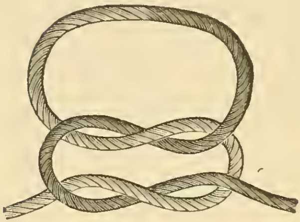
Metallic sutures are usually secured by twisting the ends together or by passing the ends through a perforated shot and clamping the shot with a shot-compressor, which securely fixes them.

Sutures and ligatures of catgut, silk, silkworm-gut or horsehair are secured by tying, and several different knots are employed to secure them.

Reef or Flat Knot.

This is one of the best forms of knot to use in securing sutures or ligatures, and it is made by passing one end of the thread over and around the other end, and the knot thus formed is tightened; the ends of the thread are next carried toward each other and the same end is again carried over and around the other, and when the loop is drawn tight we have formed the reef or flat knot (Fig. 150).

Fig. 150.

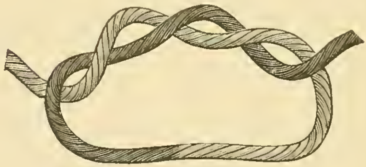


Reef or flat knot.

Surgeon's Knot.

This knot is formed by carrying one end of the thread twice around the other end (Fig. 151); and after tighten-

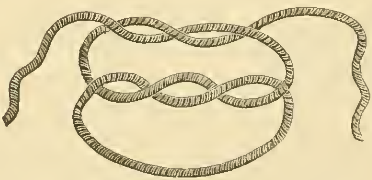
Fig. 151.



Surgeon's knot.

ing this loop the same end is carried over and around the other end as in the case of the final knot of the reef or flat

Fig. 152.



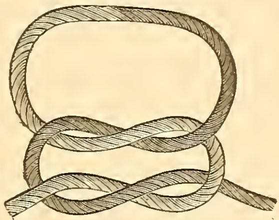
Surgeon's knot and reef knot combined.

knot. The surgeon's knot and reef knot combined is one of the best methods of securing sutures or ligatures of catgut or silk, as the first knot is not apt to relax before the second knot is applied. (Fig. 152.)

Granny Knot.

This method of tying the ligature or suture should not be employed, as the resulting knot is not as secure as the reef knot and is apt to relax; it differs from the latter in the fact that one end of the thread having been carried

Fig. 153.

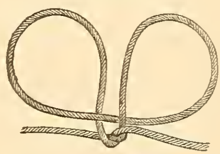


Granny knot.

across and around the other end, the knot is completed by carrying the same end under and around the other end of the thread (Fig. 153).

The *Staffordshire* knot, which is much used to secure the pedicle in the removal of the ovaries or ovarian tumors, is applied as follows: A handled-needle armed with a stout silk ligature is passed through the pedicle, and then withdrawn so as to leave a loop on the distal side; this loop is drawn over the ovary or tumor and one of the free ends is passed through it so that one end is above while the other end is below the retracted loop. (Fig. 154.) The ends are then seized and drawn through the pedicle; at the same time the thumb and forefinger are pressed against it, until sufficient constriction is made, and the ends are finally secured by tying as in the securing of an ordinary ligature.

Fig. 154.



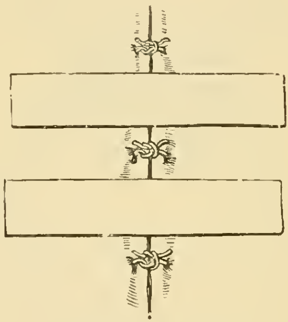
Staffordshire knot.

Varieties of Suture.

The Interrupted Suture.

This variety of suture is the one most usually employed in the apposition of wounds, consisting of a number of single stitches, each of which is entirely independent of those on either side. In applying this suture the surgeon holds the edge of the wound with the fingers or forceps and thrusts the needle, previously threaded, through the skin three or four lines from the edges of the wound. He then passes the

Fig. 155.



The interrupted suture.

needle from within outward through the tissues of the opposite flap at the same distance from the edge of the wound. (Fig. 155.) Each stitch is secured as soon as it is passed—by tying if a silk, catgut or silkworm-gut suture be used, or by twisting if a silver-wire suture is employed. A suture may be used with a needle threaded on each end, and in this case both needles are passed from within outward. The sutures may be secured as soon as applied or they may be left unsecured until a sufficient number have been introduced and then they may be secured by tying or twisting. Care should be taken to see that they make no tension on the edges of the wound and that they are so introduced as to make the best possible apposition of the parts.

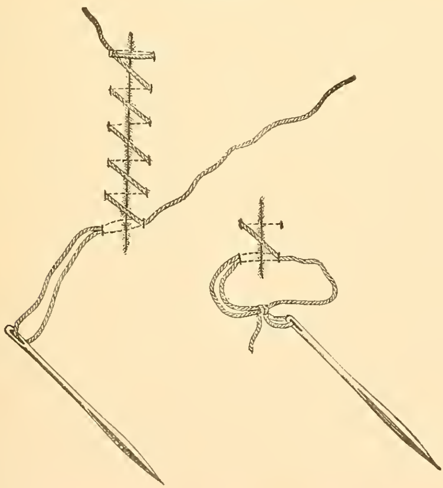
In extensive and deep wounds it may be found necesary to introduce both deep and superficial sutures, the former bringing about apposition of the muscles and deep fascia, the superficial layer bringing together the superficial fascia and skin.

The *deep* or *buried* sutures are often employed to unite fascia, muscles or tendons, and the best material for this variety of suture is either catgut or silk.

Continued or Glover's Suture.

This variety of suture is applied in the same manner as the interrupted suture, but the stitches are not cut apart

Fig. 156.



Continued or glover's suture: method of securing.

and tied; it is made with silk or catgut, and is secured by drawing it double through the last stitch and using the free end to make a knot with the double portion attached to the needle. (Fig. 156.) This suture is generally employed in intestinal sutures, but may also be employed in bringing about apposition of the edges of wounds in tissues of loose structure.

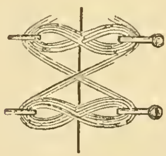
The Twisted or Hare-lip Suture.

This is a very useful form of suture where great accuracy and firmness of apposition of the edges of the wound are desired. It is applied by thrusting pins or needles through both lips of the wound, the edges being kept in contact over the wound by figure-of-eight turns with silk or wire. (Fig. 157.) The ends of the pins should be cut off by pin-cutters after the sutures are applied, or should be protected by pieces of cork or plaster to prevent them from injuring the skin of the patient and causing him pain.

The India-rubber Suture.

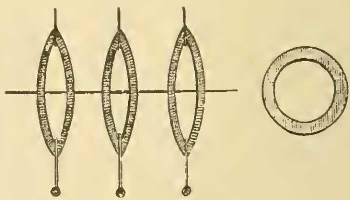
This is applied by first passing the pins or needles through the edges of the flaps, and instead of the twisted figure-of-

FIG. 157.



Twisted or hare-lip suture.

FIG. 158.



India-rubber suture.

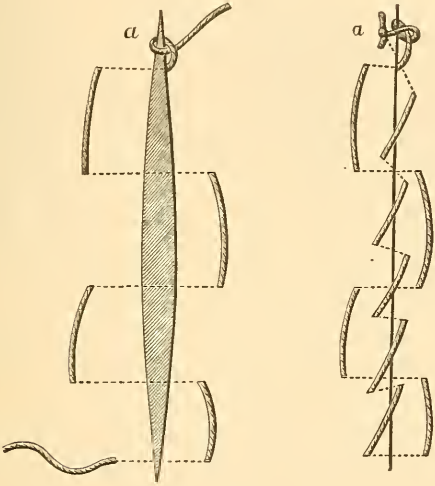
eight suture of silk, delicate rings of India-rubber are employed. (Fig. 158.)

The twisted or hare-lip suture is frequently employed in plastic operations about the face and in other parts of the body, where accurate apposition of the flaps is desired.

The Quilt Suture.

This variety of suture is made with silk or catgut, and is employed in wounds to effect very close approximation of the parts and to prevent bagging; it is often employed in connection with the continued suture, and is applied as shown in Fig. 159.

Fig. 159.



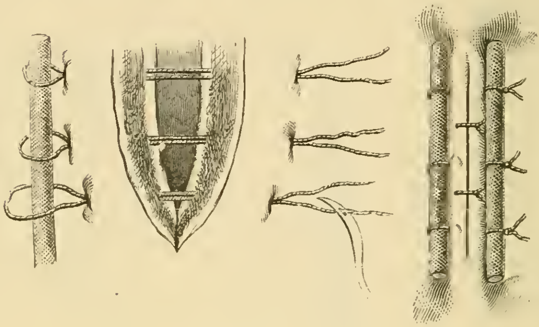
The quilt suture.

The Quilled Suture.

In making use of this suture a needle armed with a double thread of wire or silk is passed through the tissues as in applying the interrupted suture, but at a greater distance from the edges of the wound. Into the loops on one side of the wound is inserted a quill or piece of a flexible catheter or bougie, and on the opposite side the free ends of the sutures are tied around a similar object after being tightened. (Fig. 160.) This form of suture makes deep and equable pressure along the whole line of the wound. In applying this suture it may be found well in some cases to introduce a few superficial interrupted sutures along the line of the wound to secure accurate approximation of the skin.

This form of suture was formerly much employed in cases of deep wounds to secure accurate apposition of the deep

FIG. 160.



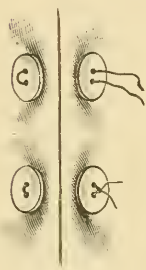
The quilled suture. (SMITH.)

portions of the wound, but recently the introduction of buried catgut sutures has supplanted the use of this variety of suture.

Button or Plate Suture.

This suture is applied by passing a needle armed with a double thread as in the case of the quilled suture, the ends of the suture being passed through the eyes of a button or through perforations in a lead plate before being threaded in the eye of the needle. After the suture prepared in this way has been passed through both sides of the wound. the needle is removed and the free ends of the suture are passed through the eyes of a button or the perforations in a lead plate on the opposite side of the wound, and are tightened and secured. (Fig. 161.) This form of suture may be employed in deep wounds to accomplish the same purpose as the quilled suture, and allows the cutaneous margins of the wound to remain free from compression, and here, as in the case of the quilled suture, a few interrupted

FIG. 161.



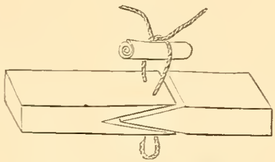
Button suture. (SMITH.)

sutures may be introduced between the button or plate sutures to secure accurate apposition of the skin surfaces if desired.

Tongue-and-groove Suture.

This variety of suture, devised by the late Dr. Joseph Pancoast, consists in slipping the margin of the flap which has been bevelled into a groove, made by dissecting up the margin of the skin surrounding the raw surface which is to be covered. In applying this suture the wire or thread used has a needle applied on each end, and after passing the sutures so as to secure the flaps the free ends are secured over a pad of adhesive plaster or a disc of lead or a button. (Fig. 162.)

Fig. 162.



Tongue-and-groove suture.

Shotted Sutures.

This suture receives its name not from any special method of application, but solely from the way in which it is secured; any of the previously mentioned varieties of sutures may be employed. The material used in applying this suture may be catgut, silver wire, silkworm-gut, silk, or horsehair, and after the suture has been passed the needle is removed, and the ends are passed through a perforated shot; the ends are then drawn upon to bring the edges of the wound in contact, and the shot is pressed down to the skin and clamped by means of a shot-compressor. The suture is then cut off flush with the surface of the shot.

This method of securing sutures is especially useful in closing wounds in the mucous cavities, such as the vagina, rectum, and mouth, where the knot or twist of the wire might cause irritation of the surface or pain to the patient; it is also a useful method of securing sutures in plastic operations; it also facilitates the removal of the sutures, as the shot is not apt to be obscured by the swollen tissues and is easily seized by forceps when the loop is divided.

Removal of Sutures.

Where sutures are buried in the tissues or used to approximate parts in cavities which are subsequently closed, such material should be used for sutures as will be absorbed in a few days, or will become encysted and remain harmless in the tissues—such as catgut, silkworm-gut, or silk—and it is needless to state that sutures used with this end in view should be rendered perfectly aseptic before being employed.

Catgut sutures, when well prepared and used for sutures in external wounds, usually undergo absorption in from ten to fifteen days; the loop buried in the tissues is absorbed and the knot may be removed from the surface with forceps or comes off with the dressings.

The other substances, such as silk, silkworm-gut, silver wire, and horsehair, are removed by cutting one side of the loop and making traction upon the knot of the suture with forceps, or in the case of the wire suture, after dividing the loop and straightening out one end of it, the wire should be withdrawn in a curved direction.

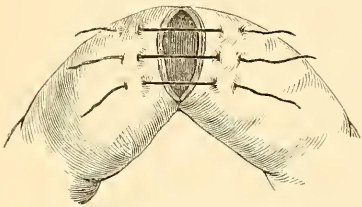
Sutures which are not causing any irritation should be allowed to remain in position until the wound is solidly healed. The time usually required for their retention in cases of aseptic wounds is from eight to twelve days.

Lembert's Suture.

Lembert's suture is used in wounds of the viscera covered by the peritoneum, with the object of bringing in contact the peritoneal surfaces. This form of suture is usually employed in closing wounds of the intestine or stomach. (Fig. 163.)

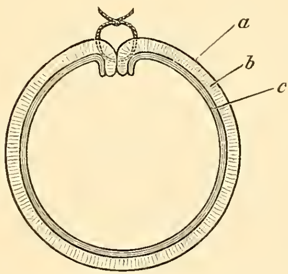
A needle armed with a fine catgut or silk thread is passed, and it is better to employ a round needle, such as the ordinary sewing-needle, in preference to the bayonet-pointed needle, as there results by its use less bleeding from the punctures. The needle is first carried through the peritoneal and muscular coats of the intestine a short distance from the wound, and it is then carried across the wound

Fig. 163.



Lembert's suture. (Bryant.)

Fig. 164.



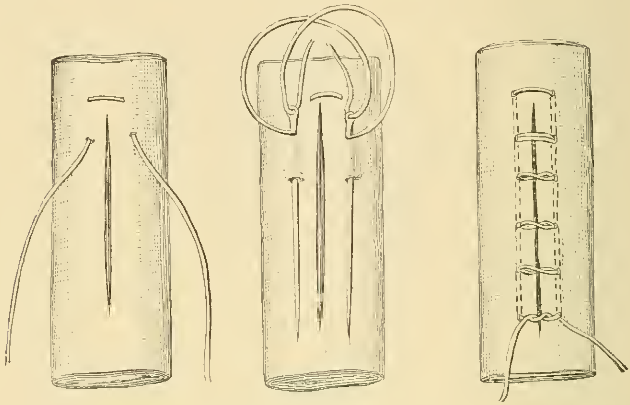
Lembert's suture. *a*, serous; *b*, muscular; and *c*, mucous coat. (Smith.)

and passed through the same portions of the intestine a short distance from the edge of the wound on the opposite side, and when the suture is tightened the peritoneal surfaces of the intestine are inverted and brought into contact with each other (Fig. 164); the interrupted or continued suture may be employed in making this form of suture.

Gély's Suture.

In applying this form of suture in intestinal wounds a ligature armed with a fine needle at each end is employed, and the punctures should be about five millimetres apart; the method of applying the suture is shown in Fig. 165.

FIG. 165.

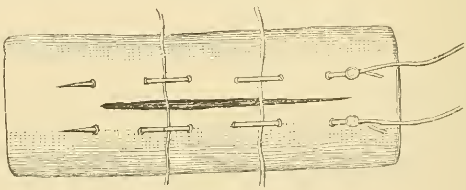


Gély's suture.

Bouisson's Suture.

This method of suturing intestinal wounds, which is more complicated than either of the previously mentioned methods and possesses no advantage over them, is applied by passing

FIG. 166.



Bouisson's suture.

a delicate pin in and out along each side of the wound as shown in Fig. 166, and drawing them together laterally by ligatures passed through the intervals, one end of each ligature being cut short and the other end being brought out at the lower angle of the external wound; a thread is also tied under the head of each pin and brought out at the upper angle of the wound, and at the end of three or four days the pins are removed by means of the threads attached to them, and at the same time the sutures, having been freed by the removal of the pins, are withdrawn.

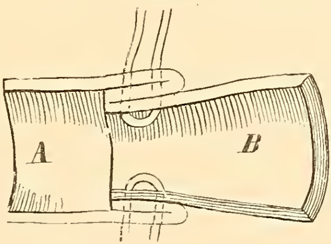
Czerny Suture.

This suture is applied in intestinal wounds by passing the needle armed with a catgut or silk thread through the serous membrane on one side of the wound of the intestine and out at the wound surface so as not to include the mucous membrane; the needle is then passed through the wound surface on the opposite side, avoiding the mucous membrane, and brought out through the serous membrane a short distance from the edge of the wound. By this suture the lips of the wound are approximated. For additional security in preventing the escape of the contents of the intestine and to secure approximation of the serous surfaces a few Lembert sutures should be introduced.

Jobert's Suture.

This suture which was employed in transverse wounds of the intestine which completely or incompletely divided the

FIG. 167.



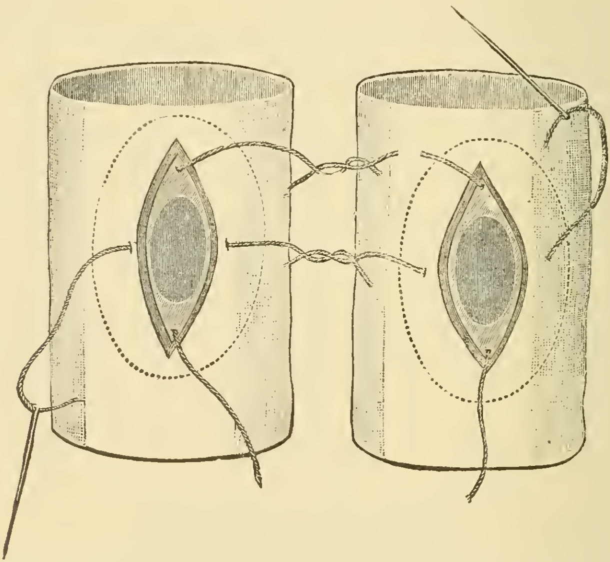
Jobert's suture.

gut, is introduced after turning the lower end of the bowel in upon itself. When the division of the gut was incomplete he employed only one suture, when complete two; the ends of the sutures were brought out of the external wound. (Fig. 167). By this method of suture the two serous surfaces are brought into contact.

Sutures Employed in Intestinal Anastomosis.

When it is desired to form a permanent orifice between two portions of the gut, the ends of the gut are closed and an opening is made in each portion of the gut and the walls

Fig. 168.



Method of applying Senn's decalcified bone plates. (Greig Smith.)

of the gut surrounding the openings are held in contact with each other by sutures attached to perforated plates of decalcified bone; this is the method devised by Senn. The manner of using the bone plates and sutures is shown in Figs. 168 and 169. To accomplish the same purpose rubber rings or perforated plates of rubber have been employed, also rings made from catgut, to which the sutures are attached, are applied in the same manner as Senn's plates. In using the rubber rings or plates it is well to divide them at one or two points and unite them by catgut sutures which will soften and be dissolved in a few days and allow the ring or plate to change its shape and facilitate its passage through the bowels; if catgut rings are employed these will be softened and dissolved in a short time so as to be passed without difficulty. Intestinal anastomosis may be

Fig. 169.

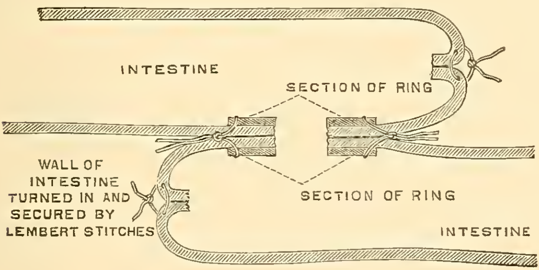


Diagram showing position of bone plates in intestinal anastomosis after resection of the bowel. (Roberts.)

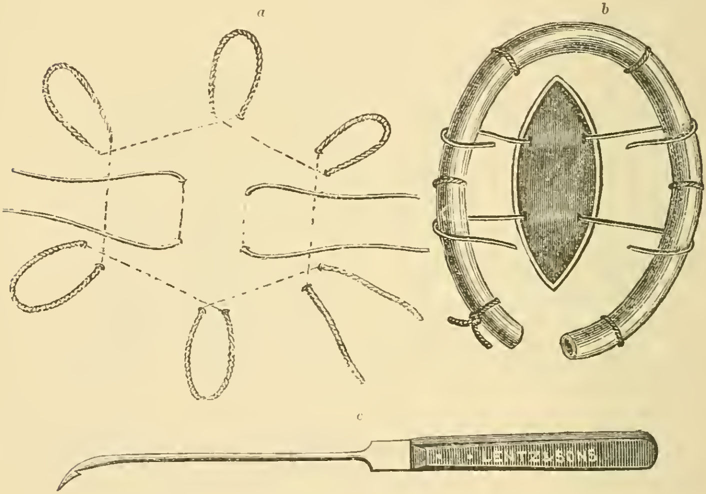
employed instead of Jobert's suture or the circular suture in wounds completely dividing the intestine and after resection of the gut for the removal of growths or for stricture.

Sutures Employed in Gastrostomy.

In this operation, when the wall of the stomach has been exposed, two hare-lip pins should be thrust through the integument and tissues near the edge of the wound and then through the peritoneal and muscular coats of the stomach, to bring the surface of the stomach in contact with the peritoneum covering the inner surface of the abdominal walls in the region of the wound; a few sutures of silk may also be introduced to secure the wall of the stomach to the edges of the wound. The opening of the stomach is postponed for four or five days if possible, until the adhesion between its walls and the abdominal parietes is secure, and at this time the sutures and the pins are removed.

When immediate opening of the stomach is required for any reason, after the wall of the stomach has been exposed two silver wire sutures are passed through the peritoneal and muscular coats of the stomach by means of a needle;

Fig. 170.



Sutures for immediate gastrostomy. (Roberts.)

these sutures should be placed transversely to the external abdominal wound and serve to draw the wall of the stomach in contact with the inner margins of the abdominal incision.

A long silk suture is next passed through the outer coats of the stomach so that the loops project upon the external surface of the organ (*a*). A needle, having a hook near its extremity (*c*), is passed through the abdominal wall and engages the loop and draws it to the surface of the abdomen near the edge of the abdominal wound; the same manipulation is repeated until all of the loops have been brought to the surface. (Fig. 170.)

A piece of rubber tube is carried around the external wound and slipped through the loops which project upon the surface of the abdomen (*c*), and by drawing the loops tight over the rubber tube and tying the ends of the suture the stomach wall is secured in contact with the inner margins of the abdominal wound, and it may be safely opened after being thus fixed.

In the operation of *gastrotomy*, where the stomach has been exposed and opened and the foreign body removed, or its cavity has been explored, or its orifices dilated as the case may be, the wound in the wall of the stomach is closed with Lembert's sutures, silk or catgut being the material employed for sutures. The abdominal wound is next closed with deep sutures which include the parietal peritoneum.

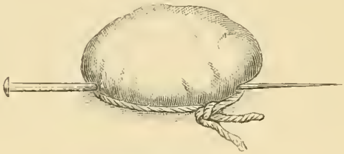
Ligatures Used in the Treatment of Vascular Growths.

Various forms of ligature are used for the strangulation of vascular growths; the material used for ligatures is usually strong silk or hemp thread, catgut, or silver wire.

The Single Ligature with Pin.

This is applied by first inserting a hare-lip pin through the skin near the edge of the growth, passing it under the growth and bringing its point out through the skin at a point opposite the point of entry; a strong silk or hemp ligature, which has been well waxed, is passed under the ends of the pin surrounding the base of the tumor and is drawn tight enough to strangulate the growth, and is secured by two knots (Fig. 171). If the growth is of considerable size it is better before applying this ligature to introduce a second pin at right angles to the first one, and then secure the ligature under the pins. In applying these forms of ligatures to healthy skin, the patient is saved much pain, and the separation of the mass is hastened, by cutting a groove in the skin with a sharp knife at the point where

Fig. 171.



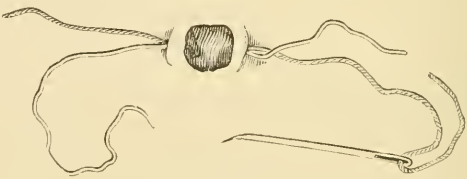
Vascular tumor strangulated with pin and ligature. (Roberts.)

the ligature is to be applied; the ligature when tied is buried in the groove thus made.

Double Ligature in Vascular Growths.

This ligature is applied by passing a needle or a needle with a handle, armed with a double ligature, through the skin near the growth, and then passing it under the tumor and bringing it out through the skin at a point directly

Fig. 172.

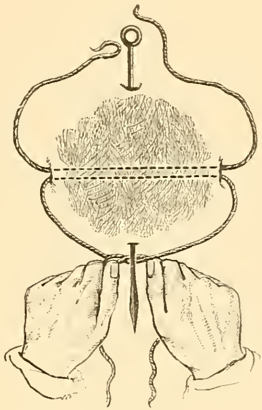


Method of applying double ligature. (Roberts.)

opposite the point of insertion; the ligature is then divided and the needle removed and the tumor is strangulated by tying firmly the corresponding ends of the ligature on each side of the tumor, each ligature strangulating one-half of the growth (Fig. 172).

The double ligature may also be applied by first passing a pin under the growth and then passing a needle armed with a double thread under the tumor at right angles to the pin, and after removing the needle the ends of the liga-

FIG. 173.



Method of applying double ligature and pin. (BRYANT.)

ture are tied and the tumor is strangulated in two sections (Fig. 173).

Quadruple Ligature.

In applying this ligature two needles carrying a double ligature are passed under the growth at right angles to each other, or if the handled needles be used they may be first passed in this manner, and then threaded with double ligatures, which are carried under the growth as they are withdrawn. The needles being removed, the surgeon ties two ends of the ligature together and repeats this procedure until the growth has been strangulated in four sections. (Fig. 174.)

Subcutaneous Ligature.

This is applied by introducing a needle armed with a ligature through the skin near the growth, and carrying it through the subcutaneous tissues around the growth for a short distance, then bringing it out through the skin. The needle is again introduced through the same puncture and is again brought out through the skin at some distance from

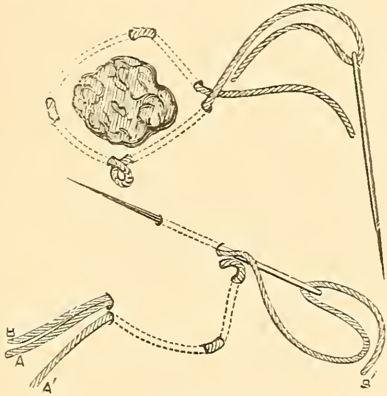
Fig. 174.

Method of applying quadruple ligature. (Liston.)

the first point of exit, and is next introduced through this puncture and brought out at a more distant point. In this way the growth is completely encircled by a subcutaneous ligature, which finally is brought out at the point of entrance; the tumor is strangulated by firmly tying together the ends of the ligature. (Fig. 175.)

If a needle armed with a double ligature is first passed under the growth the ligature is divided, and by passing each end of the divided ligature subcutaneously around the growth it may be strangulated subcutaneously in two sections.

FIG 175.

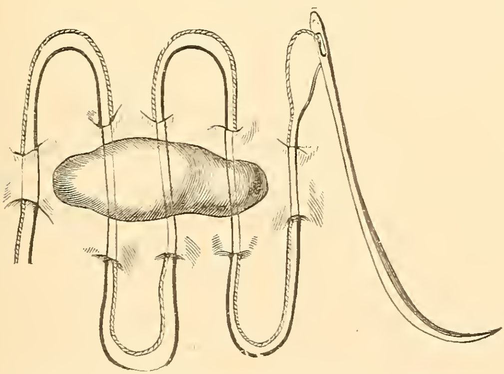


Method of applying subcutaneous ligature. (HOLMES.)

Erichsen's Ligature.

This ligature is employed to strangulate tumors of irregular shape in a number of sections. A strong silk or hemp ligature three yards in length, one-half of which is stained

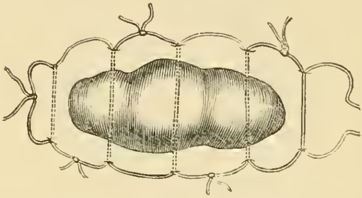
FIG. 176.



Method of applying Erichsen's ligature. (ERICHSEN.)

black, is carried by a needle as a double ligature under the growth at various points so as to leave a series of loops about nine inches long on each side of the tumor (Fig. 176); the black loops being cut on one side, the white on the

FIG. 177.



Erichsen's ligature applied.

other, the ends are then firmly tied so as to strangulate the growth in sections. (Fig. 177.)

ELASTIC LIGATURES.

Ligatures made of India-rubber varying from half a line to several lines in thickness are often made use of in surgery. They may be employed to strangulate growths such as moles or nævi, or in the treatment of fistulæ, and are especially useful in the treatment of those cases of fistula-in-ano in which the internal opening into the bowel is situated high up, as the division of such fistulæ by this means is accomplished without hemorrhage and with less risk than by the employment of the knife. In applying elastic ligatures in such cases the ligature, after being passed through the fistula by means of a probe, is carried out through the internal opening; the anus is next well stretched, and the elastic ligature is then firmly tied with two or three knots; the greater the tension made before the ligature is tied the more rapidly will it cut its way out. The smaller sizes of rubber drainage-tubes may be substituted for the solid rubber ligatures.

Treatment of Hemorrhage.

The surgeon may be called upon to treat the following varieties of hemorrhage: *arterial*, *venous*, or *capillary;* and these again are classified according to the time of their occurrence, as—*primary*, that is, bleeding which occurs at the time the wound is inflicted; *intermediary* or *consecutive*, that which occurs within twenty-four or forty-eight hours after the reception of the injury, which generally takes place during the period of reaction; and *secondary*, which takes place after forty-eight hours, and may occur at any time subsequent to this period until the wound is healed. The treatment of hemorrhage is either *constitutional* or *local*.

The *constitutional* treatment of hemorrhage consists in keeping the patient in the recumbent posture and avoiding any sudden elevation of the head or arms which might induce fatal syncope. Opium is a valuable remedy and should be freely used. Ergot, gallic acid, acetate of lead and tincture of iron may also be employed, and stimulants and food should be carefully administered, and in extreme cases auto-transfusion or transfusion of blood or normal salt solution, as described on page 168, may be resorted to.

In the *local* treatment of hemorrhage various measures may be adopted which may be either temporary or permanent in their action.

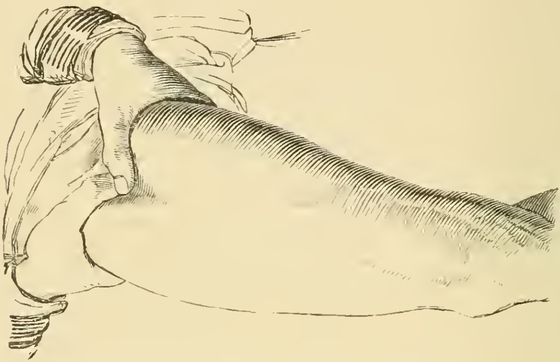
Temporary Control of Arterial Hemorrhage.

This may be effected by pressure applied directly to the bleeding vessel in the wound or by pressure applied indirectly to the main artery between the point of its injury and the centre of the circulation, and this pressure may be made by the fingers, *digital compression*, by compresses, or by means of tourniquets.

Digital Compression.

This constitutes one of the most valuable means employed in the temporary control of hemorrhage; the finger is pressed directly upon the bleeding vessel in the wound or is used to make pressure upon the artery from which the bleeding arises at some point between the wound and the centre of the circulation. (Fig. 178.) Control of hemorrhage by digital presssure can only be maintained for a few minutes,

Fig. 178.



Digital compression of the femoral artery.

for the fingers of the surgeon or assistant soon become tired, so that it is only employed until means are adopted for the permanent control of the bleeding. Digital compression of the radial and ulnar arteries is frequently resorted to for the control of hemorrhage during amputations of the fingers, also of the axillary and femoral arteries in amputations at the shoulder- and hip-joints.

It is also used to control hemorrhage from wounds either the result of accident, or those made by the knife of the surgeon, in which case the finger is placed directly upon the divided vessel, or employed to hold a sponge or compress firmly in the wound.

Compresses.

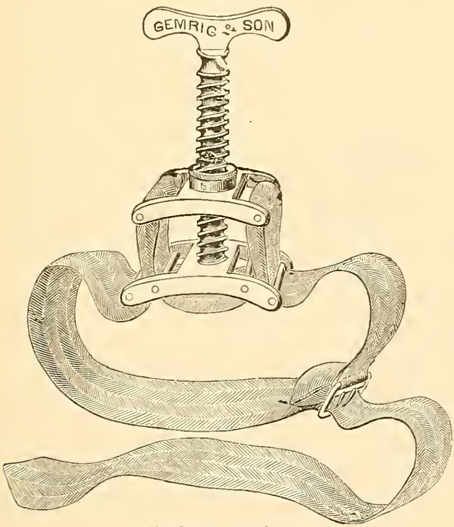
By the use of compresses placed directly in the wound or applied to the vessel between the wound and the centre of the circulation, the temporary control of hemorrhage may be very satisfactorily accomplished. Where it is possible, the compress which is applied in the wound should be made of antiseptic gauze, thereby diminishing the chances of wound-infection.

The compress should be held in position by a bandage firmly applied and is generally employed only as a temporary expedient until a more permanent means of controlling the bleeding is adopted.

Tourniquets.

These instruments, which are employed for the temporary control of hemorrhage from wounds, are of many different kinds.

Fig. 179.



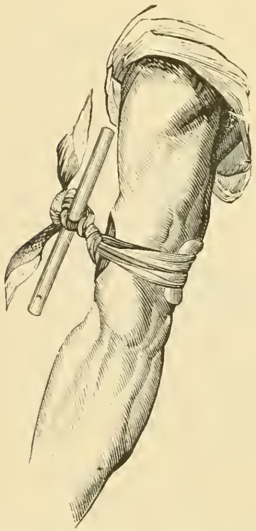
Petit's tourniquet.

Petit's tourniquet, which is the best for ordinary use, consists of two metal plates connected by a strong linen or silk strap, with a buckle—the distance between the plates being regulated by a screw. (Fig. 179.) In applying this tourniquet a compress or roller bandage is placed directly over the artery to be compressed and may be held in position by a few turns of the roller bandage. The lower plate of the tourniquet is placed directly over this pad and the strap is tightly secured around the limb to keep the instrument in place. The screw is then turned so as to separate the plates and tighten the strap, thus forcing the compress or pad upon the artery controlling its circulation. This instrument is very generally employed for the control of hemorrhage in wounds of the extremities and is especially useful in amputation of these parts, being placed over the main artery some distance above the seat of operation.

The Spanish Windlass.

An improvised tourniquet, known as the Spanish windlass, may be employed in cases of emergency; it is prepared by folding a handkerchief or piece of muslin into a cravat and placing a compress or smooth pebble on the body of the cravat; this is placed over the artery to be controlled, and the ends of the handkerchief are tied loosely around the limb; a short stick is passed through this loop, and by twisting the stick the loop is tightened and the compress is forced down upon the artery (Fig. 180).

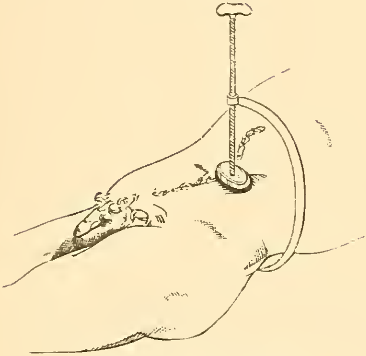
Fig. 180.



The Spanish windlass.

Many other forms of tourniquet have been devised which have the pad and counter-pad arranged as to make pressure upon the vessel desired, such as Lister's aorta compressor (Fig. 181), which is employed in the treatment of aneurism of the iliac vessels, and for the control of hemorrhage in amputation at the hip-joint. Hoey's clamp (Fig. 182) and Signorini's tourniquet (Fig. 183) are constructed upon the same principle, and are frequently employed to control the

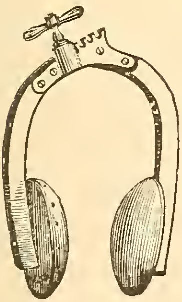
Fig. 181.



Lister's aorta compressor.

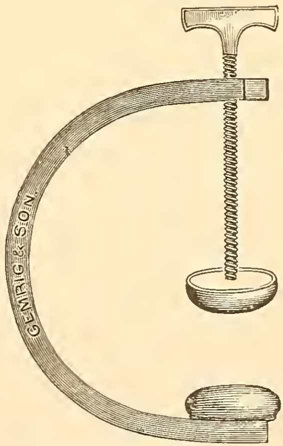
circulation in the femoral artery in cases of operations on the thigh and leg, and in the treatment of femoral or popliteal aneurism.

Fig. 182.



Hoey's clamp.

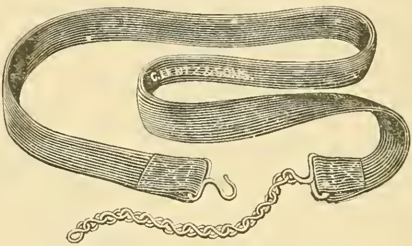
Fig. 183.



Signorini's tourniquet.

The *elastic tube*, or *strap of Esmarch's apparatus* (Fig. 184) may also be employed for the temporary control of arterial hemorrhage, being applied above the wound, and if this is not at hand, any strong rubber cord, or a piece of large-sized drainage-tube may be used as a substitute. In hemorrhage from wounds of the hands and feet, especially in children, and in controlling hemorrhage from wounds of the penis, a piece of drainage-tube, firmly applied above the wound, may be employed with advantage. This tube or

Fig. 184.



Elastic strap of Esmarch's apparatus.

strap, although generally employed to control hemorrhage from vessels of the extremities, may be used to control the femoral artery as it crosses the brim of the pelvis, by placing a compress over the artery in this position, and then applying the elastic band to secure it with a figure-of-eight turn, passing it under the thigh, crossing over the pad, and then carrying the ends around the pelvis, and securing them.

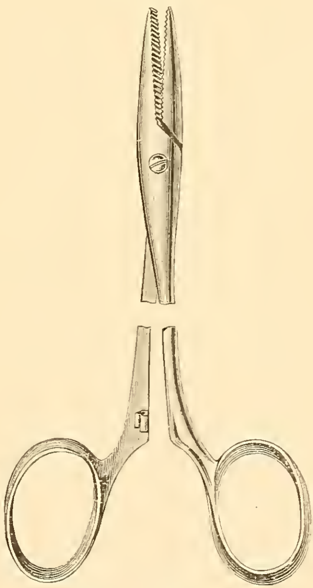
To make pressure on the axillary artery, a compress should be placed in the axilla, and the middle of the tube is placed over this to hold it in position; the ends of the tube are then carried over the shoulder and crossed, and then carried to the opposite axilla and secured.

In amputation at the shoulder-joint, to make pressure upon the subclavian artery, which is difficult to compress by an ordinary tourniquet, the handle of a large key well padded may be used; it is firmly pressed against the vessel above the clavicle, and held by an assistant, and will prove a very satisfactory means of controlling the circulation in this vessel.

Hæmostatic Forceps.

The temporary control of arterial hemorrhage by the use of hæmostatic forceps is now very generally employed in surgical operations, and their use has done much to diminish the shock following operations from the loss of blood. The hæmostatic forceps in general use is self-retaining; it is clamped upon the bleeding vessel, and is allowed to remain until the operation is completed, when the vessel is secured permanently by the application of a ligature, and the forceps is removed. The use of these forceps will be found very satisfactory in controlling hemorrhage during the removal of tumors and in cases of amputation, and for the temporary control of bleeding during the operation of tracheotomy they will be found most efficient, as also in abdominal operations, in which their utility was first demonstrated. (Fig. 185.)

FIG. 185.

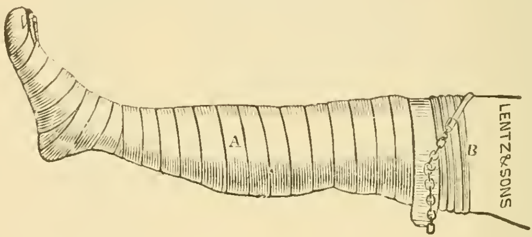


Hæmostatic forceps.

ESMARCH'S BANDAGE AND TUBE.

This apparatus, which is applied to the limbs to render them bloodless during operations, consists of a rubber bandage two and a half inches in width and three or four yards in length, and a rubber tube two yards in length, to one end of which is attached a chain and to the other a hook, or better a rubber strap, one inch in width and one and a half yards in length with a hook and chain. The bandage is applied to the extremity of the limb and is carried up the limb to a point some distance above the seat of proposed operation; the bandage is applied firmly, each turn overlapping one-fourth of the preceding one, and when the last turn has been made the rubber tube or strap is wound firmly around the limb and secured by fastening the hook into one of the links of the chain. (Fig. 186.) After securing the tube or strap the rubber bandage is removed from the limb

Fig. 186.



Esmarch's bandage and tube applied.

and if the tube has been firmly enough applied the limb will be found to be blanched, and should be free from blood during the operation. Care should be taken not to apply the tube or strap too tightly in poorly developed limbs, or on parts of the limb where large nerve trunks approach the surface, as they may be subjected to an amount of pressure which will interfere with their functions subsequently. I have knowledge of one case of this nature in which permanent paralysis of the limb followed the use of Esmarch's apparatus; the tube should be applied with just enough firmness to control the circulation.

As the strap, when firmly applied, completely cuts off the circulation of parts below. it should be applied for as short a time as possible, as gangrene has resulted from its prolonged use.

After the removal of the tube there is generally quite free capillary hemorrhage, due to paralysis of vasomotor nerves from pressure, but this in a short time stops. This apparatus is of the greatest service in controlling hemorrhage at the time of operation, and in amputations and removal of vascular tumors from the limbs will be found most satisfactory. In operations upon bone, either osteotomy or sequestrotomy, it is especially useful, as it allows the surgeon to have a view of the parts unobscured by hemorrhage. I have found its use most satisfactory in operations for the removal of foreign bodies, such as needles imbedded in the hands or feet or extremities.

Permanent Control of Arterial Hemorrhage.

To secure this end the surgeon may resort to the use of position, cold, heat, styptics, pressure, cauterization, ligation, torsion, or acupressure.

Position.

In arterial hemorrhage from wounds of the extremities elevation of the part will be found to materially diminish the amount of hemorrhage; in hemorrhage from wounds of the arteries of the hand, forearm, foot, or leg, forcible flexion of the forearm on the arm or of the leg on the thigh will be found useful in diminishing the force of the blood-current.

Cold.

The application of cold by means of a stream of cold water or an ice-bag or pieces of ice will often be found an efficient means of controlling hemorrhage from vessels of small calibre; it is especially applicable to hemorrhage from wounds of the vessels of the mouth, nostrils, vagina, or rectum.

Hot Water.

Hot water will be found a very efficient means of controlling hemorrhage from small vessels, and it may be used in the form of a hot antiseptic solution. It is of especial value in capillary or parenchymatous hemorrhage and is employed in the form of a douche or by means of sponges dipped in the hot solution and packed into the wound. Injection of hot water is a most satisfactory method of controlling uterine hemorrhage.

Styptics.

These agents are sometimes employed to control capillary bleeding or hemorrhage from small vessels, and although their use is often satisfactory as regards the control of the bleeding, they have the disadvantage of interfering with the primary union in wounds, and since the value of asepsis in wound treatment has been demonstrated they are now very seldom employed. The most valuable styptics which are used are alcohol, alum, oil of turpentine, perchloride of iron, and persulphate of iron or Monsel's solution, acetic acid, and vinegar.

Pressure.

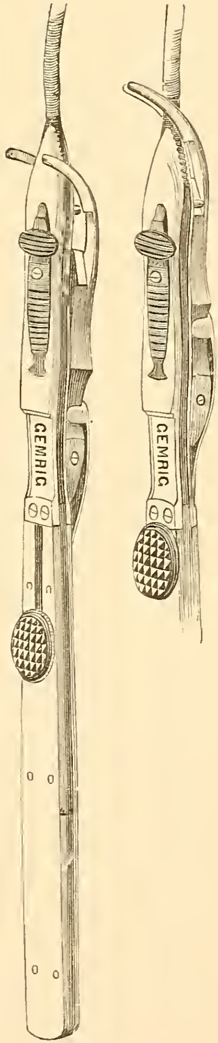
For the permanent control of arterial hemorrhage pressure may be applied directly to the bleeding-point or surface by means of a compress of antiseptic gauze or by strips of gauze packed firmly into the cavity from whose surface the bleeding arises.

Compresses are used with the best results where the proximity of a bone gives a firm substance upon which the vessel may be compressed, as is the case in the vessels of the scalp. Pressure applied by means of packing with strips of gauze will be found most efficient in controlling hemorrhage from cavities such as the nose, vagina, or rectum, and in the cavities resulting from the removal of necrosed or carious bone. Pressure may be indirectly applied by flexing the proximal joint over a compress or by firm bandaging of the limb.

In controlling bleeding from a divided artery in a bony cavity, such as the inferior dental, a piece of catgut ligature may be forced into the canal, and will control the bleeding in a most satisfactory manner.

The troublesome hemorrhages sometimes occurring after the removal of a tooth may be controlled by packing the alveolar cavity with a strip of gauze, or by introducing a wedge-shaped piece of cork and holding it in place by fastening the jaws together by means of a bandage.

FIG. 187.



Hewson's torsion forceps.

Cauterization.

The use of cauterization by means of a hot iron is a satisfactory method of arresting hemorrhage. Care should be taken to have the iron only of a dull-red or black heat, as the result desired is not the destruction of the tissues, but the coagulating effect of heat upon them. The form of cautery iron employed will depend upon the position of the vessel. Paquelin's cautery is also a satisfactory apparatus to use for the control of hemorrhage.

Control of arterial bleeding by cauterization is often resorted to in operations upon the jaws and in the removal of tumors from the mouth or pharynx or of the tonsils; it is also frequently employed to control hemorrhage in operations upon the uterus and the rectum, and also that resulting from the removal of abdominal tumors, where the application of a ligature is difficult and often impossible.

Torsion.

This method of controlling arterial hemorrhage consists in seizing the end of the artery, drawing it slightly out of its sheath and twisting it; it may be accomplished with a single pair of forceps or by two pairs of forceps. In the latter method the vessel is held by one pair of forceps and is twisted by the second pair.

Torsion of arteries in accidental wounds is quite common, and in many cases controls the hemorrhage until surgical aid is rendered. I have seen the femoral artery in Scarpa's triangle completely controlled in this manner in the case of an avulsion of the thigh from railway injury.

In vessels of moderate size it may be practised with one pair of forceps, and the ordinary double-spring artery forceps (Fig. 188) will be found satisfactory for such cases. In larger arteries two forceps should be employed, or some of the numerous forms of torsion forceps which have been devised for this purpose. (Fig. 187.)

Fig. 188.

Double-spring artery forceps.

Ligation.

The use of the ligature is by far the most generally employed method of controlling arterial hemorrhage. The materials used for ligature are silk, hemp thread, catgut, horsehair, iron or silver wire. Catgut or silk is the material generally employed. The vessel is seized with a pair of artery forceps or a tenaculum (Fig. 189) and drawn out of its sheath,

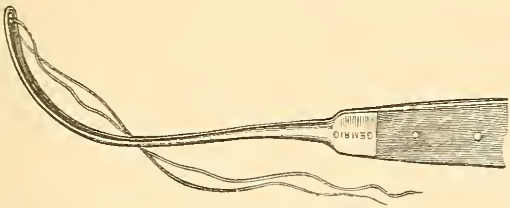
Fig. 189.

Tenaculum.

and a ligature of prepared catgut is thrown around it and secured by a surgeon's knot, or by a reef knot and surgeon's knot combined, and when firmly tied the ends are cut short in the wound. Silk ligatures which have been rendered aseptic are applied in the same manner and the ends may be cut short in the wound.

When ligatures are applied to vessels in their continuity they may be threaded into an eyed probe or aneurism needle (Fig. 190) and carried around the vessel and secured.

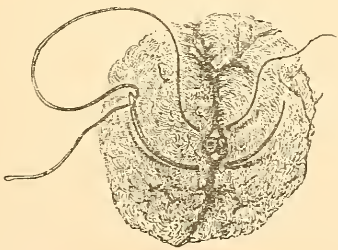
Fig. 190.



Aneurism needle armed with ligature.

A convenient method of applying a ligature to a bleeding-point in a deep wound or to a vessel in tissues which are of such a nature as not to permit of the isolation of the vessel, is to use a curved needle threaded with a catgut ligature,

Fig. 191.



Artery occluded by suture. (Esmarch.)

which is passed deeply into the tissues near the vessel and brought out on the opposite side; the ligature thus placed is then firmly tied, and the ends are cut short in the wound. (Fig. 191.)

Acupressure.

In this method of controlling arterial hemorrhage a needle or pin is used which is thrust through the tissues in such a way as to compress the artery. There are a number of methods of using the needle or pin and a few of these will be described.

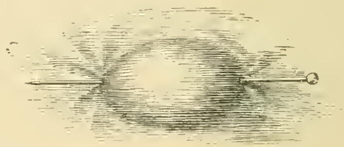
First Method of Acupressure.

In this method the surgeon places a finger of his left hand upon the mouth of the bleeding vessel and with his right hand introduces the needle from the cutaneous surface and passes it through the thickness of the flap till its point projects for a couple of lines or so from the surface of the

FIG. 192.

Acupressure—first method; raw surface. (ERICHSEN.)

FIG. 193.



Acupressure—first method; cutaneous surface. (ERICHSEN.)

wound a little to the right side of the tube of the vessel. By forcibly inclining the head of the needle toward his right he brings the projecting portion of its point firmly down on the site of the vessel, and after seeing that it occludes the artery he makes it reënter the flesh as near as possible to the left side of the wound and pushes the needle through the flesh till its point comes out again at the cutaneous surface. (Figs. 192 and 193.)

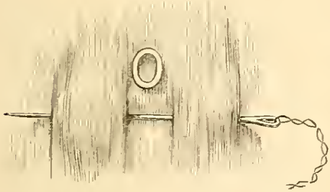
Second Method of Acupressure.

A straight needle threaded with a short piece of iron or silver wire, for the purpose of afterward retracting and removing it, is passed down through the soft parts a little to one side of the vessel; its point is then raised up and passed over the artery and is then turned down again and thrust into the soft tissues on the other side of the vessel. (Fig. 194.)

Third Method of Acupressure.

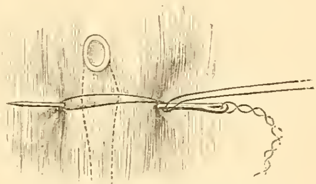
In this method the point of the needle is passed into the tissues a few lines to one side of the vessel, then passed under it and afterward pushed on, so that the point again emerges a few lines beyond the vessel. A loop of wire is next passed over the point of the needle and then after

Fig. 194.



Acupressure—second method. (Erichsen.)

Fig. 195.



Acupressure—third method. (Erichsen.)

being carried over the vessel and passed around the opposite end of the needle it is drawn sufficiently tight to close the vessel, and the ends of the wire are secured by making a twist around the stem of the needle. (Fig. 195.)

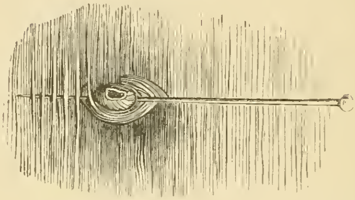
Fourth Method of Acupressure.

This method is identical with the third, except that a long pin is used in place of the needle, the head of the pin remaining outside the wound.

Fifth Method of Acupressure.

This method consists in passing a pin or needle through the soft tissues close to the artery, and by giving the pin a quarter or half rotation twisting the vessel upon itself, fixing the pin by thrusting its point deeply into the tissues beyond. (Fig. 196.)

Fig. 196.



Acupressure—fifth method. (Erichsen.)

Sixth Method of Acupressure.

This method consists in applying the pin as in the fourth method, but differs from it in crossing the ends of the wire behind the pin so as to embrace the mouth of the vessel between them.

Seventh Method of Acupressure.

This method consists in passing a long needle or pin through the cutaneous surface deeply into the soft parts at some distance from the vessel, making it emerge near the vessel, bridging over the vessel and then thrusting it down into the soft parts on the other side of the vessel and making its point emerge again from the integument.

Treatment of Venous Hemorrhage.

Bleeding from small veins often stops spontaneously unless there is some pressure upon the wounded veins upon the cardiac side of the wound. It is, however, very satisfactorily controlled by position or by the application of a compress and bandage, or by the use of a ligature; if the divided vein be a large one it is well to secure both ends of the vein by ligatures. The free bleeding arising from ruptured varicose veins of the leg is easily controlled by the application of a compress and bandage, while hemorrhage from the larger veins, such as the jugular, should be controlled by the application of ligatures as in the case of wounded arteries. The application of the *lateral* ligature to small wounds of veins of large size, such as the femoral, has been recommended, and it consists in pinching up the wall of the vein so as to include the orifice of the wound and throwing a delicate ligature around it.

The use of the actual cautery may also be required for the control of venous hemorrhage in positions in which its arrest by pressure or the ligature is not feasible.

Treatment of Capillary Hemorrhage.

Capillary or parenchymatous hemorrhage is usually arrested spontaneously by the exposure of the injured surface of the wound to the air, but it is often so profuse that its arrest becomes a matter of importance. To control this form of bleeding, pressure may be applied to the bleeding surface for a short time, and if this fails to arrest it, sponging the surface with dilute alcohol will sometimes prove satisfactory; but the best application to arrest hemorrhage of this nature is hot water, which may be used in the form of a hot bichloride solution. Acetic acid and vinegar are also sometimes employed for the same purpose. In cases where the means mentioned above fail to control the bleeding, it may be necessary to pack the wound with strips of antiseptic gauze; this dressing is most serviceable when the hemorrhage comes from cavities such as result from the removal of tumors or excisions of joints, and for the control of bleeding following the removal of necrosed or carious bone, packing the cavity resulting is the method very generally employed. To control hemorrhage from the mucous cavities, such as the nose, rectum and vagina, this method of treatment is frequently resorted to.

Treatment of Secondary Hemorrhage.

Secondary hemorrhage following the use of the ligature or other means of controlling bleeding is, since the adoption of the antiseptic method of wound-treatment, a much less frequent complication of wounds. The treatment of this complication is both constitutional and local; the constitutional treatment consists in the use of those remedies which were mentioned as serviceable in primary hemorrhage, and the drugs upon which the most reliance is to be placed are opium and ergot.

The local treatment of this form of hemorrhage consists in the use of the various means of controlling hemorrhage which have been mentioned before, such as the ligature, hot water, pressure, or the actual cautery. If possible, it is well to secure the vessel from which the bleeding arises in the wound; if for any reason this cannot be done, the main artery should be ligated above the wound if the hemorrhage be arterial.

Rules for Ligating Wounded Arteries.

The following rules for the application of ligatures to wounded arteries are laid down by Ashhurst:

1. In cases of primary hemorrhage, no operation should be performed upon an artery, unless it is at the moment actually bleeding. The exception to this rule is in the cases where the vessel is seen to pulsate in the wound or where the wound involves the region of a large artery and the patient has to be transported or may be in a position not to receive surgical aid subsequently if needed; under these circumstances, the vessel should be tied or the wound should be explored to ascertain the fact that no important vessel has been injured.

2. In applying a ligature to a wounded artery, the surgeon should cut down directly upon it at the point from which it bleeds and secure it in the wound.

This rule holds good for both primary and secondary hemorrhage.

3. Two ligatures should be applied, one to each end of the artery if it be completely divided, and one on each side of the wound if the latter has not completely severed the coats of the artery. This procedure is adopted for the

reason that the arterial anastomosis is so free that the proximal ligature will not always, even temporarily, arrest the bleeding; and if it does accomplish this object at the time, after the collateral circulation is established, bleeding is apt to occur from the distal extremity of the divided vessel. If the coats of the artery are not completely severed their division should be completed, either before or after the application of the proximal and distal ligatures, thereby favoring the contraction and retraction of the ends of the divided vessel.

Control of Hemorrhage from Special Parts.

Epistaxis or hemorrhage from the nose may be so profuse as to require surgical interference. To control this form of hemorrhage the application of iced compresses to the surface of the nose may first be made use of, and if this fails to control the bleeding, the surgeon or the patient should grasp the cartilaginous portion of the nose with his thumb and forefinger in such a manner as to keep the nostrils tightly closed, which will prevent the passage of air through the nose and thus permit clots to form, arresting the flow of blood. If these simple means fail to arrest the bleeding the nasal cavity or cavities may be packed with strips of antiseptic gauze introduced into the anterior nares, and pushed backward by a director or probe; this will often be found a perfectly satisfactory means of arresting the bleeding. This method may be supplemented by a plug of antiseptic cotton introduced into the posterior nares with the fingers. The use of a rubber tampon, consisting of a rubber bag introduced into the nares in an empty state and afterward inflated, has also been recommended for the control of this variety of hemorrhage.

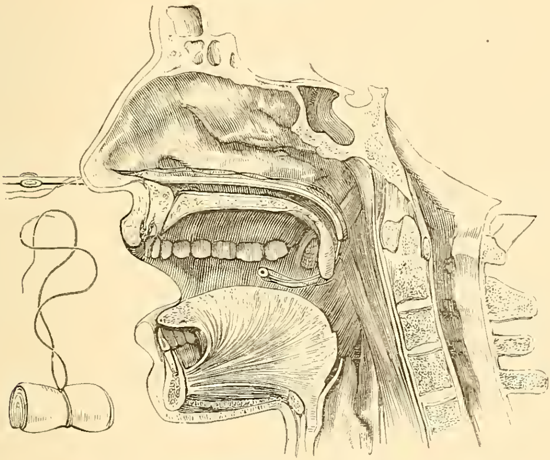
Another method of controlling hemorrhage from the nose consists in introducing a small piece of sponge, tied to a strong silk ligature, into the anterior nares and pushing it back along the floor of the nose to the posterior nares; a small piece of sponge about the size of a marble with a hole in the centre is threaded on the ligature and pushed back until it comes in contact with the first piece of sponge introduced, and thus by introducing a number of pieces of sponge in this way the nasal cavity may be completely filled up and the bleeding is arrested. Care should be taken to see that the sponge has been rendered aseptic before being introduced, and the nasal cavity should also be washed out with an antiseptic solution before its introduction. The sponges may be allowed to remain in place for twenty-four to forty-eight hours. (Fig. 197.)

Fig. 197.

Plugging the nares from the front. (Roberts.)

Plugging the nares by means of Bellocq's canula is also employed to arrest hemorrhage from the nasal cavities; the canula, armed with a strong ligature, is passed along the floor of the nose until it reaches the pharynx, when the spring being protruded, the ligature is seized and brought out of the mouth and secured to a plug of lint or antiseptic gauze of the required size, and upon withdrawing the instrument the plug is brought into position in the posterior nares and the end of the ligature is allowed to protrude from the mouth to facilitate its removal. (Fig. 198.) An

Fig. 198.



Plugging the nares with Bellocq's canula. (Fergusson.)

ordinary flexible catheter may be employed in place of Bellocq's canula for the introduction of the ligature.

Hemorrhage from the Urethra.

In hemorrhage from the urethra, if profuse, the blood will trickle from the meatus, or if efforts at micturition are made the first gush of urine will contain blood, but afterward will be clear, and the last urine will contain a few drops of pure blood.

This variety of bleeding, if it proceeds from the anterior portion of the urethra, may be controlled by the introduction of a catheter and the application of a bandage around the penis, carefully applied so as to make only moderate pressure.

If the bleeding comes from the posterior portion of the urethra, it will often be controlled by the application of cold or pressure to the perineum, or by the introduction of a cold steel bougie, or by the injection of a solution of tannic acid.

Hemorrhage from the Bladder.

In this variety of hemorrhage the first portion of the urine may be blood-stained and the last portion will contain more blood and clots as the organ contracts, which distinguishes it from hemorrhage from the kidneys, in which the admixture of blood with the urine renders it of a smoky color or dark-red if the bleeding is profuse.

To control bleeding from the bladder a catheter should be introduced and the urine and clots withdrawn; the bladder should next be washed out with a warm or cold boric acid solution, or in severe cases weak astringent solutions, such as tannic acid or alum, may be employed. The application of ice to the perineum and supra-pubic regions may also be employed with advantage.

Hemorrhage from the Rectum.

This variety of bleeding may be controlled by the injection of cold or astringent enemata. If the bleeding be profuse a speculum should be introduced, and when the source of the bleeding has been discovered the actual cautery or a ligature should be applied. If this is not feasible the rectum may be plugged with strips of antiseptic gauze, or a piece of a rubber catheter of large calibre may be wrapped with gauze and introduced into the rectum, the end of the catheter being allowed to protrude; by using this tube flatus can escape, and if the bleeding is not controlled blood will escape through the tube, preventing the risk of concealed hemorrhage. If the bleeding arises from hemorrhoids or polypus of the rectum, the operative treatment of these conditions should be undertaken to permanently control the bleeding.

Opening and Dressing of Abscesses.

Acute abscesses, as a rule, should be opened by incision, and this is best done with a straight, narrow, sharp-pointed bistoury; the incision should be deep enough to freely expose the cavity of the abscess, and should be so planned as to be parallel with and not across important structures, and it should also be made at as dependent a portion as possible. Abscesses of the limbs are opened by a longitudinal incision, and those in the region of the anus and breast by an incision radiating from the anus or nipple.

In deep-seated abscesses in the region of important structures the method of opening suggested by Mr. Hilton may be employed with advantage; it consists in making a small incision through the skin and cellular tissue; a director is next pushed through the tissues into the abscess cavity, which will be shown to have been reached by the escape of a little pus along the director; a dressing forceps with the blades closed is now pushed along the director into the abscess cavity, and when this has been accomplished the director is withdrawn and the forceps are removed with the blades expanded so as to dilate the wound and allow the pus to escape.

The cavity of the abscess being emptied of pus, it should be irrigated with a stream of carbolic acid solution 1 : 40, or bichloride solution, and if the cavity is not very large or deep no drainage-tube need be introduced, and a small piece of protective may be placed between the lips of the wound to prevent their adhesion; but if, on the other hand, the cavity is extensive and deeply situated, a rubber drainage-tube should be introduced to the bottom of the cavity to secure free drainage and fixed at the surface of the skin by a safety-pin. A piece of protective which has been dipped in bichloride solution is next placed over the wound, and over this is laid a gauze dressing, consisting of a number of layers, which has been moistened in carbolic or bichloride solution; this is covered by a number of layers of dry gauze which is in turn covered by a piece of rubber tissue, and over this is placed a few layers of bichloride cotton and the dressing is finally secured by a roller bandage. The dressing is removed at the end of two or three days, the cavity being washed out with one of the antiseptic solutions previously mentioned; the drainage-tube may be shortened or removed and the dressings are reapplied as at the primary dressing. Under this method of treatment acute abscesses usually heal more promptly and with less suppuration than under the older methods of treatment in which poultices were applied.

Chronic or cold abscesses, which occur chiefly in connection with diseases of the bones or joints or of the lymphatic system, and are generally tubercular in their origin, may be opened in various ways, the time at which this should be done depending upon the size and situation of the abscesses and the amount of constitutional disturbance which the patients experience from their presence.

A cold abscess may be evacuated by means of the aspirator; the pus being withdrawn as far as possible, the puncture is sealed with a small piece of gauze covered with iodoform collodion. Reaccumulation of the pus often takes place and the aspiration has to be repeated a number of times. The greatest difficulty in the successful removal of the contents of cold abscesses by means of aspiration is the presence of masses of lymph in the pus which occlude the canula and often prevent the complete emptying of the cavity.

These abscesses may also be evacuated by making a puncture through the skin and overlying tissues with a narrow bistoury, the surface having been previously thoroughly washed with soap and water and with a carbolic or bichloride solution; a director is next pushed through this small wound into the cavity of the abscess and the pus is allowed to escape by stretching the wound by the director; when the cavity is emptied of pus it is washed out with a carbolic or bichloride solution introduced into it by pushing the nozzle of a syringe into the cavity, and this is allowed to escape in the same way as the pus previously did, and when the irrigating solution has all escaped the cavity may be injected with an emulsion composed of iodoform one part, glycerin ten parts; after this has been introduced the small wound is closed by a compress of antiseptic gauze held in place by a compress of bichloride cotton and a bandage or by strips of adhesive plaster. The injection of the iodoform emulsion need not be repeated as long as iodoform continues to be excreted with the urine. Cold abscesses are also treated by making a free incision into the abscess cavity with full antiseptic precautions, and after the escape of the purulent matter the walls of the abscess should be thoroughly scraped with a curette, and after the cavity has been freely washed out with a carbolic or bichloride solution large drainage-tubes are introduced and an antiseptic dressing is applied to the wound. The dressings are removed as soon as they become soaked and the drainage-tubes are shortened or removed as the discharge diminishes and the cavity contracts.

In evacuating chronic abscesses by means of the aspirator or by a small puncture, there is absence of shock and the loss of blood is insignificant, so that these procedures should generally be first employed, and the more radical operation of incision and curetting of the cavity of the abscess, which is accompanied with a certain amount of shock and hemorrhage, should be reserved for those cases in which the less severe operations have failed to be followed by a satisfactory result.

Diffused suppuration is treated by numerous punctures or incisions, which allow the purulent matter to escape, and where sloughs are present free incisions may be required to give exit to the necrosed tissues; the introduction of drainage-tubes may also be required. The wounds and the cavities, as far as possible, should be washed out with a carbolic or bichloride solution and an antiseptic gauze dressing should be applied.

Sinuses resulting from abscesses, if superficial, should be laid open freely and their surfaces should be scraped with a curette and they should then be lightly packed with strips of bichloride or iodoform gauze and should be covered by an antiseptic dressing. If they are too deep to be treated by incision their healing may be facilitated by the injection of stimulating solutions introduced by means of a syringe; the employment of solutions of chloride of zinc, nitrate of silver, and sulphate of copper varying in strength from five to twenty grains to the ounce of water will often prove satisfactory.

Dressing of Wounds.

Incised wounds present the conditions favorable for prompt healing and they should first be carefully irrigated with an antiseptic solution to remove any blood-clots or foreign bodies, and after any hemorrhage which is present is controlled by the use of ligatures, if the wound be an extensive or deep one, provision should be made for drainage by introducing a drainage-tube or a few strands of prepared catgut to the bottom of the wound, allowing the extremity to project from the most dependent portion of the wound. In superficial incised wounds, after the hemorrhage has been controlled, it is not usually found necessary to make any provision for drainage. If the wound be a deep one, involving the muscles and deep fascia, buried sutures of catgut should be applied to approximate the muscles and fascia, and if important nerves or tendons have been divided their ends should be brought into apposition by sutures of catgut or sterilized silk; the superficial portions of the wound should next be brought together by the introduction of a number of interrupted sutures, catgut, silkworm-gut, silver wire or silk being employed for this purpose; the accurate apposition of the edges of wounds of this variety is secured by the introduction of a number of sutures placed closely together.

After a wound of this variety has been closed the subsequent dressing is accomplished by dusting the surface of the wound with iodoform or aristol, and a piece of protective a little larger than the wound, which has been dipped in a 1 : 40 carbolic solution, is placed over it; over this is placed a pad of antiseptic gauze, composed of ten or twelve layers, which has been soaked in a 1 : 40 carbolic solution or a

1 : 2000 bichloride solution, and over this is laid a pad of dry antiseptic gauze of the same thickness, overlapping the wet gauze by a few inches in all directions ; a few layers of bichloride cotton are next applied over the gauze dressings and the whole dressing is secured in position by the application of an antiseptic gauze bandage. Under this form of dressing prompt healing of incised wounds is the rule, and the wound need not be re-dressed for a week or ten days unless some indications exist for the change of dressing at an earlier period. At the time of the first dressing the catgut drain or the drainage-tube is usually removed and if the adhesion of the edges of the wound is firm the sutures may also be removed. An antiseptic dressing is usually next applied and allowed to remain in position for a few days longer.

Lacerated wounds present edges which are torn and not sharply cut, and the vitality of the injured parts is often so seriously impaired that prompt union in this variety of wounds is not, as a rule, to be looked for. Wounds of this nature should first be irrigated with an antiseptic solution, as in the case of incised wounds, and blood-clots and foreign bodies should be removed. If the wounds be deep, drainage-tubes should be introduced ; on the other hand if they be superficial or if the edges are not closely approximated, provision for drainage may be omitted. The torn or irregular edges of the wound should next be brought into apposition at a few points, by the introduction of a few catgut or silkworm-gut sutures, applied not very closely together ; and if the edges are discolored and their vitality seems markedly impaired, it is better not to use sutures, but rest satisfied by bringing them as nearly as possible in contact by the use of a few strips of isinglass plaster moistened with a bichloride solution. If the edges of the wound are so much crushed as to have their vitality destroyed, they may be trimmed away with scissors until a surface possessing fair vitality is secured. The evil results arising from the introduction of sutures into this variety of wounds with the idea of closely approximating their edges are so common, that the surgeon who dispenses with the use of sutures entirely errs upon the safe side. The use of many sutures in wounds of this nature often causes marked tension in the wound, which is frequently followed by impairment of the vitality of the injured tissues and sloughing results.

The wound should next be dressed antiseptically, and if it runs a favorable course it need not be re-dressed for a week or ten days; the time required for the repair of a wound of this nature is longer than that for an incised wound, and a larger number of dressings may be required.

In lacerated wounds of the extremities continuous irrigation of the wound by a warm bichloride or carbolic solution, applied as described (page 144), is often followed by the most satisfactory results; wounds produced by machinery and railway accidents, in which the vitality of the tissues is much impaired, are particularly favorable cases for this method of treatment, and here the same caution should be exercised as regards the introduction of sutures.

Contused Wounds.—This variety of wounds possesses many characteristics in common with lacerated wounds; the edges are bruised and the injury of the subcutaneous tissue is often more extensive than the size of the external wound would lead one to suspect. They are dressed in the same manner as lacerated wounds, and the same objection here exists to the use of sutures as in the latter class of injuries.

Punctured Wounds.—These wounds are inflicted by sharp-pointed instruments, and it often happens that a portion of the vulnerating body remains in the wound, as is frequently the case in wounds produced by needles; and another complication in this variety of wound is the injury of vessels, giving rise to concealed hemorrhage, or of nerves resulting in neuritis. Simple punctured wounds should be carefully washed with an antiseptic solution and covered by an antiseptic gauze dressing, and if no complication exists their healing is usually very rapid.

When, however, a foreign body remains in the wound, as it often happens in punctured wounds produced by needles and pins, the punctured wound should be converted into an incised wound, and the body should be searched for and removed if possible, and in doing this in the case of wounds of the extremities the operation is much facilitated by the employment of Esmarch's bandage and strap. After the removal of the foreign body the wound is treated as an incised wound, and an antiseptic dressing should be applied. When concealed hemorrhage occurs after a punctured wound, the wound should be laid open and the bleeding vessel searched for and ligatured if possible, and the wound should afterward be dressed as an incised wound.

Poisoned Wounds.—These wounds are caused by the absorption, by means of a cut or abrasion in the skin, of fluids from a dead body in making dissections or post-mortem examinations or in operating upon living subjects, and often result in serious consequences. Such wounds, as soon as possible after their reception, should be carefully washed out with a solution of bichloride of mercury, 1 : 2000, or a 30-grain solution of chloride of zinc, and then dressed with an antiseptic dressing. If, however, this precaution is not taken or the wound has escaped notice, and in a few hours becomes inflamed and painful, and evidences of lymphatic involvement show themselves, the wound should be opened and its surface should be thoroughly washed out with a 30-grain solution of chloride of zinc, and finally with a 1 : 2000 bichloride solution, and it should then be dressed with an antiseptic gauze dressing. Under this method of dressing the poisoned wound is often converted into a healthy one, even after the lymphatic involvement is well marked, and it usually heals promptly without further constitutional disturbance.

Gunshot Wounds.—These wounds are produced by small shot, balls, or fragments of shells, and are of the nature of contused and lacerated wounds, and the vulnerating body as well as portions of the clothing are often imbedded in the tissues.

In dressing these wounds any foreign bodies, if they can be located, should be removed, and in the search for and removal of balls from the extremities the application of the Esmarch bandage and strap will be found most useful. The wound should next be thoroughly washed out with a 1 : 2000 bichloride solution, and an antiseptic dressing applied as in the case of other contused and lacerated wounds.

Powder burns resulting from the explosion of powder, in addition to the burning and laceration of the tissues, are accompanied by the introduction of grains of unburnt powder into the skin, which, if not removed, leave permanent points of pigmentation. These wounds should first be washed with an antiseptic solution, and upon the face, to avoid unsightly pigmentation of the skin, care should be taken to pick out the small masses of powder with a needle or the sharp point of a tenotomy knife. The surface should then be dressed with lint spread with an ointment of boric acid or an ointment of aristol, consisting of half a drachm or a drachm of aristol to an ounce of vaseline, this dressing being covered by a few layers of bichloride or borated cotton, held in place by a roller bandage.

Contusions or *bruises* differ from contused wounds in the fact that the skin is not broken, though in spite of this fact there may exist very extensive laceration of the subcutaneous tissues, accompanied by more or less extravasation of blood from the injured vessels. When not severe enough to require operative treatment, they should be dressed by applying over them several layers of lint saturated with lead-water and laudanum, and over this dressing is placed a layer of waxed paper or rubber tissue, and the dressing is secured by a roller bandage.

A solution which I find most satisfactory in the dressing of contusions is as follows:

Ammonii chloridi	grs. xx.
Tr. opii } Alcoholis }	āā f℈j.
Aquæ	q. s. ad f℥j.

Several layers of lint saturated with this solution are laid over the contused tissues, and are covered with waxed paper, oiled silk, or rubber tissue.

Extensive collections of blood following contusions often remain in the tissues for some time, but usually are absorbed. If this result does not follow, or an abscess forms, the blood or pus should be removed by aspiration or by incision with full antiseptic precautions.

Burns and Scalds.

The dressings employed in the treatment of burns and scalds are similar, as the injury to the tissues is practically the same in both classes of injuries. Superficial burns or scalds, in which the effect of the heat has only extended to the superficial layer of the skin, may be treated by the application of lint saturated with a solution of carbonate of sodium, a drachm to an ounce of water; this dressing rapidly relieves the pain, and is a satisfactory application in this variety of burns and scalds. In cases in which the effects of heat have extended to the deeper tissues, the affected surface may be dressed with *carron oil*, which is prepared by rubbing together lime-water and linseed oil until a thick creamy paste results; lint is saturated with this mixture and laid over the surface of the burn or scald. The dressing is a comfortable one to the patient, but soon becomes offensive, and for this reason requires frequent renewals.

The disadvantage met with in the antiseptic method of dressing burns and scalds is the fact that the raw surface presented offers the most favorable conditions for the absorption of the antiseptic substances employed in the dressings, and for this reason the use of bichloride of mercury, carbolic acid, and iodoform is not to be recommended in burns or scalds involving a large extent of surface, on account of the toxic symptoms which may result from their employment.

A recent burn or scald, by reason of the heat employed in its production, is practically an aseptic wound, and it may be dressed by covering it with boric acid ointment, and placing over this a number of layers of borated or salicylated cotton, and holding the dressings in position by a roller bandage.

Aristol, as a substitute for iodoform, may be employed in the dressing of burns or scalds, being either dusted over the surface or used in the form of an ointment, and over this application should be placed a few layers of borated or salicylated cotton.

When blebs are present upon the surface of the burn or scald, they should be opened to allow the serum to escape. If suppuration occurs or the tissues become necrosed by reason of the severity of the injury, the surface of the burn may be washed with a 1 : 60 carbolic solution or 1 : 4000 bichloride solution and the same dressing should then be applied.

The ulcers resulting from the separation of the dead tissues should be touched with a solution of nitrate of silver, four grains to the ounce of water, and dressed with lint spread with ointment of boric acid or aristol. In the dressing of extensive burns or scalds of the neck, face, and region of the joints, the possibility of serious deformity from contraction of the tissues in healing should not be lost sight of, and position, splints and bandages, should be employed to prevent, as far as possible, this complication.

Bedsores.

These sores usually occur over the sacrum or hips in patients who are confined to bed for a considerable time, as the result of a long-continued pressure, or in those cases where the vital powers are depressed by adynamic diseases, and are also a frequent and troublesome complication in spinal injuries. Their formation may be prevented in many cases by the use of air-cushions or of a water mattress, and by keeping the parts exposed to pressure scrupulously clean and frequently bathing them with stimulating lotions, such as alcohol, olive oil and alcohol equal parts, or soap liniment. The parts should also be protected from pressure by the application of adhesive plaster, or, still better, soap plaster spread upon chamois. When the bedsore has actually formed, and in many cases its formation is very rapid and the slough will be found to involve a large surface of the skin over the sacrum, and to extend down to the bone, we have present a very serious complication, and one which requires most careful treatment.

The dressing of a bedsore before the separation of the slough consists in relieving the part from pressure by the use of an air-cushion placed under the buttocks, and the application of a fermenting poultice until the slough has separated. When the slough has become detached the ulcer remaining should be well washed with a carbolic or bichloride solution and the granulations should be touched with a 5-grain solution of nitrate of silver; and resin cerate, iodoform, aristol, or boric acid ointment, spread upon lint, should be applied to the surface of the ulcer, and a piece of soap plaster a little larger than the ulcer should be placed over this dressing and held in place by broad strips of adhesive plaster. This dressing should be renewed every day or every other day, and means should be adopted to protect the parts from further pressure, and the constitutional condition of the patient should be improved by the administration of a nutritious diet. tonics, and stimulants. The application of the galvanic current has been employed with good results to promote the healing of the ulcer in obstinate cases.

Sprains.

Sprains of joints from twists or other external violence resulting in the stretching or laceration of the ligaments are injuries which require careful dressing.

Sprains may be first treated by the application of cold- or hot-water dressings for a few hours, or by the application of lead-water and laudanum, the joint being kept at rest by the use of a splint or by confining the patient in the recumbent posture in the case of sprains of the joints of the lower extremities.

After a few days' use of the lead-water and laudanum dressing the swelling usually subsides and the joint may be fixed by the application of a moulded soap-plaster splint or felt splint held in place by a firmly applied roller bandage, which should be worn for a week or ten days; in ordinary cases after this time the splint may be removed and the patient should be encouraged to use the joint. In cases of severe sprain, on the other hand, the pain and swelling persist for some time, and here the fixation of the joint by a soap plaster, or better by a plaster-of-Paris bandage, will be found useful for a few weeks. If upon the removal of this dressing the parts are still painful and swollen, the swollen tissues should be painted with tincture of iodine; or the method of applying tincture of iodine recommended by Mr. Jordan, that is, the application of the iodine in a broad band around and not over the swollen tissues, may be employed. The joint should next be surrounded by a piece of lint spread with an ointment composed of equal parts of ointment of mercury and ointment of belladonna, and a moulded soap-plaster splint being fitted to the joint, it is held in place by a firmly applied bandage. This will be found a most satisfactory dressing in the treatment of sprains after they have passed their acute stage. The dressing is removed at intervals of three or four days, the joint is sponged off with alcohol, and a similar dressing is reapplied; and this method of dressing may have to be continued for some weeks, but the results obtained by its continuous use are often most satisfactory. An ointment of icthyol one part to lanolin three parts may also be used in the same manner as the ointment of belladonna and mercury with good results in the treatment of these injuries. The employment of pressure in the treatment of sprains, by means of strapping, is also sometimes advantageous.

In the chronic stage of a sprain, after all dressings have been removed, the methodical use of massage is often most beneficial; and after the parts have been thoroughly manipulated a flannel bandage should be applied which, by its elasticity, gives a certain amount of support to the parts.

Sprain-fracture.—Under this name Mr. Callender has described an injury which consists in the separation of a ligament or tendon from its point of insertion, with the detachment of a thin shell of bone; this injury is apt to occur about the ankle-, knee-, elbow-, and wrist-joints, and the treatment is the same as that of an ordinary fracture in the same locality. This injury is probably much more common than is generally supposed in connection with sprains of the joints, and is, I think, in many cases the cause of the tardy restoration of the function of sprained joints, this injury being overlooked and the injury simply being treated as a sprain, and the patient being encouraged to use the part before the union of the bone has been accomplished.

Strains of muscles and fascia varying in severity from simple stretching of the fibres to absolute rupture are treated by putting the parts at rest and by the application of pressure by means of adhesive straps or of a bandage; in strains of the muscles and fascia of the back the use of broad strips of adhesive plaster, applied as in cases of fracture of the ribs, will be found most satisfactory, and in the treatment of the later stages of the injury the employment of massage will often be followed by good results.

Tracheotomy.

This operation consists in dividing the tissues over the trachea in the median line of the neck, and after the trachea has been exposed it is opened by dividing two or three of the tracheal rings.

The operation of tracheotomy may be required to relieve the dyspnœa dependent upon membranous or diphtheritic laryngitis, growths in the larynx or trachea, growths external to these organs causing pressure upon them, œdema of the mucous membrane of the larynx or trachea from inflammation from burns or scalds, or from the inhalation of irritating gases or the swallowing of corrosive liquids. The operation may also be required for the removal of foreign bodies from the larynx, trachea, or from the bronchi, as well as for the relief of the dyspnœa due to their presence, and it is also required in cases of fracture or laceration of the larynx or trachea, and occasionally in cases of spasm of the glottis, and in cases of glossitis to overcome the mechanical obstruction which prevents the entrance of air into the air-passages.

The ease with which the operation is performed varies much in different cases; it is, as a rule, a much simpler operation in adults than in children. In the latter subjects the shortness of the neck, the relatively greater size of the thyroid gland and the possible presence of the thymus body, the great vascularity of the parts, and the abundance of adipose tissue, render the trachea difficult to expose and open.

Under certain circumstances the operation may be performed with very few instruments; but if the surgeon has the choice he will find it convenient to have at hand two small scalpels, one short grooved director, a tenaculum, two aneurism needles which may be used as retractors, one pair of artery forceps, hæmostatic forceps, two pairs of dissecting forceps, a pair of scissors, a sharp-pointed tenotome, a pair of tracheal forceps, a tracheal dilator, tracheotomy tubes, tapes, ligatures, sponges, a flexible catheter, and feathers. The *director* should be short; the ordinary grooved director is too long to use with satisfaction in operating upon the short necks of children; so that I have had made a shorter and somewhat broader one, which has a bevelled extremity which allows it to be passed with ease between the different layers of the tissue. (Fig. 199.)

Fig. 199.

Author's tracheotomy director.

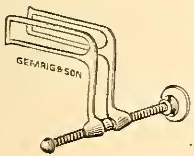
Hæmostatic forceps are also of great use in controlling hemorrhage during the operation in case of the division of vessels which bleed freely, when the operator from the urgency of the case does not think it justifiable to ligature them at the time of their division. They may also be employed under similar circumstances to clamp the isthmus of the thyroid gland on either side of the trachea when it becomes necessary to divide it to expose the trachea.

A sharp-pointed tenotome is the instrument I prefer to employ in opening the trachea as its sharp point enables it to be easily thrust into the trachea, and its short cutting surface and the narrowness of the blade obscure as little as possible the line of incision and thus enable the operator to see exactly where he is cutting.

Tracheal dilators of various kinds are employed, but the most satisfactory tracheal dilator which I have employed is that of Golding-Bird (Fig. 200), which is a self-retaining instrument; the blades are slipped through the tracheal incision and are then expanded by turning the screw to which they are attached.

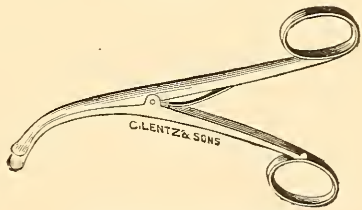
Trousseau's tracheal dilator, the blades of which are introduced through the incision in the trachea and are expanded by bringing together the handles, is also a satisfactory instrument (Fig. 201), but is not as useful as the tracheal

Fig. 200.



Golding-Bird's tracheal dilator.

Fig. 201.



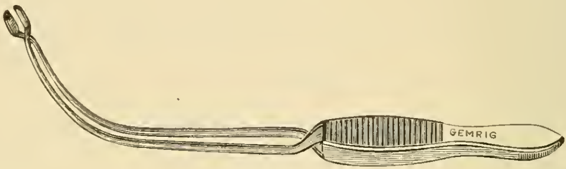
Trousseau's tracheal dilator.

dilator previously mentioned, as it has to be retained in position by the hand. Tracheal dilators may be improvised from bent hairpins or pieces of wire, which will often serve a useful purpose where ordinary dilators cannot be obtained.

It is also well to have at hand a number of pliable feathers to be used in cleaning the trachea or larynx of mucus or membrane after it has been opened, and by their use this object can be accomplished with little risk of injury to the mucous membrane.

Tracheal forceps, which are constructed with a double spring and curved blades are also useful in removing membrane or foreign bodies from the larynx above the wound or from the trachea below the tracheal incision. (Fig. 202.)

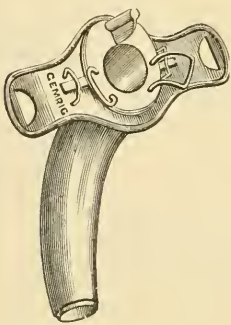
Fig. 202.



Tracheal forceps.

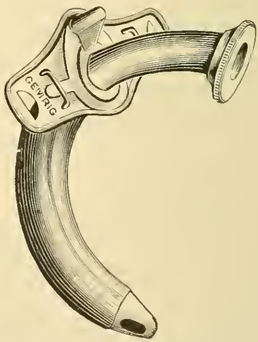
Tracheotomy-tubes of various shapes are made of silver, aluminium, hard and soft rubber, but the tube which I think is the most satisfactory for general use is a silver quarter-circle tube with a movable collar (Fig. 203), and provided with a fenestrated guide. (Fig. 204.) A good tracheotomy-tube is

Fig. 203.



Silver tracheotomy-tube.

Fig. 204.



Silver tracheotomy-tube with fenestrated guide.

one which inflicts the least possible injury upon the mucous membrane of the trachea, and to insure this object the part of the tube within the trachea should lie exactly in its axis and its free extremity should be capable of as little movement as possible. The tracheotomy-tube is held in position after being introduced by means of tapes attached to the shield of the tube and tied around the neck.

Position of Patient for Tracheotomy.

The best position in which to place the patient for this operation is that which brings the neck into the greatest prominence, and this can best be obtained by laying the patient upon his back upon a firm table and placing under the shoulders a round cushion ; or an empty wine-bottle, or a roller-pin wrapped in towels will answer the same purpose. If an anæsthetic is not used the arms should be held by an assistant, which is better than securing them by a binder fastened around the chest, which restricts respiratory movements.

Use of an Anæsthetic in Tracheotomy.

As a rule, I think it is better not to administer an anæsthetic in performing this operation, as little pain is experienced, in cases in which the dyspnœa is well marked, after the incision in the skin has been made, and I have seen the dyspnœa which was well marked before the use of the anæsthetic suddenly become so alarming that the trachea had to be opened before it was thoroughly exposed, which is a procedure always attended with risk. So strong is my conviction that the risks of the operation are much increased by the employment of an anæsthetic that in later years I have abandoned its use.

Operation of Tracheotomy.

The trachea may be opened above the isthmus of the thyroid gland or below it, and these operations constitute respectively the *high* and *low* operations.

The *high* operation is generally selected, because at this point the trachea is more superficial and is more easily exposed, whereas in the *low* operation the trachea is more difficult to expose by reason of its relatively greater depth, the large size and number of the veins, and its proximity to the large arterial trunks.

The patient being placed in position, the operator stands at the head of the patient; this position I prefer, as it is easier from this point to keep the incisions exactly in the median line of the neck. The operator next makes himself familiar with the landmarks of the neck; locating the position of the *cricoid cartilage*, he makes an incision through the skin in the median line of the neck from one and a half to two inches in length, the position of the cricoid cartilage being the middle point. There is no disadvantage in making a longer incision if a freer exposure of the parts is required. Having divided the skin, the operator will often see a large vein lying in the superficial fascia—the *superficial anterior jugular;* this should be displaced, and the fascia divided upon the director.

The surgeon should keep his incisions strictly in the median line of the neck, for this is the line of safety; and he should be careful, as the wound increases in depth, not to make the incisions too short, so that it becomes funnel-shaped.

When the deep fascia is exposed it should be picked up and divided upon the director, and any large veins in the line of the wound should be carefully displaced, or, if this is impossible, they should be ligatured on each side and then divided between the ligatures.

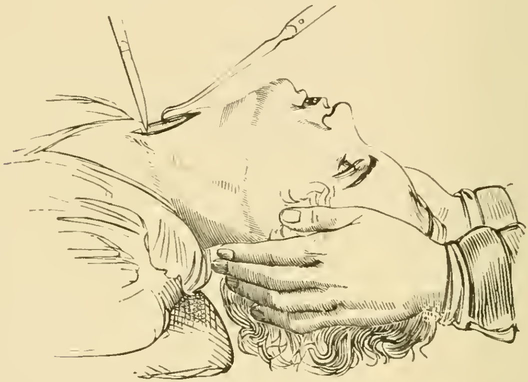
The operator now looks for the intermuscular space between the *sterno-hyoid* and the *sterno-thyroid muscles*, which can generally be found without difficulty, and the muscles are now separated in this line with the handle of the knife or with the director, and the *isthmus of the thyroid gland* will be exposed. The muscles should now be held aside by retractors placed on either side. A caution here as to the use of retractors may not be out of place: the operator should place them himself and allow the assistants to hold them. I once almost lost a case in which I had the trachea exposed, and while I turned aside to pick up a knife with which to open it, my assistant, in replacing a retractor which had slipped, included the movable trachea in the grasp of the retractor, pulling it to one side and completely shutting off respiration; when I attempted to find the trachea to open it I could only feel the anterior surface of the vertebræ at the bottom of the wound, and it was only when I appreciated what had occurred, and lifted the retractor, allowing the trachea to spring back into its normal position, that I was able to open it. Mr. Durham and Mr. Marsh mention somewhat similar cases in which the trachea and vessels were held aside with retractors by assistants until the surgeon had exposed the cervical vertebræ.

The operator should carefully explore the wound with the finger, to locate exactly the position of the trachea, and to ascertain, if possible, the presence of any anomalous arteries.

The isthmus of the thyroid gland is exposed, which generally occupies a position over the first three tracheal rings; this is usually surrounded by a plexus of veins which should be displaced with the director, or, if this is impossible, they should be ligatured on each side and divided between the ligatures. The thyroid isthmus is next displaced upward or downward, according as the surgeon desires to open the trachea below or above this body. This is often done without difficulty, especially its upward displacement; but when there is difficulty in displacing it downward, a procedure recommended by Bose may be employed, which consists in making a transverse incision across the cricoid cartilage to divide the layer of fascia by which the isthmus is bound down; a director is then passed into this incision, and the isthmus is gently depressed without difficulty.

Having displaced the isthmus of the thyroid gland upward or downward, the trachea, yellowish-white in appearance, covered by the tracheal fascia, should be exposed; this fascia should next be thoroughly broken up with the director or handle of the knife so as to bare the trachea, and in doing this the operator can feel it crepitate under the finger from the suction of air drawn in with inspiration. Having arrived at this stage of the operation the operator should examine the wound to see that it is free from hemorrhage and he should also replace the retractors so as to expose as large a portion as possible of the trachea, for, be the case ever so urgent, he now feels assured that he can open the trachea in a moment if the breathing should cease. The trachea is now fixed with a tenaculum introduced into it a little to one side of the median line; an incision is made into it with a narrow knife from below upward, from one-half to three-fourths of an inch in length (Fig. 205), care

Fig. 205.



Opening the trachea. (Liston.)

being taken to see that this incision is in the median line, for if the trachea be opened by a lateral incision the wound does not heal so promptly and the tracheotomy-tube does not fit well, and its lower extremity may cause injury to the mucous membrane of the trachea. If the wound be a deep one, after fixing the trachea with the tenaculum the operator may lift it slightly from its bed, thereby bringing it more prominently into view and making it more superficial in the wound, thus facilitating its opening. As soon as the incision is made into the trachea there is a gush of air from the wound in the trachea mixed with blood or membrane; this should be wiped away with a sponge and a tracheal dilator should next be introduced and the trachea should be cleared of membrane, if it is present in the region of the wound, with a feather or with forceps. The tracheotomy-tube is next introduced and is secured in position by tapes tied around the neck.

If respiration has ceased artificial respiration should be resorted to or the use of a tube attached to a bellows, or Fell's apparatus, and these efforts should be continued for at least fifteen minutes, for I have seen resuscitation take place in patients who were apparently dead by a persistent employment of artificial respiration.

The *care of the tube* is a matter of some importance after its introduction; the inner tube should be removed at short intervals, washed and replaced, and if the operation has been done for an inflammatory condition of the larynx or trachea a moistened feather should occasionally be passed through the tube into the trachea to withdraw any mucous or membrane which is present. In cases of croup after tracheotomy the use of a spray of steam or of a spray composed of

Carbonate of soda	ʒj to ʒijss.
Glycerin	f℥ij.
Water	f℥vj.

applied by means of a steam atomizer, the spray being directed over the opening of the tube, will be found most satisfactory in softening the discharges and thus facilitating their expulsion through the tube.

The tracheotomy-tube is usually allowed to remain in the trachea from five to ten days; its permanent removal is indicated as soon as the patient is able to breathe through the larynx with the wound in the trachea closed; its use may be required for a longer time, but as soon as the indication for its presence has disappeared the sooner it is removed the better, for its presence sometimes sets up a troublesome tracheitis. After its removal the wound rapidly diminishes in size, the healing taking place by granulation and contraction. Difficulty is occasionally met with in the permanent removal of tracheotomy-tubes; for the causes and treatment of this complication the reader is referred to special works upon tracheotomy.

Where the operation of tracheotomy is done for the removal of *foreign bodies* from the air-passages, the steps of the operation are the same, but after the removal of the foreign body the treatment of the wound is somewhat different. If the foreign body has remained in the trachea only for a short time the wound in the soft parts may be closed by means of sutures or may be allowed to remain open, being covered by a piece of moistened gauze, and the use of the steam spray is here also beneficial for a few days. If, however, the body has remained in the larynx, trachea, or one of the bronchi for some time and has set up a certain amount of inflammatory trouble, it is better to introduce a tracheotomy-tube and allow it to remain for a few days. If it is found impossible to locate or remove the foreign body at the time of operation, a tracheotomy-tube should be introduced and allowed to remain until the foreign body is expelled through the tube or removed subsequently by means of forceps.

Laryngotomy.

In this operation an opening is made into the air-passages through the *crico-thyroid membrane*. It is a simple operation, and one which is practically free from risk, and can therefore be performed much more rapidly and safely in urgent cases than tracheotomy.

In this operation the same objection exists to the use of an anæsthetic as in tracheotomy, and therefore it should be dispensed with. The patient being placed in the recumbent posture, with the shoulders slightly elevated and the head thrown back to make the neck as prominent as possible, the surgeon feels for the prominence of the *thyroid cartilage*, and steadying the larynx between the finger and thumb of the left hand, he makes an incision in the median line over the centre of the thyroid cartilage and extending downward for an inch or an inch and a half. The skin and superficial fascia being divided, the fascia between the *sterno-hyoid muscles* and the areolar tissue is exposed and divided, and the *crico-thyroid membrane* is exposed. The knife is then passed transversely through the membrane into the larynx, care being taken that both that membrane and the mucous membrane which covers its inner surface are divided at the same time. As soon as the knife enters the cavity of the larynx blood and mucus will be forcibly expelled.

The wound should be carefully enlarged and a tube introduced, which differs from the ordinary tracheotomy-tube in being slightly flattened; this is secured in position by tapes tied around the neck as in the case of the ordinary tracheal tube. The only bleeding which is likely to occur is from the *crico-thyroid arteries* or *veins*, and if these cannot be avoided, and are divided in the operation, they should be temporarily secured by hæmostatic forceps or ligatured, and if the case is not extremely urgent, all bleeding should be arrested before the crico-thyroid membrane is incised.

The after-treatment of cases of laryngotomy is similar to that of cases of tracheotomy; the same attention is required in the care of the tube and in the general management of the patient.

Laryngo-tracheotomy.

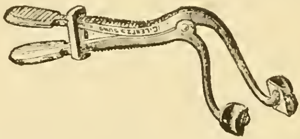
This operation consists in making an incision into the air-passages by dividing one or two of the upper rings of the trachea, the crico-tracheal membrane, the cricoid cartilage, and the crico-thyroid membrane. This operation is employed in cases where, from the age of the patient, the crico-thyroid space is too small to admit of a sufficient opening, or in those in which, for any reason, the surgeon does not deem it advisable to attempt to open the trachea lower down. The incision in the skin and superficial fascia of the neck is made in the same manner as in the operation of laryngotomy, but is carried a little further downward. It may be necessary to displace the isthmus of the thyroid gland downward to expose the upper portion of the trachea, and when the trachea is exposed the incision should be made through this and the cricoid cartilage from below upward.

This operation is more often performed in the high operation of tracheotomy than is generally supposed. A tracheotomy-tube is introduced through the wound and secured by tapes tied around the neck, and the care of the tube should be similar to that in cases of tracheotomy.

Intubation of the Larynx.

This procedure, at the present time, is widely employed as a substitute for tracheotomy in the treatment of the dyspnœa due to inflammatory affections of the larynx or trachea, or stenosis of the larynx: it consists in the introduction of a metallic tube into the larynx, which is allowed to remain in place for a few days. The operation has been recently reintroduced to the profession by Dr. O'Dwyer, of New York, who has devised a set of ingenious instruments for the purpose of laryngeal intubation.

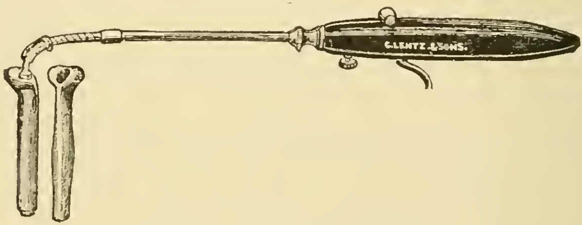
Fig. 206.



Mouth-gag.

The instruments required are a mouth-gag (Fig. 206), with which the jaws are separated and held open; an instrument for the introduction of the tube, which is fastened

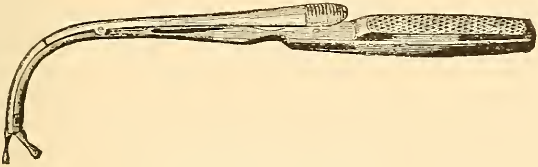
Fig. 207.



Intubation-tube and introductor.

to the obturator which fills the cavity of the tube (Fig. 207), and an instrument for extracting the tube after it has been placed in the larynx. (Fig. 208.) The tubes are of metal and have a collar which rests upon the false cords and bulge slightly toward their middle and again taper toward their lower extremity; at the collar of the tube there is a perforation through which a strand of silk is passed which is made into a loop; this is used to allow the operator to remove the

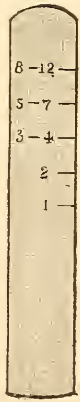
FIG. 208.



Intubation-tube extractor.

tube if on its introduction it is found to have passed into the œsophagus instead of the larynx, and also is used to remove the tube if it becomes occluded with membrane while in the larynx. The intubation set now in common use is provided with six tubes ranging in size from such as are suited for a child of one year or less up to the age of twelve or fourteen years. (Fig. 209.)

FIG. 209.



Scale of intubation-tubes.

In performing the operation of intubation of the larynx the child is placed upon the lap of the nurse or assistant wrapped in a blanket and the arms are secured by the nurse holding the elbows so as not to interfere with the respiratory movements.

The patient's head is next secured by an assistant, and the position of the head, neck and body, should be that as if it hung from the top of the head, and this position should be firmly maintained during the insertion of the tube. The mouth-gag is next inserted upon the left side and the blades dilated so as to open the jaws widely, and as the gag is self-retaining this position is easily maintained. The jaws being thus held open, the operator, sitting on a chair facing the patient, next introduces the index finger of the left hand into the mouth and passes it over the tongue until he feels the epiglottis; the introducing instrument to which the tube is attached is held in the right hand and this is now introduced into the mouth, first seeing that the silken loop is free, and it is swept over the tongue and passed down until it touches the epiglottis; this is hooked up by the index finger of the left hand and the tube is passed into the larynx; the index finger of the left hand is then transferred to the edge of the tube and by drawing upon the trigger of the instrument with the index finger of the right hand the obturator is detached, and the instrument is withdrawn, and before removing the finger it is well to place it upon the head of the tube and to sink it well into the larynx. As soon as the obturator is removed there is usually a violent expiratory effort which is accompanied by a gush of mucus, muco-purulent matter or membrane from the tube, and after this escapes the breathing is usually satisfactorily established. If the operator has passed the tube into the œsophagus and has detached it from the introducing instrument, and no improvement in the respiration takes place, it should be withdrawn by the silk loop and attached to the obturator and another attempt should be made to introduce it into the larynx.

The mistake which inexperienced operators make in introducing the tube is in not hugging the posterior surface of tongue closely, so that they pass the tube over the epiglottis into the œsophagus.

The silken loop may be brought out at one side of the mouth and fastened around the ear or fastened to the side of the face by strips of adhesive plaster for a few hours, so that by drawing upon it the nurse or attendant is able to withdraw the tube instantly if it should become obstructed with membrane; or, if it is coughed up, by this means it may be withdrawn from the œsophagus if it has not been expelled from the mouth. Some operators keep the loop attached to the tube during the time it is retained in the larynx, others prefer to remove it after several hours and remove the tube by means of the extracting instrument when required. The tube is removed at the end of the second or third day and if the child is able to breathe comfortably for an hour or two it is not reintroduced; if, however, the dyspnœa returns it is reintroduced and allowed to remain one or two days longer; several attempts may have to be made before the tube is permanently removed, but it is usually dispensed with from the third to the eighth day.

The most serious complication which is apt to occur during the introduction of the intubation-tube is the detachment and pushing of a mass of membrane in front of the tube into the trachea; if this is too large to be expelled through the tube the breathing is suddenly arrested, and the tube should be removed, and if the mass of membrane does not escape upon the expiratory efforts of the patient the trachea should be rapidly opened as the only means of reestablishing the respiratory function. So much do I dread this accident, which has occurred in a few cases, that I never introduce an intubation-tube without having at hand the necessary instruments to do a tracheotomy if it should be suddenly required, and if possible obtain the consent of the parents or friends to perform tracheotomy if it should be indicated.

One of the greatest troubles after intubation of the larynx is the satisfactory feeding of the patient; liquids as a rule are not swallowed well, a portion of them escaping into the tube, causing coughing and difficulty in breathing. The diet I usually order is of semi-solids, such as corn-starch, soft-boiled eggs, and mush; and if these are not well swallowed it may be necessary to resort to nutritious enemata or the use of a stomach-tube to introduce food. Some patients swallow liquids and semi-solids quite well if the head is dropped a little lower than the body during the act of deglutition.

PART III.

FRACTURES.

In the following article the author has endeavored to confine himself simply to a description of the varieties of fracture and to their dressing and treatment, and he has tried as far as possible to avoid the multiplication of dressings, being satisfied to describe a few of the methods of dressing most frequently employed. He has also avoided the description of complicated splints and dressings, by the use of which in certain fractures most excellent results are obtained, but has preferred to recommend the employment of simple splints and dressings, which can be obtained by physicians practising in districts remote from large cities, where the services of an instrument-maker cannot be obtained to construct special apparatus for the treatment of these injuries.

Varieties of Fractures.

A complete fracture is one in which the line of separation completely traverses the bone, involving the entire thickness of the bone.

An incomplete fracture is one in which there is only a partial separation of the bone-fibres (Fig. 210), under which name are included *partial* or "*green-stick*" *fracture*, in which some of the bone-fibres have given way, while the remaining fibres have been bent by the force and have not been broken. (Fig. 211.) Fissured, punctured, indented, and perforating fractures are also included in the class of incomplete fractures. (Fig. 212.)

A simple or closed fracture is a fracture in which there are but two fragments, and the seat of injury in the bone does

Fig. 210.

Incomplete fracture of femur.

Fig. 211.

Partial or green-stick fracture of radius.

Fig. 212.

Fissured fracture of humerus. (Gurlt.)

not communicate with the external air by a wound in the soft parts.

Compound or open fractures are fractures in which the seat of injury in the bones communicates with the external air by a wound in the soft parts.

Comminuted fractures are those in which there are more than two fragments, the lines of fracture intercommunicating with each other. (Fig. 213.)

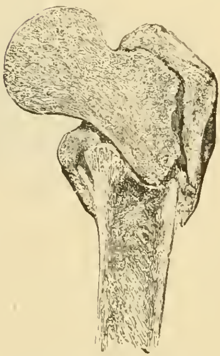
A multiple fracture is one in which a bone is the seat of two or more distinct fractures at different points, the lines of fracture not necessarily communicating with each other.

Complicated fractures are such as are accompanied by some serious injury of the parts in the region of the fracture—as, for instance, the laceration of important blood-vessels or nerves, contusion or laceration of the muscles, or dislocation of a neighboring joint.

Fig. 213.

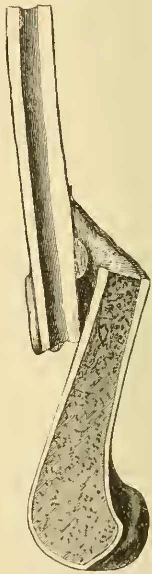
Comminuted fracture of patella.

Fig. 214.



Impacted fracture.

Fig. 215.



Transverse fracture of femur. (Gurlt.)

Impacted fractures are those in which one fragment is driven into and fixed in the other, the impaction taking place at the time of fracture, or being caused by force subsequently applied. (Fig. 214.)

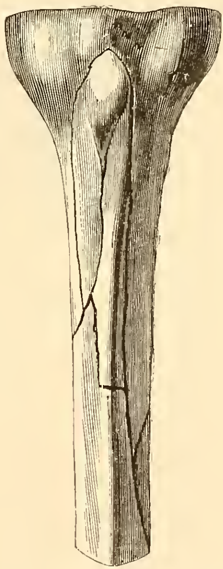
Direction of Fracture.

A transverse fracture is one in which the general line of division of the bone is at right angles with the long axis of the bone. (Fig. 215.) Transverse fractures of the long bones are rarely met with, the line of fracture usually being more or less oblique.

Fig. 216.

Oblique fracture of humerus.
(Stimson.)

Fig. 217.



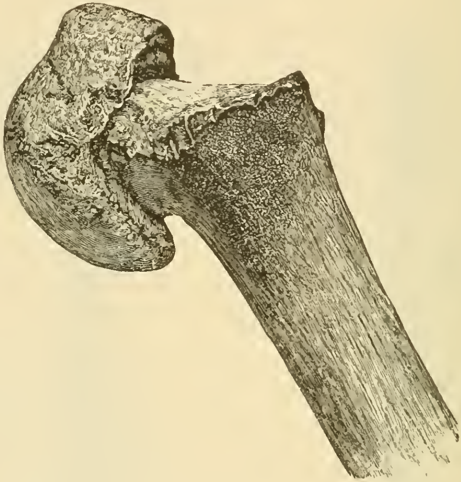
Longitudinal fracture of tibia.
(Stimson.)

An oblique fracture is one in which the line of separation is oblique to the long axis of the bone. This is one of the most common directions of the line of fracture. (Fig. 216.)

A longitudinal fracture is one in which the line of separation runs in the general direction of the long axis of the bone. (Fig. 217.) This form of fracture is rare, but is sometimes met with in the long bones as the result of gunshot injury.

Epiphyseal fracture or separation occurs before complete ossification has taken place between epiphysis and diaphysis, and is rarely seen after the twentieth year of life; the direction of the epiphyseal separation is transverse. (Fig. 218.)

Fig. 218.



Epiphyseal fracture of head of humerus. (Moore.)

The *deformity* or displacement in fractures is either angular, transverse, longitudinal, or rotary.

Repair of Fractures.

The process of repair in cases of fracture is concisely stated by Ashhurst as follows: "The traumatic irritation propagated from the broken bone causes swelling of the periosteum, active proliferation, and formation of a sheath of new bone around the seat of fracture; this is the *ensheathing* or *ring callus* of surgical writers. At the same time, the medulla feels the effect of the irritation, becomes hardened, and partially ossified; this constitutes the *interior* or *pin callus*. Lastly, the osseous tissue itself undergoes cell-proliferation, and union of the fragments takes place—*mutatis mutandis*—precisely by the same process that we have already studied in considering wounds of the soft tissues. The new material which is thus developed between the fragments themselves, constitutes what Dupuytren called the *intermediate*, *permanent*, or *definitive callus*, in contradistinction to the *ensheathing* and *interior* forms of callus, which are *temporary* or *provisional*."

Examination of Cases of Fracture.

In examining a case of fracture to locate the nature and seat of fracture, the clothing should be removed from the part with as little disturbance as possible, and it is better, in most cases, to cut or rip the clothing, rather than to attempt to remove it in the ordinary manner. The surgeon should first inspect the injured part, and, where possible, compare it with its fellow, as in the case of injuries of the extremities; much valuable information is also derived from the patient or his friends as to the manner in which the injury was produced. The part should next be carefully examined by the surgeon; if it be one of the extremities which is injured, it should be gently lifted, firm extension being made at the same time, the surgeon by his touch and by gentle movements seeking to locate the seat of fracture; and he may, by this manipulation, at the same time develop crepitus.

All manipulations should be made with care, and with the greatest gentleness, not only to save the patient from pain, but also to prevent the soft parts in the region of the fracture from being injured by the rough or sharp fragments of the bone. Rough handling of fractures may increase the muscular spasm by the irritation caused by the sharp fragments of the bones, and may also result in the injury of important vessels and nerves, and indeed a simple fracture may be converted into a compound one by forcible and injudicious manipulations.

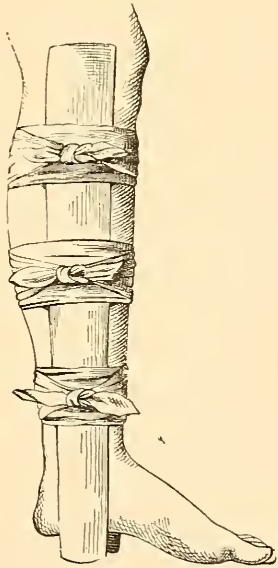
The sooner the examination is made after the fracture has occurred the better, for at this time there is less swelling in the region of the injury, and the surgeon can locate the bony prominences with much more ease, and can often discover the exact seat of the fracture with the least amount of manipulation of the parts. When a case of suspected fracture is not subjected to examination for several days after the reception of the injury, the parts in the region of the supposed fracture are often so much swollen that it is impossible to accurately locate its seat, and in such a case it is often necessary to wait until the swelling has subsided before the position of the fracture can be satisfactorily fixed, the case being treated in the meantime as one of fracture.

Anæsthetics may be employed to relieve the patient from pain and to obliterate muscular spasm in the examination of fractures, and their employment is often of the greatest service in the diagnosis of obscure or complicated fractures, especially those in the neighborhood of joints ; but the surgeon should remember that all manipulations should be made with the same gentleness as when the examination is conducted without anæsthesia, for there is the same risk of injury to the surrounding structures by the fragments ; this precaution is often neglected when an anæsthetic has been given, the surgeon often being inclined to handle the parts more roughly than he otherwise would ; such practice cannot be too severely condemned.

Provisional Dressings in Cases of Fracture.

It generally happens that fractures occur at localities more or less distant from the point where the treatment of the fracture is to be conducted, and the transportation of the patient and the temporary dressing of the fracture are, therefore, matters of the first importance. In fractures of the upper extremities, if the fracture be simple, the clothing need not be removed, and the arm should be bound to the side by some article of clothing, or supported in a sling made from handkerchiefs or the clothing, and the patient can usually walk or ride for a short distance without much injury to the parts in the region of the fracture or inconvenience to himself. When the bones of the lower extremities or the trunk are the parts involved, the transportation of the patient is a matter of more difficulty. When the bones of the trunk are involved, the part should be surrounded by a binder firmly pinned or tied, made from the clothing or from towels, or sheets or other strong materials which are at hand. When the bones of the lower extremity are involved, if the fracture be a simple one, the clothing need not be removed, and the motion of the fragments should be prevented by applying to the sides of the limb, extending above and below the seat of fracture, strips of wood, shingles, pasteboard, bundles of straw, strips of bark taken from trees, or bundles of twigs, these being held in place by handkerchiefs or strips torn from the clothing. Umbrellas or canes, or broomsticks (Fig. 219), applied in the same manner, may be employed, the object of any of these dressings being to secure temporary fixation of the fragments of bone during the transportation of the patient.

Fig. 219.



Provisional dressing for fracture of the leg. (Esmarch.)

If the fragments are not fixed in some way, but are allowed to move about during the transportation of the patient, much damage may result to the soft parts surrounding the fractured bones, and simple fractures may become compound ones by the bones being forced through the skin, the discomfort of the patient at the same time being much increased.

Having applied any dressing to bring about fixation of the fragments, the patient should next be placed upon a broad board or settee; if a mattress cannot be obtained, the fractured limb should be laid upon a mass of clothing, or upon some straw, and he should be placed in a wagon or carried to the point where the subsequent treatment of the fracture is to be conducted.

Reduction or Setting of Fractures.

This should be effected as soon as possible after the occurrence of the injury and as soon as the surgeon is prepared to apply the dressings to keep the parts in their proper position; reduction at an early period is less painful to the patient and is accomplished with more ease to the surgeon than at a later period when marked swelling and inflammation are present at the seat of fracture. It consists in bringing the fragments by manipulation as nearly as possible in their normal position, and it is accomplished by extension and manipulation with the hands, care being taken to use as little force as possible to attain the object. Very little force is often required if the surgeon places the part in such a position as to relax the muscles which produce the displacement; when this is accomplished the fragments can usually be pressed into position by the fingers without the application of any considerable force. When the reduction of a fracture has been accomplished the fragments are retained in position by the application of various splints or dressings which serve to prevent their displacement.

Materials and Appliances Used in the Dressing of Fractures.

Fracture Bed.

Many ingenious forms of beds have been devised for the use of patients suffering from fractures of the bones of the trunk and lower extremities, but a simple bedstead provided with a firm hair mattress having a perforation near its centre, into which is fitted a firm pad, and provided with a pan which slides in a framework beneath a corresponding opening in the bedstead, will prove a useful appliance. The mattress is covered by a sheet perforated to correspond to the opening in the mattress, and when the pad is removed the evacuations of the patient are passed into the pan.

In fractures of the trunk or lower extremities it will be found more convenient in handling the patient to use a single bed not over thirty-two or thirty-six inches in width, and it is not essential that the mattress be perforated, as a bed-pan can usually be slipped under the patient; the mattress should be a firm one stuffed with hair. The use of an ordinary tin pie-plate covered with a piece of old muslin to receive the fecal evacuations may be substituted for the bed-pan and will be found in many cases more satisfactory, especially in the case of children suffering from fracture of the lower extremity.

Splints.

After the reduction or setting of the fragments in cases of fracture they are usually retained in position until union occurs by the use of splints held in position by means of bandages or strips of muslin. Splints may be made of wood, or of tin, lead, copper or wire which possess the requisite amount of firmness and permit of their being moulded to the part, which latter may be found useful in certain cases.

Wooden splints.—The simplest and best splints are made from wood—white pine, willow or poplar being the best material to employ for their construction, being sufficiently strong to give fixation to the parts and at the same time being light. Splints made from smooth white pine, willow or poplar boards from one-eighth to one-half an inch in thickness may be employed in the form of straight or angular splints, and their preparation is a matter of little difficulty.

Wooden splints before being applied to the part should be well padded with cotton, wool, oakum, or hair, and where lateral wooden splints are employed in the treatment of fractures of the lower extremity it is usual to place bran-bags or junk-bags between the limb and the splint. The carved wooden splints which are sold by the instrument-makers are not to be recommended, as a rule, for unless the surgeon has a large number to select from it is rare that a splint can be obtained to accurately fit any individual case.

Binder's board or *pasteboard* is an excellent material from which to construct splints; it is first soaked in boiling water and when sufficiently soft is padded with cotton or a layer of lint and moulded to the part, and secured in position by a bandage; as it becomes dry it hardens and retains the shape into which it was moulded.

Undressed leather is also an excellent material from which to construct splints; it is applied by first soaking it in boiling water, and after padding it with cotton or lint it is moulded to the part and retained in position by a bandage.

Felt made from wool saturated with gum shellac, pressed into sheets, is also a good material from which to construct splints. This material is prepared for application to the surface by heating it before a fire until it becomes pliable, or by dipping it into boiling water.

Gutta-percha splints made from sheets of this material, in thickness from $\frac{1}{16}$ to $\frac{1}{5}$ of an inch, may often be employed with advantage; it is prepared for use by immersing it in hot water, when it becomes soft and can be moulded to the surface. Care should be taken that it is not allowed to become too soft by too long immersion to permit of its being conveniently handled.

Paper splints made from layers of manilla paper stiffened with starch constitute a very fair substitute for some of the varieties of splints previously mentioned.

Plaster-of-Paris, *starch*, *chalk and gum*, *silicate of potassium* or *sodium* may be employed for the construction of splints, either movable or immovable, in the treatment of fractures; their method of preparation and application is described (p. 84 *et seq.*); the plaster-of-Paris dressing is the one which is most generally used at the present time.

Fracture-box.—This is a form of splint used in the treatment of fractures of the lower extremity, and consists of a piece of board eighteen to twenty inches in length, with a foot-board firmly secured at its lower extremity; the sides are secured by hinges which allow them to be raised or lowered (Fig. 220). A fracture-box of greater length is required for the treatment of fractures about the knee-joint.

FIG. 220.

Fracture-box with movable sides.

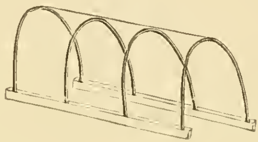
Bran, Sand, or Junk Bags.

These are constructed by taking a piece of unbleached muslin five feet in length and fourteen and a half inches in width, doubling it and securing the free margins except at the mouth by stitches so as to form a bag; the bag is then inverted so that the edges of the seams are brought in the inner surface of the bag. The bags are next filled with dry sand, bran, or hair, or with straw, and the mouth of the bag is closed by stitches or by being tied with a string. Bran bags with splints or sand bags are frequently employed in the treatment of fractures of the femur.

Bandages made of muslin are used to retain splints in the treatment of fractures, and are also sometimes applied directly to the injured part before the application of splints to control muscular spasm and limit the amount of swelling; when a bandage is so used it is known as a *primary roller.* The use of the *primary roller* is sometimes of the greatest service in the dressing of fractures; but its use in inexperienced hands has often been followed by such unfortunate results in the early treatment of fracture, or in cases which are not under constant observation, that I think it is a safe rule of practice to discard entirely the use of the primary roller.

Compresses made from a number of folds of lint, of cotton or oakum, are often employed to retain fragments in position or to make localized pressure upon certain points in the treatment of fractures. The compresses are held in position by strips of adhesive plaster, by a few turns of a roller bandage, or by the splints. Compresses are sometimes employed to protect bony prominences of the skeleton from the pressure of the splints; but this purpose is often better effected by the use of small pieces of soap plaster spread on chamois fitted over the prominent points.

FIG. 221.



Rack for supporting bed-clothes in fracture of the lower extremity.

A rack or cradle, made of wire or wooden hoops, is often employed to support the weight of the bed-clothes in the treatment of fracture of the lower extremity (Fig. 221).

Dressing of Special Fractures.

Fracture of the Nasal Bones.

Fractures of the nasal bones are often accompanied with fractures involving the septum, the nasal process of the maxillary bone, and the nasal spine of the frontal bone.

The treatment consists in replacing the fragments, if displacement exists, by manipulation with the fingers over the seat of fracture and by pressure made from within the nostrils by a probe or a steel director. When the displacement is once corrected it is not apt to recur, and in the majority of cases no dressing is required. Before resorting to any manipulation within the nasal cavities the mucous membrane should be thoroughly cocainized to render the operation painless to the patient. When there is depression of the fragments or displacement of the septum, after correcting the deformity by raising the depressed fragment or bending the septum into place by a director, the parts may be held in position by packing the nasal cavity firmly with a strip of antiseptic gauze.

In lateral displacements of the nasal bones from fracture, after reducing the displacement, a small compress held over the fragment by strips of adhesive plaster will be the only dressing required.

Mason transfixes the nose, after reduction of the fragments, with a stout needle, and steadies the pieces with a

Fig. 222.

Mason's dressing for fractures of nasal bones.

strip of plaster crossing the bridge of the nose and fastened to the ends of the needle. The needle is kept in position for eight or ten days (Fig. 222). Roberts, in cases in which there is a displacement of the cartilaginous portion of the nose, after reducing the deformity, holds the parts in position by transfixing them with steel pins.

Profuse hemorrhage sometimes occurs after fracture of the nasal bones and may require plugging of the nares to control it.

Fractures of the nasal bones are usually firmly united in from ten to twelve days, and dressings may be dispensed with after this time.

Fractures of the Malar Bone and Zygoma.

These fractures are usually the result of direct force; the displacement is upward or backward, and when the zygomatic arch is broken the fragments from pressure upon the masseter muscle or on the tendon of the temporal muscle may interfere with the movement of the lower jaw in mastication. This displacement is corrected by cutting down upon the fragment and elevating it or by passing a tenaculum into the fragment and raising it.

Outward displacements may be corrected by pressure and the application of a compress. The dressing of these fractures after the correction of the deformity, consists in the application of a compress of lint over the seat of fracture, held in position by strips of adhesive plaster or a bandage. There is little tendency to recurrence of the deformity after it has been corrected, and union at the seat of fracture is usually firm at the end of three weeks.

Fractures of the Upper Maxilla.

These fractures may involve the body, the nasal processes or the alveolar processes. The displacement should be corrected and if any teeth have been displaced they should be replaced; if there is comminution of the alveolus the teeth in the separate fragments may be fastened together by fine wire to fix the fragments and hold them in place; and the teeth of the lower jaw should be brought up in contact with those of the upper jaw, and the jaws should be secured together by the application of a Barton's or a Gibson's bandage (Fig. 223). Inter-dental splints, made of cork with grooves to fit the teeth, or of gutta-percha, are also employed in the dressing of these fractures. The patient should not be allowed to move the jaw in mastication, and

Fig. 223.

Dressing for fracture of the upper jaw.

should be nourished by liquid and semi-solid food which can be taken without removing any teeth to give space for its introduction.

The bandage should be removed every second or third day, and after the face and neck have been sponged off with alcohol it should be reapplied.

These fractures are usually firmly united at the end of four or five weeks, and dressings may be dispensed with at this time.

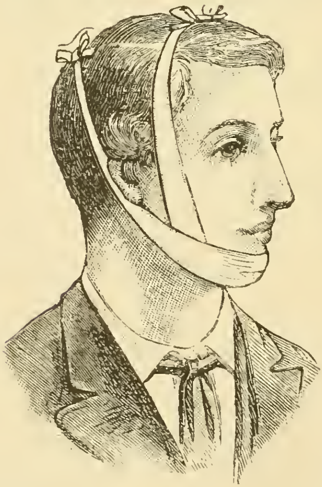
Fractures of the Lower Maxilla.

The lower jaw may be broken at or near the symphysis, the most usual seat of fracture being near the mental foramen; it is often broken at two places at once and the fractures are in many cases rendered compound by laceration of the mucous membrane, or the injury may consist in a separation of a portion of the alveolar process of the bone. The dressing of a fracture of the lower jaw, after reducing the displacement and replacing any loosened or detached teeth,

Fig. 224.

Dressing for fracture of the lower jaw.

Fig. 225.



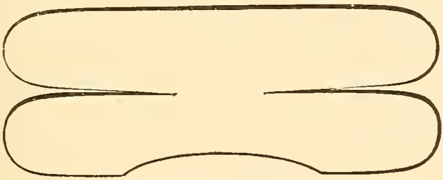
Four-tailed bandage applied for fracture of the lower jaw.

consists in applying a pad of lint under the chin and bringing the jaw up against the upper jaw and holding the compress in place and securing the jaws firmly in contact by applying a Barton (Fig. 224), modified Barton or Gibson's bandage. The bandage should be removed and reapplied at the end of the second or third day, and at like intervals during the course of treatment. The patient should be fed upon a liquid or semi-solid diet, not being allowed to chew any solid food until the union at the seat of fracture has become firm.

A very satisfactory temporary dressing for fracture of the lower jaw consists in the application of a four-tailed sling. (Fig. 225.)

Some surgeons prefer to use an external splint moulded from pasteboard or gutta-percha fitted to the chin in the

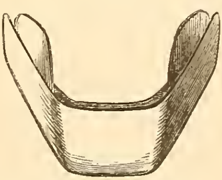
FIG. 226.



Shape of splint before being fitted to chin.

dressing of this fracture, this being padded with cotton and held in place by a Barton or Gibson bandage. (Fig. 227.) Where there is much difficulty in keeping the fragments in position the wiring together of the teeth may be employed, or the fragments may be perforated with a drill and held in place by a strong silver-wire suture; inter-dental splints of metal or gutta-percha are also sometimes used for this purpose. During the course of the treatment in fracture of the jaws the mouth often becomes very offensive from the fermentation of the saliva and discharges, and it is well to use frequently a mouth-wash of chlorate of potash, tincture of myrrh, glycerin and water.

FIG. 227.



Splint moulded to fit chin.

The dressings for fracture of the lower jaw are usually applied for four or six weeks, the union usually being quite firm at the end of this time.

Fracture of the Hyoid Bone.

In fracture of the hyoid bone, if displacement exists, its reduction is facilitated by pressure made with the finger in the pharynx.

The treatment consists in enforced quiet and the use of opium if cough is a prominent symptom, and the inflammatory symptoms may require the employment of active local treatment. A dressing may sometimes be employed with advantage, consisting of a splint of pasteboard or leather moulded to the anterior portion of the neck.

Fractures of the Larynx or Trachea.

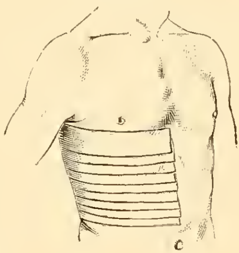
In fractures of the larynx or trachea where there is little displacement and dyspnœa is not marked, the parts should be supported by the application of compresses of lint held in place by strips of adhesive plaster. If, on the other hand, the respiration is embarrassed or there is free expectoration of blood, tracheotomy should be performed, and if the injury be seated in the larynx the displacement of the fragment may be overcome by manipulation with the finger or a director through the tracheal wound, or the larynx may be packed with a strip of antiseptic gauze to control hemorrhage or hold the fragments in position, the patient in the meantime breathing through a tracheotomy tube secured in the tracheal wound; the packing should be removed in a few days, the tracheotomy-tube being permanently removed as soon as the patient can breathe comfortably through the larynx with the tracheal wound closed. In fractures of the trachea the opening into the trachea should be below or at the seat of injury.

Fractures of the Trunk

Fractures of the Ribs.

Fractures of the ribs are more frequent than fractures of any other bones of the trunk; the ribs most commonly broken are those from the fourth to the tenth; the most common seat of fracture is near the junction of the costal cartilages or at the angle. The dressing of fractures of the ribs is best accomplished by enveloping the side of the chest on which the rib or ribs are broken with broad straps of adhesive plaster. The adhesive straps should be two and a half inches in width and long enough to extend from the spine to the middle of the sternum. The straps are warmed and the first strap is firmly applied a short distance below the seat of fracture, extending from the spine to the mid-sternal line; a number of ascending straps are applied in this way, each strap overlapping the preceding one by about one-third of its width, until half the chest is covered in. (Fig. 228.) This dressing usually gives the patient much comfort, and the straps need not be renewed until they become slightly loosened, usually at the end of a week or ten days; they should then be renewed in the same manner.

Fig. 228.



Adhesive plaster dressing for fracture of the ribs.

The dressings for fractures of the ribs are usually dispensed with at the end of three or four weeks, as repair of the fracture is generally well advanced by this time.

A satisfactory temporary dressing for fractures of the ribs consists in surrounding the chest by a broad binder of stout linen or muslin; indeed, some surgeons prefer to employ this dressing during the course of treatment, but as a rule I think it is not as good a dressing as the adhesive plaster dressing, as the former confines the movements of both sides of the chest.

Fractures of the Costal Cartilages.

These fractures often take place at the junction of the cartilages with the ribs or in the body of the cartilages, and the union of the fracture usually takes place by the production of a mass of bone at the seat of fracture. The dressing for fractures of the costal cartilages consists in the application of strips of adhesive plaster applied in the same manner as for fracture of the ribs, and the dressing should be retained for about the same time.

Fractures of the Sternum.

Fractures of the sternum are rare injuries, but diastasis of the bones of the sternum is a more common accident. The dressing for either variety of injury is the same, and

Fig. 229.

Adhesive plaster dressing for fracture of the sternum.

consists in the application of a compress over the seat of fracture held in place by a broad bandage, or, better, by strips of adhesive plaster (Fig. 229), applied so as to cover and fix the anterior portion of the chest, covering the entire length of the sternum. This dressing should be retained for at least four weeks, being renewed if it becomes loose at the end of a week or ten days.

Fractures of the Pelvis.

These fractures are often serious injuries from implication of the pelvic viscera. The reduction of the displacement should first be accomplished as far as possible by external manipulation, together with internal manipulation by the fingers introduced into the rectum, or into vagina in the female. The patient should be placed upon a firm bed on his back, with the knees slightly flexed over a pillow, and the parts should be kept at rest by surrounding the pelvis with broad straps of adhesive plaster or a stout muslin binder, or by a firmly applied padded pelvic belt. The hip-joints should be kept at rest by the application of pasteboard splints or by sand-bags. The dressings should be retained for a period of at least six weeks.

When these fractures are complicated by injury of the pelvic viscera various operative procedures may be required, which will compel the surgeon to modify the method of dressing.

Fractures of the Sacrum and Coccyx.

The dressing of these fractures, after effecting reduction of the fragments as far as possible by pressure within the rectum, and, when the sacrum is involved, the application of broad adhesive straps, or of a padded belt, should be employed, and the patient should be kept at rest in bed. When the *coccyx* only is fractured, after reduction of the displacement, the patient should be confined to bed and the bowels should be kept at rest by the use of opium by suppository. The patient should be kept at rest for three or four weeks, and, in case of fracture of the sacrum, the dressings should be retained for this time.

Fractures of the Vertebræ.

Fractures of the vertebræ are always most serious injuries, not only from the injury of the bones themselves, but also from the damage to the spinal cord, membranes, and nerves, which often accompanies them.

In transporting, or turning in bed, a patient suffering from fracture of the vertebræ, great care should be exercised, for rough or sudden motions might cause a displacement of the fragments which might, by injury of, or pressure upon, the spinal cord, rapidly prove fatal.

In the treatment of fractures of the spine, if the deformity is marked, efforts should be made to reduce it by extension and counter-extension, and the result may be successful, especially if the fracture be associated with a dislocation of the vertebræ. In some cases the use of permanent extension by means of weights attached to the legs, shoulders, and chest by adhesive plaster and bandages has been successful in reducing the deformity.

The patient should be placed upon his back upon a bed with a hair mattress, or better, if it can be obtained, a water-bed, which consists of a rubber mattress filled with water, which distributes the weight of the patient's body evenly over the surface. Whatever form of bed be used, the greatest care should be exercised to keep the patient absolutely clean, and the parts of the body or limbs which are exposed to pressure should be frequently bathed with alcohol or soap liniment, and to distribute the pressure, small pads should be placed under the parts and changed at intervals. These precautions are necessary to prevent, if possible, the formation of extensive bedsores, which are a frequent and troublesome complication of these injuries.

The bowels should be carefully watched, and, if constipation is present, it should be relieved by the use of enemata; and, as it is not desirable to lift the patient to slip a bed-pan under him, the discharges can be received in a flat tin plate pushed under the thighs and buttocks, or on pads of oakum or old muslin.

The care of the bladder is also a matter of the greatest importance; the retention which at first exists should be relieved by the use of a flexible catheter introduced with great gentleness, and when incontinence supervenes the catheter should also be used at intervals; the employment of a soft instrument, if used with care, is not apt to produce any injury to the urethra or bladder.

The employment of a plaster-of-Paris jacket has been followed, in some cases, by good results, and it may be applied early in the case, or it may be used after the patient has been kept in the recumbent posture for some weeks; by its use it is often possible to get the patient out of bed and allow him to sit in a chair.

In fractures involving the cervical vertebræ, care should be exercised in lifting or moving the head, and it is often of advantage in these cases to apply short sand-bags to the sides of the neck and head, to give additional fixation to the parts while the patient is in the recumbent posture, or, if he is allowed to get out of bed, to apply a moulded leather or pasteboard splint to the neck, shoulders, and back of the head for the same purpose.

Trephining of the spine in cases of fracture of the vertebræ, to remedy the displacement and relieve the cord from pressure, has been recommended and employed in some cases, and although the operation under strict antiseptic methods is not attended with much risk, the results obtained up to the present time scarcely seem to warrant its performance.

The course of treatment in cases of fractures of the vertebræ, if the patient does not succumb to the injury in a few days or weeks, often extends over many months, and recovery is often more or less incomplete as regards the function of the parts below the seat of fracture.

Fractures of the Skull.

The treatment of fractures of the skull, whether simple or compound, depends largely upon the nature of the injury and the condition of the cranial contents. In simple fractures unaccompanied with cerebral symptoms no special dressing is required, but in compound fractures where loose fragments are present, these should be removed; and if there is no depression of the fragments, and if no cerebral symptoms are present, the wound should be drained and closed and dressed antiseptically, the dressings being held in place by a recurrent bandage of the head.

The patient should be put to bed and the use of an ice-cap to the head is often of service. The diet should be restricted and calomel and opium and bromide of potassium should be administered; it is well to keep the patient for a few weeks in a quiet and darkened room. Where cerebral symptoms are present, either in simple or compound fractures, and trephining is resorted to, the dressing of the wound is similar, and the same general treatment should be adopted. In all cases of fracture of the skull, whether subjected to operative treatment or not, it is well to keep the patient at rest in bed for three or four weeks, and he should be cautioned to avoid excesses and should not resume active work for some months.

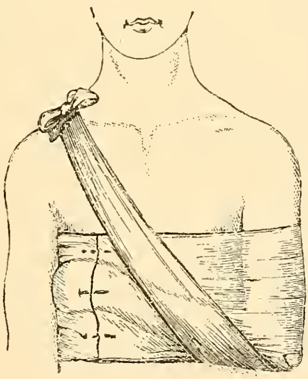
Fractures of the Upper Extremity.

Fractures of the Clavicle.

Fractures of the clavicle may be complete or incomplete, and in the latter variety of injury, the deformity is not usually very marked. The indications for treatment in complete fractures of the clavicle are to relax the sterno-cleido-mastoid muscle, to prevent the weight of the arm on the injured side from dragging down the outer fragment of the clavicle, and by fixing the scapula, to carry the attached external fragment outward and forward. A large number of dressings have been devised and used to accomplish these objects. The treatment of fractures of the clavicle by *position* is accomplished by placing the patient in bed on his back upon a firm mattress with a low pillow under his head, and the arm on the side of injury should be fastened to the side of the chest by a few circular turns of a bandage passing around the arm and chest; the deformity is usually very satisfactorily reduced upon the patient assuming this position, and after three weeks' rest in this position the union is generally sufficiently firm to allow the patient to get out of bed and be about with the arm bound to the side or carried in a sling or with a Velpeau bandage applied, without any recurrence of the deformity.

A satisfactory *temporary dressing* for fractures of the clavicle consists in the application of a four-tailed bandage; the bandage is made from a piece of muslin two yards in

Fig. 230.

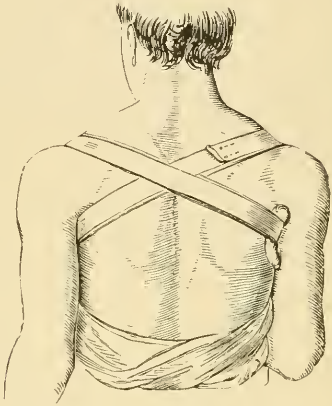


Four-tailed bandage for fracture of clavicle.

length and fourteen inches in width; a hole is cut in its centre about four inches from its margin, to receive the point of the elbow; the bandage is then split into four tails in the line of the hole and to within six inches of it; the body of the bandage should be applied so that the point of the elbow rests in the hole, and a folded towel being placed in the axilla, the lower tails should be carried, one anteriorly, the other posteriorly, diagonally across the chest and back to the neck on the side opposite the seat of fracture and secured; the remaining tails are next carried around the lower part of the chest and secured so as to fix the arm to the side of the body. (Fig. 230.)

In some cases the deformity is corrected by the application of a posterior figure-of-eight bandage, the forearm on the side of injury being carried in a sling. (Fig. 231.)

Fig. 231.

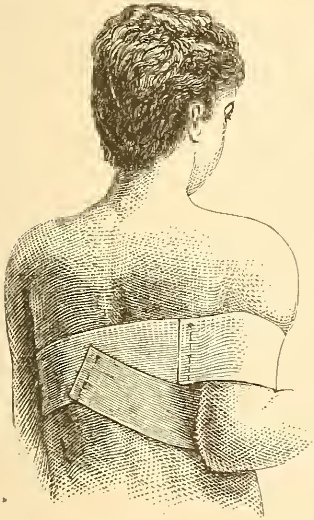


Posterior figure-of-eight dressing for fracture of the clavicle. (Hamilton.)

Sayre's dressing for fracture of the clavicle consists of two strips of adhesive plaster three and a half inches wide and two yards in length. The first strip is looped around the arm just below the axillary margin, and is pinned or sewed with the loop sufficiently open not to constrict the arm. The arm is then drawn downward and backward until the clavicular portion of the pectoralis major muscle is put sufficiently upon the stretch to overcome the action of the sterno-cleido-mastoid muscle, and in this way draws the sternal fragment of the clavicle down to its place. The strip of plaster is then carried completely around the body and pinned or stitched to itself on the back. (Fig. 232.) The second strip is next applied, commencing upon the front of the shoulder of the sound side; thence it is carried over the top of the shoulder diagonally across the back, under the elbow, diagonally across the front of the chest to the point of starting, where it is secured by pinning or sewing. A slit is made in this strip to receive the point of the elbow. Before the elbow is secured by the plaster, it should be pressed well forward and inward. (Fig. 233.)

Velpeau's dressing may also be used in the treatment of fractures of the clavicle. (Fig. 234.) A compress may also

Fig. 232.



Sayre's dressing for fracture of the clavicle. First strip applied.

Fig. 233.

Sayre's dressing for fracture of the clavicle. Second strip applied.

be secured by the vertical turns of this bandage over the seat of fracture if needed. The application of the bandage is described (p. 55).

In any form of dressing in which the arm is held against the side of the chest, it is well to apply a folded towel or piece of lint between the arm and chest to prevent the surfaces from becoming excoriated.

A modified form of the Velpeau dressing for fracture of the clavicle is applied as follows: A soft towel or piece of lint is placed against the side of the body and over the front of the chest, and held in position by a strip of adhesive plaster; the arm is next placed in the Velpeau position, a good-sized pad of lint is next applied over the scapula, and this is held in place by a broad strip of adhesive plaster two and a half inches in width and one and a half yards in length; this strip is continued downward and forward so as to pass over the point of the elbow, and is carried diagonally across the chest to the shoulder of the opposite side and is secured, a slit being cut in it to receive the point of the elbow; a compress of lint is next placed over the seat of fracture and held in place by a strip of adhesive plaster; an additional strip of plaster is next carried from the spine around the arm and chest and secured on the opposite side of the chest; circular turns of a roller bandage are then passed around the chest, including the arm, from below upward until the arm is securely fixed to the body, and the dressing is finished by making one or two turns of the third roller of Desault. (Fig. 235.)

Fig. 234.

Velpeau's dressing for fracture of the clavicle.

In the treatment of fractures of the clavicle in *children* the Velpeau or modified Velpeau dressing will be found to be the most satisfactory dressing to employ, and as these patients are particularly apt to disarrange their dressings it is well to render the dressing additionally secure by applying a few broad strips of adhesive plaster over the turns of the roller bandage, the strips following the turns of the bandage.

The removal of dressings and their reapplication will depend upon the comfort of the patient and the manner in which they keep their position. As a rule in fractures of the clavicle the dressings are removed at the end of the second or third day, the parts are inspected, and the skin is sponged off with dilute alcohol or whiskey; the dressings are then reapplied, and if they are comfortable and the

Fig. 235.

Modified Velpeau dressing for fracture of the clavicle.

parts are in good position, the dressings are made at less frequent intervals until union is completed at the seat of fracture.

Union in cases of fracture of the clavicle is generally quite firm at the end of four or five weeks, and at this time the dressings may be removed, and the patient should carry the arm of the affected side in a sling for several weeks, and should not undertake any work requiring forcible movements of the arm until eight or ten weeks have elapsed from the receipt of the injury.

The time required for union in fractures of the clavicle in children is somewhat shorter; the dressings may be removed at the end of three weeks.

Fractures of the Scapula.

Fractures of the scapula may involve the body, neck, acromion or coracoid process of the bone. Fractures of this bone are quite rare.

Fracture of the Body of the Scapula.

In dressing this fracture, if deformity is present, it is reduced by manipulation, and compresses of lint are placed above and below the seat of fracture and held in place by adhesive strips; the arm is next fixed to the side of the body by spiral turns of a roller bandage passing around the arm and chest, and the forearm is supported in a sling.

Fracture of the Neck, Acromion or Coracoid Process of the Scapula.

These fractures may be dressed by placing a pad of lint or a folded towel in the axilla and binding the arm to the

Fig. 236.

Velpeau dressing for fracture of the scapula.

body by spiral turns of a roller bandage passing around the arm and chest and supporting the forearm in a sling.

Or these fractures of the scapula may be dressed by first placing a pad of lint or a folded towel in the axilla and then securing the arm in the Velpeau position by the application of a Velpeau's bandage. (Fig. 236.) In fractures of the acromion or coracoid processes the union is usually fibrous. In the treatment of fractures of the scapula the dressing should be retained for about four weeks.

Fractures of the Humerus.

Fractures of the humerus may involve the upper extremity, the shaft or the lower extremity of the bone.

Fractures of the Upper Extremity of the Humerus include fractures of the head and anatomical neck of the bone, fractures through the tuberosities, fractures through the surgical neck of the humerus, and epiphyseal fracture or disjunction of the upper epiphysis of the humerus.

The most satisfactory dressing for all fractures of the humerus above the upper third of the bone is applied as follows: A primary roller should be evenly applied from the tip of the fingers to the seat of the fracture, the arm being flexed at the elbow before the bandage is carried above this point, to prevent the dangerous constriction which might result if the bandage were applied with the arm in the straight position, and it were afterwards flexed at the elbow. A folded towel or a thin pad of lint should next be placed in the axilla and over the outer surface of the chest, to furnish a firm basis of support for the humerus and also to prevent excoriation from the contact of the skin surfaces. A splint of pasteboard, felt or leather (Fig. 237) is next moulded to the shoulder and arm; this should be long enough to extend some distance below the seat of fracture and wide enough to cover in about one-half of the circum-

Fig. 237.

Moulded splint for shoulder and arm.

ference of the arm, and is padded with cotton and fitted to the shoulder and arm. The splint and arm are next secured to the side of the body by spiral turns of a roller bandage including the arm and chest in its turns and applied from the elbow to the top of the shoulder. The forearm is carried in a narrow sling suspended from the neck (Fig. 238). This dressing should be removed at the end of twenty-four

FIG. 238.

Dressing for fracture of the upper extremity of the humerus.

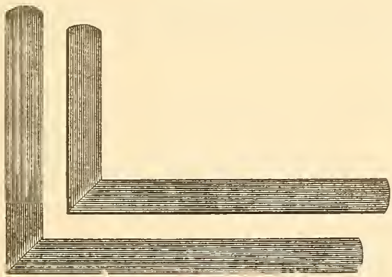
or forty-eight hours, and after the parts have been inspected and sponged over with alcohol, the dressings should be reapplied in the same manner, and if the patient is comfortable they need not be disturbed again for three or four days, subsequent dressings being made at the same intervals. Union in fractures of the upper extremity of the humerus, except in *intra-capsular* fracture, in which bony union is the exception, is usually quite firm at the end of five or six weeks, and the dressings can be dispensed with at this time.

Fractures of the Shaft of the Humerus.

The dressing consists in the application of a primary roller from the tips of the fingers to the seat of fracture; a short well-padded wooden splint extending from the axilla to a point a little above the internal condyle is next placed on the inner surface of the arm and against the chest; a moulded pasteboard or felt splint, fitted to the shoulder and outer side of the arm and extending a short distance below the seat of fracture, is padded with cotton and applied to the shoulder and arm. The splints are held in position and the arm is secured to the body by spiral turns of a roller bandage carried around the chest and arm, and the forearm is carried in a sling suspended from the neck. The dressing is much the same as that for fracture of the upper part of the humerus, with the addition of the short internal splint.

Fractures of the shaft of the humerus may also be dressed by first applying a primary roller and then placing the forearm and arm upon a well-padded internal angular splint. (Fig. 239.) Care should be taken to see that the end of

FIG. 239.



Internal angular splints.

the splint extends only to the axilla and does not press upon the brachial vein. A pasteboard or felt moulded splint is next applied to the shoulder and outer side of the arm. The splints are held in position by turns of a roller bandage beginning at the fingers and carried up to the shoulder. (Fig. 240.) The arm is supported by a sling applied at the wrist, and sometimes for additional security the arm is secured to the side of the body by spiral turns of a bandage carried around the arm and chest. The after-treatment of these fractures as regards the removal and renewal of the dressings is the same as in cases of fracture of the upper portion of the humerus.

Fig. 240.

Dressing for fracture of the shaft of the humerus with internal angular splint.

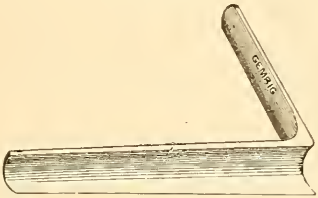
In fractures of the shaft of the humerus the dressings should be retained for five or six weeks.

Fractures of the Lower Extremity of the Humerus.

These include fractures at the base of the condyles, splitting fractures between the condyles or those of the internal or external condyle, and epiphyseal fracture or disjunction of the lower epiphysis of the humerus.

In dressing fractures of the lower extremity of the humerus, if a primary roller is employed it should be carried up only to the elbow; the displacement is reduced by extension and manipulation, and before applying any splint it is well in many cases to apply over the region of the fracture several folds of lint saturated with lead-water and laudanum, and to cover this dressing with waxed paper or rubber tissue to diminish as far as possible the swelling, which is very marked after these injuries. An anterior angular splint (Fig. 241) well padded with cotton or oakum

FIG. 241.



Anterior angular splint.

is next applied and held in position by the turns of a roller bandage applied from the fingers to the upper portion of the splint. (Fig. 242.) These fractures may also be dressed with a well-padded internal angular splint, this splint being

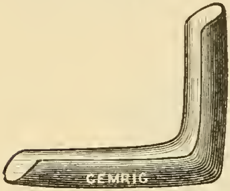
FIG. 242.

Dressing for fracture of the lower extremity of the humerus with anterior angular splint.

substituted by an anterior angular splint at the end of ten days or two weeks.

These fractures may also be dressed by placing the arm in a posterior angular trough (Fig. 243) made of pasteboard or leather. Some surgeons prefer to dress fractures of the condyles of the humerus with the arm in the extended position upon a straight anterior splint, or with short, narrow pasteboard splints applied around the joint, as favoring more accurate coaptation of the fragments. If this position is employed a straight wooden splint is applied to the anterior surface of the arm and forearm, or moulded splints of pasteboard may be used, and after the union is moderately firm, at the end of two weeks, the elbow should be flexed and kept in this position during the remaining time of the treatment.

Fig. 243.



Posterior angular trough.

When fractures of the lower extremity of the humerus involve the elbow-joint a certain amount of impairment of joint-motion is apt to occur either from ankylosis or from displacement of the fragments which in many cases it is impossible to completely reduce, so that flexion and extension of the joint is restricted. Bearing these facts in mind, it is well to make passive motion in these cases as early as the second or third week. It is well to explain to the patient or his friends that impairment of joint-motion may result in these fractures in spite of the greatest skill and care in the treatment. In a case of fracture in the region of the condyles of the humerus the dressings should be removed in twenty-four hours and it should be re-dressed in the same manner, and if the swelling does not increase and the dressing is comfortable to the patient it should afterward be dressed at less frequent intervals; the union is generally quite firm at the end of four weeks and the splint may be removed at this time. Fractures of the condyles of the humerus are very common in children and epiphyseal disjunctions of the lower epiphyses are also met with; the dressing of these injuries in this class of patients is similar to that described for fractures of the condyles of the humerus.

FRACTURES OF THE OLECRANON PROCESS OF THE ULNA.

Fractures of the olecranon may consist in simply a separation of the cortical layer of bone over the summit of the process to which the triceps is principally attached, or the line of fracture may pass through the sigmoid fossa.

Fractures of the olecranon are dressed with the arm slightly flexed at the elbow, or with it completely extended;

FIG. 244.

Adhesive strap applied to draw fragment downward.

the former position is possibly a little less irksome to the patient. The separation of the fragment by the action of

FIG. 245.

Fracture of olecranon dressed in the extended position.

the triceps muscle is usually not very marked; but, if the displacement is marked, it may in a measure be overcome by the use of a compress above the fragment, over which figure-of-eight strips of adhesive plaster are fastened to draw it down into position (Fig. 244). A primary roller should then be carefully applied to the forearm and arm with figure-of-eight turns at the elbow to reinforce the action of the strips of plaster, and a well-padded straight wooden splint extending from the upper third of the arm to the ends of the fingers is next securely fastened to the arm by the turns of a roller bandage (Fig. 245).

This fracture may also be dressed by first applying a primary roller up to the elbow, and then placing the arm upon a well-padded anterior obtuse-angled splint, or a straight splint with a good-sized pad of lint or oakum fastened at a point corresponding to the position of the flexure of the elbow. When either of these splints is placed upon the arm a position of moderate flexion is obtained. A compress of lint is next placed above the fragment, if there is displacement, and one or two narrow strips of adhesive plaster are fastened to this and passed obliquely downward and attached to the splint on either side. The splint is then securely fastened to the arm by the turns of a roller bandage applied from the fingers to the upper end of the splint.

The dressings in a case of fracture of the olecranon should be removed at the end of twenty-four or thirty-six hours, or sooner if there is evidence of swelling of the tissues in the region of the fracture, and they should be reapplied in the same manner. If the dressing is comfortable to the patient, and there is no evidence of swelling, the subsequent dressings should be made at less frequent intervals ; the dressings are usually retained in this fracture for five or six weeks. Passive motion should not be made until this time, as flexion of the elbow tends to separate the fragments, unless union has taken place. The repair of a fracture of the olecranon is, in most cases, by fibrous union, but in a few instances bony union has been found to have taken place.

Fractures of the Coronoid Process of the Ulna.

Fractures of the coronoid process are rarely met with, and their dressing is accomplished by placing the arm in a flexed position and applying a well-padded internal right-angled splint, or a posterior right-angled splint, and securing it to the arm by the turns of a roller bandage. A moulded pasteboard or leather gutter may be substituted for the angular splints. The dressings should be changed at intervals, and after their removal at the end of three or four weeks, passive motion should be practised.

Fractures of the Head and Neck of the Radius.

These fractures are also quite rare, and, when met with, should be dressed, after reducing the fragments by manipulation, by flexing the elbow and keeping it in this position by the application of a well-padded anterior right-angled splint, the splint being firmly secured in position by the turns of a roller bandage applied from the tips of the fingers to the upper end of the splint. The splint should be changed at intervals, and should not be permanently removed for four weeks, at which time passive motion, consisting in flexion and extension at the elbow and pronation and supination of the forearm, should be made. (Fig. 242.)

An internal angular splint applied to the inner surface of the forearm and arm may also be used in the treatment of these fractures. (Fig. 240.)

Fractures of Both Bones of the Forearm.

These fractures are often met with as the result of direct or indirect violence, and after reducing the displacement, which is always marked when both bones are broken, and is not so marked when one bone only is broken, by making extension from the hand and by manipulation; the forearm is placed in the supine position or in a position between pronation and supination. The supine position is, as a rule, to be preferred in any fracture of the radius, as the upper fragment is supinated by the action of the biceps and supinator brevis muscles, and, therefore, unless the lower fragment be placed in the supine position union with rotary deformity will almost inevitably ensue.

Two straight wooden splints, well padded, a little wider than the forearm, are employed. The anterior splint should be long enough to extend from the elbow to the tips of the fingers, and the posterior splint should extend from the elbow to the wrist. A primary roller should never be ap-

Fig. 246.

Dressing for fracture of both bones of the forearm.

plied to the forearm in dressing these fractures, as its application diminishes the interosseous space and its use has been followed by gangrene of the hand and forearm. In applying the anterior splint to the palmar surface of the forearm and hand care should be taken to see that the upper end of the splint does not press upon the brachial artery and vein at the elbow when the forearm is flexed; the posterior splint is next applied from the elbow to the wrist and the splints are held in position by the turns of a bandage carried from the fingers to the elbow. (Fig. 246.)

In fracture either of the shaft of the radius or of the ulna alone, the deformity is usually not so marked as when both bones are broken at the same time, the unbroken bone acting as a splint; the dressing for these fractures is the same as for fracture of both bones of the forearm.

The dressing should be removed in twenty-four or thirty-six hours, and after inspecting the parts and sponging them with dilute alcohol the splints should be replaced in the same manner and secured, and the dressings should be removed and renewed at intervals of two or three days for two weeks at least, and after this time the dressings should be made at less frequent intervals. The time required for union in these fractures is usually five or six weeks, and the splints should be retained for this time.

Fractures of the forearm should be seen by the surgeon frequently for the first two weeks of the treatment, for it is in these fractures that the most unfortunate results have occurred from neglect of this precaution.

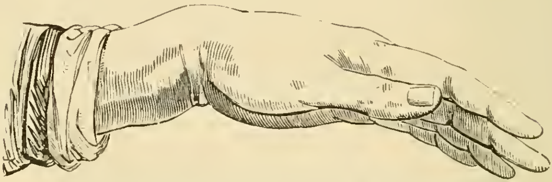
In children *incomplete* or *green-stick* fractures of the bones of the forearm are very common; their dressing, after reducing the deformity, which consists in bending the bones back into place, which often converts the incomplete fracture into a complete one, is accomplished in the same manner as described above. In these patients there is a great tendency to displace the splints or rather to draw the forearm out of the splints, and to prevent this I often employ an anterior angular splint, in place of the straight anterior splint, the upper portion of which, being fastened to the arm, prevents the child from dragging the arm out of the dressings.

Fractures of the Lower End of the Radius.

The most common fracture of the radius is one situated from one-half of an inch to one and one-half inches above the lower articular surface of the bone, the line of fracture being more or less transverse, although it may in some cases be slightly oblique; the characteristic deformity in this fracture is represented in Fig. 247.

The most important point in the treatment of this fracture is to effect complete reduction before the application of any splint; this is done by making extension from the hand, and at the same time, by extending and flexing the wrist and by manipulation, the deformity can usually be completely reduced. The arm should then be brought into the position of supination, and a firm compress of lint is next placed over the lower end of the upper fragment on the

Fig. 247.

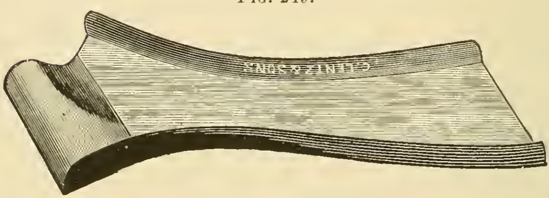


Fracture of the radius near its lower extremity.

Fig. 248.

Position of compresses in Colles's fracture.

Fig. 249.



Bond's splint.

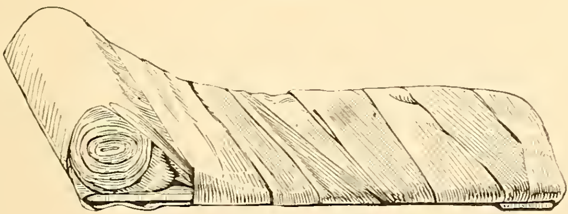
palmar surface of the forearm; a second compress is then placed over the upper end of the lower fragment (Fig. 248), and a well-padded Bond splint (Fig. 249) is applied to the palmar surface of the arm and held in place by the turns of a roller bandage. (Fig. 250).

Fig. 250.

Dressing for fracture of the lower end of the radius.

Many surgeons treat this fracture with the hand in a position between pronation and supination, the thumb pointing upward. A substitute for Bond's splint may be prepared by fastening a roller bandage obliquely upon a straight wooden splint as suggested by Dr. Hays. (Fig. 251.)

Fig. 251.



Substitute for Bond's splint.

Two straight splints with compresses are also employed in the treatment of this fracture, and a vast number of splints have been devised; among these may be mentioned those of Gordon, Coover, and the metal splint of the late Dr. R. J. Levis. The most important point in the treatment of this fracture is the complete reduction of the deformity at the first dressing, and if this has been satisfactorily done almost any splint may be used with a good result, and indeed some surgeons use no splint, applying only a compress over the palmar fragment, held in place by a strip of plaster, the arm being carried in a sling.

The after-treatment of these fractures consists in removing the splint and compresses after twenty-four or thirty-six hours and in sponging the surface of the skin with dilute alcohol, and the compresses and splint should then be reapplied in the same manner; the fracture should be dressed every second or third day for the first two weeks, and after this time it should be dressed at less frequent intervals. Union is usually quite firm at the end of four weeks, and the splint should be dispensed with at this time. A certain amount of stiffness of the wrist and fingers is apt to follow this fracture, which is usually soon overcome by passive motion and physiological use of the parts.

In *children* epiphyseal separations or fractures of the lower epiphysis of the radius are often met with, and their treatment is similar to that described above; a Bond splint with compresses or two straight splints with compresses being the most satisfactory dressing to employ in this injury, the dressings being retained for three weeks.

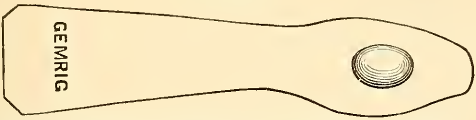
Fractures of the Carpal Bones.

These fractures are usually compound or open fractures, and are so frequently associated with extensive laceration of the arm and hand that operative measures have to be resorted to; but if such is not the case they are dressed, when compound, with an antiseptic dressing, and the hand and forearm are supported upon a well-padded palmar splint held in place by a roller bandage; more or less impairment in the motion of the wrist is apt to follow these fractures. In simple fractures of the carpal bones the use of an evaporating lotion for a few days, in connection with the splint just mentioned, will be found useful. The dressings should be retained for three or four weeks, and after their removal passive motion should be employed to overcome as far as possible the joint-stiffness resulting.

Fractures of the Metacarpal Bones.

These fractures are often met with as the result of direct or indirect force applied to the metacarpal bones. The treatment of fractures of the metacarpal bones consists in first reducing the deformity, which is usually an angular one, the projection of the angle being toward the back of the hand; this is reduced by pressure with the fingers, and the hand and forearm should then be placed upon a palmar splint (Fig. 252) with a pad of oakum or cotton under the

Fig. 252.



Agnew's splint for fracture of the metacarpal bones.

palm; a compress of lint is next placed over the seat of fracture, and the hand and forearm are bound to the splint by the turns of a roller bandage. (Fig. 253.) At the end

Fig. 253.

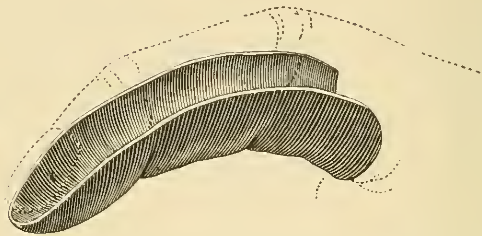
Dressing for fracture of the metacarpal bones.

of three weeks union at the seat of fracture is usually quite firm, and the splint should be dispensed with at this time.

Fractures of the Phalanges.

The treatment of fractures of the phalanges consists in reducing the displacement by extension and manipulation, and in placing the finger in a moulded gutta-percha or pasteboard splint (Fig. 254), and securing the splint in position

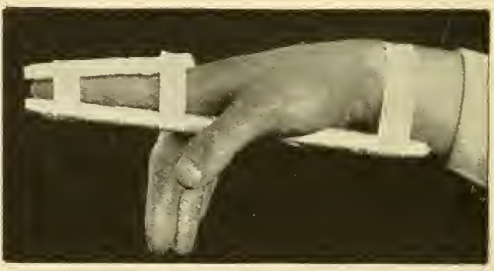
Fig. 254.



Gutta-percha splint for fracture of phalanx. (Hamilton.)

by the turns of a roller bandage. When the proximal phalanx is fractured a narrow, padded, wooden splint extending from the end of the finger to the wrist should be applied upon the palmar surface of finger and hand, and a short dorsal splint should also be used; if there is a tendency to

Fig. 255.



Dressing for fracture of phalanx with anterior and posterior splints.

lateral displacement short lateral splints should also be employed, and the splints should be held in place by strips of plaster or by a roller bandage. (Fig. 255.)

Union in fractures of the phalanges is usually quite firm at the end of three weeks, and the splints can be dispensed with at that time.

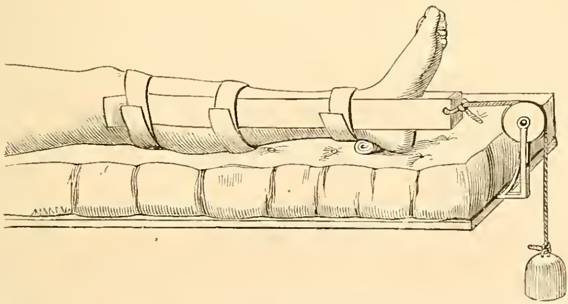
Fractures of the Lower Extremity.

Fractures of the Femur.

Fractures of the upper extremity of the femur are those involving the neck, great trochanter, and upper end of the shaft of the bone.

In dressing fractures of the upper extremity of the femur the patient should be placed in bed upon a firm mattress, and an extension apparatus made from adhesive plaster should be applied to the leg, extending as far as the knee-joint. The extension apparatus is constructed by taking a piece of adhesive plaster two and a half inches in width and long enough to extend from the outer side of the knee

Fig. 256.

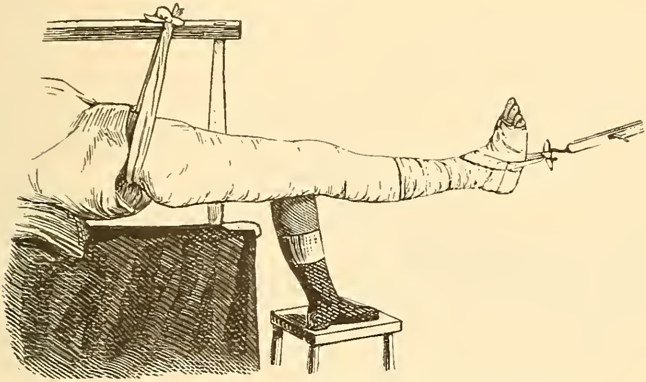


Adhesive plaster extension apparatus applied to limb. (Ashhurst.)

to four inches below the sole of the foot, and from this point back to the inner side of the knee; in the centre of this strip is placed a block of wood, two and a half inches wide and four inches in length, with a perforation in its centre; the block and the inner surface of the strip on each side are next faced with a similar strip of adhesive plaster to a point about an inch above each malleolus; a few straps are next wound around the wooden block to fix the previously applied straps; the strip of plaster is next warmed and applied to the sides of the leg and held in position by three strips of adhesive plaster carried around the leg at intervals (Fig. 256), and the plaster is made additionally secure by the application of a roller bandage applied to the foot and leg and carried up to the knee. Through the perforation in the block or stirrup is fastened a cord which passes over a pulley attached to the bed, and to this cord is attached the extending weight. The extension apparatus being applied, lateral support is given to the leg and thigh by sand-bags applied on either side; the outer sand-bag should extend from the foot to the axilla, and the inner one from the foot to the groin. A weight of five or ten pounds is attached to the extending cord, and the lower feet of the bed should be raised on blocks a few inches high to prevent the patient from slipping down in bed; a pad of oakum or cotton should also be placed under the tendo Achillis to relieve the heel from pressure. This dressing is kept in place for from four to six weeks, and if union has occurred the patient is kept in bed for a few weeks longer and is then allowed to be about using crutches. In the majority of cases of fracture of the neck of the femur fibrous union only takes place, and after employing the dressing before described for six weeks the patient is allowed to get up and go about on crutches. It often happens that the subjects in whom these fractures occur are old and feeble, and if it is found that restraint in bed with the dressings here described is not well borne, under such circumstances they should be discarded and the patient should be allowed to sit up in bed with the limb resting on a pillow, or in a chair, the treatment of the local condition having to be disregarded, attention being given to the patient's constitutional condition.

The application of a plaster-of Paris bandage to the leg, thigh and pelvis is also sometimes made use of in the treatment of fractures of the upper extremity of the femur; extension should be made from the foot while the bandage is being applied. (Fig. 257.) In fractures of the neck of the femur and of the upper part of the shaft of the bone the anterior wire splint of Prof. N. R. Smith is sometimes

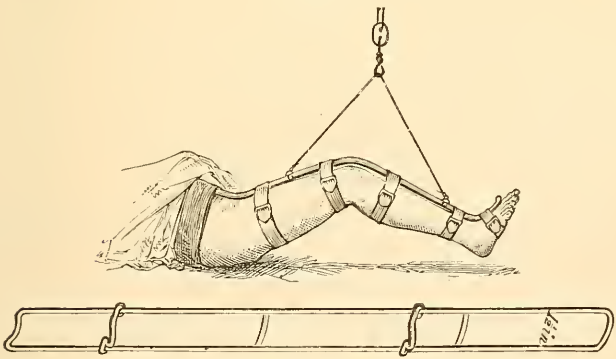
FIG. 257.



Plaster-of-Paris bandage applied to thigh. (HAMILTON.)

used with advantage; the limb being swung from the splint the patient is able to move in bed without causing him pain

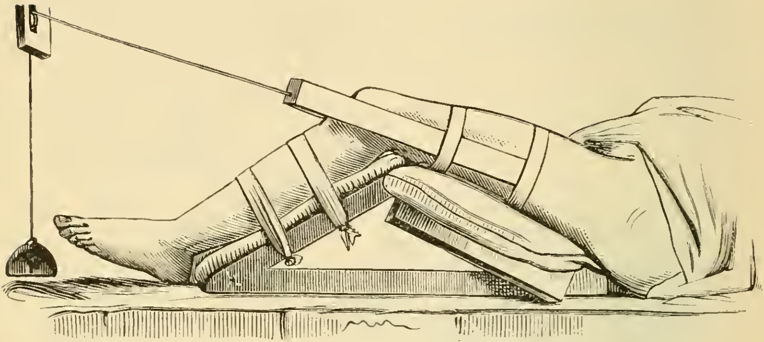
FIG. 258.



Smith's anterior splint for fracture of the femur.

or disturbing the fragments. (Fig. 258.) In fractures in the upper portion of the femur where there is marked tilting forward of the upper fragment Prof. Agnew employs extension made from the thigh and places the limb upon a double in-

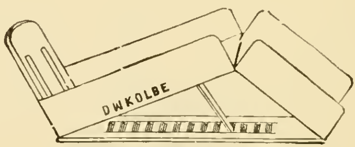
FIG. 259.



Dressing of fracture of the femur with extension upon an inclined plane. (AGNEW.)

clined plane and maintains this position during the treatment of the case. (Fig. 259.) With the same object in view, in place of the double inclined plane a double inclined frac-

FIG. 260.



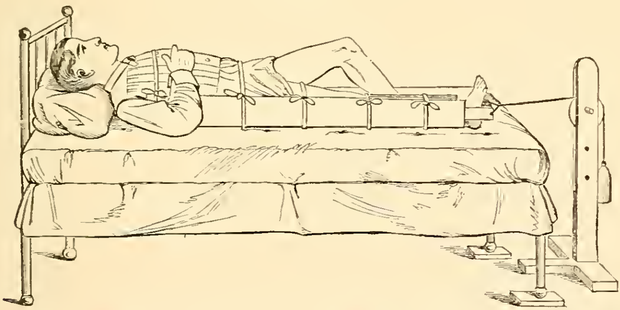
Double inclined fracture-box.

ture-box may be employed, extension being made from the thigh by means of adhesive plaster strips applied above the knee, to which a weight is attached. (Fig. 260.)

Fractures of the Shaft of the Femur.

In the treatment of fractures of the shaft of the femur the dressings are applied to diminish as far as possible the shortening and to prevent angular or rotary displacement of the fragments. In dressing these fractures the patient should be placed upon a fracture-bed or an ordinary bed with a firm hair mattress; an extension apparatus of adhesive plaster is applied and extension is made by a weight attached to this as previously described. Lateral support is given to the limb by the application of two wooden splints—the outer or long one extending from the axilla to the foot, the inner or short one extending from the groin to the foot. The splints at their upper extremity should be about six inches in width and at their lower extremity about three and a half inches. The splints are wrapped in a splint cloth which extends from the foot to the groin, and after this has been placed under the limb the splints are fixed in their proper positions, the short one to the inner side, the long one to the outer side of the limb. Between the limb and the splints are interposed bran-bags: the outer bag should be long enough to extend from the axilla to the foot, the inner one from the groin to the foot. The splints and bran-bags are held in

Fig. 261.



Dressing for fracture of the shaft of the femur with splints and bran-bags. (Ashhurst.)

place by five or six strips of bandage passing under the limb and body and around the splints and bran-bags at intervals. The heel is saved from pressure by placing a wad of oakum or cotton under the tendo Achillis and after the splints have been brought into place the strips of bandage are firmly tied to secure them and a weight of ten or twelve pounds is attached to the extending cord. The foot of the bed is raised to prevent the patient from slipping downward and to allow the weight of the body to act as a counter-extending force. After the application of the dressings the thigh should be slightly abducted. During the after-treatment of these fractures the surgeon should see that the splints and bran-bags are kept firmly in place and that the foot does not roll outward: this is accomplished by untying the strips and readjusting the bags and then bringing up the splints and securing them in position by fastening the strips. The extension apparatus usually does not require renewal during the course of treatment. The extension and splints are kept in place for four or six weeks and at this time union at the seat of fracture is usually quite firm, so that they may be removed, and the fracture is then supported by moulded pasteboard splints or by the application of a plaster-of-Paris splint for several weeks longer, and at the end of eight weeks it is safe to allow the patient to be up and around on crutches.

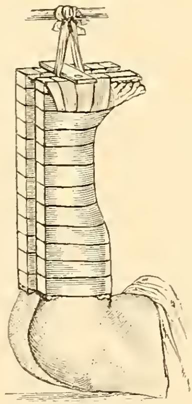
Many surgeons, in fracture of the shaft of the femur, prefer to use a long external sand-bag and a shorter internal one in place of the corresponing long and short splints and bran-bags, and, if care is observed to see that the sand-bags are kept accurately in contact with the limb and body, excellent results may be obtained by this form of dressing. After considerable experience with both methods of furnishing lateral support in the dressing of fractures of the shaft of the femur, I am well satisfied that angular deformity is less likely to result where the splints and bran-bags are employed.

The plaster-of-Paris dressing, including the foot, leg, thigh, and pelvis, is employed by some surgeons in the early treatment of fracture of the shaft of the femur, the limb being kept well extended until the plaster has thoroughly set. The double inclined plane and the anterior angular wire splint are also sometimes employed in the dressing of fractures of the shaft of the femur.

Fractures of the Shaft of the Femur in Children.

The treatment of these fractures in young children by extension by a weight and pulley and lateral splints is often unsatisfactory on account of the difficulty in keeping the patient quiet upon his back, and from the soiling of the dressings by the feces and the urine. In children two years of age and over I have never found much trouble in employing extension and lateral support by splints and bran-bags or sand-bags, and in these cases I make additional fixation at the seat of fracture, and guard against displacement of the fragments by the child sitting up in bed when not watched, by carefully moulding external and internal pasteboard or felt splints to the thigh, and holding them in place by the turns of a bandage. I have employed this form of dressing even in children under two years of age with the most satisfactory results.

Fig. 262.



Fracture of the femur treated by vertical extension.

In cases of fracture of the femur in children from a few months to a year or eighteen months of age, in whom it is difficult to obtain quietude, or who have to be moved to give them nourishment if they are taking the breast, the dressing which I have found most satisfactory consists in first applying a roller bandage from the foot to the groin, and then moulding to the outer half of the foot, leg, thigh, and also to half of the pelvis, a pasteboard or felt splint which is well padded with cotton, and held in position by the turns of a bandage carried from the foot to the pelvis and finished with circular turns about the pelvis. The splint should be so moulded as to include a little more than one-half of the circumference of the thigh and leg. If this splint becomes soiled it is easily replaced by a fresh one, and its removal and renewal is much easier than that of the plaster-of-Paris splint which is recommended by some surgeons in these cases.

In young children fractures of the femur are often *incomplete* or *green-stick fractures ;* and, even when complete, the shortening is usually not marked, as the line of fracture is apt to be transverse, the periosteum often not being completely ruptured, which tends to hold the fragments in position.

In green-stick fractures the deformity should be reduced by manipulation, even if it is necessary to convert the incomplete fracture into a complete one to accomplish this object.

Mr. Bryant recommends that fractures of the femur in young children be treated in the vertical position; the injured limb, together with the sound one, is flexed at a right angle to the pelvis and fixed with a light splint, and attached to a cradle or bar above the bed. (Fig. 262.)

If the plaster-of-Paris dressing is used, the limb should be first enveloped from the foot to the pelvis with a flannel bandage, and extension should be made while the plaster-of-Paris bandage is being applied and should be kept up until the bandage has become fixed. The plaster bandage should extend from the toes to the pelvis, and it is well to fix the hip-joint by carrying several turns of the bandage about the pelvis. To prevent the splint from absorbing the discharges and becoming offensive, the upper portion of it may be coated with shellac.

The time required for union in fractures of the femur in children is about three weeks, and the dressings may be removed at this time, but the child should not be allowed to use the limb for several weeks after this period.

Fractures of the Lower End of the Femur.

The fractures met with in this portion of the femur are supra-condyloid fractures, or those in which one condyle is separated, or comminuted fractures in which both condyles are separated; epiphyseal disjunctions of the lower end of the femur, met with in young subjects, may also be classed with fractures at this portion of the bone.

The dressing of supra-condyloid fractures, if there is shortening, should be similar to that employed in fractures of the shaft of the femur, consisting in the application of an extension apparatus, and bran-bags and splints or sand-bags to give lateral support; if, however, there is no marked shortening the dressing employed should be the same as that applied in fractures involving one or both condyles or epiphyseal separations.

The dressing employed in fracture of one or both condyles or in epiphyseal disjunction of the lower end of the femur consists in placing the limb in a long fracture-box extending from the foot to the upper third of the thigh, the box being well padded with a soft pillow, or a well-padded posterior splint, or a moulded pasteboard or felt gutter may be employed; if either of these dressings is employed, the splint or gutter should be long enough to extend from the lower part of the leg to the middle of the thigh.

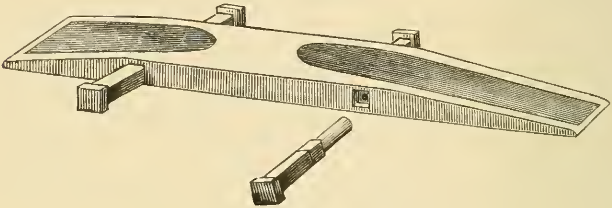
If there is much effusion into the joint or soft parts, lead-water and laudanum should be applied over the region of injury for some days, until the swelling has subsided. At the end of two weeks it is well to place the limb in a plaster-of-Paris dressing, extending from the foot to the middle of the thigh. This dressing should be retained for four weeks, and at the end of this time the dressing should be removed, and if the union is sufficiently firm to allow the patient to go about on crutches, a fresh plaster-of-Paris splint should be applied extending from the middle of the leg to the middle of the thigh, or lateral splints of pasteboard may be substituted for the plaster dressing.

A certain amount of permanent impairment of the joint motion is apt to follow fractures involving one condyle or both condyles of the femur.

Fractures of the Patella.

The dressing of fractures of the patella consists, first, in the application of a roller bandage from the toes to the upper part of the leg; a well-padded posterior wooden splint long enough to extend from the middle of the leg to the middle of the thigh, or an Agnew splint, which is provided with pegs for the attachment of strips of adhesive plaster (Fig. 263) is next placed under the limb. A small compress of lint is next placed above the upper fragment, and a

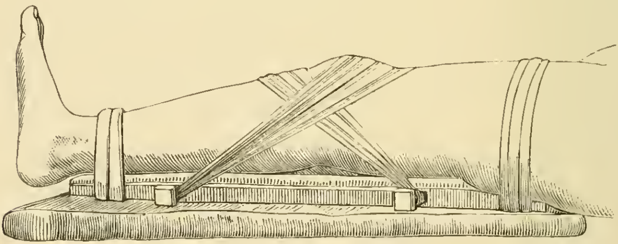
Fig. 263.



Agnew's splint for fracture of the patella.

similar compress is placed below the lower fragment; a strip of adhesive plaster one and a half inches in width and twenty-four inches in length has its middle portion applied over the compress, and its ends are then brought obliquely downward and fastened to the splint, or to the pegs if

Fig. 264.



Agnew's splint applied.

Agnew's splint be used; this may be reinforced by a second or third strip. The object of these strips is to bring the upper fragment down in contact with the lower fragment. A strip of plaster with the ends passing in the opposite direction is next placed over the lower compress, and the ends are fastened to the splint or pegs; this strip serves only to steady the lower fragment, as it cannot be drawn upward to meet the upper fragment by reason of the inextensibility of its ligamentous attachment. (Fig. 264.) If the Agnew splint is employed the strips of plaster may be tightened by turning the pegs to which they are fastened without removing the splint.

The splint is next firmly fixed in contact with the limb by the turns of a roller bandage extending from the lower to the upper end of the splint. The limb should next be placed upon an inclined plane or in a long fracture-box with its foot elevated to relax the quadriceps femoris muscle. This dressing should be removed and reapplied in a few days, as the dressings become loose as the swelling about the seat of injury subsides, and after this disappears the dressings require renewal at less frequent intervals and usually at the end of three weeks the splint may be removed and a plaster-of-Paris bandage may be applied extending from the middle of the leg to the middle of the thigh. At the end of six weeks the patient may be allowed to walk upon the limb, the knee-joint being fixed with a plaster-of-Paris or pasteboard splint.

It is well, after the removal of the splints, for the patient to wear for some months a laced muslin knee-supporter, which gives some support to the knee-joint.

The union in fractures of the patella is usually fibrous, although in rare cases bony union has occurred.

A great variety of splints have been devised and used in the treatment of fractures of the patella, the main object of which is to fix the knee-joint and bring the fragments as nearly as possible in apposition. Malgaigne's hooks or Levis's modification of the same are employed by some surgeons to secure close apposition of the fragments. The method of treatment in fractures of the patella, which consists in exposing the fragments by an incision and drilling and suturing them with catgut or silver wire sutures, is also employed at the present time, the strictest antiseptic precautions being taken to prevent infection of the wound.

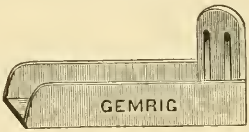
In cases of rupture of the fibrous union after fracture of the patella, which is not an uncommon accident, the treatment of the case should be the same as that for a recent fracture of the patella.

Fracture of the Bones of the Leg.

In fractures of both bones of the leg the displacement is usually very marked: when one bone only is broken, the sound bone, acting as a splint, prevents much deformity, except in case of fracture at the lower end of the fibula, when the foot inclines to the injured side.

The dressing for fractures of both bones of the leg or for fracture of the tibia or fibula alone, except in cases where the lower portion of the fibula is the seat of injury, is best accomplished by the use of a fracture-box. (Fig. 265.)

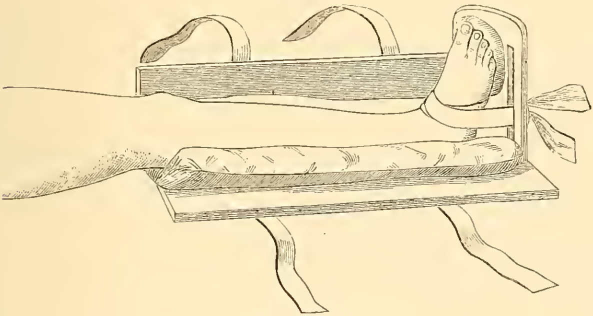
Fig. 265.



Fracture-box with movable sides.

The displacement being overcome as far as possible by extension and manipulation, the leg is placed in a fracture-box, which is prepared for the reception of the limb by having the sides let down and having a soft pillow laid in it; the foot is next secured to the footboard by a loop of bandage passed around the foot, the ends being tied after passing through the slots in the footboard; a pad of oakum or cotton is placed under the tendo Achillis to relieve the heel from pressure, and a similar pad is placed between the sole of the foot and the footboard. (Fig. 266.) The sides of the box are then brought up and secured by two or three strips of bandage tied around the box. In using a fracture-box in the treatment of fractures of the bones of the leg the surgeon should see that the foot is kept well down to the footboard and is at a right angle with the leg, that there is no eversion of the knee and that the pillow is full enough to make equable pressure upon the leg when the sides of the box are secured, and that the heel is not subjected to undue pressure—the use of a pad of oakum or

Fig. 266.



Application of the fracture-box.

cotton under the tendo Achillis being employed to prevent this complication. Where there is a tendency to tilting upward of the lower end of the upper fragment the lower fragment can be brought in line with this by raising the foot by a mass of oakum or cotton placed under the tendo Achillis and heel and so overcoming the deformity.

Fig. 267.

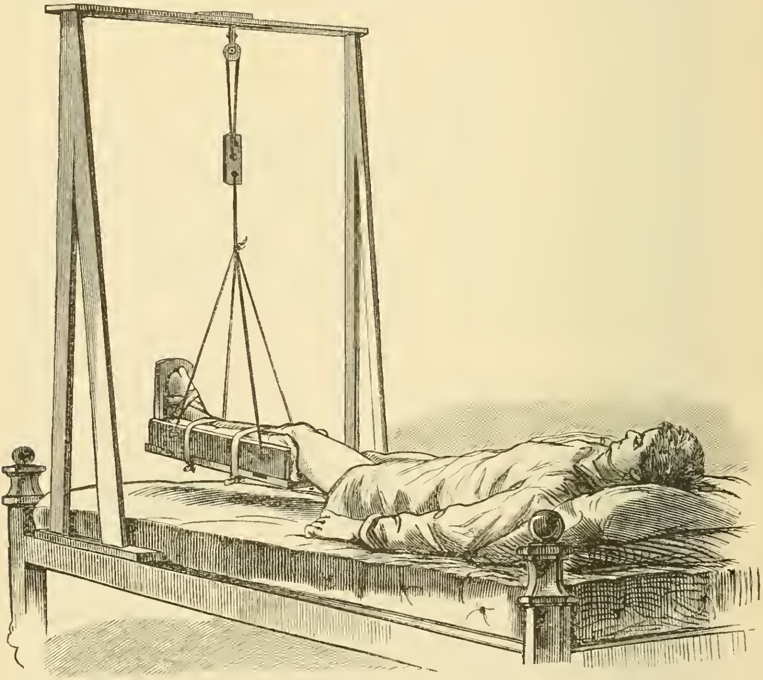
Plaster bandage applied to fracture of the leg.

The subsequent dressings of the cases are conducted by letting down the sides of the box and correcting any displacement, if present, by adjusting the limb and pads in their proper position, and again bringing up the sides of the box and securing them. At the end of two or three weeks the fracture-box may be removed and a plaster-of-Paris dressing may be applied to the limb, which will allow the patient more freedom of movement in bed, or permit of his sitting up without disturbing the fragments (Fig. 267).

Union in fractures of the bones of the leg is usually quite firm in six weeks, but the patient should not be allowed to put his weight upon the limb in walking for at least eight weeks.

If the patient is restless, and finds his position with the fracture-box resting upon the bed irksome, the fracture-box may be swung from a frame fastened over the bed (Fig. 268).

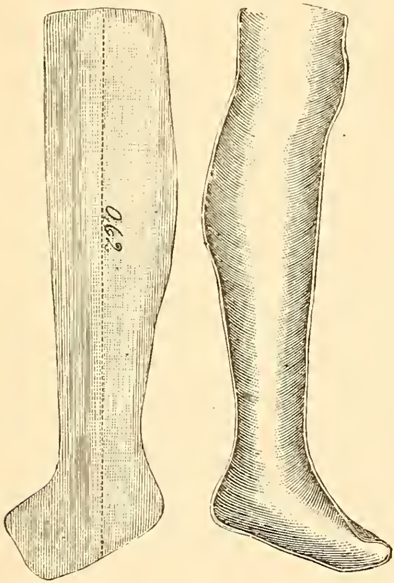
Fig. 268.



Fracture-box suspended. (Agnew.)

The application of a plaster-of-Paris dressing as a primary dressing—the ordinary plaster-of-Paris bandage or the Bavarian dressings being applied—in fractures of the bones

FIG. 269.



Moulded binder's board splints for fractures of the leg.

of the leg, is adopted by some surgeons, and, if employed, the case should be under constant supervision for a few days, so that the dressing can be removed if a dangerous amount of swelling takes place. Moulded splints of felt or pasteboard are also sometimes applied in the treatment of these cases. (Fig. 269.)

In patients suffering with delirium tremens, or in maniacal patients, the use of a fracture-box in the treatment of fractures of the bones of the leg is often not satisfactory on account of the difficulty in restraining the movements of the patient, and the consequent displacement of the fragments. In such cases it is well to apply a few strips of binder's board, well padded with cotton, to the limb, extending above and below the seat of the fracture, holding them in place by a few turns of a roller, and then to wrap the limb and foot in a soft pillow and hold this in place by the turns of a roller bandage applied with moderate firmness. This dressing allows the patient to move the limb without serious disturbance of the fragments, and, after the patient recovers from his attack, the leg may be placed in the fracture-box.

In fractures of the bones of the leg *in young children* the same difficulty is often experienced in keeping them quiet, and for this reason a fracture-box cannot be used with satisfaction. In dressing these cases, two lateral splints of pasteboard, moulded to the foot and leg and well padded with cotton, may often be employed with the best results. The splints should not be wide enough to meet on the anterior or posterior surface of the leg or foot. The splints, after being carefully adjusted, are held in place by the turns of a roller bandage; and, after these splints have been applied for two weeks, and all swelling has subsided at the seat of fracture, a plaster-of-Paris bandage may be substituted for them, which should be worn for three weeks; at the expiration of this time union is usually firm enough to dispense with all dressings.

Fractures of the Fibula.

In fractures of the fibula, with the exception of that fracture occurring at the lower end of the bone, the deformity is not marked, and they are usually dressed with a fracture-box applied as in the dressing of fractures of both bones of the leg, and at the end of two weeks a plaster-of-Paris dressing should be applied, and the patient may be allowed to get out of bed and move about on crutches. The union in a fracture of the fibula is usually quite firm at the end of five weeks, and all dressings may be dispensed with at that time.

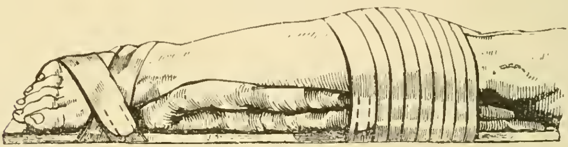
Fracture of the Lower End of the Fibula.

This fracture usually occurs in the lower fifth of the bone and is often associated with a laceration of the internal lateral ligament of the ankle-joint or a sprain fracture of the internal malleolus and is usually accompanied by marked eversion of the foot. This fracture is commonly known as *Pott's fracture.*

In this fracture after reducing the displacement by extension and manipulation, the limb should be placed in a fracture-box provided with a soft pillow, the foot should be secured to the footboard and a pad of oakum or cotton should be placed under the tendo Achillis; before bringing up the sides of the box and securing them two firm compresses of lint or oakum should be placed in contact with the leg, one just above the inner malleolus, the other just below the outer malleolus. The sides of the box are next brought up and secured, and by the pressure of these compresses the foot is brought into an inverted position and the deformity is corrected.

The after-dressing of this fracture consists in letting down the sides of the box, and in inspecting the parts to see that the foot is kept in the proper position, and care should be taken to see that undue pressure is not made upon the skin by the compresses, which might result in ulceration; this may be avoided by sponging the skin with alcohol and changing the positions of the compresses slightly at each dressing. At the expiration of ten days the fracture-box and compresses may be removed and the limb may be put up in a plaster-of-Paris dressing including the foot and leg up to the knee. The patient may then be allowed to go about on crutches and at the end of five weeks all dressings may be dispensed with. A certain amount of stiffness and even permanent impairment in the motion of the ankle-joint often results from these fractures. This fracture is also dressed by means of *Dupuytren's splint*, which consists of a straight wooden splint long enough to extend from the condyles of the femur to end of the toes; this splint is provided with padding the thickest part of which, several inches in thickness, should rest upon the skin just above the inner malleolus when the splint is applied to the inner side of the leg. The splint is applied to the inner surface of the leg with the thickest part of the pad resting upon the skin just above the inner malleolus, and is secured in position by the turns of a roller applied over the foot and at the upper part of the leg. After using this dressing for a few days if the displacement is satisfactorily corrected the splint may be removed and the leg may be placed in a fracture-box or in a plaster-of-Paris dressing. (Fig. 270.)

Fig. 270.



Dupuytren's splint applied.

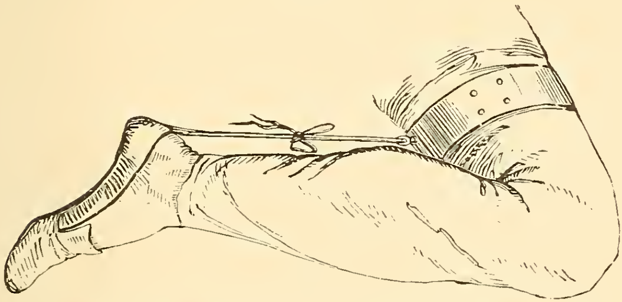
This splint, when applied with sufficient firmness to correct the displacement, is not, as a rule, a comfortable dressing to the patient, so that in practice the use of the fracture-box and compresses will be found a more comfortable dressing and one equally satisfactory in correcting the deformity.

Fracture of the Bones of the Foot.

Fractures of the Tarsal Bones.

The *calcaneum* and *astragalus* are the tarsal bones most frequently fractured. The dressing of fractures of the *calcaneum* after reducing the displacement, which is not usually marked unless the posterior portion of the bone is involved, by manipulation, consists in placing the leg and foot in a fracture box, and care should be taken to see that the foot is kept at a right angle to the leg. When the fracture involves the posterior portion of the bone and there is displacement by the action of the muscles inserted into the fragment, the leg should be flexed upon the thigh and the foot should be extended; this position may be maintained by applying a well-padded curved splint to the anterior portion of the leg and foot and securing it in position by a bandage, or the same result may be obtained by applying a band or padded collar around the thigh, which is made fast by a cord or strap to the heel of a slipper applied to the foot. (Fig. 271.)

Fig. 271.



Apparatus for fracture of posterior portion of the calcaneum. (Hamilton.)

Fractures of the *astragalus*, after reducing any deformity which is present by extension and manipulation, are dressed by placing the foot and leg in a fracture-box, care being taken to see that the foot is kept at a right angle to the leg. This precaution is important, as ankylosis not infrequently occurs after this fracture, and if the foot is in the proper position it is much more useful to the patient.

As soon as the swelling, which is usually very marked after fracture of the calcaneum or astragalus, subsides, the foot and leg should be put up in a plaster-of-Paris bandage. The amount of tension and the inability to reduce the displacement in cases of fracture of the astragalus may be indications for excision of the fractured bone. The time required for union in fractures of the tarsal bones is from five to six weeks.

Fractures of the Metatarsal Bones.

These fractures are dressed by placing the foot upon a well-padded plantar splint, and using compresses to hold the fragments in place if there is much displacement, the splint and compresses being held in position by a bandage; or they may be treated by placing the foot and leg in a fracture-box, the foot-board of the box acting as a plantar splint; the plaster-of-Paris dressing may also be used in these cases. The time required for union in fractures of the metatarsal bones is from three to four weeks.

Fractures of the Phalanges of the Toes.

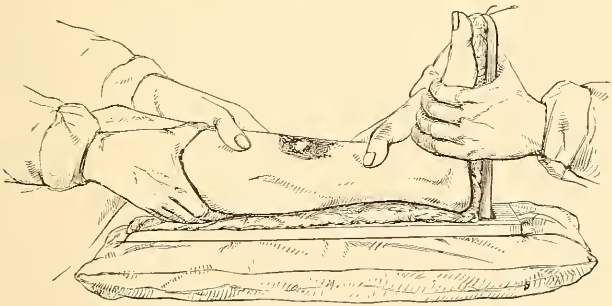
These fractures are often compound and attended with so much laceration of the soft parts that immediate amputation is required; when, however, the fractures are simple, or in compound fractures where amputation is not required, the dressing consists in applying a plantar splint of wood or binder's board, extending beyond the toes and securing it in position by the turns of a roller bandage. When a single toe only is broken a moulded splint of gutta-percha or binder's board may be applied and a portion of the splint should extend some distance upon the sole of the foot to fix the proximal joint and also to give it a firm point of fixation; the moulded splint should be held in position by a narrow roller bandage or by strips of adhesive plaster. The time required for union in fractures of the phalanges of the toes is about three weeks.

Dressing of Compound or Open Fractures.

In the dressing of compound or open fractures the same dressings and splints which are generally used in the treatment of simple or closed fractures may be employed; the wound in the soft parts requires a special dressing and this should be so arranged as to secure free drainage and promote its prompt healing. In some cases of compound fracture the treatment of the injures of the soft parts demands attention first, and in such cases the injury to the bones is for a time disregarded, care being taken to see that the fragments are kept quiet so as to prevent further damage to the soft parts until the wound is in such a condition that the proper manipulation to reduce the displacement and fix the fragments by splints and suitable dressings can be undertaken without interfering with the repair of the wound.

In the dressing of compound or open fractures the skin surrounding the wound should be first carefully cleansed and the wound should next be thoroughly irrigated with a 1 : 2000 bichloride solution or a 1 : 40 carbolic solution and any foreign bodies or loose fragments of bone should be removed, and if there is hemorrhage it should be controlled by securing the bleeding vessels with ligatures. The reduction of the displacement should next be accomplished by making extension and by manipulation (Fig. 272); if the

FIG. 272.



Method of reducing a compound fracture. (HAMILTON.)

fragments project from the wound, before this can be satisfactorily accomplished it may be necessary to enlarge the wound, and to resect one or both ends of the fractured bones, and in some cases it may be necessary to drill the ends of the fragments and introduce a strong wire or catgut suture to hold them in their proper positions. After reduction of the displacement the wound should again be thoroughly irrigated with the antiseptic solution, and after making provision for drainage by the introduction of a drainage-tube or tubes, counter-openings being made to secure free drainage if necessary, the dressings should be applied.

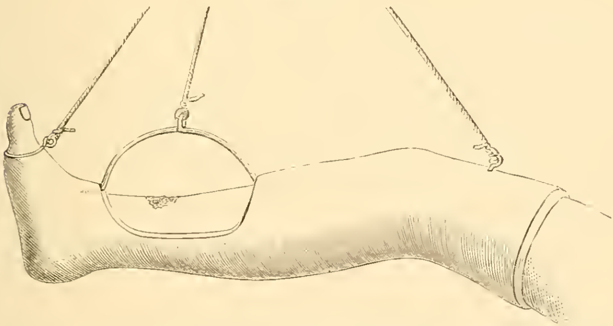
The wound, if a small one, need not be closed with sutures; but, if extensive, a few catgut, silk, or silkworm-gut sutures may be applied to bring the edges of the wound into apposition, care being taken to avoid making undue tension; if the soft parts have been much lacerated or contused, it is better to introduce no sutures. A final irrigation of the wound through the drainage-tube is next made, and the wound is covered by a piece of protective, and the ordinary gauze dressing should be applied and covered by a number of layers of bichloride cotton, the whole dressing being held in position by a gauze bandage applied with moderate firmness.

The reduction of the fragments and the dressing of the wound having been accomplished as has been described, the splints and dressings appropriate for a similar fracture, if it were a simple or closed one, are next applied. If the surgeon has been able to render the wound aseptic, and has applied an antiseptic dressing, the compound fracture is often soon converted into a simple one, by the prompt healing of the wound, and the patient may exhibit no more constitutional disturbance than he would have with a similar simple or closed fracture. The re-dressing of a compound fracture dressed in this way need not be made for a week or ten days, unless there is a rise in the patient's temperature or the dressings become soaked with discharges from the wound, or they become uncomfortable to the patient by reason of swelling of the soft parts in the region of the wound. When the re-dressing of the fracture becomes necessary, the dressings are removed, and the drainage-tubes may be removed if no longer needed; the wound being re-dressed with an antiseptic dressing, the splints are reapplied, and, after the wound is healed, the subsequent dressing of the fracture should be the same as that of a simple fracture. The time required for union in a compound fracture is usually much longer than in a corresponding simple fracture.

Many ingenious splints have been devised for the dressing of special compound fractures, but these were principally used before the introduction of the antiseptic method of wound-treatment, and as the treatment of these cases has been much simplified by its use, they possess no special advantage over the ordinary splints and dressings used in simple fractures.

The plaster-of-Paris dressing may be used as a primary dressing in compound fractures; the displacement being reduced and the wound being dressed with an antiseptic

Fig. 273.



Fenestrated plaster dressing for compound fracture of the leg. (Stimson.)

gauze dressing, a plaster-of-Paris bandage is applied to the part so as to firmly fix the fragments; the joints on either side of the fracture should be fixed by the bandage, and the parts should be held in position until the plaster has set firmly. After the plaster has become firm, a fenestrum should be made over the position of the wound, so that it can be inspected or dressed through this when necessary. The ends of a piece of stout wire, bent into a semicircle, may be incorporated in the turns of the plaster bandage above and below the position of the fenestrum, to give it additional strength after the removal of a portion of the bandage to make the fenestrum. (Fig. 273).

If the plaster-of-Paris dressing is applied as a primary dressing in compound fractures the case should be carefully watched for a few days, and if much swelling occurs at the seat of fracture its removal and renewal is indicated; profuse discharge of serum may also soak the dressings and bandage so that its renewal is necessitated. Some surgeons, therefore, prefer to defer the application of the plaster-of-Paris dressing in compound fractures for a few weeks until the swelling has diminished and the wound is nearly or quite healed; the wound being covered with an antiseptic dressing the plaster bandage is applied and a fenestrum is made over the position of the wound if required.

Binder's-board or felt splints may also be employed in the dressing of compound fractures, being moulded to the parts after an antiseptic dressing has been applied to the wound, and held in position by the turns of a roller bandage.

The principal advantage in the use of these splints is the ease with which they can be removed and reapplied if frequent dressings of the fracture are necessary for any reason. They may be used during the course of treatment, or, after a few weeks when the swelling has diminished at the seat of fracture and the wound is well advanced toward repair, they may be discarded and a plaster-of-Paris dressing substituted. In compound fractures of the bones of the leg, after reducing the displacement and applying an antiseptic dressing to the wound, I usually apply moulded binder's board splints to either side of the leg, including the foot, and place the leg in a fracture-box for additional security, and after a few weeks I discard the binder's-board splints and apply a plaster-of-Paris dressing.

The *bran dressing* for compound fractures was formerly a popular dressing in this city, especially for compound fractures of the leg and thigh. It was applied by placing a piece of muslin or rubber cloth over the bottom and sides of a fracture-box and upon this was placed a layer of bran; the fractured leg was next placed in the box upon the layer of bran, the foot was then fastened to the footboard and the sides of the box were brought up and secured; bran was next poured into the box and firmly packed around and over the limb. The bran absorbed the discharges which escaped from the wound and at the subsequent dressings the soiled bran was renewed without disturbing the limb and fresh bran was packed about the limb.

Sawdust which has been saturated with a solution of bichloride of mercury and dried may be used in the same manner as bran in the dressing of compound fractures and the former, which has been rendered antiseptic, has decided advantages over the bran dressing.

Continuous irrigation of compound fractures by a warm antiseptic solution either of bichloride of mercury 1 : 4000 or of carbolic acid 1 : 60 in cases in which so much contusion or laceration of the soft parts exists that the application of the ordinary dressings would be attended with the risk of gangrene, will be found a most satisfactory method of treatment. This dressing is applied by supporting the injured extremity upon a splint laid on a pillow covered by a rubber cloth, and a can or jar with a nozzle containing the solution is placed over the part and the irrigation is accomplished by allowing the fluid to run continuously over the wound; this irrigation may be kept up for days or weeks and when the vitality of the parts is assured, an antiseptic dressing with the ordinary splints or a plaster-of-Paris bandage may be applied.

PART IV.

DISLOCATIONS.

A DISLOCATION is the displacement of the articular surfaces of bones which enter into the formation of a joint.

Dislocations may be *complete*, *partial*, *simple*, *compound*, and *complicated*, and they are also known as *recent* and *old* dislocations, the latter terms being used not entirely with reference to the length of time the displacement of the articular surfaces of the bones has existed.

A complete dislocation is one in which no portions of the articular surfaces of the bones remain in contact with each other.

A partial dislocation is one in which portions of the articular surfaces of the bones still remain in contact with each other.

A simple dislocation is one in which there exists displacement in the relation of the articular surfaces of the bones with little injury to the soft parts adjacent to the joint, and the displaced ends of the bones do not communicate with the air by a wound in the soft parts.

A compound dislocation is one in which there exists displacement of the articular surfaces of the bones which communicates with the air through a wound in the soft parts.

A complicated dislocation is one in which in addition to the displacement of the articular surfaces of the bones, there exists a fracture, or a laceration of important bloodvessels, nerves, or muscles in proximity to the dislocation.

A recent dislocation is one in which the displacement of the articulating surfaces of the bones has existed for such a period, that time has not been afforded for inflammatory changes to have taken place in the articular surfaces of the bones or in the adjacent tissues, which would seriously interfere with their reduction.

An old dislocation is one in which the displacement of the articulating surfaces of the bones has existed for some time, and in this variety of dislocation the displaced bones often form firm adhesions to the surrounding tissues.

Treatment of Dislocations.

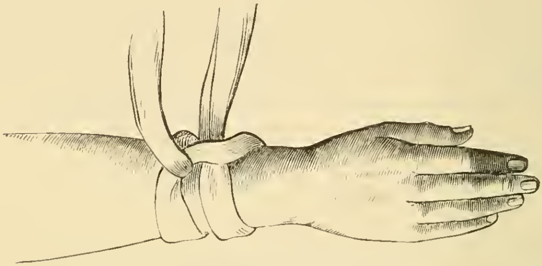
The first indication in the treatment of dislocations is to return the displaced articular surfaces of the bones to their normal position and to retain them in this position by the use of suitable dressings The return of the articular surfaces of the bones to their normal position or *the reduction* of the dislocation, is accomplished by manipulation, extension, and counter-extension. The reduction of dislocations should be attempted as soon as possible after they have occurred.

The principal obstacles to the reduction.of dislocations are muscular resistance and the anatomical peculiarities of the joints. The former is best overcome by the use of an anæsthetic given to the point where complete muscular relaxation is produced. The resistance offered by the changed relations of the articular surfaces and the ligaments is to be overcome by the surgeon making such manipulations, founded upon his knowledge of the anatomy of the parts, as will make the ligaments, muscles, and bones assist in the reduction of the dislocation.

In recent dislocations by the use of extension and manipulation, especially if an anæsthetic be employed, the reduction is usually accomplished without the use of much force, but in old dislocations, where absolute muscular shortening has taken place, the use of extending bands is often required, and in securing these bands to the limb the clove-hitch knot is useful. (Fig. 274.)

The treatment of dislocations after reduction consists in placing the joint at complete rest by the application of suitable splints and bandages, and in treating any inflammatory complications if they arise, by the application of

Fig. 274.



Clove-hitch knot applied. (Erichsen.)

evaporating lotions, and in a week or two after the injured ligaments have been repaired, passive motion should be resorted to for restoring the function of the joint.

Special Dislocations.

Dislocations of the Vertebræ.

Dislocations of the *lumbar* and *dorsal vertebræ*, as simple dislocations, are extremely rare accidents; they are occasionally met with, but are more often associated with fractures of the vertebræ in these regions; their occurrence in the cervical vertebræ is more common. The treatment of dislocations of the vertebræ, whether complicated with fracture or not, consists in attempting reduction by making extension and counter-extension with manipulation, and by this means in many cases the luxations can be reduced. If, however, the efforts at reduction are unsuccessful, permanent extension should be applied by means of a weight-extension apparatus from both legs, and from the shoulders and head. The after-treatment consists in keeping the patient at rest upon his back in bed upon a firm mattress, and if the cervical vertebræ have been involved the head and neck should be supported by short sand-bags, and in case of the vertebræ below this point, the application of a plaster-of-Paris jacket may be used to give support and fixation to the parts. The general management of the case as regards complications is similar to that in cases of fracture of the vertebræ.

Dislocations of the coccyx are reduced by manipulation with the finger in the rectum and external manipulation at the same time. The only after-treatment required is rest in bed for a few days, and the administration of opium to keep the bowels quiet.

Dislocation of the Jaw.

This dislocation may consist in the displacement of one or both condyles of the jaw from the glenoid fossæ, consti-

Fig. 275.

Bilateral dislocation of the jaw. (Ashhurst.)

tuting the unilateral or bilateral dislocation of the jaw; the latter is the more common form of dislocation of the jaw met with, and the deformity resulting is shown in Fig. 275.

The reduction of a dislocation of the lower jaw is accomplished as follows: The surgeon placing his thumbs, well protected by strips of bandage or a towel, on the molar teeth or behind them presses the angles of the jaw downward while he elevates the chin with his fingers, and by this manipula-

FIG. 276.

Method of reducing dislocation of the lower jaw. (HAMILTON.)

tion the condyles of the jaw usually slip back into place with a snap. After reduction of the dislocation the jaw should be fixed for a week or ten days by the application of a Barton's bandage or a four-tailed sling.

Dislocation of the Hyoid Bone.

A few cases of dislocations of the *hyoid* bone have been recorded; the treatment consists in throwing back the head as far as possible, to place the muscles of the neck upon the stretch, depressing the lower jaw and pressing the luxated bone into position.

DISLOCATIONS OF THE RIBS.

The *ribs* may be dislocated at their vertebral articulations, or at the junction with their costal cartilages. The treatment of these dislocations consists in reducing the displacements by manipulation and pressure and then in fixing the chest to secure immobility of the ribs by strapping the affected side with strips of adhesive plaster, the same dressing being applied as in case of fracture of the ribs, the dressings being retained for three or four weeks.

Dislocation of the Sternum.

Dislocation or diastasis of the *sternum* may occur at the junction of the manubrium and gladiolus or at the junction of the ensiform cartilage and gladiolus. The reduction is effected by extension of the chest by bending the dorsal spine over a firm cushion placed under the back and by pressure upon the projecting bone; when the displaced bone has been reduced, a compress should be placed over the seat of injury and held in place by broad strips of adhesive plaster or by a bandage to keep the parts at rest. The dressing should be retained for three or four weeks.

In the few examples of dislocations of the ensiform cartilage which have been reported, the displacement of the cartilage has in some cases given rise to persistent vomiting, which was relieved by reduction of the displacement; it is, however, almost impossible to keep the fragment in place after reduction, and the vomiting gradually disappears after a time in these cases where it was impossible to keep the cartilage in its normal position.

Dislocations of the Pelvis.

Dislocations or diastasis of the bones of the *pelvis* may occur at the pubic or sacro-iliac symphyses.

These are generally serious injuries, as they are apt to be complicated by lesions of the pelvic viscera.

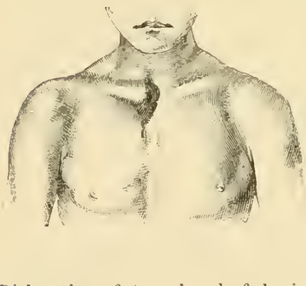
The reduction of these dislocations is effected by pressure and manipulation, and after reduction the parts should be supported by a compress held in place by a stout binder or by broad strips of adhesive plaster, the patient being kept quiet in bed, and the pelvis being supported by means of sand-bags. The dressings should be retained for from four to six weeks.

Dislocations of the Clavicle.

Dislocations of the clavicle may occur either at the sternal or acromial end, and the latter injury some writers describe as a dislocation of the scapula, following the general rule that the distal bone is the one dislocated.

Dislocations of the sternal end of the clavicle may occur in a forward, backward, or upward direction, and the displacement is generally well marked. (Fig. 277.) The reduction of this dislocation is effected by placing the knee against the spine and drawing the shoulders outward and backward and pressing the displaced end of the clavicle

Fig. 277.



Dislocation of sternal end of clavicle forward. (Bryant.)

Fig. 278.

Dislocation of clavicle at acromial end. (Bryant.)

into place. The reduction is generally easy, but it is often difficult to keep the end of the bone in its proper position. To accomplish this, a compress should be placed over the end of the bone, and this should be secured in place by broad strips of adhesive plaster; the shoulders should be brought well backward and secured by a posterior figure-of-eight bandage of the chest, and the arm of the injured side should be fastened to the side of the chest by spiral turns of a bandage. In some cases, in addition to the compress over the end of the bone, securing the arm of the injured side in the Velpeau position will be found all that is necessary to retain the bone in position.

Dislocation of the acromial end of the clavicle may be upward, downward, or backward. (Fig. 278.) The reduction is effected by manipulation of the arm and scapula and by pressure over the displaced end of the clavicle; the displacement is usually reduced without much trouble, but it is often a matter of difficulty to keep the end of the bone in its proper place.

The dressing consists in placing a compress over the acromial end of the clavicle and holding it in place by broad strips of adhesive plaster; the arm should at the same time be fixed in the Velpeau position. These dressings after reduction of dislocations of the clavicle should be kept in place for at least three weeks. Although in many cases a certain amount of deformity persists, the disability resulting from the injury is not often marked.

Dislocations of the Scapula.

Dislocation of the acromion processes of the scapula from the outer end of the clavicle, which has been described under dislocation of the acromial end of the clavicle, is classed by some writers as a scapular dislocation.

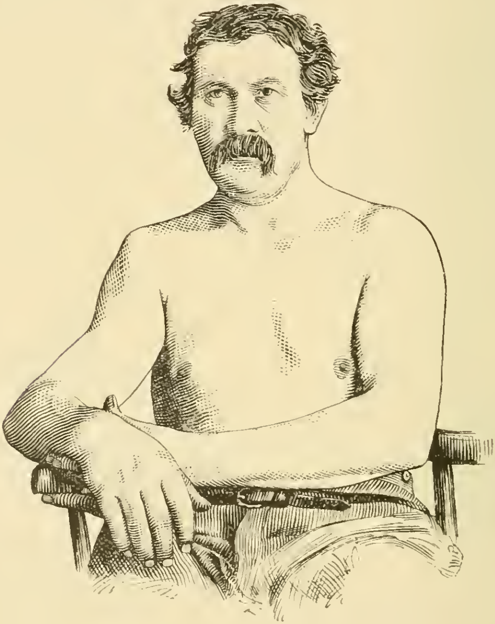
Dislocation or projection of the inferior angle of the scapula, due to its escape from under the latissimus dorsi muscle or relaxation of this muscle and of the serratus magnus, is sometimes described as a dislocation of the inferior angle of the scapula. The reduction of this deformity consists in the employment of manipulation and pressure to overcome the displacement, and the use of a compress held in place by broad strips of adhesive plaster to secure the bone in its proper position.

Dislocations of the Shoulder.

The head of the humerus may be dislocated downward, forward, or backward.

Subglenoid or downward dislocation of the head of the humerus is that variety of dislocation in which the head of the bone rests in the axilla. (Fig. 279.)

Fig. 279.

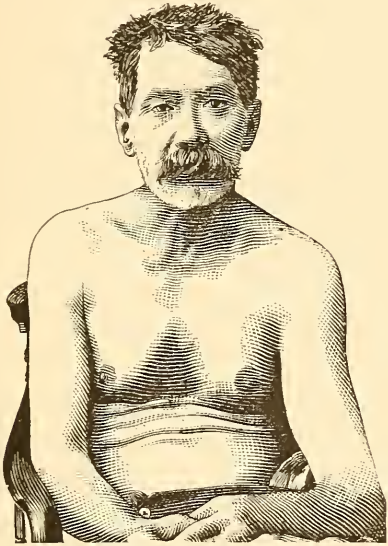


Subglenoid dislocation of the shoulder. (Stimson.)

Subcoracoid or forward dislocation of the head of the humerus is that variety of dislocation in which the head of the humerus rests beneath the coracoid process of the scapula. (Fig. 280.)

Subclavicular dislocation of the head of the humerus may be considered an aggravated form of the latter variety of dislocation; the head of the humerus in this variety of dislocation rests beneath the clavicle.

FIG. 280.



Subcoracoid dislocation of the shoulder. (STIMSON.)

Subspinous or backward dislocation of the head of the humerus is that variety of dislocation in which the head of the humerus rests beneath the spine of the scapula. (Fig. 281.)

The reduction of dislocations of the humerus is effected by manipulation, by extension and counter-extension, and by a combination of these methods.

Manipulation in the reduction of *subglenoid dislocation* of the humerus is practised by first flexing the forearm upon the arm to relax the long head of the biceps muscle; the elbow is next seized and abducted so as to bring it to the side of the patient's head, thus relaxing the deltoid and supra-spinous muscles; the surgeon or an assistant next places his hand upon the head of the humerus in the axilla, and, as the arm is drawn outward to a right angle with the

FIG. 281.

Subspinous dislocation of the head of the humerus. (ERICHSEN.)

body by the other hand, he pushes the head of the bone into the glenoid cavity.

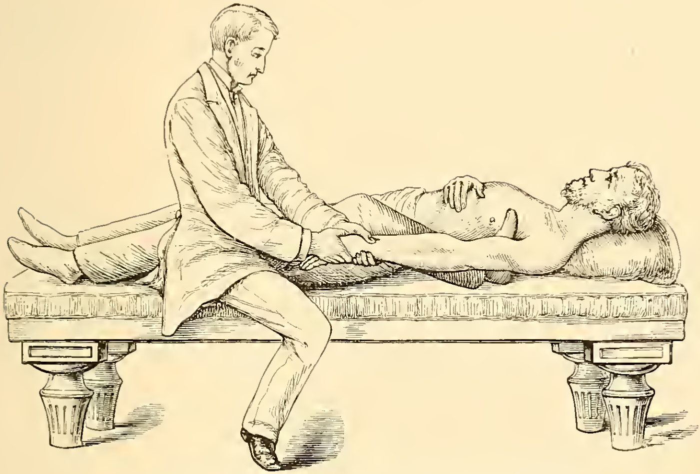
In the reduction of *subglenoid* and *subclavicular* dislocations the manipulation is the same except that the arm is to be rotated outward before being carried downward.

In the reduction of *subspinous* dislocations after the arm has been abducted it should be rotated inward and direct pressure should be made upon the head of the bone as the arm is adducted. Reduction may also be effected by extension and counter-extension as in Cooper's method, where extension is made from the arm downward and counter-extension is made by the heel in the axilla. (Fig. 282.)

Reduction may also be accomplished by extension made upward, as in Mothe's method, the scapula being fixed by the foot or hand placed over the acromion process. (Fig. 283.)

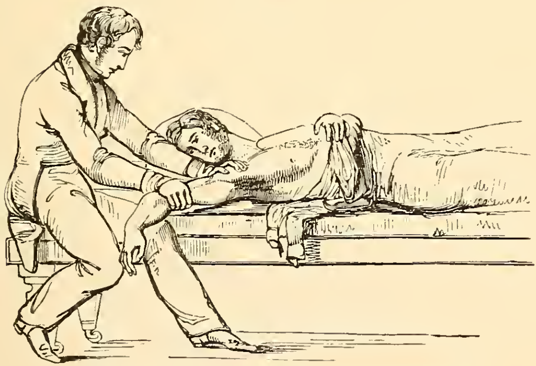
After reduction of dislocations of the head of the humerus the arm should be bound to the side of the body by the

FIG. 282.



Reduction of shoulder by heel in the axilla. (ERICHSEN.)

FIG. 283.



Reduction of shoulder by extension upward.

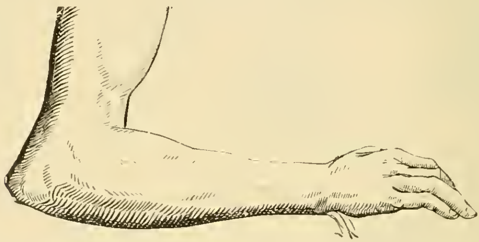
turns of a spiral bandage of the chest, or should be held against the side by the application of a Velpeau bandage (Fig. 46, p. 55); this dressing should be removed at intervals of a few days, and after ten days or two weeks all dressings should be dispensed with, passive motion should be employed and the patient should be allowed to move the arm.

Dislocations of the Elbow.

Dislocation of the Bones of the Forearm.

Dislocations of the bones of the forearm at the elbow may either be backward, forward, or lateral. The backward dislocation is the most common form. (Fig. 284.)

Fig. 284.



Dislocation of both bones of the forearm backward. (Liston.)

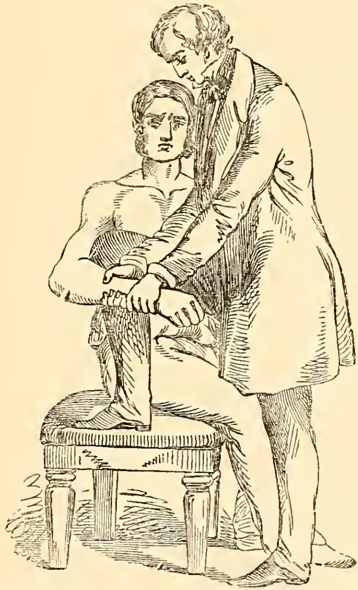
The reduction of *backward dislocations* is effected by making traction upon the forearm and at the same time making pressure upon the lower end of the humerus as the forearm is flexed upon the arm.

Or the reduction may be accomplished by bending the arm slowly and forcibly over the knee placed upon the inner surface of the elbow so as to press upon the radius and ulna, separating them from the humerus and freeing the coronoid process from its abnormal position. (Fig. 285.)

Lateral dislocations of the bones of the forearm at the elbow are reduced by making extension from the forearm, and at the same time making direct pressure on the displaced bones and counter-pressure on the lower end of the humerus.

Forward dislocations of the bones of the forearm at the elbow are reduced by making forced flexion at the elbow, together with extension or counter-extension, or by making

Fig. 285.



Reduction with the knee in the bend of the elbow. (Hamilton.)

Fig. 286.

Dressing after reduction of dislocations of the elbow.

forced extension of the forearm at the elbow, pressing the humerus backward and suddenly flexing the forearm.

The dressing, after the reduction of dislocations at the elbow, consists in the application of a well-padded anterior

FIG. 287.

Dislocation of head of the radius forward. (LISTON.)

right- or slightly obtuse-angled splint, to keep the forearm in a flexed position—the dressing being practically the same as that for fractures of the lower end of the humerus, with an anterior angular splint (Fig. 286). This dressing should be retained for two or three weeks, being removed at intervals of several days; after the removal of the splint, passive motion should be practised, to prevent stiffness of the elbow-joint.

Dislocation of the Head of the Radius.

The head of the radius may be displaced forward, outward, or backward, the forward dislocation being the most frequent. (Fig. 287.) The reduction of these dislocations is effected by making extension from the forearm and counter-extension from the lower end of the humerus, and at the same time the head of the bone is pressed into its proper position. The dressing after reduction of the displacement consists in the application of a compress over the head of the bone, and the arm and forearm should be placed upon a well-padded anterior angular splint, which is secured by a roller bandage. The dressing is similar to that employed in fractures of the lower end of the humerus, in which an anterior angular splint is employed (Fig. 242, page 325). Difficulty is sometimes experienced in keeping the head of the bone in position after reduction, so that the use of the compress in addition to the use of the splint is often required. The arm should be kept upon the splint for three weeks, being redressed at intervals.

Dislocation of the Upper End of the Ulna.

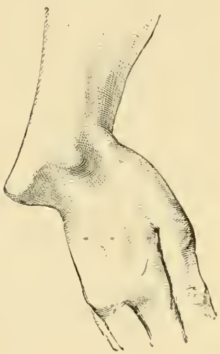
The upper end of the ulna may be displaced backward, the olecranon projecting behind the condyles of the humerus, while the head of the radius occupies its normal position. The reduction of this displacement is effected in the same manner as that of both bones of the forearm backward, and the dressing after reduction is similar to that employed when both bones have been displaced.

Dislocations at the Wrist.

The lower end of the ulna may be dislocated from the radius forward, backward, or inward. The reduction of these displacements is effected by fixing the radius and pushing the ulna back into place. The dressing after reduction consists in placing the wrist-joint at rest by the application of well-padded anterior and posterior straight splints. The splints should be retained for three or four weeks, dressings being made at intervals of two or three days.

Dislocations of the carpus upon the bones of the forearm may be forward (Fig. 288), or backward (Fig. 289). The

Fig. 288.



Dislocation of the carpus forward. (Hamilton.)

Fig. 289.

Dislocation of the carpus backward. (Hamilton.)

reduction in either variety of displacement is effected by extension from the hand and by pressure. After reduction of the displacement, which does not tend to recur, the hand and forearm should be placed upon a well-padded straight splint applied to the palmar surface of the hand and forearm. The splint should be retained for ten days or two weeks.

Dislocations of the Bones of the Carpus.

The displacement of the individual bones of the carpus occasionally takes place, the *os magnum*, the *semilunare* and *pisiform* being the bones most usually displaced, although other bones of the carpus are sometimes dislocated. Reduction is effected by means of extension and pressure, and the part should afterward be dressed with a palmar splint and compresses.

Dislocations of the Metacarpal Bones.

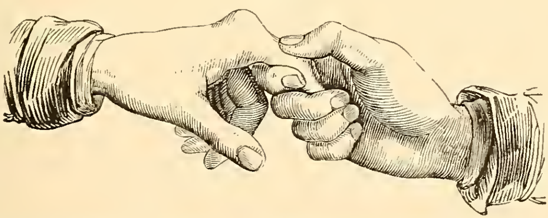
The metacarpal bones may be dislocated upon the carpus; the bones most commonly displaced are those of the thumb, and of the index and middle fingers; the latter are usually displaced backward, while the metacarpal bone of the thumb may go either backward or forward.

Reduction is effected by extension and pressure. The dressing after reduction consists in the application of a palmar splint to the hand and forearm and a compress over the displaced bone. The dressings should be retained for two weeks.

Dislocations of the Fingers.

Dislocations of the phalanges of the hand usually take place at the metacarpo-phalangeal junction, but sometimes occur at the intra-phalangeal joints. The reduction is usually easily effected by extension (Fig. 290), or by push-

Fig. 290.

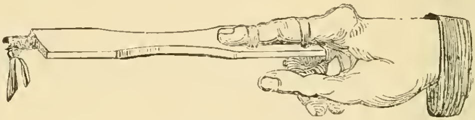


Backward dislocation of phalanx. Reduction by extension. (Hamilton.)

ing the phalanx back until it stands perpendicularly upon the metacarpal bone, when by strong pressure upon its base, from behind forward, it is readily carried by flexion into its natural position.

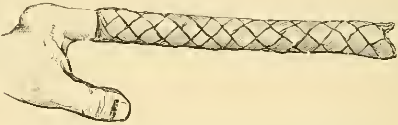
Where difficulty is experienced in making extension in the reduction of these dislocations, the ingenious apparatus of the late Dr. Levis (Fig. 291), or the "Indian puzzle" apparatus (Fig. 292) may be employed with success.

FIG. 291.



Levis's apparatus for dislocation of the phalanges applied.

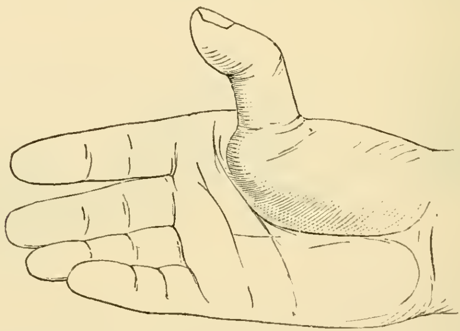
FIG. 292.



Extension by Indian puzzle. (BRYANT.)

In *dislocations of the proximal phalanx of the thumb backward* (Fig. 293), great difficulty in reduction is often

FIG. 293.

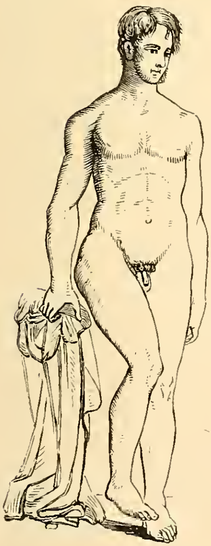


Dislocation of proximal phalanx of thumb backward. (FARABEUF.)

experienced from the head of the metacarpal bone slipping between the two heads of the short flexor muscle, or between the lateral ligaments. The interposition of the external sesamoid bone is considered by some surgeons to be the cause of difficulty in the reduction of this displacement.

In this dislocation reduction is effected by firmly pressing the metacarpal bone of the thumb strongly toward the palm of the hand to relax the two portions of the short flexor muscle. The thumb is next extended upon the wrist until its tip points to the elbow. An assistant now places his finger behind the proximal phalanx to prevent its slipping backward and by bringing the thumb down to the flexed position the bone slips into place. It sometimes happens that all efforts at reduction fail, and in such cases

Fig. 294.



Backward and upward dislocation of femur. (Cooper.)

Fig. 295.

Backward dislocation of femur. (Cooper.)

it may be necessary to divide one head of the short flexor muscle subcutaneously or through an open wound, before the displacement can be relieved.

The dressing of dislocations of the phalanges after reduction consists in the application of splints of wood, or moulded splints of binder's board or gutta-percha to fix the joint, which should be retained for ten days or two weeks.

Dislocations of the Hip.

The head of the femur is most frequently dislocated backward, downward or upward, although it may assume other positions in exceptional cases.

Posterior or *backward dislocations of the head of the femur* are either backward and upward, and are described as *iliac* or *dorsal*, the bone resting upon the dorsum of the ilium (Fig. 294). Or the dislocation may be backward, the head of the bone resting upon the ichiatic notch; these are known as *ischiatic* dislocations or dislocations of the femur *dorsal below the tendon* (of the obturator internus), according to Bigelow (Fig. 295).

Fig. 296.

Reduction of backward dislocation of femur. (Bigelow.)

The reduction of the posterior dislocations of the femur can generally be effected by manipulation. The patient being anæsthetized and placed upon his back, the surgeon grasps the leg at the ankle and knee, flexes the leg upon the thigh, and the thigh upon the pelvis; he then abducts the limb and rotates it outward, bringing it in a broad sweep across the abdomen, and by bringing it down to its natural position the head of the bone will slip into the acetabulum (Fig. 296).

Downward Dislocation of the Head of the Femur, or Downward and Forward Dislocation.—In this variety of dislocation the head of the bone rests upon the thyroid foramen; this form of displacement is sometimes spoken of as a *thyroid* dislocation. (Fig. 297.)

The reduction of downward and forward dislocations of the head of the femur is effected by flexing the leg and thigh and bringing the limb into a position of abduction; it is then adducted and rotated inward in a broad sweep across the abdomen and brought down to its natural position, and the head of the bone slips into the acetabulum. (Fig. 298.)

FIG. 297.

Downward and forward dislocation of femur. (COOPER.)

FIG. 298.

Reduction of downward and for ward dislocation of he femur (BIGELOW.)

In making these manipulations the head of the bone sometimes slips back upon the dorsum of the ilium, converting the downward dislocation into a posterior one if this accident occurs the displacement should be remedied by making the manipulation appropriate for the reduction of the latter dislocation.

Upward Dislocation, or the Dislocation Forward and Upward, of the Head of the Femur.—In this variety of dislocation the head of the bone rests upon the pubis; this form of displacement is also spoken of as a pubic dislocation. (Fig. 299.)

Fig. 299.

Forward and upward dislocation of the femur. (Cooper.)

The reduction of forward and upward dislocations of the head of the femur is effected by much the same manipulation as is employed in the reduction of downward and forward dislocations, except that in the pubic dislocation the flexed limb should be carried across the sound thigh at a higher point. The thigh being flexed the head of the bone is drawn down from the pubis; it is then semi-abducted and rotated inward to disengage the bone completely. While rotating inward and drawing on the thigh the knee should be carried inward and downward to its place by the side of its fellow, and the head of the bone will usually slip into the acetabulum.

As before stated various *anomalous displacements of the head of the femur* occasionally occur; the head of the bone may pass directly upward, or downward between the sciatic notch and thyroid foramen, or downward and backward on the body of the ischium, or downward and backward into the lesser sciatic notch, or downward, inward, and forward into the perineum. These anomalous displacements usually occur where there has been extensive laceration of the capsular and Y-ligaments.

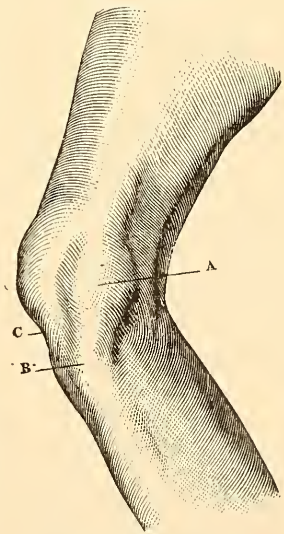
The dressing of cases, after reduction of dislocations of the head of the femur, consists in keeping the patient at rest in bed upon his back, and the limb should be kept at rest by sand-bags applied to either side of the limb, or the knees should be tied together.

The patient should be kept at rest for two or three weeks, and at the end of this time may be allowed to get out of bed and go about on crutches.

Dislocations of the Patella.

The patella may be dislocated *outward*, *inward*, or *upward*, or it may be rotated upon its own axis. The *outward* dislocation is the displacement most usually seen. (Fig. 300.)

Fig. 300.



Outward dislocation of the patella. (Duplay.)

Upward dislocation of the patella can only result from laceration of the ligamentum patellæ, and the treatment in such cases is similar to that for fracture of the patella.

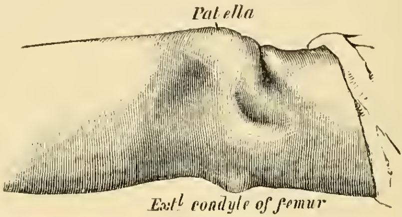
The reduction of dislocations of the patella is effected by extending the leg upon the thigh, and flexing the thigh upon the pelvis to relax the quadriceps femoris muscle, when the patella can usually be forced back into place; in some cases alternate flexion and extension of the leg will accomplish the same result.

The dressing after reduction of the displacement consists in the application of a posterior straight splint or a moulded binder's-board or felt splint to keep the joint at rest; the splint should be worn for a week or ten days.

Dislocations of the Knee.

The head of the tibia may be dislocated *forward, backward*, or *laterally;* the latter dislocations are always incomplete, forward dislocation being the variety of displacement most commonly met with. (Fig. 301.)

Fig. 301.



Forward dislocation of the knee. (Bryant.)

The reduction of dislocations of the knee is effected by extension and counter-extension with forced flexion of the knee with pressure, aided by rocking movements. The treatment of cases of dislocation of the knee after reduction consists in fixing the knee-joint by the application of a straight posterior splint or a moulded splint of binder's board. As there is usually marked swelling following these injuries from violence to the joint-structures, the application of evaporating lotions for a few days will be found useful. As soon as the swelling has subsided the joint should be put up in a plaster-of-Paris dressing and this should be retained for four weeks.

Dislocation of the Semilunar Cartilages.

The displacement here consists in the slipping forward or backward and wedging of the semilunar cartilages between the femoral condyles and the tibia.

Reduction of the displaced cartilages can usually be effected by hyper-flexion of the knee followed by sudden full extension, or by alternately flexing and extending the joint. Excision of the displaced cartilages is sometimes required in cases in which they cannot be reduced by manipulation.

The dressing of these cases after reduction of the displaced cartilages consists in the application of a posterior straight splint or a plaster-of-Paris dressing to fix the knee-joint; the splint should be worn for three or four weeks, and if there is a tendency to redisplacement the patient should wear a knee-cap of leather or muslin to partially fix the joint, with compresses so arranged as to make pressure upon the edge of the joint.

Dislocation of the Fibula.

Dislocations of the fibula may occur at either of its extremities, and the direction of the displacement may be *forward*, *backward*, or *upward*, dislocation of the head or upper extremity of the fibula being the most common, although all are rare forms of displacement.

The reduction of dislocations of the head of the fibula is effected by flexing the leg upon the thigh and making direct pressure and extension. Dislocations of the lower extremity of the fibula are reduced by manipulation and pressure. The dressing of cases after reduction of dislocations of the fibula consists in the application of a compress and moulded binder's board splint, and the dressing should be retained for three or four weeks.

Dislocations of the Ankle.

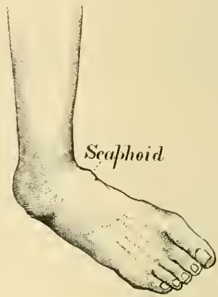
Dislocation of the foot upon the bones of the leg results from the separation of the articular surface of the astragalus from that of the tibia and fibula, and the displacement may be *forward*, *backward* (Fig. 302), or *lateral* (Fig. 303), the latter variety being often associated with fracture of the malleoli.

The reduction of dislocations of the ankle is effected by traction, combined with flexion and rotation of the ankle-joint, the leg being first flexed upon the thigh to relax the tendo Achillis, and in some cases the subcutaneous division of this tendon is required before the reduction can be satisfactorily accomplished.

Fig. 302.

Dislocation of foot backward.
(Bryant.)

Fig. 303.



Dislocation of foot inward.
(Bryant.)

The dressing of dislocations of the ankle after reduction consists in the application of a fracture-box, or of pasteboard splints to fix the ankle, care being taken to see that the foot is fixed at a right angle to the leg, and in the application of evaporating lotions for a few days ; after the swelling has subsided, a plaster-of-Paris dressing should be applied and retained for three or four weeks.

Dislocations of the Tarsal Bones.

The *astragalus* may be dislocated from the bones of the leg and from the other tarsal bones, being thrust *forward*, *backward*, *outward* (Fig. 304), or *inward*. The reduction of dislocations of the *astragalus outward* is effected by first flexing the leg upon the thigh and making extension from the foot and rotating it at the same time, direct pressure being made upon the displaced bone; in some cases subcutaneous section of the tendo Achillis has assisted materially in the reduction of the displaced bone. *Backward dislocation of the astragalus* is usually irreducible, the patient, however, in many cases recovers with a useful foot. In cases of irreducible dislocations of the astragalus, excision of the astragalus may ultimately be required.

Fig. 304.

Dislocation of astragalus outward. (Hamilton.)

After the reduction of dislocations of the astragalus, the foot and leg should be put at rest in a fracture-box, or by means of moulded splints of pasteboard or felt; evaporating lotions should also be employed to the region of the injury for a few days, and when the swelling has subsided, a plaster-of-Paris dressing should be applied and retained for three or four weeks.

Dislocations of the calcaneum and scaphoid upon the astragalus, or of the *calcaneum* upon the *astragalus* and *cuboid*, or upon the *astragalus* alone; of the *scaphoid* and *cuboid* upon the *calcis* and *astragalus;* or of the *cuboid*, *scaphoid*, or *cuneiform* bones, are occasionally met with.

Their reduction is effected by traction and direct pressure, and, after this has been accomplished, the parts should be put at rest by the application of a splint and compresses.

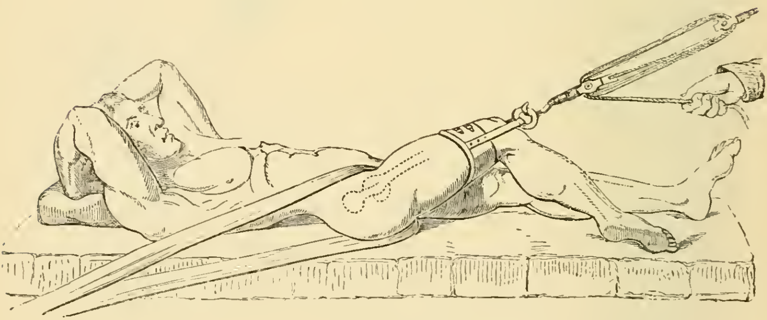
Dislocations of the Metatarsal Bones and Phalanges of the Toes.

These dislocations usually result from crushing forces which destroy the vitality of the soft parts so completely that amputation is required. Their reduction in cases of simple or uncomplicated dislocations is effected by traction, manipulation, and pressure. After reduction of the displacement, the parts should be kept in position by the application of splints and compresses.

Old Dislocations.

The reduction of old dislocations is attended with more difficulty and danger than that of recent dislocations, due to the permanent contraction and structural changes which

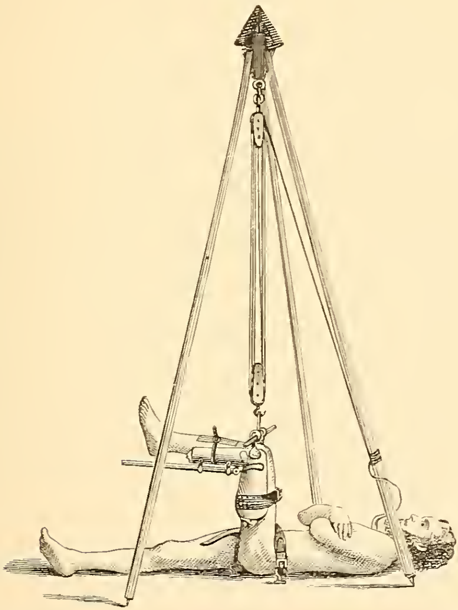
Fig. 305.



Reduction of old dislocation of the femur by pulleys. (Cooper.)

occur in the muscles, and to the abnormal adhesions which form between the displaced bone and the parts with which it is in contact. The reduction of old dislocations can usually be accomplished by the manipulations appropriate for recent dislocations of the same variety, but occasionally the use of more forcible extension is required, which is made by bands and pulleys (Fig. 305), or by vertical extension (Fig. 306). The first step in the reduction of old dislocations consists in thoroughly breaking up the adhesions which have been formed between the displaced bone and the surrounding tissues; this has, in some cases, resulted in the laceration of

FIG. 306.



Reduction of old dislocation of hip by vertical extension. (BIGELOW.)

muscles, nerves, and bloodvessels, and in the fracture of the displaced bones or neighboring bones, so that the manipulations should be made with the least force that will accomplish the object desired. After the reduction of old dislocations, difficulty is sometimes experienced in maintaining the bone in its proper place, due to the changes which have occurred in the articular surfaces.

Compound Dislocations.

These are always grave injuries, and amputation or excision is often required. When, however, operative measures are not required, the reduction is effected in the same manner as in simple dislocations of corresponding parts, the greatest care being taken to render the wound aseptic, and to keep it in this condition by the application of a full antiseptic dressing.

Complicated Dislocations.

In dislocations complicated by fracture near the seat of displacement, the displaced bone should, if possible, be first reduced, and this in many cases is a matter of much difficulty as the fracture prevents the surgeon from using leverage otherwise present, in the reduction, and he has often to depend entirely upon pressure and manipulation to restore the displacement.

After reduction of the dislocation the fracture should be reduced and dressed.

Dislocation complicated by rupture of the main artery of the limb may require, after reduction of the displacement, exposure and ligation of the vessel or amputation of the limb. Rupture of an important nerve trunk complicating a dislocation may call for subsequent exposure and suturing of the divided nerve.

Spontaneous Pathological and Congenital Dislocations.

In the treatment of these varieties of dislocations after the reduction of the displacement by manipulation and pressure much difficulty is often experienced in maintaining the reduction. To effect the latter object the use of splints and bandages is employed and also the use of many ingenious forms of apparatus adapted to particular dislocations.

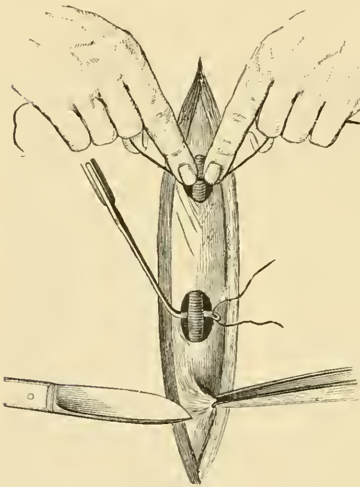
Tenotomy or *myotomy* are often required to prevent recurrence of the deformity, and continuous extension is also of much value in the treatment of these displacements.

PART V.

LIGATION OF ARTERIES.

IN the application of a ligature to an artery in its continuity the surgeon should make his incision in the line which corresponds to the general course of the vessel and he should be thoroughly familiar with the anatomy and with the surgical landmarks of the part. A portion of the vessel, when possible, should be selected for the application of the ligature half an inch or an inch from any large collateral branch. The position of the incision being selected the surgeon steadies the skin with two fingers and makes an incision of the required length through it with a scalpel; the superficial fascia is next picked up on a director, any large superficial veins which come into view being displaced, and divided to an equal length with the incision in the skin; the deep fascia being exposed it should be nicked and divided upon a director; the inter-muscular space or the edge of the muscle or muscles which are the guide to the vessel should next be sought for, small vessels coming from the main vessel through these spaces will often serve as valuable guides to the position of the vessel. The surgeon next separates the tissues with the director, handle of the knife, or the finger until the sheath of the vessel is exposed; this is recognized by its communicated pulsation and by the absence of the smooth shining surface and pinkish-white color which the surface of the artery presents. The sheath of the artery should be picked up with forceps and nicked with the point of the knife applied flatwise; the incision into the sheath should be very limited, only large enough to allow the aneurism needle to pass through it around the vessel; extensive dissections or separations of the sheath from the vessel should be avoided as the nutrition of the artery at the point of ligature may thus be impaired and sloughing and secondary hemorrhage may result. A distinct sheath is found only about the main arterial trunks, which is replaced in the smaller arteries by a layer of loose cellular tissue. The wall of the artery being exposed an aneurism needle is

FIG. 307.



Opening sheath. Passing ligature around the vessel. Tying artery. (BRYANT.)

FIG. 308.

Aneurism needle.

passed around the vessel, threaded with a catgut ligature, and withdrawn; the needle may be threaded before being passed, in which case the ligature is grasped with forceps and drawn through while the needle is withdrawn. The best material for ligatures is carefully prepared chromicized catgut. The needle should be passed away from important structures such as accompanying veins and nerves.

Before the ligature is tied the surgeon should satisfy himself that the ligature when tied will control the circulation in the vessel below its point of application, by placing the tip of his finger upon the vessel and drawing upon the ends of the ligature so as to occlude the vessel at the point of application. Being satisfied as to this point the ligature is tied with a reef-knot, or a surgeon's-knot and reef-knot combined.

Some authorities recommend the application of two ligatures a short distance apart in the ligation of vessels in their continuity, and a division of the vessel between them, so that both ends can retract into the cellular sheath.

The ends of the ligature are cut short in the wound, which is irrigated and drained if necessary, and is closed by the application of a few sutures, and an antiseptic dressing is applied.

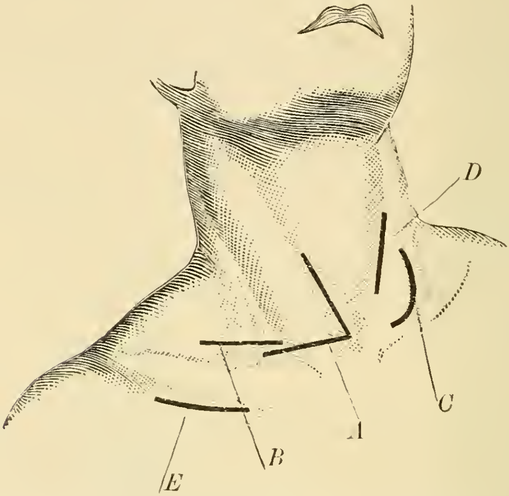
Ligation of Special Arteries

Ligation of the Innominate Artery.

The innominate artery lies immediately behind the sterno-clavicular articulation, and is in relation in front with the innominate veins and pneumogastric nerve, on the inner side with the trachea, on the outer side and behind with the pleura.

Incision.—A V-shaped incision, each branch of which is two and a half or three inches in length, one of which lies over the anterior edge of the sterno-cleido-mastoid muscle, and the other parallel to and a little above the clavicle. (Fig. 309, *A*.) The incisions are carried down to the superficial fascia and a flap is dissected up. If the anterior jugular vein is met with it should be displaced. The sternal and clavicular attachments of the sterno-cleido-mastoid are next divided upon a director half an inch above the bone. The sterno-thyroid and sterno-hyoid muscles and the middle cervical fascia are next exposed, covered by the thyroid veins. The outer fibres of the sterno-hyoid and sterno-thyroid muscles are next divided, the thyroid vein being held aside, when upon tearing through the fascia with a director the common carotid artery is exposed and traced down to the innominate artery; the innominate veins are pressed against the sternum with the finger and the artery is separated from its sheath about half an inch below its bifurcation, and the

Fig. 309.



Line of incision for—*A*, innominate artery; *B*, right subclavian artery; *C*, left subclavian artery; *D*, vertebral or inferior thyroid artery; *E*, axillary artery below clavicle. (Stimson.)

aneurism needle is passed around the vessel from the outer side so as to avoid the vein, pneumogastric nerve, and pleura.

Ligation of the Subclavian Artery.

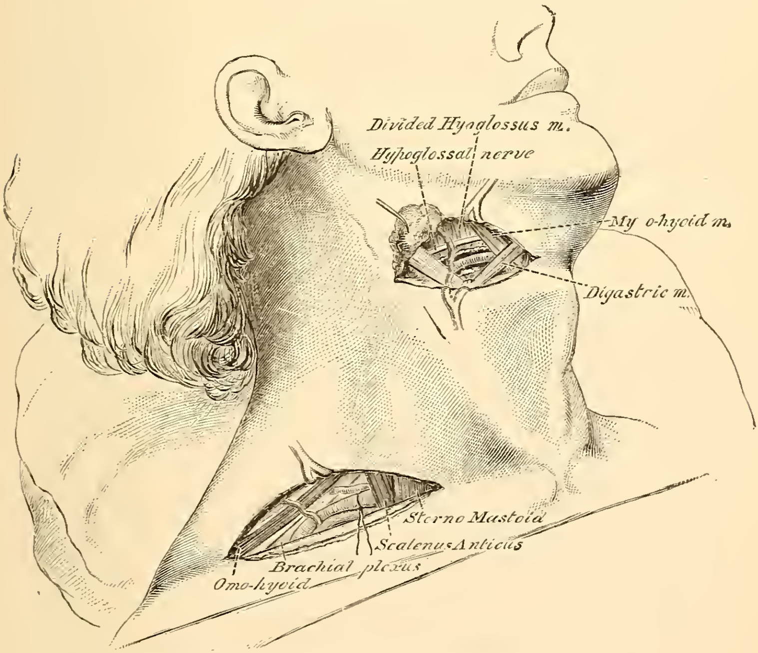
This artery may be tied at three points; in its *first* portion, between the trachea and scaleni muscles; in its *second* portion, behind the scaleni muscles, and in its *third* portion external to the scaleni muscles.

The left subclavian artery in its first portion is larger and more vertical in its direction than the right subclavian and is situated more posteriorly; from the difficulty in exposing this portion, and from the possibility of injuring the thoracic duct, the ligation of this artery in its first portion has been seldom attempted.

Incision for the *first portion* of the subclavian artery is the same as that for the innominate (Fig. 309, *A*), and the ligature is passed from the outer side, the pneumogastric and phrenic nerves being pressed inward toward the carotid artery.

The right or left subclavian arteries are also seldom tied in their second portions, that is behind the scaleni muscles, but are frequently tied in their third portions, that is external to the scaleni muscles.

Fig. 310.



Ligation of subclavian and lingual arteries. (Bryant.)

Incision for the *second portion* of the subclavian artery begins an inch external to the sterno-clavicular articulation half an inch above and parallel to the clavicle, and is three or four inches in length. (Fig. 309, *B* or *C*.) The steps of the operation are the same as for ligation of the third portion, and when the scalenus anticus muscle has been exposed it is divided upon a director; the phrenic nerve which lies upon its anterior aspect is to be avoided.

Incision for the *third portion* of the subclavian artery is the same as for the second portion. (Fig. 309, *B* or *C*.) The skin and platysma being divided, the jugular vein is exposed and drawn to one side or divided between the ligatures; the superficial fascia is next divided upon a director; the posterior belly of the omo-hyoid muscle is next found and drawn upward and outward; the outer border of the scalenus anticus is next felt for and followed down to the tubercle of the first rib—the artery lies against this, between it and the lowest bundle of the brachial plexus. The artery is next denuded with the director and the needle is passed from below, care being taken not to include the lowest bundle of the brachial plexus in the ligature. (Fig. 310.)

Ligation of the Vertebral Artery.

Incision for the ligation of the vertebral artery is three or three and a half inches in length, parallel with the anterior edge of the sterno-cleido-mastoid muscle, ending an inch above the clavicle. (Fig. 309, *D*.) The anterior edge of the sterno-cleido-mastoid being exposed the middle cervical fascia is divided and the carotid artery and jugular vein are exposed and drawn inward. The gap between the longus colli muscle and the scalenus anticus muscles is next felt for about an inch below the carotid tubercle; the fascia covering it is next torn through and the muscles are separated and the vertebral vein comes into view: this is held aside and the vertebral artery is exposed, and the ligature is then passed around it.

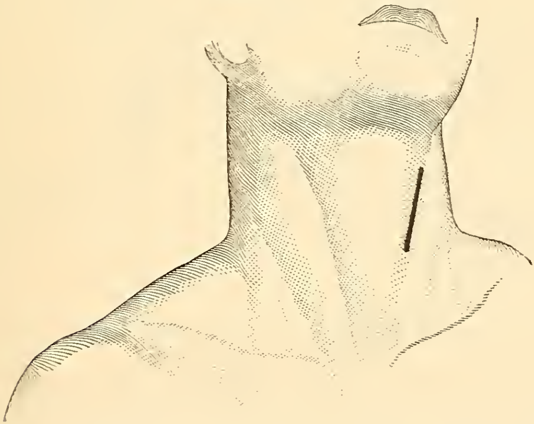
Ligation of the Inferior Thyroid Artery.

Incision for the inferior thyroid artery is the same as that for the vertebral artery. (Fig. 309, *D*.) The anterior edge of the sterno-cleido-mastoid muscle being exposed it is drawn outward, the middle cervical fascia is next divided and the carotid artery and internal jugular vein are drawn outward with a retractor. The head being flexed slightly, the surgeon feels for the carotid tubercle, and then separates the cellular tissue with a director and the artery should be found below the carotid tubercle. The needle should be passed between the artery and vein.

Ligation of the Common Carotid Artery.

The point of election for the ligation of the common carotid artery is just above the omo-hyoid muscle, about

Fig. 311.



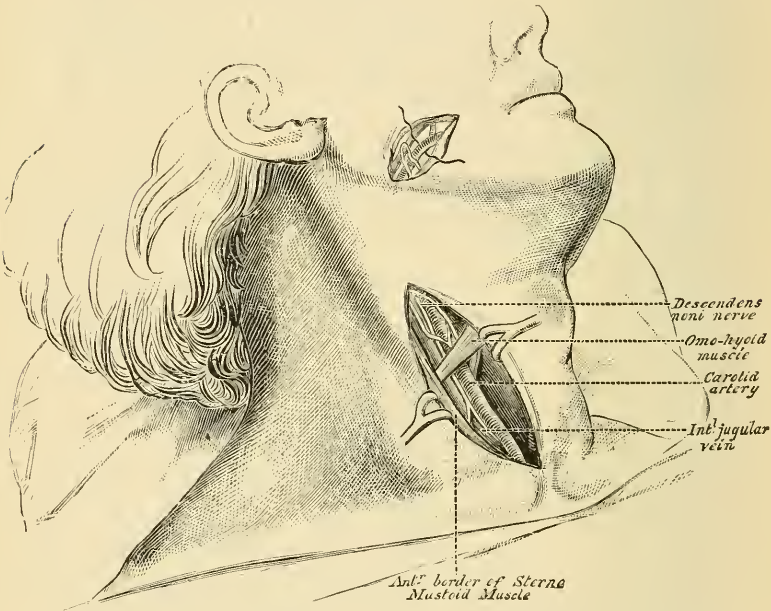
Line of incision for common carotid artery at point of election. (Stimson.)

three-quarters of an inch below the bifurcation of the vessel, which takes place at a point on a line with the upper border of the thyroid cartilage.

Incision for the common carotid artery, is three inches in length along the anterior border of the sterno-cleido-mastoid muscle, the centre of which corresponds with the crico-thyroid space. (Fig. 311.)

Divide the skin, platysma and cellular tissue and aponeurosis, avoiding the superficial veins, and expose the anterior edge of the sterno-cleido-mastoid; seek for the inter-

Fig. 312.

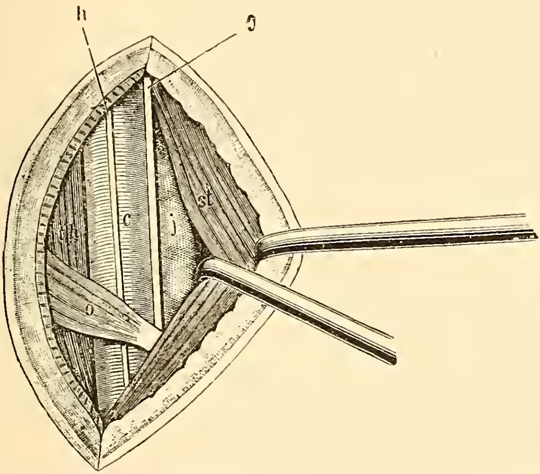


Ligation of common carotid artery. Ligation of facial artery. (Bryant.)

space between this muscle and the sterno-hyoid and sterno-thyroid muscles, draw the latter muscles inward and the artery will be exposed with the jugular vein external to it; the descendens noni nerve lying upon its sheath, which should be displaced outward. The sheath is next picked up and opened and the artery is separated from it with a director;

the artery lies internally, the internal jugular vein externally and somewhat more superficial, and the pneumogastric nerve lies between the two and is more deeply placed. (Fig. 312.)

FIG. 313.



Relation of the left common carotid artery above the omo-hyoid muscle. (ESMARCH.)

The sympathetic nerve is posterior to the vessel external to the sheath. The needle is passed from without inward, care being taken to avoid injury of the vein and nerve. (Fig. 313.)

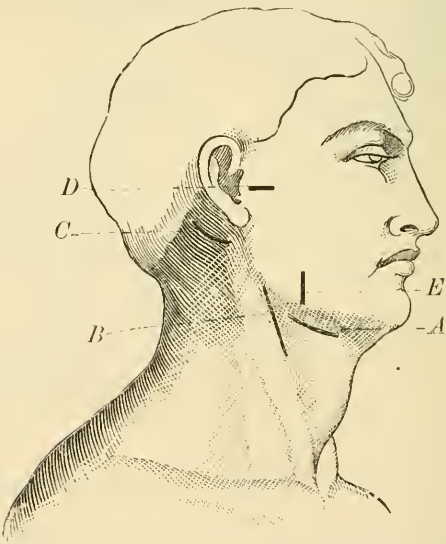
LIGATION OF THE EXTERNAL CAROTID ARTERY.

Incision for the ligation of the external carotid artery is over the inner edge of the sterno-cleido-mastoid muscle from the angle of the jaw to a point corresponding to the middle of the thyroid cartilage. (Fig. 314, *B.*) The skin, platysma and cellular tissue being divided, the external jugular vein is drawn aside when encountered; the deep fascia being opened, the facial and lingual veins will be exposed, which should be drawn to one side; the artery is next exposed covered by the hypoglossal nerve and the stylo-hyoid and digastric muscles. The vessel should next be isolated from the internal carotid artery and internal jugular vein, both of which lie along its outer side. The needle should be passed from without inward.

Ligation of the Internal Carotid Artery.

Incision the same as for the external carotid artery (Fig. 314, *B*); the vessel is external to the external carotid artery,

Fig. 314.



Line of incision for—*A*. Lingual artery. *B*. External and internal carotid artery. *C*. Occipital artery. *D*. Temporal artery. *E*. Facial artery. (Stimson.)

and in passing the needle the point should be directed from the internal jugular vein, that is from without inward.

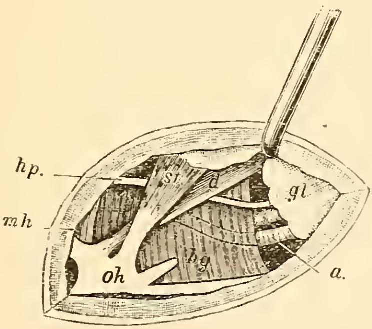
Ligation of the Superior Thyroid Artery.

Incision about three inches in length along the anterior border of the sterno-cleido-mastoid muscle, starting a little lower down than that for the external carotid artery. The skin, superficial fascia, platysma, and deep fascia being divided, the cellular tissue in the sulcus between the upper portion of the larynx and the great vessels of the neck is broken up with the director and the vessel is exposed. The needle should be passed around the vessel from above downward.

Ligation of the Lingual Artery.

Incision a curved one two inches long, its concavity directed upward from the anterior edge of the sterno-cleido-mastoid muscle, half an inch above the great horn of the

Fig. 315.



Relations of the lingual artery. (Esmarch.)

hyoid bone, to a point one inch short of the median line of the neck. (Fig. 314, *A*.) Divide the skin and platysma, displacing the superficial veins, and open the deep fascia, when the submaxillary gland will be exposed; this is displaced upward with the handle of the knife and the tendon of the digastric muscle attached to the hyoid bone, and the hypoglossal nerve will be exposed ; next divide the fibres of the hyoglossus muscle midway between the hypoglossal nerve and the hyoid bone, and the lingual artery will be exposed. (Fig. 315.)

The needle should be passed around the vessel from above downward in order to avoid the nerve.

Ligation of the Facial Artery.

The facial artery passes over the inferior maxilla just in front of the anterior edge of the masseter muscle and is accompanied by the facial vein, which lies nearer to the muscle.

Incision either a horizontal one along the lower border of the maxilla or a vertical one an inch in length. (Fig. 314, *E*.) The skin, subcutaneous tissue, and fascia being divided, the artery is exposed and the needle should be passed around the vessel away from the vein.

Ligation of the Occipital Artery.

Incision two inches in length, starting from a point half an inch below and in front of the apex of the mastoid process carried obliquely backward parallel to the border of this process. (Fig. 314, *C*.) Divide the skin and fascia and expose the insertion of the sterno-cleido-mastoid muscle, which is also divided, and the aponeurosis of the splenius is exposed ; this is also opened and the digastric groove is felt for, and when the belly of the digastric muscle is exposed the artery is brought into view by separating the cellular tissue in the anterior angle of the wound with a director. (Fig. 316.)

Ligation of the Temporal Artery.

Incision a transverse one, one inch in length, starting from the tragus of the ear forward over the zygomatic arch

(Fig. 313, *D*), or a vertical one of the same length a little in front of the tragus of the ear.

Divide the skin and expose the subcutaneous cellular tissue, which in this region is very dense and fibrous. This

FIG. 316.

Ligation of the occipital artery. (SKEY.)

FIG. 317.

Ligation of the temporal artery. (SKEY.)

tissue should be broken up with a director and the artery should be found in it about a quarter of an inch in front of the ear. (Fig. 317.) The temporal vein accompanies the artery and lies nearer to the ear, and in some cases the auriculo-temporal nerve is in close relation to the artery. The needle should be passed from behind forward.

LIGATION OF THE AXILLARY ARTERY.

The axillary artery extends from the middle of the clavicle to the insertion of the teres major into the humerus; the axillary vein lies upon the inner side and in front of the artery. The axillary artery is tied either in its upper portion, just below the clavicle, or at its lower portion in the axilla.

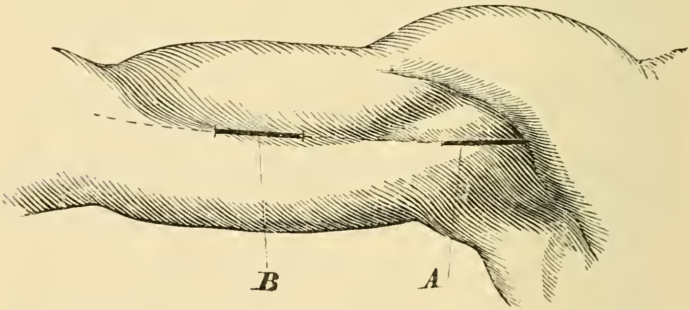
Ligation of the Axillary Artery Below the Clavicle.

Incision four inches in length from the summit of the coracoid process inward a short distance below the clavicle

(Fig. 309, *E*), or an incision three inches in length commencing at a point one-half an inch from the sterno-clavicular articulation and carried obliquely downward toward the axilla.

The skin and subcutaneous tissue having been divided the deep fascia is exposed and opened, or the axillary artery may be reached by following the intermuscular space between the sternal and clavicular fibres of the pectoralis major which leads upward toward the clavicle and to the pectoralis minor; or the fibres of the pectoralis major being exposed are cut through and the costo-coracoid fascia is next torn through with a director, care being taken to avoid injury of the cephalic vein at the outer portion of the wound; the pectoralis minor is now seen, and after separating the cellular tissue with a director the axillary vein is seen crossing from the upper edge of the muscle to the clavicle; the

Fig. 318.



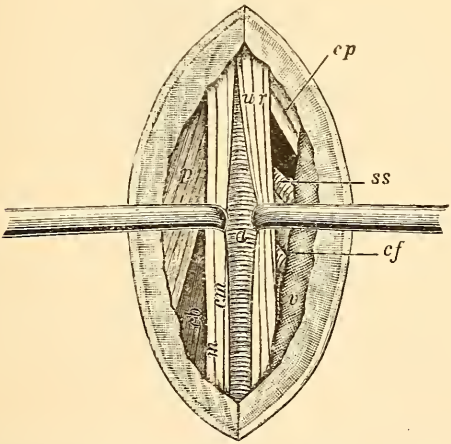
A. Incision for axillary artery in axilla. *B*. Incision for brachial artery. (Stimson.)

vein almost completely covers the artery, which is exposed by drawing the vein inward. The needle is passed around the artery from within outward.

Ligation of the Axillary Artery in the Axilla.

Incision two and a half inches long, started at the upper part of the axilla and carried down the arm at the edge of the coraco-brachialis muscle. (Fig. 318, *A.*) The skin only is divided in the first incision and the deep fascia is picked up and divided upon a director, and the fibres of the inner border of the coraco-brachialis muscle are exposed and held aside by a retractor, and the operator will see the median nerve, the musculo-cutaneous nerve, and the axillary artery. To the inner side of the artery are the axillary vein, ulnar

FIG. 319.



Relations of right axillary artery in axilla. (ESMARCH.)

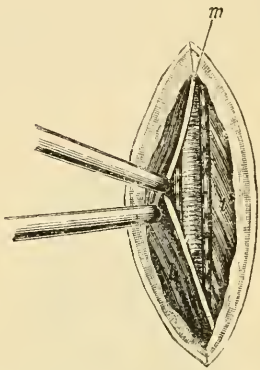
and internal cutaneous nerves. The needle should be passed around the artery from the vein toward the coraco-brachialis muscle.

LIGATION OF THE BRACHIAL ARTERY.

Incision at the middle of the arm three inches long on a line corresponding to the inner edge of the biceps muscle. (Fig. 318, *B.*) The skin and cellular tissue being divided, care being taken not to injure the basilic vein, which should be drawn posteriorly, the deep fascia is next cut through and the fibres of the biceps muscle are exposed (Fig. 320);

this should be drawn forward and the sheath of the vessels enclosing the artery, veins, and median nerve is exposed;

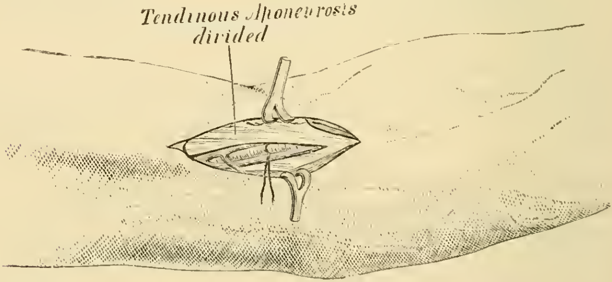
Fig. 320.



Relations of right brachial artery at middle of arm. (Esmarch.)

this is opened, the median nerve is pressed aside and the artery is separated from its veins and the needle is passed from the side of the nerve around the vessel.

Fig. 321.



Ligation of the brachial artery at bend of elbow. (Bryant.)

In ligating the brachial artery the occasional high division of the vessel must be borne in mind.

Ligation of Brachial Artery at Bend of Elbow.

Incision two inches in length, along the inner border of the tendon of the biceps muscle. Divide the skin, superficial fascia, and the bicipital aponeurosis, under which the artery will be exposed, resting upon the brachialis anticus muscle. (Fig. 321.) The median nerve is to the inner side and some distance from the artery. The needle should be passed around the vessel, after isolating the veins, from within outward.

Ligation of the Radial Artery.

The radial artery extends in a straight line from a point half an inch below the centre of the fold of the elbow to the inner side of the styloid process of the radius.

The radial artery may be tied at its upper, middle, or lower third, or at the root of the thumb.

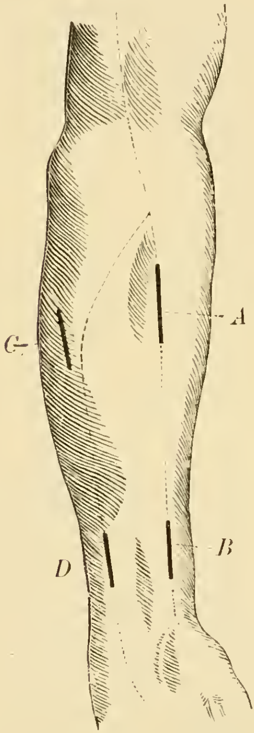
Ligation of the Radial Artery in the Upper Third of the Forearm.

Incision for the radial artery at its upper third is two and a half inches in length on a line drawn from the middle of the bend of the elbow to the ulnar side of the styloid process of the radius; the incision should begin one and a half inches below the bend of the elbow. (Fig. 322, *A*.) Divide the skin and superficial fascia, avoiding the superficial veins. When the deep fascia is exposed find the edge of the supinator longus muscle and divide the aponeurosis along its ulnar side and expose the fibres of the pronator radii teres muscle. The vessel lies in the interspace between these muscles surrounded by adipose tissue, and upon being exposed the veins should be isolated and the needle passed from without inward. The nerve lies so far external to the artery that it is not often exposed in the operation. (Fig. 323.)

Ligation of the Radial Artery in the Middle Third of the Forearm.

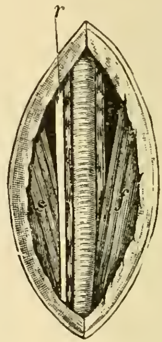
Incision two inches in length, following the same line as that for the upper third of the artery. After dividing the skin, superficial and deep fascia, the artery is found in the interspace between the flexor carpi radialis on the inner side

Fig. 322.



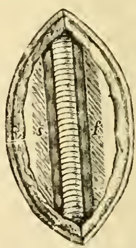
Line of incision for—*A*. Radial artery in upper third. *B*. Radial artery in lower third. *C*. Ulnar artery in upper third. *D*. Ulnar artery in lower third. (Stimson.)

Fig. 323.



Relations of right radial artery in the upper third of the forearm. (Esmarch.)

Fig. 324.



Relations of right radial artery above the wrist. (Esmarch.)

and the supinator longus on the outer side; the radial nerve at this part of the arm is in close relation with the vessel to the radial side, and the needle should be passed around the artery from without inward.

Ligation of the Radial Artery in the Lower Third of the Forearm.

Incision two inches in length following the same line (Fig. 322, *B*), ending one inch above the wrist. The skin, superficial fascia, and deep fascia being divided, the artery will be found between the tendon of the flexor carpi radialis on the inner side and the tendon of the supinator longus on the outer side. (Fig. 324.) The veins being separated the needle may be passed in either direction.

Ligation of the Radial Artery at the Root of the Thumb.

The radial artery may also be tied at the root of the thumb.

Incision one inch in length between the tendons of the extensor ossis metacarpi pollicis and extensor primi internodii pollicis on the outer side, and the tendon of the extensor secundi internodii pollicis on the inner side. The skin and superficial fascia being divided and the radial vein being displaced, the deep fascia is opened and the artery is exposed at the bottom of the wound; the needle may be passed in either direction.

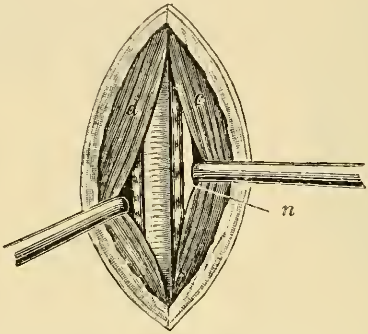
Ligation of the Ulnar Artery.

The ulnar artery is tied at the junction of the upper and middle third of the forearm and at the lower third.

Ligation of the Ulnar Artery at the Junction of the Upper and Middle Thirds of the Forearm.

Incision three inches in length, starting four inches below the internal condyle of the humerus, on a line passing from the internal condyle of the humerus to the outer border of the pisiform bone. (Fig. 322, *C*.) Divide the skin and superficial fascia, and when the deep fascia has been exposed the interspace between the flexor carpi ulnaris and the flexor sublimis digitorum appears, enter this interspace and raise the flexor sublimis digitorum and work transversely across the arm, and the artery will be found resting upon the deep flexor, with the ulnar nerve to the ulnar side. The needle should be passed from the nerve around the artery. (Fig. 325.)

FIG. 325.

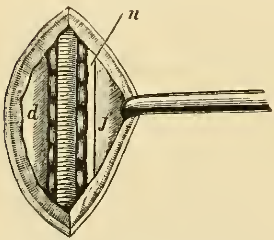


Relations of the right ulnar artery at upper third of forearm. (ESMARCH.)

Ligation of the Ulnar Artery in the Lower Third of the Forearm.

Incision two inches in length a little to the radial side of the tendon of the flexor carpi ulnaris, which is attached to the pisiform bone, ending an inch above the wrist. (Fig. 322, *D*.) Divide the skin and superficial fascia and open the deep fascia, and the artery will be exposed, with accompanying veins, between the tendons of the flexor carpi ulnaris and flexor sublimis digitorum, the ulnar nerve being to the ulnar side of the vessel. The needle should be passed from within outward to avoid the nerve. (Fig. 326.)

FIG. 326.



Relations of right ulnar artery above the wrist. (ESMARCH.)

Ligation of the Interosseous Artery.

Incision similar to that employed in the ligation of the ulnar artery in its upper third.

Ligation of the Abdominal Aorta.

Incision in the linea alba from a point three inches above the umbilicus to a point three inches below it. The superficial structures being divided the peritoneum is opened upon a director, and the intestines are pressed aside and the aorta is exposed covered by peritoneum, with the filaments of the sympathetic nerve resting upon it, and the vena cava to the right side. Tear through the peritoneum and pass the needle from left to right around the vessel. After tying the ligature the ends should be cut short, and the external wound should be closed as in the ordinary laparotomy wound.

The vessel may also be exposed by an incision along the anterior border of the quadratus lumborum muscle, from the last rib to the crest of the ilium. The skin, lumbar muscles, and fascia transversalis being divided, the wound is held open with blunt hooks, so that the retro-peritoneal space is exposed and the aorta brought into view. The vessel being separated from the vena cava and nerves, the needle is passed around it and the ligature applied.

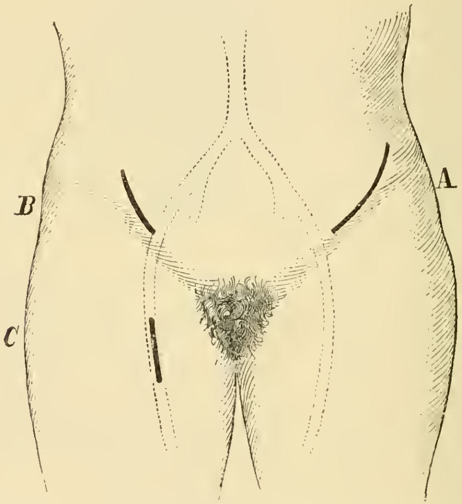
Ligation of the Common Iliac Artery.

The aorta divides into the two common iliac arteries on the left side of the fourth lumbar vertebra, and these arteries are usually about two inches in length, and bifurcate opposite the sacro-iliac synchondrosis to form the internal and external iliac arteries; the length of the common iliac artery, however, may vary considerably, being three or four inches in length in some cases.

Incision for ligation of the common iliac artery is four to six inches in length, beginning one-half inch above the middle of Poupart's ligament, and is carried outward curving upward after passing the anterior superior spine of the ilium. (Fig. 327, *A*.)

Divide the skin, superficial fascia and aponeurosis of the external oblique muscle, and then divide the fibres of the internal oblique and transversalis muscles upon a director, and expose the transversalis fascia. This is opened at the lower

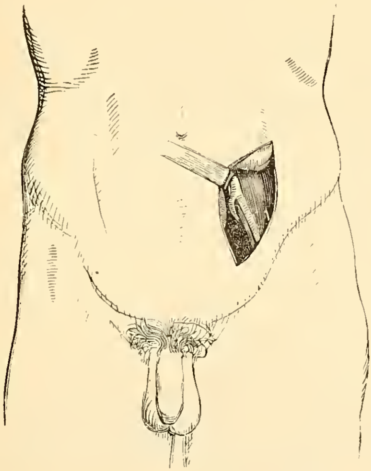
Fig. 327.



Line of incision for—*A*, common iliac artery. *B*, external iliac artery. *C*, femoral artery in Scarpa's triangle. (Stimson.)

part of the wound, and the finger is introduced and the peritoneum is pressed back; the opening in the transversalis fascia is next enlarged, and the peritoneum is carefully drawn inward and upward with the fingers toward the inner edge of the wound. The operator next feels for the external iliac artery, and passes the finger along this until the common iliac artery is reached. The loose cellular tissue in which it is imbedded is next separated, and the needle is passed from within outward, to avoid the common iliac vein (Fig. 328), which on the left side lies on the inner side of the artery, and on the right side it lies behind the artery. The ureter generally remains attached to the peritoneum; if not, it is seen crossing the bifurcation of the common iliac with the

Fig. 328.



Ligation of the common iliac artery. (Liston.)

genito-crural nerve, and care should be taken to avoid injury of these structures if present.

The common iliac artery may also be exposed and tied by an incision made over the artery through the peritoneal cavity; the vessel being tied, the ends of the ligature are cut short, and the external wound is closed in the same manner as that resulting from the exposure of the abdominal aorta by incision through the peritoneum.

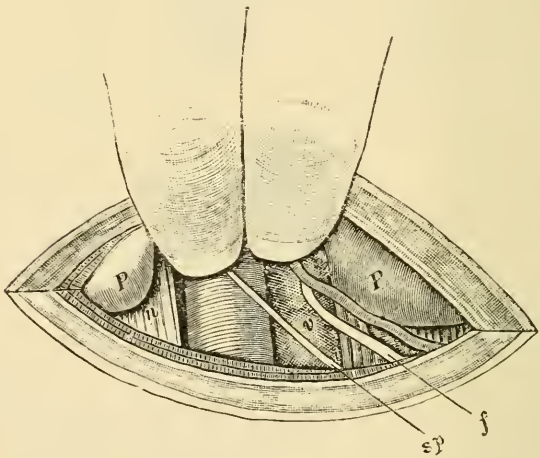
Ligation of the Internal Iliac Artery.

Incision in the same line as for the common iliac artery, but it need not be quite so long. (Fig. 327, *A*.) The peritoneum being exposed, it is pushed upward and inward, and the internal iliac artery is exposed. The vessel is carefully isolated from the vein, which lies behind and on the inner side, and the needle is passed from within outward.

Ligation of the External Iliac Artery.

Incision three or four inches in length, half an inch above the middle of Poupart's ligament, made at first parallel to it and then curved upward. (Fig. 327, *B*.) The tissues of the abdominal wall being divided and the peritoneum exposed, it is pushed upward and inward in the same manner as for exposure of the common iliac artery. The artery lies at the inner border of the psoas muscle, the vein on its inner side, and the anterior crural nerve covered by the iliac fascia on the outer side ; the genito-crural nerve passes obliquely across the artery. (Fig. 329.) The needle should be passed from within outward.

Fig. 329.

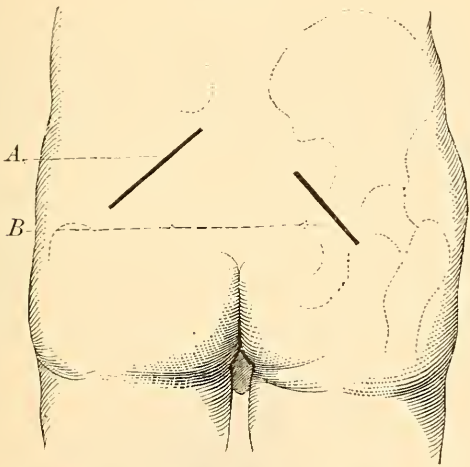


Relations of the right external iliac artery. (Esmarch.)

Ligation of the Gluteal Artery.

Incision three or four inches in length, from the posterior superior spinous process of the ilium to a point midway between the tuber ischii and the great trochanter. (Fig. 330, *A*.) After division of the skin and fascia, the fibres

Fig. 330.



Line for—*A*, gluteal artery. *B*, sciatic and internal pudic artery. (Stimson.)

of the gluteus maximus muscle are separated and held apart, and the deep fascia is divided, and the artery is sought for above the pyriformis muscle at the upper border of the great sacro-sciatic notch. It is accompanied by large veins, injury to which should be avoided in exposing the artery and passing the needle.

Ligation of the Sciatic and Internal Pudic Arteries.

Incision three or four inches in length, a little lower than that employed for exposure of the gluteal artery. (Fig. 330, *B*.) Divide the skin, superficial fascia and fibres of the gluteus maximus muscle and deep fascia, and search for the vessels as they leave the great sciatic notch at the lower edge of the pyriformis muscle. The internal pudic artery enters the pelvis through the lesser sciatic notch, lying on the inner side of the sciatic artery during its passage over the spine of the ischium. The vessels are isolated and the needle is passed so as to avoid injury of the veins.

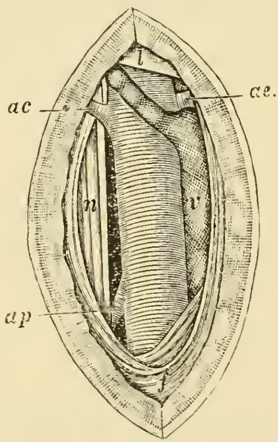
Ligation of the Femoral Artery.

The femoral artery may be ligated just below Poupart's ligament, at the apex of Scarpa's triangle, at the middle of the thigh, or in Hunter's canal.

Ligation of the Femoral Artery below Poupart's Ligament.

Incision beginning midway between the anterior superior spinous process of the ilium and the symphysis pubis,

Fig. 331.



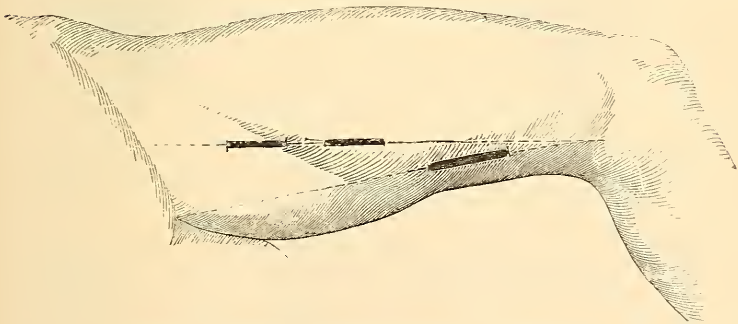
Relations of the right femoral artery below Poupart's ligament. (Esmarch.)

one-fourth of an inch above Poupart's ligament, and extending ten inches downward. Divide the skin and superficial fascia and the deep fascia and expose the sheath of the vessels; open this one-half an inch below Poupart's ligament and isolate the femoral artery from the femoral vein which lies to the inner side; the anterior crural nerve lies to the outer side. Pass the needle from within outward.

Ligation of the Femoral Artery at the Apex of Scarpa's Triangle.

Incision three inches long, the centre of which should be a little above the point where the sartorius muscle crosses a line drawn from the middle of Poupart's ligament to the inner condyle of the femur. (Fig. 332.) Divide the skin,

Fig. 332.



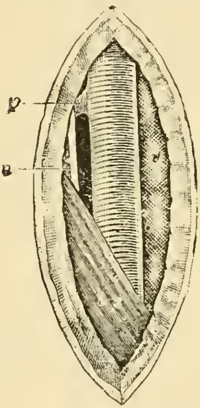
Lines of incision for the femoral artery. (Stimson.)

superficial fascia and deep fascia, avoiding the internal saphenous vein, and expose the edge of the sartorius muscle, which may be recognized by the direction of its fibres. This muscle is drawn outward and the sheath of the vessels is exposed and opened; the vein lies on the inner side and somewhat behind the artery and the long saphenous nerve is on the outer side. (Fig. 333.) Pass the needle from within outward.

Ligation of the Femoral Artery in the Middle of the Thigh.

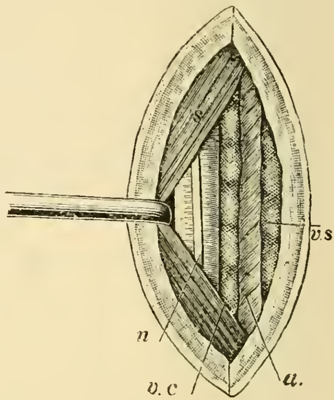
Incision in the line above mentioned, its centre being a little above the middle of the thigh. Divide the skin, superficial and deep fascia and expose the sartorius muscle which is drawn outward after the leg has been flexed; the sheath of the vessels is exposed and opened; the long saphenous nerve lies upon the artery and the femoral vein lies behind the artery; the saphenous vein lies more superficially and internal to the vessel. Pass the needle from within outward. (Fig. 334.)

Fig. 333.



Relations of right femoral artery at the apex of Scarpa's triangle. (Esmarch.)

Fig. 334.



Relations of the right femoral artery in the middle of the thigh. (Esmarch.)

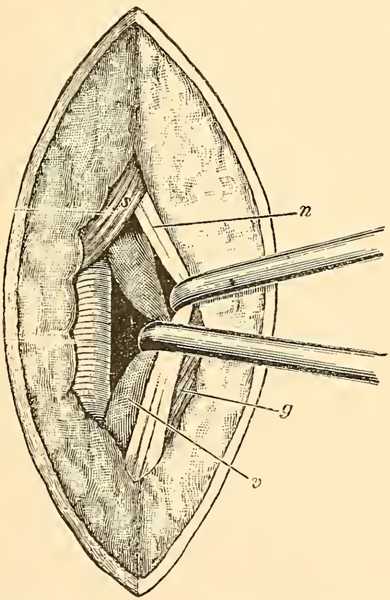
Ligation of the Femoral Artery in Hunter's Canal.

Incision three inches in length along the tendon of the adductor magnus, the centre of which is at the junction of the lower and middle thirds of the thigh. (Fig. 332.) Divide the skin, superficial fascia and deep fascia, care being taken not to injure the internal saphenous vein, which should be displaced and expose the sartorius muscle, which should be displaced downward and expose the aponeurosis which forms the anterior wall of the vascular canal; this should be opened upon a director, and the artery is uncovered and should be separated from the vein, which lies upon the outer side. The needle is passed from without inward.

Ligation of the Popliteal Artery.

Incision three or four inches in length, along the external border of the semi-membranosus muscle. Divide the

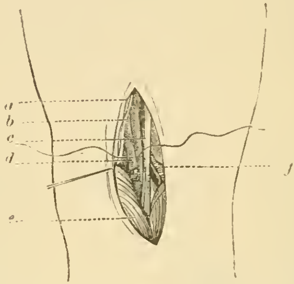
Fig. 335.



Relations of the right popliteal artery. (Esmarch.)

skin and superficial fascia, taking care not to injure the saphenous vein, and open the deep fascia. The edges of the wound being held apart the adipose tissue is broken up with a director, and the internal popliteal nerve will be first

Fig. 336.



Ligation of popliteal artery. (Smith.)

exposed, and next the vein—both external to the artery. (Fig. 335.) The artery is isolated and the needle is passed from without inward. (Fig. 336.)

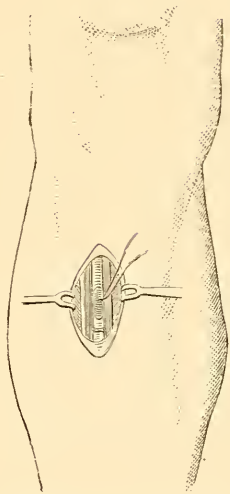
Ligation of the Anterior Tibial Artery.

The anterior tibial artery may be tied in the upper, middle, and lower thirds of the leg; the general direction of the artery corresponds with a line drawn from the middle of the space between the head of the fibula and the tubercle of the tibia to the middle of the anterior intermalleolar space.

Ligation of the Anterior Tibial Artery in the Upper Third of the Leg.

Incision two and a half to three inches in length, one and one-fourth inches external to the spine of the tibia. Divide the skin and superficial fascia, and when the deep fascia is exposed open it on a line corresponding to the intermuscular space between the tibialis anticus and the extensor longus digitorum muscles. Separate the muscles and work down in this interspace, and the artery will be found with a vein on either side of it, and the anterior tibial nerve externally. (Fig. 337.) The needle should be passed from without inward, after isolating the veins.

Fig 337.



Ligation of the anterior tibial artery at its upper third. (Stimson.)

Ligation of the Anterior Tibial Artery at its Middle Third.

Incision three inches in length in the same line as that for the upper portion of the vessel. After dividing the skin, superficial and deep fascia, the interspace between the tibialis anticus and the extensor longus digitorum muscles is opened and a third muscle comes in view, the extensor proprius pollicis The artery lies between the extensor proprius pollicis and the tibialis anticus muscles, and the anterior tibial nerve is to the outer side. The veins should be isolated and the needle should be passed from without inward.

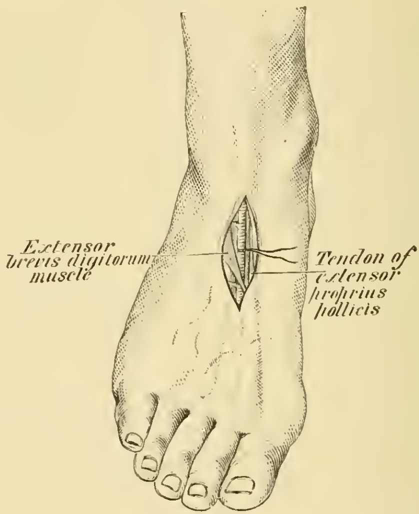
Ligation of the Anterior Tibial Artery in its Lower Third.

Incision two inches in length, beginning three inches above the ankle-joint on the line of the artery. Divide the skin, superficial and deep fascia, and seek for the tendon of the extensor proprius pollicis muscle, the second tendon from the tibia. The artery is found in the interspace between this tendon and the tendon of the extensor longus digitorum muscle, the nerve being to the outer side. The veins are isolated from the artery, and the needle is passed from without inward.

Ligation of the Dorsalis Pedis Artery.

Incision one inch in length on a line drawn from the middle of the anterior inter-malleolar space to a point midway between the extremities of the first two metatarsal bones or along the outer border of the tendon of the extensor proprius pollicis. Divide the skin, superficial and deep fascia, and

Fig. 338.



Ligation of the dorsalis pedis artery. (Bryant.)

the artery will be found lying next to the inner tendon of the short extensor muscle of the toes. (Fig. 338.) The nerve is to the outer side. After separating the veins the needle is passed from without inward.

Ligation of the Posterior Tibial Artery.

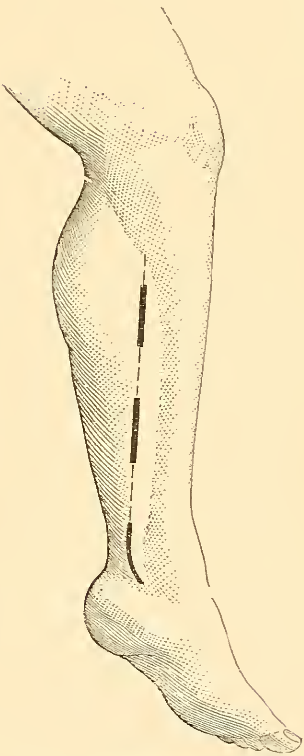
The course of the posterior tibial artery is indicated by a line drawn from the middle of the popliteal space to a point midway between the tendo Achillis and the internal malleolus of the tibia.

The posterior tibial artery may be ligated in its upper, middle, and lower thirds.

Ligation of the Posterior Tibial Artery at its Upper Third.

Incision three inches and a half in length, one-half inch from the inner edge of the tibia, beginning two inches from the upper edge of the tibia. (Fig. 339.) Divide the skin and superficial fascia, avoiding large superficial veins; next open the deep fascia and detach the origin of the soleus muscle from the tibia, and on raising it, its under surface will present a white shining sheath of tendinous material, beneath which will be seen a layer of fascia covering the tibialis posticus muscle. If search is made toward the middle of the leg, the artery will be found covered by the intermuscular fascia, the nerve being to the outer side. The needle is passed from without inward after the veins have been separated from the artery (Fig. 340).

Fig. 339.



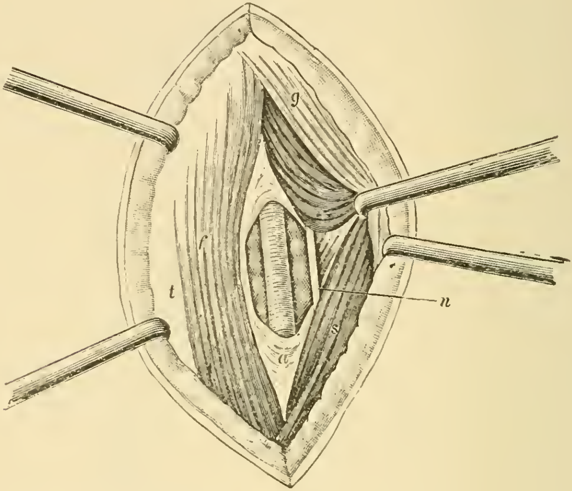
Lines of incision for the posterior tibial artery. (Stimson.)

Ligation of the Posterior Tibial Artery at its Middle Third.

Incision two and a half inches in length, parallel with the inner edge of the tibia and half an inch from its border.

Divide the skin, superficial and deep fascia, and the inner edge of the soleus will be exposed; press this outward and

Fig. 340.



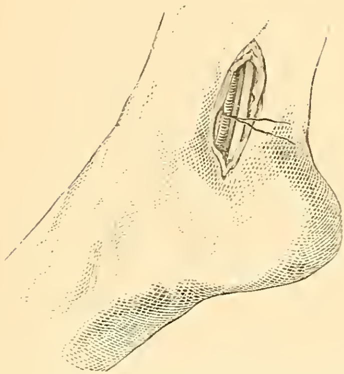
Relations of the right posterior tibial artery in its upper third. (Esmarch.)

the artery with its veins will be exposed, also the posterior tibial nerve to the outer side. Pass the needle from without inward after separating the veins.

Ligation of the Posterior Tibial Artery Behind the Inner Malleolus.

Incision a curved one two inches in length, midway between the tendo Achillis and the internal malleolus. (Fig. 339.) Divide the skin and superficial fascia and lift the deep fascia upon a director and open it freely and the artery will be exposed with the tendons of the tibialis posticus and flexor longus digitorum muscles on the inner side and the posterior tibial nerve and the tendon of the flexor longus

Fig. 341.



Ligation of the posterior tibial artery behind inner malleolus. (Bryant.)

pollicis muscle on the outer side. (Fig. 341.) After separating the veins from the artery the needle should be passed from without inward.

PART VI.

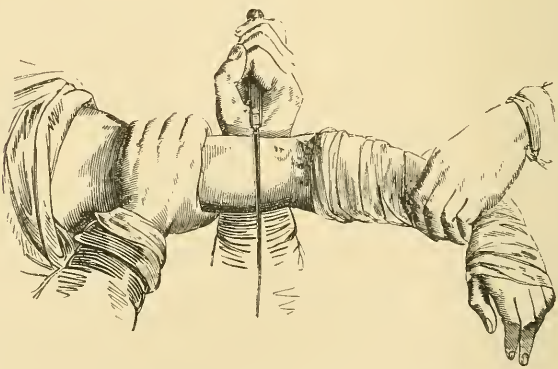
AMPUTATIONS.

The term amputation is now generally applied to the removal of a limb, and this may be removed through the bones, when the operation is spoken of as an amputation in the continuity of the limb; or it may be removed through its joints, and is then known as an amputation in the contiguity or a disarticulation.

Methods of Amputating.

Amputations may be performed by the *circular*, *flap*, *oval*, and *elliptical* methods; the *modified circular* operation, and *Teale's method* by rectangular flaps, are also employed.

Fig. 342.



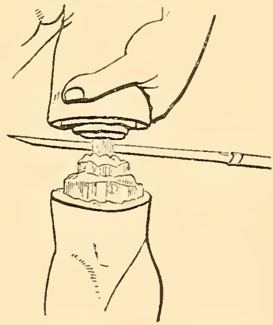
Amputation by circular method. (Druitt.)

Circular Method.

In performing an amputation by this method the incision of the skin is made at a distance below the point where the bone is to be divided. An assistant grasps the limb and draws the skin evenly and firmly toward the root of the part and the surgeon passes the heel of the knife well into the tissues and makes a circular sweep around the limb and completes the division of the skin and cellular tissue with one motion of the knife. (Fig. 342.)

In some cases a cutaneous sleeve consisting of the skin and cellular tissue is dissected up and turned back, and sometimes it may be necessary to make a slit on one side of the flap to allow it to be turned up.

Fig. 343.



Division of muscles in circular amputation. (Smith.)

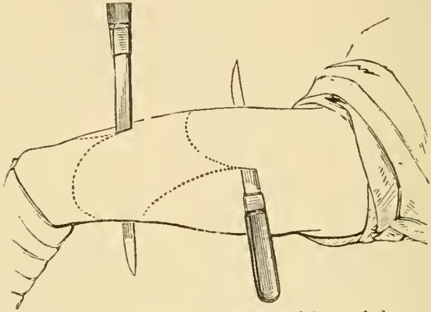
The second incision in an amputation by the circular method consists, after retraction of the skin, in making a circular cut through all of the tissues down to the bone. (Fig. 343.)

The third step in an amputation by the circular method consists, after retracting the skin and muscles and holding them back by a retractor, in the division of the bone with a saw.

Flap Method.

This method of amputating is susceptible of many variations. There may be one or two flaps of equal or unequal length; the flaps may be cut antero-posteriorly, laterally, or obliquely. (Fig. 344.) They may be made by transfixing the limb and cutting outward, or they may be cut from without inward, or they may be made to include the whole thickness of the tissues down to the bone, or merely the skin and superficial fascia, the deeper structures being divided by a circular incision. The flaps may have a curved outline or may be rectangular in shape. In amputating by the antero-posterior flap operation the surgeon grasps the limb

Fig. 344.



Double-flap amputation; antero-posterior and lateral flaps. (S. Smith.)

and enters the point of a long knife into the tissues at the side nearest himself, and pushing it across and around the

Fig. 345.

Amputation by antero-posterior flaps. (Bryant.)

bone or bones brings its point out through the skin at a point diametrically opposite its point of entrance. He then shapes the flap by cutting downward with a rapid sawing motion and then cuts obliquely forward until all the tissues are divided. The flap being turned up, he reënters his knife at the same point and passes it on the other side of the bone or bones and cuts the second flap in the same manner. (Fig. 345.) A retractor is next applied and the bone is divided with a saw.

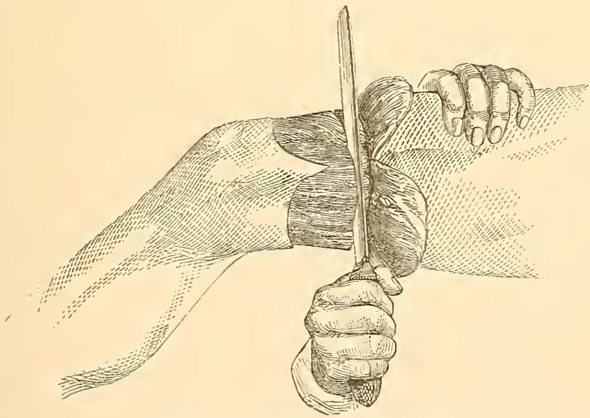
The Oval Method.

The oval amputation is really a circular one in which the cuff of skin has been slit at one side and the angles rounded off. This is the form of amputation frequently performed at the metacarpo-phalangeal and metatarso-phalangeal joints, and is one of the methods of amputation at the shoulder-joint.

Elliptical Method.

This is a form of the oval method of amputation which is employed in amputations at the knee- and elbow-joints, the incision forming an ellipse coming below the joint on the front or outside of the limb, the resulting flap being folded upon itself.

FIG. 346.



Modified circular amputation. (SKEY.)

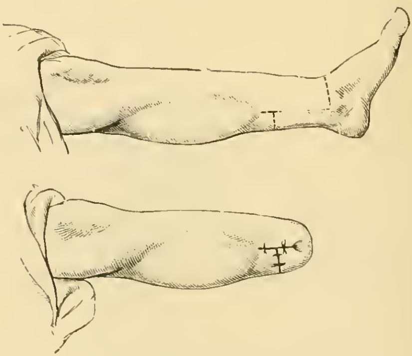
Modified Circular Method.

In this method of amputation two oval skin flaps, antero-posterior or lateral, are turned up, and the muscles are next divided by a circular sweep of the knife down to the bone (Fig. 346).

Teale's Method by Rectangular Flaps.

In this method of amputation, two flaps are made of unequal length; the incisions are so planned that the shorter flap contains the main vessel or vessels. The flaps are cut of equal width and the length of the long flap should be one-half of the circumference of the limb at the point where the bone is to be divided; the length of the short flap should be one-eighth of the circumference of the limb. The flaps are cut from without inward, and embrace all of the tissues of the limb down to the bone. After the flaps have been dissected up, the bone is divided with a saw, and the long flap is folded over and sutured to the short flap (Fig. 347).

FIG. 347.



Teale's method of amputation. (BRYANT.)

The disadvantage of this method of amputation is that in muscular limbs it requires the bone to be divided at a higher point than would otherwise be necessary.

Periosteal Flaps.

In any of the methods of amputation previously described the periosteum may be dissected up in two flaps attached to the muscles, or pushed up as a sleeve by means of a director or periosteotome before the bone is sawed. This procedure is most easily accomplished in young subjects. When these flaps are made and they are brought together, the periosteum covers the cut surface of the bone, to which it soon forms adhesions.

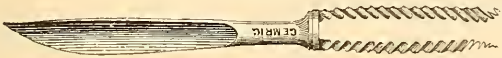
INSTRUMENTS REQUIRED FOR AMPUTATIONS.

The instruments required for amputations are knives of various shapes and sizes, saws, dissecting forceps, bone forceps, artery forceps, tenacula, hæmostatic forceps, scissors, periosteotome, tourniquets, Esmarch's bandage and strap, retractors, ligatures, sutures, and suture needles.

Amputating Knives.

The knives required for amputations vary according to the method of amputation and the part to be amputated.

FIG. 348.



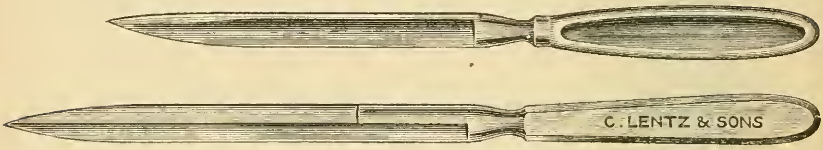
Scalpel.

FIG. 349.

Straight bistoury.

In certain amputations a scalpel (Fig. 348) or straight bistoury may be used (Fig. 349), while in other cases the employment of amputating knives of various sizes will be found more satisfactory. For amputations of the thigh a knife with a blade of eight or nine inches is generally employed, and for smaller limbs a knife with a blade of six or seven inches in length; double-edged catlins are employed in

FIG. 350.



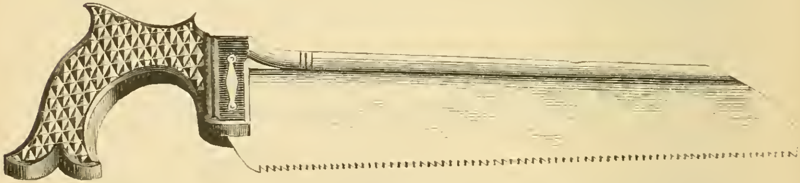
Amputating knife and catlin.

amputations of the leg and forearm to divide the interosseous tissues before applying the saw. The amputating knives now employed are constructed with solid metal handles so that they can be rendered thoroughly aseptic by immersion in boiling water before being used.

Amputating Saws.

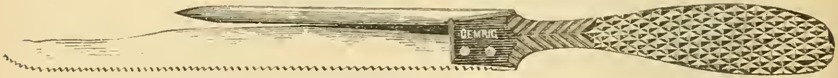
Several kinds of amputating saws are in general use; one with a blade ten inches long by two and a half inches wide,

FIG 351.



Amputating saw.

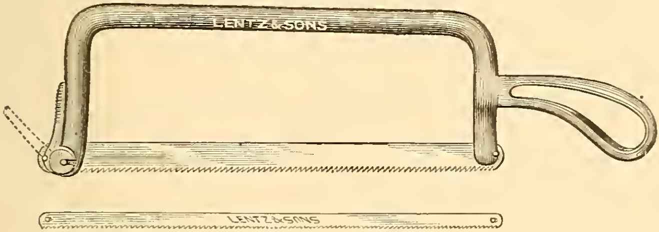
FIG. 352.



Small amputating saw.

with a heavy back to give it additional firmness, is a very good variety of saw (Fig. 351). For amputations about the foot or hand a narrow saw with a movable back will be found very convenient. (Fig. 352.) A bow saw with a metallic handle and a reversible blade is a very useful variety of saw, as it can be used either in amputations or in

FIG. 353.



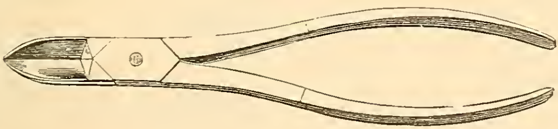
Amputating saw with reversible blade.

excisions, and, being constructed entirely of metal, it can be easily rendered aseptic. (Fig. 353.)

Bone Forceps, or Cutting Pliers.

These instruments are used in smoothing off any rough edges of bone left after the use of the saw, or for the division of the small bones in amputations of the fingers and toes.

FIG. 354.



Bone forceps, or cutting pliers.

The forceps should be from ten to twelve inches in length, with blades from one to one and a half inches in length. (Fig. 354.)

Periosteotome.

The periosteotome, or raspatory, is employed for dissecting up a flap of periosteum, which, after sawing the bone, is drawn down over the sawed end of the bone. (Fig. 355.)

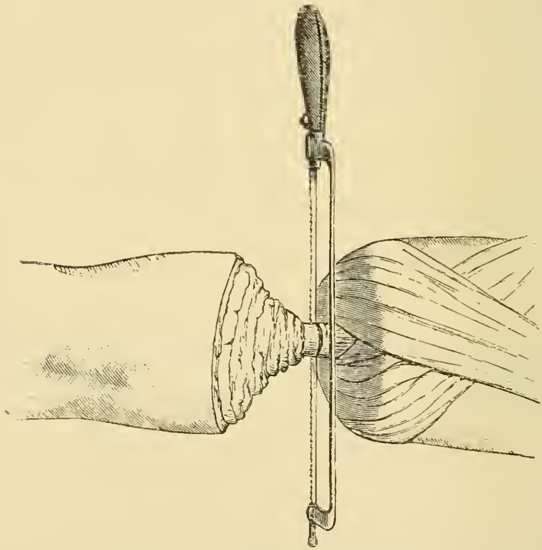
FIG. 355.

Periosteotome.

Artery Forceps and Tenacula.

These instruments are used for taking up the vessels, and one of the best forms of artery forceps is that known as the double-spring artery forceps. (Fig. 188, p. 252.) Tenacula

FIG. 356.



Retractor applied. (ESMARCH.)

are also employed for the same purpose. *Hæmostatic forceps* will also be found most useful in cases of amputation, for the rapid control of hemorrhage from small vessels after the tourniquet has been removed, the vessels being secured by ligatures before the hæmostatic forceps are removed.

Retractors.

These consist of pieces of muslin six or eight inches in width, one end of which is split into two or three tails; the former variety of retractor is employed where one bone is divided, as in amputations of the arm and thigh, and the latter in cases where two bones are divided, as in amputations of the forearm and leg. (Fig. 356.)

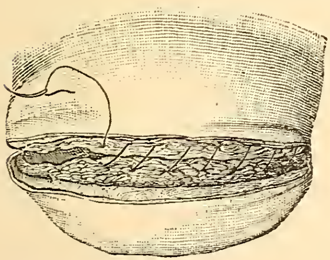
Ligatures.

The best material to employ for the ligature of vessels is juniper or chromicized catgut, the preparation of which has been described.

Sutures.

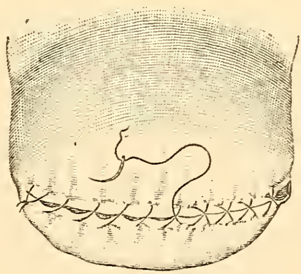
The materials employed for sutures in cases of amputation may be silkworm-gut, catgut, silk, or silver wire; deep or buried sutures of catgut in bringing together the edges of the

Fig. 357.



Deep or buried sutures of muscles. (Esmarch.)

Fig. 358.



Sutures of skin. (Esmarch.)

periosteal flaps, muscles, and fascia, are often employed with advantage in amputations (Fig. 357), the skin flaps being brought together with interrupted or continuous sutures of silk, catgut, silkworm-gut, or silver wire. (Fig. 358.)

Tourniquets.

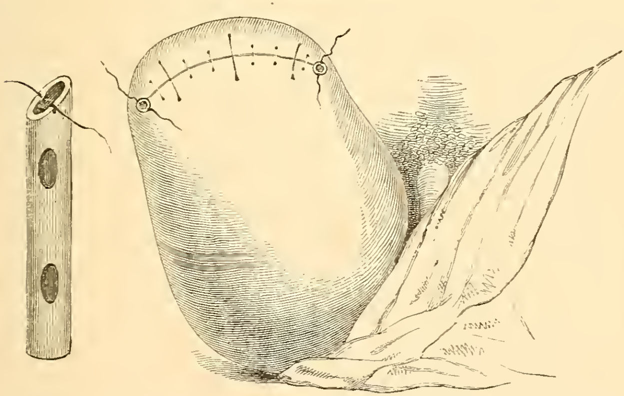
For the control of hemorrhage during the amputation the Esmarch apparatus (Fig. 186), or Petit's tourniquet (Fig. 179) is employed; or the employment of both at the same time will often be found most satisfactory. The Esmarch bandage and tube being applied, after the removal of the bandage the tourniquet of Petit is loosely applied at a higher point, and after the main vessels have been secured the elastic strap is removed and the tourniquet is screwed down and controls the bleeding until the smaller vessels have been secured by ligatures.

Details of an Amputation.

The following are the steps of an amputation of the lower part of the thigh:

The skin is first thoroughly cleansed by rubbing it with turpentine and soap and water and is then washed with an antiseptic solution either of carbolic acid 1 : 40 or bichloride of mercury 1 : 2000. Provision is next made to prevent the loss of blood during the operation by the application of Esmarch's bandage and tube; the bandage being removed a tourniquet is placed over the femoral artery in Scarpa's triangle and loosely secured. The limb is again washed with bichloride solution. The instruments having been previously placed in an antiseptic solution, a rubber cloth covered with towels wrung out in a bichloride solution is placed under the limb. The variety of amputation having been decided upon, the flaps are cut and the muscles are divided down to the bone; the periosteum being dissected up, a two-tailed retractor is applied and the tissues are held back by an assistant while the surgeon divides the bone with the saw. When the bone has been divided the retractor is removed and the surface of the wound is irrigated with a 1 : 2000 bichloride solution. The femoral artery and vein are next found and secured with ligatures, and any branches which can be found are also secured. The elastic strap is removed after screwing down the tourniquet, and by letting up the pressure on this, smaller vessels which bleed are picked up with artery forceps or hæmostatic forceps and secured. After all bleeding has been controlled the tourniquet is removed and the wound is again thoroughly irrigated with a 1 : 2000 bichloride solution. If there is much oozing from smaller vessels this solution should be as hot as the hands of the operator can comfortably stand, which will act promptly in controlling this variety of bleeding. The periosteal flaps, if they have been made, are brought together by two or three catgut sutures, and a drainage-tube is next introduced or two short tubes are introduced at either extremity of the wound

Fig. 359.



Stump showing application of sutures and drainage-tubes. (Smith.)

and secured by sutures or safety-pins; the muscles should next be brought together by a few deep or buried sutures of catgut, and the skin flaps should then be brought into apposition by a number of interrupted sutures. The inner surface of the stump is next irrigated by a stream of bichloride solution introduced through the drainage-tube, and the surface of the stump is washed with the same solution; a piece of protective is next placed over the line of the wound and over this is placed a moist carbolized, bichloride, or iodoform gauze dressing, and over this a number of layers of dry gauze; this is next covered by rubber tissue and a number of layers of bichloride cotton, or if the dry method of dressing is preferred the rubber tissue is omitted and a number of layers of bichloride cotton are laid over the gauze dressing, and the whole dressing is held in place by a recurrent bandage of the stump.

Re-dressing of Amputations.

The first dressing of an amputation, if strict antiseptic precautions have been observed at the time of operation, need not, as a rule, be made for a week or ten days, except in cases where the oozing is so profuse as to soak the dressings, or where consecutive hemorrhage has occurred, or the patient's condition shows that the wound is not running an aseptic course. The re-dressing of a stump can be accomplished without pain to the patient if the surgeon and his assistants are careful in their manipulations.

The dressings to be applied, the solutions for irrigation, and the instruments required should be prepared and at hand before the stump is exposed. The surgeon and his assistants should wash their hands carefully, and then dip them in a 1 : 2000 bichloride solution. The bandage retaining the dressings to the stump should be divided with bandage scissors without lifting the stump from the pillow upon which it rests. After the bandage has been divided and turned aside, the gauze dressing is next unfolded and turned down; an assistant now slips his hands under the stump and gently raises it from the dressings, and at the same time a rubber cloth covered with towels which have been wrung out in a 1 : 2000 bichloride solution is slipped under the stump and the soiled dressings are removed. The protective covering the incision is next removed and the surface of the stump is irrigated with a 1 : 2000 bichloride solution; the drainage-tubes are next examined and the cavity of the stump is irrigated with the bichloride solution through the tubes by means of a syringe or an irrigating apparatus.

If the wound is aseptic and there seems to be no further indication for the use of the drainage-tubes they may be removed and the track of the tube should be washed out with the antiseptic solution by the syringe or irrigator. The sutures are next examined and if the wound is firmly healed alternate sutures may be removed; if catgut or silkworm-gut sutures have been used they need not be disturbed at this dressing, and their removal may be postponed until a subsequent dressing.

The wound should next be covered with a piece of protective, and a gauze dressing should be applied consisting of a number of layers of bichloride cotton, and the dressings should be held in place by a recurrent bandage of the stump. In holding the stump the assistant should hold it firmly to prevent muscular spasm, and after the dressings have been secured it should be placed upon a clean pillow prepared for its reception. The same procedures are adopted at subsequent dressings, and if the wound has run an aseptic course, two or three dressings, at most, will be required.

Special Amputations.

Amputations of the Hand.

Amputations of the Fingers.

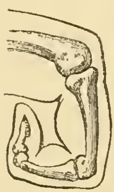
The fingers may be amputated in the continuity of the phalanges or in their contiguity, and, as a rule, as it is important to save as much as possible of the finger, the former method is generally to be employed instead of disarticulation at a higher point. The incisions should be so planned that the cicatrix does not occupy the plantar surface; the larger flap should, therefore, be taken from the palmar aspect of the finger. In amputating the phalanges of the fingers in their *continuity* the circular method (Fig. 363, *B*) or a short dorsal flap and a long palmar flap may be employed. In *disarticulating* a phalanx it is best to enter the joint with a narrow knife from the dorsal side, and after having carried it through the joint, to cut a long palmar flap, keeping close to the bone. (Fig. 360.) In locating

Fig. 360.

Amputation of finger: long palmar flap. (Erichsen.)

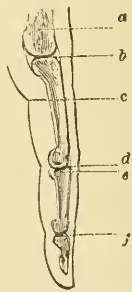
the position of the phalangeal joints it is well to remember that the prominence of the knuckle, when the finger is flexed is formed entirely of the head of the proximal, and

Fig. 361.



Phalanges flexed.

Fig. 362.



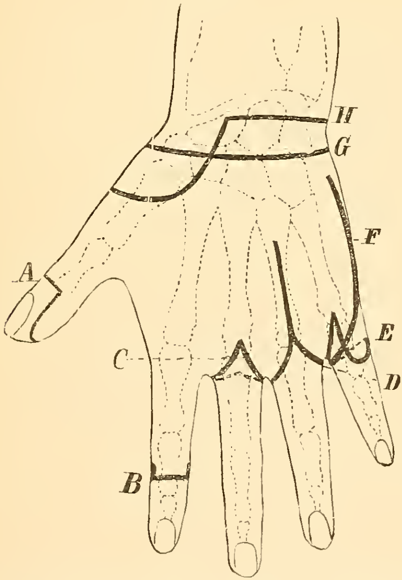
Guides to articulations of the finger. (Smith.)

not of the base of the distal phalanx (Fig. 361), and also that the folds on the palmar surface of the finger do not correspond exactly to the joints. (Fig. 362.)

Amputation of the Finger through Metacarpo-phalangeal Articulation.

In this variety of amputation an incision is made from a point of the dorsal surface of the metacarpal bone a quarter of an inch above the articulation, which is carried through the interdigital web and back upon the palmar sur-

FIG. 363.

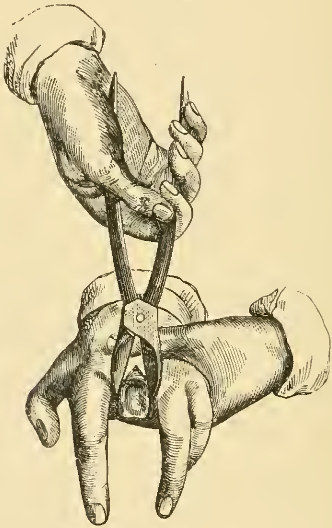


A. Disarticulation of phalanx, palmar flap. *B.* Amputation in continuity, circular. *C.* Metacarpo-phalangeal disarticulation. *D.* Amputation of metacarpal bone in continuity. *E.* Disarticulation of little finger. *F.* Disarticulation of fifth metacarpal bone. *G.* Amputation at the wrist, circular. *H.* Amputation at the wrist. (STIMSON.)

face to a point a quarter of an inch above the flexor fold (Fig. 363, *C*). A similar incision beginning and ending at the same points is made upon the opposite side of the finger. The flaps are dissected back, and the lateral ligaments, tendons, and remainder of the capsule are divided. The finger may also be amputated at the metacarpo-phalangeal joint by making an incision on one side and dissecting the flap back to the joint, then dividing the lateral ligament, opening the joint and carrying the knife across this, dividing the tendons and lateral ligament on the other side and cutting a flap from within outward.

Removal of the head of the metacarpal bone if desired may be accomplished by the use of cutting pliers (Fig. 364),

FIG. 364.



Removal of head of metacarpal bone. (SKEY.)

but, as a rule, this procedure is not to be recommended, for, although the deformity is diminished, the strength of the hand is also diminished.

In amputating the *little* and *index* fingers a full lateral flap may be cut on the free side and an incision is next carried across the palmar surface to the angle of the web and thence back to the joint, which is opened and the disarticulation is effected. (Fig. 363, *E*.)

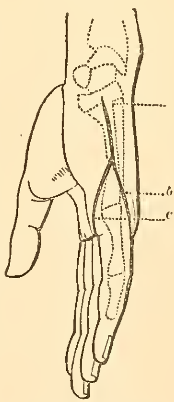
In amputations of the finger at the phalangeal joints or at the metacarpo-phalangeal joints two vessels usually require ligaturing, and after these are secured a catgut drain or a small drainage-tube is introduced and the flaps are brought together by a few interrupted sutures.

Amputations of the Metacarpal Bones.

In amputating the metacarpal bones it is advisable to leave the carpal ends of the bones to avoid opening the wrist-joint, except in the case of the first and fifth metacarpal bones, which do not communicate with the others and with the synovial sacs.

The incisions for the removal of the metacarpal bones are the same as for the removal of a finger at the metacarpo-phalangeal joint, the incision being prolonged backward as far as necessary over the dorsal surface of the bone. (Fig. 363, *D.*) After the metacarpal bone has been bared for a sufficient distance, it is cut through with bone-pliers or disarticulated, and the distal end is raised from its bed and carefully separated from the soft parts, care being taken to avoid injury of the structures of the palm of the hand.

Fig. 365.



Incision for removal of the fifth metacarpal bone. (Smith.)

In amputating the fifth metacarpal bone the incision should be made along the inner border of the hand and carried down to the bone between the skin and the abductor minimi digitii muscle. (Fig. 365.) The lower end of the incision passes over the knuckle to the web of the finger and backward under the palmar surface to join the first incision.

Amputation of the entire thumb with its metacarpal bone is effected by making an oval flap from the palmar surface; in case of the left thumb the joint may be opened by an oblique incision on the dorsal surface of the hand, beginning a little in front of the joint and being carried down to the web between the thumb and forefinger; the palmar flap is then made by thrusting the knife upward to its point of entrance and cutting downward and outward. In amputating the right thumb with its metacarpal bone it is better to make the palmar flap first by transfixion, the dorsal flap being made subsequently.

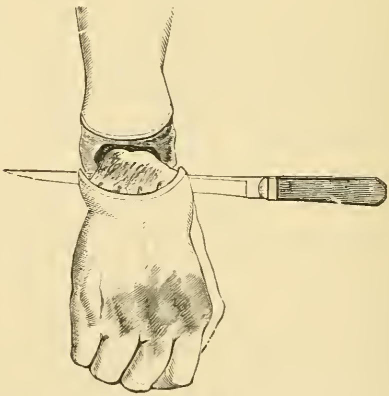
Amputation of the hand at the carpo-metacarpal joint is occasionally performed, or between the rows of carpal bones, but is not as a rule to be recommended, as the carpal bones are apt subsequently to become diseased and require removal, so that it is better to amputate at the radio-carpal joint.

AMPUTATIONS AT THE WRIST.

Circular Method.

The skin of the forearm near the wrist being retracted by an assistant, a circular incision of the skin and cellular

FIG. 366.



Amputation at the wrist. (ERICHSEN.)

tissue is made half an inch below the point of the styloid process of the radius. (Fig. 363, *G*.) The skin and cellular tissue are next dissected back as far as the joint, which is opened and the disarticulation is completed.

Antero-posterior Flap Method.

This method is also employed in amputations at the wrist-joint; an incision carried downward is made on the back of the hand from one styloid process to the other; the hand being flexed the tendons are divided and the joint opened, and the palmar flap, which should extend as far as the base of the metacarpal bones, is cut from within outward. (Fig. 366.) Amputation at the wrist is sometimes done by cutting a single flap from the palm, the joint being opened by a transverse incision on the back of the hand from one styloid process to the other.

Lateral Flap Method.

This method (Fig. 363, *H*) is also sometimes employed in amputation at the wrist, and may be employed with advantage in cases of laceration of the hand, in which the injury to the tissues prevents the formation of the flaps used in the other methods of amputation.

Amputations of the Forearm.

The forearm may be amputated by the circular or flap methods, or by making rectangular flaps (Teale's method).

Circular Method.

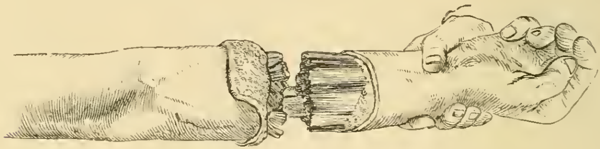
At the lower portion of the forearm the circular method of amputation is to be preferred. A circular incision of the skin and cellular tissue is made and a cuff is dissected up, the muscles and interosseous membrane being cut through; a three-tailed retractor is next applied and the bones are divided with a saw.

Mixed Method.

Amputation of the forearm by the mixed method, which consists in first dissecting up two antero-posterior oval flaps of skin and cellular tissue and then dividing the muscles by a circular incision, is also a satisfactory operation. (Fig. 367.)

In amputations at the upper portion of the forearm, *antero-posterior*, or *lateral* flaps, cut from without inward or by transfixion, or *rectangular* flaps may be made with advantage.

FIG. 367.



Amputation of the forearm by mixed method. (BRYANT.)

The principal vessels requiring the application of ligatures in amputations of the forearm are the radial, ulnar, and interosseous arteries.

AMPUTATIONS AT THE ELBOW.

The methods of amputation employed at the elbow are the anterior flap, lateral flap, and circular.

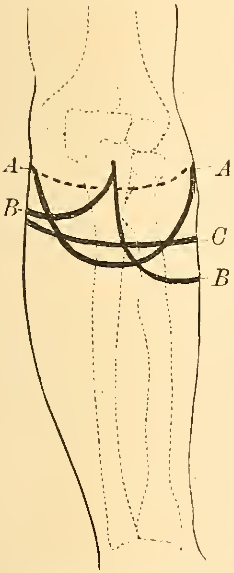
Anterior Flap Method.

A flap three inches in length with its base parallel to and half an inch below the condyles of the humerus, is cut either by transfixion or from without inward. The joint is next opened and the lateral ligaments divided and the olecranon is exposed and the attachment of the triceps is separated and a posterior flap is cut from without inward, or from within outward a little below the line of the condyles. (Fig. 368, *A*.)

Lateral Flap Method.

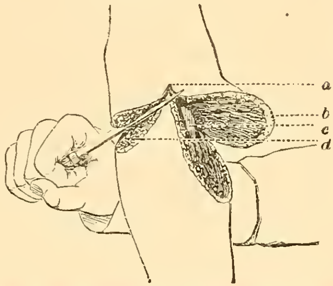
In amputation at the elbow-joint lateral flaps may be employed, cut either from without inward or by transfixion. (Fig. 368, *B*.) An external flap three inches in length is made on the outer side of the arm, starting from a point a finger's breadth below the bend of the elbow, by transfixion or by cutting from without inward; a shorter internal flap is next cut in the same manner, and the joint is opened and the disarticulation effected. (Fig. 369.)

FIG. 368.



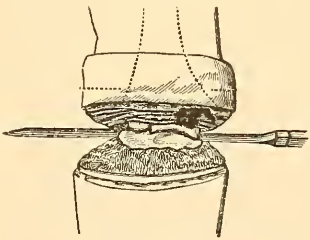
Amputation at the elbow-joint. *A.* Anterior flap method. *B.* External flap method. *C.* Circular method. (STIMSON.)

FIG. 369.



Lateral flap method of amputation at the elbow-joint. (SMITH.)

FIG. 370.



Circular amputation at the elbow. (SMITH.)

Circular Method.

An incision dividing the skin and cellular tissue is made around the limb three inches below the line of the condyles of the humerus (Fig. 368, *C*), the skin is dissected up and a circular incision made through the muscles, the joint is opened and the disarticulation effected. (Fig. 370.)

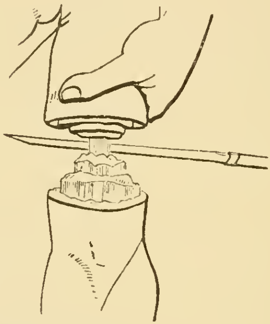
Amputations of the Arm.

The arm may be removed at any point below the attachment of the muscles at the axilla, by either the circular, flap, oval, or modified circular methods.

Circular Method.

This operation is usually employed in removing the arm in its lower third: a circular incision of the skin and muscles

Fig. 371.



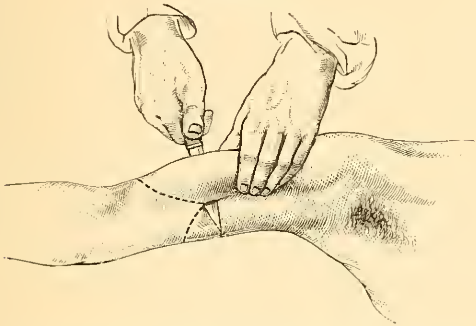
Circular amputation of the arm.

is first made, and when the cuff has been dissected up, a circular division of the muscles is made, and after applying the retractor the bone is sawed through. (Fig. 371.)

Flap Method.

From the central position of the bone in the arm the flap method in amputating the arm is preferred by many operators. The arm being grasped by the hand the point of a medium-sized amputating knife is thrust through the arm so as to pass over the humerus and make its exit at a corresponding point in the skin on the opposite side; a flap of sufficient length is cut from within outward. The knife is next passed behind the bone and a posterior flap is cut in the same manner (Fig. 372); the bone is next cleared of muscular tissue and the flaps are retracted and it is divided with a saw.

FIG. 372.



Amputation of the arm by flap operation. (BRYANT.)

Lateral flaps may be made in this amputation in the place of the antero-posterior flaps, and they are cut from within outward in the same manner.

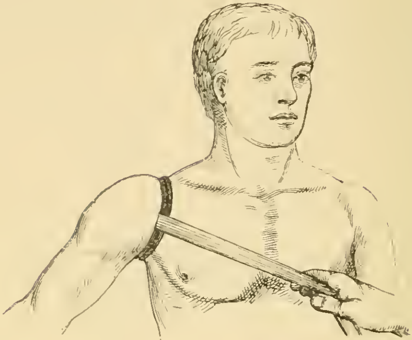
Oval, or Modified Oval Method.

This method of amputating the arm is also employed with advantage. An oval flap of skin and cellular tissue is made and dissected up, and the muscular tissue is divided by a circular incision. Or two oval flaps of skin and cellular tissue are cut and dissected up, and the muscles are next divided by a circular sweep of the knife.

In all amputations of the arm it is well to remember the possibility of a high division of the brachial artery, and to see that the abnormal vessel is properly secured, if present.

In high amputations of the arm there is sometimes not room enough to apply Esmarch's strap or a tourniquet to the arm itself to control the hemorrhage during the operation, and in such cases the strap may be passed from the axilla around the outer end of the clavicle, as is done to control the bleeding during amputation at the shoulder-joint. (Fig. 373).

FIG. 373.

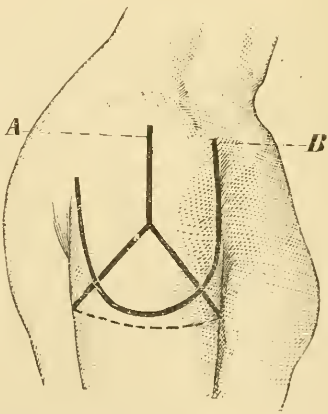


Esmarch's strap applied in high amputation of the arm. (SMITH.)

AMPUTATIONS AT THE SHOULDER-JOINT.

Several methods of operation are employed in amputating at the shoulder-joint, such as the oval method, or Larrey's method, flap method, Lisfranc's or Dupuytren's method, and

FIG. 374.



Amputation at the shoulder-joint. *A*. Oval, or Larrey's method. *B*. Double-flap, or Lisfranc's method. (STIMSON.)

Spence's method. (Fig. 374.) The control of the bleeding from the axillary artery during the operation is a matter of the first importance, and it may be arrested by pressure made upon the subclavian artery, as it crosses the first rib, with the thumb, or the padded handle of a large key, or by the fingers of an assistant grasping the axillary flap and compressing the vessel after the head of the bone has been disarticulated, or by the use of an elastic strap applied around the axilla and shoulder. (Fig. 373.)

Oval, or Larrey's Method.

In this method of amputation the point of the knife is entered just below the acromion process, and a deep incision

FIG. 375.

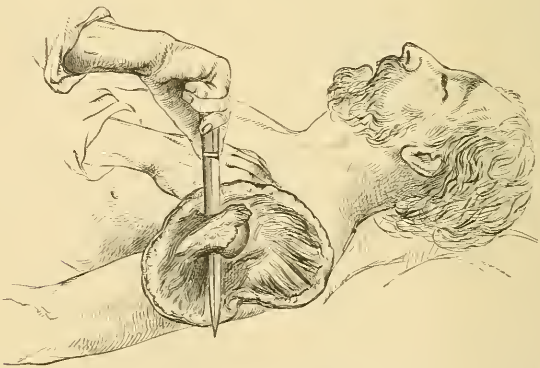
Amputation at the shoulder-joint by Larrey's method.

three inches in length is made down to the head of the bone in the axis of the arm; from the middle of this incision two others are made obliquely downward to the points where the anterior and posterior folds of the axilla end in the tissues of the arm; the latter incision should be only deep enough to divide the skin and superficial fascia. The flaps are then dissected up until the head of the bone is well exposed, and, after opening the capsule and dividing the muscles inserted into the neck and tuberosities of the humerus, which division may be facilitated by rotating the head of the bone outward and inward, the disarticulation is effected by adducting the elbow; the knife is next passed downward behind the bone and made to cut outward in the line of the cutaneous incisions—an assistant controlling the artery before it is divided, by grasping the axillary tissues behind the knife with his fingers.

Flap, or Dupuytren's Method.

In this method of amputation at the shoulder-joint the flaps may be cut either by transfixion, or from without in-

Fig. 376.



Amputation at the shoulder-joint, Dupuytren's method. (Bryant.)

ward; the large flap embraces the greater part of the deltoid muscle, and the smaller or short flap is cut from the inside of the arm after the head of the bone has been disarticulated. When cut by transfixion, the point of the knife should be entered an inch in front of the acromion process and pushed across the outer aspect of the head of the humerus, and should be brought out at the posterior fold of the axilla; the knife is made to cut downward until a large deltoid flap is formed. This flap is turned up, and the head of the bone is disarticulated; the knife being placed behind it, a short flap is cut out, keeping close to the bone so that the vessel is divided with the last cut of the knife. (Fig. 376.) An assistant should control the vessel by grasping the axillary tissues with his fingers behind the knife.

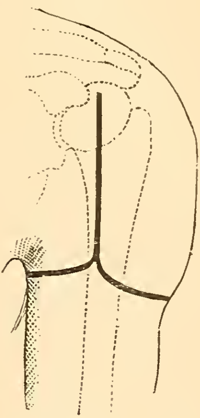
Double Flap, or Lisfranc's Method.

In this method of amputation at the shoulder-joint the point of the knife is entered at the outer side of the coracoid process, and is carried across the outer aspect of the head of the humerus and brought out a little below the posterior border of the acromion process, and a long flap is cut downward. This flap is turned up and the attachments of the head of the bone are divided and it is disarticulated. The knife is again entered behind the bone, and a long posterior flap is cut from within outward. (Fig. 374, *B*.)

Spence's Method.

In this method of amputation at the shoulder-joint an incision is made down to the head of the humerus immediately in front of the coracoid process, and is continued downward through the clavicular fibres of the deltoid and pectoralis major muscles until the attachment of the latter to the humerus is reached. (Fig. 377.) The incision is now carried backward to the posterior fold of the axilla. A second incision, including only the skin and cellular tissue, is next made from the anterior portion of the first incision

Fig. 377.



Amputation at the shoulder-joint. Spence's method. (Stimson.)

across the inside of the arm to meet the incision on the outer part. The outer flap thus formed is turned up and the head of the bone is disarticulated, and the operation is completed by dividing the remaining tissues on the axillary aspect.

Many other methods of removing the arm at the shoulder-joint have been devised and employed, including the circular method.

Amputation above the Shoulder-joint.

This form of amputation consists in the removal of the arm with a part or the whole of the scapula and sometimes a portion of the clavicle.

As this form of amputation is required in cases in which the laceration of the parts has passed beyond the shoulder-joint, or in cases of growths involving the tissues beyond the joint, no definite rule can be laid down for the incisions; the only rule being as far as possible to make the incisions in such a manner that the least possible amount of skin is sacrificed, so that a sufficient covering for the wound can be obtained.

Amputations of the Foot.

Amputations of the Toes.

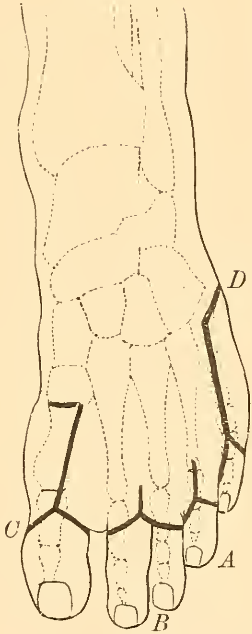
The phalanges of the toes may be removed in the same manner as those of the fingers. It is better to amputate at the metatarso-phalangeal articulations than to attempt to remove them at the joints in front of this articulation, except in the case of the great toe, as the preservation of a portion of a toe is rather a discomfort than an advantage, except in the instance mentioned. All incisions should be made so that the resulting cicatrix does not occupy the plantar surface, and it is well to remember that the web of the toes is considerably below the position of the metatarso-phalangeal joint. (Fig. 378.)

The toes are usually removed by an incision on the dorsal surface a little above the joint, which is carried down the bone for about an inch and then diverges into the web, and

Fig. 378.

Relations of web and metarso-phalangeal joint of toes. (Stimson.)

Fig. 379.



Incisions for amputation of toes and metatarsal bones. (Stimson.)

is carried under the toe and back on the other side to the point of divergence. (Fig. 378.)

Amputation of Two Adjoining Toes.

The dorsal incision should be made in the inter-metatarsal space just above the level of the joint (Fig. 379, *B*) and carried down to the beginning of the web; then over the toe to the beginning of the adjoining web, and under the plantar surface of both toes in the line of the digito-plantar fold, through the web and back to the point of divergence.

Amputation of the Great Toe.

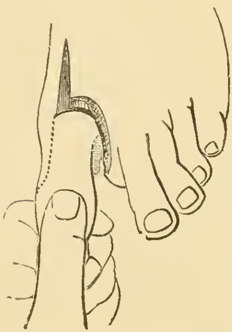
This may be accomplished by means of the racket-shaped incision employed in amputation of the other toes or by means of a lateral flap. In the latter case the knife is made to enter the joint by cutting through the commissure, and the operation is completed by carrying the knife through the joint and along the outer or inner side of the bone, forming a flap of the required size. (Fig. 380.)

In this amputation a short dorsal flap and long plantar flap may be employed, or a long internal flap may be used.

Amputation of All the Toes.

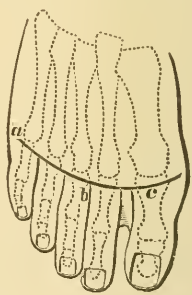
To amputate all the toes, make a dorsal incision from the head of the fifth to the head of the first metatarsal

FIG. 380.



Amputation of the great toe. (SMITH.)

FIG. 381.



Incision for amputation of all the toes. (SMITH.)

bone; the incision should be a curved one passing just in front of the joints. (Fig. 381.) Dissect up the flap and open the joints, dividing the lateral ligaments, and pass the knife behind the phalanges and cut a flap from the plantar surface.

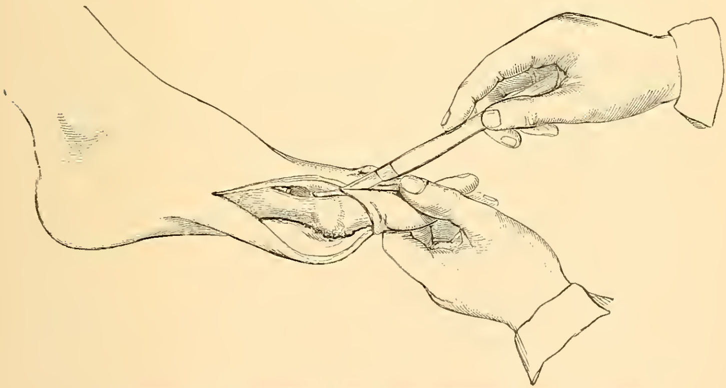
Amputation of the Metatarsal Bones.

It is better in these amputations to leave the tarsal head of the metatarsal bone in place and divide the bone, or in other words to do an amputation in continuity to prevent opening up the tarsal articulations.

Amputation of the Metatarsal Bone of the Great Toe.

The incision begins upon the dorsal surface of the metatarsal bone, a little below the point at which the bone is to be divided, and is carried down below the metatarso-phalan-

Fig. 382.



Amputation of the great toe and first metatarsal bone. (Smith.)

geal joint, then diverges and passes under the toe and comes back again to the point of divergence. (Fig. 379, *C*.) The bone is exposed and cut through with cutting forceps and is then lifted up and dissected loose from the tissues. (Fig. 382.)

Amputation of the Fifth Metatarsal Bone.

The incision for the removal of the fifth metatarsal bone is made over the bone a little below the metatarso-tarsal articulation, and is carried down and curved around the toe (Fig. 379, *D*), and after the bone is exposed by dissecting back the flaps, it is divided, or the joint is opened and it is dissected out.

Amputation Through the Metatarsal Bones.

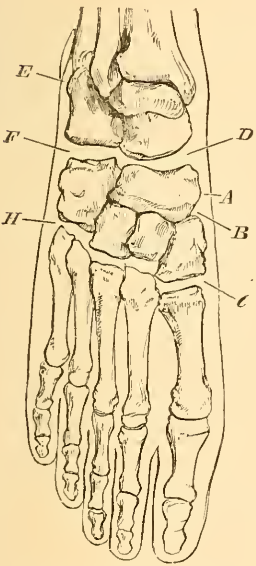
In performing this amputation an incision is made across the dorsum of the foot and a short dorsal flap is dissected up; the metatarsal bones are next divided with a saw and a long plantar flap is cut from within outward by entering the knife behind the ends of the bones.

Tarso-metatarsal Amputations.

In all amputations of the foot involving the tarsus the surgeon should be thoroughly familiar with the anatomy of the foot and the surgical landmarks of the different articulations. I shall refer to those laid down by Mr. Bryant, which are as follows:

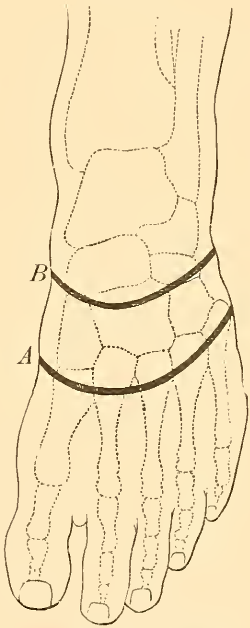
"On the *inner* side of the foot not far from the inner malleolus the tubercle of the scaphoid (Fig. 383, *A*), is to be felt as a marked prominence; about one-half an inch in front of this will be found the articulation with the cuneiform bone (*B*), and one inch in front of this the joint which the surgeon will have to open in Lisfranc's or Hey's operation (*C*); just above the tubercle of the scaphoid will be found the articulation with the astragalus, the line of Chopart's amputation (*D*). On the *outer* side of the foot, one inch below the external malleolus, a sharply defined projection will always be felt. which is the peroneal tubercle (*E*), one-half an inch in front of this will be found the joint which separates the os calcis from the cuboid (*F*), this joint forming the outer circle to Chopart's amputation. Half an inch in front again or one inch from the tubercle, the prominence of the fifth metatarsal bone is always to be felt (*H*), the line above this prominence indicating the articula-

FIG. 383.



Surgical guides to the foot as expressed by anatomy. (BRYANT.)

FIG. 384.



Incision for—*A*. Lisfranc's amputation. *B*. Chopart's amputation. (STIMSON.)

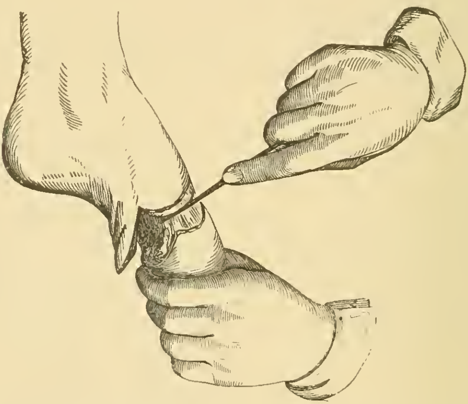
tion with the cuboid bone, which forms the outer boundary of the incision for Hey's or Lisfranc's amputations.

Tarso-metatarsal Amputation (Lisfranc's).

The incision for this amputation is a curved one carried across the dorsum of the foot from the base of the fifth to the base of the first metatarsal bone. (Fig. 384, *A*.) The incision should involve the skin only, its centre lying half an inch or more below the centre of the line of the articulations, and it should begin and end at the sides of the foot at their junction with the sole. A plantar flap should be marked out by a curved incision crossing the sole of the foot near the origin of the toes, starting and ending at the same points as the dorsal incision.

The dorsal flap is next dissected back to the line of the articulations; the tendons, muscular fibres, and fascia being divided, the joints between the tarsal and metatarsal bones are opened with a stout, narrow-bladed knife. (Fig. 385.)

Fig. 385.



Amputation at tarso-metatarsal joint (Lisfranc's). (Skey.)

Difficulty is sometimes experienced in opening the joint between the head of second metatarsal bone and the second cuneiform bone, which occupies a position higher on the foot than the other articulations. The disarticulation may also be facilitated by forcibly depressing the anterior portion of the foot. After the joints have all been opened, the knife is passed behind the ends of the metatarsal bones and a plantar flap is cut from within outward, following the line of the incision previously marked out. The plantar flap may be cut from without inward if preferred.

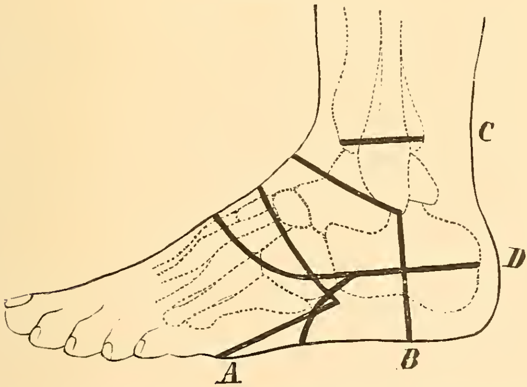
Tarso-metatarsal Amputation (Hey's).

The line of incision and the steps of this operation are similar to those in Lisfranc's amputation, with the exception that Hey sawed off the projecting portion of the internal cuneiform bone after disarticulating the metatarsal bones. This modification, although it improves the appearance of the stump, possesses no advantages over the previous procedure.

Medio-tarsal, or Chopart's Amputation.

In this amputation the disarticulation is through the joints formed by the astragalus and calcaneum behind and the scaphoid and cuboid in front. An incision is made from

FIG. 386.



Line of incision for—*A*. Chopart's amputation. *B*. Syme's amputation. *C*. Section of bone in Syme's amputation. *D*. Subastragaloid amputation. (STIMSON.)

the tubercle of the scaphoid across the dorsum of the foot an inch in front of the head of the astragalus to the lower and outer border of the cuboid. (Fig. 386, *A*.) The plantar flap is next marked out by an incision beginning and ending at the same points as the first incision and crossing the sole of the foot four or five finger-breadths nearer the toes. The dorsal flap is next dissected up, and after the tendons and fascia have been divided the joint is opened

Fig. 387

Chopart's amputation. (Bryant.)

and a plantar flap is cut from within outward following the line of the previously marked out plantar incision. (Fig. 387.)

Subastragaloid Amputation.

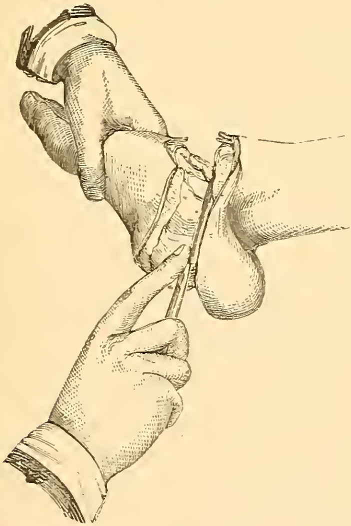
In this amputation all the bones of the foot are removed except the astragalus. An incision is made beginning an inch below the tip of the external malleolus which is carried forward to the base of the fifth metatarsal bone; it is then carried over the dorsum of the foot to the calcaneocuboid articulation. (Fig. 386, *D*.) The joints between the scaphoid and astragalus and between the astragalus and calcis are opened, and the latter bone is carefully dissected out; the ligaments are divided and the astragalus only is allowed to remain in place.

Amputations at the Ankle-joint.

Syme's Amputation at the Ankle-joint.

In this amputation, the foot being at a right angle to the leg, an incision is made from the centre of one malleolus directly across the sole of the foot to the centre of the opposite malleolus. (Fig. 386, *B*) The tissues of the heel are next carefully dissected from the bone by keeping the knife close to the osseous surface until the tuberosity of the os calcis is fairly turned. The two extremities of the first incision are then joined by a transverse one across the instep, and, the joint being opened, the lateral ligaments are divided to complete the disarticulation. (Fig. 388.) The

Fig. 388.



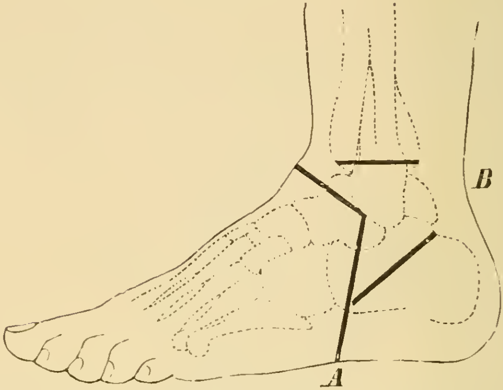
Syme's amputation at the ankle-joint. (Skey.)

knife is next used to clear the malleoli, and they are next removed by the saw in the line indicated. (Fig. 386, *C.*)

Pirogoff's Amputation at the Ankle-joint.

In this amputation the posterior portion of the os calcis is retained. The incision is carried from the tip of the inner malleolus, over the instep, half an inch in front of the anterior edge of the tibia, to a point half an inch in front of the tip of the outer malleolus; a second incision, crossing the sole of the foot and carried down to the bone,

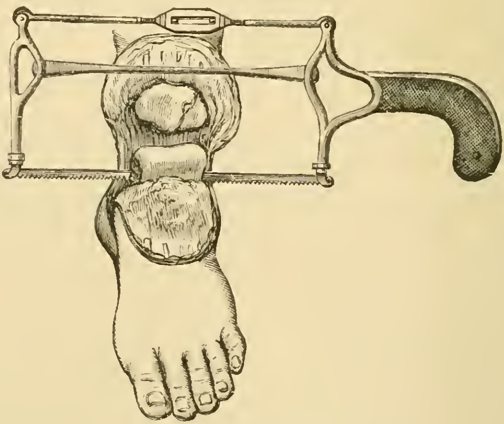
FIG. 389.



Pirogoff's amputation. *A*, cutaneous incision. *B*, line of section of bones. (STIMSON.)

is next made. (Fig. 389, *A*.) The plantar flap is dissected back for a quarter of an inch, the joint is opened by dividing

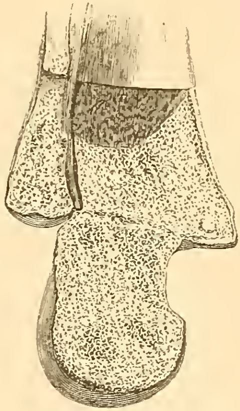
FIG. 390.



Application of saw to calcis in Pirogoff's amputation. (ERICHSEN.)

the lateral ligaments, and the astragalus is disarticulated, and the malleoli are exposed. A narrow saw is next applied to the upper and posterior part of the calcaneum behind the astragalus, and it is divided obliquely downward in the line of the plantar incision. (Fig. 390.) The malleoli and a thin slice of the tibia are next removed with the saw as in Syme's amputation. (Fig. 386, *C*.) Some surgeons do not remove the malleoli, but press the sawed surface of the os calcis between them when it is possible to do so. The position of the os calcis in relation to the tibia after union has occurred, is shown in Fig. 391.

Fig. 391.



Union between calcaneum and tibia in Pirogoff's amputation. (Hewson.)

Roux's Amputation at the Ankle-joint.

In this method of amputation an incision is made at the outer edge of the tendo Achillis, a little above its insertion, which is carried forward under the outer malleolus, and across the instep half an inch in front of the anterior edge of the tibia, and back to a point just in front of the inner malleolus; the incision is carried from this point downward and partly across the sole of the foot, and then back to the point of origin of the original incision. (Fig. 392.) The flaps are dissected up for a short distance, the ankle-joint is then opened, and the disarticulation is effected, and the internal flap is carefully dissected from the bones.

Other methods of amputation of the foot are sometimes emloyed; such, for instance, as that advocated by *Hancock*, who has combined Pirogoff's amputation with the subastragaloid method, bringing the sawed surface of the os calcis in contact with a transverse section of the astragalus.

Hancock has advocated the propriety of amputating in the foot without regard to the position of the tarsal joints, cutting the flaps of sufficient length and dividing the bones with a saw.

Tripier has also modified the subastragaloid amputation by leaving the upper part of the calcaneum, which he saws through on a level with the sustenaculum tali, and at right angles to the axis of the leg; the external incisions are made as in Chopart's amputation.

Fig. 392.

Incisions in Roux's amputation.

In the method advocated by *Mikulicz* the astragalus and calcaneum are removed, the ends of the tibia and fibula are sawed off, and the sawed surface of the scaphoid and cuboid are approximated to these, the stump resulting resembling the foot of *pes equinus*.

Amputations of the Leg.

The leg may be amputated at its lower, middle, or upper third, the rule being to save as much of the limb as possible, but as regards the application of prothetic apparatus, I think the stumps resulting from amputations in the middle and upper thirds will be found more satisfactory. It is well also in sawing the bones to divide the fibula at a slightly higher point than the tibia.

Amputation at the Lower Third of the Leg.

At this position the leg may be amputated by the circular, modified circular, or elliptical method.

Circular Method.

A circular incision is made through the skin and connective tissue just above the malleoli and the cuff is dissected up for a sufficient distance, and a circular incision of the tendons and muscles is next made and the tissues being retracted the bones are divided with a saw.

Modified Circular Method.

In this method of amputation of the leg a circular incision of the skin and connective tissue and two short lateral incisions are made and the flaps are dissected up to the end of the incisions, and a circular division of the muscles is next made. (Fig. 393, *A*.) Or oval skin flaps are made and dissected up, and the tissues are next divided down to the bone by a circular incision and the bones are divided with a saw. (Fig. 395.)

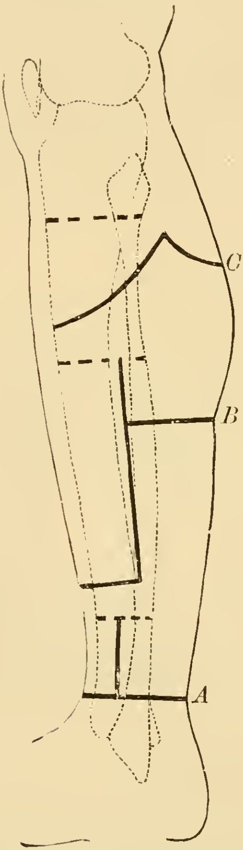
Elliptical Method.

In this method of amputation the incision is in the form of an ellipse, its lower end crosses the heel below the insertion of the tendo Achillis and the upper end of the incision is about an inch above the anterior articular edge of the tibia. (Fig. 394, *B*.)

Long Anterior Flap Method.

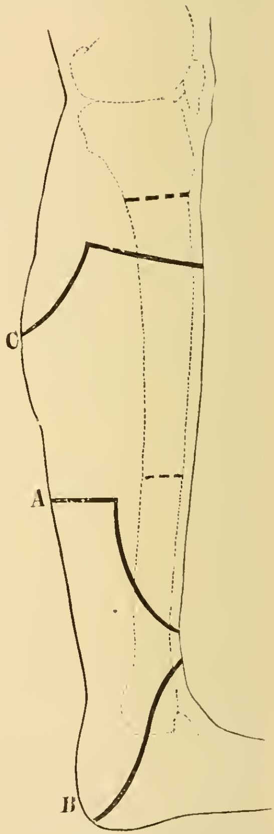
An anterior flap equal in length to the diameter of the leg at its base is marked out by a curved incision through the skin beginning at the posterior edge of the tibia on the inner side, a little below the point at which the bones are to be divided, and is carried over the leg to a point directly opposite over the fibula. (Fig. 394, *A*.) The anterior muscles are divided transversely half an inch above the

Fig. 393.



Amputation of the leg. *A*. Modified circular method. *B*. Rectangular flap. *C*. Antero-posterior flaps. (Stimson.)

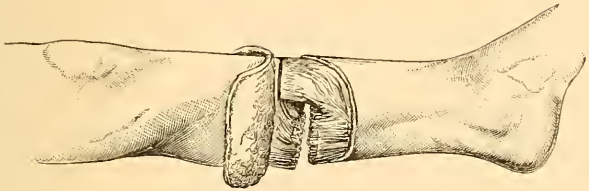
Fig. 394.



Amputation of the leg. *A*. Long anterior flap. *B*. Supra-malleolar long posterior flap. *C*. At upper third. (Stimson.)

lower end of the flap and are dissected from the bones to the base of the flap.

FIG. 395.



Oval skin flaps with circular division of the muscles.

The posterior flap is then made by entering the knife behind the bones at the point of the original incision and cutting directly outward.

Long Anterior Rectangular Flap Method. (Teale.)

In this method of amputation of the leg an incision equal in length to half of the circumference of the leg is made from the point at which the bones are to be divided on one side of the leg and is carried across the limb and back upon the opposite side to a point opposite the point of starting. The flap thus marked out is dissected up to its base and a posterior flap one-fourth the length is next cut by a transverse incision down to the bones and is dissected back to the line of the origin of the first incision. (Fig. 393, *B.*) The long flap is next doubled back and its edges secured to the posterior flap, or the long flap may be cut from the posterior surface of the leg and the short flap from the anterior surface.

Antero-posterior Flap Method.

A long anterior flap including half of the circumference of the limb may be cut from without inward, composed of skin, connective tissue, and muscles, and a short posterior flap cut from within outward may also be employed. This method is often employed in amputations in the upper portion of the leg. (Fig. 393, *C.*)

Lateral Flap Method.

In the lower and middle thirds of the leg the method of amputation by means of lateral skin flaps may be employed with advantage. In this method an incision is made over the spine of the tibia and an oval flap, embracing one-half of the circumference of the leg, composed of the skin and connective tissue, is dissected up; starting from the same point a similar flap is cut upon the opposite side of the leg and dissected up; the muscles at the upper extremity of the flaps are next divided by a circular incision and the bones are divided with a saw.

External Flap Method. (*Sédillot.*)

In this method of amputation of the leg the point of the knife is entered a finger's breadth external to the spine of the tibia and carried outward, grazing the fibula and is brought out as far as possible to the inner side; a flap three or four inches in length is then cut from within outward; the extremities of the incision are next united by an incision across the inner side of the limb involving the skin only; any remaining muscular tissue is next divided and the bones are sawed, and the long external flap is brought over the ends of the bones and fastened to the edges of the incision on the inner side of the limb. Prof. Ashhurst modifies this operation by cutting the long external flap from without inward, and makes also a short internal flap in the same manner. By either method the resulting stump is a good one, with the ends of the bone covered by the tissues of the external flap.

Amputations at the Knee-joint.

Amputations at the knee-joint may be done either by the circular or elliptical incision or by means of flaps, and may consist in simple disarticulations or sections through the condyles of the femur.

Elliptical or Oval Method.

In this operation an incision crossing the spine of the tibia five finger-breadths below the lower extremity of the patella is carried around the back of the leg three finger-breadths higher than in front; the tissues on the front of the leg are dissected up until the tendon of the patella is exposed; the leg is then flexed and the ligament of the patella is divided; the capsular ligament and the lateral and crucial ligaments are next divided, care being taken not to injure the popliteal vessels with the point of the knife. The tibia is next drawn forward and the knife is passed behind its posterior border, and the remaining soft parts are divided from within outward.

Anterior Flap Method.

In this method of amputation a long cutaneous flap is formed; the incision beginning half an inch below the articulation is carried five inches below the patella; crossing the anterior surface of the leg it is carried back to the condyle of the femur on the opposite side. This flap is dissected up and the ligament of the patella is divided, and the disarticulation is effected. A short posterior flap, uniting the anterior incision one inch below its extremities, is next cut by transfixion or from without inward. (Fig. 396, *A*.)

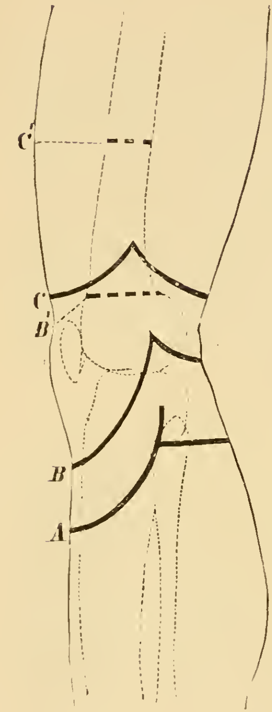
Amputation through the Condyles of the Femur.

In this amputation, which is known as *Carden's* amputation, an anterior flap, whose lower extremity is three finger-breadths below the patella, is cut and the disarticulation is effected, and the posterior soft parts are divided. The patella is removed and the condyles next sawed through just above the edge of the articular cartilage. (Fig. 396, *B*.)

Lateral Flap Method.

In this operation an incision is made just below the patella, which is carried down the spine of the tibia for

Fig. 396.



Amputations at the knee-joint and lower third of thigh. *A.* Long anterior flap. *B.* Amputation through condyles. *C.* Modified flap at lower third of thigh. (Stimson.)

Fig. 397.

Amputation at knee-joint by lateral flaps. (Smith.)

three inches, and is then carried backward to the middle of the leg to a point opposite the beginning of the incision; a similar flap is cut on the opposite side of the leg, and the flaps are dissected up to the line of the articulation, and when this point is reached the joint is opened and the disarticulation is effected. The patella is not removed. (Fig. 397.)

Gritti's Amputation at the Knee-joint.

In this operation a long rectangular anterior flap is first cut and dissected up, and after the disarticulation has been effected the skin covering the posterior surface of the knee is cut from within outward. The condyles of the femur are next removed by a saw above the edge of the articular cartilage, and the articular surface of the patella is removed by the saw or cutting forceps. The patella is next brought down so that its sawed surface is in contact with the sawed surface of the condyles, and the flaps are brought together. (Fig. 398, *A*.)

Amputations of the Thigh.

Modified Flap Method.

Two semilunar flaps of skin and connective tissue, the upper extremity of which are several inches above the condyles of the femur, are cut and dissected up, and the muscles are next divided by a circular incision, and the bone is cut through with the saw. (Fig. 396, *C*.)

Long Anterior Flap Method.

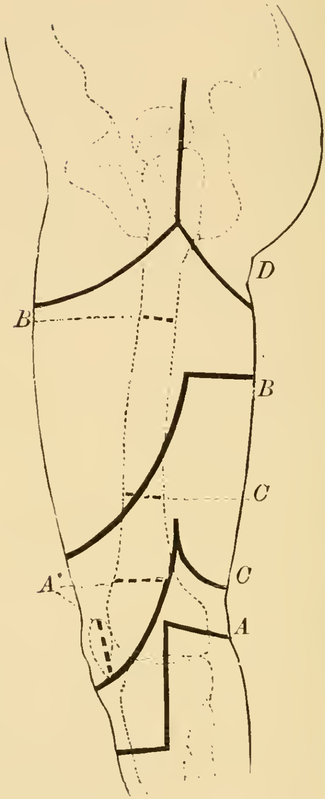
In this operation an incision is made on the anterior aspect of the thigh, marking out a flap whose length is equal to one-third, and whose width at its base is equal to two-thirds, of the circumference of the limb. The anterior muscles are next divided obliquely upward and backward, so that the flap shall not be too thick, and the posterior muscles are cut transversely and the bone is divided with a saw. (Fig. 398, *B*.)

Amputation in the lower third of the thigh may also be effected by employing a *long anterior* and *short posterior* flap. The anterior flap is cut, its lower extremity extending down to the lower edge of the patella, and after dissecting up the skin and cellular tissues to the upper extremity of the patella, the muscles are cut obliquely up to the point at which the bone is to be divided. A short posterior flap is next cut, and the soft parts being retracted, the bone is sawed through. (Fig. 398, *C*.)

Amputation of the Thigh by Transfixion.

In amputations of the thigh the flaps may also be cut by transfixion, either *lateral* or *antero-posterior* flaps being employed. (Fig. 399.)

FIG. 398.

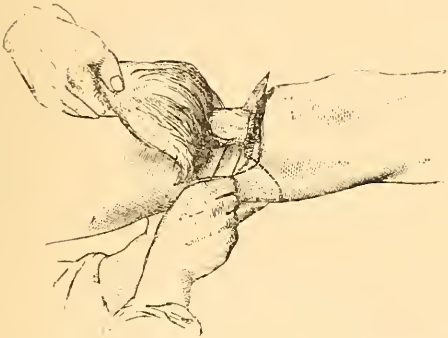


A. Gritti's amputation at the knee. *A'*. Lines of division of the bones. *B*. Amputation of the thigh, long anterior flap. *B'*. Division of the bone. *C*. Amputation at the lower third of the thigh. *C''*, Division of the bone *D*. Disarticulation at the hip-joint.

Amputation of the Thigh through the Trochanters.

When, for any reason, it is inadvisable to amputate at the hip-joint, an amputation may be made through the trochanters, a long anterior and short posterior flap being employed with a circular division of the muscles.

Fig. 399.

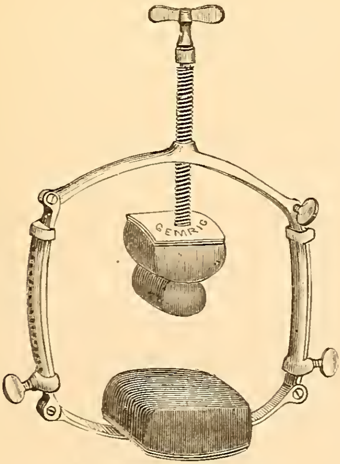


Amputation of thigh by flaps cut by transfixion.

Amputations at the Hip-joint.

In amputations at the hip-joint it is important that provision be made for the control of hemorrhage during the

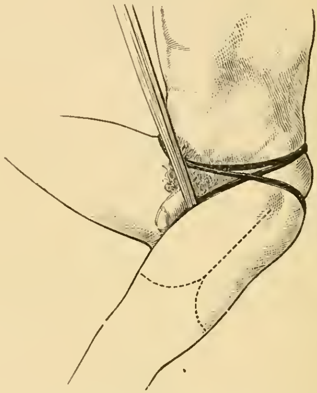
Fig. 400.



Abdominal tourniquet.

operation, and this is accomplished by the use of an abdominal tourniquet (Fig. 400), or by the use of Davy's lever making compression upon the common iliac artery from the rectum, or by compression of the femoral artery by the fingers of an assistant, or by the preliminary ligation of the femoral artery just below Poupart's ligament. Esmarch's

Fig. 401.



Esmarch's elastic strap applied to control hemorrhage during amputation at the hip-joint.

elastic strap may also be employed for the control of bleeding during amputation at the hip-joint, the strap being applied in such a manner that it occupies the position of the turns of a spica bandage of the groin. (Fig. 401.)

The most satisfactory method of controlling the bleeding during amputation at the hip-joint, or at the trochanters, is that recommended by Wyeth, which consists in the use of two stout steel pins twelve inches in length, and a piece of rubber tubing one-half of an inch in diameter and five or six yards in length. The point of one pin is inserted into the tissues one and a half inches below the anterior spine of the ilium, and is passed through the tissues external to the neck of the femur, and its point is made to project from the skin just back of the great trochanter; the second pin is passed through the skin an inch below the level of the groin internal to the saphenous opening, and is carried through the adductor muscles and its point made to emerge half an inch in front of the tuberosity of the ischium; the rubber tubing is next wound around the thigh above the pins and securely tied.

The methods of amputation at the hip-joint are the *oval*, *antero-posterior flap*, and *lateral flap*, and *modified circular* methods.

Oval Method.

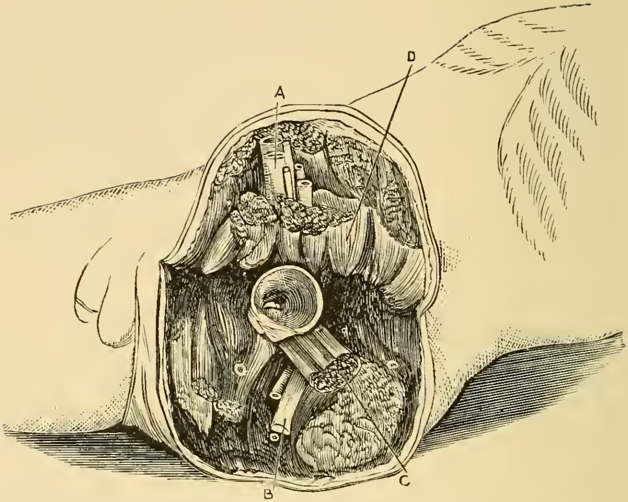
This is performed by entering the point of a strong knife into the tissues below the anterior superior spinous process of the ilium and making two oblique incisions, one forward and downward and the other backward, both incisions meeting on a transverse line on the inner side of the thigh. The muscles are next divided on a little higher line, and when the joint is exposed disarticulation is effected from the outside and any remaining tissue is divided.

Antero posterior Flap Method.

In this method the point of a long amputating knife is thrust into the tissues about two finger-breadths below the anterior superior spinous process of the ilium, and is pushed through the tissues grazing the hip-joint and is brought out on the opposite of the thigh close to the junction of the scrotum. The knife is next carried downward close to the bone and an anterior flap of sufficient length is cut from within outward. This flap is held up by an assistant and the head of the bone is disarticulated, and the knife being passed behind the bone, a posterior flap of equal length is cut from within outward. (Fig. 402.)

Guthrie's method of amputation at the hip-joint consists in cutting the flaps from without inward, a smaller knife being used for this purpose and the posterior flap being cut first.

Fig. 402.

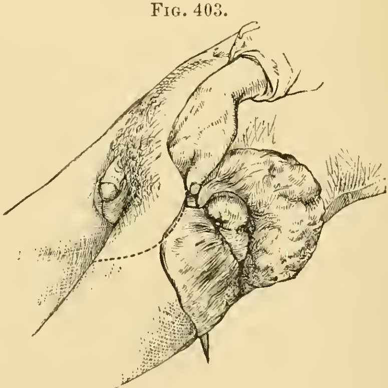


Amputation at the hip-joint by antero-posterior flaps. (Holmes.)

Modified Circular Method.

In this operation short antero-posterior flaps of skin and connective tissue are cut and dissected up, and the muscles

Fig. 403.



Amputation at the hip-joint by external and internal flaps. (Bryant.)

are divided by a circular incision on the level of the joint, and the disarticulation of the head of the femur is next effected.

Lateral Flap Method.

In this operation two flaps are cut from the inner and outer side of the thigh by transfixion, or by cutting from without inward and exposing the joint, which is opened and the disarticulation of the head of the femur is effected as in the previous methods. (Fig. 403.)

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