Pye's elementary bandaging and surgical dressing : with directions concerning the immediate treatment of cases of emergency for the use of dressers and nurses.

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ELEMENTARY BANDAGING
AND
SURGICAL DRESSING

PYE

TWELFTH EDITION

PYE'S

ELEMENTARY BANDAGING

AND

SURGICAL DRESSING

WITH DIRECTIONS CONCERNING
THE IMMEDIATE TREATMENT OF CASES
OF EMERGENCY

FOR THE USE OF DRESSERS AND NURSES

REVISED AND PARTLY REWRITTEN

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TWELFTH EDITION

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PREFACE
TO THE TWELFTH EDITION

THE numerous alterations in this Edition have
been adapted for the most part from the recent
new Edition of Pye's " Surgical Handicraft."

W. H. CLAYTON-GREENE.

43, QUEEN ANNE STREET, W.,
September, 1910.

PREFACE TO FIRST EDITION

THIS little book is chiefly a re-issue of those portions of " Surgical Handicraft " which deal with bandaging, splinting, etc., and of those which treat of the management in the first instance of cases of emergency, only such new matter being added as is required to give some sort of continuity to the extracts.

While I am anxious that the book should not pretend to be anything but a reprint, I yet hope that within its own limits it is fairly complete, and that it will prove to be useful to students when they begin their work in the wards and casualty rooms, and useful also to surgical nurses and probationers.

WALTER PYE.

4, SACKVILLE STREET,
March, 1886.

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ELEMENTARY BANDAGING.

SECTION I.

OF APPARATUS FOR RESTRAINT AND SUPPORT (BANDAGES, SPLINTS, ETC.).

CHAPTER I.

OF BANDAGES AND KNOTS.

THE first part of this section deals with the several kinds of **bandages**, and the second part with **splints** in their varieties and modes of application.

On all sides the tendency of modern surgery is towards greater simplicity in dressing wounds, and in other procedures which involve the use of bandages. The number of distinct " patterns " of bandages now in use is very much less than we find described even in recent books on the subject, and infinitely less than classical authors, such as Scultetus and Paré, considered it necessary to describe and figure. Only those ways of applying bandages now in constant use will be described.

Bandages may be roughly divided into " Triangulars " or " Scarfs," " Rollers," and bandages of special form such as the " T," the " H," or the " many tailed." The material employed is usually grey shirting, i.e., unbleached calico, but roller bandages are often made of flannel, or of some woven material, for greater elasticity or strength ; or of muslin, for holding plaster-of-Paris, etc.

The choice of the form of bandage, and of the material, will depend on such points as these—

The amount of restraint or support required. Thus, a simple triangular bandage will serve to keep a large dressing on the scalp, while a twisted or

knotted roller will be required to restrain the hæmorrhage from a recent wound there.

The effect of the bandage on the skin and circulation of the part. Consideration of this point leads to the selection of material, care as to its tightness, and choice of the best method of applying it. Thus, in a limb likely to swell, an elastic pattern, such as " figure of 8," will be chosen, while if firmness be most required, the " turned" bandage should be used.

The contour of the part. The " spiral " may be used for parts which are uniform ; the " figure of 8 " or " reverse " for parts of varying girth, like the calf, and the " figure of 8 " or the " spica " for joints.

The length of time the bandage will have to be kept on. If the bandage be for a temporary purpose only, there will not be the same elaboration required as if it were meant to be kept on for some time ; in this latter case the particular plan will often be settled from considerations of future cleanliness.

THE TRIANGULAR BANDAGE.

This bandage is the half of a square yard or rather more, and is usually made of unbleached calico.
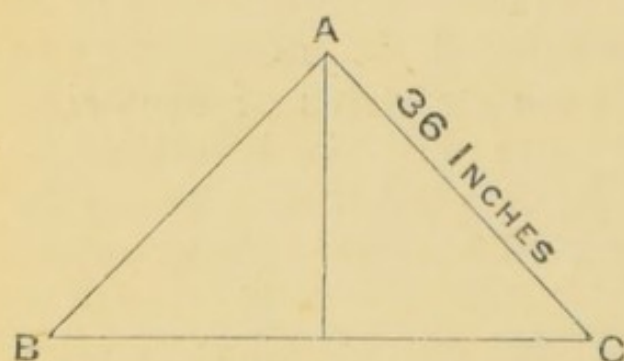
Fig. 1—The Triangular Bandage.

The first and most obvious use of this bandage is to simply tie it round where it may be wanted, with a reef knot, after having previously folded it into a *cravat.* A *Cravat* is made by bringing the point to the centre of the lower border, and folding once or twice again in the same direction, according to the width required. Improvised splints may be thus attached, an emergency tourniquet made, or a leg swung from a cradle, etc.

The *Sling* is another very useful bandage, and very quickly put on ; indeed, of all the applications

of the triangle it is the most frequently required. Although its application may be shown in a few seconds, a written description of it, as with other bandages and knots, is more complicated.

Let the right-angled corner (*Fig.* 1), the " point," be called A, and the upper and lower acute-angled ones, the " ends," B and C respectively.* Standing in front of the patient, corner A should be placed in the axillary line on the affected side, midway between the axilla and the ilium ; B should reach up to, and hang over, the opposite shoulder. The line B to C will then hang diagonally across the body, and between it and the arm to be slung. The arm should be placed in the required position, and C brought up over the shoulder on the affected side and tied with B in a bow, behind or to one side of the neck. The elbow should then be kept in position by pinning A round it (see *Fig.* 2).
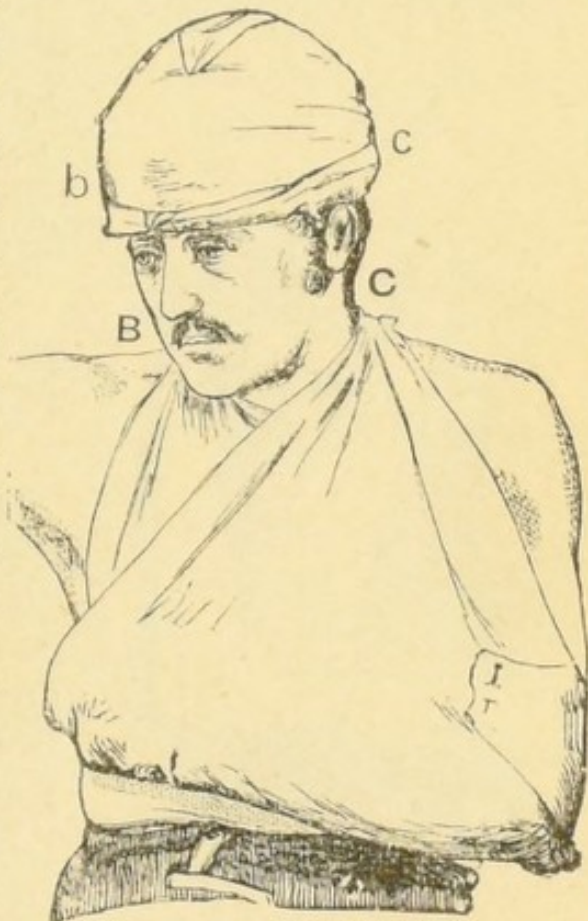
Fig. 2.—The Sling and Head Bandages.

In slinging the forearm, the sling should be made just short enough to slightly elevate the shoulder, or the patient will not trust all the weight of the limb to it. The hand should be a little higher than the elbow. Sometimes, as in fractures of the humerus, the weight of the forearm is used as an extension, while the hand and wrist alone are slung by the bandage folded up into a cravat, three or four inches

* These letters apply to the rest of the triangular bandages where they may appear on the figures, in the same way.

wide, and tied behind the neck. *In this case the position of the ends of the sling should be reversed, the anterior going over the shoulder of the unaffected side (Fig. 3).*

The Head bandage (Fig. 2) differs hardly at all from the picturesque head-dress of the Italians, which may be seen worn by the women organ-grinders. It is very useful as a cap to retain dressings in their place on the scalp, but it is not fitted for compression. As a cap it is infinitely superior to the " capeline " roller bandage, which is hot and difficult to apply.

Standing behind the patient, who should be sitting down, the middle of the long side of the bandage, opposite **A**, is placed along the forehead above the eyes, the triangle covering the head, and corner **A** hanging down behind ; the rest of the long side is then brought round the sides of the head, taking care that the hands, as they apply the bandage, are kept low, so as to bring the lower edge well below the occiput.

Fig. 3.—Forearm slung, with the elbow hanging free,

The tails **B** and **C** should be crossed, *not knotted*, over **A**, below the occipital protuberance, brought forward again round the head to the forehead, and tied. **A** is then turned up and pinned to the surface of the triangle on the head.

The only points to be attended to are, the keeping the hands low while working from before backwards, and to cross the ends well below the occiput. If this is done the cap cannot slip off, and if not, no tightness will make it firm.

THE ROLLER BANDAGE.

To bandage neatly is to bandage well, and to be able to bandage well is essential. The art of using the roller bandage properly is one not to be learned without practice, even though it be freely allowed that the subject has been quite uselessly complicated by needless rules and patterns.

As to the materials for these roller bandages, a strip of any stuff which fulfils the conditions of sufficient strength, with lightness and softness, will do. The length of the strip varies from $4\frac{1}{2}$ to 6 yards, the width from 2 to 4 inches; $2\frac{1}{2}$ and $3\frac{1}{2}$ inches being the commonest sizes; the larger sizes, 6 inches, are known as " rib-rollers."

For description, roller bandages may be divided into *elastic, semi-elastic*, and *in-elastic kinds.*

Elastic bandages are of several kinds, woven, indiarubber, etc.

Semi-elastic bandages are either woven in a special manner or made of somewhat elastic material. Under this heading come all flannel bandages, domette, silk or cotton net, etc. The application of these bandages is much more simple than that of the in-elastic, for they will lie smoothly, if they are merely rolled on firmly, so that they hardly ever require turning or other manipulation. They should be rolled up rather loosely before use.

The *in-elastic*, or common bandages, are the most frequently used, especially in hospitals, where the other kinds would be too expensive, even if they were firm enough for the requirements.

They are usually made of " grey shirting " or unbleached calico, or the same bleached ; or for use about the eyes or face, a very cool, light bandage may be made of finer cotton stuff or linen. Very old worn damask linen is not infrequently used for covering pads or cushions, and, speaking generally, it may be said that washed stuffs are better than new, which often contain a stiffening dressing. They should always be torn, and no selvage retained.

The general rule is to use the 2½-inch bandage for the arms and head, the 3½-inch for the legs and pelvis, and the 4½-inch for the chest and abdomen.

Except for the trunk, however, it will be found that the narrowest bandage is the easiest to apply and the most comfortable in all cases.

Application.—In order to apply the *common Roller bandage* to any part of the body, the first thing to learn is how to judge of the firmness and support required, and to distribute the pressure evenly about the limb. For this purpose the bandage must always be kept rolled up (dropping it is a sure sign of a bungler or beginner), and held (as in *Fig.* 4) three or four inches away from the part, while the finger and thumb are used to retain the bandage in its place when it is being applied. The next point is the manipulation known as
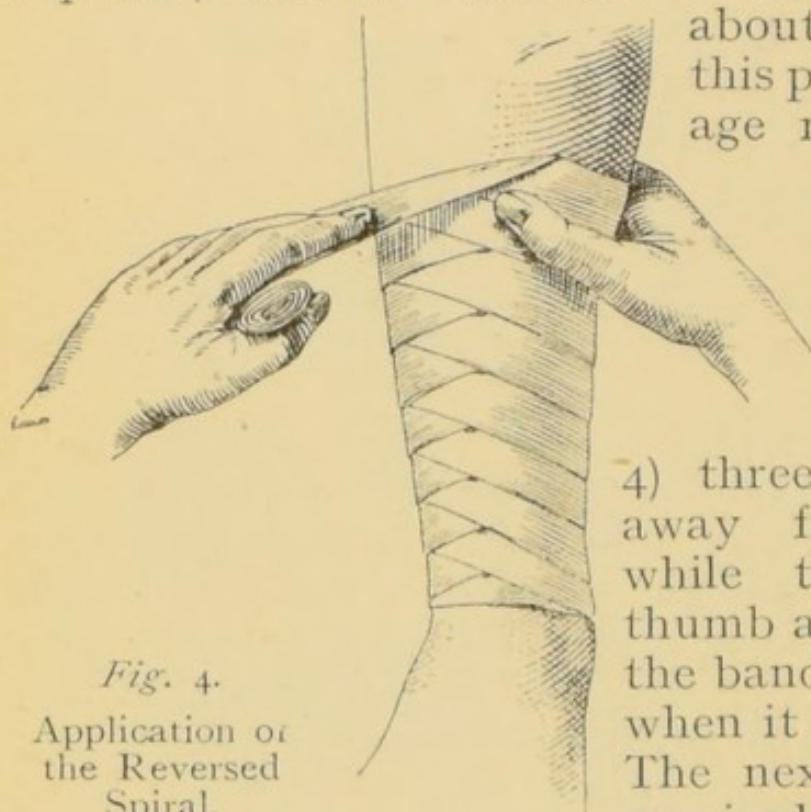
Fig. 4.

Application of the Reversed Spiral.

" turning " or " reversing," by means of which the bandage is turned over on itself while it is being applied. The object of this turning is that the bandage may lie smoothly, and be firm as well ; for inasmuch as all parts of the limbs, etc., are constantly varying in diameter, and the edges of the bandage will not stretch to make one side longer than the other, it follows that if it be simply rolled on in a spiral fashion, only the largest diameter of the limb covered by each turn of the bandage will be grasped by it, and the bandage will be loose elsewhere, as in *Fig.* 5.

To avoid this, the bandage is, when necessary,

turned over as in *Fig.* 4, and by this means the upper and lower edges are frequently changed, so that the whole width of the bandage grips the limb. This turning requires a little knack, but is easily learned. The secret of doing it well consists in having the portion in the hand (*Fig.* 4) quite loose, so that, by bringing the roller down, it naturally falls over. The thumb must, therefore, be holding the turn of the bandage last applied during this manœuvre. Moreover, the bandage should be brought across the limb with a good slope upwards, say 45° to its long axis, and the reverse similarly be brought boldly down, so that the bandage is well doubled over, otherwise some of the fold will appear on the other side of the limb when the bandage comes round.

The most common fault is that of screwing the roller round
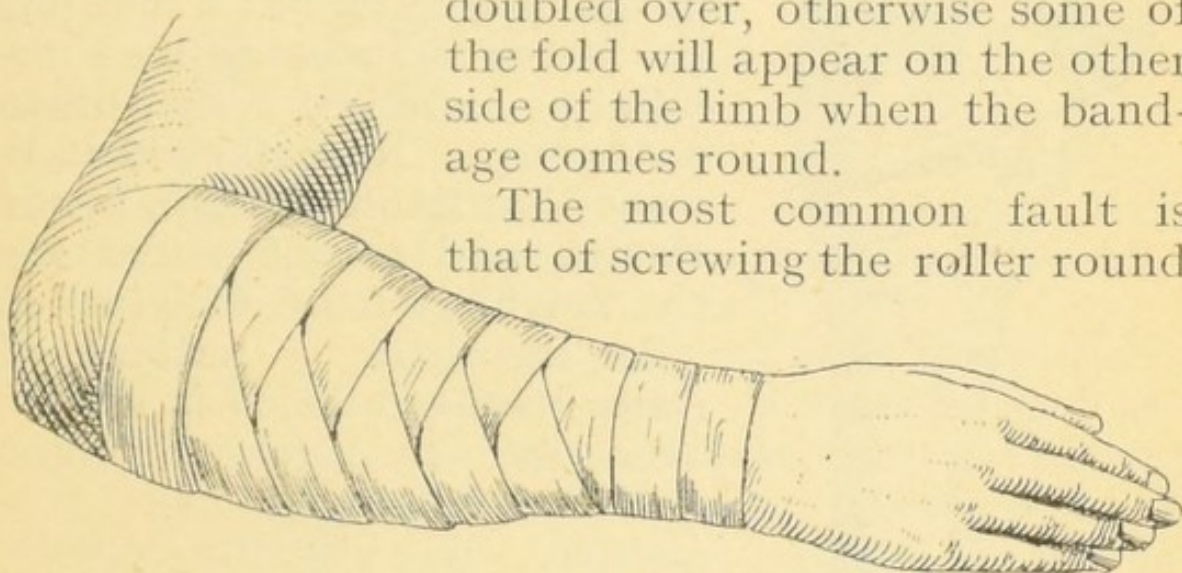
Fig. 5,—Forearm bandaged below with a simple Spiral; above with the "Reversed" Spiral Roller. The latter grasps the limb evenly, the former does not.

on its own axis, instead of allowing the bandage to fall over into position, as it should do almost of its own accord.

As a rule it is best to turn every time the bandage comes round, and the turns should be made in the same straight line, which should lie on the outer aspect of the limb; but these points are not essential, and both depend rather on the æsthetics of bandaging than on any practical advantage.

General Rules for Bandaging. — Bandage from below upwards, and always have the upper part of the bandage looser than the lower.

Bandage smoothly without irregularities or creases.

Start from within outwards, except in fractures of the femur and Pott's fracture at the ankle.

Do not bandage a limb under splints. There are exceptions to this rule, as will be seen later.

Pass the end of the bandage obliquely across the limb at the start, and fix it with one or two turns round the limb so that it does not slip.

Before applying the bandage, wash and shave the limb and dust it with starch and boracic powder.

The roller bandage with reverses is a common method of bandaging. It may be applied to the trunk or limbs (as in *Figs.* 4 and 6), to fasten splints, and on an infinite number of other occasions. Nevertheless it is somewhat liable to slip, is not elastic, and is not suited for the neighbourhood of joints.

In its stead, a pattern of roller bandage which is hardly ever used in England might well be employed more frequently, namely the *double-headed Spiral with Reverses* (*Fig.* 7). Its description, like that of many other bandages, is more complex than its application. The bandage is a combination of a simple spiral roller with a reversed spiral; so that whilst one head of the roller is applied spirally, each of the turns thus made is covered and fixed by a reversed turn made with the other head. Inasmuch as even compression can always (other things being equal) be more efficiently made with a double-headed than with a single roller, the value of this pattern lies in the firmness with which it can be applied to a limb, while it is nearly

Fig. 6.—Reversed Spiral of Foot and Leg.

impossible that it should slip. The heads must of course be of unequal length; that used for the reverses being the longer. The pattern requires some practice to apply with ease, but the labour will be well spent.

A pattern which is at once firm and elastic, and which can be applied over most joints, is the *Figure of* 8 (*Fig.* 8). This bandage, when applied to the length of the limb, or over
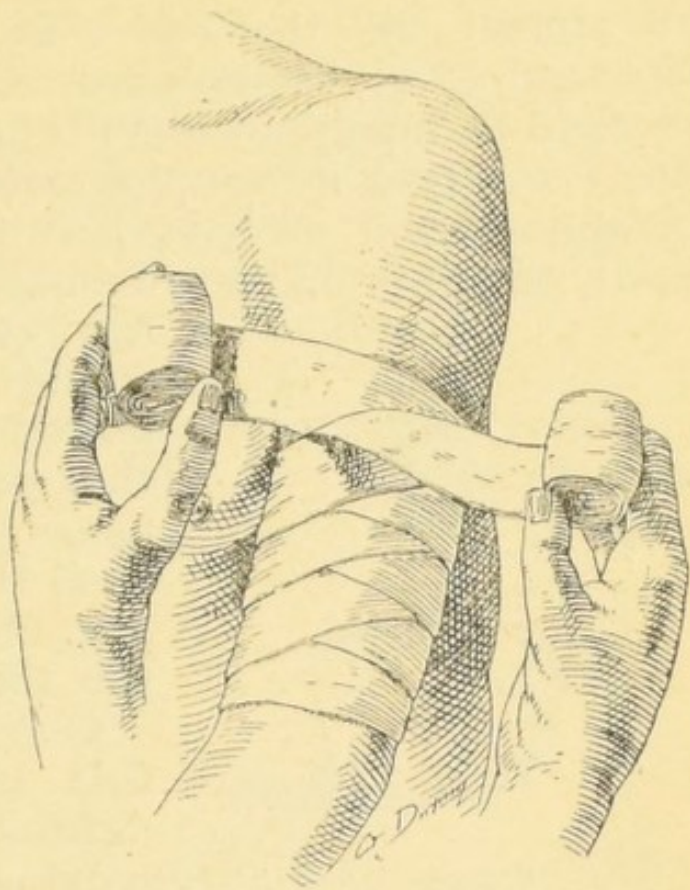
Fig. 7.—Double-headed Spiral with Reverses.

a joint so as to cover it completely, presents much the same appearance when finished as the spiral roller with reverses (compare *Figs.* 4 and 8), but in its application it is entirely different. The accompanying illustration (*Fig.* 8) will give a better idea of this than any words can do. The great point to bear in mind is to make the loops of the 8 as open as possible, by going boldly up the limb and coming down again as far as the bandage will allow.

As has been implied, this bandage may be employed
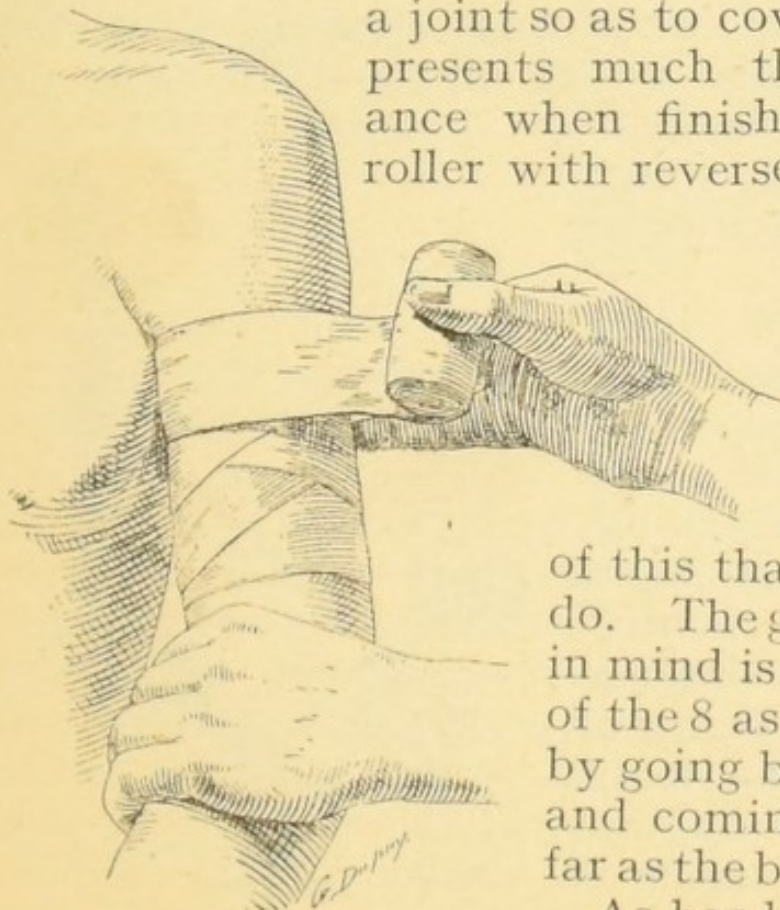
Fig. 8.—Application of the Figure of 8 Bandage.

in almost all the cases in which the turned bandage is generally used, and it is often really preferable, being not less firm and yet more elastic ; but as a rule its employment is confined to the neighbourhood of joints, so that if a limb *and* a joint, or joints, have to be bandaged, say the ankle, leg, knee and thigh, there would be a *turn* or two placed round the foot, then the ankle would have the *figure of* 8 (leaving out the heel) the leg the *turned* (see *Fig.* 6), the knee *the* 8, and the thigh the *turned* again.

One practical reason for this change is that the figure of 8 requires more bandage to cover a limb than the turned spiral does.
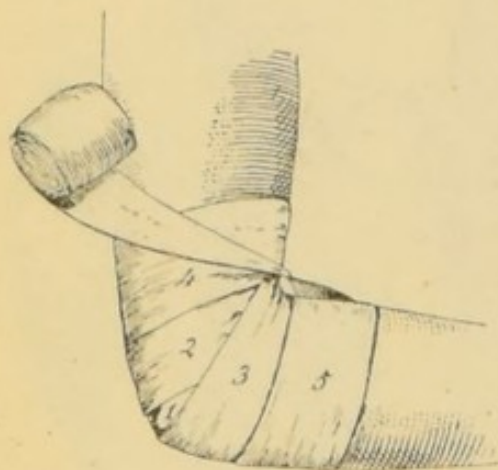
Fig. 9.—Figure of 8 for Bend of Elbow.

The figure of 8 bandage is also used for joints, simply as one or two turns, crossing over the centre of the flexor aspect of the joint (*Fig.* 9). This pattern is useful in a number of cases, which need not be mentioned in detail.

The point of the Heel, and the *point of the Elbow*, with their respective joints, may be completely covered by a series of en- larging figures of 8, start- ing from the centre, having the crossings placed over the front of the joint, and the loops above and below the line drawn from the middle of the front of the joint to

Fig. 10.—Bandage taking in the Heel.

the point of the heel or elbow, and getting always

more and more open and further away from the middle line as the bandage progresses. (*Fig.* 10). In this way the elbow may be conveniently bandaged.

The heel pattern is nearly or quite the hardest one to adjust of all the common forms. It is very neat looking, but it is seldom worth the trouble of its application save as exercise in bandaging.

The Spica (*spike or spathe,* a botanical term applied to a head of seeds arranged as in an ear of wheat) is extremely useful for applying firm pressure to joints, or fastening dressings over them. The pattern is the same whether the bandage be applied to the shoulder, groin, thumb, or great toe, and is that of a figure of 8, combined with a firm attachment to the limb in the neighbourhood of the joint, —the wrist for the thumb, the arm for the shoulder, the thigh for the groin, and the ankle for the great toe. Taking the *Spica of the Groin* as an example

Fig. 11.—Spica of Groin.

(*Fig.* 11), the bandage begins by two or three reversed turns from within outwards (or overlapping 8's) round the top of the thigh.. The bandage is then carried outwards over the groin to just below the anterior spine of the ilium, and then round the back, taking care to keep just below the iliac crest. The bandage is then brought obliquely across over the symphysis pubis, crossing over the starting-point to reach the outer part of the top of the thigh, and is then passed round it, and brought
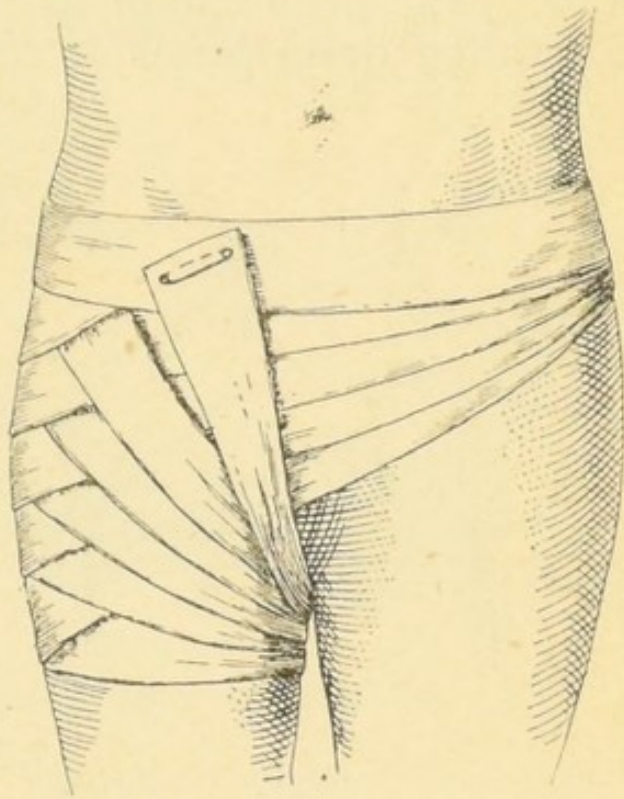
up ready to repeat the roll, but this time a little lower down, and so on till the groin and hip are sufficiently covered. The hip should be very slightly flexed at the time, and care must be taken not to let the bandage slip on to the abdomen as it is passed round the brim of the false pelvis.

Double Spica.—With a long bandage the spica may be easily enough applied *to both groins*, starting from one side, and repeating every manœuvre on the other before returning ; but in practice this is a bandage very rarely used, and requires mention only. The principle of the spica being understood, a detailed description of the different applications
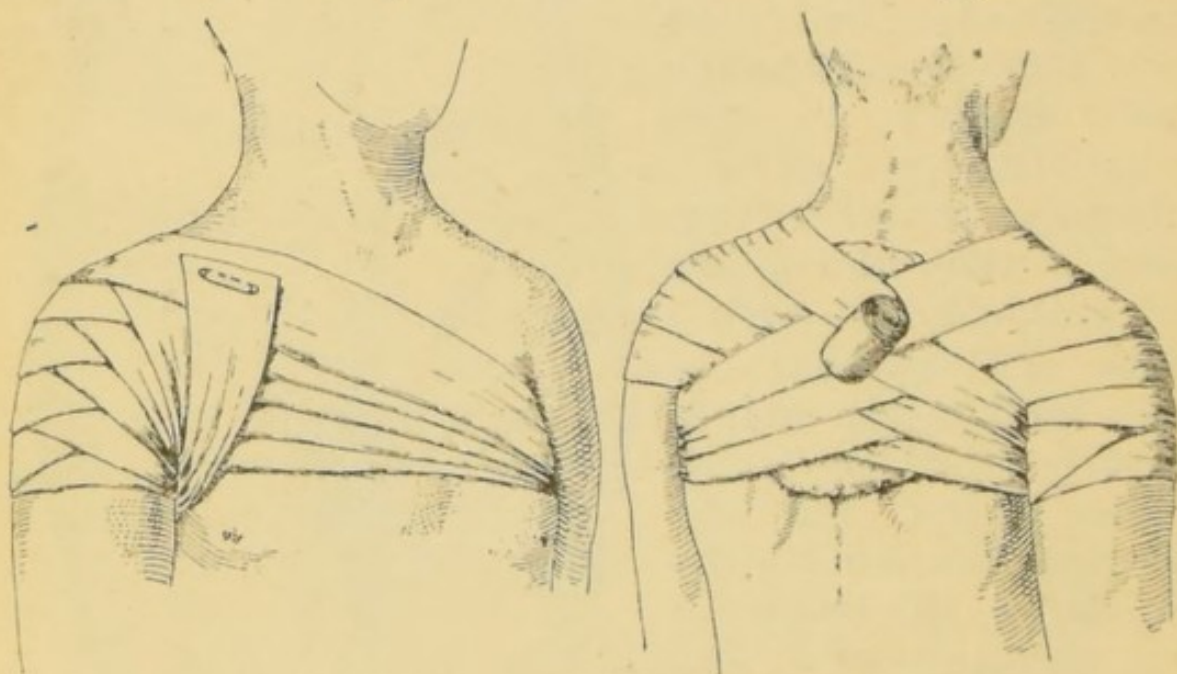
Fig. 12.—Spica of Shoulder.

of the pattern is not called for, and the special points only will be noticed.

The Spica of the Shoulder is an extremely firm bandage (*Fig.* 12) ; the starting-point is taken from the upper arm, the turns being rolled round as high as the axillary folds will allow. The bandage is then brought through the axilla, over the shoulder, and round the chest, passing under the opposite armpit, and the crossing of the first turn should go as high up upon the shoulder as the bandage will lie. This pattern requires a long

bandage, and it may, as in the case of the groin spica, be doubled for both shoulders if required.

The Spica of the Thumb (*Fig.* 13) is the regular bandage for the common sprain of that joint. As with the bandages for the phalanges, the roller must be quite narrow, not more than three-quarters of an inch wide. The spica is begun with a few turns round the wrist, from within outwards, if the outside of the thumb is to be the more supported, and the reverse if the ball be the part requiring the firmer pressure. It is then taken round the thumb as high as the bandage will lie, and the succeeding turns lower and lower (as in all spicas), till the ball
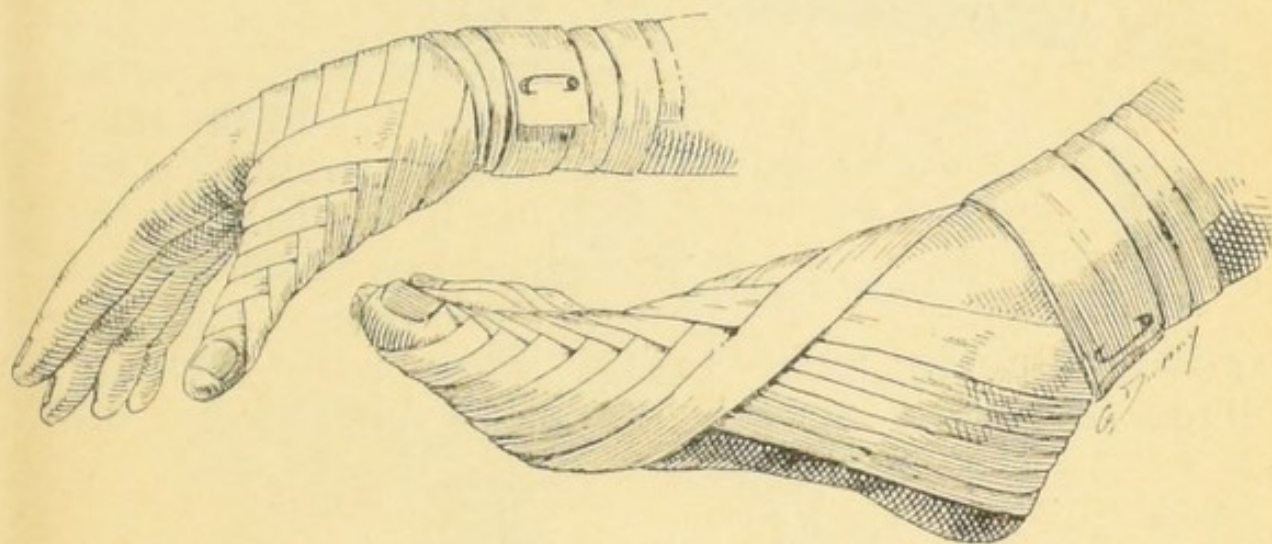
Fig. 13.—Spicas of the Thumb and Big Toe.

is covered. It is then fastened round the wrist either by a safety pin, or by splitting the end of the bandage into two tails, which are tied together. *The Spica of the Big Toe* (*Fig.* 13) is applied in precisely the same way, the ankle standing in the place of the wrist. It is, however, more difficult to apply without getting an awkward quantity of bandage material between the toes.

The Fingers may sometimes be sufficiently covered with a simple spiral bandage, with reverses, or 8's, using a narrow bandage with neat edges, commencing at the tip, and finishing off at the root of the finger.

The Bandage for a Stump is a pattern known as the recurrent bandage (*Fig.* 15). The roller for this should never be more than two inches wide; and for an amputation of the arm, or for a "Syme," it may well be still narrower. The bandage is first attached three or four inches above the stump by one or two circular turns; and then the thumb being placed over the middle of these turns in front, and the forefinger similarly behind, it is brought right over the face of the stump from the
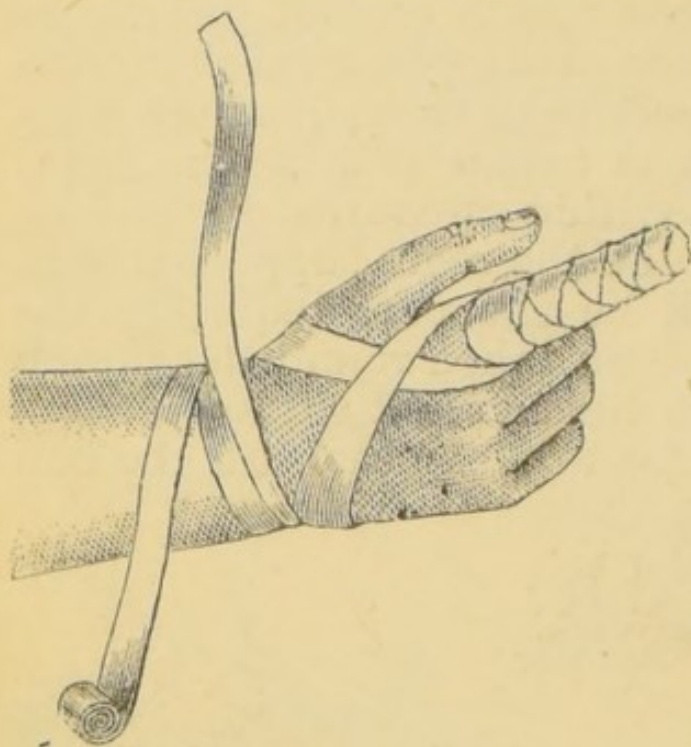
Fig. 14.—Finger Bandage.

middle line in front to the same point behind. This reverse is kept in its place behind by the
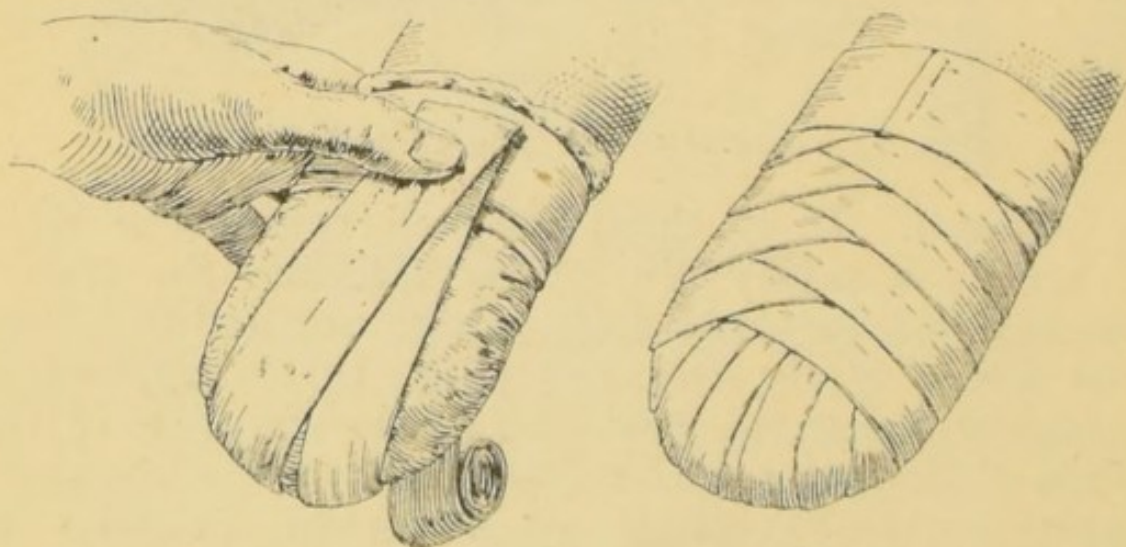
Fig. 15.—Recurrent Bandage for Stump.

forefinger, and the bandage is brought back again, now a little to one side of the middle, but converging to it when it reaches its starting-point. This is then fixed by the thumb, and the bandage is

brought over again, passing this time to the other side of the middle line and converging to it behind. These returns are continued till the whole stump is covered, and then, by one or two firm circular turns, they are fixed in the position in which they were held by the thumb and finger, as shown in the figure. It is often wise to make a circular turn or two in the course of making the reverses, so as to fix those already made. This pattern may also be put on, so as to cover half or all the head, but to be secure the circular turns must be kept low down on the forehead and well below the occipital protuberance.

Amputation Stumps and also *the Head* may be bandaged by a method — which, although it results in a pattern which looks like the recurrent, is yet different in principle and firmer — namely by the use of a
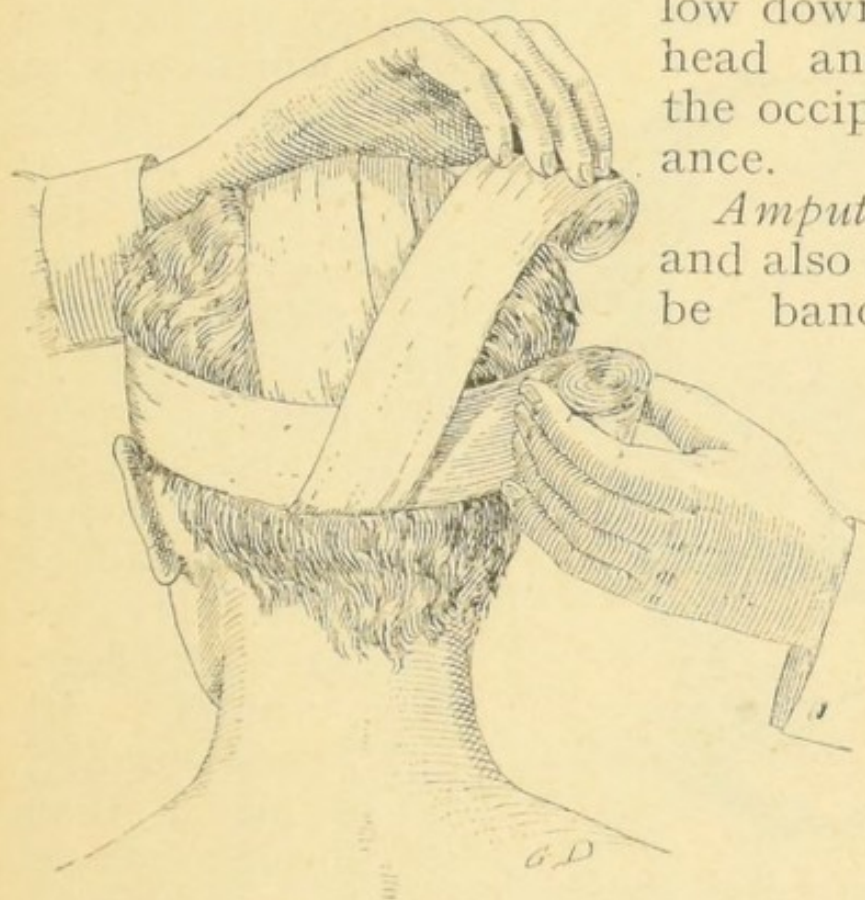
Fig. 16.—Capeline Bandage.

" double-headed " roller, a bandage, that is, both ends of which are rolled up towards each other in the centre. This is the bandage which, when applied to the head, is known as the " capeline." The application for a stump is the same in all respects. To put on the capeline it is more convenient for the patient to be sitting. The surgeon standing in front or behind takes both heads of the roller (*Fig.* 16), and places the middle of the bandage

on the forehead. The two parts are then brought round and crossed below the occiput. One of the ends is then continued round, and the other, which is lying below it, is turned up and brought over the head as in the " recurrent " bandage. It is now met by the other half of the bandage which has gone round the head, while this half has gone over it, and the former, continued round, fixes the bandage so that it can again be brought over the head, when the manœuvre is repeated. In this way, by adjusting the subsequent turns of the bandage alternately to one side and the other of the first one, which was in the middle, either half (*Fig.* 17), or the whole of the head (*Fig.* 16) may be covered with folds converging to the middle line in front and behind and a somewhat attractive bandage is made. Its appearance is, however, almost its only good quality. It is firmer than the simple recurrent bandage, but it is

Fig. 17.—Capeline for Half the Head.

still very liable to slip. It is troublesome to apply, hot, and if at all tight round the head, apt to become painful, while it fulfils few indications which cannot be at least as well met by the more homely, but far more comfortable, triangular bandages (*Fig.* 2). It may sometimes be useful when applied to a stump.

The *Twisted or Knotted* bandage for the head (*Fig.* 18) is generally described as one which requires a double-headed roller, but this is not at all necessary or desirable. It is an extremely useful bandage,

and is easy to apply. For example, taking the neighbourhood of the temple as the situation in which the pressure of the twist is required, the bandage should be unrolled for about a foot and the end held in the right hand, which is kept close to the temple. The roller is then carried round the forehead and occiput, so that it comes back to the unrolled end at the wound. The roller is then twisted round sharply, as shown in the figure, and is carried down below the chin and round to the vertex. On coming to the temple again the

Fig. 18.—Twisted Bandage for Head.

same twist is made, and the roller is once more passed round horizontally; when sufficient pressure is obtained, the bandage is fixed by knotting the two ends together.
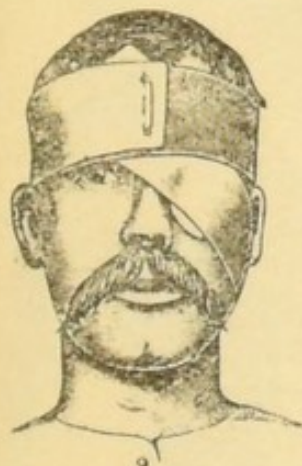
The *Eye bandage* (*Fig.* 19). This may be conveniently applied by placing the end of the bandage obliquely above the root of the nose, passing downwards on the affected side to below the ear, then round the back of the head to above the opposite ear, and lastly horizontally round the head above both ears for $1\frac{1}{2}$ turns, so as to fix the whole with one pin in front.

Fig. 19.—Eye Bandage.

In discussing the treatment of fractures of the lower jaw the *Four-tailed bandage* will be again referred to, but it may properly be described here. It is a very useful pattern, and serves for the attachment of dressings in wounds about the chin

or face, as well as for fractures. For the bandage (*Fig.* 20), a piece of calico four or five inches wide and two feet long is required. It is then doubled on itself and torn down until a piece four inches long only is left undivided in the middle. In the middle of this a slit two inches long is generally cut, in which the point of the chin is inserted, but this is often omitted.
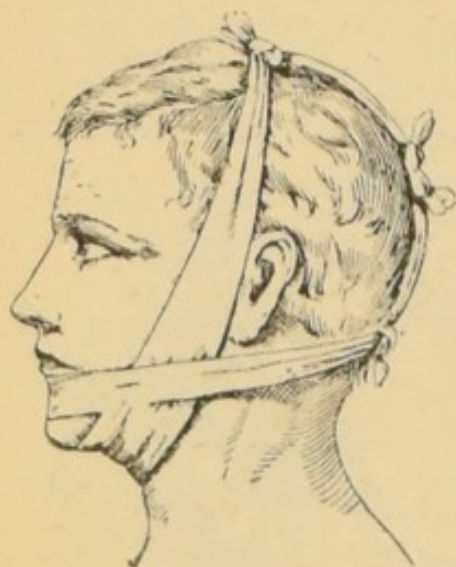
Fig. 20.—Four-tailed Bandage for Jaw.

The middle of the undivided part is placed over the chin, and the under pair of the four tails made by tearing the bandage are then brought up over the side of the face in a line with the masseter muscle and loosely knotted or held half an inch in front of the vertex of the skull. These pass underneath the other pair, which are brought round to just beneath the occipital protuberance and are firmly tied together with a reef knot. The first pair on the vertex are then tied with sufficient firmness to fix the lower jaw against the upper one ; and finally, the vertical part is kept from slipping forwards, and the horizontal from slipping downwards, by
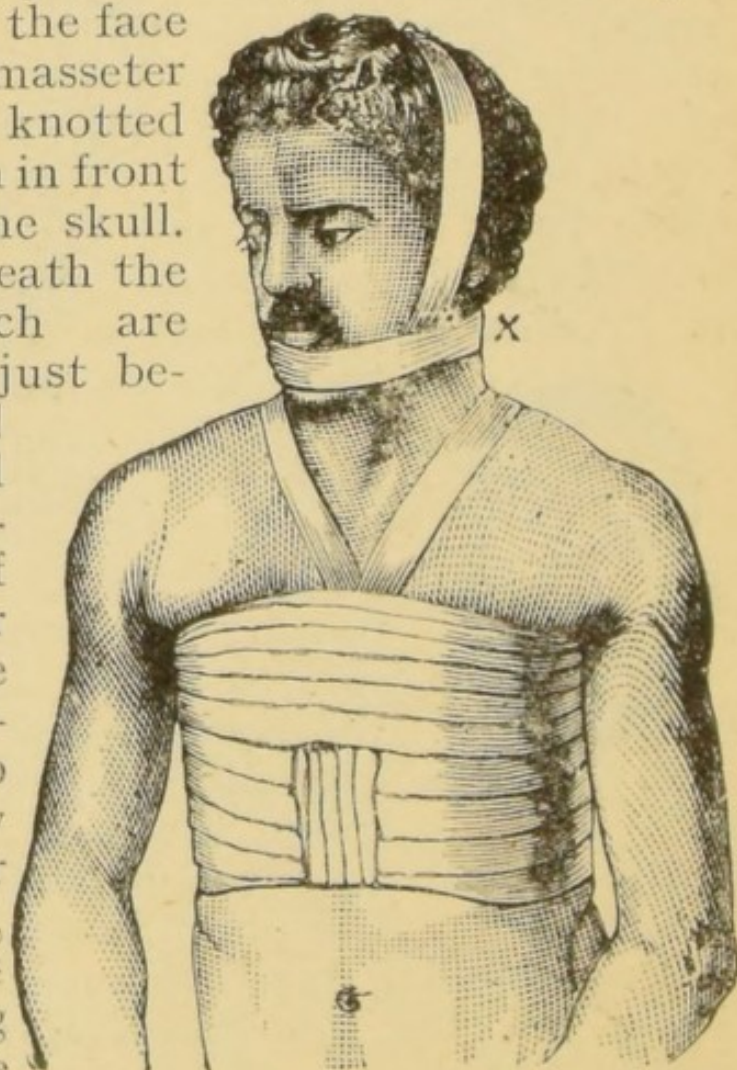
Fig. 21.—Four-tailed Bandage for Jaw, with Chest Bandage.

tying the four tails together (*Fig.* 20). In adjusting this bandage it is necessary to see that the length of the undivided part fits the jaw to which it has to be applied, and this can only be done by tying it on before it is finally fixed.

In bandaging *the Chest* there is a tendency for the bandage to slip down on account of the decrease in size of the thorax.from above downwards. This is best overcome by using a brace and bandaging from below upwards. A piece of bandage should be split in the centre, and the head passed through the opening, so that one end hangs down in front and
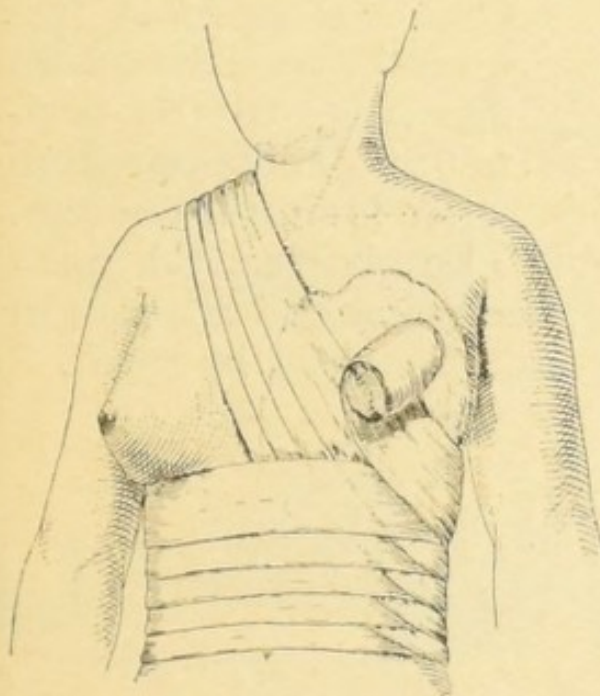
Fig. 22.—Breast Bandage.
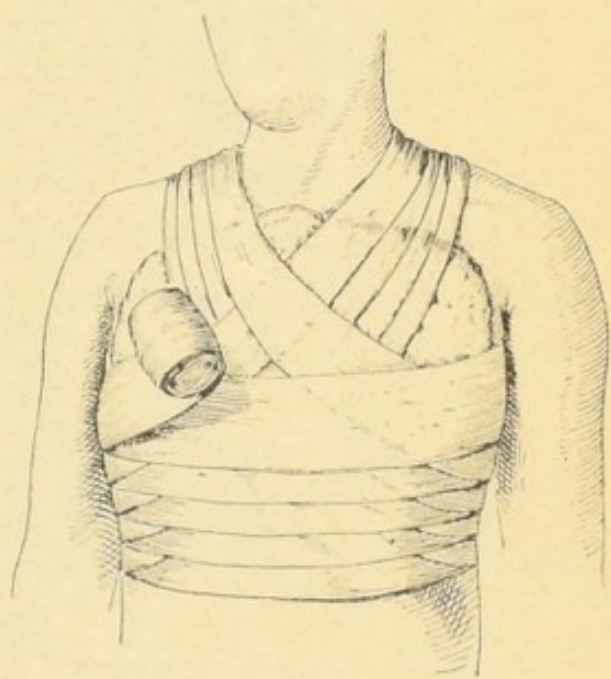
Fig. 23.—Applied to both Breasts.

the other behind. The bandage should be applied over this, being fixed by one or two turns round the chest, and then carried up with a reverse in each turn, thus overcoming the tendency to form an open spiral. The two ends of the brace should be brought up and fixed (*Fig.* 21).

For bandaging the breast the roller is first fixed by a couple of turns round the chest, starting from and below the affected gland ; it is then carried upwards over the lower part of the breast and the opposite shoulder, descending across the back to

the original starting-point, then horizontally round the chest. These turns are then repeated, each oblique turn being fixed by the succeeding horizontal one, and rising higher on the breast until it is covered. It is important always to bandage from the affected side (*Fig.* 22).
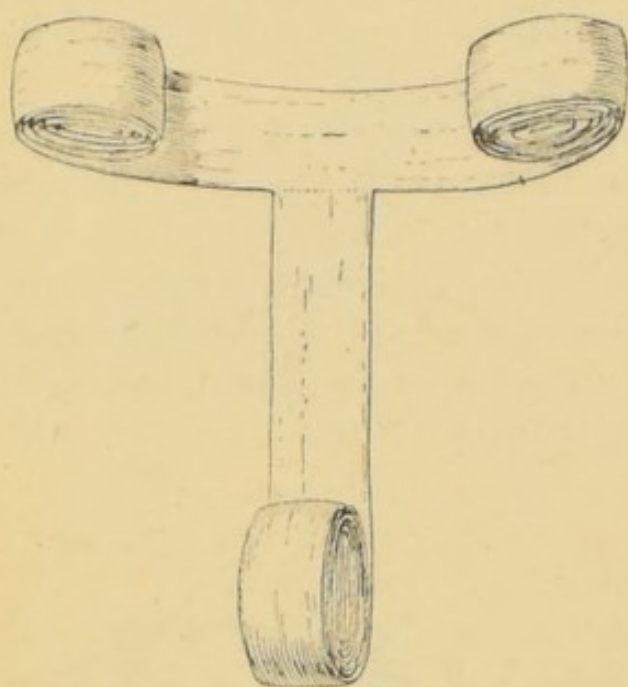
The *single* T *bandage* (*Fig.* 24) is most frequently used for fixing dressings to the perineum. Its application there is simple enough. The horizontal part being fixed round the waist, the other end is brought forward between the legs and fastened in front.

Fig. 24.—Single T Bandage.
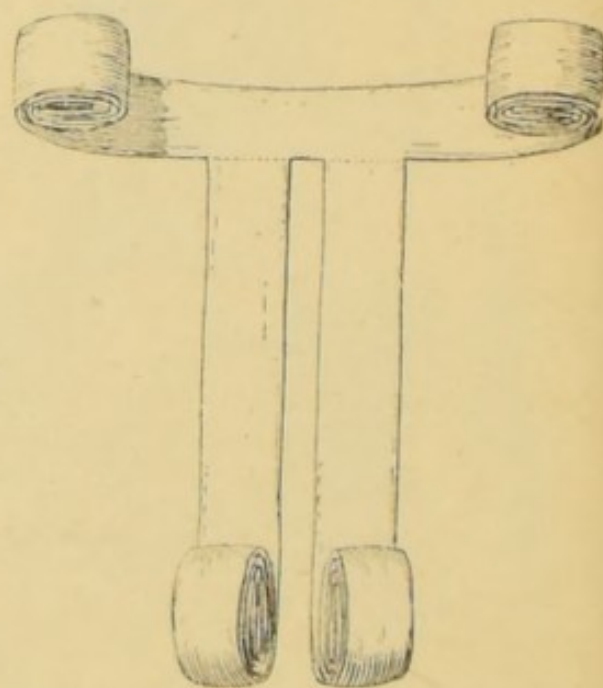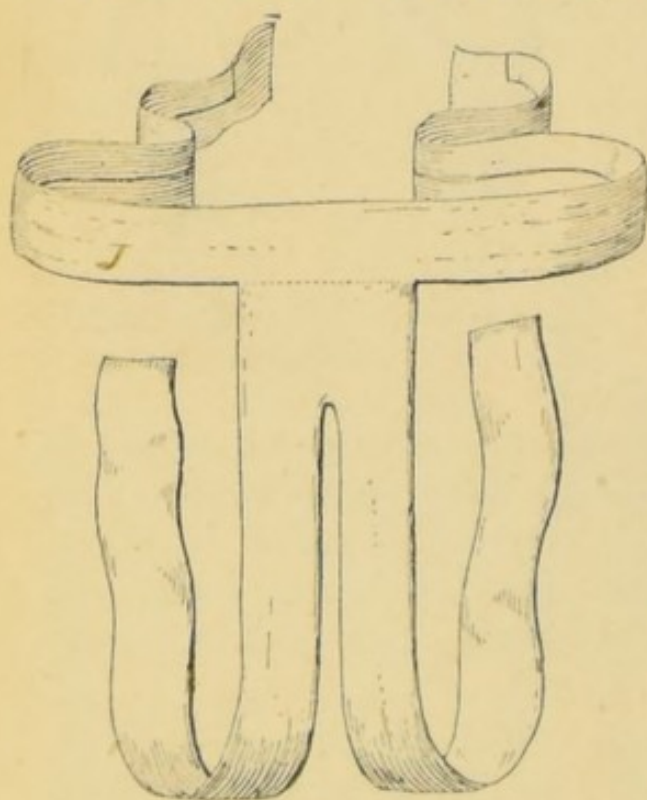
Fig. 25.—Double T incomplete.   Fig. 26.—Double T complete.

The bandage can also be applied to the head or elsewhere. For the perineum, a good average size

is five feet for the horizontal piece, three for the
vertical, and it should be about three inches wide.

For the perineum, a better pattern than the
simple T is the " *double* T " complete (*Fig* 26), or
incomplete (*Fig.* 25). The latter is made from the
simple one by tearing the perpendicular portion
into two tails, except for five inches behind. By
using either of these bandages the awkwardness of
bringing up the single vertical piece in the middle
line in front is avoided. This will be a fitting place
to describe a perineal bandage, which is very con-
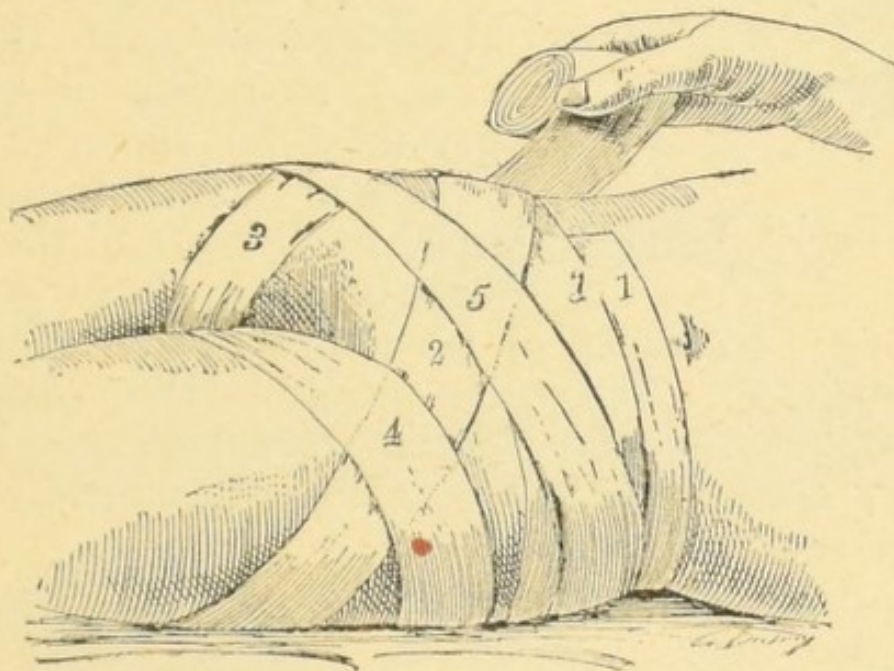
Fig. 27.—Bandage for the Perineum.

venient for keeping dressings upon the *Pubes* and
Perineum without the necessity of displacement
for the performance of the natural functions.

The principle of its application can be easily
understood from the illustration (*Fig.* 27), and it is
known as the " St. Andrew's Cross."

If, as in the illustration, the bandage is to be put
on from the patient's right side to the left, from
the front, or standing over him if he be lying down,
the bandage is first fixed by a turn or two round
the pelvis from right to left (1), then carried from
the right anterior spine of the ilium diagonally
downwards across the left groin (2), around the

left thigh upwards between the thighs to the right spine (3), around the pelvis posteriorly to the left spine; from which point it is carried down between the thighs (4), around the right buttock, upwards across the right groin to the left spine (5), and around the pelvis to its starting-point at the left iliac spine; these turns are then repeated.
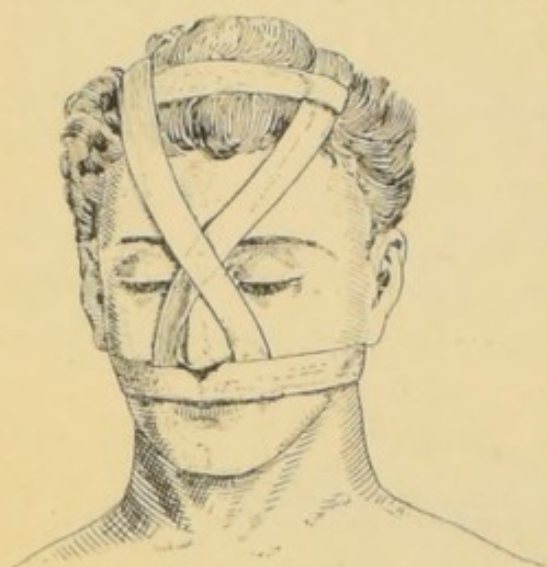
Fig. 28.—Double T applied to Nose.

The T is also a very good bandage to apply to the head, to retain dressings. If used *for the Head* the vertical strips should be two feet long, and the horizontal one about a yard and a half, to allow of its going round the head twice or thrice. The width should be three-quarters of an inch. *For the Nose* a good bandage is the double T applied as in *Fig.* 28, or the single T with a slit in the vertical part, of the requisite size to partly admit the nose; while if, in addition, a slit be made in the middle of the horizontal part of either the single or double T, for the mouth, it becomes a good bandage for the application of dressings *to the Lips* (*Fig.* 29).

The single or double T, or a T with a small triangular piece inserted at the junction of the vertical and horizontal portions, makes a good bandage for the ear, and other modifications may easily be imagined.

Fig. 29.—Double T Bandage for the Nose and Mouth.

The many-tailed binder (*Fig.* 30) is a form of

bandage frequently used in abdominal surgery, when security combined with easy application is desired. It consists of a series of seven or eight overlapping strips of flannel, each about four inches wide, fixed together by stitching to a piece of calico in the middle. The bandage extends from the lower border of the thorax to the pubes. The ends of the strips may be tied together separately when the bandage is in position, or better still, may be secured by overlapping in series from below upwards.

A similar bandage made by tearing a strip of calico into a number of tails on each side is often useful in retaining dressings on the limbs; it is
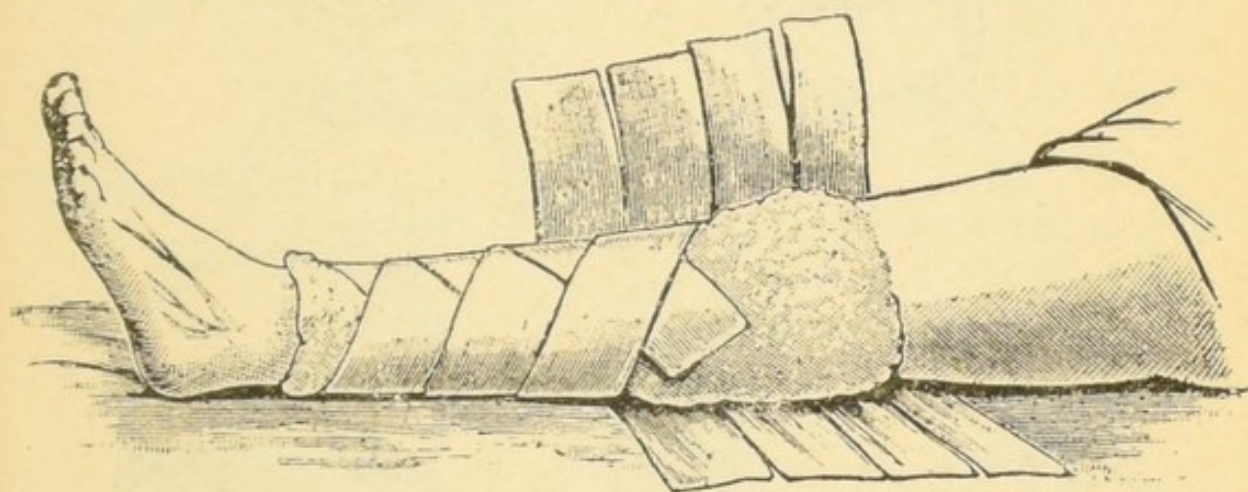
Fig. 30.—Many-tailed Bandage.

especially valuable when the dressings need changing frequently, and when it is advisable for the limb to be kept perfectly at rest.

OF KNOTS.

Among the smaller but necessary accomplishments of the complete surgeon must be reckoned the art of making a " reef," a " bow," a " slip knot," or a " clove-hitch," neatly, quickly and firmly. The importance of this need not be insisted on, for in surgery, very literally and very often, it happens that life hangs on a thread, and the results may be disastrous if this be insecure. To describe in words the actual movements of the fingers in making these knots would be only waste of time; it is a know-

ledge which each student must acquire for himself by practice, after he has been shown how to do it.

 Fig. 31 shows a cord tied in (I) a *Reef knot*; (II) a *Granny*; (III) a *Clove-hitch*, which in the left is half made, and in the right is shown completed, by placing the loop *a* in front of loop *b*; (IV) *Surgeon's knot*. The surgeon's knot consists of a reef-knot with an extra turn in the first part which diminishes its tendency to slip. Where firmness is wanted,
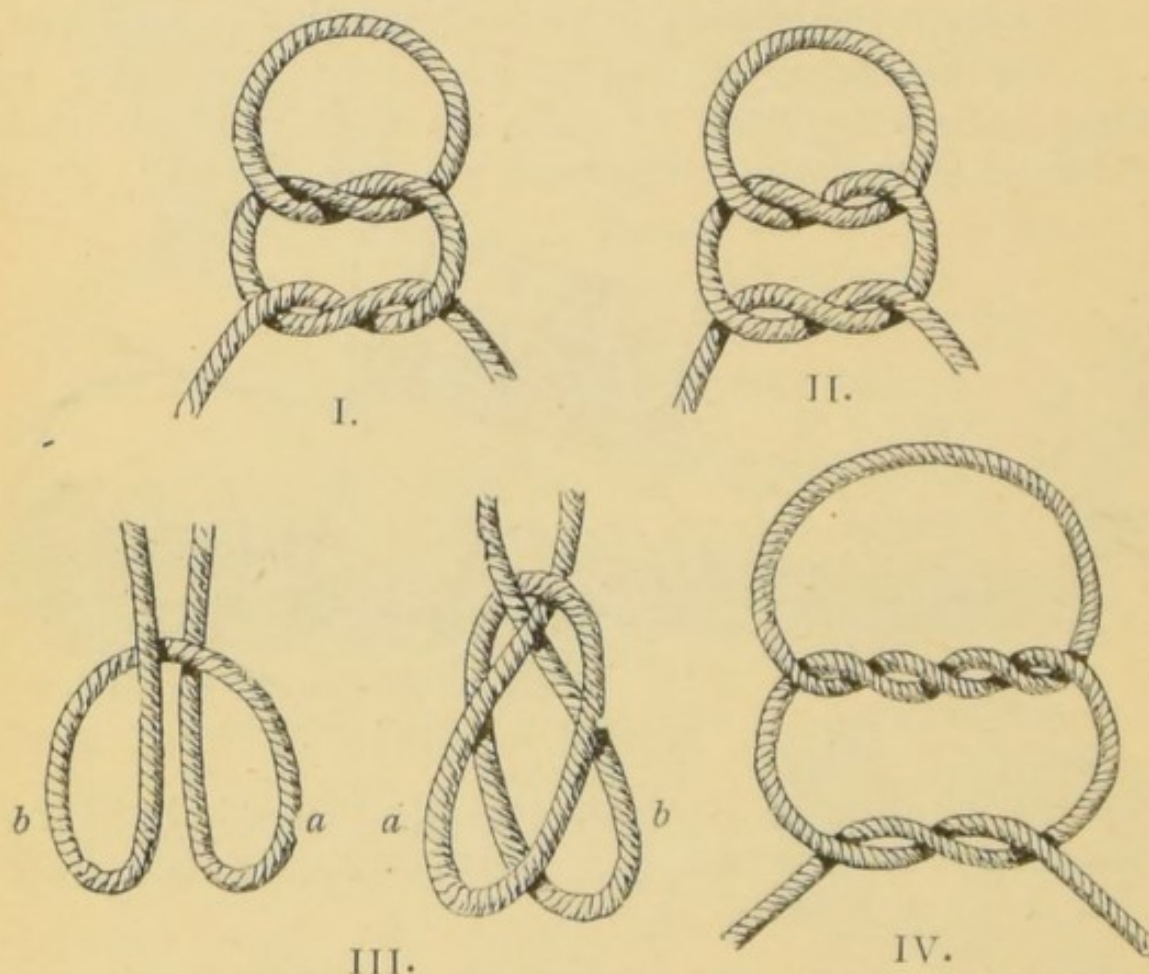
Fig. 31.—(I.) Reef Knot; (II.) Granny Knot; (III.) Clove-hitch (half made, and completed); (IV.) Surgeon's Knot

as for the ligature of a vessel, and for all ordinary purposes of knotting, the *reef* is the one for surgeons to use—the *granny*, never—and the dresser must go on practising the manœuvres until his fingers acquire a perfect automatic skill, so that he never has to think of their individual movements.

The *Clove-hitch* is very useful when a pull upon any part is required; as, for example, in dislocations of the shoulder, when a jack towel is fastened

by this knot round the arm (*Fig.* 31). Its great advantage is that it gets firmer the more it is pulled upon, while yet it can be loosed in a moment. Moreover it has no tendency to slip like a noose. There are one or two ways of making it, all practically coming to the same thing, but its main idea and purpose can be gathered from the figure.

Neither time nor space need be wasted in discussing the virtues of the bow or half bow ; other knots well known to sailors or builders, as the carrick bend, the bow line, or weaver's knot, etc., are not used in surgery : but what is known as the
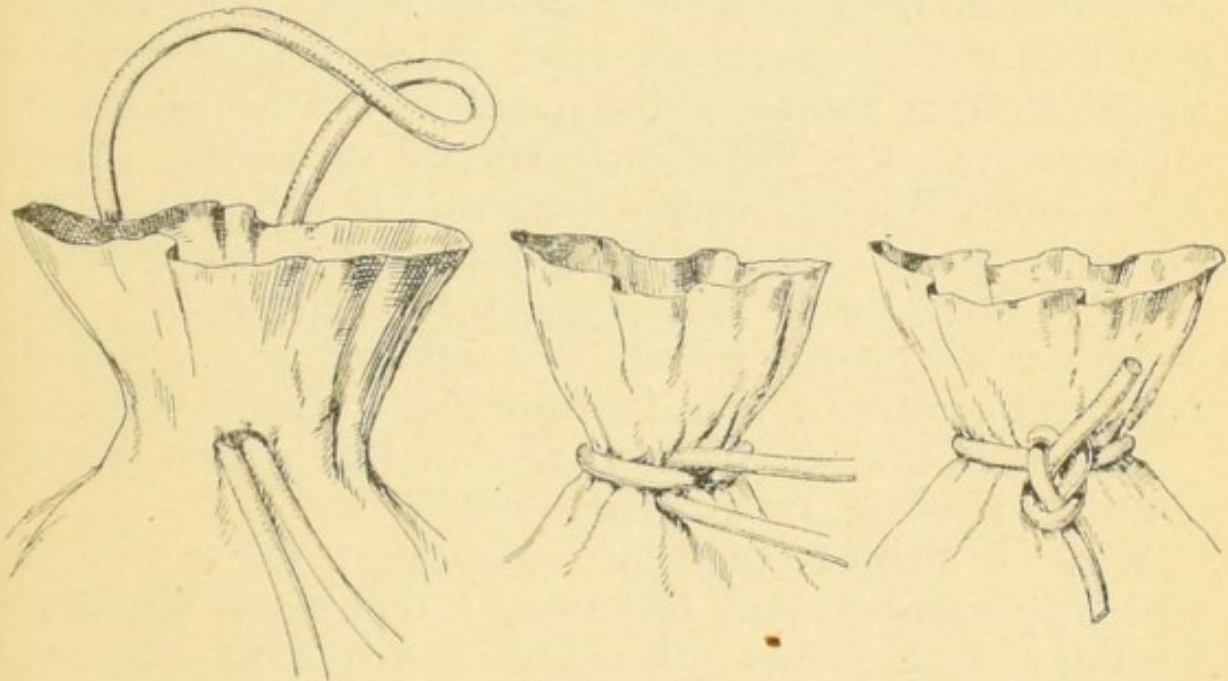
Fig. 32.—Staffordshire Knot.

Staffordshire Knot is a very useful one for securing the cut end of a vascular pedicle by transfixing it with a double-threaded needle on a handle, and slipping the loop over the stump down to the entrance of the threads into it (the needle having been withdrawn). One of these entering threads passes over and the other remains under the loop, so that they can be tightened, one first and then the other, and lastly must be tied in a reef knot, so that both halves of the stump are simultaneously but separately constricted by the single string and knot (*Fig.* 32).

CHAPTER II.

OF THE USE OF ADHESIVE STRAPPING.

THE use of this material in surgical dressing, for purposes of mechanical support, is now very general, and the number of medicated plasters is being almost daily added to. Of these little need be said, for, with few exceptions, their value is still undecided.

The ordinary *Adhesive strapping*, diachylon or lead plaster (emplastrum plumbi), is the form which is still in most general use and, unless it is otherwise mentioned, must be understood to be the material employed. It is sometimes spread on paper, when it is almost useless, but is generally laid on linens of varying fineness. No good purpose is served by using a fine linen, and a useful strapping for all ordinary occasions is what is known as " Leslie's Hospital quality," sold in rolls eight inches wide.

Other kinds of plaster are often spread upon chamois leather, or on white basil.

A very useful form of strapping, the basis of which is indiarubber, has been introduced, namely, Seabury and Johnson's Rubber Adhesive Plaster. Its advantage is that no heating is required, the adhesive surface being protected by a layer of coarse muslin until it is used.

A good kind, for small surfaces, is the *Isinglass* plaster, made by painting thin silk with that material. It requires wetting only, and is very cleanly.

For clean-cut wounds about the face, and in other cases where great nicety is required, court plaster or gold-beater's skin is often used.

No detailed description is required of the ways in which strapping may be cut into strips, and used to fasten splints or dressings. The oft reiterated warning must be repeated, that if unyielding strapping is applied to encircle a limb, strangulation

of the parts may result, and serious complications arise.   Such a disaster may even occur if the plaster be spread on any kind of leather, though this, for economical reasons, will not often be used ; and it may be taken as a rule, to be followed almost invariably, that strapping should be put on either spirally, or obliquely, so as to form the half of an 8.

If strapping is to be applied round a limb, it should be cut in strips and put on so as to secure an even, steady pull from both ends ; otherwise the skin may be painfully wrinkled.   It should always be thoroughly warmed first, for which purpose cylindrical hot-water tins are generally
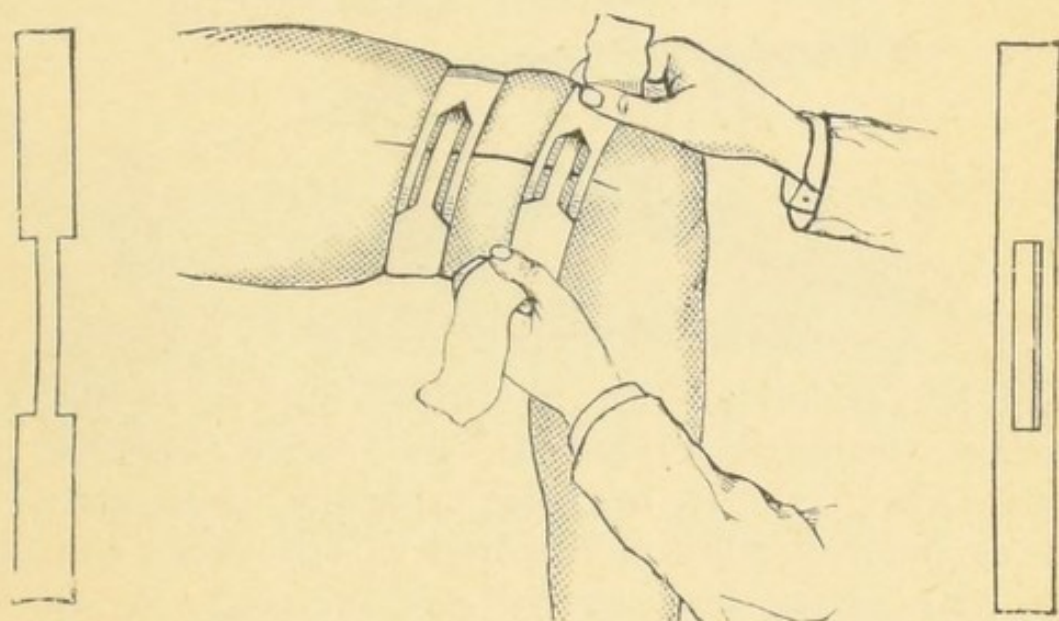
Fig. 33.—Strapping applied to support a wound accurately.

used, or some gas apparatus.   Sometimes strapping is softened by dipping it for a moment in very hot water ; this makes it more pliable, and not much less adhesive.

When strapping is required to adjust accurately or support the edges of wounds, amputation flaps or the like, the strips should never be stuck on one side first and then pulled over to the other, or " cockling " will occur, but it should be cut in pairs, and applied as Fig. 33, or on some similar plan.   One strip is placed on one side of the wound, and the other on the other ; the middle parts are

slipped within each other, and then an even, regular pull can be made simultaneously on both sides.

Some special cases in which strapping is a common plan of treatment will here be shortly described.

The case of fractured ribs will be again referred to. Not only in fracture, but where the thoracic walls have been badly bruised, it is often desirable to place them as completely at rest as possible. This may be done very effectually by strapping them in the same way as if they had actually been broken.

Enlarged phalangeal joints may often be strapped with common plaster, or with the iodine strapping to be hereafter mentioned. The method of doing this is the same as for the larger joints.
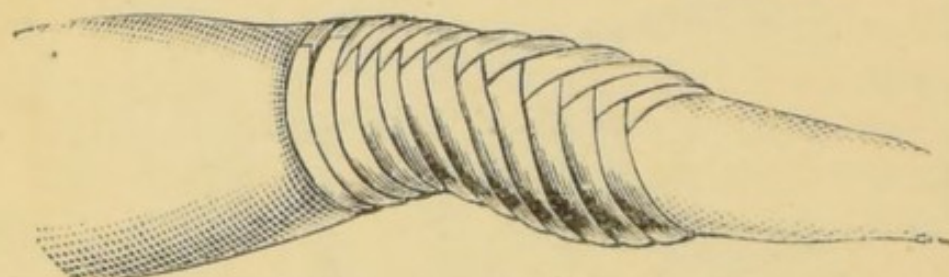
Fig. 34.—Knee, Strapped (ordinary way).

The Wrist, either for a simple sprain or for the common tenosynovitis of the extensors of the thumb lying over it, may be strapped with strips of linen or leather plaster applied in the same manner as for the knee, *Fig.* 34.

The Knee.—Every dresser should know how to strap the knee joint efficiently, for it is one of the principal methods of treatment of chronic derangement of this articulation. The usual plan is to apply strips of the plaster, overlapping each other, from below upwards, in half loops of 8, until the whole joint is covered. This may be done well with the plaster spread on linen or holland if great care be exercised.

The *Ankle*, likewise, may be strapped by narrow strips of linen, the middle of which is applied to the sole of the foot, and the two ends brought up and crossed in a figure of 8 over the front of the foot, and round the malleoli. (*See* " Sprains.")

For an *Enlarged or Inflamed Breast*, long strips of adhesive, or diachylon strapping, may be usefully employed to support and, to a moderate extent, compress it. The centre of the strips must be placed below, and the ends crossed above, working from below upwards, the breast being thus supported by the overlapping plaster; but generally, this kind of support can be more easily and comfortably maintained by a " Martin's " rubber bandage.

The Stirrup (*Fig.* 35) is a very common mode of employment of strapping material ; by it extension can be applied to a limb by means of a weight and pulley or, less frequently, through some mechanical arrangement of rubber springs.
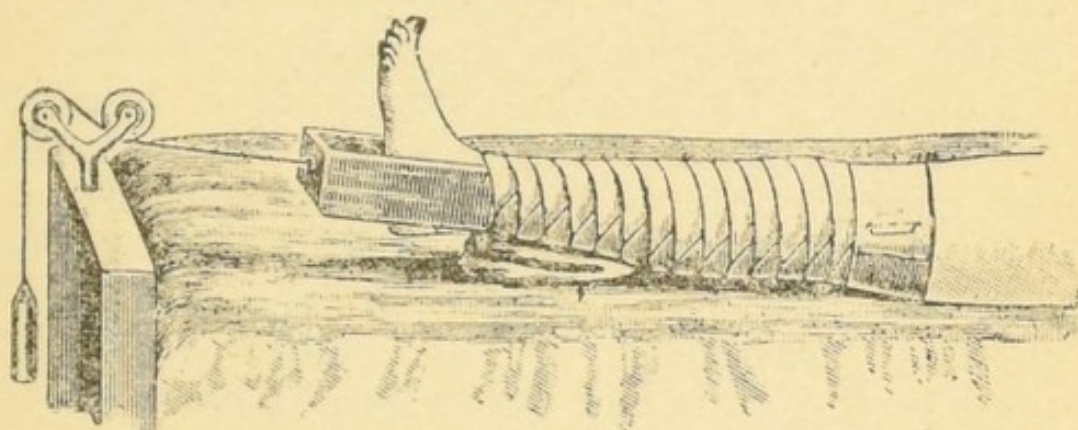
Fig. 35.—Stirrup and Weight adjusted to Leg.

Stirrups may be applied to various parts of the body, but they are most frequently used in the treatment of hip disease and fractures of the thigh ; and a description of the application of one to the leg will suffice for other forms as well.

With as little disturbance of the limb as possible, a flannel or domette roller should be applied firmly to the leg and foot, reaching to just below the knee. Over this *the stirrup* must be put on, thus :—A piece of wood about a quarter of an inch thick is taken (it should be square, and the width of the ankle at the malleoli), and placed in the middle of a broad strip of strong strapping ; this wood forms the foot-piece of the stirrup, and the broad strip is fastened to it by some more strapping wrapped

round it. The side strips of strapping are then warmed and adjusted to the outer and inner sides of the leg over the flannel bandage, reaching the thigh above the knee, and so that the footpiece is quite parallel to the sole of the foot. It is then firmly fastened on by overlapping strips of strapping, put on obliquely, from the ankle upwards. A roller bandage is then put over all, finishing it above the knee and incorporating the upper ends of the side strapping, which are turned down. In adults the underlying flannel or domette bandage may be dispensed with except just above the malleoli.

A neater and more comfortable, but a more expensive way, is to use strips of white basil leather, spread with some adhesive plaster. These are put on in the same way as the strapping, and look very workmanlike. The leather strapping is especially useful in stirrups for hip disease. In extremely tender cases, chamois leather strips may be used.

It has hitherto been assumed that the strapping has been employed simply for the purpose of mechanical support, or of compression. But frequently the adhesive material possesses in itself (or is applied over ointment possessing) medicinal properties. As examples of these special plasters the *Emplastrum belladonnæ*, *E. opii*, and *E. menthol* are frequently used for their anodyne properties ; the *E. hydrargyri* or *ammoniaci c. hydrargyro* and *E. potassii iodidi* for promoting absorption.

As a stimulant, the *E. picis* (poor man's plaster) is supposed to have merits, as to which we may be allowed to be a little sceptical, while the use of the milder cantharides plaster, *E. calefaciens*, as well as the *E. cantharidis*, is obvious.

Lastly, in addition to the soap and lead preparation, the *Emplastrum ferri* (called also *E. roborans*, but omitted in the 1898 British Pharmacopœia) has great adhesive power, and is often applied to the lumbar region, with the idea of strengthening the muscles of the back.

Of the anodyne preparations, the *Belladonna Plaster* is most frequently used for the purpose of allaying pain in the breast, and for arresting the lacteal secretion, but it is a good anodyne for general use.

For strapping joints, etc., the *E. hydrarg. c. ammoniaco* will be found on the whole to be the most useful. Another extremely useful strapping is the iodine plaster, but it loses its activity on keeping, and so should be freshly prepared and kept in a tin case.

One of the most effective modes of treatment of enlarged joints, inflammatory bursal enlargements, chronic orchitis, etc., is to cover strips of lint with some absorptive ointment, to lay them over the part, and then strap it up firmly with soap or lead plaster. The ointments most commonly used are the various *mercurial* ones, all the *iodine, iodide of lead*, and *iodide of potassium* preparations, but especially the *camphorated mercurial ointment*, the well-known *Scott's dressing*.* The strapping, with the ointment beneath it, should be left on until the latter is absorbed, or until the parts below have shrunk so as to make it loose ; it may then be re-applied if necessary.

When strapping has been applied to any part of the skin which is hairy, its removal is always painful, sometimes very much so, unless the adhesive material be softened. This may be done with very hot water, but a better way is to soak a pledget of lint in spirits of turpentine, and to soften and dissolve the plaster from the hairs as the strapping is turned gradually back. The discomfort of removal may be obviated by shaving the part before applying the strapping.

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* So called from the name of the surgeon who introduced it. It is composed of Mercury ointment, 5 ; Yellow wax, 3 ; Olive oil, 3 (by weight) ; Camphor, 1½.

CHAPTER III.

OF SPLINTS—CONSIDERED GENERALLY.

DEFINITION.—A splint is a contrivance or apparatus possessing absolute or relative rigidity, which when attached to some part of the body increases its natural stiffness, or remedies undue mobility caused by disease or injury.

The subject of the application of splints is therefore a very wide one. We propose, in the first place, to give only a general description of the principal methods of splinting, and of the common forms of splints, postponing a more exact account of many of them until the various fractures and injuries which require their employment come to be discussed.

Natural Splints.—In many parts of the body, an uninjured bone in the neighbourhood of one that is broken will often serve as a splint to keep the fragments of the latter in their place, and in some parts the attachment of ligaments, etc., will serve the same purpose. Thus, in fractures of the fibula, the tibia, if unbroken, will make a very efficient splint for it. The same may be said of the ribs, where the muscles and ligaments, which form with them the cage of the thorax, very often prevent serious displacement. A fractured lower jaw, again, may often be held in good position by keeping the fragments closed against the upper jaw, and many other instances might be adduced.

Improvised Splints.—There is hardly a limit to the number of the materials which may be pressed into the service of the surgeon, to form splints in the first instance, in cases of fracture or other injury.

The usefulness of cardboard, book-covers, news-papers, firewood, and many other things familiar in

daily life, will be mentioned in this connection under the heading of " Immediate Treatment of Fractures." The list is only limited by the ingenuity of the surgeon. It will be convenient here to give a short classification of the splints and splint materials which are recognized as belonging to the surgical armament.

Surgical Splints may be divided into those of some fixed form and shape, and of some rigid material, as wood or iron, to which the trunk or limbs may be attached by bandages or strapping ; and those which are capable of being moulded to injured or diseased parts, to give them the needful support or to remedy deformity. All of these latter possess the property of being soft when applied, and then of setting or hardening after adaptation.

RIGID SPLINTS.

These are for the most part of wood or iron ; though other materials, such as vulcanite, etc., are sometimes used. They may be subdivided into those of a simple and of a complicated form.

Plain *wooden splints* are the simplest of all, and will need little description. In most cases
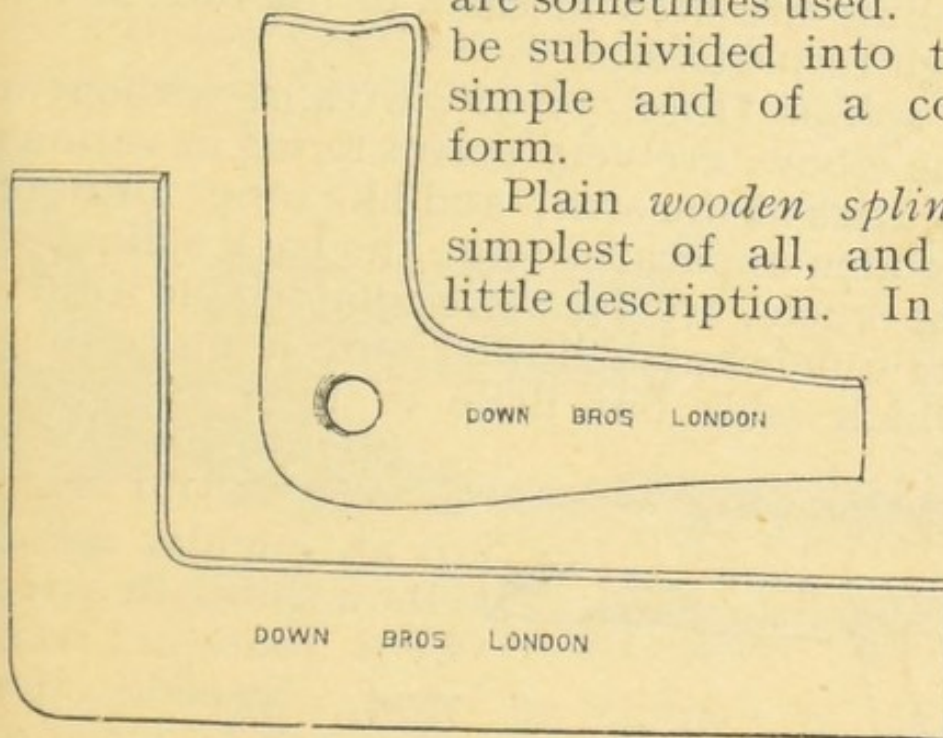
Figs. 36, 37.—Simple Angular Splints.

they are simply pieces of white pine, of various lengths and breadths, planed, and with their edges rounded off. They are used for fractures of the limbs, or to prevent flexion of joints, as in the

common " patella splint," etc.   Not infrequently they are made of strips of wood lined with canvas, on the plan of the kettle-holder or Gooch's splinting to be presently mentioned ; and other materials, such as rattan, cane, etc., have been used from time to time.

The pistol-shaped splint, again, which is sometimes used for Colles's fracture, is an example of
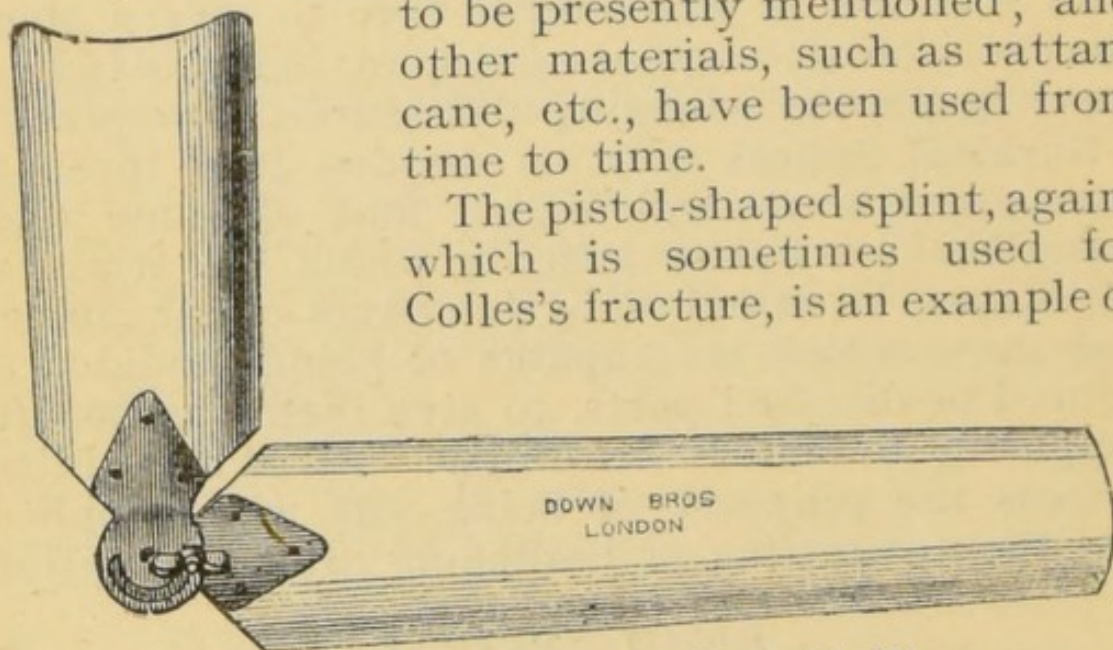
Fig. 38.—Wooden Angular Splint with Hinge.

a simple wooden splint, and similarly, Cline's and Liston's splints are used in cases of fracture of the leg and thigh respectively.

Angular splints (*Figs.* 36–38), with or without a hinge at the elbow, are very useful forms in various injuries of the arm; and like other forms of wooden apparatus (e.g., the back splint for the knee), are far more comfortable if they are somewhat hollowed out, a proceeding which adds but little to their expense.
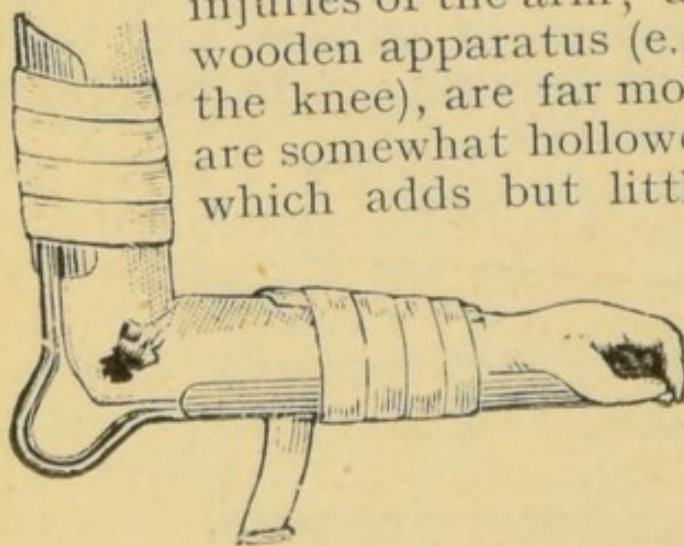
Fig. 39 illustrates a very useful form of an angular metal elbow splint invented by R. Jones, of Liverpool, specially for compound injuries of that articulation ; it

Fig. 39.—Angular Metal Elbow Splint.

is very simple, effective, and cheap.

Of the more complicated splints, in which wood is the principal material employed, the chief are Bryant's " (*Fig.* 40), for the excision of the hip,

fracture of the thigh, etc. ; splints for fractured patella, and the double inclined plane.

It is often necessary, in cases of compound fracture or after excision of joints, etc., where we must be able to get at a wound which therefore must not be covered by the splint, to make *an*
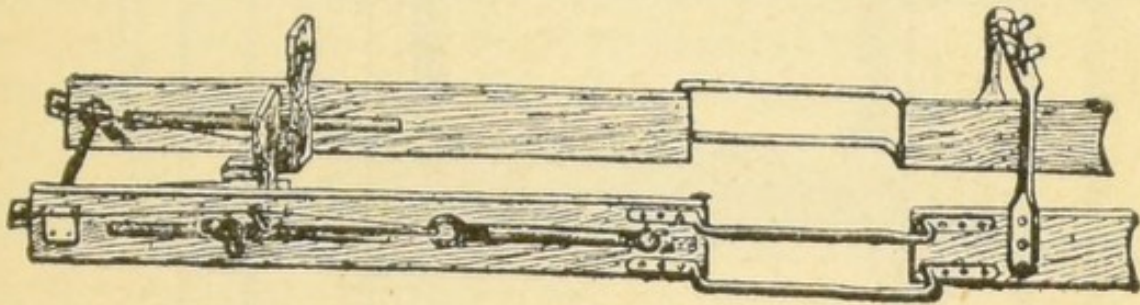
Fig, 40.—Bryant's Splint

interruption, as it is termed, and although this is done in iron as well as in wooden splints, it is far more easy in the latter, as in *Fig.* 41. In making such a splint it is best to choose one as if the necessity for the interruption did not exist, and then to saw away the parts required to be removed, *after* having fastened on the iron supports.
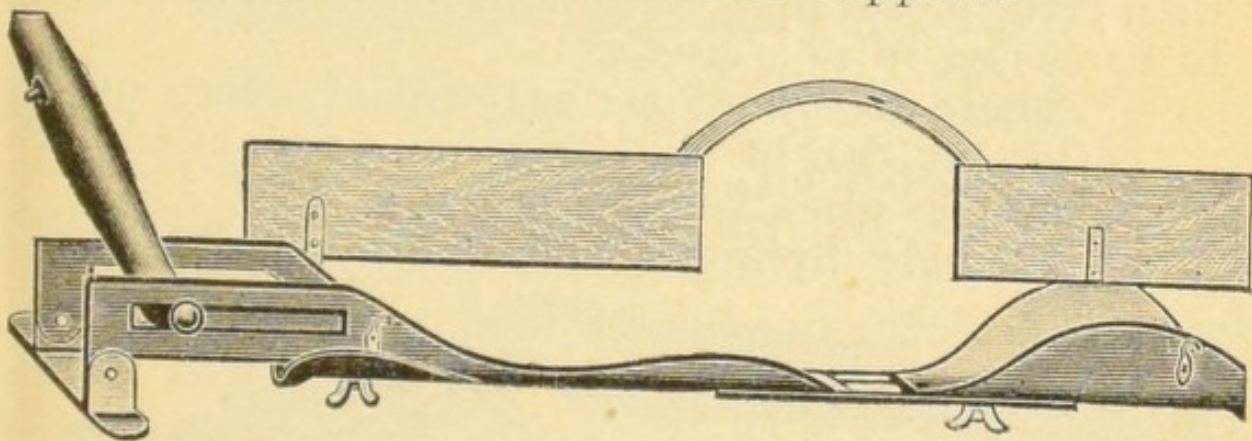
Fig. 41.—Iron Back Splint for the Knee, with "Interrupted" Wooden Side Splint.

Iron splints may be simple or complicated ; among the former may be mentioned the angular elbow splint, generally having a hinge at the elbow, the simple back splint for the leg and thigh with a foot-piece, used for fractures of the leg, generally called " Neville's splint " (*Fig.* 42), and the different patterns of that very useful splint,

"MacIntyre's" (*Fig.* 43), which consists of a movable foot-piece, and leg and thigh pieces with a joint between them, and with some mechanical arrangement of screws, or rack and pinion, to
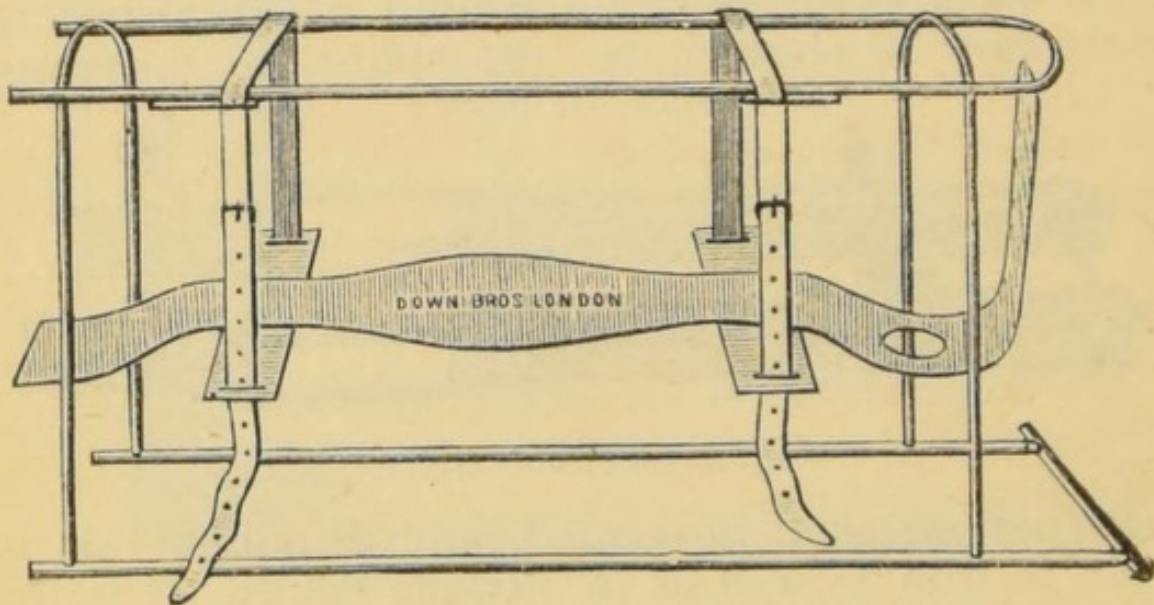
Fig. 42.—Neville's Back Splint

alter the angle at the knee. These can also generally be adjusted for limbs of different lengths.

All leg splints for fractures should be furnished with cross pieces or other device to enable the limb to be swung from a cradle.

There are numerous patterns of splints used after excision of the elbow and knee, of which examples are given in *Figs.* 39 and 41.

Flexible Splints.—Splints are also made of
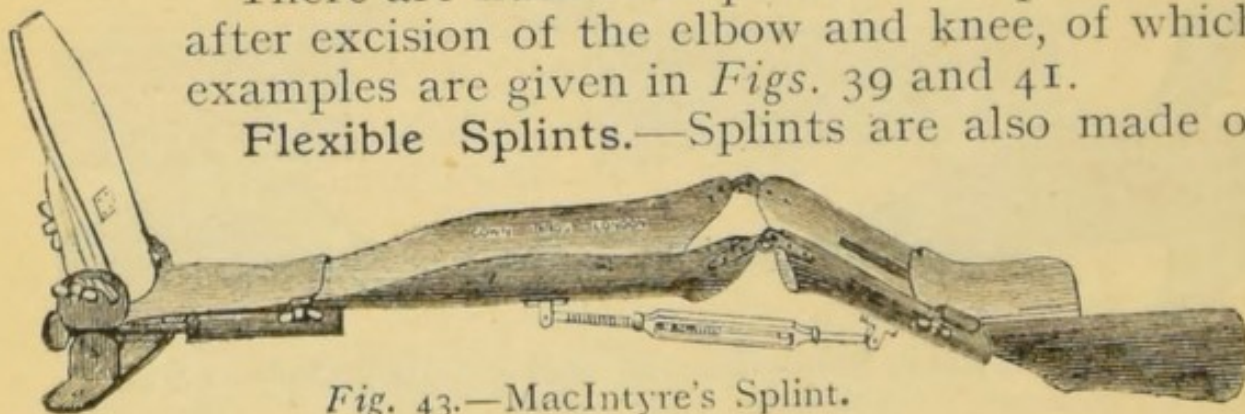
Fig. 43.—MacIntyre's Splint.

tin or some other flexible metal which can be readily bent into any required shape. These are often used in the treatment of talipes.

Kettle-holder or *Gooch's Splinting* is made by attaching long thin strips of wood to canvas or leather with strong glue. It is made in large sheets, and splints of different patterns can be cut or sawn

out of it, its great merit being that it is flexible in one direction and rigid in the other. It is especially used for fashioning splints to partially encircle a limb, as in fractures of the arm; or in combination with a back splint in cases of broken thighs.

Padding Splints.—All splints should be *padded* before they are applied, to avoid injury of the softer parts. This may be done in several ways, and with different materials. Of all paddings, however, the most elastic and convenient is *tow*, well teased, so that the fibres lie all one way, and with no lumps in it. Soft linen, such as old napkins, makes the best covering for the tow.

For the simple forms of splints, the pads should be made like miniature pillows, and either sewn on with a lace stitch at the back, which is best, or fastened—but as a makeshift only—with bands of strapping very smoothly applied (*Fig.* 44). Pads
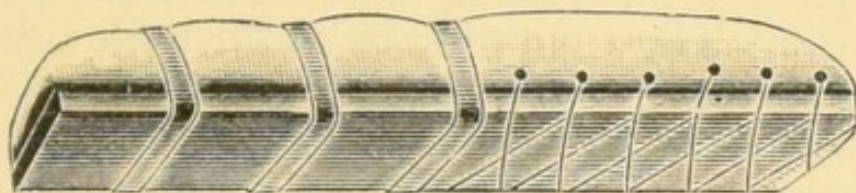
Fig. 44.—Pad, sewn or strapped upon a Splint.

should always be complete cushions, not layers of tow laid upon the splint and covered. They should overlap the edges.

Next to tow as a stuffing comes cocoanut fibre; and, last of all, cotton wool, which is very apt to work into hard lumps. Very good but extravagant pads may be made of several folds of lint.

In all cases where the moisture from dressings, or the discharge from wounds, can possibly soil the pads, they should be covered with some form of oiled silk or with gutta-percha tissue. The former should be sewn on, but the best and neatest way of fastening the latter is to moisten the edges with a piece of lint dipped in chloroform, when they will readily adhere.

Iron splints are usually perforated for the sewing on of the pads, but if not they must be managed like the wooden ones. Before padding them it should be seen that the metal is not exposed by the wearing off of the lacquer, or the cover will be iron-moulded.

In jointed splints the pads should be made separately for each part, and special pains must be taken to have them very smooth and of the proper thickness where they have to protect prominences of bone, such as the trochanters or malleoli. This is particularly true of the heel, under which the pad should be firm and rather thin, while the tendo Achillis immediately above it should be well supported with a thicker pad. A " sore heel " is a surgical disgrace to the dresser of a fractured leg or thigh.

Too much pains cannot be taken to select perfectly fitting splints, and such as are in good condition. They should, in almost all cases, be a little wider than the limb for which they are chosen ; if this be attended to, partial strangulation, through their being put on too tight, is almost impossible.

Attachment of Splints.—With regard to the various methods of attachment of splints, we need only mention here that strapping, bandages, and buckled straps of webbing or leather are the chief agents employed ; any one or all combined may be found most suitable, in each particular case. In bandaging, the same rules apply as have already been given ; but whatever way of attachment is selected, it should, if possible, be so managed that the limb can be examined from time to time without disturbing the whole apparatus ; and, in the case of extremities, the fingers or toes should be easily got at, in order that the condition of the circulation may be noted. Lastly, complaints of pain, or even of discomfort, in parts which are covered by splints, should never be neglected or thought lightly of.

SPLINTS MADE OF PLASTIC MATERIALS.

These splints fall naturally into two divisions ; in the first are placed all those which are fashioned accurately to the part, out of a mass or a sheet of material which can be moulded when softened (generally by heat), and which is then allowed to set. The second class comprises those made by enveloping the part to be splinted with pieces of flannel or other suitable material of the desired shape, or with rollers, saturated with a material, liquid at the time of application, but which afterwards hardens.

DIVISION I.

In this division are included splints moulded from *leather, felt, gutta-percha, or cardboard*, the skilful fashioning of which is an important branch of mechanical surgery.

Leather Splints.—Far too often, money is thrown away with very unsatisfactory results, through the mistaken notion that the making of these splints is either below the surgeon's or dresser's dignity, or above his mechanical powers. There can be no doubt a leather splint for such a case as a chronic enlargement of the knee, or a fractured patella, will be more efficient if made by one who understands the surgical necessities of the case, than by an instrument maker who must, from the nature of his trade, proceed in a beaten track, and according to a fixed pattern. Something of finish and appearance will, no doubt, be sacrificed, but the one splint will do its work, the other, very often indeed, will not. With a little care, a dresser may easily turn out a very good-looking leather splint, without giving any inordinate time or trouble to it. The best leather for the purpose is ordinary *sole leather, of medium thickness*, arm splints requiring a lighter kind than those for the leg. In all cases, the leather should be carefully examined for flaws. The piece being chosen, it must, before softening,

be cut out to the pattern with a very sharp knife.

. Patterns for the chief kinds of moulded splints are given on *Figs.* 45–47, but in all cases the shape should first be *cut out in paper* and fitted as nearly as possible to the limb. The figure should then be marked out on the leather before cutting.

Splints may be made of leather for the ankle, knee, hip, spine, shoulder, elbow, wrist, and jaw. The question of spinal splints will be considered in a separate chapter, and inasmuch as among the rest, those for the elbow and knee are by far the most common, and as many of the directions for making them will hold good for splints fashioned out of the other plastic materials, these two will be described in detail.

. The *back splint for the Knee* is one often required for the treatment of fractured patella in the later stages of union, or for chronic disease of that joint, or after its excision has been performed. The pattern should first be cut in paper (of the shape shown in *Fig.* 46, *No.* 5), of such a length as firmly to grasp the leg and thigh, and of a width such as will allow an interval of about half an inch between the two sides of the splint in front. The paper pattern must be carefully fitted to the part, and the leather then cut out from it. This then must be thoroughly softened in a bucket of cold water, which will take from twenty-four to forty-eight hours; if it should be desirable to shorten this time, a tumblerful of vinegar or of dilute acetic acid may be added to the water, when three or four hours will be enough to soften the leather. The splint should then be applied to the limb, which has been covered previously with a flannel bandage, or what is far better, to a plaster cast of the limb, and bandaged firmly, while it is at the same time moulded to fit the curves with all the exactness possible. Too much care cannot be exercised in this, the most important stage of the work. When it is done, the

leather must be allowed to " set " on the limb, a process which will take some hours, when it may be carefully taken off and allowed to dry thoroughly. It is then fit to be trimmed and finished by cutting away whatever leather is redundant, or where the edges seem as if they might chafe. The edges, too, must be bevelled on the inside with a very sharp knife. If it is considered advisable further to strengthen the splint with an iron backing, this may now be riveted on by a smith.

The *lining* is best done with *chamois leather*; it must be cut out from the same shape as the splint, but large enough to over-lap it everywhere for about half an inch. The inside of the splint is now brushed over with very hot thin glue, and the chamois lea-ther stuck on. It will adhere very firmly; and the edges must be turned over and similar-

Fig 45.—Patterns for Moulded Splints; (1) For Hip and Thigh; (2) For the Elbow.

ly fastened down, and then trimmed to an even width.

The finishing touch is given by punching the necessary holes for lacing and inserting the brass eyelets with the proper bootmaker's tool. If it is desirable to polish the leather outside, this may easily be done with beeswax and oil melted together and rubbed in, while warm, with a flannel. *Fig.* 48 show an ordinary knee splint, finished and applied.

There are two equally efficient ways of moulding an angular splint to the *Elbow*.

Fig. 46.—Patterns for Moulded Splints; (3) For the Shoulder;
(4) For the Elbow; (5) For the Knee; (6) For the Ankle; (7) For
the Front of the Arm; (8) For the Shoulder.
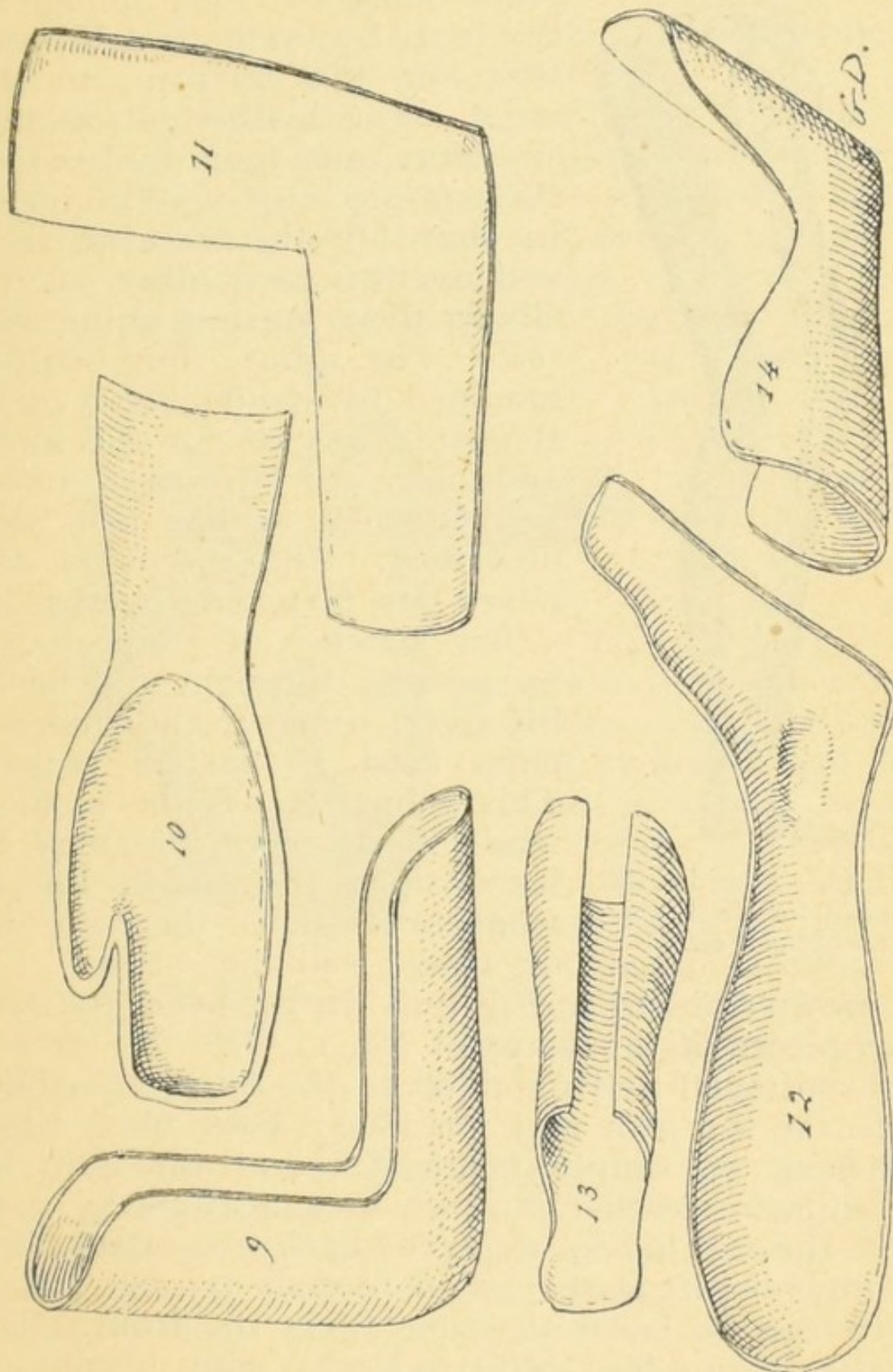
Fig. 47.—Patterns for Moulded Splints ; (9) For the Back of the Elbow ; (10) For the Hand ; (11) For the Elbow ; (12) For the Leg ; (13) For the Wrist ; (14) For the Ankle.

The first pattern is as in *Fig.* 45, *No.* 2, the arm-piece being cut long enough to reach to the axillary fold, and that for the forearm, to the wrist. The leather is softened as before, and then, by bending the arm-piece up at right angles to that for the forearm, they will overlap each other at the elbow, the arm edges going outside. The splint, thus bent, is moulded by bandaging it on in the same way as for the knee, and may be trimmed, lined, and finished, as has just been described. The pieces at the elbow are fastened together by a few stitches of whipcord, or by passing through, and bending over, some of the common clips used to fasten papers. This splint, it will be seen, is made of one piece, and may be laced along the middle line in front or fastened there by two or three webbing straps. It

Fig. 48.—Moulded Back Splint for the Knee, in Leather or Felt.

is shown finished in *Fig.* 49. In the other pattern, two pieces of the shape of *No.* 11, *Fig.* 47, are cut out, softened and moulded to the outer and inner sides of the arm and forearm. They may, when finished, be simply fastened round the limb by webbing or leather straps; or a neater way is to glue the two halves along the back to a broad piece of tape or soft leather, so as to make a hinge; they then can be laced together along the front. The advantage of this splint is that it may be put on and off very readily, but it is more troublesome to make, and is not quite such a firm support.

Poroplastic Felt.—It often happens that joints suitable in other ways for leather splints are too

tender to bear the necessary manipulation of moulding. In this case it would be better to make the splint of poroplastic felt, which is easily moulded and sets quite as hard as leather.

This material closely resembles leather in its mechanical properties, but is more easily applied, and has now to a great extent superseded it for moulded splints, both large and small. It consists of felt, saturated with some resin, in such a way that while it preserves its porosity and is but slightly increased in weight, it is rendered quite plastic by heat, but becomes again extremely stiff when cold. The advantages it possesses over leather are its lightness and porosity. Its disadvantages are that it is not so strong, and is more liable to crack or break. The fact that it sets very quickly cuts both ways, being sometimes useful, sometimes embarrassing. It is sold in sheets of various thicknesses and qualities ; the medium quality is the best.

Fig. 49.—Moulded Splint for the Elbow.

As with leather, the description of the use of this felt in spinal cases is given later. For other splints the patterns in *Figs*. 45–47 are those in most common use ; most of them may be had ready made, or they may be cut out of sheets of the material. The best way of softening is by means of a steam chamber, made for the purpose ; but an oven will do very well if the felt be first thoroughly moistened ; in many cases water, nearly boiling, will serve. If softened in this way, the

felt must be laid flat and quickly pressed between the folds of a towel to remove the superfluous water before it is applied to the limb.

The method of moulding is in all respects the same as for leather, save that, in consequence of the extreme rapidity with which it sets, the manipulation has to be very quickly performed. These splints may be lined, and eyelet holes punched as in leather, but care has to be taken not to break the edges. If required, portions of the splint may be left unstiffened, or the resin may be removed from such parts after moulding, by soaking them in methylated spirit.

Gutta-percha Sheeting.—Next in usefulness to poroplastic felt comes *gutta-percha sheeting*, which is even more readily moulded. It is not, however, porous, and is not so comfortable as felt or leather, while in durability it is far inferior to them ; on the other hand it admits of much more complete softening, so that it can be moulded more easily to tender parts, or to parts of a complicated shape.

The sheeting, of about the thickness of sole leather, having been cut out, is softened in water as hot as can be borne by the hands, and rapidly moulded to the part, which should first be moistened. If the water be of the proper heat, some care will be required to keep the sheet from losing its shape through undue softening ; and if it be too hot this will certainly happen, while on the other hand, water merely " hot " (e.g., 100° F.) will not render it sufficiently pliable. The splint will quickly set sufficiently to allow it to be removed without losing its shape, and it should then be plunged into quite cold water, which will give it greater rigidity than it would have if allowed to remain on continuously. It may then be trimmed, and, if desirable, lined and punched for lacing as before. It will, however, generally be best simply to put it on the limb over a piece of soft lint, and to secure it with webbing straps and buckles, for the gutta-percha is rarely

durable enough to make the former proceedings worth the trouble.

Cardboard.—In the absence of leather, felt, or gutta-percha, a fairly efficient moulded splint may be made from common *cardboard*. After having been cut out of very stout board to the required form, the splint must be thoroughly softened in water, and the details of manipulation may be in all respects similar to those for plastic felt. In most cases, however, the best support will be obtained by cutting the millboard in strips, about $1\frac{1}{2}$ inches wide, softening, and then applying them to the limb, one or two at a time, while a roller is at the same time applied, so as to mould and fix them as well. In this way the strips come to be within the layers of the bandage, and give considerable rigidity to the limb. The splint thus applied has to remain on, and cannot be finished up like the preceding ones, and for this and other reasons cardboard splints are now nearly superseded by felt.

There remain to be mentioned one or two materials occasionally used in general or special surgery, as for example, *gutta-percha* in mass, *vulcanite*, and *gum resins*. All these are principally used in dental surgery, or to form splints for cases of fractured jaw ; but the student may be reminded that for splints of delicate construction, materials such as these may be used ; so, too, metals, other than those already mentioned, may sometimes be found useful, e.g., lead, silver, or aluminium, the last being specially valuable for its lightness, although its cost prevents its extensive employment.

DIVISION II.

Moulded Splints made of bandages saturated with a plastic material. Whatever be the stiffening agent used, the principle is the same for all the splints described in this division, namely, that the part required to be supported must be covered with material, into the interstices of which there

can be introduced some substance which, soft at the time of application, becomes afterwards hard, so that the part is enclosed in an accurately fitting case.

The substances in common use for this purpose are *plaster-of-Paris, gum and chalk, silicate of potash, stearine,* and *starch ; glue* mixed with spirits of wine, to enable it to dry, has also been used.

Plaster-of-Paris is the best and the most commonly used material for both kinds of splints, for injured limbs, and also for one important variety of spinal support. It is a fine white powder, obtained by burning and thus expelling the water of crystallization from *gypsum,* a peculiar form of sulphate of lime. Its value depends upon its power of quickly reabsorbing this water and solidifying.

In surgery it is used (*a*) As a means of *stiffening roller bandages,* as will be described below ; (*b*) As a means of giving a similar *stiffness to pieces of coarse flannel,* which, having been shaped and immersed in the plaster, are then moulded to the limb ; (*c*) For *making casts* on which splints or other material can be blocked, and a many other purposes.

Whichever plan is adopted, bandage or shaped flannel, the skin must be protected from direct contact with the plaster.

HOW TO USE PLASTER-OF-PARIS.—A few words as to the manner in which plaster should be practically handled, when used for purposes of support, or any other surgical objects, may be useful.

It should be recollected that, except when used on a very small scale, it is always a very messy thing to apply, and also difficult to clean up afterwards. Clothes, carpets, and everything that is upholstered should be protected or removed. Aprons and sleeves (or bare arms) will be wanted also.

If the roller bandage is the method chosen, the dry plaster, in powder, must be distributed as evenly as possible on the unrolled bandages a short time before they are wanted. But they will keep a week if they are put in a tin in a dry place.

The best way to *charge the bandages* from end to end with the powder, is to pass them over a table or board with a heap of loose plaster upon it, and then to sprinkle them with it, rubbing it lightly into their meshes; passing them on from left to right, and rolling them up at the end of the table.

The manner of *wetting the bandages* is as follows: The vessel in which they are immersed must contain water sufficient to cover them. None must be put in water until everything else is ready. Then one only is to be thoroughly wetted through and the air expelled, and as it is taken out of the basin to be applied, an assistant puts another into the water. The times of application and of soaking will then coincide in a convenient fashion.

It will be seen that there is no regular rule given here for the amount of water to be taken up by the roller, and practically as much will be taken up by the powder as it lost as gypsum in the furnace, and no more.

But a little more accuracy and practice is required if the second way of applying the plaster is adopted, namely, by so adding the dry powder to the water that the mixture is a complete and creamy fluid, in which the pieces of coarse house-flannel, already shaped as required, can be immersed and saturated with it, and still be flexible enough to be moulded to the limb before setting.

The best way is to take a quantity of water, in a basin or bucket, equal to about two-thirds of the quantity of plaster cream which is estimated to be wanted; then, taking the powder and gently and slowly scattering it all over the surface of the water, let it sink by itself. This it will do very quickly at first, and then more slowly, until the plaster ceases to sink, but remains on the top of a cone of thoroughly moistened plaster in the water. The contents of the basin must now for the first time be stirred, and this is best done by the hand at the bottom, and quietly, so that there are no surface

bubbles ; it will soon become uniformly thick, and can be used at the consistency of rather thin cream. At the end of the setting it hardens very quickly. The cream for taking solid casts, as of the limbs or trunk, is used rather thinner than for stiffening flannel ; that is, it is used as soon as it is mixed.

Application of Plaster Bandage.—The part to be splinted is first evenly covered with a soft flannel bandage, or some well-fitting flannel clothing. The bandages, which should be about two-thirds the length of an ordinary roller, and 2 or 3 inches wide, are made of a very coarse muslin, generally called *crinoline*.

They are prepared by rubbing the dry plaster, in powder, well into the meshes, and then rolling up loosely. When made they should be kept in a warm dry place, lying on their sides in a tin box, till required. They should be prepared fresh for each case, as the plaster seems to lose its power of setting satisfactorily after it has been kept long.

To make the splint it is only necessary to put the bandages in water till all the plaster is well soaked, and then to roll them on the limb, allowing them to take their own course to a great extent, avoiding reverses, and not attempting to form any regular pattern. The more oblique the general direction of the bandage is, and the more figures of 8 are made, the better. Three layers of the bandage are generally enough to make a firm case.

In all cases where a stiff bandage is applied to the leg, *great care must be taken to keep the foot at right angles.* This is easily done by passing a clove-hitch round the big toe with a long piece of bandage, which may be fastened to the head of the patient's bed, or round his neck. When the case has been applied, it must be kept quite still until it has set ; this will require from half an hour to three hours, according to the weather, the dampness of the bandages, etc. The setting may be hastened by hot-water bottles or proximity to a fire.

Sometimes it is desirable to retard the setting; this can be done by soaking the bandages in mucilage and water. When this plan is followed, some surgeons cut the saturated and moistened bandages into strips, which are laid down, overlapping each other; the limb is then laid upon them and they are brought round it in order, and the ends crossed in front in a spiral fashion so as to produce the appearance of an 8 bandage (see *Fig.* 34). See also "Spinal Jackets."

In all cases where plaster-of-Paris is used, while the bandage is being put on, a moderate amount of the plaster, moistened, should be rubbed into it, and the hands, well wetted, should be passed up and down to distribute the plaster evenly, and to rub it into the bandage thoroughly.

Application of Plaster by means of Shaped Flannel.— *Croft's method.*—This method
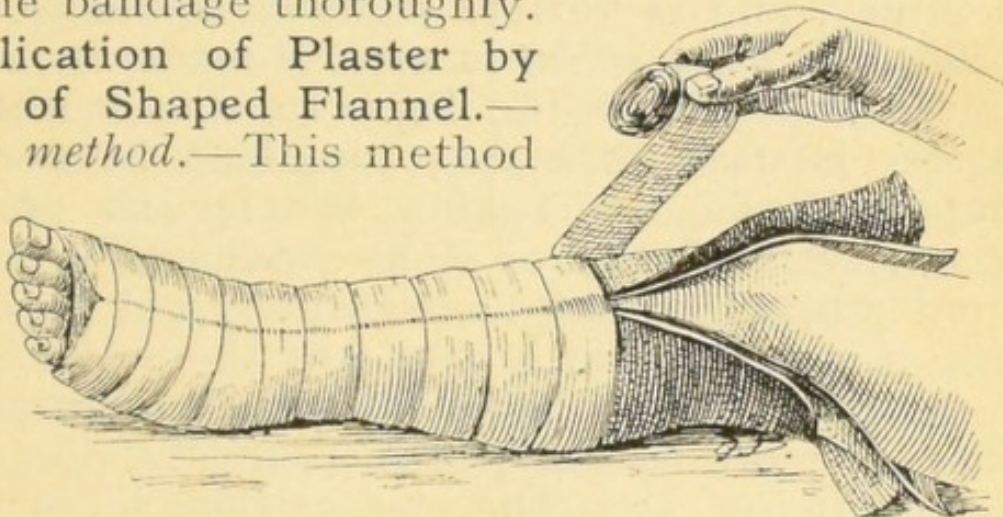
Fig. 50.—Croft's Method.

of immediate splinting, or some slight modification of it, has come into very general use. It has all the advantages of the original " Bavarian " splint in the way of being able to be opened for inspection of the limb, and is yet much simpler. Their chief use is for cases of simple fracture of the leg, but they are not confined to these injuries. Each splint (for the leg two will be required) consists of two layers of house flannel. The inner layer, which is generally moistened with warm water, is applied to the limb, while the outer one, after moistening, is thoroughly soaked in plaster-of-Paris cream and put on over it. Both layers are then moulded to the limb while the

assistant holds it in position. *Muslin* bandages are then rolled on so as to thoroughly shape the splints and to bind them together. The turns of the bandage adhere to the plaster, but as the interval between the splint pieces is spanned by the muslin only, this can be cut up for examination of the limb along the upper interval, while it serves as a hinge at the lower. In the case of the leg, the pattern for the pieces of flannel, as in the case of the Bavarian splint, can be got from the flattened-out stocking of the patient. Inside and outside splints will here be required, and they must be cut of such a size that they will not meet in front or behind for about half-an-inch. This plan of splinting can be adopted in many different forms of injury, and in various parts of the body.

The Bavarian splint is usually made for cases of simple fracture of the leg. In this method the plaster is used as a mass moulded between two shaped bandages. Taking the leg as example : two pieces of flannel or stout canvas are cut out to a pattern, which can be accurately got by cutting open a stocking which would fit the patient, along the front of the leg and foot, and then spreading it out ; or more roughly, by making " a double " of *No.* 12 in *Fig.* 47. The pieces of flannel or canvas are then laid one on top of the other and stitched down in the middle line. The limb being laid upon them, the piece next to the leg and foot is brought round these parts and fastened along the front with safety pins. The outer piece of flannel is spread out evenly on one side, and a layer of plaster, about half an inch thick, is spread over it and also over the outer surface of the inner flannel, care being taken that the plaster goes well up to the seam. The outer flannel is then folded over the inner, and plaster is spread over its outer surface. The same procedure is then carried out on the other side. When the whole is set it may be removed for inspection of the limb, the seam acting as a hinge,

and herein lies the advantage of this splint : it is held in place by a bandage over it. After the splint has hardened it should be removed and left for twelve hours in front of a fire ; this will make it much firmer.

The next step is to trim it. Trimming is performed with stout scissors—all rough, uneven parts are removed from the edges, and the corners rounded off. Strips of strapping well warmed are now applied round the edges of the plaster, like braid trimming to a coat. This step will prevent the edges from cracking and fraying, and imparts a neat, workmanlike appearance to the whole structure. It can be fixed on with strapping and bandages, can be readily removed, and is durable.

The plaster-powder in all cases must be very dry ; it is therefore a wise precaution to have it put into an oven for an hour before it is wanted.

Gum and Chalk.—A sufficient quantity of dry powdered chalk, free from lumps, is mixed in a basin with mucilage, until it is of the consistence of gruel. The limb being first bandaged with flannel (and in the case of the leg or thigh, the foot fixed at right angles with the heel elevated on a block), is carefully bandaged with a common calico roller, the flannel roller extending beyond it for about half an inch. The mixture is then rubbed into the bandage with the hands, so as to permeate it thoroughly. Another bandage is then put on and treated in the same way, and generally a third will be found necessary. The case is then left to dry.

The advantages of a well-made gum and chalk case are many. It is lighter when dry than plaster of Paris, and though abundantly strong, has a certain flexibility which prevents its cracking. On the other hand it requires more time and patience in application, and the length of time it takes to set is sometimes inconvenient. It is, however, generally preferred by those who are accustomed to put it on.

The **Silicate Case** is made with ordinary bandages and a saturated solution of silicate of soda, with or without the addition of a little chalk or whiting ; it is applied in precisely the same way as the gum and chalk one. In their mechanical properties also the two cases are similar. The silicate is slightly heavier, and perhaps not quite so durable : on the other hand it sets more quickly, taking from three to four hours, while the gum and chalk takes from twelve to eighteen.

Starch is the least efficient material for making a supporting case, but, on the other hand, it is one which is always ready to everyone's hand.

It is applied like gum and chalk, by rubbing starch paste into the interstices of ordinary bandages. Four, or even five thicknesses will be required for any useful degree of support. The limb must be kept very still while the case is drying.

Its chief drawback is the shrinkage which occurs as the splint dries on the limb, which is not present when other materials are used. This may even produce gangrene, and must prove a source of anxiety, necessitating careful observation of the circulation until the splint is dry.

It may be here mentioned that a common roller bandage (e.g., one used for securing fracture splints) has a more neat appearance, and is less liable to be disturbed, if a little thin starch paste is brushed or rubbed over it after it has been put on.

Spicas.—Plaster of Paris, or gum and chalk spica bandages, are very frequently used in early or convalescent cases of hip disease, or in fracture about the neck of the femur. They are applied like the ordinary spica, but require rather a firmer and longer hold on the thigh. That part of the bandage which goes round the pelvis does not require to be so much stiffened as the rest ; but the junction between it and the thigh portion must be very firm, and to this end should be reinforced by strips of cardboard, tin, thin wood, or the like,

It is often necessary to apply a *stiff bandage or case to some part where there is a wound.* If the discharge from this be extremely slight, it will be sufficient to cover it with dry lint ; but if not, an opening or " *trap-door* " must be made. This is best done with a very sharp knife after the splint is firmly set, a careful note being taken at the time of application as to the exact position of the wound.

It will happen, every now and again, that through chafing, or some other cause, a *sore* develops underneath one of these splints. In such a case no time must be lost in cutting away the chafing part. This may be sufficient, but very often the whole splint will have to be removed and the sore allowed to heal. It is therefore very evident that every
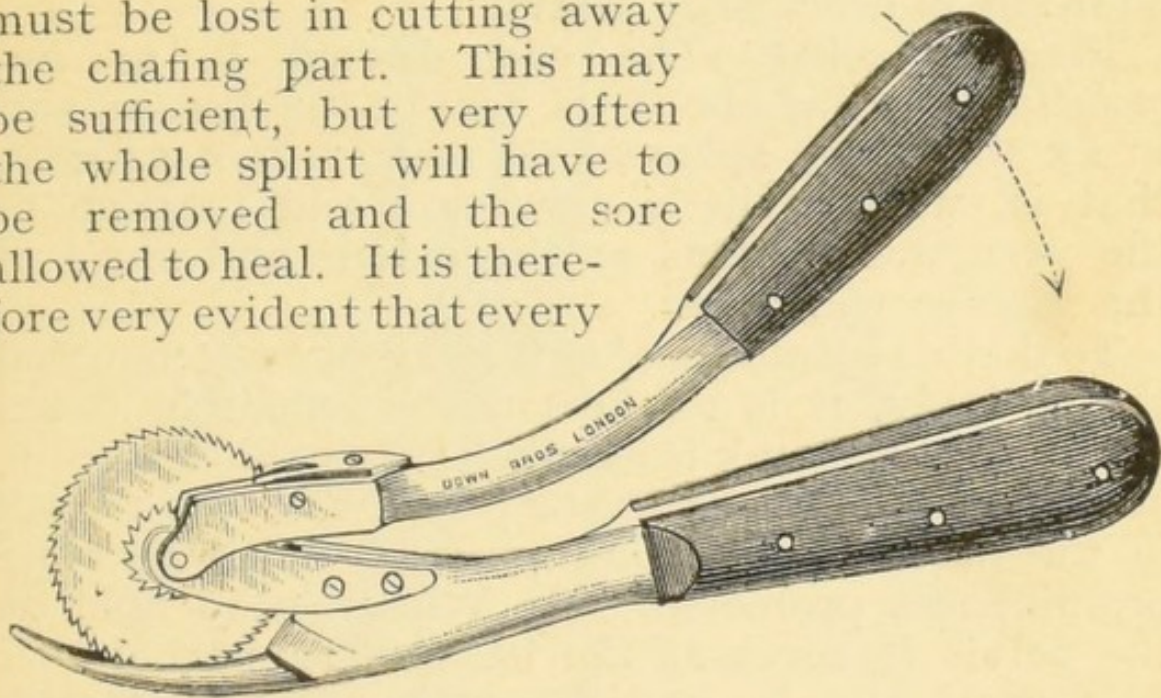
Fig. 51.—Bandage Saw.

care must be taken while applying the case to avoid creases or constrictions which may lead to such serious consequences. Another common act of carelessness which may lead to the above result is that of leaving pins within the folds of the bandages.

When plaster or gum and chalk cases have to be removed, a pair of strong cutting pliers (Seutin's) may be used, or an instrument devised by Davy (*Fig.* 51), which is a combination of a knife and a saw, and which is very suitable for the purpose, if the splint is to be cut up along the middle line without other damage so that it may be used again. In other cases a strong jack knife will do. On the

other hand, if the limb be very tender, it may be best to soak it and the splint in water until the plaster or chalk is sufficiently softened to allow of the layers of bandage being peeled off.

JACKETS.

These are made of plaster-of-Paris, leather, and poroplastic or resinous felt, all of which can be moulded to the body. Plaster is not so popular as it was, for, although cheap and easily applied, it is apt to crack and become soiled, and it is in addition unnecessarily heavy.

Plaster Jacket.—The end desired is to *immobilize the spine* about the seat of the disease, and to fix the whole spine *in the best position possible*, that is, with as little curvature and rotation of the vertebral sections as the extent and stage of the disease will allow.

To do this by means of any splint or case, moulded to the body, it is obvious that it must be fitted (1) While the trunk is as much extended as it may, or rather as it ought to, be ; (2) With the thorax in the position of inspiration ; (3) With all bony prominences protected ; (4) With a good hold on the pelvis to serve as the basis of support.

It must also be as light as is compatible with strength, and be loose enough over the abdomen to allow of moderate distention by food or flatus.

The Extension of the Trunk may be attained by Sayre's method of suspension, or, in the case of children, by simply holding them up with the hands in the armpits, or by the inclined plane ; this latter however, cannot be used for the ordinary plaster case.

Of these three methods, the *suspension* from the tripod requires the most care. As shown in the figure (*Fig.* 52), the patient can be suspended with the feet just *off* or just *on* the ground—in England the general practice, with which we thoroughly agree, is not to swing the patient clear
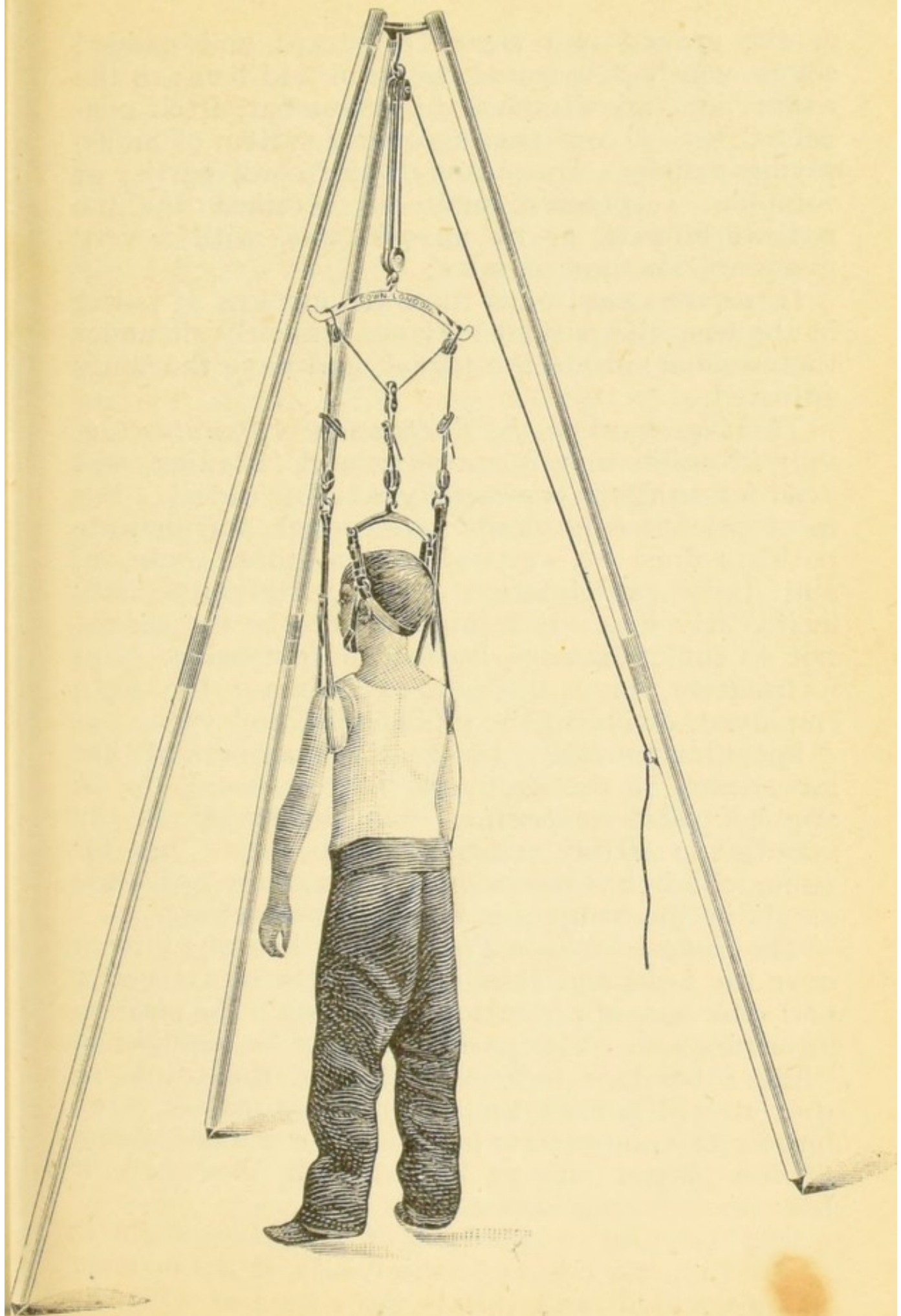
Fig. 52.—Suspension (partial) by Tripod and Pulleys,

of the ground—by means of straps and padded slings, which pass round the head and beneath the axillæ, and are attached to a crossbar, itself connected with a cord passing over a system of multiplying pulleys. By means of this cord, partial or complete suspension may be attained by the patient himself, or by an assistant, with a very moderate amount of force.

In severe cases, or if there be any loss of power in the legs, the patient may conveniently sit under the crossbar, inside the tripod, and have the slings adjusted.

The Objections to the Suspension Apparatus are, that in children it is alarming and fatiguing, and even for adults it is generally a trying ordeal. For most cases it is no doubt safe enough, but delicate patients must be watched lest faintness come on, and if the consolidation of the vertebræ be only in its early stages it is impossible to be too careful not to inflict damage by forcible extension. Unfortunately, it is difficult to estimate the force employed, owing to the multiplying pulleys.

Speaking generally, however, it may be said that for adults, if the ordinary plaster case is to be applied, *gentle suspension* from the tripod, in the standing or sitting position, will be best ; but for young children, suspension by an assistant with the hands in the armpits is much to be preferred.

The *Simple Inclined Plane*, with the arms thrown over the head and grasping a bar, is even a better and safer way of producing extension in the position of inspiration. This position cannot be maintained while a bandage is being rolled on the trunk, so that it will not do for an ordinary plaster case ; but for the poroplastic jacket, or for a modification of the plaster one to be presently described, it has much to recommend it.

The Inspiratory Position of the chest-walls is secured by the raising of the hands, if the inclined plane be used, and this is the case also with the

tripod, if the patient be self-suspended ; if not, the hands may be raised to grasp the legs of the support, but the management of this is often a difficulty. In holding up children by the hands in the axillæ, it is easy to maintain the desired position of the arms and chest-walls.

The Protection of Prominences is most important. Not only the angle at the curvature of the spine, if one be present, but any other projection which seems in the least likely to be rubbed, must be protected by pads placed on either side, or around, but not over it. The pads are best made of tow, covered with old table-linen, and are placed in position next to the skin. Careful moulding of the case to all irregularities, by pressing and squeezing it into shape before it sets, will also prevent chafing.

The Hold on the Pelvis is very important, and its neglect is the most common cause of failure of the treatment. If the case merely encloses the trunk as in a barrel, there is no relief afforded in the way of support for the weight of the head and upper extremities, nor is the rotation of the spine at all prevented. The requisite grip is easily secured by taking care to bring the bandage, or the felt, at least $1\frac{1}{2}$ inches below the iliac crest, and to mould the case to the prominence of that bone.

We pass now to a description of the actual application of the common plaster jacket, of its modifications, and of the poroplastic jacket.

Ordinary Application of the Jacket.—A time should be chosen not less than two hours after a meal, if possible upon a dry day, and there should be a fire in the room in which the operation is to be performed. A firm horse-hair mattress, ready to place the patient upon as soon as the jacket is adapted, should be laid on the floor near the fire.

The patient is then stripped, and the singlet or jersey which is to go under the jacket, and which should be of a kind specially made for the purpose,

is slipped on, and the tags for the shoulders tied or fastened with safety pins (on no account must an ordinary pin be used anywhere in these cases). The pads must then be adjusted to protect the angular curve. If the abdomen be unusually retracted, it is wise to place a temporary pad to bring up the circumference of the jacket there to its normal size. The permanent pads at the back or elsewhere should be fastened to the jersey with a stitch or two, after they have been carefully adjusted. The bottom of this garment is then fastened, back and front together, between the thighs, with a safety pin.

If the patient is a girl about the age of puberty, care must be taken to leave room for the developing breasts. This is usually done with pads in the same way that allowance is made for any temporary enlargement of the stomach by a meal.

All is ready now for suspension. In the case of a child, as we have said, this is best performed by an assistant placing his hands in the axillæ, so as to grasp the arms at their highest point. The child can thus easily be held with the shoulders well thrown back and with the toes just touching the ground. But if *suspension by straps and pulleys* is to be employed, the patient must have the head and shoulder-slings of the tripod adjusted to give an equal pull on every part, as seen in *Fig.* 52. The straps of the slings, and of the chin and occiput supports, can be altered to suit different patients, and too much care cannot be taken to get the support exact before applying the bandage. Generally, the patient stands for the suspension ; but if there be great weakness, or any paralysis, or simply if it be found more comfortable, a seat without a back (a rotary music stool does best) may be placed beneath the tripod.

When the slings have once been adjusted, the actual raising should not be made until everything is ready for the application of the bandage, and in

our opinion it is never advisable to swing the patient quite clear of the ground or stool.

The general manipulation of rolling on a plaster bandage has already been described, and this particular form does not differ in any essential point.

Six or eight freshly-rubbed muslin bandages will be required, and both they and a small quantity of loose plaster should be put into an oven for about an hour before they are wanted. In moistening the bandages, a large basin of warm water should be used ; as soon as one is ready, it is taken out and another is put in the water, while the surgeon rapidly rolls the first on to the trunk of the patient, allowing the bandage to take pretty much its own course, but endeavouring to work generally in figures of 8, the upper loop encircling the chest and the lower one grasping the pelvis. The bandage must on no account be drawn upon, but merely rolled on. When the first is finished the second is taken out of the water and a third one put in, and so on. As a rule, for a child of eight years of age, four bandages will be enough to make a jacket three layers thick everywhere, and four layers in the parts that most require strength. For an adult, six will generally be necessary.

While the bandages are being rolled on, an assistant should rub in additional loose plaster with the hand, moistening it as is required ; and when all the bandages are put on, the whole jacket must be worked over with moistened plaster, well rubbed in, until the surface has a uniform smooth feeling. The prominences of the pelvic crest and spine must now be moulded before the plaster sets.

All this must be done very quickly, for the position is a fatiguing one. In most cases it is wise to have one assistant whose whole care is to watch the patient, and to look after the suspension. If, in the process of applying the jacket, any symptoms of embarrassment, either of breathing or circulation, appear, the patient must be promptly let down.

When the application is finished, some patients, if there be no great discomfort, may be left partly suspended for about ten minutes while the jacket begins to set, but as a rule it is advisable to remove them from the apparatus as soon as possible, and lay them flat on the mattress, placed ready on the floor near a fire. The removal must be made with great care, to avoid any cracking of the case. Hot-water bottles, or hot bricks, laid near the case, will hasten its drying, especially in damp weather.

As a rule the patient had better remain still for three or four hours while the case is setting. It will then probably require a little trimming and cutting away in the armpits, etc., which can conveniently be done with a sharp knife.

The safety pin in the perineum, and the stomach pad, when present, can be removed when the patient is laid down.

Fig. 53 is drawn from a case of angular curvature of ordinary severity, in which a plaster case had been applied.

In the poor, particularly when a child is allowed to go home with a jacket on, some means must be taken to prevent vermin getting inside the jacket. Soaking the jersey or sprinkling the skin with boric acid is generally sufficient.

Fig. 53.—Plaster-of-Paris Jacket applied.

One great drawback to this treatment is the impossibility of getting at the skin to wash it, or of cleansing the jersey. If only one jersey be used, it cannot be changed without making a new jacket.

There are two ways in which this difficulty may

be partially overcome. The first, recommended by Keetley, consists in laying two clean handkerchiefs or napkins, back and front, between the jersey and the skin (and of course inside the pads) before the jacket is applied. When these have to be changed, it is easily done by pinning a clean napkin to the lower edge of the soiled one, which should project a little below the plaster jacket; then, by pulling the latter out at its upper end, the new follows the old one and lies in its place.

The other is Oxley's device. Two jerseys are worn throughout the treatment, the pads being fastened to the outer one only. This one adheres to the plaster, and forms part of the case, but the second can be removed by pulling it off, over the head and shoulders, after having tacked a clean one to its lower edge all round.

Poroplastic Jackets.—The moulding of *resinous felt* into a spinal jacket does not differ in its main principles from the moulding of that material for other splints, but the large amount of felt employed, together with the great rapidity with which it sets, necessitates practice in order to be able to fit a case of spinal curvature properly.

Advantages.—A well-fitted poroplastic jacket is often an admirable method of treatment. It is not much more than half the weight of a plaster one, is porous, so that the action of the skin is but little interfered with, and it can be removed altogether, or widely loosened, at frequent intervals, for the purposes of cleanliness, although it will not long stand being taken off every night, as is sometimes advised.

These jackets are sold roughly blocked out (*Fig.* 54) in a sufficient number of sizes, and of three qualities, of which the two most expensive are about equally good, though the dearer one is rather the lighter of the two. The third and coarsest quality is not recommended.

The jackets are fitted with the necessary straps,

buckles and eyelet holes, and lately an additional improvement has been to leave unstiffened the felt corresponding to the front iliac spines, and (in women) to the breasts, as shown in the figure. Other parts may also be left unstiffened as required, as over tender prominent ribs, or spinous processes.

A jacket of about the right size having been chosen, it must be *accurately fitted* to the body of the patient while the position of extension is maintained.

One way of doing this is to take a plaster cast of the trunk, and block the jacket upon that instead of upon the body. This is a plan very generally followed by instrument makers, and has this advantage, that any number of jackets can be moulded in the future without further trouble to the patient. But the first cast is difficult to make, except by a professional modeller, and generally speaking, the position of extension is not well maintained. A cast, however, would be absolutely necessary if leather were used instead of felt.

Fig. 54.—Poroplastic Felt Jacket.

But the general practice is either to suspend the patient from the *tripod*, or to procure the extension, and the inspiratory position, by means of an *inclined plane*. As we have said before, we consider the latter is, in ordinary cases, to be preferred.

In either case, the fitting of the jersey and pads is the same as if the plaster jacket were about to be made, and if the tripod be used, the head

and shoulders are adjusted exactly as has been before described. If the plan of the inclined plane be chosen, the patient lies down on it, and, raising the arms above the head, catches hold of some bar or support. The best inclined plane is the simplest, namely, a board about two feet wide, and with an inclination of about two feet in six. There must be no foot-piece, nor any pillow for the head.

The same method of *Softening the Jacket* can be employed in either case. This can be done very well in a good-sized oven at the ordinary cooking heat, in which the jacket should be suspended from some support, such as a surgical cradle; it must hang free, and must not touch the sides anywhere, or it will burn; it must also be well moistened, and a pan of water should be placed on the floor of the oven.

A more convenient plan is to use a specially contrived *steam chamber*, sold or let out by instrument makers, and which consists of an iron cylinder with a double bottom, into which an oil stove-lamp, a spirit-lamp, or a gas-jet is put. A pan of water stands within the cylinder, which has a tight-fitting lid.

The lamp quickly generates the steam, and there should be heat enough to thoroughly soften the jacket in three or four minutes. It is then ready for application, and must be *at once* and *as quickly as possible* put on. The patient being suspended from the tripod, an assistant (who is advised to have gloves on) quickly draws, first the waist-strap and buckle together, then the pelvic ones, and lastly those about the breast, the responsible surgeon the while moulding and kneading the felt to the prominences of spine and other parts.

This is a good plan to follow, but a better is to have, ready cut, six or eight lengths of broad, stout bandage stuff; then, whether the patient be suspended or be lying on the inclined plane, the jacket can be quickly slipped on and the sides

brought round into position, care being taken that the softened parts of the felt correspond to the hips and breasts, and that the buckles come opposite the straps. The lengths of bandage are then quickly passed round and knotted in front by the assistant, while the surgeon brings the sides accurately forward, and moulds them as he does so. The waist bandage is tied first, then those for the hips; the breast ones next, and then intermediate ones as may be required. In this way all fumbling with hot buckles and straps is avoided, the jacket is easily put on before it can set, and a closer, more accurate fit is attained.

The jacket sets too firmly in a minute or two for any further moulding to be done, but it is not really strong for about half an hour, so the patient must lie still for that time, if on the plane, or may remain semi-suspended if this can be borne, or, as in the case of the plaster, may be carefully released from the tripod and laid flat on a mattress, but in this case *not* close to a fire.

When the felt has set, the bandages may be cast off, and the straps and buckles closed. These will very likely require some adjustment, and for this reason it is often wiser to mould the jacket *before* the straps and buckles are sewn on. The jacket itself will almost certainly have to be cut away somewhere, or slightly altered, and this may be done in one of two ways, as may seem best: namely, with a hot iron, which will re-soften parts that do not quite fit, or by dissolving the resin out of the felt with spirits of wine sufficiently to make it much more pliable. This is often a very good plan for such parts as the armpits.

If the jacket be a failure, or if, as ought to happen in the progress of a case, it seems as if a further improvement were possible, the case must be slipped off and re-softened in the steam chamber, unless it be badly cracked, or be worn out.

Cervical Caries—Jury-masts.—When the seat

of the spinal disease is in the cervical region, it is obvious that no jacket can, of itself, fix the vertebræ. In acute cases it is generally necessary to make the patient lie absolutely flat, with the head fixed with *pillows and sand-bags*.

But there are many stages in the disease in which it is both safe and advisable to allow the patient to get about, provided that in some way or another the weight of the head and neck can be taken off the diseased vertebræ. This may be done by the simple plan known as the " jury-mast " system.

Its main features can be seen in the accompanying figure (*Fig.* 55). It consists of a light plaster jacket, from which springs the mast itself, which is a light bar, with a joint for the adjustment of its length, arching overhead, and having a crossyard about five inches long, from which hang straps to support the head from the chin and occiput.

The mast is forked below, so as not to press upon the vertebral spines, and has attached to it thin strips of tinned iron, with pierced rough holes ; these go round the body and are worked into the plaster jacket.

Fig. 55.—Jury-mast applied

In fitting the mast, the steel bar should first be bent with wrenches to the right shape, and then tempered. The exact height may be afterwards adjusted.

The jacket may be put on with, or without, suspension, as may seem best, but if the tripod be used, the greatest possible care must be taken not to put too much strain on the vertebræ of the neck. The plaster jacket must be as light as will fix the
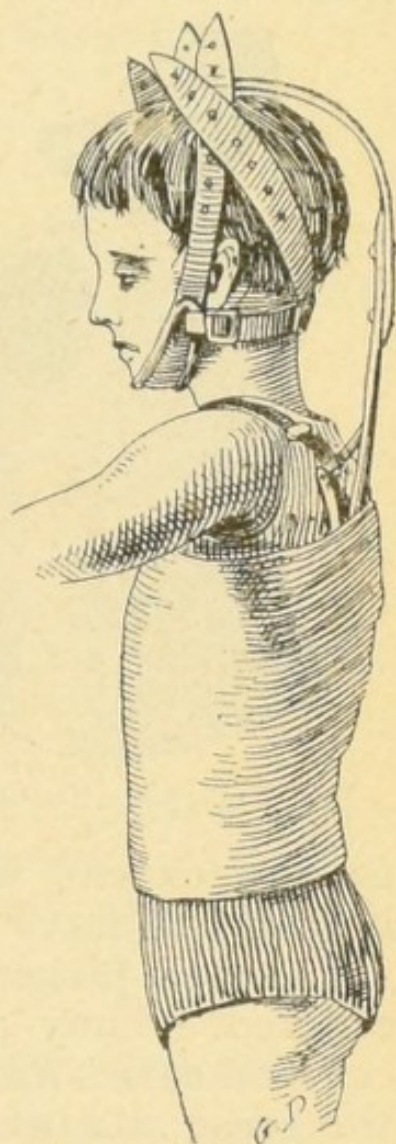
mast, which, with the cross strips, is imbedded in its substance, having layers of plaster both above and beneath the iron.

As soon as the jacket is set, the straps may be adjusted, and the length so fixed that the bar is just clear of the head, when the latter is supported
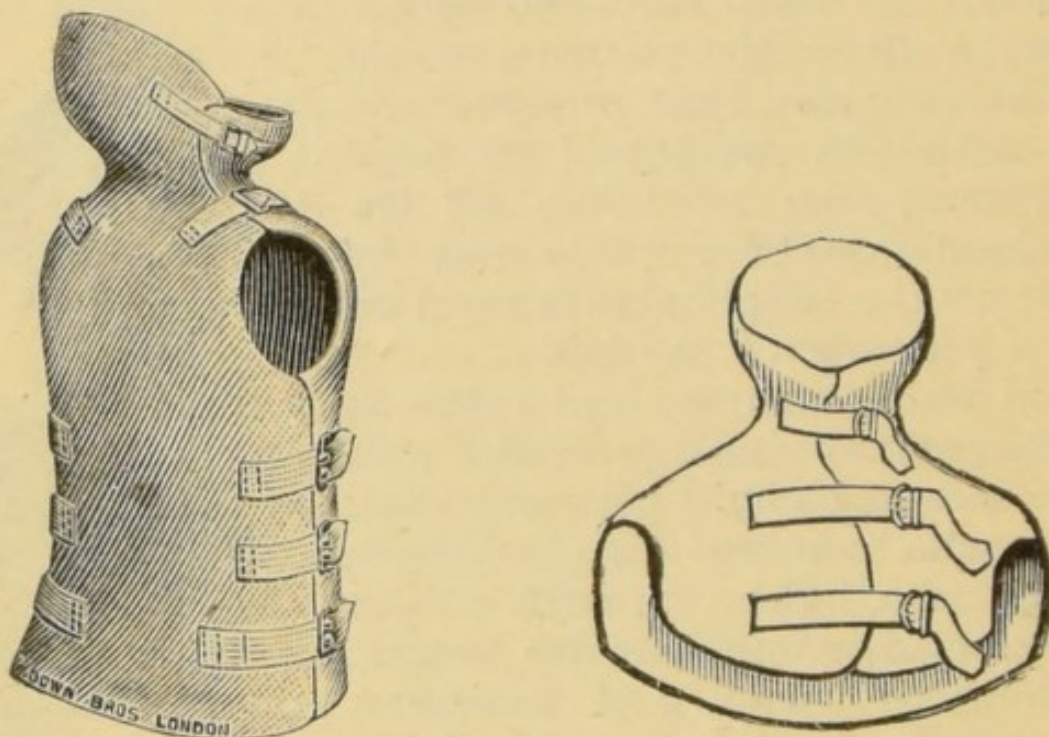
Fig. 56.—Poroplastic Jackets for Cervical Curvature.

to the extent which gives greatest relief. This height will have to be altered from time to time.

Leather Jackets are very expensive and rarely ordered. They are, however, very serviceable in cervical caries instead of a jury-mast, and they have the great advantage of fixing the head more firmly than any other form of apparatus.

SECTION II.

OF THE SIMPLER WAYS OF DRESSING WOUNDS, BURNS, AND SCALDS.

CHAPTER IV.

OF THE DRESSING AND SUTURING OF WOUNDS.

FOR any wound *to heal well,* the following conditions must be fulfilled :—

1. The wound must be cleansed, and kept clean by means of aseptic or antiseptic methods.

2. The divided tissues must be accurately readjusted and retained in position.

3. The parts must be kept at rest.

4. All effused fluids must be able to escape. The primary blood effusion *must be arrested completely,* and the wound must be covered and protected by some dressing material.

1.—THE CLEANSING OF THE WOUND.

As some confusion may arise in the minds of beginners between the words aseptic and antiseptic, we may explain that aseptic is " applied to substances which are free from putrefaction and which cannot convey the causes of putrefaction to others " : while antiseptic is employed to designate " substances which prevent or check putrefaction, these acting by destroying the germs upon the presence of which putrefaction depends."

A wound must be considered to have run a *perfectly aseptic course,* when there is, throughout its healing, no fever *and no suppuration.* The

object aimed at is to secure this, and however well the patient may recover, all cases must be regarded as failures in which, after antiseptic and aseptic precautions have been taken, traumatic fever, or profuse suppuration, or both, develop. It is hardly necessary to say that both aseptic and antiseptic precautions should always be taken in every case in which there is a wound of the surface.

It is obvious that the Listerian method, when it is applied to operation wounds, starts under far more favourable conditions than in the case of accidental injuries ; but in both instances the same end is desired, and much the same means are taken to attain it.

These means are, all of them, intended to ensure absolute purity and the absence of germ elements, and they may be considered under the following heads : (*a*) Of the instruments ; (*b*) Of the persons of all concerned in the operations and dressing of the wound ; (*c*) Of the wound itself and the parts adjoining.

Moreover, this method is concerned not only with the dressing of the wound in an absolutely cleanly fashion, but with the maintenance of it in this condition.

(*a*). **Purity of Instruments.**—*Everything that is likely to come into contact with the wound during an operation should be boiled or sterilized by steam under pressure.*

In the case of instruments, care must be taken to see that they have been thoroughly cleaned after an operation before further use, since blood and septic matter are liable to collect between the teeth of artery forceps and other appliances, in which case mere boiling may not be sufficient to ensure absolute asepsis. After every operation the instruments should be well scrubbed with a nail-brush in running warm water, and then boiled in a solution of carbonate of soda before a final cleaning and drying.

Distilled water is much less injurious to instruments, especially knives, than ordinary tap water.

Before any operation the instruments should be boiled for fifteen to twenty minutes, and all swabs, trays, drainage tubes, gauze plugging, and towels, that may be used by the operator or his assistants, should have been thoroughly sterilized in an autoclave or other apparatus.

Whatever view the surgeon may hold with regard to his own use of gloves, there can be no question that all assistants and nurses should wear them, since each pair of hands that is introduced into a wound or comes into contact with instruments or swabs which are to be employed is an additional source of avoidable danger.

Pads of Wool twisted up in gauze, or large pads of gauze, are used now in place of sponges for absorbing blood or discharges from a wound. They are very convenient, and can be sterilized with certainty. They are burnt after being once used.

(*b*). **Purity of Person of Dressers and Surgeons.** —Very great importance is laid on the *cleanliness of the operator's and assistant's hands*, for it is believed that septic matter is far more frequently conveyed to a wound by them than from the air or elsewhere. Many operators now make use of india-rubber gloves, which can be sterilized by boiling, and we are of the opinion that by their use one possible source of infection is eliminated.

These gloves cost 2s. to 2s. 6d. per pair, and may be put on wet or dry, but in each case the hands must be scrupulously cleaned beforehand, since if this is not done, and the glove is punctured during the operation, the wound will be contaminated.

To purify the Hands.—They should be scrubbed for ten minutes in running hot water with a nail-brush and ether soap. They should then be carefully dried, and soaked for two minutes in a solution of biniodide of mercury in spirit 1–1000 ; afterwards they are rinsed in an aqueous solution of the

same salt 1–2000. By these means the fat and epidermal scales are removed and the skin is rendered as far as possible innocuous to the patient upon whom the operation is to be performed.

(c). **Purity of the Wound and Adjacent Parts.** —Cleansing of the wound will be necessary, even when it has been inflicted with a perfectly clean instrument, lest blood-clots remain in it. For ordinary cases, the thoroughness with which the washing is performed is more important than the fluid which is employed. Unless the wound be contaminated, sterile normal saline is the best.

If there be any suspicion that septic or poisonous matter has been introduced into the incision (e.g., in a dissection wound), it should be thoroughly swabbed or syringed out with a 1–40 carbolic lotion, or of perchloride of mercury of the strength of about 1–2000, or hot peroxide of hydrogen. The process of cleansing tends of itself greatly to check the capillary oozing, and hæmorrhage from other sources must be thoroughly arrested before any attempt is made to close the wound.

It must be understood that the foregoing applies especially to the cases of incised wounds which are seen in the casualty-room practice of a hospital, or under similar conditions elsewhere. When wounds are inflicted, as in operations, by a surgeon, with deliberate intention, they may and should be aseptic from the first, and not merely either fairly clean or of various degrees of foulness. In such no efforts should be spared to maintain this aseptic condition throughout the healing, after one of the plans described later. Even in casualty-room practice this should also be aimed at unless the dirt, which is always found in wounds on the patients presenting themselves, cannot be removed.

It goes without saying that all foreign bodies must be removed from accidental wounds, and in view of the discovery that ordinary mud and earth are especially dangerous on account of the

occasional presence in them of the bacillus of tetanus, special care must be taken to remove every particle from the wound. If the earth has literally been ground into the wound, the best plan is to place the patient under an anæsthetic, and having washed away the more loosely adherent dirt, to scrub the wound with an ordinary nail-brush and 1–40 carbolic lotion, or irrigate it with hot peroxide of hydrogen. Further, since tetanus is likely to follow the infliction of such wounds, it is advisable to give a prophylactic injection of 10 cc. of tetanus antitoxin into the subcutaneous tissues of the abdominal wall.

There is no question but that one of the greatest causes of failure of repair is the continuance of bleeding within a closed wound. The actual bringing together of its sides does, no doubt, often effectually check further capillary bleeding, but it should not be trusted to do so. Should there be much oozing from the cut surface, a strand of catgut or a small tube should be left in a wound for a day or two, and the edges brought together over it. This, combined with firm pressure with some elastic material, such as the prepared wools now in use, will have the desired result.

2.—THE ADJUSTMENT AND CLOSURE OF THE WOUND.

(a). **Closure of its Deeper Parts.**—With the exception of the parts which are necessarily separated by the presence of drainage tubes, the adjustment and replacement of the divided tissues must be carried out throughout the whole extent of the wound, and if possible, as perfectly in its deeper parts as on the skin surface ; for upon this the manner of healing, as well as the appearance when whole, will greatly depend. But the means at our disposal for keeping the deeper parts together after replacing them, are somewhat imperfect. In

most cases the support and pressure afforded by pads and bandages put on outside the wound are trusted to keep the sides together, and if these will suffice, so much the better. But in many instances it is necessary to fix the parts more securely, either by sutures, passed far below the surface (deep sutures), or by what are known as " buried sutures," by means of which periosteum may be joined to periosteum, fascia to fascia, and finally, if necessary, skin to skin by an external stitch. These buried sutures are used especially in aseptic surgery, and are designed to obviate the use of deep sutures or of drainage tubes. They must be made of catgut or fine silk, and absolutely sterile, or they will be a source of trouble.

Deep Sutures.—If the depths of the wound have to be kept together in this way, it must be because there is a tendency for the parts to separate. There will, therefore, be *tension* on the sutures, and unless some precautions are taken they will speedily cut out. All the contrivances which have been devised to prevent this have for their object that the sutures shall pull upon an area of skin at the margin of the wound, which is shielded in some way from the direct pressure of the wire or thread. For this purpose, the suture, which is passed through the wound at the depth desired, enters and emerges from the skin at a little distance from its edge, and is then fastened to a piece of quill or catheter, or passed through a perforated ivory cylinder, or piece of sheet lead or zinc cut to the requisite size, or shaped as a stud or button. *Fig.* 57 shows the general principle of these fastenings, of which the details may be modified in many ways. The suture employed is very often made of stout silver wire, but thick silkworm gut may be used. The suture may be passed with a common needle, or with one of the numerous patterns of handled ones.

For most of the cases where deep sutures are required, the best shield for practical use is a piece

of sheet lead. It is sold in strips, ready perforated, but is best cut out with scissors to the shape required in each instance. A piece may be laid along each side of the wound, from $\frac{1}{4}$ in. to $\frac{1}{2}$ in. away from its edges ; holes may then be bored in it to correspond
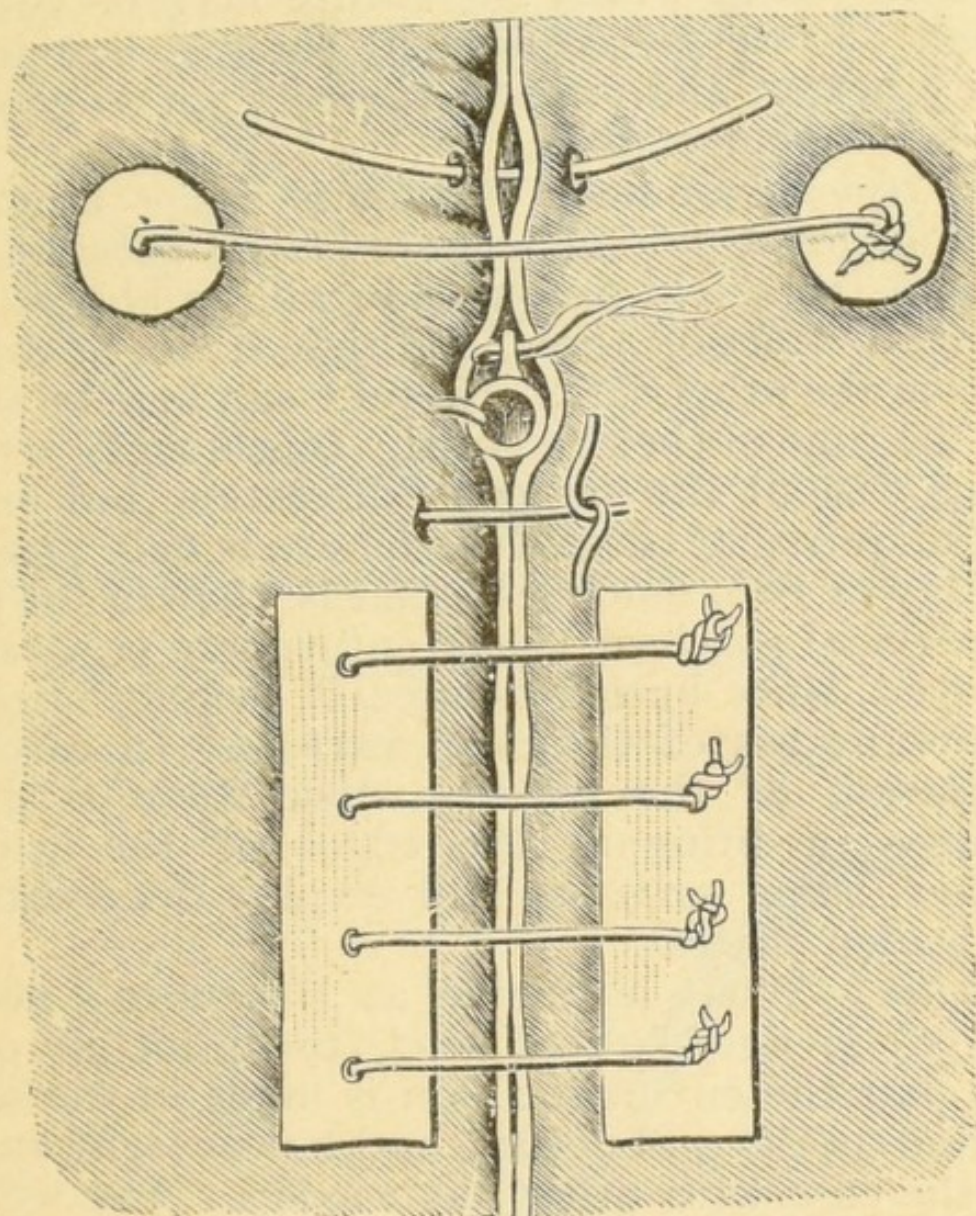
Fig. 57.—Illustration of some forms ot Deep and Superficial Suture, and of the Fastening of Drainage Tubes (after Mac-Cormac). (The attachment of the thread to the Tube is imperfectly shown.)

to the number and distance apart of the sutures. The suture having been passed through the strips, the two ends are simply twisted together or tied so as to close the depths of the wound. The twists should be to one side, and lying upon the metal strip, as shown in the figure.

Instead of using one long piece of shielding metal for each side of the wound, a rounded piece like a trouser button is very commonly cut out for each suture (also shown in *Fig.* 57), or pieces of lead of this form are to be had ready made with two studs on them, round which the suture may be twisted or tied. These are convenient enough, but are in no way better, and in some respects not so good as the plan first described.

The *removal* of deep sutures is easier than the insertion, for a pair of scissors placed between the skin and the shield on one side will be able to cut the suture short off there, and then it can be drawn out from the other side. No rules can here be given as to the time of their removal ; this must be settled in each case at the surgeon's discretion, but in the great majority of cases their tenure is only possible for a day or two, much less, that is, than in the case of superficial stitches. Deep sutures are very rarely employed, since buried sutures, if aseptic, have all the advantages of the deep variety. In cases of amputation of the breast, when there is great difficulty in bringing the edges of the wound together, some surgeons still employ deep sutures with leaden plates.

Needles.—What is known as Hagedorn's needle (*Fig.* 58) is now largely used, the principle of it being that the cut in the skin is made in the same direction as the pull occurs, and not at right angles as is the case with other flat needles. The wound made by the needle is not then pulled open. Some surgeons employ tubular needles, but they are falling out of use on account of the difficulty— supposed or otherwise—of keeping the tube clean. Another objection is that they are not convenient when catgut is used.

If short needles be used it will be convenient, and sometimes necessary, to use some kind of holder. For needles of the ordinary kinds a pair of Spencer Wells' forceps (see *Fig.* 80) does very well, but

several forms of needle-holders are now obtain-
able.

(b) **Closure of the Lips of the Wound.—**
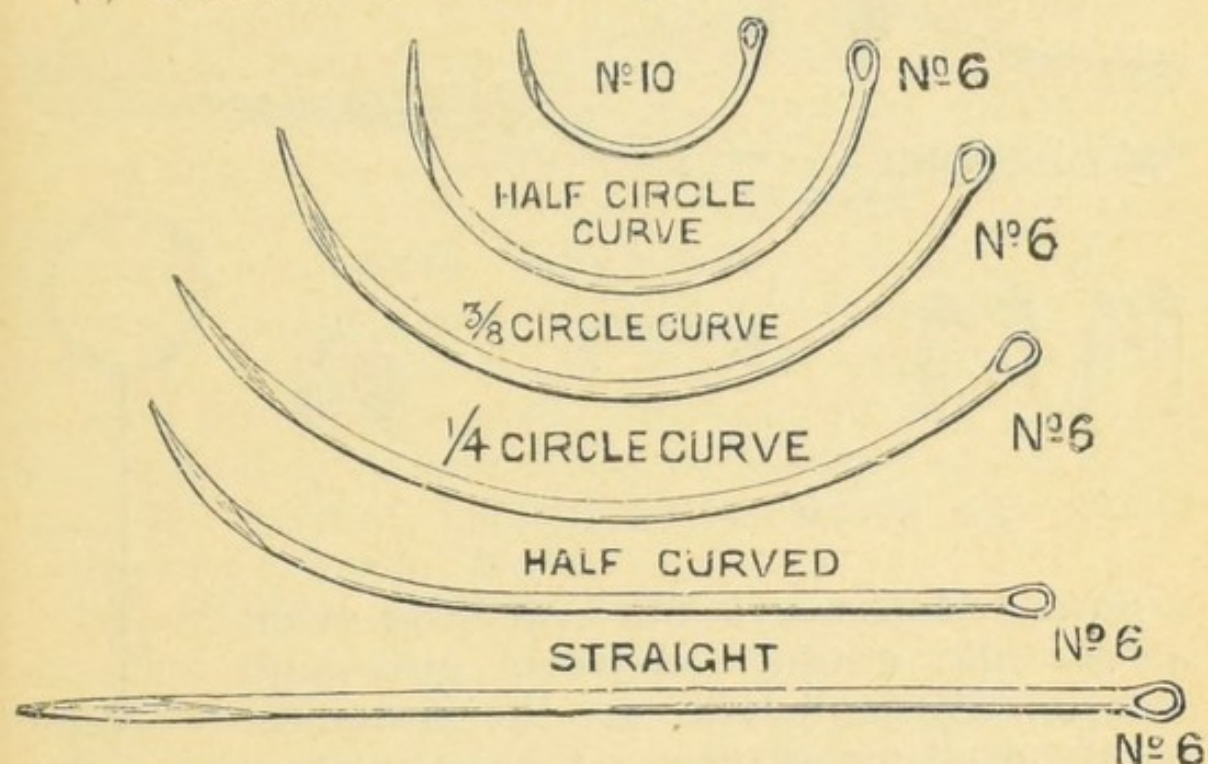
Fig. 58.—Needles for Hagedorn's Needle-holder.

Superficial sutures are for the accurate adjustment
of the divided skin surface, and of the tissues
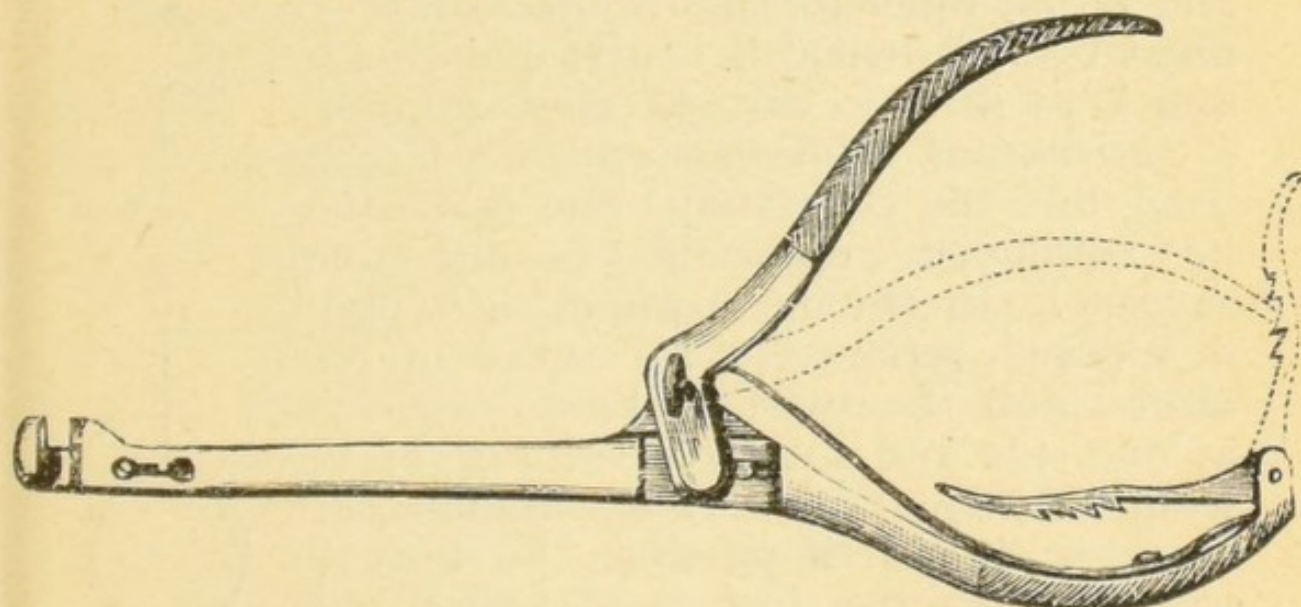
Fig. 59.—Hagedorn's Needle-holder.

near it; in most wounds they are the only ones
required. No strict rule can be laid down as to
the depth at which they should be passed, but
it is often convenient to put them deep enough

to arrest bleeding from vessels in the cut edges of the wound.

FULL SIZE
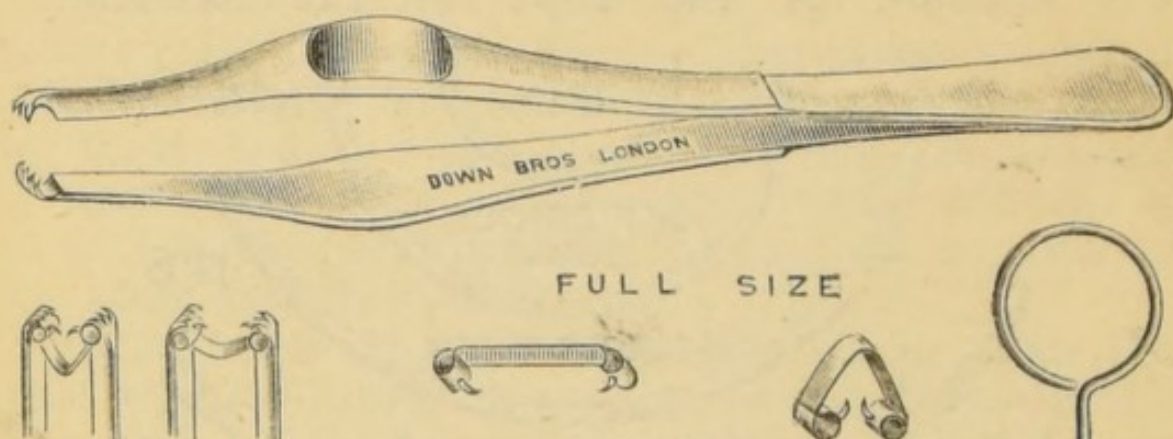
Fig. 60.—Michel's Suture Clips.

Suture Materials.—Wire, silvered or of silver, silk, catgut, silkworm gut, and occasionally horsehair, are the materials chiefly used for sutures. Catgut sutures are not quite trustworthy ; they stretch, and may be absorbed too soon ; silkworm gut is now largely used instead, and is not open to these objections. It must be well boiled in water before use, and kept in 1–20 carbolic acid solution.

Interrupted Sutures are still very largely used, but the continuous one may often be employed, especially in intestinal surgery. In the interrupted, each point is secured separately by tying in reef knots, and the twist or knot should be at one side and not over the line of the wound (*Fig.* 57). The actual skin surfaces should, if possible, be brought together exactly, but it is better that the edges should be a little everted rather than inverted. A little inversion is often overlooked at the time of adjustment; the result being an unsightly depression.

Another way of bringing the skin edges together

is by means of Michel's clips (*Fig.* 60), small bridges of pliable metal armed at each end with a minute point. They are held over the wound and at right angles to it by means of a special pair of forceps, and are then pressed down on to its edges, while at the same time the blades of the forceps are forced together, causing the pliable bridge to bend in the middle. These clips bring the edges into accurate apposition with slight eversion, and if removed on the fourth or fifth day leave very little scarring. They have the further advantage that as they do not penetrate through the skin, all risk of infection spreading from the surface of the body into the wound is abolished. They are easily removed by special hooks.

The Number of Sutures must be just as many as will close the wound throughout ; fewer will not do, and more are needless. So long as stitches are not doing harm, there is no limit to the time they may be kept in ; but as soon as there is any tension, or area of inflammation around them, they are better away.

As catgut sutures should become absorbed they require no removal, and will come away by gentle traction on the loose end. Silk or silkworm gut sutures require only to be snipped and removed with forceps, but wire ones should always have the little hook which will be found at the end which is to be pulled through the wound, carefully straightened out or cut off. No more needless pain can well be inflicted than that caused by neglect of this small precaution.

Adhesive Strapping may be used to relieve tension which would otherwise be borne by the sutures alone, or may be the sole means employed to close a wound. In either case, care must be taken to avoid puckering, and the best way to do this is by cutting the strips as shown in *Fig.* 33. If the adjustment be carefully made, it is a good way of closing a wound. The widely diffused support of

the plaster is extremely useful, but no wound, not even very small and clean cuts, should ever be completely closed over with strapping ; a drop of pus thus shut in may work very great mischief. The strapping should always be applied over a layer of antiseptic gauze.

There only remains to be mentioned a mode of closing small wounds, especially about the face, by *collodion* ; the ordinary or the flexible kind may be painted over the wound or applied upon a piece of lint, wool, or gauze, and by its contraction a close apposition may frequently be attained.

3.—ARRANGEMENTS FOR REST.

It is not necessary to enlarge on the importance of arrangements for rest, i.e., for retaining the wound surfaces in apposition. It will be understood that a wound can hardly heal unless it be kept at rest, and also that the means of securing this must vary with every case.

In the case of wounds of the extremities, the end desired can generally be attained by splints, interrupted if necessary, and slings and other contrivances may be brought into use, the limb being placed in the position which causes least tension on the edges of the wound. Moulded splints are especially useful in fixing the parts about a wound.

This necessity for rest must always be kept in mind in considering the firmness with which a wounded part should be bandaged.

4.—THE DRAINAGE, COVERING, AND PROTECTION OF THE WOUND.

The means to be adopted to secure the fulfilment of these conditions, include the different ways in which wounds may be drained, and the several " dressings " that may be put on them.

There will be in all cases some fluid exudation, whether a wound has been closed before the bleeding has stopped or no, and provision must be made

for its escape, except in wounds which are at once small and perfectly healthy.

The materials for drainage are, *Indiarubber Tubing*, of different sizes, *Strips of Gauze*, *Wisps of Horsehair*, or *Catgut*; but almost anything of the nature of a tube or thread, if it be in itself un-irritating and aseptic, may be placed in a wound to facilitate the escape of the discharges.

As the whole object of a drain is to prevent fluid remaining within a wound, no exception can be made to the rule that all surgical cavities are to be drained *from the bottom*. The place of exit for the drain should therefore be the most dependent part of the wound, unless, as is often advisable, a separate aperture is made for the tube alone. Often, too, it is necessary to pass the drain right across the cavity, either by making it enter the wound at one end and leave it at the other—as may be done in amputations of the limbs or of the breast—or by making apertures and counter-apertures.

If horsehair be used as a drain (and for wounds with but little discharge it is very useful, especially in sinuses, where it can be laid right along), some 20 or 30 hairs must be cut of equal length and tied together at each end. Catgut, silk, thread, or a short piece of gauze may also be used.

Coming to *Drainage tubes* proper, glass ones have been almost entirely abandoned, except for draining the pelvis, and as fluid cannot flow upwards, unless drawn by the capillary attraction, a wisp of gauze should be placed inside.

But the drainage material which will probably be for long in most general use, is *indiarubber tubing*, of which special kinds are made, of various sizes, and perforated at frequent intervals.

The points to be kept in mind as to the drainage of a wound by indiarubber tubing are: (*a*) The size of the tube; (*b*) The mode of introducing it; (*c*) The keeping it in its place; (*d*) The occasions of its withdrawal for cleansing or shortening; and, finally,

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the time when it may be permanently discarded.

All drains are foreign bodies, and, *ipso facto*, hurtful. The tube, therefore, must be as small as will freely carry off the discharges. No general rule can be laid down as to the mode of its insertion. It may be put in before or after the wound is sutured, and a probe or director, or the special instrument devised by Lister, may be used. Ordinary forceps are objectionable, as they disturb the tissues.

The tube is apt to *slip out accidentally*, though this (which should not happen if the dressings are properly applied) may be prevented by passing a stitch through the tube wall (see *Fig.* 57), from $\frac{1}{4}$ to $\frac{1}{2}$ an inch from its end, and fixing it to the skin. A safety pin may be put across the aperture of the tube, or some form of shield employed, which will effectually prevent its slipping in.

For the same reason that the tube should be as small as will be efficient, it should be *removed as soon as it is safe to do so*; and if it cannot be withdrawn altogether, it should be shortened up from day to day. But it is impossible to lay down any strict rules; in such a case as an amputation of a limb or breast, healing by first intention, the tube may be removed on the second or third day, while in abscesses it may have to be left in for some weeks; but in any case it is a safe rule that every time the dressing is changed, the tube must be taken out and syringed through with carbolic lotion.

In cases of accidental wounds a drainage tube is usually required, but in many operations it is possible to do without one, in those, for example, where the incisions have passed through healthy structures. Here, if all bleeding be stopped before the wound be closed, and firm, equable pressure applied, not only by the dressings, but also during the time that they are being put on, it will be found that healing will take place perfectly. There are many advantages in being able to dispense with a drainage tube, and amongst them by no means

the least, both as regards disturbance of the wound and the comfort of the patient, is the greatly lessened need for changing the dressings. A tube is in itself irritating, and affords a space into which leakage of serum must, and will, take place. Its presence may also lead to the formation of a troublesome sinus which materially delays the healing.

In cases where it is not thought desirable to close the wound entirely, one angle may be left open, so that any discharge may find a ready means of escape.

SURGICAL DRESSINGS.

The wound having been made absolutely aseptic, or as near it as possible, the next point to consider is, how it is to be *dressed*, that is *covered up*, so that the changes which it will go through from this time, until it is completely healed, may be performed in an absolutely healthy fashion, without fever, suppuration, or pain. To effect this, some form of antiseptic dressing is usually employed.

The wound having been sutured up, the surrounding skin is wiped clean, a cloth being pressed fairly firmly near it and swept away from the wound, while another is held on it to prevent any dragging on the sutures or accidental removal of the drainage tube, if one has been inserted.

Immediately over the wound is usually placed some gauze—either that prepared with perchloride of mercury, known as sal alembroth, or with the double cyanide—which has been soaked for a few minutes in carbolic lotion. Some surgeons use boric lint. Over this are placed several layers of thin lint or gauze, and above all a large pad of some prepared wool, either absorbent wool, iodoform wool, sal alembroth wool, or wood wool, according to the fancy of the surgeon. The whole mass is then bandaged firmly on, or held in place by broad pieces of strapping.

Although we are using the term " the dressing of wounds " in its larger meaning, to include all the

details of its management, " surgical dressing " is a phrase generally used in a more contracted sense, to express the materials and medicaments which are put over a wound to cover and protect it, and to forward its healing.

The medications used may have for their purpose the prevention of decomposition, or the maintenance of simple cleanliness, or some stimulation of the wound ; or a cool, a warm, or a moist atmosphere may be desired, or simple greasiness of the surface. But whatever be the nature of the dressing it must before all fulfil the indications of cleanliness, and absorption of the discharges.

Just as in former times it was believed that a simple fracture could not unite, unless healing salves of various kinds were applied to the skin, so, even to the present day, many seem to find it difficult to remember that the nature of wounds is to heal, and that nothing applied to a wound can of itself heal it, though many things can be done to retard or prevent the healing process. In fact the results now desired are almost absolutely negative ones, such as the avoidance of movement, of irritation, or of tension, the removal of discharges, and the like.

But, while it is every day more recognized that the best way to dress a wound is to let it " severely alone," in general some kind of application will be required, and the nature of the dressing does in many cases affect the course of repair. Thus granulations will often become large and flabby under fomentations, and again small and prone to bleed under the use of chloride of zinc. A choice, therefore, has to be exercised, but experience alone will give the power of judicious selection.

Classification.—For the purposes of description, some classification of wound dressings must be adopted. We shall therefore divide them into *Dry*, *Watery*, and *Oily dressings*, and then arrange the drugs and materials used under each head, according

as to whether they are chosen because they are non-irritant, anodyne, antiseptic, or stimulating.

Dressing by Dry Absorbent Pads is a plan now universally adopted by surgeons. The principles of this method are dry and infrequent dressings, with immobility and pressure.

A great many different materials have been used for pads in this form of dressing, and, sometimes one, sometimes another, will answer best, each individual operator having his own likes and dislikes in this as in most matters connected with surgical procedures. What is wanted is a proper firmness, combined with elasticity, so that a moderate restraining pressure is kept on the wound. At the same time the material must be *absorbent*, to provide for the infrequency of dressing. Pads of lint, of salicylic wool, boracic lint, wood-wool, and carbolic or other prepared gauze, and many more have been used. It would be impossible to say that one preparation is better than another, for all the materials now obtainable are so carefully prepared that the choice depends more on the individual surgeon than on their relative value. A wound dressed with any of these absorbent materials must have its edges, and if necessary, its deeper parts, adjusted with the appropriate sutures, and provision must be made for its drainage ; secondly, the mechanical fixation of the neighbouring parts should, if necessary, be secured by moulded splints, or plaster-of-Paris bandages or similar contrivances for the fulfilment of the indication of immobility ; and thirdly, the parts immediately concerned in the wound must be covered, and lightly but firmly pressed upon by the absorbent pads, secured by bandages or strapping.

If the discharges from a wound thus treated are only moderate in amount, there will be no necessity to change the dressings for some days, and no method gives better results in the case of large healthy wounds.

Wet Dressings.—This class of application is a very large one, and comprehends all lotions, tinctures, and hot or cold compresses; every dressing, in short, by means of which the surfaces of wounds may be kept moist. In the great majority of cases, the moistening fluid is applied by soaking gauze or strips of lint in it.

Antiseptic lotions are generally used at the immediate dressing of an incision. A few layers of gauze, generally that prepared with the double cyanide, or with perchloride of mercury, or lint saturated with boric acid, are soaked in some antiseptic solution and laid over the wound.

The number of *lotions* now used has been considerably reduced, the experience of the last few years having taught surgeons that carbolic acid 1–40 or 1–100, perchloride of mercury 1–2000 or 1–5000, biniodide of mercury 1–2000 or 1–5000, peroxide of hydrogen 5 to 10 vols. are the most suitable; but for operations on the eye, or for delicate structures, a saturated solution of boric acid or normal saline must be used.

Irrigation is a form of wet dressing which is sometimes, though rarely, used for clean wounds, especially when they are near joints, but it is much more often adopted for foul or sloughing ulcers, under which head it is again mentioned. Its great drawback is the risk to the patient of catching cold from the exposure, which can hardly be avoided.

To set up an irrigation apparatus, all that is required is an arrangement by which a constant drip of water, or of some lotion, can be made to fall upon the wound, as shown in *Fig.* 61. This may be done by suspending a vessel over the wound, properly fitted with a tap and indiarubber tubing, or the tube may be allowed to act as a siphon. In either case the difficulty is to get the drip to be sufficiently slow, and quite as good a plan is the simpler one of hanging one or two strips of lint from a vessel supported above the wound. The

fluid is evenly distributed, drop by drop, by the strips, which act as siphons by the capillary attraction of their fibres (see *Fig.* 61). It will be necessary to put some pan or basin beneath the wounded part, and the bed must be kept dry with waterproofing ; but there is always some slopping, and the patient had better lie in blankets.

Plain boiled water, a solution of permanganate of potassium, carbolic, or boric acid, are the fluids most frequently used for irrigation, and although, if this treatment be continued for many days, the
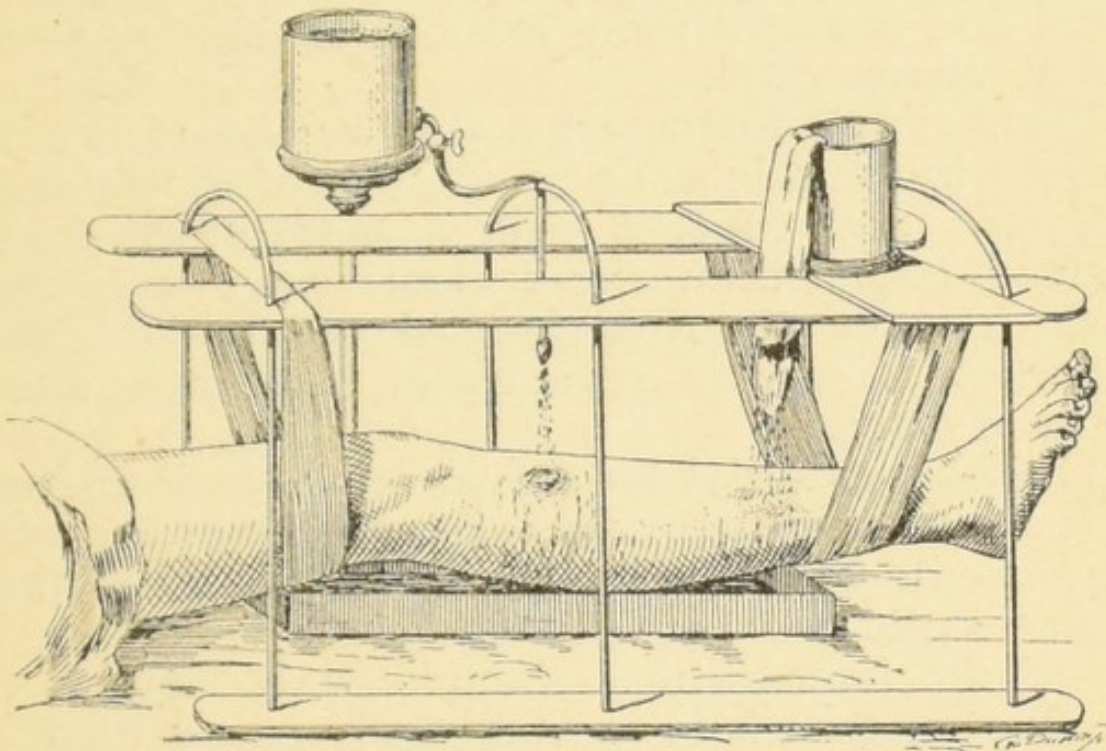
Fig. 61.—Methods of Irrigation.

granulations are apt to become sodden, no dressing will more efficiently clean a wound ; immersion of the wounded part in a bath of warm carbolic, a solution of permanganate of potassium, or boric acid, for many hours, is often very beneficial.

Fomentations. — A fomentation is made by soaking a piece of lint in boiling water, and wringing it as dry as possible in a warmed towel. Some few people, laundresses especially, are able to perform this wringing with their unaided wrists, but for most it will be necessary to use a set of wringing

sticks. These consist of two pieces of stick like rulers, about a foot in length, passed through the ends of a round towel, about 2 ft. 6 in. by 10 in. When the soaked lint is picked out of the boiling water, it should be allowed to drip for a few seconds, and then it must be placed in the centre of the towelling, and the whole twisted up by the leverage of the sticks until no more water comes away. This should take but a few moments. Another good way is to sew the ends of a piece of flannel together and to pass the sticks through before the boiling water is poured on to it. It can then be lifted and wrung without loss of time, and put into a dry, warm towel.

For a simple fomentation the lint should just be applied to the skin as an application of warmth and moisture, and covered with a piece of oiled silk slightly larger than the fomentation ; over this again a layer of cotton-wool should be laid, and the whole fixed with a triangular bandage or a few turns of a roller.

The best material for fomentations is boric lint, or if a stronger antiseptic is required, carbolic acid 1–40 should be added to the boiling water so that an antiseptic dressing is made.

Carbolic fomentations should not be applied to the fingers, especially in young women, as there is a risk of gangrene being produced.

But these fomentations are often used with some counter-irritant or anodyne ; thus laudanum, or the tincture of belladonna, may be sprinkled over the flannel, which may be substituted for lint if it is not to be placed on a wound ; or turpentine is used more frequently still. This last forms the common turpentine stupe, so often used for lumbago. In all cases, if the fomentation is to produce its proper action, the flannel must be wrung dry out of boiling water, and if the wringing be not effectually performed it is quite likely that some scalding of the skin will take place.

Certain alcoholic *Tinctures*, generally freely diluted, were once, and are still by some, used as wet dressings. Of these, friar's balsam (tinctura benzoini co.) should be mentioned as an admirable stimulant for wounds which are slow to heal. It is applied by soaking pads, or strips of lint, in the tincture, and is probably the best of the preparations of aromatic gum resins.

Tincture of iodine, freely diluted, is often used as an antiseptic and stimulant application ; it is an admirable irrigating fluid, especially for foul wounds.

Oily Dressings are rarely employed except for burns and ulcers.

Ointments of various kinds are largely employed as dressings for wounds, especially in the later stages of their healing. Some are chosen for this purpose because they are non-irritant, as the ung. simplex, or ung. acidi borici, or because they have more or less stimulant properties, as the ung. zinci oxidi, or the ung. hydrarg. ammoniati, diluted with an equal quantity of vaseline or lard. For others the reader is referred to the text-books on therapeutics.

Vaseline is a clean and bland dressing, and serves also as a basis to which various drugs may be added, so that they can be applied as ointments.

Lanolin (*adeps lanæ*), the purified cholesterin fat of sheep's wool, is largely used as a basis for ointments on account of the power it has of penetrating the skin, and because it does not become rancid.

Generally, ointments are most conveniently applied by spreading them on lint or on butter-cloth.

STERILIZATION OF DRESSINGS.

In most hospitals the dressings are sterilized by heat the day before an operation. Special apparatus for doing this has been invented, the principle being that by the heat employed any micro-organism which may have been conveyed to the dressing is destroyed. The need of this precaution will be seen when it is mentioned that

many, or even most, antiseptic dressings do not become active until they are moistened, with the result that unless the germicidal power of the antiseptic held in suspension is strong enough to destroy any germ that may be present, the discharge from the wound with the warmth of the patient, by washing away the antiseptic, creates an ideal cultivating ground.

While all these precautions are taken by the majority of surgeons, there are some who hold that the use of antiseptic solutions is not only un-necessary, but harmful. They sterilize their instruments by heat and use no lotion but pure boiled water or sterilized saline, the theory being that by removal of all blood-clots, etc., by such an un-irritating medium as water, the tissues are not damaged in any way, and the natural activity of the cells—the *vis medicatrix naturæ*—is sufficient to destroy any organisms that may have strayed into the wound. This is especially so in abdominal surgery. At the same time, for general work we recommend the moderate use of antiseptics.

RE-DRESSING OF WOUNDS.

The steps to be taken at the future dressings are precisely the same as for the original one, and all the precautions for cleanliness of hands, instruments, etc., must be as rigidly carried out.

It is impossible to lay down rules as to the time of re-dressing. Some cases may be left for a week, indeed, until the wound is completely healed, while but few require to be dressed daily, unless there is much discharge, as in septic cases.

Any circumstance which arouses a suspicion that things are going wrong, such as undue pain, or a high temperature, will call for prompt re-dressing. The wound will be known to be aseptic by the absence of smell, by its edges presenting a quiet, inactive appearance, and the almost total absence of tenderness anywhere. The discharge should be

serous, or, in recent cases, blood-stained, moderate in amount, and freely discharged through the tubes.

In re-dressing, the skin surface around the wound should be lightly sponged with 1–40 carbolic solution, and gentle pressure made to ascertain that there is no bagging of discharge. The drainage tube should be taken out, boiled, and replaced if necessary. The wound should not be syringed through, as this will only separate parts which are adhering. If at any time the wound becomes in the least offensive, or freely suppurates, antiseptic precautions may be said to have failed, and means must be taken to attempt to bring it to an aseptic condition. It may be necessary to take out the suture and thoroughly cleanse the raw surface, and after taking means for the escape of any discharge of pus, a dressing is then applied. It is in these cases that the use of iodoform is of such value, some of the foulest surfaces becoming rapidly sweet when the powder is freely sprinkled on.

CHAPTER V.

OF THE MAKING OF POULTICES, CUPPING, ETC.

POULTICES.

These are rarely required in *surgical* cases. In *medical* cases they are mainly intended to reduce an inflammation of parts at a distance from the skin surface to which the heat and moisture are applied. But in all cases the immediate object to be served by putting on a poultice is to warm and moisten the tissues with which it is in contact. The manner of its action is partly mechanical—for by relaxing the tissues, pain and tension are reduced —and partly physiological, as it affects, primarily, the circulation of the part poulticed, and secondarily, the tissues or organs at a distance.

A great variety of materials have been used at one time or another for making poultices, such as carrots, turnips, potatoes, etc., but we shall here consider the following only :—

1. Poultices of crushed linseed meal.
2. Poultices of crushed linseed meal with mustard flour.

The Linseed Meal Poultice is the one in most general use, and is the easiest to make. The *crushed seed*, not the ground linseed flour, should always be chosen, for the former still retains a good deal of oil, which gives a surface to the poultice mass, and prevents it from sticking to the skin.

All that is necessary to make a good linseed poultice is to see that the water is boiling to begin with, and to waste no time in the mixing. By far the best way is to warm the basin first, then to pour in the boiling water, afterwards adding the meal

gradually to it with the left hand whilst stirring with the right. It is sometimes made by putting the meal into the basin and then adding the boiling water, but this is less satisfactory. In a third way, in which all cooling of the mass during mixing is avoided, a sufficient quantity of water may be kept boiling in a saucepan upon the fire, and the linseed gradually stirred into it. In any case, when the proper consistence has been reached, the contents of basin or saucepan should be emptied out upon a piece of linen or cotton material, of the shape of, but a little larger every way than, the poultice required, and quickly spread with a spatula or large knife (an ivory paper knife does well), which must be kept well wetted with boiling water, until the poultice is everywhere about $\frac{1}{4}$ inch thick. This spreading should have distributed the mass evenly over the stuff, up to about an inch of its edges ; this inch must now be neatly turned over upon the margins of the poultice, to which it will adhere.

Another good plan is to card out tow and fashion it into a bed for the poultice mass. The manipulation of the tow requires some practice, and can hardly be described in words, but it forms a very light, non-conducting backing.

If the mean has been hit between sloppiness and dryness, the poultice should now be able to be folded up or handled freely without coming to pieces, and its surface should be smooth and non-adherent to the skin, to which it should be, when first made, still too hot to be applied.

If it be desired to keep a poultice hot for a little time before it is applied, or if it has to be carried for any distance, it is best to fold it up and place it between two hot plates.

Poultices should be applied as hot as they can be borne, and to get the full benefit of them they should be changed at least every two hours, for, whatever they are made of, they soon get stiff and cold ; as a rule, every three or four hours is considered to be

the time for changing poultices, and in hospitals it is perhaps hardly possible that it should be otherwise. But under no circumstances should eight or ten hours be allowed to pass, for by that time the poultice will have become sour.

Of whatever kind the poultice may be, the surface of the mass must be placed upon the skin itself, without the intervention of any woven stuff, even of the thinnest muslin.

If oiled silk or oiled paper and cotton wool be placed over the back of the poultice it will retain its heat and moisture better.

All old poultices should be burned directly, never allowed to remain in a ward or be thrown into a dustbin.

Antiseptic fomentations have taken the place of so-called antiseptic poultices, and the *Charcoal poultice*, made of three parts of linseed to one of charcoal powder, has become almost obsolete.

For counter-irritation mustard flour may be added to the crushed linseed in varying proportions (generally equal parts of each), and the poultice made as before.

CUPPING. ETC.

Cupping.—By means of " Cups " the blood may either be merely drawn to the surface by taking off the atmospheric pressure, or it may, having been thither attracted, be removed by a scarificator. The former proceeding is " dry," the latter " wet " cupping. The nape of the neck and the posterior surfaces of the thorax and loins are by far the most common situations, but any part which will hold the glass will do.

In order to cup successfully some dexterity is required. The principle on which it depends is the creation of a considerable vacuum beneath bell-shaped glasses, which are made in various sizes (*Fig.* 62). These glasses are sometimes made so that they can be attached to an exhausting syringe

like the bell jar of an air pump. But in skilful hands a better vacuum is obtained by quickly rarefying the air by heat. A good cupper will do this by simply putting a lighted paper spill within the cup for an instant and immediately applying the latter to the surface of the skin ; but for most people it will be easier to put a few drops of methylated spirit into the cup, and to distribute the spirit over its interior. A pledget of cotton wool placed on a stick should then be dipped in spirit, lighted, and mopped round the inside of the glass. This will produce a large but momentary flame, and as soon as it is alight, the cup should be " clapped " upon the required place. The flame will be immediately extinguished, and the vacuum will show itself by an almost instantaneous rising of the skin.

The essential points to attend to are, that only just so much spirit should be put into the cup as will moisten its sides, and that the rim of the cup be applied perfectly to the skin, so as to exclude all air.

Fig. 62.—A Cupping Glass.

It is hardly necessary to mention that severe blistering may result from the edge of the cup being too hot, an accident not likely to occur if only a small quantity of spirit is placed in the glass.

In *dry cupping* six or eight glasses are frequently used.

In cases of suppression of urine, cupping over the renal regions is an extremely valuable form of treatment.

Passive Congestion (Bier's Treatment).— This treatment, which was introduced by Bier, of
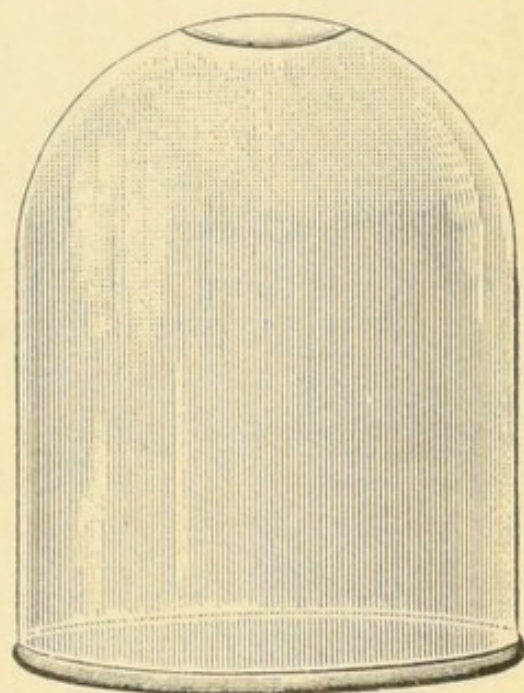
Kiel, aims at an imitation of the phenomena of inflammation, the active hyperæmia of this state being copied by a passive congestion which results from congestion of the veins. It is applicable to a large number of different disorders, especially those of the extremities, such as whitlows and suppurative states of the joints and tendons. It is also of service in tuberculous disease, and a modification of the method may be practised for the treatment
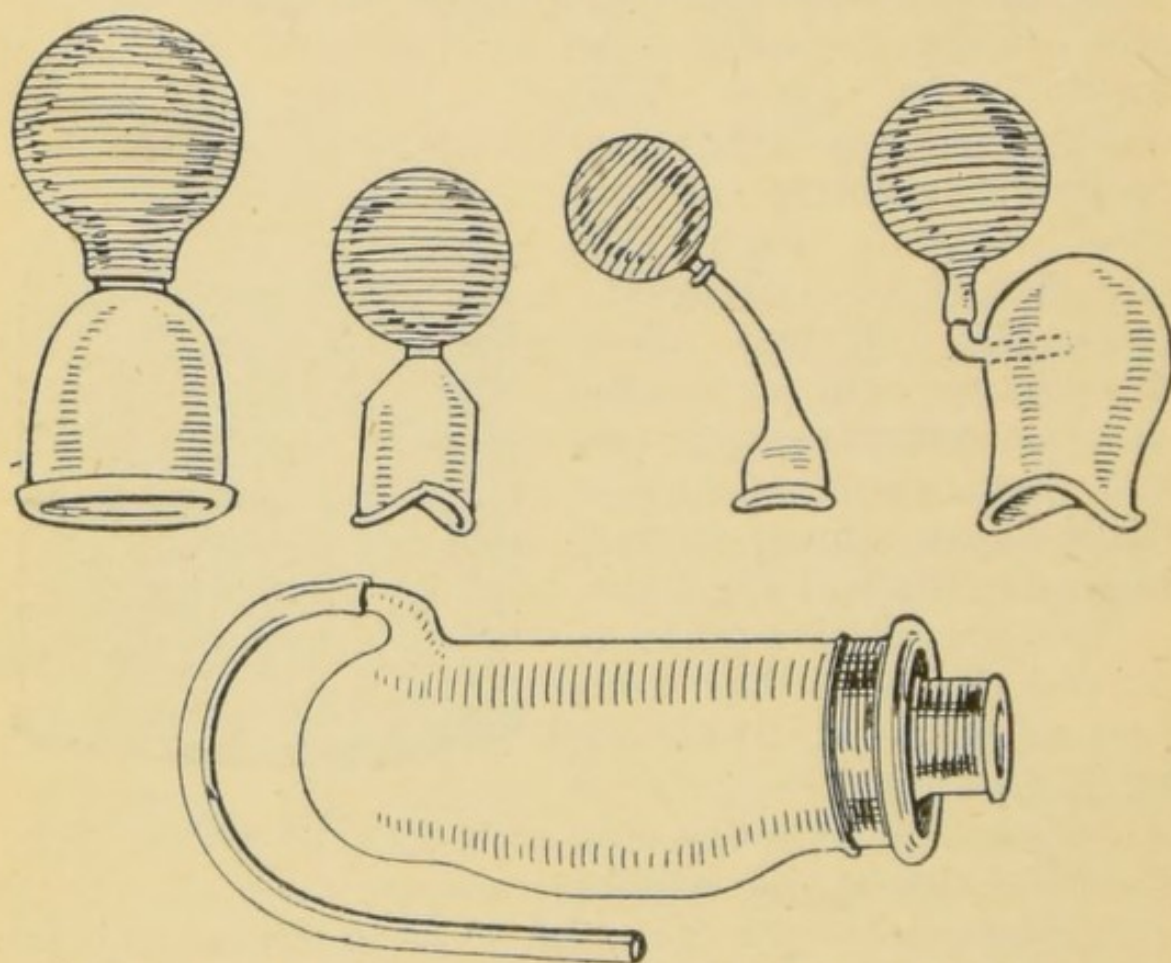
Fig. 63.—Cupping Glasses as used in Bier's Treatment.

of sinuses and similar lesions. To practise the treatment, a soft broad rubber bandage is bound round the limb on the proximal side of the lesion, and should be applied with sufficient tension to render the part below bluish-red and swollen, not cyanotic or anæmic. Above all, it must not affect the pulse, which should remain unchanged. If properly applied, except in neurotic subjects, little or no pain is caused; indeed, the throbbing agony of whitlows

is markedly relieved by the application of the bandage. The length of time during which the bandage may be applied varies in different cases ; it is better to start with short periods of half to three-quarters of an hour, and later the bandage may be retained in acute cases for as many as twenty out of twenty-four hours without inconvenience or injurious effect. With the application of the bandage the morbid tissues are flooded with serum, which has a beneficial effect in combating any infection which may be present. If any wounds have been made they will be found to run freely with serum during the time the bandage is applied. One important result of the treatment is that small incisions only are required for the relief of whitlows, abscesses, and septic states, the general duration of treatment being thereby shortened considerably. In the case of sinuses, which from their position are not amenable to the application of the bandage, good results can be obtained by the application of cupping glasses or a suction apparatus ; a test tube which will just fit over the margins of the sinus is an excellent substitute for a cupping glass. The action of these glasses is to cause a free flow of curative serum over the morbid tissues, stimulating them to activity and healing. This treatment may be combined with the application of Wright's solution, which consists of 4 parts of sodium chloride and 1 part of sodium citrate to 120 parts of water.

Leeching.—If leeches are to be applied anywhere within the cavity of the body, such as in the mouth, nose, etc., a leech glass from which they cannot escape should be used ; but if they are required for outside surfaces, they may be placed within a pill-box, covered with a piece of lint, or held lightly in the hand. The part to be leeched should be washed with warm water, or milk, and must be perfectly clean. Those leeches should be chosen which are the thinnest and most lively, and should be allowed to remain on until they drop off.

It is estimated that a leech should extract from ℥j to ℥ij of blood before it is gorged, but if a poultice be put over the bites much more will flow.

A leech should never be allowed to bite into a vein, or troublesome hæmorrhage may follow; pressure would always stop this in any situation where it could be applied, but it may be necessary to adopt such measures as passing a needle below the bite, and twisting silk around it, etc.

Blisters are usually produced by painting blistering fluid (Liquor Epispasticus P.B.) over the required area, or by applying a cantharides plaster, cut to the desired shape. If there are any hairs on the part to be blistered they should be shaved off, and the skin washed with a strong soap, to remove the natural fat.

If the blistering fluid be used, the most convenient way to apply it is to cut a hole of the desired size in a piece of note-paper, to hold it firmly over the part, and then to paint on the fluid with a camel's-hair brush. In this way the blister is strictly limited. Another plan is to smear a simple ointment round the part to be blistered. The dresser or nurse must be careful to keep the hands well away from the eyes during the application of any blistering fluid.

When the bleb has fully formed, it may either be snipped at its most dependent part and the serum soaked up with blotting-paper; or, if it be desired that the blister should remain open for some time, the whole cuticle should be cut off and the sore dressed with some irritant ointment, of which the unguentum savinæ is the most frequently employed. Blisters are occasionally dressed with mercurial ointment when a powerful counter-irritation is required. The active principle of cantharides being soluble in oil, the blister will be found to rise better and quicker if the surface of the skin where the plaster is to be placed is moistened with olive oil.

CHAPTER VI.

OF THE DRESSING OF BURNS AND SCALDS, AND THE PREVENTION OF BEDSORES.

WHEN a large area of the body is involved, burns and scalds give rise to many complications, and they are injuries which it is difficult to treat satisfactorily. In the early stages profound shock and great bodily depression must be combated ; indeed, the mortality following burns is greatest during the first twenty-four hours which follow the injury. This shock must receive appropriate treatment, saline injections being most valuable, and at the same time every effort must be made to prevent any further loss of vitality through prolonged exposure and manipulation. In any case of extensive burns there is a danger of asphyxia, or of poisoning by carbon monoxide. It is necessary to bear these dangers in mind, for prompt performance of artificial respiration, together with oxygen inhalations, may be most effective in meeting these complications. Subsequently there is considerable risk of septic absorption from the large sloughing surface, and fatal issues are due to the development of low forms of pneumonia, duodenal ulceration, and meningeal inflammation and thrombosis. In the final stages much trouble will be experienced in dealing with large granulating surfaces, and with rapidly-contracting scars—scars which if left may cause permanent deformity and disablement.

TREATMENT.

This will therefore be considered according to three main stages : (1) *Immediately after infliction ;*

(2) *During separation of the sloughs when repair is taking place ;* (3) *When granulations have appeared and the wound is beginning to cicatrize.*

1. **Immediate Treatment.** — The patient must be put to bed as soon as possible, the clothes must be cut off, and without delay or exposure a dressing must be applied over the whole of the damaged area. If the burn is very extensive, it is better to deal gradually with different regions than to completely strip and expose the whole surface at once. Charred skin or dead tissues should be snipped away carefully with scissors, if this step can be accomplished quickly. Blisters should be cut open, so that the serum can drain away. If the clothes adhere, and if there is a large amount of dirt present, it is advisable either to immerse the part in a warm (100° F.) boracic acid bath, or to soak it with warm boracic acid solution.

- A number of different applications have been recommended after the above preliminaries :—

(*a*). *Oily dressings,* which have little tendency to adhere to the burnt surface—eucalyptus oil and vaseline, or the ointment of Réclus :—

℞	Antipyrin	℥j	Phenol	gr. xv
	Salol		Hydrarg. Perchlor.	gr. ij
	Acidi Borici	āā ℨ ss	Vaselin. (pur.)	℥vij
	Iodoformi	gr. xv		

This can be diluted by the addition of more vaseline if necessary.

(*b*). *Antiseptic dressings,* which may be left unchanged for some time. Lint soaked in a saturated solution of picric acid is applied to the part, and over this layers of cotton wool secured by a bandage. As an alternative an antiseptic cyanide gauze dressing may be used.

Werner's treatment consists in soaking the burnt part in a 2–5 per cent solution of carbolic acid, which is anæsthetic and antiseptic. The acid is removed by a second bath of normal saline solution, and the surface of the burn is dusted with a powder composed of acetanilide 1 part, zinc stearate 5 parts ;

over this narrow strips of Lister's green protective are placed, and the whole region is finally covered with wet sublimate gauze and bandaged.,

Stimulants will be required until the shock has passed off ; later, iron and quinine should be given, digitalis and nux vomica if there is evidence of cardiac weakness. Morphia may be necessary, but must be given with caution.

When the part has been dressed, provided no symptoms of septic poisoning arise, no attempt should be made to interfere with the damaged part. The dressings may be left alone for several days. But if, as is usually the case, the wound does not remain clean, the dressing must be changed repeatedly, as in the case of any large septic wound. It is often necessary to perform this dressing under an anæsthetic, owing to the pain which it inflicts upon the patient.

2. **Treatment during the Separation of the Sloughs.**—If the burn has not remained aseptic— and it is very difficult to ensure this condition—a considerable amount of offensive discharge will accompany the separation of the dead from the living tissues. At this period, as has been said, there is a great danger of complications developing from septic absorption. The separation of the sloughs should be assisted with scissors, so that very little dead tissue remains to harbour putre-factive organisms. All purulent blebs or foci should be opened up, and the dressings should be frequently changed. If the position of the part permits, a weak antiseptic bath is most satisfactory ; this failing, large fomentations applied to the sloughing surfaces are satisfactory. In milder cases an oily dressing, as above described, may be continued until granulations have appeared.

If antiseptic baths or lotions are used, they must be made up very dilute, as the large surface exposed to their action readily permits of the absorption of the poisons from which they are made, and it is no

unusual thing for carbolic or mercurial poisoning to occur during the treatment of a burn.

During this stage the patient's temperature will rise, and he will exhibit signs of septic poisoning.

3. **Treatment when the Wound has begun to Granulate.** — The main objects now are to accelerate the healing process and to prevent undue contraction. If the granulations are flabby and unhealthy, stimulating lotions—lotio rubra (Zinc Sulphate gr. ij, Tinct. Lavandulæ Co. ℥ xij, Water to ℥j)—should be applied, and general tonics—nux vomica and iron—should be administered. As a dressing, nothing is more satisfactory than a piece of green protective, a number of holes being cut in it to prevent the retention of the discharge. The protective is placed directly over the granulating surface, and it is then covered by sterilized gauze. Under this treatment the granulations become flat and healthy, while the growing epithelium is not damaged each time the dressing is changed. The wound should be well irrigated with normal saline or boracic acid solution once or twice a day.

If large areas of granulation remain, and the epithelium is sluggish in covering them, skin grafting must be employed in order to diminish the risk of subsequent contraction.

During this stage every care must be taken to check this contraction, especially in the neighbourhood of joints. For this purpose splints should be employed which exert a force in the direction opposite to that of the adjoining fibrous tissue, and as soon as possible the scar should be massaged and stretched. Gentle kneading and stretching alone are required, or the scar will be torn open.

SCALDS OR BURNS OF THE LARYNX AND PHARYNX.

These present such special features that they must be mentioned separately.

They are produced generally by drinking scalding

liquids, and are thus far more frequent in children than in more sensible adults. (The habit of allowing children to drink out of the spout of a kettle will account for more scalds of these parts than all other causes put together.) But breathing hot air, as in a fire, may produce the same effects, and practically the action of any chemical caustic is the same in this situation as that of the thermal ones.

Scalds of the *Pharynx* itself are not usually very serious, unless the consequent œdema of the tongue and fauces reaches a very high degree ; but when the scald extends further down, so as to affect the aryteno-epiglottidean folds and the œsophagus, there is both an immediate and remote risk of complications. The remote one is that the scald of the gullet may cause a contracting cicatrix, and thus become itself a simple stricture, or that the cicatrix may be the seat of a new growth, and thus develop into a malignant one.

But it is with the immediate risk of suffocation through œdema of the larynx that we are concerned here. These cases always cause anxiety, and require very prompt treatment. If, shortly after the accident, there be a distinct difficulty of breathing, from obstruction, the safest plan will be not to wait for more urgent symptoms, but at once to perform *laryngotomy*, or, in young children, a high *tracheotomy*, and then to treat the case with a warm moistened atmosphere, and in all other respects as if it were a case of diphtheria in which the operation has been called for. But often there is a deceitful calm for some hours, and we may be tempted to think that the larynx has escaped altogether, when suddenly the most urgent dyspnœa may be developed. Whenever, therefore, inspection of the mouth and throat shows that a scalding fluid or a corrosive liquid has passed down it, the patient must be carefully watched, made to breathe a steamy atmosphere, and the surgeon should be

ready himself, and have his instruments in readiness, to open the windpipe if necessary.

SKIN GRAFTING

may be employed to cover large granulating surfaces, or to make good recent deficiencies resulting from operation. The main objects of the procedure are to accelerate healing, since, although the epithelium may ultimately grow over a large granulating area, the process is slow; and also to diminish the amount of contraction which always occurs to a great extent during the period of epithelial growth.

Before considering the various methods which may be employed, it is necessary, for success, to insist upon the most *rigid asepsis*. The greatest enemy to any form of plastic surgery is sepsis. Antiseptic lotions should not be used, since they injure the delicate epithelial cells. Sterile gloves should be worn by the operator, fat and epithelial débris should be removed from the patient's skin with ether soap followed by absolute alcohol, and all instruments should be dry or immersed in normal saline.

Of the various methods employed, three only will be considered : (1) Transplantation of the whole thickness of the skin—devoid of fat ; (2) Transplantation of the epithelial layers, together with a thin slice of the corium (Thiersch) ; and (3) Small particles of epithelium which have been snipped off with scissors are dropped on to a granulating surface, where they grow like seeds in a suitable soil (Reverdin).

The first method is more particulariy applicable to recent wounds, such as those caused upon the face by the removal of a large rodent ulcer ; but it may be used to cover granulating surfaces, and it has the advantage of providing a thicker and more resistant covering than the succeeding methods.

If a granulating surface is to be treated, it is advisable, a few days previously, to remove with a

sharp spoon redundant granulations down to the firm fibrous layer, taking care not to destroy the deeper parts too thoroughly; the surface is then dressed with perforated oil-silk covered with gauze moistened by normal saline. This preliminary treatment ensures that the granulations shall be young and vigorous and that the surface shall be uniform and flat.

If the surface to be covered is that of a recent wound, all bleeding must be checked, and if any antiseptics have been used the surface must be *well irrigated* with normal saline.

" The skin required is removed from a suitable situation—thigh or abdomen—after careful preparation, in the form of a long ellipse. The incisions are made down to the aponeurotic covering of the muscles. The flap thus includes skin and sub-cutaneous fat, and is set aside in warm saline solution. The wound is sutured and dressed. The surface to be grafted is now uncovered. The flap is taken from the saline solution, and the fat is removed. This is done by turning it over in the palm and cutting away the fat with scissors curved on the flat. When the surface to be covered is large, the graft may be divided into as many pieces as necessary for distributing it over the surface at suitable intervals. After the application of the grafts the wound is covered with an oil-silk and gauze dressing as before described."

This method is a modification of that of Wolfe Krause as suggested by Young, of Glasgow, who advises that the dressings should be changed each day. If this is done the greatest care must be exercised not to displace these grafts, and it is advisable as a precaution that the grafts be stitched to the margins of the wound with a few points of fine silkworm gut at the time of the grafting.

Grafts may be taken from other patients, the foreskin of a child that has just been circumcised being of great service when there is a very large

area to be covered. It should be kept in warm saline until the surface to be grafted is exposed. Frog's skin and mucous membranes have also been used.

Thiersch's method is the one usually employed. The details are as follows : A surface of skin on the thigh, arm, or abdomen is carefully prepared by shaving and cleaning, and the granulating surface is washed over with normal saline preparatory to the placing of the grafts. There is some difference of opinion as to how this granulating surface should be prepared. Thiersch advised the removal of the granulations, but this does not always seem satisfactory. If the surface can be prepared a few days previously as above described, it is in the best condition for the reception of the grafts. If, however, Thiersch's advice is followed, the surface granulations should be removed by gently rubbing with a piece of gauze until the firm deep layers are exposed and the whole surface is smooth and uniform. *Bleeding must be checked with hot saline and gentle pressure.*

Thin slices are now cut from the prepared surface with a sharp razor ; these should just include the tops of the papillary layer, and if cut correctly they will be free from fat and will leave a uniform bleeding surface. They are cut with a gentle sawing movement. A little practice will enable the operator to cut long even strips.

Unless the grafts curl up in a troublesome manner, it is better to transfer them direct on the razor to the surface to be treated, where they can be flattened out by means of a probe. The objection to transferring them to saline is that they are apt to curl up in a still more troublesome way, and it is not always easy to tell which is the " cut " surface, and moreover the less exposure and manipulation they are subjected to the better.

When the whole surface has been adequately covered—and as many as ten strips may be needed

—a piece of oil-silk or protective, perforated so as to allow the discharge to escape, is placed on the wound, over which moist gauze and wool are bandaged. The dressing should not be changed for four days, at the end of which period the grafts should be found adherent.

The surface from which the grafts were taken should be dressed with some antiseptic ointment, as a gauze dressing is apt to stick to it and cause pain.

Reverdin's method can be easily applied with the above-mentioned preparations and precautions, but is less satisfactory.

Whichever method is selected, success will depend upon absolute asepsis.

The Tagliacozzian method is not considered here.

OF THE PREVENTION AND MANAGEMENT OF BEDSORES.

Experience alone as to what bedsores may become if neglected, will enable the student to realize the extraordinary amount of destruction which this form of ulceration from pressure can cause, or the rapidity with which it spreads, or the insidiousness of its commencement. It is also very necessary for every surgeon and every nurse to understand that, with the exception of certain paralytic cases, bedsores are almost always preventable and are, as a rule, standing evidence of neglect or mismanagement. But, though we will not qualify this assertion further, it must be allowed that sometimes it is extremely hard to prevent soreness, as, for example, in a case of hip disease with extreme emaciation, contraction of both legs, and suppuration. Sometimes, again, tissues have such a low vitality that it seems as if the least touch would produce a slough ; still, with incessant watchfulness, with the exception of the paralytic cases we have mentioned, bedsores *can* be prevented, although

once begun they are very hard indeed to arrest or to heal.

In warding off the formation of bedsores, attention must be specially directed to the following points :—

1. The bed must in all cases be smoothly made, elastic, and soft ; a spring mattress is often a great help, and water cushions may be used for the buttocks, etc. But in cases where there is a well-marked tendency to soreness there is nothing like a complete water bed. In filling one of these beds, care must be taken to have the water properly warmed, and not to put in more than will just support the patient.

2. In every possible way *continuous pressure must be avoided* upon the parts which are liable to become sore, such as the sacrum, trochanters, ischial tuberosities, heels, occiput, elbows, or the spines of the scapulæ. Taking every precaution when precaution is needed, as in fractures, against doing local harm by movement, in some way or other it must be managed that the patient shall shift his points of pressure upon the bed, lying now a little low, now a little high ; first with the head to one side, next day turned slightly over (for the least shift is as efficient as a great one) to the other ; a pillow may be put under the knees one day and omitted the next, etc.

3. Something may be done to improve the nutrition of the skin by bathing the parts with stimulant lotions (whisky or brandy and water is a common application). Starch or violet powder should be freely used, and if the tendency to soreness appears imminent, the part, which will be a bony prominence, should be strengthened by washing it with brandy and white of egg mixture, or spirits of wine and perchloride of mercury lotion, 1–2000, and the sore or threatening part protected by a circular pad of wool or lint.

4. *Absolute cleanliness*, as regards removal of

excretions, is another essential in the prevention of bedsores, for nothing softens the skin more and makes it more liable to break down than to be constantly wet with urine or foul with fæcal matter. Incontinence of either or both must make one doubly careful.

Nowadays, in hospitals or where skilled nursing has been employed from the first, such precautions as we have mentioned will be sufficient to prevent soreness altogether, or at the worst to limit it to a superficial excoriation. The cases we meet with where true ulceration is present, are those where there has been previous neglect of nursing care, through ignorance or poverty.

Such cases are not infrequent among those who come at last to be hospital in-patients, and whatever the nature of the original illness may be, the bed-sores will count heavily against recovery. These ulcerations are indeed very hard to dress; they present the characters of deep, foul, sloughing ulcers, not generally painful, but tending to destroy all the soft parts between the skin and the bone, and often complicated by necrosis of the bone itself.

The great point then is to remove all pressure, and to get the ulcer to begin to clean. If a sore has already developed it must be dressed with some antiseptic ointment, such as boric ointment, or with resin ointment if a more stimulating preparation is required.

Very much will depend upon whether there is improvement of the constitutional condition, or the reverse. If there be general recovery, local recovery is often extremely rapid when once it is started.

SECTION III.

THE TREATMENT, IN THE FIRST INSTANCE, OF ACCIDENTS AND EMERGENCIES.

CHAPTER VII.

OF THE IMMEDIATE TREATMENT OF FRACTURES, IMPROVISED SPLINTING, Etc.

IN this section, only such fractures as require manipulative surgical treatment will be considered, and of these only such as the dresser or house surgeon may reasonably expect to meet with, and which he must learn to treat, during his hospital experience. With regard to apparatus and manipulations, we shall describe chiefly those which are commonly used in this country.

But before proceeding to the treatment of fractures individually, there are certain general points which must be understood.

Extent of Injury.—The first time the student makes a post-mortem examination of a recent case of fracture, however simple, even if there be to outward seeming only a very slight amount of injury, he cannot fail to be astonished at the extent to which the tissues have really suffered, at the amount of bruising, and disorganization of the muscles, and at the infiltration of all the softer parts with extravasated blood. And yet, provided that such a fracture be simple, or if compound that septic forms of inflammation are successfully warded off, it is astonishing how quickly tissues, bruised and hurt as these are, will recover.

A further examination of a recent fracture on the post-mortem table will show that the injury of the soft parts has been, to a large extent, due to the working of the sharp, splintered fragments among the more yielding tissues ; indeed, in fractures by indirect violence, this is the only cause of their injury.

In considering, then, the general line of conduct in cases of fracture, the student should think of the condition of the limb beneath the skin, and appreciate that it is probably much worse than appears upon the surface ; and further, he should recollect that between the time of the occurrence of the fracture and of its being set, careless or improper handling may do much mischief, so that it not infrequently happens that, by movements on the part of the patient or of his friends, a simple fracture is converted into a compound ; or, much more rarely, an important vessel or nerve is seriously injured.

It will therefore be seen that there are many points for consideration in the treatment of a case of fracture, in addition to the actual and, so to speak, permanent setting of the bones.

So long as the patient can be left lying, little further harm can come to the broken bones, so that there need be no hurry.

The chief points in the immediate treatment of fractures are :—

I.—The prevention of further injury (*a*) by means of some improvised support or splint, (*b*) by proper precautions in transport.

II.—The arrangement of the bed on which the patient has to lie, probably for some weeks ; the getting him into it ; and the general management of affairs in the interval which must elapse before the setting.

I.—MEASURES FOR PREVENTION OF FURTHER INJURY.

(*a*). Improvised Splinting.—This is desirable when there is any appreciable movement between the

fragments, any painful spasm of the muscles, or whenever the patient has to be moved to a distance. The ways in which more or less efficient splints may be made are very numerous ; so that in this matter, the principles of the improvisation being indicated, the details must be left to the individual resource and energy of the surgeon. Whatever comes first to hand will of course be used first, as firewood, match - boarding, cigar boxes, book covers, paper, etc., and it will hardly ever be found difficult to give sufficient support to any fracture. Even a newspaper will be of great service, if it be folded often enough, especially if it be bent round so as
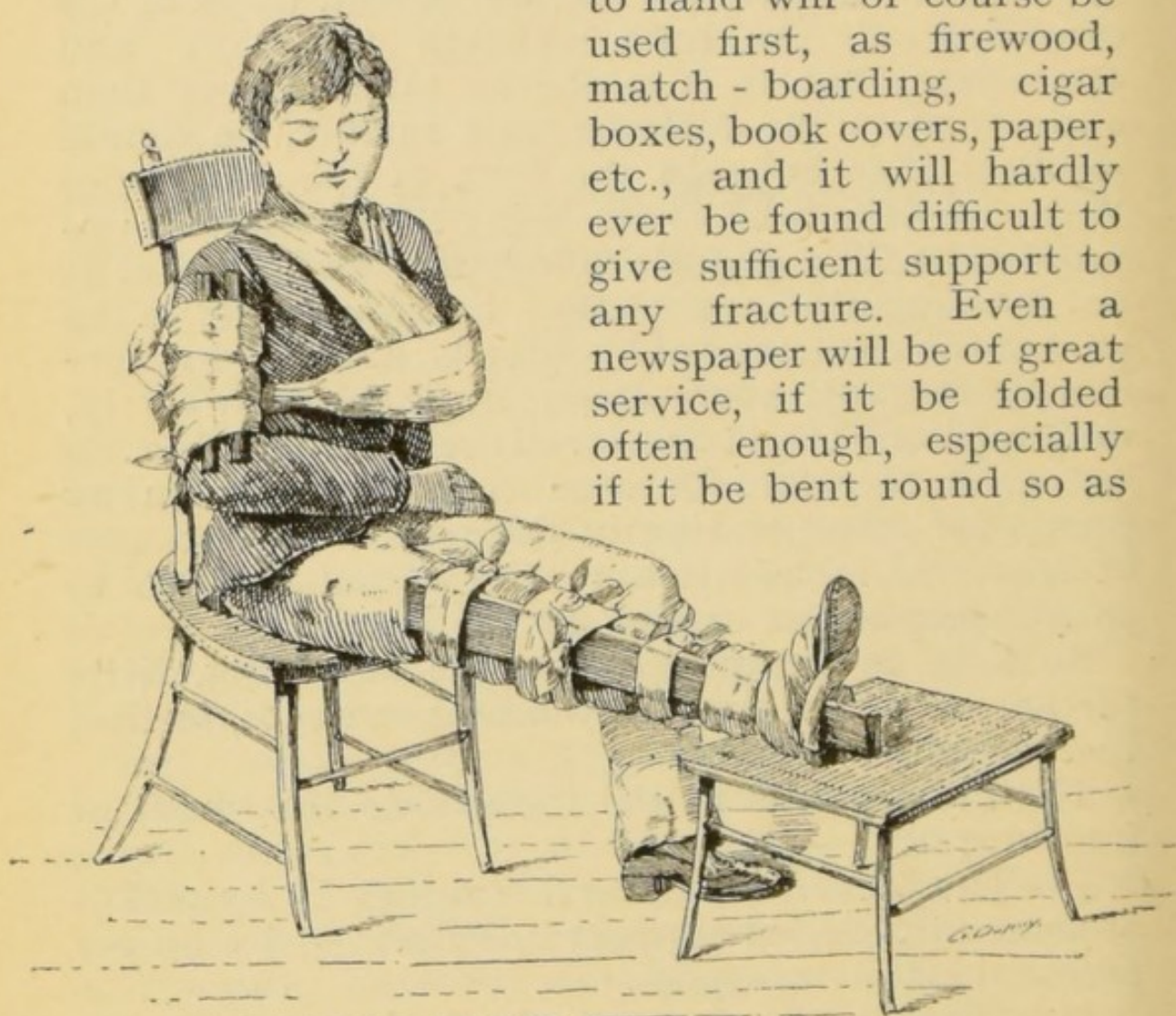

Fig. 64.—Illustration of Improvised Splinting.

to form part of a hollow cylinder. In fractures of the leg or thigh of one side, the use which may be made of the opposite sound one as a splint, by tying the two limbs together, should always be remembered.

Fig. 64 has been drawn to show a few of the ways in which common materials, such as firewood, towels and handkerchiefs, may be used for the

temporary support of fracture of the collar bone, humerus, and of the bones of the leg.

As a rule, *removal of clothes* is unwise until the patient is about to be put into bed, when it can be done deliberately and so as to cause as little pain as possible ; but if the fracture be badly compound, or if there be serious hæmorrhage, the clothing must be removed for the careful examination of the parts. These cases of hæmorrhage in connection with fracture are always serious, and the necessity of attending to this condition will take precedence of the question of supporting the broken bones.

Improvised splints should always be put on in a way which will allow of their ready removal, and in applying them there need be no effort made to replace the fractured parts accurately, but merely in a general and gentle fashion to reduce the deformity and give support.

The following directions will serve as *examples* of what may be done in some of the more common accidents involving fracture of bones, in the way of a rough-and-ready splinting, it being understood that they are examples only.

1. *Fractured Lower Jaw.*—This is a result of some direct violence, and there will be a good deal of bruising of the soft parts. All that will be required in the first instance will be to tie up the lower jaw against the upper one with a soft hand-kerchief, passed under the chin and over the vertex of the skull. The patient must not talk, and if any nourishment has to be taken it should be poured slowly into the mouth at one of the angles.

2. *Broken Collar Bone.*—This may happen in adults from direct violence, as by a bullet or any severe direct blow ; in such a case the symptoms will be well marked. Or it may occur at birth or in young infants, by rough handling or slight drags or falls, in which case it may often be overlooked. But it is generally the result of an indirect shock, as by falling on the shoulder or on the outstretched

hand. The patient instinctively supports the elbow and forearm of the injured side with the other arm, and so pushes up the shoulder, which would otherwise droop. If the patient can be conveniently put to bed on a hard mattress, flat on the back, with a small pillow between the shoulders, and a very small one (or none at all) under the head, the fragments of the clavicle will come absolutely into apposition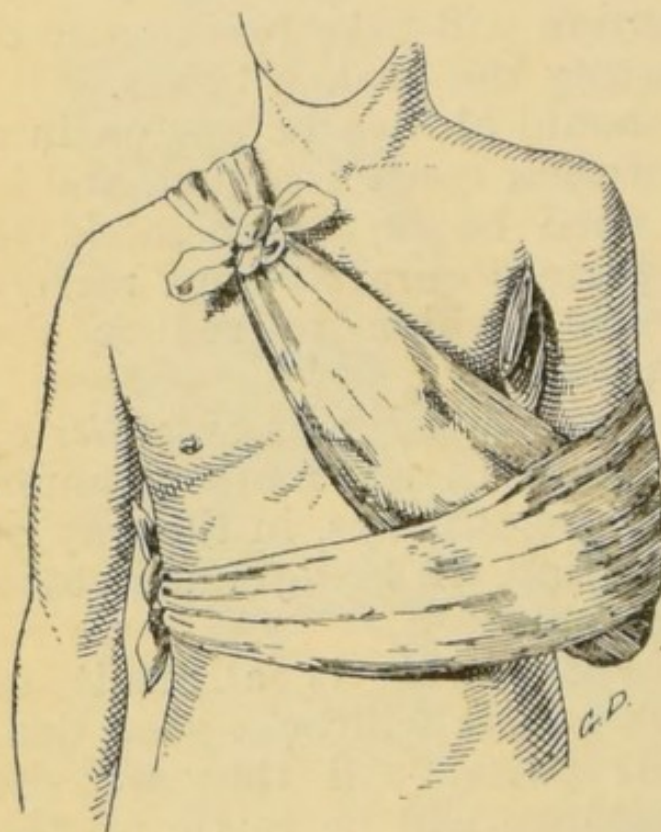. But when this accident happens, the sufferer has often to travel for some distance, and although, by merely slinging the arm, all risk of any great additional damage will be avoided, a better plan is to use a couple of towels, or triangular bandages, in the way now to be described. With these the arm can easily be fixed in a position which will give complete comfort, and in many cases they will bring the fragments into sufficiently good

Fig. 65.—Treatment of Fractured Clavicle with two Towels, or Triangular Bandages.

position to enable union to take place without any noticeable deformity. This method is also suitable for the permanent setting.

The indications to be fulfilled in cases of fractured clavicle are that the shoulder must be well pushed up, the arm must be fastened to the side with the elbow behind a vertical line dropped from the point of the shoulder, and that the shoulder joint should be forced away from the thorax by a pad placed in the axilla to counteract the tendency of the broken

ends of the clavicle to overlap. A way in which
this may readily be done is shown in *Fig.* 65. A
soft but firm pad is made, of about the size of one's
fist, as with a cricketing cap or a newspaper, and is
placed in the axilla ; the forearm is crossed over
the chest, with the hand pointing to the opposite
shoulder, the point of the elbow being held well
back. A towel is then folded as a broad scarf, the
elbow is settled into the middle of it, and then by
tying the ends over the opposite shoulder, the hand
and forearm being covered by the scarf, the arm on
the injured side can be pushed well up. The other
towel is then brought round so as to fasten the arm,
forearm, and hand,
firmly to the trunk,
and the ends are
knotted or pinned
beneath the opposite
armpit. A reference
to the figure (*Fig.*
65) will explain,
better than words
can do, these simple
but efficient arrange-
ments.

A roller bandage
may be employed for
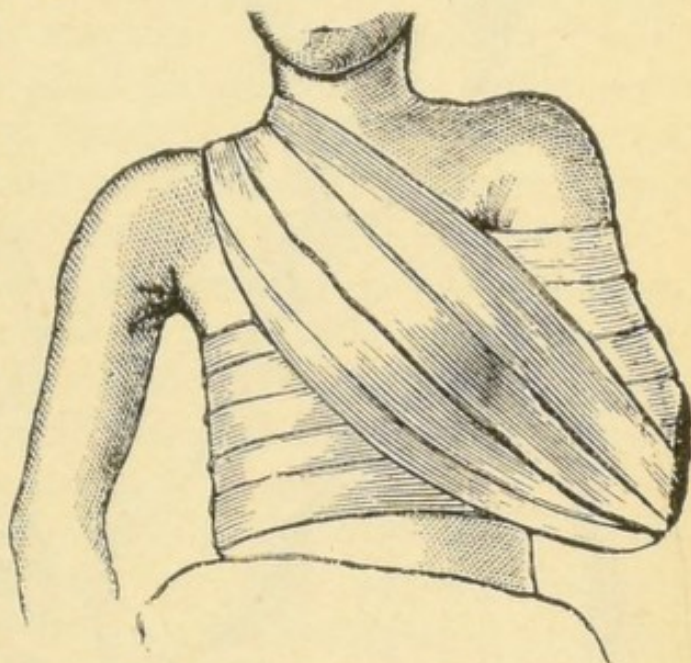the same purpose, as
in *Fig.* 66.

Fig. 66.—Fractured Clavicle fixed
with a Roller Bandage.

Treatment by Broad Strips of Adhesive Plaster is
a plan introduced by Sayre, which is now in very
general use in this country.

The principle and practice of this method will be
understood from *Figs.* 67 and 68. The limbs
should be washed and shaved, the axillary hairs be
cut short, and the whole area well powdered with
boric acid and starch. Two strips of adhesive
strapping are cut, three to four inches wide, and of
sufficient length. The arm being held in position,
one piece is first fastened round it, just above the

centre, and secured by a few stitches ; the strip is then carried backwards round the body, and fixed to it.   The second piece is carried downwards from just behind the uninjured shoulder, and obliquely across the back, the point of the elbow on the affected side is received in a slit, and the strapping is then carried up over the forearm and hand, which are flexed on the chest, and fastened at the place it started from.   Sayre does not use an axillary pad, but if it improves the position it should be employed.
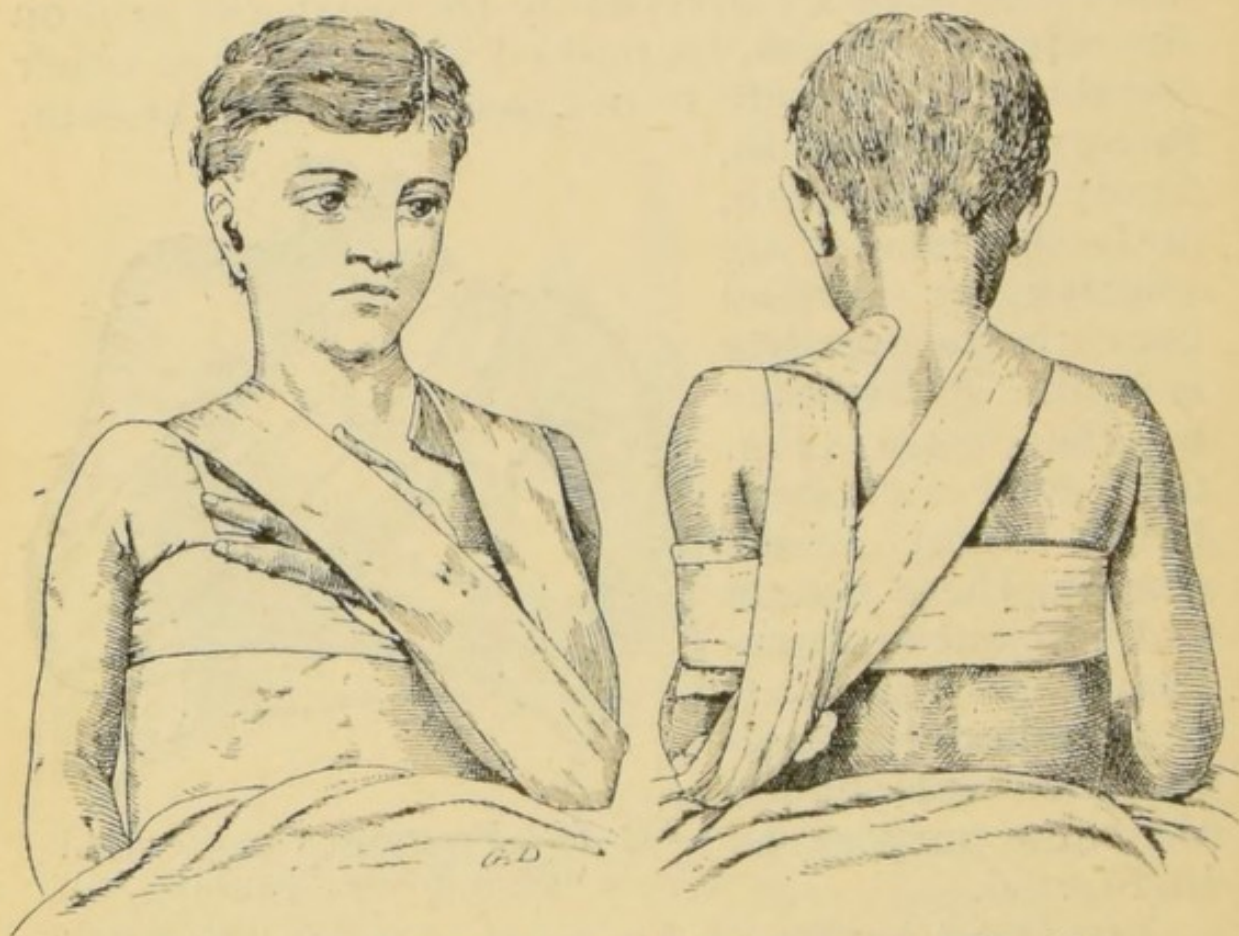
Figs. 67, 68.—Sayre's method for Fractured Clavicle.

The principle of Sayre's method is as follows : By means of the first turn of strapping the arm is fixed, and the strapping forms a fulcrum on which the arm may be moved.   The first piece of strapping is applied with the point of the elbow directed backwards.   Before the second piece of strapping is adjusted the point of the elbow is brought forward, and the first strapping acting as a fulcrum, the shoulder is carried well back and the deformity is rectified.

3. *Fractures in the neighbourhood of the Shoulder Joint.*—For these, inasmuch as the displacement and mobility of the fragments are both very slight, a well-adjusted sling is all that is required at first, or during removal.

4. *Fracture of the Shaft of the Humerus.*—Here the displacement may be considerable, and the ends of the broken bone, by moving on each other, may cause much pain and muscular spasm. The weight of the forearm must be utilized to prevent overlapping of the fragments, and a little gentle traction may be made at the elbow. Some short pieces of firewood, cardboard, etc., should then be tied round the limb, outside the sleeve, with handkerchiefs, etc., care being taken that those on the inner side and front are so short that the circulation is not impeded. The hand and wrist should then be slung in a towel or triangular bandage folded scarfwise.

5. *Fractures about the Elbow Joint.*—The forearm should be slung, but it will be unwise to attempt any reduction of the fracture, which is often complicated with dislocation, till arrangements have been made for its regular setting.

6. *Fracture of the Bones of the Forearm.*—The limb should be supported by two splints, which need not be very rigid (brown paper folded several times will do very well), placed along the front and back of the hand and forearm, and reaching from the elbow to beyond the tips of the fingers. The hand should be placed midway between pronation and supination, with the thumb upwards ; the splint on the flexor side must not embarrass the brachial artery when the arm is bent. The splints may be tied on with handkerchiefs, and the arm supported with a broad sling.

7. *Colles' Fracture at the Wrist.*—A simple sling is all that will generally be necessary ; but sometimes, when there is painful spasm of the flexors of the fingers, relief is afforded by a soft splint along the front of the hand and forearm, lightly tied on.

The fracture should always be set as soon as possible.

8. *Fractured Ribs.*—When an accident has happened which in the nature of things may have caused one or more ribs to give way, and the injured person complains of a stabbing pain or " catch " in the breath on inspiration, with other signs of embarrassment of the breathing movements, it will not be necessary in the first instance to distinguish whether there has been a bruising merely or an actual fracture of the thoracic walls. In the majority of cases it will be found that immediate relief is afforded by placing the hands on either side of the chest and compressing the thoracic walls gently but firmly. Very often the patient will have found this out, and may even have tied his scarf tightly round his body. Until a more complete support can be given to the thorax by strapping and bandaging, something in the way of a scarf or towel must be tied round the chest tight enough to give the greatest amount of relief.

A patient with broken ribs may thus be able to get home without much suffering, but he should be cautioned against any movements which would require any but the shallowest respiration, for though he may be comfortable enough so long as the diaphragm alone is concerned in the performance of breathing, his pain would be much aggravated by any effort which would bring the chest walls into play. When adhesive strapping is at hand it should be cut into strips about $1\frac{1}{2}$ inch wide and applied to the affected side, the strips overlapping and extending from the spine behind to the breast-bone in front.

9. *Fractured Spine.*—Whenever, or under whatever circumstances, the back appears to be broken, no question of splinting can arise, but the harm or disaster which may be wrought by rough or careless handling cannot be too thoroughly realized.

The symptoms of fractured spine being present,

the injured person should be placed in the supine or prone position on the ground, with the trunk as straight as it can be gently put. In the absence of a stretcher, a gate, hurdle, shutter, or some other rigid platform should be procured, and placed close to the patient, who must be put on it with the least possible alteration of position.

10. *Fractured Pelvis.*—This may occur from a fall, but in most cases the cause will be a crush, as between buffers, or by the passage of the wheels of a wagon over the patient's body. Little requires to be done in the first instance; but relief may be given by tying a broad scarf or belt round the pelvis, and the patient must be quickly placed on a stretcher or its substitute. It sometimes happens that even after a most severe injury to the pelvis, the patient is able to walk after a fashion, but this must never be allowed. The bladder, urethra, etc., may be damaged in this fracture.

11. *Fracture of the Neck of the Thigh Bone.*— (i) *Fracture in old people.* This will only require that the patient be moved with gentleness on a stretcher; no other precautions are necessary. (ii) *Fracture with violence*, and injury to the softer parts around. This will usually be extra-capsular, and generally occurs in adults. In any case precautions must be taken to prevent further damage in removal; these, however, will be practically the same as are required in the following case.

12. *Fractures of the Shaft of the Femur.*—In consequence of the length and strength of this bone, its fracture may be attended with great disorganization of the surrounding parts, and the injury is very easily made more serious still by rough or unskilful handling. In these cases the principal difficulty is that of transport, and the reader has only to imagine what might be the consequences of ill-advised efforts to move a heavy man with his thigh broken in the middle and unsupported, to see at once that no attempt should be made to move an adult thus

injured till the limb has been rendered fairly stiff by improvised splinting. The end desired is practically to make the patient's body rigid from the arm-pit to the ankle, so as to prevent all risk of a bending or buckling up of the broken ends of the bone, which would otherwise readily occur. The patient should be kept lying *absolutely flat on the back*, and search should be made for something long and strong enough to serve as a " *girder* " *to run the whole length of the body* (a rifle or a broomstick will do admirably). This must then be laid along the injured side, the top going beneath the axilla, and the limb should be very gently straightened, since by this time it will probably have become much abducted and rotated outwards. Then with numerous handkerchiefs, towels, etc., this long splint must be fastened on, passing the bandages round the thorax and pelvis. Along the inner side of the lower extremity, a short splint, say an umbrella, should then be placed, and a splint of thin board, or stiff paper folded, may be placed along the back of the thigh. These supports must then be fastened round the thigh, leg, and foot, as can best be managed. Finally, the injured limb must be tied to the sound one in two or three places.

If these proceedings have been thoroughly carried out, it should be possible, although it would be unwise, to carry the patient simply by the head and heels, without any bending.

13. *Fracture near the Knee Joint.*—Here the risk of injury is very much less, and one of two plans may be adopted. If the limb be lying fairly straight, an inside and an outside splint, as two walking-sticks, should be tied on with several handkerchiefs, which avoid the actual seat of fracture ; or what will be found more comfortable, especially if the limb be bent, will be to place beneath the joint a thick pillow or other support, keeping this in the flexed position with a few bandages tied round all.

14. *In a Fractured Patella,* the great indication

is to avoid increased separation of the fragments and
further damage to the knee joint beneath. This
will best be done by a strong back splint of
umbrellas or boarding, running behind the whole
length of the thigh and leg, and tied on firmly with
handkerchiefs. The knee must not be bent, even
for a moment.

15. *Fractures of one or both Bones of the Leg*
generally occur from direct violence, and because
the skin is so thin over the shin bone they are very
apt to become secondarily compound, and may be
so from the beginning. These fractures are thus
often extremely severe injuries, and require much
care and gentleness in handling. If the fracture be
compound an antiseptic dressing should be first
bandaged over the wound. If the limb be very
much crushed, with comminution of the bones,
whether the fracture be compound or not, probably
the best plan will be to take a soft pillow and
arrange the stuffing so as to form a trough, lay the
limb in it, and tie it up with soft bandages. In
slighter cases, splints long enough to reach below
the feet must be put on both the outer and inner
sides, or on the outer one only (see *Fig.* 64). If
the boot can be easily taken off, as by cutting up
the side springs or laces, this should be done, but it
should be left alone if it seems that removal would
cause the slightest damage.

16. *In Pott's Fracture with Dislocation at the
Ankle Joint*, it is unwise to use any force to rectify
the deformity, which will often be considerable.
The boot should be cut off, and a splint, extending
from the knee to below the foot, should be put on
the inner or the outer side, as seems best, with
handkerchiefs. For the time being the foot should
be placed in as nearly a natural position as it will
readily come to.

Finally, in those cases of *Compound Dislocation
of the Ankle*, or of a *general crush* of the parts about
the foot, caused by great violence, little can be done,

except to apply an antiseptic dressing if at hand, and to tie the parts up in a pillow, or to use such other materials for soft support as the circumstances of the case will admit of.

(b). **Methods of Transport of cases of fracture, and precautions to be taken therein.**—In military surgery it naturally happens that great stress is laid upon the best ways of moving people, helpless from injury, whether through fracture or otherwise. A regular stretcher drill is laid down, and other plans for lifting and carrying are carefully considered. But in civil practice, and in connection with the proper work of house surgeons and dressers, elaborate descriptions of the
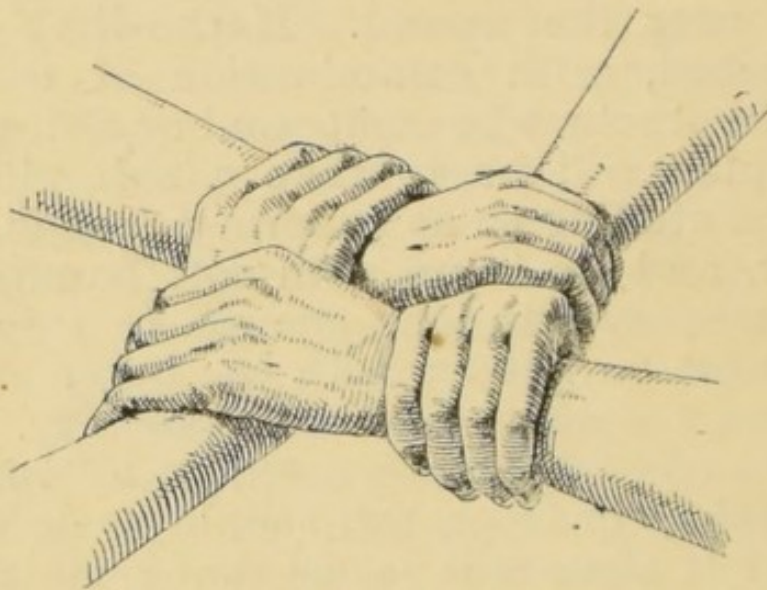

Fig. 69.—Hands forming a Four-handed Seat.

different kinds of stretchers and of kindred details would be out of place ; still, it is desirable that all civilian dressers, surgeons, nurses, or porters, who have to do with helpless people, should have some acquaintance with the best ways of lifting and moving them, and one or two of these ways will here be mentioned, supposing always that the injured person is unable to walk at all. (The case of children need not here occupy our time.)

If two people only, A and B, are available for the transport, and the person is able to sit up a little,

the best way to manage will be for them to make a " sedan chair " by crossing their arms. Of this " chair " there are three patterns, but one only is figured because it is the best for general use.

1. The fingers of the right hand of A and the left hand of B are interlocked to form a " two-handed seat," while A's left hand is placed on B's shoulder, and vice versa, to make a back support.

2. Both A's and one of B's hands are joined to form a triangular seat, and B's other hand rests on A's shoulder, thus forming a " three-handed " seat, with back.

3. But the third way (*Fig.* 69) is the best, where both pairs of hands are used, locked together to form a four-handed seat, and where the patient supports himself by his hands placed upon the bearers' shoulders.

If the patient be quite helpless or senseless, whether he has to be carried any distance, or has only to be lifted on to a stretcher or bed, the assistance of three people is desirable, two, A and B, to do the lifting, and the third, C, to look after the injured limb and the patient generally.

A and B take up a position on the opposite sides of the patient, near his haunch bones, facing each other ; they then stoop down, and each gradually gets one hand under his back, near the shoulder blades, till they meet and are clasped ; the other hands are then passed and locked under the breech. Having secured a firm grasp they rise together from the stooping posture with the patient, and are ready to move. It is not advisable for either to kneel, unless they cannot stoop low enough, but if one does both must.

A patient lifted in this way can readily be placed on a bed, or lowered on to a stretcher for more convenient carriage. In lifting a stretcher the taller of the bearers should go to the head, and should give the directions as to the time of lifting, etc. The head should always be lifted a little before.

and lowered a little after, the feet. *In carrying anyone* on a stretcher, the bearers should *not keep step*, but the left foot of the one must be put forward with the right of the other, to avoid swaying.

With regard to conveyance in vehicles, a four-wheeled conveyance is much better than one with two wheels. If the injury be very severe the patient should be lying down if possible, either from seat to seat, or if that space be insufficient a stretcher may be laid across the floor of the cab, both doors being opened.

Lifting Patient to Bed.—When a patient has been brought to the bedside, the bed being ready, he should, if completely disabled, be very gently lifted on to it, and the knowledge of how to do this properly and with the least discomfort to the patient does not come naturally.

The stretcher, or whatever the patient has been carried on to his bedroom, is placed on one side of the bed, say the left side ; those about to lift him kneel on one knee on the patient's left, and after carefully inserting their hands and forearms under him, at a given signal rise to their feet and lift him gently. An assistant then draws away the stretcher, and the lifters taking a pace forward gently deposit the patient in the centre of the bed. With a sufficient number of assistants this may be done expeditiously and without pain.

It may also be done by placing the stretcher with the patient's head at the foot of the bed. The assistants kneeling on either side insert their arms well under the patient, and at a given signal rise to their feet and lift the patient up. By moving along sideways the patient is brought over the bed and gently deposited.

This method is not so good as the former, but it allows of more assistants being employed, which is convenient in the case of heavy people. The lifters may either lock their hands under the patient, or, still better, grasp each other's wrists.

The patient having been placed on the bed, the clothing should be removed, cutting off the boots and ripping up the seams of the clothes, if this has not been done before, the sound arm or leg being the one which should first be slipped out of the sleeve or trouser. As a rule, everything in the shape of temporary splints may now be taken off, and the limb should be placed in the most natural position in which it will easily lie, on a pillow fashioned into a kind of trough. *Sandbags* are very often useful in restraining spasmodic movements or in steadying the limb. All pressure of the bedclothes must be taken off by a *regular cradle*, or one improvised out of some such thing as a bandbox split open.

II.—OF FRACTURE BEDS.

There are certain points to be looked to with regard to the bed on which a patient with a fractured limb will have to lie, and inasmuch as it is probable that once there, any further movement will be hurtful, these circumstances should be met *before* the patient is placed on it.

The essential qualities which the bed should possess are, that there should nowhere be any " sagging " or possibility of giving way, that the surface should be evenly smooth and comfortably elastic, and that the foot of the mattress should be somewhat higher than the head.

In practice it will be found that very few bedsteads fulfil these requirements ; even the best (the wire-woven and the various spring mattresses) will allow of a certain giving way where the greatest weight of the body comes, while this occurs to a much greater extent in sacking or sofa-spring beds. The evils of this yielding and formation of a hollow under the patient are not so apparent at first as they afterwards become ; the patient gradually slips down, the head and shoulders are pushed forward, and the heels come up, until, instead of lying in a

straight line, the body forms two sides of a triangle, the apex of which is at the ischial tuberosities, to the grievous alteration of the parts about the seat of fracture, and the great risk of inducing bedsores.

Fortunately the remedy is easy, and involves no apparatus, all that is required being a light wooden frame, or a few light boards, placed on the bedstead underneath the mattress. If the mattresses are of the kind to be described directly, no discomfort will be felt from the rigidity of these boards after a very little time, even by those who are accustomed to lie softly, while they are quite as efficient as any special bedsteads that have ever been devised.

A big bed is a big misfortune in all cases of sickness, but especially in fractures. The best size is that of the ordinary single bed, namely 6ft. 6in. by 3ft. or 3ft. 6in.

It is a matter of great importance that the *mattresses* in fracture cases should possess the qualities of smoothness and elasticity in perfection, and for this reason any form of " bed," either of feathers or any other material, is quite inadmissible. Flock mattresses are objectionable, as, even if they are well made, they tend in time to form knots or lumps. It is best to use a single horse-hair mattress, placed directly on the fracture-boards, and covered by a blanket. The sheets, etc., require no particular directions, save that if a draw-sheet and mackintosh are required, they should be arranged before the patient is put to bed.

In cases of fracture of the lower extremities, or of the spine, *all* pillows, bolsters, etc., are harmful, except the merest cushion beneath the head, at any rate in the early stages of union ; and if the patient can be induced to lie flat thus, the position will not produce discomfort after a short time. Any pillows should be small, firm, and covered with separate slips.

A full-sized water-bed should be used for a fractured spine.

OF SPRAINS.

Sprains may be defined as injuries to the soft parts, ligaments, muscles, tendons, or nerves, caused by a twist or wrench of a joint, or by an abnormal forcible movement of a joint. The term sprain will, therefore, be employed to cover a large number of common injuries, and all grades of severity may be encountered, from a slight stretching of some ligamentous structure unaccompanied by swelling, up to the most severe forms where extensive rupture of muscle and ligaments has occurred.

Sprains have been classified as follows (Sir William Bennett) :—

1. **Sprains with Fractures.** — The introduction of the X rays has shown us that many conditions which were formerly treated as uncomplicated sprains, are really a combination of sprain and fracture. This is especially so in cases of injury to the hand and foot. A sprain may cause the tearing away of a tendon from its bony attachment, a layer of bone accompanying the tendon ; in other cases the bone is fractured transversely or obliquely, this accident often occurring in the phalanges. It must therefore be clearly understood that, when possible, all cases of severe sprain should be examined with the X rays to ascertain the exact extent of damage.

2. **Sprains with Effusion into Joints.**—As a result of damage to the ligaments of a joint, or from tearing and bruising of a synovial membrane, a sharp attack of traumatic synovitis may follow an injury. These cases are very important, since if not treated with great care stiffness is very likely to occur, and it must be borne in mind that, when a sprain is complicated by a synovitis, adhesions which subsequently may limit the movements of the joint will be both extra- and intra-articular.

3. **Sprains with Marked Swelling.** — These injuries are associated with rupture of muscular fibres, and of blood-vessels. There is great swelling

and discoloration of the skin if the sprain is super-ficial ; in some cases very large hæmatomata form.

4. **Sprains with Displacement of Tendons** occur usually in the neighbourhood of the ankle, shoulder, or wrist, when the fibrous sheath which maintains the tendon in position is ruptured, and the tendon itself slips out of place. These injuries are difficult to diagnose correctly until the swelling has subsided.

5. **Sprains with Injury to Nerves.**—All grades of injury may be met with, from simple bruising to complete rupture. In some cases the nerve is stretched, becomes slightly inflamed, and ex-quisitely tender. This is likely to occur when a nerve trunk passes over the region of a damaged joint, and as examples we may take the brachial plexus in relation to the shoulder, the external popliteal in relation to the knee, and the sciatic in relation to the hip. In mild cases the symptoms soon pass off, but in the more severe types there may be very great trouble.

In a few instances the nerves are actually ruptured. Fortunately, this accident is rare, since the nerves are sufficiently elastic to yield to a con-siderable amount of stretching, and it usually occurs where they are more or less fixed, as, for example, rupture of the upper roots (5, 6) of the brachial plexus in injuries and sprains of the neck, or of the circumflex nerve in some injuries to the shoulder.

In all cases of severe sprain examine the patient for signs of injury to nerves. If numbness of the limb persists for twelve hours after an injury, the nerves have probably been damaged (Bennett).

TREATMENT OF SPRAINS.—In cases where fracture complicates a sprain, the treatment adopted should allow the fracture to consolidate, and at the same time prevent the formation of adhesions.

In most instances it is advisable to place the limb

on a splint, in the best position obtainable, and to start massage the next day. How far it is justifiable to omit the splint must depend on the nature of the fracture and the opinion of the surgeon, but we are of opinion that in most cases the use of a splint for ten to fourteen days at least is desirable.

Passive movement may be begun with massage if no risk appears of producing displacement.

Sprains without swelling are best treated by *immediate* massage, followed by the application of
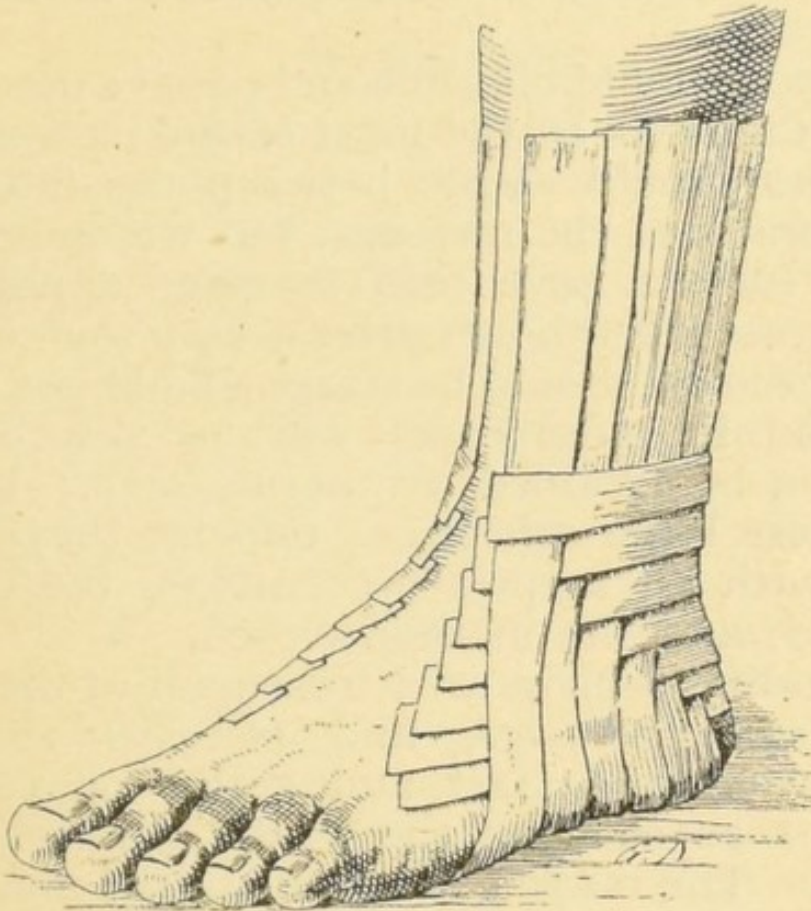
Fig. 70.—Ankle strapped. A gap is left in front, so that the strapping shall not constrict the limb.

strapping or a crêpe Velpeau bandage. Indeed, many cases of slight sprain can be easily *walked off*.

Sprains with Swelling should be treated by rest during the acute stage, a suitable splint being provided, and hot or cold application employed. Cold is apt to produce sloughing in patients whose vitality is poor, and on the whole hot compresses are more satisfactory. If preferred, evaporating

lotions, spirit lotion, lead lotion, or a solution of chloride of ammonium, may be employed. As soon as the swelling has begun to subside, the part should be firmly strapped.

Some authorities recommend immediate strapping as tending to prevent the swelling from taking place (*Fig.* 70). It must be employed with great care, since pressure round a swollen limb may lead to sloughing and gangrene. The local application of iodine, vasogen ointment, or mercury in the form of Scott's dressing, is recommended in the more chronic cases.

How soon should massage and passive movements be undertaken? In the most severe cases twenty-four hours should elapse between the injury and the beginning of the massage, but we do not insist on this, for we have seen massage applied with great success a few hours after a very severe sprain.

Hæmatomata should be strapped and not opened. The blood in most cases will be absorbed, the absorption being aided by the massage. In a few cases where large collections remain, they may be opened with all aseptic precautions, the contents evacuated, and the incision closed.

The guiding principles of treatment of these cases are *pressure*, *massage*, and *movement* : passive movement at the start and active or voluntary movement as soon as the acute symptoms have subsided. The range and extent of the movements must be limited by the results they produce ; and in no case should they excite a return of the swelling and pain. Within a few days (five to seven), the patient should be encouraged to use the limb for ordinary movements—walking or grasping—until the normal condition is obtained.

Sprains with Effusion into joints are treated in the same way. For an acute effusion a splint is necessary, followed by strapping, massage, and passive movements. It is very necessary in these cases to massage the muscles around the joint. If

the joint is very tense and the pain severe, the joint should be aspirated, and the excess of synovial fluid withdrawn.

Sprains with Nerve Injury are the most difficult to treat. Massage often causes the most intense pain ; but it must be employed as soon as the patient can bear it. Blisters over the course of the nerve are often of great value, as is also the use of an electric current, and douching.

Gross injury, such as rupture, will require operative treatment.

OF BRUISES.

Whenever capillaries or veins are ruptured in or beneath the skin, some variety of *bruise* is produced. Under this head fall two chief kinds of injuries. In the first there is a general infiltration of the tissues, in the second there is a bag of blood ; and, speaking generally, in the one the capillaries, and in the other a vein of some size, has been ruptured. In either case the great point to keep in mind is, that the effused blood should be *left alone*, except under one or two quite exceptional conditions.

For the common bruise, or infiltration of blood, in the vast majority of cases no special treatment is required. It is very doubtful if any external application can appreciably affect the re-absorption of the effusion, or the course of the discoloration, but it is probable that local cold and astringent dressings may be useful, if applied early, in limiting the extent of the primary escape of blood. For this purpose cold applications and evaporating lotions are useful.

The astringent action of dilute liq. plumbi subacet. is also very effective, and the actions of cold and astringents may be combined.

A still better line of treatment is that by firm, even compression, but only when it can be applied in time to prevent the infiltration of the tissues taking place. A wet bandage smoothly applied, or

a Martin's indiarubber roller, may in such cases quite prevent the development of an ecchymosis.

This moderate pressure can never be hurtful ; but it must be remembered that the vitality is greatly lowered in bruised tissues, so that all tight constriction or unyielding compression, as that of a circular piece of strapping, or the corner of a splint, must be avoided, lest an ulcer, which would certainly be slow to heal, should be caused.

Severe bruises will often be associated with great swelling and tension of the parts. These must be met by adaptation of position and bandaging ; only in the *most extreme cases*, when the vitality of the surrounding area of skin is seriously threatened, should the surgeon be tempted to relieve this tension by operative measures. The conditions are just the reverse of those present in inflammation, and an extraordinary degree of stretching will be now borne by the tissues without their giving way or sloughing. If it becomes absolutely necessary to incise an ecchymosed area, small and numerous punctures should be made, and antiseptic precautions adopted. But it is, we repeat, generally bad surgery thus to interfere with the natural process of re-absorption.

When a fairly large vein is ruptured beneath the skin, a *Hæmatoma*, or bag of blood, is the result, and much of what has just been said will apply accurately to its management. The fluctuating swellings thus caused are sometimes very large. Rest, position, local cold, and especially, carefully regulated pressure, as with india-rubber or other bandages, will in almost all cases effect their re-absorption. They do, however, sometimes suppurate, and sometimes they remain with the blood unabsorbed for an indefinite time. In the first case the tumour must be opened and drained like any other abscess ; in the second, when patience has fairly been exhausted, and it is plain that absorption is not going to take place, the

fluid must be removed. Sometimes aspiration, or the use of a small trocar and cannula, will be sufficient to empty the sac, but in most cases it will have to be laid more freely open, and the contents turned out; the operation should be performed aseptically, and the cavity thoroughly washed out, while there should always be pressure put upon its walls to prevent a fresh filling up. In most cases it will not be necessary to drain, and the incision may be sutured up completely.

Lastly, as in the case of a diffused ecchymosis, sometimes, but very rarely, the tension on the tissues bounding a hæmatoma may be so great that it must be relieved by incision. This procedure should be delayed as long as possible, but if it must be done it should be with the strictest antiseptic precautions.

Special Bruises.—First among these may be mentioned *Hæmatoma of the Scalp*, generally occurring in newly-born infants, as one of the accidents of labour, but also as a complication of fractures and other injuries to the head. Unless actual death of the skull bone takes place, which is very rare, the blood is invariably re-absorbed, and incision is never required.

Subconjunctival Ecchymosis is sometimes of importance as a diagnostic sign in suspected fracture of the anterior fossa of the base of the skull, but it commonly occurs almost spontaneously, as during a paroxysm of whooping-cough. It should always be left alone, as it is never in itself a matter of importance, and is generally soon absorbed.

So, too, with the ordinary *Black Eye*, when the extravasation has once taken place, no application will affect the rainbow-like hues of the discoloration, or make them disappear more quickly than in their own good time. But the early application of cold, as by an ice-bag or an evaporating lotion, or of astringents, and especially of the acetate of lead, may do a good deal to limit the actual escape of blood and serum.

CHAPTER VIII.

OF THE ARREST OF HÆMORRHAGE.

HÆMORRHAGE is any escape of blood from its vessels whose walls, through injury or disease, have been divided or torn. It is commonly described as being **Capillary, Venous,** or **Arterial.**

There are few accidents which test the qualities of courage, readiness, and energy more than the occurrence of a violent hæmorrhage ; and in such a case the prompt adoption of common-sense measures will be found to be of far greater service than any routine of book-learnt rules.

GENERAL RULES.

A few general principles bearing on this subject may be shortly considered under the heading of " The Primary Arrest of Urgent Hæmorrhage."

Natural Arrest, Pressure, and **Position** are the cardinal points in the primary arrest of hæmorrhage.

The measures which must be taken on the first emergency are :—

1. *Encouragement of the Process of Natural Arrest,* by attention to position and getting free circulation towards the heart in the veins.

2. *Prompt Digital Pressure,* on the wound first, and afterwards upon the trunk vessel, if necessary.

3. *Absolute Quiet,* and the recumbent position.

Arrest of Capillary Hæmorrhage is usually simple and quick enough. The capillary vessels proper contract, and the blood coagulates over the surface of the wound, while underneath the surface of this coat of clot there is poured out a layer of highly coagulable lymph, which seals up the ends of the vessels, and is the first step towards repair.

In the Veins, the chief agent in natural arrest is

the contraction of the venous walls, combined with coagulation of the blood. This contraction occurs at the cut ends only, and does so more rapidly than in the case of arteries, so that one may often see the veins on the face of an amputation stump distended with blood but with their ends completely closed, taking the shape of nipple-like projections.

Veins do not appear to retract so perfectly within their sheaths as arteries do ; with regard to the later stages of the process of natural arrest, such as the formation of external and internal coagula, etc., all that need be said here is that in its general outlines the process is similar to what happens in the case of arteries, but that it is somewhat less perfect.

In the Arteries.—It is convenient in the natural arrest of hæmorrhage to recognize two stages, which may be termed those of *temporary* and *permanent* arrest.

Temporary Relief.—This process in the case of small arteries consists (*a*) in the coagulation of the blood effused around the vessel, over its mouth, and between its sheath and its proper wall, (*b*) in the gradual contraction of the mouth of the vessel, and the formation of a coagulum in the lumen of the tube, (*c*) in the retraction of the vessel within its sheath.

Permanent Arrest.—The process is here a gradual one, and often takes considerable time to complete. It consists (*a*) in a continued retraction of the vessel within its sheath, (*b*) of a general shrinking up of the vessel itself and the parts in the neighbourhood, (*c*) of a disappearance of the clots and effused lymph, partly by absorption, partly by fibrous changes, and (*d*) of an organization of the internal coagulum. Finally, all that is left of the divided vessel, up to the nearest offshoot, is a fibrous cord which itself will subsequently disappear.

Syncope.—If the vessel divided be a large

one, or if from any cause the bleeding has been copious, there is added another factor in the arrest, namely, *syncope*, which within certain limits is often a most fortunate occurrence for the patient, for the lowered action of the heart ceasing to pump the blood into the vessels, gives time for clots to form, and for contraction and retraction to go on. Moreover, the coagulability of the blood increases after a considerable amount has been shed.

Importance of Pressure.—Again, it has been well said that there is no bleeding from the exterior of the body which cannot be temporarily arrested by *firm pressure with the fingers*. It matters not for the moment whether the bleeding be arterial, or venous, or capillary ; the thing required is to stop it, and pressure will always do this. Too much stress should not be laid upon the kind of vessels involved in the bleeding. A distended vein may bleed as furiously as an artery ; so may a mass of capillaries in inflamed tissues. But in all the first means of arrest must be local digital pressure.

Importance of Position.—Blood, like water, will not run up hill except upon compulsion. The effects of *position* and of an unhindered return of blood to the heart are thus very important. Yet how often may we see a man with severe epistaxis stooping over a basin, his neck the while encircled by a tight collar ; or a bleeding varicose ulcer, with a garter grasping the saphena vein.

General Directions for the arrest of capillary and venous bleeding, and of severe mixed hæmorrhage from injuries, requiring plugging, etc., will now be given.

Capillary Hæmorrhage.—Brisk bleeding from small arteries, veins, or capillaries is often best checked by simply *keeping the wound cold*. Exposure to the air or to a stream of cold water will aid the process of natural arrest, while swathing up the injured part may, by the increased heat produced, directly increase the escape of blood.

Pressure is sometimes useful, and limited incisions, or abrasions of vascular tissues, with few exceptions, are followed by oozing of blood which stops in a few minutes, and needs no further notice.

Venous Bleeding.—In some books, especially in those which are written to gratify the taste of the outside public for amateur or domestic surgery, we may still read that venous bleeding occurs only from the distal end of the cut vessel, and therefore the proper thing to do in the case of a cut vein, is to put a pad somewhere below the wound. Such directions are wholly misleading. For ordinary venous bleeding, the first thing to see to is that there is nothing hindering the return of blood to the heart. Next, to remember that almost all venous bleeding will cease on raising the limb ; and thirdly, that pressure will always effectually stop the flow of blood, if it be applied to the wound itself.

The measures which are most immediately effective for the restraint of *severe hæmorrhage* from vessels of all kinds, provided it is caused by external violence, now remain to be considered.

Plugging.—Pressure will here be even more necessary than in the other forms, and to be effectual it must be attained by plugging. Harm can only come of tying up a wound in a half-hearted way, laying on covering after covering, rather with the idea of hiding the danger, than mastering it. On the other hand, a furious rush of blood, such as may come from a wounded carotid, or a ruptured aneurysm, may be controlled for a time by a firm and judicious plugging of the wound, followed by pressure over it.

The best and most convenient material for plugging a wound is some one of the *absorbent and medicated preparations, having as a basis cotton wool* from which the fatty particles have been removed, such as the " sal-alembroth " wool, which has incorporated in its meshes mercuric perchloride. This material is generally stained blue for distinction

from ordinary absorbent cotton. The bicyanide, salicylic, or iodoform wool, or some other preparation of wool in which a chemical body with antiseptic properties has been incorporated, may be used for plugging. All this kind of material should be used dry, small pieces being packed away with a director, until the wound or cavity is filled.

In a similar fashion narrow strips of *Gauze* may be packed into the wound, very gradually but firmly, taking care that the deeper parts of the wound are plugged as well as the more superficial ones.

Pieces of Sponge used dry, or with some iodoform dusted on them after they have been washed in an antiseptic fluid, make a good temporary plug. Being elastic they can be made to exercise considerable pressure. In deep wounds, or in such places as the vagina, rectum, or pharynx, it is wise to attach a string to the sponge, to be able to recover it. In recent surgery there is, however, a growing distrust of sponges as a plugging material for temporary bleeding, and as a rule they are best avoided.

The wound, when plugged, usually requires a *Firm Compress* over all. This may be conveniently made of several layers of prepared lint, or better, of a large pad of wool of some sort, cut to the required shape, and secured by a roller bandage ; or by a triangular scarf or bandage arranged so that the knot comes over the pad.

The " Graduated Compress."—It is often necessary to make a compress which shall be much thicker in the middle than at the edges. This is effected by a series of pads of similar form, but diminishing in size, placed one on the top of the other until a more or less flat-topped pyramid of lint is made.

The principal use for this sort of compress is for wounds in such situations as the palm of the hand, the axilla, etc., where it is often very difficult to secure efficient direct pressure.

It must not be supposed that all wounds require

to be plugged. A pad and bandage firmly applied will be sufficient to check most hæmorrhages, and it must be remembered that plugging destroys all chance of healing except by granulation.

How Long should Plugs or Pads remain Untouched ?—This will largely depend upon the locality in which they are employed. In the case of the rectum it has been advised to leave the plugs untouched for a week or so. It must, however, be remembered that there is a tendency for all plugs to become impregnated with organisms after a very short time, and a plug inserted under what appear to be the most perfect surgical conditions becomes abominably offensive at the end of twenty-four or forty-eight hours. This is most undesirable ; and the tendency in modern surgery is to change the plugs in twenty-four to forty-eight hours in nearly all cases where they have been used to check hæmorrhage. In most instances the hæmorrhage will have been checked, and a light plugging can replace the original ; but should bleeding recur, it will be necessary to reinsert a firm plug, and again change it in forty-eight hours. In plugging cavities it is very essential to see that the material used goes to the very bottom of the cavity, otherwise the hæmorrhage may continue beneath the compress, and cause considerable destruction of the surrounding tissues. All such cavities must be allowed to heal slowly by granulation.

OF SOME SPECIAL MEANS FOR THE ARREST OF ARTERIAL HÆMORRHAGE.

1. **By Digital Compression.**—The procedure which of all is the simplest, in most cases the most efficient, and the readiest in cases of severe arterial bleeding, is the compression of the trunk vessel with the finger, above the seat of the injury, against some neighbouring bone. It is of course only applicable in cases of hæmorrhage in certain places,

such as in the limbs, the neck, and some parts of the head and face. Moreover, unless relays of capable assistants can be procured, it cannot, in consequence of the fatigue it produces, be continued for more than ten minutes or a quarter of an hour. Long before that time, however, help may arrive, or some improvised tourniquet (*vide infra*) may be applied.

The great value of digital compression lies in the fact that it can be applied at once.

With regard to the digital compression itself, practice alone will enable the student with absolute confidence to place his finger on the spot beneath which the artery is beating ; but as to the manner in which it should be done, there are one or two points to recollect.

He should endeavour as far as possible to compress the vessel only. Great pain is caused by bruising large nerve trunks against the bone. And again, if in compressing the artery we at the same time compress the large venous trunks, or with the hands partially strangle the limb, the venous congestion, and therefore the general bleeding, is increased.

In compressing, we should get the artery fairly against the bone, and press directly upon it. In this way a very moderate amount of pressure will suffice, and the pressure should be always as little as possible.

The position of the hand and finger to be employed will vary, but as a rule the thumb had better be used to make the pressure (*Fig.* 71), and reinforced if necessary by that of the other hand. The limb must always be raised.

THE POSITION AND COMPRESSION OF PARTICULAR ARTERIES.

The following directions for the digital compression of important arteries will serve also for their compression by the various forms of tourniquets, improvised, or of the regulation patterns.

The Arteries of the Head and Neck.

In cases of injury to the scalp, the underlying skull affords an admirable resisting surface for compression of a main artery ; but pressure upon a trunk at a distance from the wound is not effectual here, in consequence of the extremely free anastomosis existing all over the surface. Nevertheless in some cases compression of the trunk of one of these vessels may be useful. In such a case they are readily found, and a very slight pressure against the bone with the fingers will suffice.

The Occipital Artery on the scalp at first lies behind the mastoid process, and higher up may be felt pulsating, and may be compressed half an inch behind, and on a level with, its base.

The Temporal Artery splits up into its main divisions soon after it passes over the zygoma, and should therefore be compressed against that process of bone immediately in front of the tragus of the external ear. Some of its branches may also be felt, and compressed higher up on the frontal bone.
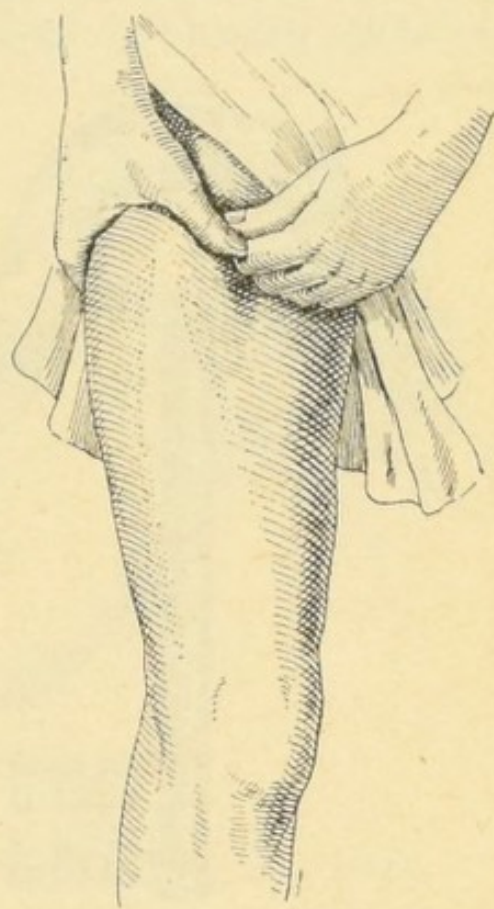
Fig. 71.—Position of Hands Compressing an Artery.

The arteries of the face, like those of the head, anastomose so freely that the compression of their trunks only partially arrests the circulation in their branches. It is, however, frequently necessary to compress either the facial trunk or its coronary branches as they encircle the mouth.

The trunk of the *Facial artery* may be easily compressed an inch in front of the angle of the jaw, as it passes over its lower border in a slight depression.

The *Coronary arteries* form an exception to the rule of making digital compression against bone, for they are best compressed between the fingers introduced into the mouth and the thumb on the face. They run round the mouth close beneath the mucous membrane, and about the third of an inch from the border of the lips. Their compression is often required in cases of operations, or cuts about the lips, and may then be effected between the blades of a pair of " bull-dog," " hare-lip," or other specially arranged forceps.
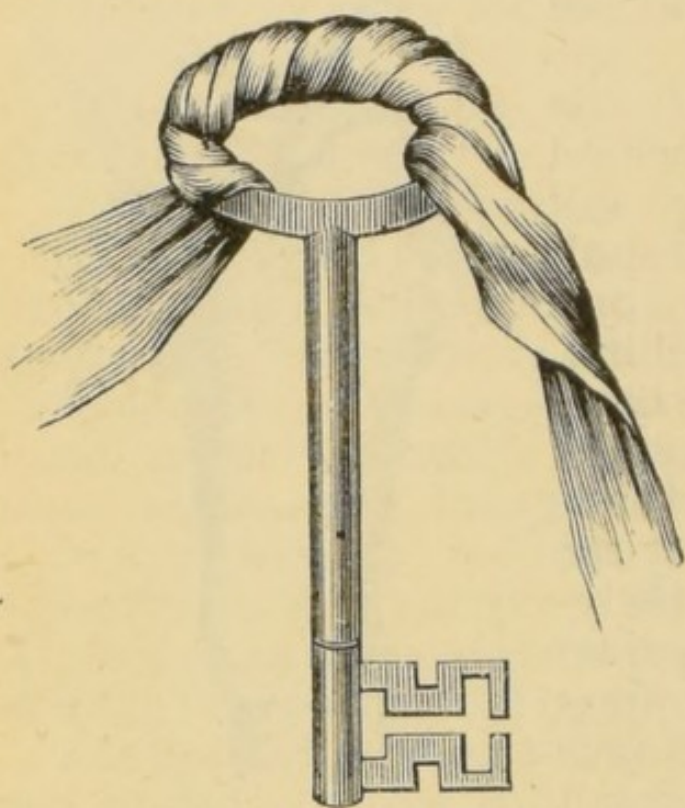
Fig. 72.—Handle of Door Key, padded.

In the centre of the neck the only artery which ever has to be compressed is the *Common Carotid*, and the operation requires considerable care, in consequence of the proximity of structures which may not themselves be safely pressed on, such as the vagus nerve, jugular vein, trachea, etc.

The thumb should be placed over the artery at the level of the transverse process of the 6th cervical vertebra, which is about $1\frac{1}{2}$ inches above the sterno-clavicular articulation : pressure should then be made *inwards* and backwards. In this way the artery is forced away from the vein and nerve, and is compressed against the transverse process or the " carotid tubercle."

Another method is to pass the thumb and finger on either side of the sterno-mastoid muscle and grasp the artery between them.

The *third portion of the Subclavian* is the only part

which it is possible satisfactorily to compress, and it is here sometimes very difficult, sometimes very easy, to occlude.

The bone against which it is to be pressed is the upper surface of the first rib, immediately outside the tubercle for the insertion of the scalenus anticus. In children or thin people, pressure behind the clavicle downwards and backwards, at the inner margin of the subclavian triangle, will control the circulation, no matter what the position of the limb and neck may be; but even in moderately fat people it will be necessary to depress the clavicle
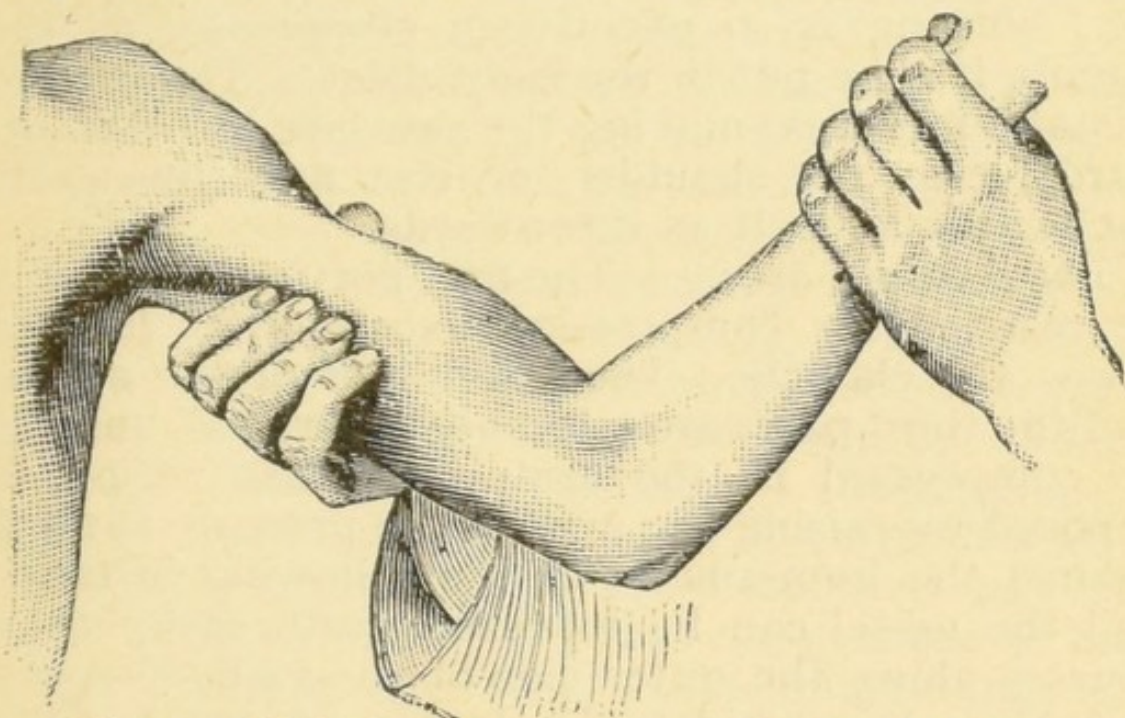
Fig. 73.—Method of compressing the Brachial Artery.

and shoulder, to bring the artery near enough to the surface. This is usually easy to do, but it occasionally happens in the course of operations about the axilla or shoulder that the surgeon requires the limb to be raised, while the assistant in charge of the vessel would prefer that it should be kept depressed. This especially happens in amputation at the shoulder joint, where, just at the moment when efficient pressure is most required (i.e., just after the limb has been removed), the clavicle, freed from the downward drag of the arm, rises in the neck in a very exasperating fashion.

Various devices, such as the handle of a door key (*Fig.* 72), properly padded, a surgical " key " of a somewhat similar form, etc., have been devised to meet the difficulty, and it is sometimes advisable to divide the skin, platysma, and fascia over the triangle, so that the finger may be placed effectually on the artery. This may be readily done by dragging the skin downwards, and dividing it on the clavicle, as in the first stage of the operation for ligature of the subclavian.

This incision is no doubt sometimes absolutely necessary, but with regard to the use of the key, etc., nothing is so effective a compressor as the thumb, if it be put in the right place. The general mistake is either making the pressure too far outwards, near the shoulder, or else not sufficiently backwards as well as downwards.

The Axillary artery.—The first portion can hardly be reached for compression except after incision below the clavicle. The lower half of the second and the third parts are tolerably superficial, and can be compressed in the armpit, if that region be exposed by raising the arm. The pressure is made against the humerus as in the following instance, and the vessel can be localized quite easily as it courses along the outer side of the axillary space, and then lies amidst the trunks of the brachial plexus, with the coraco-brachialis to its outer side.

Brachial artery.—This artery probably more frequently requires compression than all the others put together, by reason of the great number of accidents to which the upper limb is liable.

It may be said to be practically subcutaneous in its whole length, and may be compressed very readily against the humerus. The inner edge of the biceps, which overlaps it in the middle third, is the guiding line for the vessel.

It is inadvisable to follow the advice given in some text-books, viz., that the inner seam of the coat sleeve is a guide to the brachial artery of the wearer.

The method usually employed is shown in *Fig.* 73.

In flexion, too, of certain of the joints, we have a most valuable means of stopping arterial bleeding.

The positions of the brachial artery at the elbow, of the popliteal behind the knee, and of the femoral at Poupart's ligament, are such that forcible flexion of elbow, knee, or hip joints, combined with placing a firm pad in the hollow of the joint, will, in many cases, completely stop the blood supply to the limb.

The flexion must be forcible, and may be maintained by fixing the limb with a bandage. An example of its application will be adduced *àpropos* of bleeding from the palm of the hand.

At the bend of the elbow the artery may be compressed by the fingers, but not easily, and therefore arrest of hæmorrhage by flexion is preferable.

In the forearm, except at the wrist, the circulation in the *Radial* and *Ulnar* arteries can hardly be controlled by any means short of strangulation. At the wrist, however, both arteries become superficial, the radial somewhat more than the ulnar. The former lies to the outer side of the tendon of the flexor carpi radialis, the latter to the radial side of the flexor carpi ulnaris, and here they may be readily compressed. The digital compression of the palmar arches is practically inconvenient, and the pressure is usually made in other ways (see " Wounds of Palmar Arch ").

The digital compression of the *Abdominal aorta* is in some cases not so extremely difficult as is often supposed. It can generally be effected in children unless they are very fat, and in adults if they are thin, have lax abdominal walls, and a bold anterior curve to the lumbar spine ; and in women, especially those who are sparely nourished and have borne children.

The aorta divides into the common iliac arteries at a spot a little to the left of the middle line on a level with the highest part of the iliac crests. Digital compression should be applied just above

this point. The pressure may be made by the middle and forefinger of one hand, beneath which a small pad of lint should be placed, reinforced by the pressure of the fingers of the other hand.

The position of the umbilicus is so variable that it should not be taken as a trustworthy guide.

Compression of the *Common Femoral artery*, as it lies over the arch of the pubes, is frequently required. In this situation the circulation may be completely controlled by making pressure directly downwards, i.e., at right angles to the surface, midway between the pubic symphysis and iliac spine.

Care must be taken to avoid pressure on the vein as far as possible ; this is best done by putting a small pad of lint underneath the finger. Frequently,
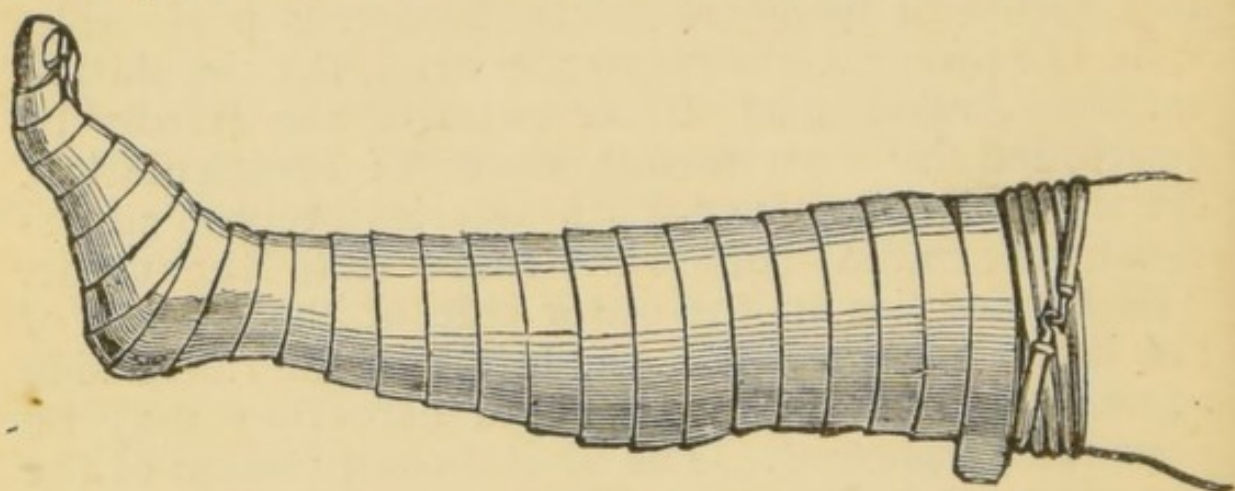
Fig. 74.—Esmarch's Bandage and Tube applied.

however, the vein is so situated that it cannot escape the pressure. The inguinal glands must be avoided.

The line of the *Superficial Femoral artery* is one taken from the point above mentioned, between the symphysis pubis and anterior superior iliac spine, and the adductor tubercle of the femur, with the thigh in a position of flexion, eversion, and slight abduction. Firm pressure all along this line will generally succeed in stopping the current of blood, but as the artery gets deeper in its course, more and more force will be required ; the artery cannot be pressed directly against the bone.

With the *Popliteal,* digital compression is very

inefficient, but the circulation may be readily stopped by flexion, if a firm pad, about the size of a hen's egg, be placed in the hollow of the knee, and the knee be then bent up on it.

By any means short of complete strangulation of the limb, it will not be found possible, as a rule, to compress either the *anterior* or *posterior Tibial* vessels in the leg, but the posterior one becomes quite superficial, as it lies a little internal to the middle of the hollow between the heel and the inner malleolus.

The Dorsal artery of the Foot, the continuation of the anterior tibial, may be felt and compressed against the astragalus, scaphoid, and cuneiform bones between the extensors of the big toe and of the other toes.

2. **By Strangulation of the Limb.**—The process generally known by the name of Esmarch's bloodless method, consists in first of all emptying the limb of its blood, by rolling a long india-rubber bandage, from below upwards, to the spot where it is desired to control the circulation. At this spot a stout indiarubber tube two feet long, with a hook at each end, is passed round the limb, sufficiently tight to strangulate all the vessels, and the ends of the tube are then hooked into each other (*Fig.* 74). The indiarubber bandage is then removed, and the limb, thus rendered bloodless, will remain so until the tube is taken off.

This method is simple enough, and with ordinary care all chance of bleeding is prevented. It is especially useful in operations upon the bones, in which it is important to have the parts as bloodless as possible ; it will also serve as a tourniquet in amputations, or in other cases where it can be applied at a little distance from the seat of operation.

The strangulation by this method is so complete, veins, arteries, and capillaries being all compressed, that it is not safe to allow the tube to remain on long.

Its use, therefore, is not fitted for the restraint of

accidental hæmorrhage except as a temporary measure, and indeed in some very prolonged operations it is wise to remove the tube before the operation is finished.

When the Esmarch's bandage has been used in an operation, and only general oozing is expected to occur in the wound, it is generally convenient to apply the dressings, using such pressure as may be required, *before* the tube is taken off, for the absolutely bloodless condition of the small vessels has caused a temporary loss of tone in their walls, so that when the blood current is allowed to flow into them again, they for a time are much dilated and the whole limb becomes injected. Unless the wound has already been bandaged up, and pressure applied, there may be much capillary oozing, and a corresponding delay in the dressing.

This applies only to the smaller vessels, and arteries large enough to give trouble should be secured by forceps or ligature before taking off the tourniquet.

There has been latterly an increasing desire to simplify Professor Esmarch's procedure, and to do away with the indiarubber bandage, while retaining the tube. It is found, if the limb be raised and the larger veins emptied of blood by the passage of the hand along the limb towards the trunk, that the former may be rendered nearly bloodless, and that the application of the tube alone is able to keep it so (*see* page 151.)

The limb should simply be raised before putting on the tube in cases of septic inflammation or malignant growth, as morbid products may be forced into the blood-stream if pressure be applied over the affected area.

The tubes used for encircling the limb should always be tested before they are used, for they are very liable to crack or break unexpectedly, especially at the ends, where the hooks are fastened.

In cases of operation about the shoulder or hip,

the tube may very usefully be put on in the form
of a figure of 8, and in this way even such operations
as amputations at the shoulder or hip joints have
been rendered almost bloodless. The plan succeeds
best when the patient is thin.

3. **By Tourniquets.**—A tourniquet is, properly
speaking, an apparatus for screwing down a pad
upon a vessel. Practically, however, the term is
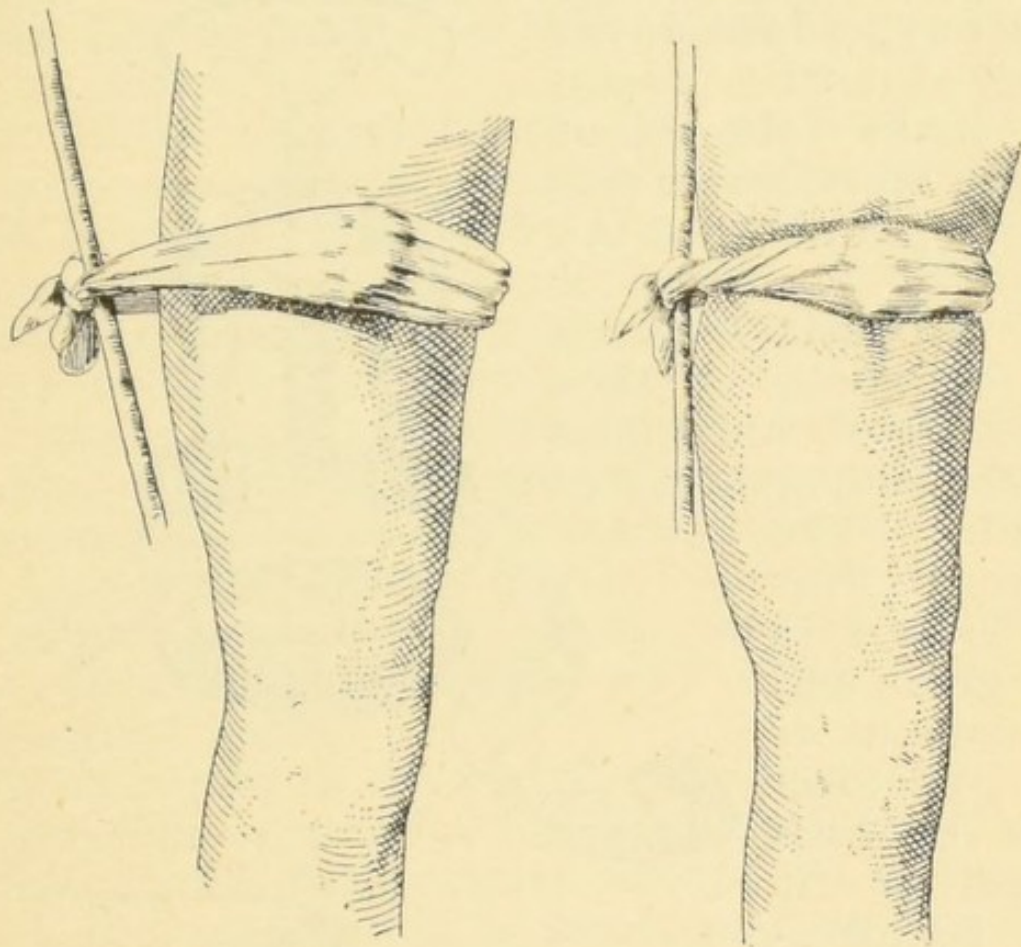
Figs. 75, 76.—The Improvised Tourniquet.

applied to any means by which mechanical pressure
may be maintained upon a vessel.

The principal forms, which alone will be described,
may be roughly separated into three classes—im-
provised, screw, and indiarubber or elastic.

The *improvised* tourniquet is an efficient and ready
improvement on the time-honoured method of
stopping bleeding from any part by tying something
round it, somewhere between the wound and the
heart, tightly enough to arrest the circulation.

In the improvised tourniquet especial pressure is put upon the main artery, and therefore the force required is very much less, and the venous return is at least not wholly obstructed.

Its manufacture and application are simple enough. A handkerchief is taken, folded up like a cravat, and a piece of cork or wood or a pebble is inserted between the folds, so as to act as a pad. This pad is placed over the artery, and the cravat *loosely* knotted round the limb, the knot coming on its outer side (*Figs.* 75 and 76). An umbrella, or ruler, or any moderately strong rod or stick, is then passed between the limb and the knot and twisted round. The leverage thus obtained is very great, and the amount of compression must be estimated, or it may be afterwards found to have been damaging the tissues.
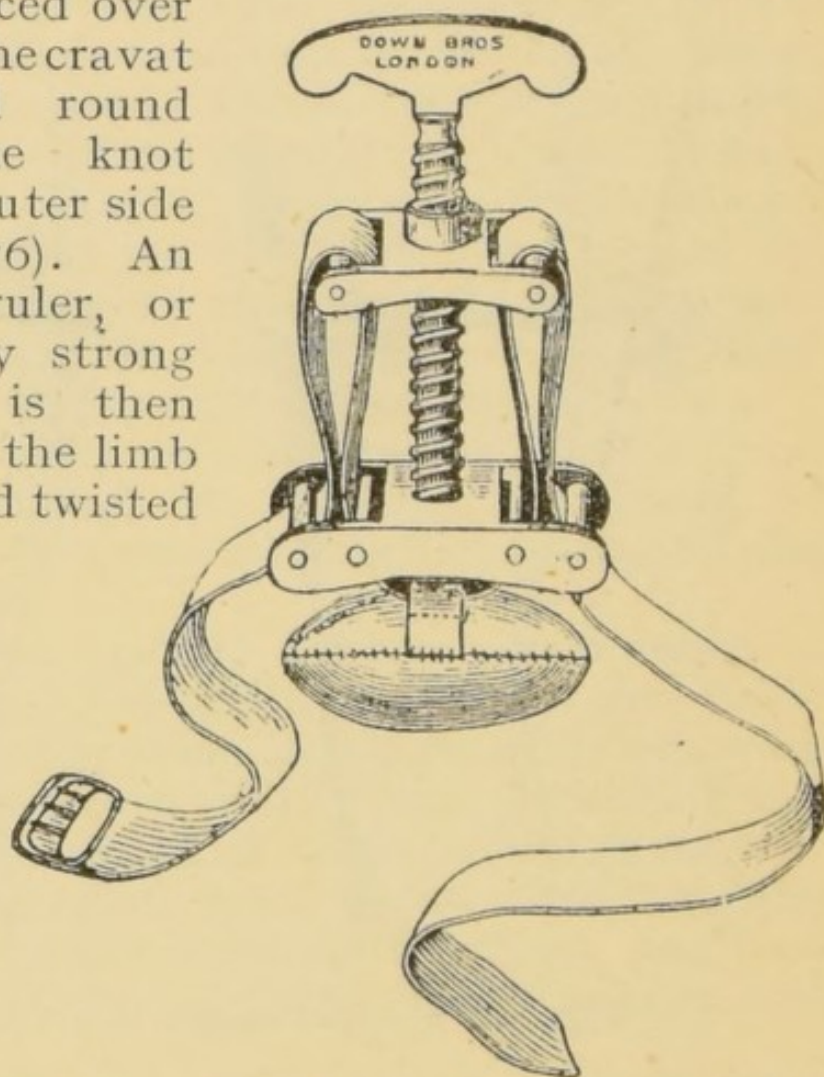
Fig. 77.—Petit's Tourniquet (modernized).

Care should also be taken that the skin is not pinched at the point where the twisting is done.

This form of tourniquet is known also by the names of "The Garrot" or the "Spanish Windlass."

Of *screw* tourniquets, the oldest form which is still retained in use is known as Petit's.

Its action and method of application can be readily enough seen from the illustration. The

strap is first fastened round the limb, not so tight as to make any compression, but sufficiently to prevent the whole tourniquet, or the small pad of lint generally placed underneath the larger pad, from shifting about.

The tourniquet should be unscrewed to its full extent before the strap is buckled.

When pressure is to be made, the screw must be turned very gradually, and great care should be taken that the pad never shifts from its position on the artery.

It will be noticed that in this pattern, in addition to the especial pressure on the artery, the limb is tightly grasped by the strap. In consequence, Petit's tourniquet is very painful, and could not possibly be used for long. But other forms of screw tourniquets have been designed to free the venous circulation through the limb, by making pressure only between two opposite points. The principal forms of these are, Signorini's, which is easy of application, but is liable to slip round the limb, Carte's, or Skey's (the safest pattern), for the vessels of the thigh, and Lister's for the abdominal aorta.

With regard to the use of these tourniquets, the localization of arteries has been sufficiently dealt with ; in all the pressure should be made very gradually, and either a small pad or the finger should be placed over the artery itself, underneath the pad of the instrument.

Elastic Tourniquet.—In addition to the elastic band used in Esmarch's method, which has been already described, an improvement has lately been introduced, viz., a small piece of wood with a groove in it, smaller in calibre than the elastic band. After one firm turn has been taken round the limb, the band, while stretched, is passed into the groove from either side. The relaxation and swelling of the indiarubber holds the band quite securely. Samway's tourniquet is used in much the same way.

If more than one turn round the limb is required, care should be taken that the skin is not pinched between the turns of band. It was partly to do away with this latter objection that Mr. Pollard introduced a *Flat Rubber* tourniquet, which has the additional advantages that it does not constrict the deeper tissues so extensively nor cause any abrasion of the skin.

4. **By Heat, Cold and Drugs.** — In former editions of this work many pages were devoted to the consideration of styptics, or substances which, by their application to a bleeding surface, had some effect in promoting coagulation. Formerly, many such drugs were freely employed by the surgeon, some being very unpleasant, painful, and even harmful, and it is no longer looked upon as good surgery to make use of the messy preparations of iron and tannin that were once employed. We shall therefore briefly consider here only a few styptics which are now applied.

Mechanical Styptics.—*Collodion*, prepared by dissolving one part of pyroxylin in a mixture of thirty-six parts of ether and twelve parts of rectified spirit, is extremely useful in cases of wounds about the face, in which, if a scar has to be avoided, the edges have not only to be brought together but must be held together firmly enough to prevent blood being effused between them. This is readily done by painting three or four coats of this collodion over the wound with a camel's-hair brush, or by saturating a piece of lint in it and applying it to the wound. The collodion as it dries contracts, and thus the required pressure is kept up.

Flexile collodion, prepared by adding to 12 oz. of collodion ½ oz. (by weight) of Canada balsam and ¼ oz. (by weight) of castor oil, may be used instead of the above. It is not so liable to crack, but is not so contractile as ordinary collodion.

Gauze Wool acts as a hæmostatic—the fibres giving numerous points from which the process of

coagulation can start. When impregnated with some antiseptic body it is very generally used.

Drugs.—Four drugs are of service when applied locally to a bleeding surface, and they are the modern survivors of a long list of twenty or thirty varieties of past decades :—*Adrenalin Chloride, Antipyrin, Gelatin, Hamamelis.* These are fairly efficient styptics in many cases ; they are not messy or painful, and in the case of antipyrin there are certain analgesic properties which are very valuable.

Hamamelis is the least satisfactory, and can still be accused of being somewhat dirty and unpleasant. It is of value in washing out a bleeding cavity such as the bladder, one ounce of the extract being added to a pint of hot saline.

Adrenalin Chloride is prepared from the medullary part of the suprarenal capsule, and contains the active principle of the gland which, according to the experiments of Oliver and Schäfer, even in minute quantities causes an increase of the blood-pressure by constricting the arterioles. This property renders it of considerable service in cases of shock (*vide* Chapter IX).

Locally, it acts upon the vessels, causing them to contract, and so it checks the hæmorrhage. It is used most frequently in operations upon the eye and nose, when it is combined with cocaine. It can now be obtained in standard 1–1000 sterilized solution, and for use should be diluted 1–5000 to 1–10,000 according to the amount of bleeding and the size of the bleeding surface. In large doses it is toxic.

Antipyrin is largely used by several French surgeons, who speak highly of its value. It can be applied in powdered form, or made up into an ointment with an antiseptic basis.

Gelatin is described later on (*see* page 170.)

With regard to the above we would say generally, *never rely on a styptic when any simple surgical procedure can be employed as an alternative.*

The Application of Cold to a bleeding part has always been recognized as one of the most valuable means of arrest. Free exposure to the air is often alone sufficient to promote coagulation of the blood and constriction of the blood-vessels. This may be seen in cases of recurrent hæmorrhage after an amputation or any other large cutting operation, when a few hours after the operation the wound or the flaps become distended with blood, which may be dripping away at quite an alarming rate. In such a case, if the flaps be opened and the clots cleared out, so that the air can get to the surface of the wound and to the ends of the vessels, the bleeding will very probably cease without anything further being done, provided, of course, that no big vessel has been overlooked.

A very efficient way of applying cold is by means of the *Ether Spray*. The effect of this spray should not be pushed so far as to cause the parts to be absolutely congealed, if this can be helped, for they become very painful on thawing, and the blood-vessels being partly paralyzed the bleeding is apt to recur.

By means of this spray we have seen furious bleeding from a fungating cancer of the breast completely arrested in less than fifteen seconds.

Hot Water.—As a converse to this method of freezing, another way of stopping general oozing is the application of lint wrung out of water as hot as can be borne by the skin, i.e., about 120° F. to 130° F., but not so thoroughly as to be quite dry, and applied immediately. The mode of action would seem to be a direct stimulation of the vaso-constrictor nerves, or perhaps of the musculature of the arterioles, as a temperature of 100° to 105° is known to produce a tonic contraction of muscular tissue. The effect of hot-water injections on uterine hæmorrhages is very well understood by obstetricians, and for bleeding from a cavity or an extensive surface a hot irrigation may be employed.

When it is a mere question of choice between heat and cold, or hot water and cold applications, for checking hæmorrhage, heat should always be chosen. The prolonged application of an ice-bag or cold water may seriously injure the vitality of tissues, while the irrigation of a large surface or cavity with ice-cold water, after much blood has been lost, will often bring on severe shock.

Actual Cautery.—We come now to " that cruel and barbarous method " of stopping bleeding which Ambrose Paré denounced, and which a few years ago was employed but rarely, and only in cases where the bleeding vessel could not be secured in any other way. Now, however, owing to the improvements in the instruments, and to the fact that anæsthesia has robbed the actual cautery of half its terrors, it is very frequently employed.

The principal apparatus for the application of the actual cautery are the old cautery irons, the galvano-cautery, and Paquelin's thermo-cautery.

Cautery Irons are still frequently employed to stop bleeding, or for the purposes of cautery. They, however, are gradually being displaced by the newer forms mentioned above.

These irons are of precisely the same shape and size as they were in the days of Scultetus or still further back. They consist of pieces of iron with ends of various shapes, themselves of iron or copper, set into ordinary handles; they are, in fact, just like a whitesmith's soldering iron, ending either in a point or a " button," a straight or bent " olive," and are best heated by being put into a fire.

The most efficient heat for the arrest of bleeding is a just visible red. If this heat be exceeded, the iron begins to cut rather than sear the tissues. The iron should be wiped clean from the fire, and the bleeding part itself should be dried as far as possible. The instrument should be passed over the surface very lightly, and kept in contact with the bleeding point for a few seconds.

The cautery used often to be applied to the bleeding surface of a bone, but this should be avoided lest necrosis follow. Cauterization seems to cause necrosis more certainly than any other injury to bone, so that it should not be used for counter-irritation on the scalp, prominences of the jaws, or wherever the bone is close to the skin.

Galvano-cautery.—This apparatus is a great advance upon the cautery irons, and is itself well enough adapted for the arrest of bleeding.

The principle on which it depends is that platinum, a metal of high resistance and great infusibility, will become red or white hot if a galvanic current of sufficient intensity be passed through it. Though frequently heated, platinum does not become oxidized.

The wires from a cautery battery are connected by binding screws to the handle of the galvano-cautery instruments. In the handle the wires are continued to the joints which receive the platinum terminals or rheophore. One of these wires is broken, so that only when the knob is pressed or the trigger pulled is the circuit complete. In this way the current passes through the rheophore only when the current is brought into action, whether it be a noose of wire or some other burner. The resistance to this current in the platinum is so great that heat is generated sufficient to cause the wire to become of a dazzling whiteness. If the rheophore used be of the kind known as the *Galvanic Ecraseur* the wire to be heated is so arranged that it can be shortened up like a snare.

Two great advantages are possessed by the galvano-cautery. The first is that a very small pointed rheophore may be used to a limited bleeding surface without its losing heat before it can be well applied. The second is that the wire as a noose can be fitted with the fingers round whatever requires cauterization, before the knob is pressed, and the wire becomes hot. This is very often an

enormous gain. The difficulty of its use lies in keeping the temperature of the wire low enough, when once contact has been made.

The introduction of electricity for lighting purposes has rendered the use of the galvano-cautery much more available, for by suitable apparatus it can be attached to the mains and is always ready.

Fig. 78.
Paquelin's Thermo-cautery
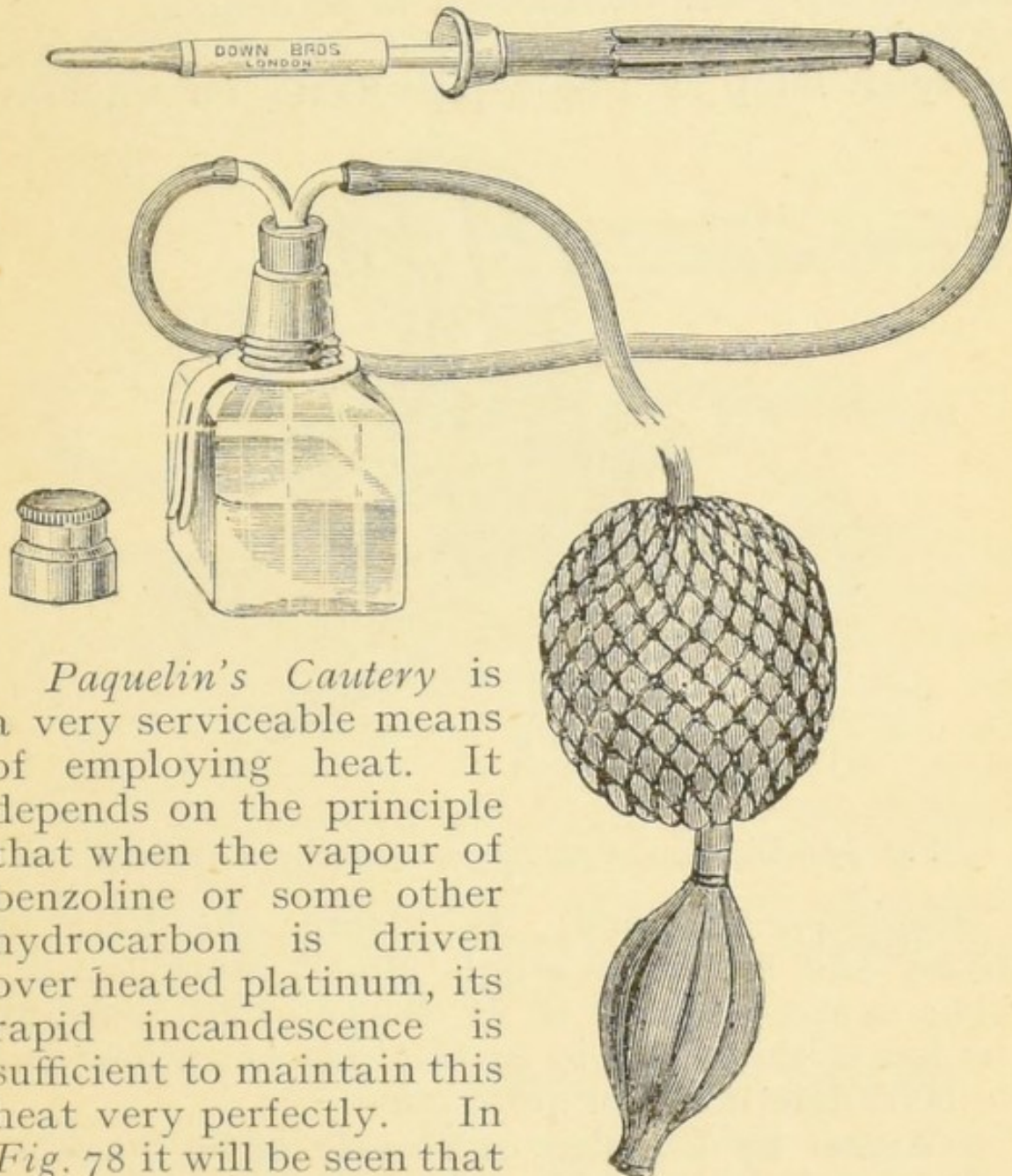
Paquelin's Cautery is a very serviceable means of employing heat. It depends on the principle that when the vapour of benzoline or some other hydrocarbon is driven over heated platinum, its rapid incandescence is sufficient to maintain this heat very perfectly. In *Fig.* 78 it will be seen that with an ordinary Higginson's syringe and safety ball to give a continuous blast, atmospheric air is blown over the surface of the benzoline, and then being saturated with its vapour, passes on through the tube and holder

into the platinum point, which contains some spongy platinum.

The platinum point having been first heated in a spirit flame until it just begins to glow, the ball of the syringe is worked by hand, and the air, charged with benzoline, undergoes active combustion as it passes through the point, and thus not only maintains its heat, but increases it to whiteness.

The readiest way to heat the platinum is to use the spirit lamp as a blow-pipe flame, for which it
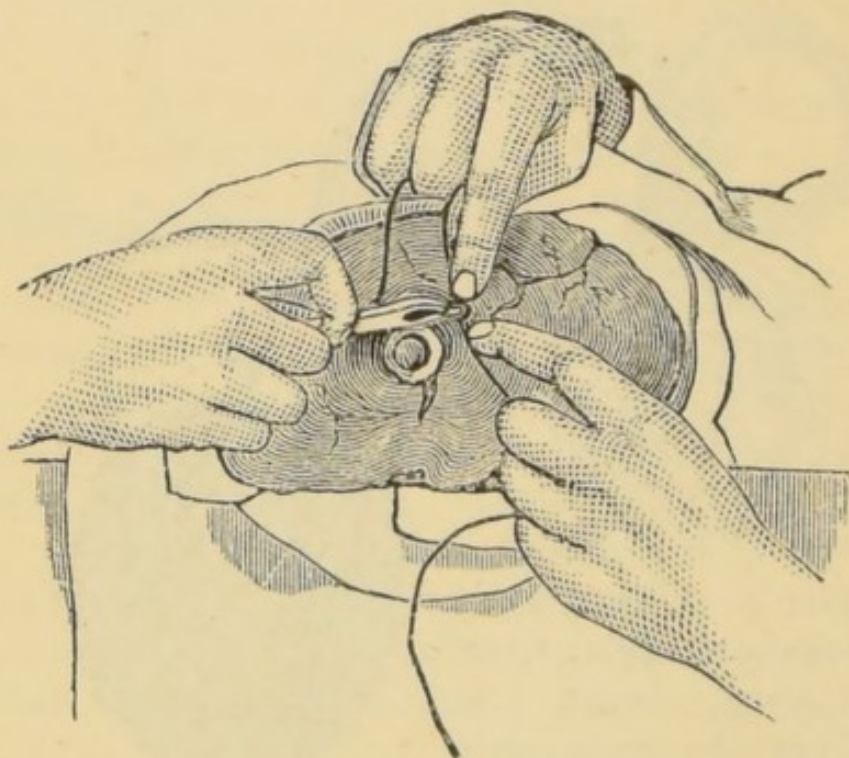
Fig. 79.—Ligation of an Artery (position of Hands).

is generally arranged. As before, the heat to employ as a styptic is a dull, almost invisible, red.

The cautery should be in charge of an assistant who has nothing else to distract his attention, and the benzoline must be quite pure.

5. **Arrest by Ligature of Vessels, or by Forceps.** —The usual method of ligature is to seize the vessel with a pair of forceps, hold it up, and tie a cord of some kind round its mouth in a reef knot. In catching the vessel it should be taken up as cleanly as possible, with none of the surrounding tissue, and slightly drawn upon. The ligature should then

be thrown round the forceps, slipped on to the vessel, and tied tightly in a reef knot.

Forci-pressure.—This name more especially designates the use of a pattern of self-closing forceps suggested by Sir Spencer Wells, for the purpose of checking temporarily the bleeding from small arteries and arterioles in the course of an operation.

Not only may these instruments be used to check bleeding from small vessels during the course of an
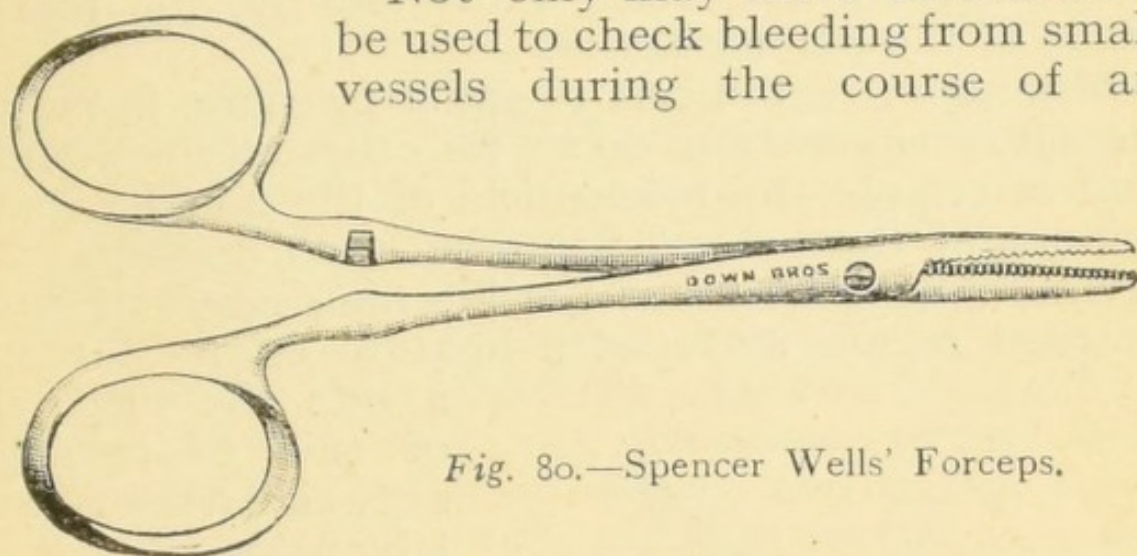
Fig. 80.—Spencer Wells' Forceps.

operation, but in the case of arterioles the pressure exerted is usually sufficient to prevent any further bleeding, without the necessity for the application of a ligature. Again, the method of *Torsion* may be applied by means of these forceps, which have therefore superseded a special form of torsion forceps at one time employed solely for this purpose ; and, lastly, they are sufficiently powerful to be of use in seizing a large trunk vessel during an amputation, the vessel being secured with a ligature after the limb has been removed.

SOME SPECIAL KINDS OF BLEEDING.

Wounds of the Scalp often bleed very freely, especially at first. In dressing them the hair should be cut off all round the wound, which itself should be well washed. Even if the spouting vessels are plainly to be seen, it is almost always waste of time to try and pick them up for the purpose of ligature. A firm compress, secured with a knotted

bandage, will, by ensuring pressure against the underlying bone, arrest any ordinary hæmorrhage.

Wounds of the Palmar Arch are very troublesome, and the bleeding from them is very apt to recur. This is due partly to the intimate anastomoses of the arteries, and partly to the difficulty of applying efficient pressure, the vessels themselves lying beneath, and being protected by, the thick bands of the palmar fascia.

Although it is difficult to apply pressure, in most cases it is necessary to do so, for other means would tend to cripple the mechanism of the muscles and tendons of the palm. Sometimes, no doubt, it is advisable to dissect out the bleeding vessel in this crowded region and put a ligature on it, but as a rule the hazards of this proceeding outweigh its obvious advantages.

In applying pressure to the palm of the hand, a firm smooth pad must be used, and the palmar fascia must be relaxed. These two conditions are well fulfilled by bending the fingers over a round piece
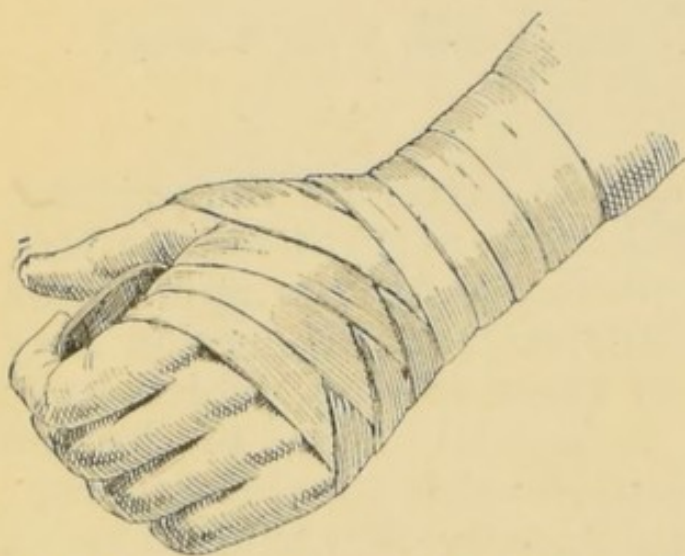
Fig. 81.—The Hand Bandaged for a Cut in the Palm.

of wood, like a ruler, covered with three or four layers of lint, or over a tight roller bandage. If this be firmly grasped, and the fingers bandaged over the cylinder, very good pressure will be made (*Fig.* 81). Should the bleeding still continue, the forearm should be forcibly flexed at the elbow, with or without the addition of a pad of lint in the flexure of the joint. This will almost always stop the bleeding, but should it fail (and it is wonderful how this form of bleeding will persist) it will be

necessary to compress the radial and ulnar arteries at the wrist. This is best done by laying two pieces of wood, e.g., portions of a lead pencil, over two small pads placed on the arteries, and fastening them firmly with strapping, the hand, forearm, and arm being firmly bandaged from below upwards.

But it may happen that even yet the bleeding recurs, and by this time, as several expedients have been fruitlessly adopted, the patient may be getting exhausted by loss of blood. A tourniquet or digital compression of the brachial artery can be adopted as a temporary expedient at any stage of the proceedings; but it cannot be for long, especially in this exsanguine condition of the patient.

On the whole the best plan seems to be, first of all to open up and thoroughly examine the wound, and if it appears feasible by dissection, to find and tie the bleeding vessel or vessels, and failing this, to tie the brachial artery high up in the arm—a somewhat desperate remedy truly, and one which can very rarely be required if the milder measures before mentioned have been thoroughly carried out. It should be borne in mind that the tourniquet can always be put on for an hour or two, so that the visiting surgeon can be sent for; and also that bleeding so obstinate as this may probably be associated with a morbid condition of the blood or its vessels. (*Vide* " Bleeders," *infra*.)

In many cases of palmar hæmorrhage the old method of the graduated compress may be employed, either with or without the additional measures of pressure on the radial and ulnar vessels. The compress is made as follows : A circular piece of lint, the size of a shilling, is cut to fit over the wound, and successive layers, each somewhat larger than the preceding, are placed on the top of one another, so that a conical compress is formed, the apex resting against the bleeding area. The fingers are flexed on to the compress, and the whole hand firmly bound up. The principle of the treat-

ment is that the maximum pressure of the compress is directed to the region of the bleeding vessel, and is sufficient to empty it and to keep the walls together until clotting can take place.

In cases of hæmorrhage from sloughing wounds of the palm, *no attempt must be made to apply compression.* No treatment is worse than the application of pressure to an inflamed and sloughing surface. Sloughing cavities are to be *lightly* packed with antiseptic gauze, but no pressure is to be exerted, or the sloughing will extend.

In these cases, the wound must be opened up, and a search made for the bleeding point ; sloughs must be cut away, and the whole wound cleansed with peroxide of hydrogen. If the attempt to secure the vessel fails, the choice will be between trying compression of the radial and ulnar arteries with flexion at the elbow, and ligaturing the brachial. When the bleeding is profuse it will be wise to perform the latter operation.

Bleeding from a burst Varicose Vein is often one of the most furious, and yet one of the most easily arrested of hæmorrhages. It is important rightly to understand it, for many lives are thrown away every year in consequence of the foolish, unreasoning conduct of would-be assistants, when this accident happens.

No one can be long in a hospital casualty department without seeing some such case as the following : A man who for a long time has had varicose veins, and subsequently a condition of chronic eczema and ulceration of the legs, stupefied by cold or drink, subjects the legs to some slight violence, so slight that often it is hardly noticed. Presently he is aroused by the sensation of something warm trickling down the ankle, and looking down he sees his boot and stocking full of blood, which is coming from the position of the ulcer. He then becomes faint and falls. A crowd collects, and although the prone position on the ground would be the safest for

him) he is immediately lifted and made to sit up. The bystanders then get some brandy, and proceed carefully •to choke him while he is unable to swallow. Someone then sees the blood trickling along the floor or ground, and taking his handkerchief ties it tightly somewhere round the leg, which is still allowed to hang down. The patient being then put into a cab, is driven off to the hospital, perhaps to die before he gets there, as the blood is escaping from his leg all the time.

All this might have been easily avoided by the exercise of common sense. Since the recumbent position is the best for syncope, the patient should not be raised from the ground until a suitable stretcher is provided. Then, the leg being raised a foot or so, the bleeding surface should be exposed, and any constriction round the limb on the " heart " side removed. In all probability the bleeding will practically cease immediately the limb is raised, and a small pad and bandage being placed on the wound, it will not recur while the patient is lying down.

It should be remembered that the blood comes principally from the *proximal* end of the ruptured vein, the valves of which have been rendered incompetent by the dilatation.

If, however, the patient *must* walk soon after he has had a burst vein, the leg and foot should be firmly bandaged from the toes upwards, to a little above the bleeding point, on which there must have first been placed a pad and bandage. It is also necessary to keep the patient warm ; the loss of blood is often very great, and such patients cannot bear it well, so that it sometimes happens that after the bleeding has been stopped, they get a sudden failure of the heart's action, and die because they have been allowed to get too cold.

Nose Bleeding or **Epistaxis** is either symptomatic or traumatic, and is venous or capillary in character. It is of all kinds and degrees of severity, and may require for its arrest a number of expe-

dients, some very simple, some requiring considerable skill.

But it is *often desirable not to check the bleeding* at all, as when it occurs in children in good health, and young adults of a lusty habit ; or in some cases in young women in whom the hæmorrhage is vicarious to the menstrual flow.

Symptomatic Epistaxis may be roughly divided into two classes ; the one in which it depends on simple congestion of the mucous membrane of the nose, occurring in healthy people, and the other in which it is a strictly passive congestion, caused by cardiac or hepatic disease.

The hæmorrhage in the first class tends to stop of itself, when by the bleeding the congestion is removed ; but in the second the cause is constant, and the longer the epistaxis goes on, the more difficult it is to stop, in consequence of degenerative changes taking place in the blood. The bleeding in these cases is not a brisk flow accompanied with a good pulse and other signs of a strong circulation, but is rather a feeble dribbling, sometimes stopping altogether, and then being again a little more rapid. In this way a great deal of blood may be lost by those who cannot spare it, and the bleeding, instead of being a relief, is accompanied by great depression, a feeble fluttering pulse, shallow respiration, etc.

A little experience of the aspect of sick people will enable the student to recognize those who are suffering from visceral disease, whether it be morbus cordis, or cirrhosis of the liver, or chronic Bright's disease, or a malignant growth, and to separate sharply in his own mind those in whom moderate epistaxis is rather a relief, from those in whom it is certainly an alarming symptom, and may be a source of danger. In these latter it should always be promptly checked ; in the former, delay is never hurtful, and may be useful. It must be remembered that epistaxis is often caused by a new growth of the nasal fossæ or the parts around

them, and a careful examination of the nares is essential in most cases, both with a view to diagnosis and treatment. In children, a foreign body, such as a pea or a piece of cinder, may be the starting-point of a mucopurulent discharge, and this is sometimes masked by a smart attack of epistaxis from the ulcerated mucous membrane.

The rule therefore should be, in cases of epistaxis in children, to bear in mind the possibility of a foreign body being present.

The patient should be made to sit up with the head thrown back, a towel being spread like a bib around the neck to prevent soiling of the clothes. Frequent blowing of the nose must be prevented, as it only tends to aggravate the bleeding. If in addition to this position the venous return to the chest be promoted by loosening all the clothes round the neck, and in women by unlacing the stays, the bleeding will in most cases cease ; at the same time, if it persists, raising the arms above the head so as to lower the intrathoracic pressure will most likely prove effective.

The application of cold, either externally to the nape of the neck and the bridge of the nose, or internally in the form of an iced nasal douche, may be tried if the above measures fail.

Cautery.—But while all these devices have the value of being readily applied and of a domestic nature, it is unwise in any given case to persist with them when a short trial has failed. In the majority of cases the bleeding comes from a small spot on the septum within a short distance from the anterior nares, called " Kiesselbach's spot," or from a hypertrophied, turgid inferior turbinate bone. Both these points are easy of access, and it is often the simplest matter to touch the bleeding point with a cautery and stop the hæmorrhage entirely. For this purpose it is well to insert a plug of cotton-wool soaked in 10 per cent solution of cocaine and adrenalin into each nostril, and to leave it *in situ*

for five minutes; although the bleeding may continue (in some cases the application of the adrenalin is sufficient to check the hæmorrhage), the cocaine, which is a vasoconstrictor, is beneficial. and will anæsthetize the part sufficiently to enable the operator to apply the cautery without pain. The nasal speculum is now inserted into the nostril, and by means of a reflected light the bleeding point may be seen; some small swabs of cotton-wool should be prepared to mop up the blood and so clear the field. If there are a large number of clots, the nares should be well washed out by means of a nasal douche. When the bleeding vessel is seen, the cautery at a dull red heat is pressed against it for several seconds, and if the operator has not an electric cautery at hand, a probe heated in a spirit lamp will be quite as satisfactory.

No method is at once so thorough and certain as the above, for it not only enables the operator to deal with the actual bleeding point directly, one of the first axioms in the treatment of hæmorrhage, but it enables him at the same time to inspect the anterior nares and so detect other conditions which may give rise to hæmorrhage.

Styptics.—Very little will be said on this subject, since they have nearly disappeared from modern surgery : they are messy, unpleasant, and uncertain. If for any reason the above treatment cannot be applied, then a plug of lint soaked in adrenalin chloride 1–5000 should be inserted into the nostril and pushed well back ; this styptic is probably the least unpleasant of those recommended, but although it is now easily obtainable its action is not as certain as that of the cautery.

Plugging.—In cases of continued failure—and they will not be numerous—we fall back on the last resource of plugging the bleeding nostril. This may be done from the front alone as already mentioned, or by completely shutting up the nasal cavity on one or both sides by plugging the posterior

as well as the anterior nares, or by means of a nasal tampon or inflating bag.

Plugging from the Front alone.—If this operation be thoroughly performed, it will not often be necessary to resort to the disagreeable and not altogether safe practice of plugging the posterior nares. To plug from the front, a strip of lint or gauze 18 inches long and a third to half an inch wide, and a stiff director are required. The strip must be packed right on to the bleeding point. Under no circumstances must small detached pieces be used, as they may be pushed back out of reach and cause considerable trouble ; a long end of the plug must always be left outside the nostril to facilitate its removal. This removal is aided by syringing at the end of twenty-four hours with some weak antiseptic, such as peroxide of hydrogen, so as to moisten the plug. It *may* be left in longer, but this is rarely advisable, since the plug frequently becomes exceedingly offensive.
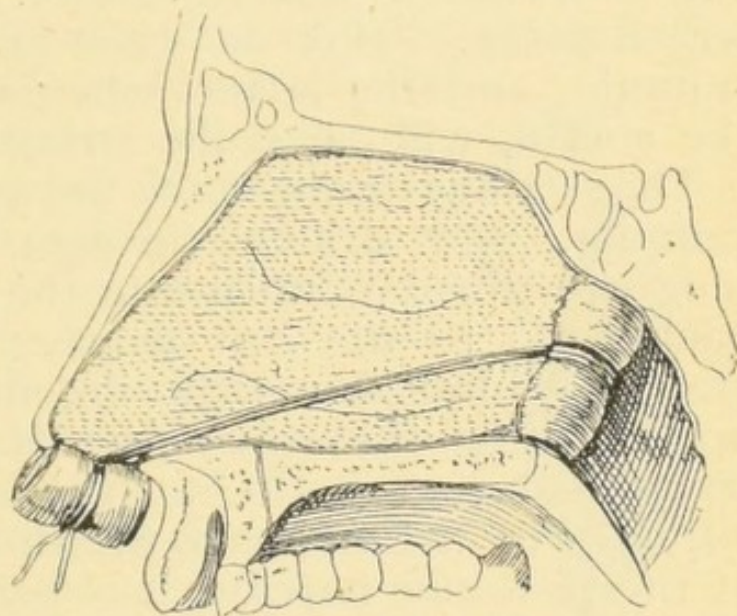
Fig. 82.—Section through the Head showing Nasal Plugs in position with Bellocq's Sound.

To Plug the Posterior Nares, a " Bellocq's sound," or some substitute for it, will be required, and two suitable little plugs fashioned to fit the anterior and posterior nares respectively. They are best made of lint, tightly rolled, so as to make two cylinders about an inch long, and half an inch wide. The one which is to go into the posterior nares must be tied round the middle with a piece of string so that two ends, not less than a foot long, hang from

it in front (*Fig.* 82), while another piece, not shown in the illustration, should be fastened to it behind, so that when the plug is adjusted into the posterior nostril, this may lie in the pharynx, ready to be brought forward out of the mouth when the plug has to be removed. These being ready, the sound, consisting of a cannula, within which is a piece of watch-spring, which will curl round the soft palate into the mouth on being pushed out of the tube, is introduced along the floor of the nostril which is bleeding. The watchspring is protruded, and is hooked forward by the forefinger of the left hand into the mouth, and *both* ends of the string, having the plug of lint attached, are quickly passed through the eye, which will be found at the end of the watchspring. This is then retracted into the cannula, and the latter, when withdrawn through the nostril, will carry the string with it.

- The strings must now be separated from the cannula, and drawn through the nostril. The plug will thus be drawn into the mouth and carried backwards to the soft palate; it must then be passed behind this with the fingers, and pushed upwards into the upper part of the pharynx, and, traction being made on the strings, it can be adjusted by the fingers to fit into the proper opening of the posterior nares. This being done, the other plug is adjusted into the anterior nostril, *between* the ends of string, which are firmly tied over it and fasten it tightly to the nostril, which is thus converted into a closed cavity.

The principal difficulties in this plugging operation are first, the introduction of the sound, and the bringing forward of the watchspring; and secondly, the adjustment of the posterior plug. It is often awkward to pass it round the soft palate, but this being done, the rest is easier. Still it is not difficult to mistake the opening into which the plug is to be placed, and to avoid this, the fingers must be passed right back, and the nostrils thoroughly explored.

If a Bellocq's sound cannot be got in an emergency, an improvised one may be made from a soft gum-elastic or rubber catheter, about No. 6 or 8. Passing this through the nostril, it can be hooked forward from the pharynx out of the mouth ; the strings attached to the posterior plug must then be fastened to its end, and the catheter withdrawn through the nose, with the same manipulation of the plug round the palate as before described.

Difficult as the application of these plugs may be, once applied, it is impossible for bleeding to continue. Unfortunately, it is not safe to retain them in position long, thirty-six hours being probably the outside limit ; necrosis of the palatine bones, extreme fœtor, and blood poisoning being apt to occur.

In a comparison of the two methods of anterior and posterior plugging, it may be well to point out the principles which govern their application. In anterior plugging it is hoped that pressure will be exerted on the actual bleeding point, a commendable object and one in accordance with the principles of the treatment of hæmorrhage. In posterior plugging, on the other hand, the nasal chamber is converted into a closed cavity into which bleeding can take place, until that cavity is filled with blood, and the pressure has risen to such a point
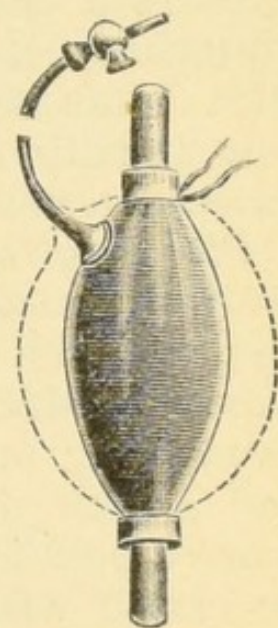
Fig. 83.—Rose's tampon.

that the bleeding is checked by it. Obviously such a method is very unsatisfactory, as it allows of the collection of a quantity of clot in the nasal fossæ, which may easily become infected and a source of internal mischief.

Inflating Tampons are sometimes used to arrest epistaxis by filling the nasal cavity with a blown-out indiarubber bag of a suitable shape, the principle being the same as that of a " Barnes' Bag "

for uterine hæmorrhage. Of these " Cooper Rose's Inflating Plug " is perhaps the best pattern.

Bleeding from the Socket of an Extracted Tooth.—This occurs very rarely indeed to any troublesome extent, considering the enormous number of extractions performed. When it does happen, it is almost always in patients who are either in very feeble health, or are affected with some form of the hæmorrhagic diathesis, or scurvy.

Sometimes, indeed pretty frequently, the socket of the tooth goes on bleeding for some hours, in consequence of the nutrient vessel being unusually large or unable to contract. In such a case, the bleeding comes from one or two points, and it is not at all dangerous. In the really serious cases, from the whole gum and lining of the socket there appears a general welling up of blood, and this is sometimes hard to check. An " alveolar tourniquet " has been invented for the purpose, but it is now hardly ever used, and reliance is placed on conscientious plugging, and the actual cautery.

Plugging the Socket.—Lint or cotton wool is generally used, either plain, or dipped in some styptic, such as turpentine, carbolic acid, creosote, alum, or adrenalin. In any case it must be packed away very firmly indeed, filling the whole socket, and a little more, so that the plug may be kept in proper position by the opposite tooth, if the jaws be closed with a four-tailed bandage.

A method which we have never known to fail was suggested to us by Sir A. E. Wright. It consists of filling the cavity in the gum with a mixture of formalin and gelatin. If the latter be used alone, it is soon washed away by the stream of blood, but the combination of formalin and gelatin forms a solid mass which is excellent for this purpose. Gelatin is a valuable styptic, clean and pleasant, but care must always be taken to obtain a pure sterilized specimen. This warning is a very necessary one, since ordinary commercial gelatin

often contains the spores of the *B. tetani*, and many cases have been recorded where the application of gelatin has led to the development of tetanus. It is now, however, possible to obtain without difficulty a sample of bacteriologically sterile gelatin, and this can be used without fear.

For the purpose of checking hæmorrhage from a tooth socket the procedure is as follows : Place a test tube containing the gelatin in a bowl of water sufficiently warm to melt the gelatin. Care must be taken that the water is not too hot, for, if over-heated, gelatin loses its power of solidifying when cooled. When the contents of the tube are fairly fluid, add to them $\frac{1}{20}$ part of pure formalin, i.e., if the test tube contains 40 cc. gelatin, add 2 cc. formalin. Shake the tube so that the two mix. Now, with the patient's mouth wide open, sponge away the blood with gauze or wool pledgets until the socket is fairly dry, and then, soaking a thin strip of gauze in the mixture in the test tube, press it well home to the bottom of the cavity. Keep it thus for one or two minutes, withdraw it, and pour in the mixture of gelatin and formalin, which is now nearly solid. A little care will enable the operator to fill the whole socket with this valuable styptic, which soon solidifies.

SECONDARY HÆMORRHAGE.

A bleeding is called *Secondary* when it comes on at some period subsequent to the division or injury of the vessels maimed, either by accident or operation. It is divided into *Recurrent Hæmorrhage*, and *True Secondary Hæmorrhage*.

Recurrent or Secondary Hæmorrhage is that which comes on as soon as the period of lowered cardiac action and partial collapse, which is occasioned by the shock of an operation, or of an accident, passes off, i.e., within four or five hours of the injury. By this time, too, the contraction occasioned by the exposure and division of the

vessels has largely passed away. There is then present a condition of increased cardiac activity and relaxed vascular walls, so that it is not surprising that very frequently there is free general oozing from a wound, which at the time it was done up appeared quite dry. The bleeding is chiefly capillary, or proceeds from small arterioles, which had been so firmly contracted as not to declare their presence at the former examination. Larger trunks which have not been tied firmly enough (which should never occur), may burst their bonds and bleed freely.

TREATMENT.—Much will depend on the discretion and common sense of the house surgeon in these cases. While it is a most serious error to overlook a case of active reactionary hæmorrhage, it is at the same time needlessly distressing for a patient to have a painful wound opened up—often in the middle of the night—for a slight oozing which pressure would have checked. The house surgeon must be guided by the nature of the operation performed, i.e., whether large vessels have been divided, as in the case of an amputation, and by the condition of the dressings, whether the " coming through " of the dressing is due to serum and a little blood, or a quantity of blood and a little serum. In this connection he may remember that with a fairly large dressing, a serous exudation is more likely to appear at the end of the stump in cases of amputation, and forms a yellowish-green zone several inches wide round a red centre, whereas in hæmorrhage proper the blood will be found at the most dependent part of the dressings—that is, in a case of amputation of the lower extremity, on the under aspect of the stump, trickling towards the buttock, and the surrounding stain of the serum will be faintly marked. Lastly, he must be guided by the condition of the patient. If the pulse is good and full, and there is no feeling of faintness, he may, in conjunction with the considerations

given above, rightly decide to pack the wound and
wait. To pack a wound under these circumstances,
the outside bandage should invariably be removed.
It has been in contact with the bedclothes and
other materials which are not sterile, and to bury
it under a large pad of wool is, in our opinion, most
unwise. When the bandage has been removed, a
large pad or pads of wood-wool should be placed
on the top of the original dressing and the whole
region *firmly* bandaged. If this be properly done,
and if the house surgeon has been right in his
selection of the case for the application of this
treatment, there will be no more trouble.

But, on the other hand, where he suspects that
there is serious bleeding, or perhaps where he has
had recourse to packing and it has failed, what is
to be the next step ? All preparations must be
made to open up the wound, and these preparations
must be undertaken as carefully and as methodically
as for the original operation. Too often the care-
lessness of hurry in the anxiety of the moment
causes grave omissions in our technique of asepsis.
An anæsthetic is to be administered, either in the
ward or the theatre, wherever the operation is to
be performed, and we would insist most strongly
on this point.

Then, without hurry or the infliction of pain, the
wound is opened up, irrigated with hot saline,
120°F., and a search made for the bleeding points ;
no difficulty will attend this search if proper
preparation has been made. They must be secured
with ligatures, the wound cleared of clot, and the
edges brought together again. If a large amount
of blood has been lost, it will be necessary to inject
some saline solution into the tissues or the vein
(*vide infra*).

After reactionary hæmorrhage has once occurred,
the patient should be carefully watched.

True Secondary Hæmorrhage rarely occurs earlier
than a week or ten days after the injury or operation,

and its cause is almost always some ulcerative or sloughing condition of the walls of the larger vessels. Thus it may come from an artery which has been ligatured in its continuity, in consequence of the coats near the ligature taking on an unhealthy action ; or it may come from a lacerated wound at the time of separation of the sloughs, or from ulceration of a vessel ligatured in the flaps of an amputation wound.

The single exception to this form of hæmorrhage proceeding from a morbid inflammatory process is in those cases in which an animal ligature has become absorbed too quickly (a rare occurrence with the well-prepared catgut at present in use), or a silk one has cut the coats or come untied, so that the arterial coats, weakened by the tying, will then give way.

A form of hæmorrhage which may be classed under this heading, since the treatment is similar, is that resulting from ulceration of a large vessel, either from the destructive process of phagedæna or from the proximity of an abscess.

Secondary hæmorrhage is very serious. It constitutes a most formidable complication, and in considering the means for its arrest, questions of amputation, re-amputation, or ligature of main vessels, have to be weighed by the visiting surgeon ; but for us the subject is narrowed to the best ways for its immediate arrest.

It has been customary to look upon secondary hæmorrhage as occurring in two varieties : (1) *with warning* ; (2) *without warning*. In the first type a little dribbling will be noticed when the wound is dressed, about the ninth or tenth day after the operation. The wound will have become sloughy and septic, and there will have been considerable destruction of the tissues. No time must be lost in putting a tourniquet round the limb and preparing for further treatment, and it may be taken as an axiom *that when arterial bleeding occurs*

independently of probing, under the above conditions all measures for the treatment of secondary hæmorrhage must be taken. Unfortunately this warning is occasionally neglected, and the trifling hæmorrhage is regarded contemptuously, until a sudden violent gush of blood depletes the patient and possibly determines a fatal issue.

Whether the amount of blood lost in cases of secondary hæmorrhage is large or small, steps must be taken to bring about its immediate arrest.

Treatment.—If hæmorrhage occurs from *an Amputation Stump*, it must be arrested in the first instance by elevation, and compression of the main artery by the fingers or a tourniquet. The means to be adopted for the permanent arrest will depend on the condition of the stump ; whenever practicable, the most satisfactory proceeding is to open up the flaps, and tie the artery. A little blunt dissection will nearly always permit of the artery being seized with forceps and drawn down so that a ligature can be applied to a portion of the vessel that is healthy. It is better to use a stout ligature, and on the whole kangaroo tendon seems the best material. If this is not possible from the sloughing condition of the parts, then the choice will lie between re-amputation, and ligature of the trunk-vessel higher up.

If the hæmorrhage proceed from *Extensive Sloughing* of a lacerated wound, it takes place about the time of the separation of the sloughs ; in dressing bruised wounds, therefore, great care should be taken about the tenth day not to tear the sloughs away before the vessels have become occluded by natural processes. The bleeding is generally arrested by plugging and compression, but any vessel that will hold a ligature should be tied. The actual cautery may be used with good effect, but styptics, especially the perchloride of iron, should be avoided.

Secondary hæmorrhage is now of rare occurrence,

but the house surgeon is likely to meet with it after removal of the tongue, the bleeding coming from the lingual artery. The same principles should be applied in this instance, and it is the best treatment to secure the vessel with forci-pressure forceps and ligature ; but as a temporary measure, and one which may have permanent effect owing to the small size of the vessel, a firm gauze plug should be packed down on to the bleeding point.

In cases of secondary hæmorrhage when sepsis is present the wound is to be freely opened, and well washed with peroxide of hydrogen.

" **Bleeders.**"—Reference has been made several times to the constitutional conditions known as the " *Hæmorrhagic Diathesis*," or *Hæmophilia*, and those possessing this diathesis are generally called " bleeders." It is in a very marked degree hereditary, and is transmitted by both the male and the female sides, but it affects males far more frequently, the most common transmission observed being through the females, who do not suffer, to their sons.

" Bleeders " manifest their complaint either by spontaneous hæmorrhages from such parts as the gums and palate, the rectum, or the bladder ; or by persistent bleeding from some wound, large or small, or by the effusion of blood and serum into the synovial and serous cavities or subcutaneous tissues.

The chief change in the blood seems to be a deficiency of fibrinogen, and the danger can be gathered from the statistics of Litten, who found that 60 per cent of patients die before the age of eight, while only 12 per cent live to twenty-two and over.

TREATMENT.—In considering the best means of checking the bleeding, constitutional as well as local remedies must be thought of ; hence it is important to find out in any case of unusually prolonged bleeding, whether the patient be a

genuine bleeder or not. Enquiry will generally elicit a history either of some previous injury, in which the bleeding " seemed as if it would never stop," or of a father, brother, or uncle who had shown similar characteristics.

Local Treatment.—The character of the bleeding puts the idea of trying to ligature any of the bleeding vessels out of the question, and a little reflection makes it plain that the ligation of a trunk-vessel will only substitute two bleeding wounds for one.

Compression should be applied to the bleeding area with either 1–5000 adrenalin solution or the formalin and gelatin mixture in addition. In some cases the actual cautery may be tried. The local effects of subcutaneous injection of ergotine are sufficiently marked to indicate its employment.

Constitutional Treatment.—Absolute rest should be imposed on the patient, and 1 dr. daily of chloride of calcium should be ordered. Reverdin recommended sulphate of soda (30 grains every two hours). A prolonged use of dried extract of pig's liver and chloride of calcium is the best preventive treatment.

According to Wright, the inhalation of CO_2 for a few seconds, which increases the venosity of the blood, will always check the bleeding in hæmophilia.

Perchloride of iron is more useful in the later stages, while for a dangerous anæmia produced by the bleeding, if this has been checked, the injection of saline solution into the rectum may be advisable.

The action of *Opium* in quieting and regulating the circulation gives it great therapeutic value as an indirect hæmostatic in this form of bleeding, when the heart's action becomes feeble and the pulse empty and jerky.

CHAPTER IX.

OF THE FIRST TREATMENT OF SHOCK AND COLLAPSE, FITS, Etc.

SYNCOPE.

THIS condition is a temporary inhibition of the vital functions, produced, it appears, by an anæmic state of the brain. Whether this anæmia is the outcome of changes in the pial vessels or of loss of blood which has been poured out into the splanchnic area, is not clear, nor is it of much importance.

Practically an attack of syncope or fainting is a temporary condition, soon recovered from if simple measures are resorted to. These measures consist in lowering the head below the level of the body, or in forcing it between the patient's knees when he is sitting down. Some stimulant—a drachm of the spiritus ammon. aromat., or half an ounce of brandy in water—is sufficient. As the attacks are likely to recur, the patient should rest for the remainder of the day.

Sometimes a condition similar to this occurs under anæsthesia, and has been called chloroform syncope. How far this has been confused with shock it is difficult to say, but undoubtedly we meet with cases of transient failure of pulse and respiration before any operative procedures which can produce shock have been attempted ; and as is well known, elevation of the head of the patient while under the influence of chloroform is often serious owing to the anæmia of the brain which is caused thereby.

The general treatment of such cases will clearly be on the same lines as when no anæsthetic has been administered, but the danger is considerably greater under such circumstances, since the various

systems of the body do not so readily react when under the influence of an anæsthetic. The head should be lowered, artificial respiration performed, and strychnine administered hypodermically. In addition to these measures, a very hot compress applied to the head will be found effective.

SHOCK.

Shock appears to be a condition of lowered blood-pressure of gradual onset and prolonged duration, brought about by exhaustion of the vasomotor centres. It is chiefly produced by violent or prolonged manipulation of the contents of the abdomen, or by damage to the nerves or the great nerve trunks of the body, as in severe crushes. The injurious impulses thereby generated appear to act upon the central nervous system, so that the vasoconstrictor centre ceases to exert any effect upon the peripheral vessels of the body ; a great fall of blood-pressure results, and death may occur.

The severity of the shock will depend upon :—

1. The extent of the injury. The severe collapse caused by an extensive superficial burn is a good example of shock caused by peripheral irritation. In this case it is the extent of surface involved rather than the depth of the burn that determines the severity of the symptoms.

2. The nature of the part affected. Those parts most richly supplied with nerves, such as the abdominal viscera, will, when injured, give rise to the most profound collapse.

3. The nature of the injury. The form most likely to produce severe symptoms is a crushing force, which not only involves a number of nerves, but is most likely to severely irritate them.

COLLAPSE.

Collapse appears to be a *sudden* failure of the vital functions ; or as Crile puts it, " immediate depression or death." There are many causes

which bring about this condition—injury to the heart, damage to the respiratory mechanism, *profuse hæmorrhage, anæmia of the vasomotor centres as the result of sudden dilatation of the splanchnic vascular area.* All these conditions which produce collapse are important in influencing the incidence of shock at a later date.

Briefly, we may say collapse comes on suddenly ; there is great depression ; but if appropriate remedies are adopted it will soon pass off. Shock, on the other hand, comes on later ; its development is often favoured by a previous state of collapse ; it is of longer duration ; is much more serious, and is more difficult to treat.

In both shock and collapse the symptoms are similar. The patient usually lies flat on his back, his limbs flaccid, and he makes no spontaneous movements. Occasionally, however, there is restlessness. The surface of his body is cold and clammy, the face and lips are pale, and the eyes are sunken. The pulse is small, feeble, and flickering. The respiration is shallow and sighing in character. The temperature is subnormal, often markedly so. The sphincter ani may be relaxed, whilst the urine is retained. Consciousness may be more or less impaired, as shown by delay in answering questions, or incoherence of speech. Vomiting often occurs at the outset of recovery. The weakened heart can barely keep the cardiac and the respiratory centres going, still less the cerebral centres.

Preventive Treatment.—Before proceeding to the general treatment of these accidents after they have occurred, we must see what precautions may be taken to avoid them. Clearly the preventive treatment for collapse is to check all bleeding as soon as possible, from whatever source or under whatever conditions it may occur.

With shock we may adopt a number of measures of undoubted prophylactic value.

1. Before any severe operation the patient must

be well wrapped up, and the exposure during the operation be reduced to a minimum.

2. The patient should be kept as dry as possible. Too often one sees him swamped with lotions which soon cool down and chill the surface.

3. An injection of morphia $\frac{1}{8}$ to $\frac{1}{4}$ gr., and atropine $\frac{1}{150}$ to $\frac{1}{100}$ gr., should be given.

4. All lotions used for the patient during the operations should be at or above the normal temperature of the body.

5. Purging and starvation, which form part of the routine preparation of a patient before operation, should be curtailed. Often it is advisable to feed a patient a few hours before the performance of a serious operation.

6. Injections of saline with the addition of adrenalin may be given either into the veins or the submammary tissues, or a 6 per cent solution of glucose may be substituted for the saline.

7. It may be advisable to inject 4 per cent solution of cocaine into the main nerve trunks of a limb previous to the performance of the operation—a procedure which is said to be very valuable in blocking the nerve trunks and preventing the injurious impulses from affecting the higher centres.

REMEDIAL TREATMENT.—When once shock has supervened—as shown by the slow, weak, often imperceptible pulse, the blanched surface, the feeble respirations, the loss of control over the bladder and rectal sphincters—remedial measures must be adopted. Allowing that our explanation of the cause of shock is correct, clearly we must endeavour to raise the blood-pressure, and trust to the final recovery of the higher centres if we assist them in their work, as we apply artificial respiration until the respiratory centre continues of its own accord.

The most valuable form of treatment is the injection of saline, and in addition to the three methods of injection described below, we may, in

abdominal operations, make use of a fourth route for the administration of this fluid, by injecting it into the peritoneal cavity, from which it is soon absorbed.

The addition of adrenalin to make a solution of 1–50,000 to 1–100,000 has a marked, but unfortunately transient, effect.

Two-grain doses of Parke Davis's aseptic ergot may be added with advantage to the saline. The effect of the drug is more lasting than that of adrenalin. In addition to these measures, the head should be kept low, the limbs bandaged, and the abdomen, when possible, tightly compressed with a broad binder.

The value of strychnine in cases of shock, either as a preventive or remedial measure, is difficult to estimate. Custom has sanctioned its use, and many of us are hardly prepared to forswear our allegiance to a drug which we believe to be of value. The results of experiments on animals are not absolute indications of what may occur in the human subject, and for the present we confess that we have confidence in strychnine and advise its use, both before and after the appearance of shock ; at the same time we are strongly of opinion that its value is enormously increased after the injection of saline. Oxygen inhalations are exceedingly valuable.

The treatment of collapse is similar to the above, but owing to the more transient character of the vasomotor paralysis, a quicker response and a better result are to be anticipated.

The similarity between the collapse after an internal hæmorrhage and the shock of a severe abdominal injury can now be more fully appreciated, and the difficulty in deciding on the diagnosis and treatment will be more obvious. Clearly, until such diagnosis has been made, active treatment must be suspended, but we would again insist that, when the patient's condition is so serious that a fatal issue seems imminent, the various remedies

for shock suggested above must be adopted even in the absence of a decided opinion.

INTERNAL HÆMORRHAGE.

Whenever a large quantity of blood escapes from the blood-vessels, whether it flows away from the body, or into one of its cavities, the prominent symptoms are those of cerebral anæmia. There is a sudden feeling of nausea and giddiness, with a buzzing in the ears; then the sight goes, and the patient becomes insensible. In such a case there is sometimes a superficial resemblance to an epileptiform or apoplectic seizure, but as a rule the extreme pallor and the fluttering pulse, which is often nearly extinguished at the wrist, will be sufficient indications of what has happened.

IMMEDIATE TREATMENT.—The immediate treat-ment of severe internal hæmorrhage, apart from operative measures, is sufficiently simple. It may be summarized thus :—

(1) To prevent further loss of blood ; (2) To keep the circulation quiet; (3) To keep up the blood-supply of the nerve centres in the brain for circulation and respiration.

1. *Measures for Preventing further Loss* will vary in different cases, but the chief ones are—absolute rest, local application of cold, and lowering the functional activity of the organs affected as much as possible. Thus, if the bleeding be from the lungs, the patient should be kept lying flat, with very light and loose clothing ; be made to suck ice, and enjoined not to speak. In this way the lungs are placed at rest as far as this is possible.

2. *To keep the Circulation Quiet.*—The absolute rest will greatly help this, but the administration of $\frac{1}{2}$ gr. morphia will be found of great value.

3. *To maintain the Blood-supply to the Brain.*—The fulfilment of the third indication—the blood-supply of the respiratory and cardiac nerve centres —is best attained by lying flat. We all know that

this is the best position for syncope, because then the feeble heart can most readily drive out its scant supply of blood to the brain. Placing a patient head downwards, when the breathing has stopped during the administration of chloroform, is only an extension of the same principle.

But in *Very Severe Hæmorrhage*, position alone may be insufficient, and we may see the syncope getting nearer and nearer to death, from the bloodless condition of the base of the brain. In the first place, all the blood that is in the body should be utilized for the purpose of brain supply. To do this effectually, the head must be lowered and the pelvis raised; the arms held so that the veins tend to empty themselves into the heart; while the legs should be raised, and bandaged from below upwards—an elastic bandage (Martin's) is best—so as to squeeze all the blood out of them, as far as possible. All these proceedings are sometimes called "autotransfusion."

Artificial Respiration.—In extreme syncope from bleeding, as from any other cause, the surgeon must be prepared for complete failure of the breathing, and must be ready to begin artificial respiration (q.v.) whenever he sees the movements of the chest becoming suspiciously shallow.

But, further, there can be no doubt that, rather than allow a patient to simply die from want of blood, the deficit ought to be supplied from elsewhere; the difficulties of transfusion from one person to another, and the satisfactory results obtained from the administration of a solution of sodium chloride, have resulted in the practical extinction of all other methods.

Saline Transfusion.—This treatment is based upon the fact that in severe hæmorrhage the patient suffers from loss of quantity rather than of quality, and that if a sufficiency of fluid isotonic (that is, having roughly the same percentage of salts, ·9%) with the blood, be intro-

duced into the circulation the crisis can be tided over.

In a case of emergency, a solution containing 1 drachm (1 teaspoonful) of common salt to 1 pint of boiled water is satisfactory.

There are three recognized ways of administering this saline solution for the treatment of severe hæmorrhage or shock : (1) Into the veins ; (2) Into the subcutaneous tissues ; (3) Into the rectum ; but the selection of the appropriate method must depend upon the urgency of the case. Where an immediate crisis is impending, the venous route should always be selected.

Certain general principles must govern the injection of saline, whether into the veins or the subcutaneous tissues.

1. The most rigid asepsis is to be observed.

2. The fluid must reach the body at a temperature above the normal 98·7° F.

3. The fluid must not be injected too quickly. The average rate should be 1 pint per $\frac{1}{2}$-hour into the subcutaneous tissues ; 1 pint per $\frac{1}{4}$-hour into the veins.

4. The quantity. Except in children it is no use injecting less than two pints, but it is often advisable to inject considerably more than this.

Intravenous Method.—For apparatus all that is required is a fine nozzle, preferably of metal, a piece of indiarubber tubing and a funnel or irrigator.

The vein, preferably the median basilic, having been exposed, a double ligature is passed beneath it, a nick is made in the vein between the two ligatures, and the nozzle is introduced into the proximal part of the vein. It is tied with one of the ligatures, the other securing the distal part of the vein. The cannula and indiarubber tubing should be filled with the solution before introducing the former, a pair of forceps being used to compress the tubing to prevent the escape of the fluid. The funnel is raised to such a height as will allow

the fluid to run slowly in, and the clamp on the tube is removed. The use of ligatures may be avoided by using a special cannula (made by Weiss) which has a tapering shaft with a solid blunt point, the opening being a lateral one about half an inch from the end. This can be inserted through a small opening in the vein so tightly as to stop any hæmorrhage. Everything connected with the operation must be boiled.

Subcutaneous Injection.—In this method we nearly always make use of the irrigator, but attached to the rubber tubing we have a sharp exploring needle of wide calibre. Both the irrigator and the tubing are surrounded with packing to preserve the heat, and it is a good plan to stand the irrigator in a bowl of hot water on a shelf or table above the level of the patient.

An ingenious apparatus can be made out of a large glass flask, a tripod, and a nightlight, and the saline can be kept at a uniform temperature.

A convenient spot is selected, usually the sub-mammary region, and the needle is thrust sharply into it. If properly introduced the fluid will soon start running, and the rate must be controlled by raising or lowering the level of the irrigator.

Careful watch must be kept on the chest, so that the tissues are not unduly distended ; but if the injection is allowed to run slowly it is usually possible to get in about three to four pints without much inconvenience to the patient. We insist strongly on the fact that if pain is caused it is because the fluid is running too quickly. If it is necessary to repeat the operation, the opposite breast or region of the buttock may be selected.

Injection per Rectum.—Fluid introduced into the rectum is readily absorbed, and we make use of this channel for the introduction of saline under a number of circumstances. It will be sufficient here to indicate the two chief ways by which the injection is effected.

Interrupted Injections.—Plain enemata of one to two pints slowly introduced into the bowel and allowed to remain.

Continuous irrigation into the rectum by means of an irrigator and tube, as in the preceding operation, a long soft rectal tube pushed well up into the bowel being substituted for the needle. Saline given in this way is extremely valuable in cases of collapse, hæmorrhage, or toxæmia, and it is surprising how readily great quantities can be absorbed, and with what benefit to the patient.

Raising the pelvis not only assists the introduction of the fluid, but helps the patient to retain it.
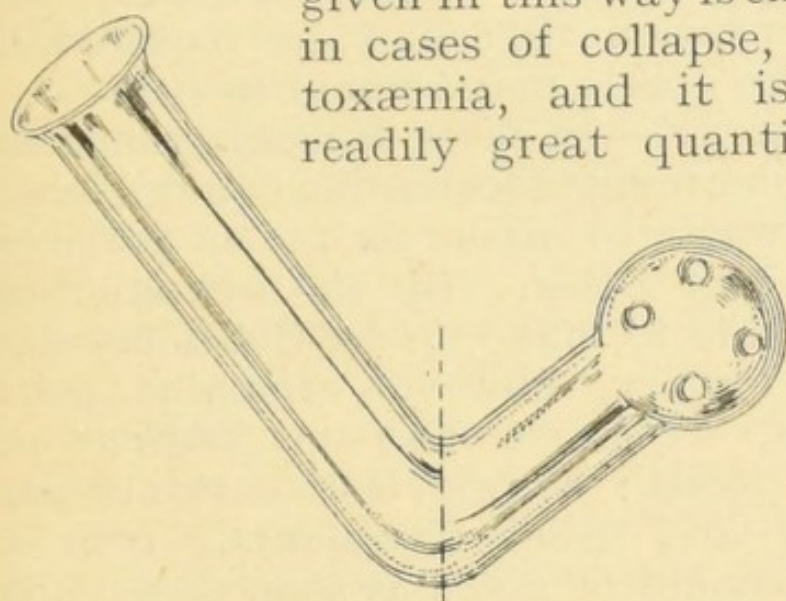
Fig. 84.—Cannula for the Administration of Saline per Rectum. The portion beyond the dotted line lies within the lumen of the bowel.

The method of injecting saline into the rectum in a continuous manner is now largely employed in the treatment of cases of peritonitis, with excellent results. The patient is propped up in bed in what is called " Fowler's Position," and a glass tube bent to a right angle three inches from the rounded end (*Fig.* 84) is introduced into the rectum. The tube is connected to an irrigator, or some other form of apparatus which maintains the saline at a temperature of 103–110°, according to the length of tubing through which it has to pass. The saline is then allowed to flow slowly into the bowel, from which it is absorbed and carried into the circulation. As much as seven or eight pints may be absorbed in twelve hours, but the flow must be regulated so that the fluid does not distend the bowel, only to be ejected later.

This treatment may be maintained with advantage

for several days. In some cases it will be found that the saline cannot be retained at all—the prognosis is very grave in these circumstances, the patient rarely recovering,—but as a substitute for the rectal method that of subcutaneous injection should then be employed.

It is better to use a rounded glass nozzle with several perforations than a rubber catheter, and during the interruption that may be required in administration the nozzle may remain *in situ*.

LATER TREATMENT.—In cases of hæmorrhage we have—(1) To promote rapid formation of new blood ; (2) To prevent waste of tissue as far as possible.

1. *To Make Fresh Blood.*—By the introduction of saline we are able to make up for deficiencies in quantity ; the quality, however, remains poor. To improve this, we must feed our patient on highly nutritive foods : strong beef extracts and jellies, burgundy and other stimulants. Iron or iron and arsenic should be given as soon as possible in the form of hæmatogen, hæmaboloids, and later, the tartrate and perchloride may be substituted for them. One important point is to see that the patient has *plenty to drink*.

2. *To Prevent Tissue Change*, or work of the body of any kind, is also important. Absolute rest and quiet must be kept up for some days ; in many cases moderate doses of opium will be very useful.

CONCUSSION.

By concussion is meant that form of shock which results from a direct injury to the head— brain shock. As a result its functions are in abeyance. In slight cases the patient may feel giddy and confused for a few minutes. In more severe cases he is motionless and insensible, or answers only in monosyllables when shouted at, relapsing again into insensibility. The general symptoms are identical with those that have been described under the heading of " Shock." There is

the same pallor, cold clammy skin, feeble pulse, shallow respiration, and lowered temperature. The pupils react sluggishly to light. The insensibility may last only a few minutes, or persist for days.

The warmth of the body is maintained by hot-water bottles. The diet should consist of milk only, and that sparingly. The bowels should be opened on the second day. Care should be taken that the bladder does not become distended.

The patient should be kept absolutely quiet in every way and be watched carefully for the development of signs of compression or cerebral irritation. No effort should be made to restore consciousness, but, on the contrary, the shaken brain should be allowed the most complete repose ; and darkness, silence, and such warmth in bed as may be necessary to promote recovery from the shock, are indicated. After the actual concussion has passed away, it is always wise to keep the patient quiet, with a milk diet, and to avoid excitement and brain-work, for the remote effects of concussion may be serious, although the immediate stunning may have lasted hardly more than a few seconds.

FITS.

The term " fit " is used popularly and loosely to include a number of convulsive conditions, usually accompanied by unconsciousness. Two of these conditions are more common than the rest, and must be referred to. They are the *apoplectic* and *epileptic* states.

Apoplexy.—By the term apoplexy is meant a sudden loss of consciousness and power of movement, due to a morbid condition of the brain. In popular language it is called a stroke. It is most frequently due to hæmorrhage into the brain, less commonly to an obstruction of the vessels to some part of the brain by a clot, which may be derived from a distant part (embolism), or be formed at the spot itself (thrombosis).

But the apoplectic state or *fit*, from whatever cause it may arise, will present very much the same symptoms, namely, *loss of consciousness without failure of the heart's action*; while, in the vast majority of cases, there will be evidence also of some local cerebral lesion in the shape of convulsive movements, or paralysis, or both, the paralysis generally remaining after the actual fit has passed off. As we have here only to consider the practical management of the patient during the attack, a differential diagnosis is not at all necessary.

Taking the case of an apoplectic fit arising from cerebral hæmorrhage, its course will be something like the following.

After a varying prodromal period, during which there may have been warnings, in the way of mental confusion, giddiness, etc., the fit proper generally comes on quite suddenly, often during some emotion or some unusual exertion. The prominent symptom is the complete loss of consciousness, but preceding this there may be a short period of convulsive twitchings of the face or limbs. When consciousness is lost, the patient falls to the ground, the breathing becomes laboured and stertorous, with a flapping in and out of the cheeks, caused by their loss of tone. Usually the face, arm, and leg of one side of the body will be found convulsed or, more commonly, paralyzed. As the fit continues, the paralytic symptoms become more developed, and with this there is steadily deepening coma. Reflexes are nearly or quite abolished, and the pupils may be widely dilated, or unequal, or small, but are generally fixed, and do not react to light.

The pulse, as a rule, is full and slow. The larger venous trunks are often distended. (In uræmic fits, pallor and a small pulse are frequently present.) In such a case the coma may get steadily deeper and end in death, in a few hours or days, without any effort at a rally. If this does not happen, after a period so variable that no estimate is possible,

there is a gradual lessening of the coma, and the reflexes gradually return. Later, the patient can be partially roused, and then returns to a state of consciousness. This, however, is rarely at first unclouded, and with it there generally appear indications of permanent paralysis of the limbs or face, and often of aphasia in some one of its forms. The after-history is generally one of improvement.

Bearing in mind the usual cause of this condition of apoplexy, it will be plain that all direct attempts at rousing or restoration of consciousness will not only be futile, but will be actually harmful. The first and great point in the treatment will be to keep the circulation as quiet, and the heart's action as free from embarrassment, as is possible. A " do nothing " policy is therefore on many points essential ; but, except in the more transient and slighter attacks, or, on the other hand, in those cases of *apoplexie foudroyante*, in which death occurs almost immediately, there are certain indications for relief of the cerebral circulation which should, if possible, be fulfilled.

There will be little difficulty in recognizing whether the case be one in which nothing is required except absolute rest and quiet watching, or whether more active treatment is called for. In the latter case, the chief measures are the local application of cold to the head and free purgation. If the head be hot, or the face flushed, it can never be unwise to cut the hair short and apply an ice-bag or cold compress to the vertex.

Such measures as bleeding, leeching, wet or dry cupping, or a free drastic purging may, any of them, be ordered by the responsible medical officers, but in the majority of cases of apoplexy, the one thing needful in the first place is to keep the patient still in bed, with the head slightly raised, in a dark room, taking particular care that there be no obstruction to the respiration, and, if necessary, performing artificial respiration until the arrival of medical aid.

Compression of the Brain.—The signs of this condition resemble those of apoplexy mainly, being generally those of coma. The condition may be caused by a depression of the skull or by an effusion of blood within it pressing upon the brain, and in any case demands the early attention of a surgeon. Cases of apparent concussion may gradually become manifest cases of compression.

Epileptic Fits.—The practical management of an epileptic fit may be very shortly described. In the epileptic, as in the apoplectic state, the prominent feature is the absolute loss of consciousness. The attacks also vary greatly in their severity and duration, from those cases of *petit mal*—in which there is a momentary confusion and loss of consciousness, gone almost before it is felt—to the most violent storms of convulsions, perhaps lasting a full half-hour. The following may be taken as an account of a moderately severe epileptic fit :—

Quite suddenly, or after some subjective premonitions, as of a creeping sensation, or travelling wave of coldness or the like, which is known by the name of an " aura," the patient becomes unconscious and falls to the ground, often with a cry or groan. Almost all the body is then thrown into a state of *tonic* convulsion ; the back is rigid and slightly arched, the legs are extended, and the head is thrown back or to one side ; the respiratory movements are arrested, and the patient becomes more or less asphyxiated. The asphyxia, however, seldom becomes extreme ; and after a time, shorter than it appears to the onlookers, the tonic contraction passes into a state of general *clonic* convulsion, in which there is a rapid succession of to-and-fro movements ; the limbs are alternately flexed and extended, the eyelids and jaws opened and shut, the head and eyes turned to one side, and froth appears at the mouth. At this stage, too, the tongue may be bitten, or the nails driven into the palms. Gradually, and generally after a very few

minutes, the convulsive movements quieten down, and a condition resembling coma, but which only in the most severe cases is true coma, follows. Soon this comatose state passes into one more like natural sleep ; the asphyxial colour disappears, and, as a rule, the patient wakes up within half-an-hour or an hour, ignorant of what has happened, unless previous experience has taught him to understand the position of affairs.

In such an attack, nothing ought to be done with the idea of any restoration to consciousness, and all that is called for is to see that, during the convulsions, the patient does himself no injury, either by tossing his limbs or head about, or by getting into such a position that respiration is interfered with. Anything tight about the neck, chest, or abdomen should be loosened, and especial care should be taken that the tongue does not get caught between the teeth. If this happens, the jaws must be forced open, and a piece of cork, or wood, or some other suitable wedge inserted to keep them apart. Indeed, in every case it is wise at the onset to put something between the teeth to prevent the tongue being severely bitten.

Strenuous efforts at restraint of the convulsions appear rather to excite them, and are never necessary. As soon as the violence of the fit is over, the quieter the patient is left the better ; and, if natural sleep follows, it should be encouraged to last as long as possible. On waking up, if any signs of exhaustion are present, a little soup or beef-tea is useful, but alcohol should not be given.

Epileptiform Attacks.—It must be borne in mind that convulsive attacks resembling those which occur in true epilepsy are sometimes met with in some other nervous diseases, and also in uræmia, puerperal eclampsia, and other toxic conditions. The diagnosis of the actual cause does not come within the scope of this book.

Epileptic Malingering.—In hospital practice the

house surgeon or dresser must be on his guard against being deceived by malingerers, who feign to be epileptics in order to obtain admission. The only way to detect them with certainty is to be thoroughly acquainted with the symptoms of the genuine attack.

Foaming at the mouth may be simulated by soap, and much " lather " about the lips is in itself suspicious ; but the crucial point is the insensibility. In genuine cases this is absolute. Many malingerers are aware of this, and will bear pain inflicted as a test, with a fortitude worthy of a better cause, but faradization judiciously applied can hardly be resisted for more than a few moments.

Hysterical Fits.—Convulsive attacks are by no means infrequent in cases of hysteria, but in these there is no true loss of consciousness.

Although no two of these attacks are alike, there is rarely any difficulty in the diagnosis ; indeed, it is only when the attack exhibits the more serious characters of what is termed *hystero-epilepsy*, that any doubt can arise. In ordinary cases, the flushed tearful face, the panting breath, the emotional laughter or sobbing, the jerking movements, not truly convulsive, and the almost invariable termination in a flood of tears, and (though this is naturally not so evident) a profuse secretion of almost colourless urine ; all these points are characteristic of the hysterical attack, and could not occur in a real fit.

Moreover, if there be any doubt, analysis of the symptoms will show that the condition is a mimicry of graver disease, and that there is a " contrariness " in the behaviour of all these patients which is very characteristic. Try to open the eyes, and they will be screwed up ; or the mouth and the teeth will immediately be clenched, the tongue, however, never being bitten. So, if an effort be made to sit the patient up, she will immediately flop down on the floor, but in doing so will give a further evidence

of the nature of the attack, for in falling, even though there be apparent loss of consciousness, the patient will carefully guard herself against injury.

Apparent unconsciousness is often present, and a kind of anæsthesia, so that needles may be run deeply into fleshy parts without eliciting a sign of pain ; yet both these states are really deceptive. The anæsthesia is the result of an exaltation akin to the ecstasy of a flagellant, and the unconsciousness is only on the surface. In fact, as in the conditions of hypnotism (which in many other respects resembles hysteria), there is quite an abnormal intelligence of surrounding affairs. No hysterical woman, though she may be to all appearances profoundly unconscious, would allow any one to cut off her hair. Moreover, while this emotional condition lasts, patients are very completely *en rapport* with the states of mind of those around them, and promptly become much worse, or speedily recover, according to the behaviour of the bystander.

Although we have said that the symptoms are a mimicry of other disease, no greater mistake can be made than to treat these sufferers as malingerers. The illness is real enough, although it is a mental, rather than a physical, ailment ; and although the symptoms are not genuine, the object to be attained is to cut the attack as short as possible, and to diminish the chances of its recurrence. On the one hand, the tendency to recur will be increased if the symptoms are treated as if they were signs of a grave, mysterious illness ; and on the other, the severity of the present attack will very likely be aggravated by harshness or rough treatment. The " bucket of cold water " we believe to be always harmful, but so is the other extreme of profuse sympathy, mixed with restoratives.

As we have stated before, hysterical people may be quite trusted not to hurt themselves, so in almost all cases the best thing to do is to leave them alone. Nothing conduces more to a quick recovery than

that the patient shall be convinced that her condition is one which excites no alarm, no pity, and no anger ; and bearing in mind how hyper-sensitive these patients are to external conditions, all fussy friends should be rigidly excluded. Indeed, there is no necessity for anyone to remain in attendance, and if the patient be simply laid on her bed at the commencement of an attack, and left to come out of it as soon as she will, nothing better can be done.

A mixture of hysterical and alcoholic excitement is not uncommon in hospital casualty rooms. These cases again may be left to themselves, or may often be more quickly restored to their right minds by a brisk emetic. Faradization to the facial muscles is an excellent way of bringing these patients round. They bear it well at first, but there comes a time when it becomes too tantalizing : then they get up and walk home.

The Convulsions of Infants.—The equilibrium of the cerebral government is, in infants, very easily upset, and convulsive attacks may occur from very slight causes. Worms, teething, intestinal irritation, or some cutaneous irritation, such as that caused by a pin, may, any of them, be sufficient to bring on an attack. It is especially in children suffering from rickets that peripheral irritation from any cause is liable to induce convulsions. On the other hand, the fit may be an indication of the gravest brain disease, or may stand in the place of the initial rigor which in adults heralds the onset of some acute fever.

In a typical convulsion the child, after being hot and fretful for some hours previously, is noticed suddenly to " look queer," or to squint. A general spasm of rigidity then passes over the body, the face becomes pale and set, the eyeballs are turned inwards, and respiration is almost arrested, in consequence of which an asphyxial look quickly develops. This rigidity, however, generally lasts only for a few seconds, and is succeeded by twitchings of the face,

and other clonic convulsions. These again quickly subside, and the child falls into a sleepy, semi-comatose condition, which soon becomes a natural sleep. Consciousness is quite abolished during the fit itself.

This is an account of a rather severe fit, and fits are found of all degrees. Often the whole attack is compressed into a momentary loss of consciousness, with a spasm of rigidity, followed by a little drowsy heaviness. But in all, except the very slightest, the condition is certainly one which must be hurtful to the brain ; the cerebral circulation, therefore, should be relieved if possible, and that quickly ; such relief can be given most directly and readily, by putting the child into a hot bath *at once*, at as high a temperature as can be borne (say 105° F.). If this can be got directly, the child may with advantage be put in, clothes and all, and undressed in the water. It should be immersed up to the neck, and a sponge of cold water may be placed at the back of the head.

Indirectly, too, the bath fulfils several good purposes. The undressing of the child will enable a thorough examination to be made, and will discover if, by any carelessness, there be a pin running into the skin, or any other local irritation. Possibly the warmth may hasten the appearance of the rash of some fever, or if there be intestinal colic, this will be relieved. A grain or two of calomel should be placed on the tongue, especially if there is any likelihood of intestinal irritation. Bromide of potassium should be given by mouth (5 grains) or by rectum (7–10 grains). Chloral (3–5 grains) may be usefully combined with it.

CHAPTER X.

OF DROWNING AND SOME OTHER FORMS OF SUFFOCATION.

Asphyxia.—In all forms of asphyxia it is important to recollect, first, that insensibility comes on very soon, some time before the convulsive struggles cease, and is succeeded by a paralysis of all the voluntary muscles, including those of respiration ; and secondly, that the *heart's action may continue* for a long time after the ordinary muscular movements are abolished.

The actual cause of death is probably the hyper-distention of the right side of the heart, and it can easily be shown in animals that recovery from asphyxia is possible even after the heart has ceased to beat, if the right heart be rapidly unloaded of its blood by opening the jugular vein. In man, it is very doubtful if such a recovery has ever taken place ; but it certainly seems that prompt vene-section, although it is very rarely resorted to, offers in extreme cases almost the only chance. It should be remembered, too, that the performance of artificial respiration, to be directly described, in addition to re-oxygenating the blood, also relieves the distention of the right ventricle by facilitating the passage of the blood through the capillaries of the lungs.

It will probably save needless repetition if we here consider the steps to be taken with the object of restoring suspended animation in ordinary cases of drowning ; and taking this account as a typical case of suffocation, to leave it to the reader's common sense to fill in the details of the slight variations which are called for by the different circumstances of other forms.

Drowning.—Several causes are generally present here to produce a condition of lifelessness, in addition to the asphyxia itself. Thus, *shock* is often present, and may be a very important factor. *Exhaustion* from long-continued struggling, and the effects of *exposure to cold*, are also common, and have to be dealt with.

Still, the great agent in producing the condition is suffocation, and this must first of all be combated.

Supposing, then, that the body of an apparently drowned person has been recovered from the water, and that respiration is found to have stopped, it may well be that the breathing can be set going again by simply making sudden forcible pressure at the pit of the stomach some three or four times, at intervals of three or four seconds; but should this not be quickly followed by respiratory movements, artificial respiration proper should at once be begun on the spot. This not only acts mechanically upon the lungs, but by the suction action of the expanding chest is a potent factor in maintaining the circulation.

For this process to be of the least avail, all its details must be carried out regularly and thoroughly; the object being so far to imitate the natural thoracic and abdominal movements that air may be sucked into, and squeezed out of, the chest.

In *Sylvester's Method* (*Figs.* 85, 86) the arms are first used as levers, acting so as to expand the chest walls by means of the muscles placed between the limbs and the trunk, and then as media for compressing the chest.

The patient should be first laid on his back and some convenient support placed under the shoulders, so that the chest may be thrown out and the neck extended with the head thrown back (*Fig.* 85). If this be properly managed, there will not generally be any necessity for the tongue to be drawn out of the mouth, for the larynx will be kept open by the chin being kept well up. But it may sometimes be

desirable for an assistant to draw the tongue forwards, and if so, the best way to hold it, in the absence of proper forceps, is with the corner of a handkerchief between the finger and thumb. This is much better than trying to fasten the organ down to the chin with an indiarubber band, or running a hair-pin through it, as has been recommended.

Everything which in the least confines the neck, chest, or abdomen, must be loosened, and the mouth
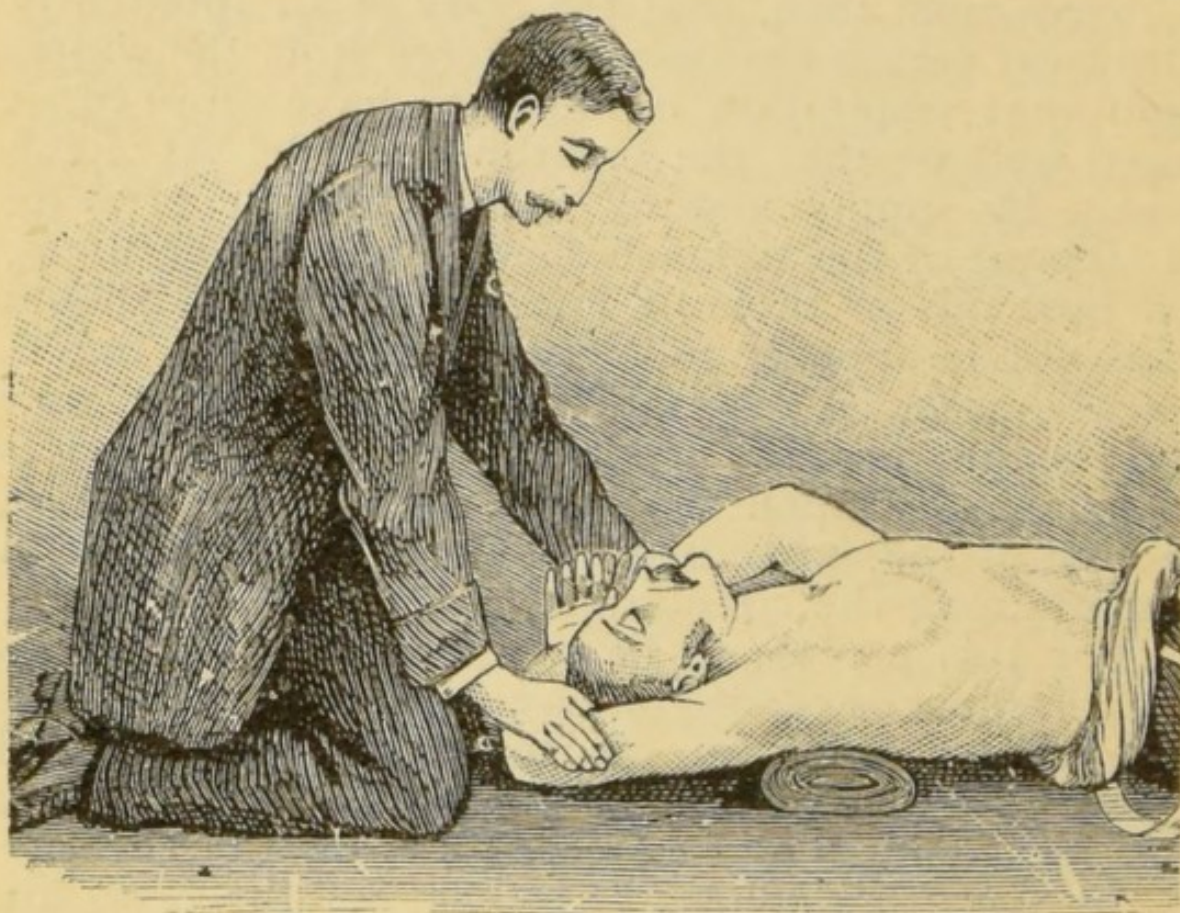
Fig. 85.—Sylvester's Method.—Inspiration.

and nostrils must be cleansed from mud, etc. Should there be any water lying in the pharynx, the patient may be turned over on one side to let it run out of the mouth, but no direct attempt should be made to empty the stomach.

These preparations should occupy only a few moments. The attendant, then kneeling at the patient's head, must take hold of the arms above the wrists and carry them well over the head right back as far as they will go (*Fig.* 85). The chest

walls will then be expanded, and air can generally
be heard passing through the glottis. The arms
must then be brought down against the sides and
the forearms crossed over the pit of the stomach.
Leaning now with his weight upon them (*Fig.* 86),
the operator makes forcible pressure upon the
abdomen, so as to press up the diaphragm, and
if there is water in the air passages, produce bubbles
at the nostrils. This should elicit a distinct grunt
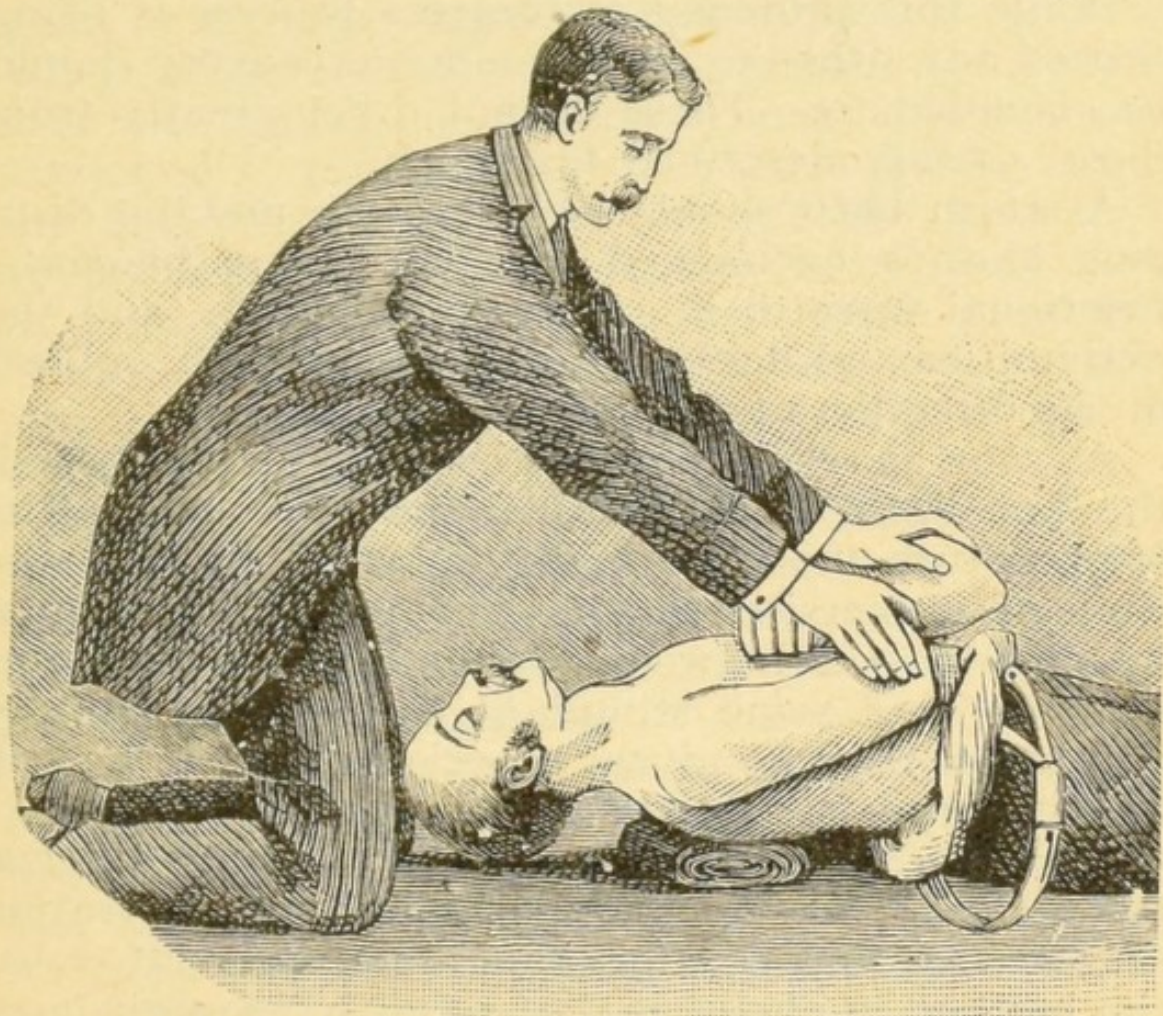
Fig. 86.—Sylvester's Method.—Expiration.

from the patient; if it does not it is doubtful if
air has entered the chest cavity at all: the whole
process is then repeated.

The rate at which artificial respiration should be
made varies with the age of the patient, and should
be about the rate of normal breathing for that age,
say, for an adult, seventeen times a minute. Most
persons, the first time they perform artificial
respiration, do it very much too quickly.

If recovery be going to take place, generally a very few minutes will be sufficient to restore natural breathing movements, and then care must be taken not to interfere with the short gasps with which natural respiration begins ; but the patient must still be carefully watched, for the condition, like that of shock, is one very prone to relapse, and the respiration may fail again after it has been restored.

While this principal restorative process is being carried out, other secondary aids to recovery should be attended to. These do not differ greatly from those already described for shock.

A warm bath should be prepared, and the dripping clothes exchanged for dry, warm blankets. Frictional warmth is a very useful agent, and the extremities and flanks may be energetically rubbed in the direction of the venous circulation.

As soon as respiration has been fairly established, the hot bath, if procurable, may be used. The temperature must be high, say 104° F., and the time of immersion short. The patient may then be put to bed between blankets, with hot-water bottles ; and some stimulant such as hot brandy and water may be given, especially if there be still feebleness of the heart's action, or shivering.

Sylvester's method is applicable to many surgical emergencies, as, for example, failure of respiration under anæsthesia ; for the apparently drowned the method of choice is that recently recommended by Schäfer.

Schäfer's Method.—Place the patient face downwards on the ground, preferably with a folded coat under the lower part of the chest. Do not lose time in attempting to remove his clothing. Begin artificial respiration as follows :—

1. Place yourself athwart or on one side of the patient's body in a kneeling posture and facing his head.

2. Place your hands flat over the lower part of

the back (on the lowest ribs), one on each side, and gradually throw the weight of your body forward on to them, so as to produce firm pressure—which must not be violent—upon the patient's chest.

3. Raise your body slowly, so as to remove the pressure, but leaving your hands in position.

4. Repeat this forward and backward movement every four or five seconds.

This course must be pursued for at least half an hour, or until the natural respirations are resumed. When breathing has been established, the patient may be turned on his back and active means employed to promote the circulation by friction of the limbs in a direction towards the heart, the application of hot flannels, hot bottles, etc. As soon as the patient can swallow, small quantities of wine, warm brandy and water, beef-tea, or coffee may be administered. He should then be put to bed and encouraged to sleep.

In *suffocation by the fumes of charcoal or coke*, by the *carbonic acid in brewing vats*, or by the *choke damp* of mining accidents, or in cases of *hanging* other than those performed by the public executioner, we have examples of suffocation, in all of which the great agent for resuscitation must be artificial respiration. As a rule the conditions are more simple than in drowning, as shock, exhaustion, and cold, the effects of which in drowning have to be overcome, are not generally present, but the main principles of treatment remain the same.

The inhalation of oxygen gas may prove of value in these cases.

We have mentioned already, when considering the treatment of extreme shock and syncope, most of the other measures which are accessory to artificial respiration in cases of suspended animation, from whatever cause arising ; but although *faradization* is alluded to in the treatment of some cases of poisoning, etc., the details of the administration of

the electric current have not yet been given. The following are in brief the directions which should be followed.

The faradic current is usually employed, but the interrupted galvanic current might answer the purpose.

Graduate the current to a strength sufficient to produce vigorous contractions of the muscles of the ball of the thumb. Then press the electrodes firmly over the phrenic nerves, between the sterno-mastoid and scalene muscles ; or, put one electrode over one phrenic nerve and the other in the seventh intercostal space.

Interrupt the current about three times a minute, while the assistant presses firmly on the abdomen, pausing occasionally to observe the effect.

If no inspiratory movements appear after a number of interruptions, increase the strength of the current.

- The electrodes must be large, and well moistened.

The resuscitation of stillborn infants, though carried out on the same general principles as that of the other cases of suffocation, does not come within the list of emergencies to which we have limited ourselves.

CHAPTER XI.

OF THE TREATMENT OF CASES OF POISONING.

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WE have now to consider the measures which should be taken when some one of the substances which are commonly used as poisons, or which may be so used, has been taken into the body in sufficient quantity to produce toxic symptoms. The following are the chief of these substances, and we will consider them in the order given :—

General Poisons.
1. Alcohol
2. Ether
3. Paraffin oil
4. Opium
5. Strychnine
6. Belladonna
7. Prussic acid
8. Nitro-benzol
9. Chloral

Irritant and Corrosive Poisons.
1. Carbolic ⎫
   Oxalic ⎪
   Sulphuric ⎬ Acids
   Hydrochloric ⎪
   Nitric and other ⎭
2. Corrosive sublimate
3. Arsenic
4. Antimony
5. Phosphorus
6. Caustic alkalies

Poisonous Foods.

Shell-fish	Mushrooms

The general poisons vary too greatly among themselves to admit of any general description, and must be considered separately.

Acute Alcoholic Poisoning may be conveniently divided into *Drunkenness*, and *Acute Alcoholism with insensibility or coma*. The former is not in itself dangerous, and usually the best course to take with drunken men or women is to

leave them to sleep off the effects of the alcohol. Nevertheless, even a moderate grade of drunkenness may be *dangerous in old or feeble people*, with degenerated tissues and weak circulation, for it may be the cause of a grave cerebral disturbance (generally of the nature of an apoplexy), or of a failure of the heart's action. The latter event must be particularly guarded against in cold weather, for, in consequence of the dilated condition of the arterioles of the skin, drunken people lose heat very quickly. Care must be taken, therefore, in thus leaving drunkards alone, that their conditions are such that there is no chance of their becoming dangerously cold.

Emetics.—It often happens, in the casualty department, that it is desirable to make a patient sober as soon as possible. For this purpose nothing is more effectual than a brisk emetic : one of the safest and best is a dessertspoonful of powdered mustard in half a tumbler of warm water ; instead of this a solution of a dessertspoonful of common salt dissolved in half a tumbler of warm water may be given, or $\frac{1}{2}$-dr. doses of carbonate of ammonia dissolved in water. Sulphate of zinc in $\frac{1}{2}$-dr. doses has been recommended as a safe emetic, but it is better to try the above non-poisonous substances first if possible. For children 1 dr. of ipecacuanha wine is an excellent emetic.

The use of substances like tartar emetic, vinum antimoniale, copper sulphate, and apomorphine is to be avoided, since they are poisonous in themselves. Apomorphine is a very powerful cardiac depressant, and it is a dangerous drug to give in doses sufficient to cause vomiting. If possible, the stomach should be washed out with warm water, the contents being withdrawn ; for this purpose a soft tube should be passed and the proximal end of this attached to the stomach pump, or else to a piece of rubber tubing about three feet in length, at the end of which is a glass funnel. If the stomach

pump is used, a little warm water is first passed in and the stomach contents are withdrawn. Fresh quantities of warm water are passed in and withdrawn in like manner until the liquid comes away fairly clear. The rubber tubing and funnel can be used in a similar manner : warm water being poured into the funnel, which, when raised, allows the water to pass into the stomach ; on lowering the funnel the gastric contents can be syphoned away, and thus the stomach washed out.

Faradism.—For the common occurrence of a drunken and disorderly person being brought to the hospital, and refusing to give his or her name and address, faradism, strong enough to produce painful contraction of the muscles, will generally prove effectual when it is really worth while.

Acute Alcoholism.—A short experience will enable the dresser to separate ordinary cases of drunkenness from other forms of poisoning, and we need not particularize its symptoms. It is undesirable also to attempt a hard and fast differential diagnosis between the higher grades of acute alcoholism and other grave conditions, but this is for a different reason, namely because it is now not an alternative question, " drunk or dying ? " but a positive statement, " drunk, *and* dying." Any patient who has swallowed enough alcohol to produce symptoms which may be confounded with apoplexy or any other severe illness, must be considered to be poisoned and to be in need of careful treatment. If brought to hospital he should be kept in until the severe symptoms have passed, since it may be impossible to distinguish severe alcoholic poisoning from cerebral hæmorrhage.

In these cases the condition of the circulation and respiration will be the best guide as to whether the patient may be left to recover from his stupor without further measures beyond those which are required for keeping him warm, or whether the *stomach pump* should be used ; but in most cases

it will be best to wash the stomach out with warm water, and this should always be done if there be any sign of failure of the heart's action, or if the breathing be suspiciously shallow. Alcohol may remain for a long time nearly unchanged in the stomach, and should therefore be removed, to prevent further absorption. In extreme cases, artificial respiration may be called for, but these are generally speedily fatal.

In acute alcoholic poisoning, as distinguished from simple drunkenness, if the stomach pump be not at hand, emetics may be used, but as it is undesirable to irritate further the already injured stomach, preference should always be given to the pump if possible. This irritable condition of the stomach should always be kept in mind in the treatment of the case after the acute stage has passed.

In acute alcoholic poisoning, after withdrawing the contents of the stomach or after the use of an emetic, about a pint of strong, warm coffee should be given. The patient should be kept warm, and if there is heart failure, 5 min. liq. strychninæ may be given hypodermically, and repeated if necessary.

Ether.—This form of intoxication is hardly known in England, but attention has been called to its frequent occurrence in some parts of Ireland. As a result of inhalation, it is of daily occurrence in all hospitals. When it is swallowed, its effects nearly resemble those of alcohol, but the period of excitement is more marked, and that of stupor less so. It is much more rapidly eliminated, so that the whole intoxication is shorter, and is less poisonous, although fatal cases have been recorded. Its treatment is that of alcoholic poisoning.

Paraffin or one of the so-called mineral oils may be taken accidentally or with suicidal intent, and when swallowed produces flushing and excitement, followed by drowsiness. In these cases the major part of the oil is generally vomited spontaneously, but the stomach-pump should in all cases

be used, or failing that, an emetic should be given.

Opium Poisoning, or Poisoning by its Alkaloids, is very common, and is becoming more so, not from any increase of suicide by this means, but from inadvertence occurring amongst the growing class of people who have acquired the habit of administering the drug to themselves.

When opium is taken for suicidal purposes, laudanum is generally employed, and it often happens that the suicide swallows a very large quantity. This very frequently leads to failure through the active vomiting which is set up.

The Symptoms of opium poisoning are generally distinct enough. The slow, shallow respiration and feeble fluttering pulse, the pallid, almost livid skin, covered with a cold sweat, the obstinate drowsiness or profound stupor, and above all, the fixed contracted pupils, are sufficient evidence of the condition, without any external or circumstantial proofs.

TREATMENT.—In this condition the respiratory centre is the part in greatest danger of striking work, and it must be kept going until the poison has been eliminated. By every possible means the patient must be roused, and *kept awake.*

If the poison has been taken by the mouth, the stomach should be immediately washed out by means of the pump or soft tube, as described above, and the contents withdrawn. If no stomach pump or tube is available, an emetic will be necessary (*vide supra*, under " Alcoholic Poisoning "). As soon as the contents of the stomach have been removed, a solution of permanganate of potash should be given as an antidote. Two ounces of the liq. potass. permang. B.P., diluted with 10 oz. of water, or 10 gr. of potassium permanganate crystals dissolved in half a pint of water, are suitable quantities for administration. It is most important that the respiration of the patient be kept up ; thus ammonia vapour should be applied to the nostrils

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in the form of smelling-salts, and in severe cases artificial respiration is always to be resorted to.

Faradic stimulation of the phrenic nerve is useful; oxygen should be administered in severe cases.

Both atropine and strychnine are useful antidotes in opium poisoning, and should be administered hypodermically. Thus an injection of liq. strychninæ 6 min., and liq. atrop. sulph. 3 min., should be given in a severe case at once. After half an hour to an hour the stomach should be again washed out, and about a pint of very strong, warm coffee introduced, or if no stomach pump is available, the coffee is given without removal of the gastric contents. The patient must be kept warm, and the respiration kept going by the above means. Hypodermic injections of strychnine 3 min. every two hours should be continued until the breathing improves. In severe cases it is unwise to walk the patient about, as this often leads to heart failure.

When improvement has once commenced, it is generally continuous. The pupils may remain contracted for a long time, but when the respiration and circulation appear to be well established, and the patient is able to keep himself awake, the best treatment will be warmth in bed, when natural sleep will probably soon come on and may be encouraged. The patient should be watched, however, lest the respiration should again begin to fail and other symptoms of poisoning re-develop. It is important also to keep a close watch on the pulse and condition of the heart, since attacks of heart failure are common after the patient has apparently recovered from the symptoms of respiratory failure. Rest in bed for a few days is essential. Hypodermic injections of strychnine should be continued for two or three days, and ammonia and digitalis given by the mouth in a suitable mixture. Alcoholic stimulants seem to be hurtful in all stages of the poisoning.

Strychnine. — This alkaloid is a common

ingredient of " vermin powders," " beetle paste," and the like, so that strychnine poisoning by misadventure is rather frequent. The symptoms may be mistaken for those of acute tetanus, but this error can hardly be made if attention be carefully given to the case for a short time. The condition is a " tetanus " in both cases ; but in the poisoning, the rapid development and acuteness of the attack, the universality of the convulsions, as opposed to the almost invariable spreading from the neck and jaw muscles in the ordinary tetanus, the nearly complete relaxation in the intermittent periods, and the fact that the duration of the whole attack is to be measured by hours—all these will enable a diagnosis to be made with almost absolute certainty, although indeed this is of the less importance in that the treatment may be much the same in either case. It is stated that in strychnine convulsions consciousness is usually retained. This is by no means always the case, and the condition sometimes resembles an epileptic fit ; however, between the convulsions consciousness usually returns, while in the " status epilepticus " of epilepsy the patient remains deeply comatose. In a case presenting severe convulsions where strychnine poisoning is suspected, careful enquiries should be made as to the taking of drugs, medicines, food, etc., since the symptoms are usually rapid in onset. The convulsions of acute meningitis, uræmia, and cerebral irritation from local lesions are distinguished by the marked associated symptoms and by the less sudden nature of the onset.

SYMPTOMS.—In strychnine poisoning there is a very short period of abnormal restlessness, quickly followed by a general trembling, and then a general convulsion occurs, with complete opisthotonos, and marked " risus sardonicus " and cyanosis. In half a minute, or a minute, the spasm relaxes, and there is a period of exhaustion and respite, to be succeeded on the slightest irritation, or apparently without

any cause, by a similar storm of reflex contraction. Death will generally be from asphyxia or exhaustion, and may occur in less than an hour. If the dose has not been a fatal one, the convulsions will gradually diminish in frequency and force.

TREATMENT.—The main reliance must be placed upon inhalations of chloroform, and when the patient is under the anæsthetic the stomach should be washed out (*vide supra*), and large and frequently repeated doses of chloral hydrate and bromide of potassium given. Chloral hydrate may be given hypodermically in 5-gr. doses dissolved in water, and frequently repeated. Nitrite of amyl may be inhaled, and artificial respiration performed if possible. The administration of oxygen is of service in severe cases. If by any means the first few hours can be tided over, hopes of recovery may be fairly entertained.

Belladonna Poisoning is generally accidental, as from eating the berries of the deadly nightshade (*Atropa belladonna*), swallowing belladonna liniment (which contains spirit and camphor in addition to belladonna), or glycerin and belladonna, or some preparation containing atropine or belladonna, or through some similar mistake. The *symptoms* are very characteristic. The pupils are widely dilated, and the skin capillaries injected, producing a rash like that of scarlatina. There is much cerebral excitement; the delirium is generally chattering and restless, but may be extremely violent. The mouth is always parched, the skin very dry, and the temperature often raised.

Emesis must be produced by the stomach pump, or by a suitable emetic (*vide* under " Alcoholic Poisoning "), and following this, stimulants in the shape of alcohol or ether, as well as strong tea or coffee, which are also useful from the tannin they contain. Artificial respiration may be necessary in very severe cases, and in others external stimuli, such as douche, faradization, etc.

Both morphia and chloral have an antagonistic action to atropia, but this is in neither case so distinct as that of pilocarpine. Tabloids containing from $\frac{1}{10}$ gr. to $\frac{1}{2}$ gr. of the nitrate of pilocarpine are now procurable, and are very convenient when it is desirable to use the drug in an emergency. One-third of a grain of nitrate of pilocarpine in solution should be given hypodermically, and repeated every two hours until the skin becomes moist. In cases where there is much delirium, morphia hypodermically in $\frac{1}{2}$-gr. doses of the tartrate may be substituted for the pilocarpine. Hot coffee should be given by the mouth. The patient should be kept warm, and oxygen administered if there is collapse ; artificial respiration may be necessary in severe cases. Retention of urine is common in these cases, calling for the use of the catheter.

Prussic Acid Poisoning.—The action of hydrocyanic acid is so intense that death is often almost instantaneous, or there may be just time enough for a cry of agony. Even in less acute cases the symptoms come on within a few minutes. There is first respiratory difficulty, and then a period of violent convulsive movements, which are general throughout the body, but especially affect the expiratory muscles. Vomiting, and involuntary urination and defæcation, occur. This stage is followed by a period of calm, with rapidly deepening paralysis and cyanosis. This usually is quickly followed by death. In fact the whole attack is one of acute asphyxia.

TREATMENT.—Should there be time for any attempts at restoration, an emetic should be given, or the stomach pump used, if it can be employed *at once*, and then ammonia on a handkerchief, as strong as can be borne by the patient, should be inhaled, and other stimulants freely given by the mouth if they can be swallowed ; if not, then brandy and ether should be given hypodermically. Stimulant enemata may also be made use of.

Alternate douches of cold and hot water are powerful stimuli to respiration, and strong faradization should always be applied if possible. Artificial respiration will most probably be called for as soon as the convulsive stage is over, and must be persevered in, although the condition may seem to be almost hopeless. Atropine should be given hypodermically, e.g., 4 min. of the liquor atrop. sulph. B.P., immediately, repeated if necessary.

The materials used for prussic acid poisoning are usually either impure bitter almond oil, or the pharmacopœial, or " Scheele's " acid, or potassium cyanide, which is used by photographers, or by gardeners to destroy wasps and hornets.

Nitrobenzene.—This is an oily liquid smelling of almonds ; it is sometimes known as commercial oil of bitter almonds. If taken internally, symptoms commence in a quarter of an hour to two or three hours. Headache, vomiting, marked cyanosis, and giddiness, with much collapse, are the characteristic features of a case, and if much poison is absorbed coma is likely to supervene.

TREATMENT.—The stomach should be thoroughly washed out or an emetic given at once. Stimulants and external warmth, liq. strychninæ 3 min. every hour for a few hours. Oxygen inhalations and artificial respiration may be necessary.

Chloral.—The symptoms resemble in great measure those of opium poisoning, but the fixed contraction of the pupils is absent, and the circulation is affected quite as much as is the respiration.

TREATMENT.—The stomach should be washed out at once, or an emetic given. The patient must be kept warm. A pint of hot coffee should be given by the mouth. Inject. strychninæ hypoderm. 5 min. should be given at once and repeated in half an hour if necessary. Oxygen inhalations are beneficial, and artificial respiration will be necessary in a severe case. The subsequent treatment is directed against the heart failure which is likely to supervene (vide supra, " Opium Poisoning ").

Irritant and Corrosive Poisons may conveniently be grouped together, for the symptoms of the latter only differ from the former in their greater intensity. Moreover, many of the substances in our list are irritant poisons in weaker solutions, and corrosive when concentrated. In most cases the local effects are so marked that any constitutional results of their absorption are unnoticed.

SYMPTOMS.—The following is the general sequence of events after an irritant poison has been swallowed. There is first a burning, metallic taste in the mouth and throat, and then a sense of intolerable pain referred to the chest, behind the sternum (heartburn). This is followed by increasing general abdominal pain, so that the legs are drawn up, as in peritonitis, and the belly becomes tumid. Vomiting is almost invariably present, and there is generally great thirst.

If the poison has been taken in a quantity insufficient to cause speedy death, and if it be *irritant* only, and not corrosive, the above are the chief symptoms. In the less severe cases these may, with appropriate treatment, be subdued ; on the other hand, if the dose be a fatal one, the symptoms of irritation will quickly be followed by dyspnœa and increasing collapse, so that the patient looks to be in the algid stage of cholera, and this will continue until death by syncope occurs.

But if the substance be truly *corrosive* in its action, such as one of the concentrated mineral acids, the symptoms are even more severe, and run a much more acute course ; it is probable that no recovery has ever taken place after any considerable quantity of such a poison has passed into the stomach, although instances are common of great damage to the throat and œsophagus being followed by recovery, or by recovery in the first instance ; for generally the consequent cicatrization has led to contraction and stricture.

The damage to the lips and throat is the first and

most prominent symptom, and gives the measure of the extent of the corrosion of the parts lower down. The corners of the mouth may be marked, and the tongue and palate covered, with a whitish coat of slough, " like a coat of white paint," if sulphuric or hydrochloric acid or corrosive sublimate has been used ; or with a yellow stain, in the case of nitric acid.

In the presence of these signs of corrosion a very few minutes will decide whether the poison has been really swallowed. If so, the symptoms which have just been detailed will develop, but more rapidly and more acutely. The *stage of collapse* is reached more quickly, and there are signs of actual corrosion of the viscera. The vomit contains shreds of sloughing mucous membrane, or, it may be, casts of whole sections of the œsophagus. The abdomen becomes enormously distended with gas. The dyspnœa and dysphagia are both intense, and death usually occurs within a few hours.

TREATMENT.—In many respects the treatment of poisoning by irritant and corrosive substances is common to them all ; and again, with regard to many, there are some particular antidotal drugs, or some special measures to be taken or avoided.

With corrosive poisons, such as sulphuric, hydrochloric, or nitric acids, and the caustic alkalies, it is unsafe to use the stomach pump or to give emetics, as there would be great risk of perforation. The appropriate antidote should be given freely, and by it the poison is readily neutralized. In the case of the irritant poisons, such as oxalic acid, carbolic acid, and corrosive sublimate, which are only to a slight extent corrosive, the appropriate antidote should be given at once, and then the contents of the stomach may be carefully withdrawn and a fresh quantity of antidote introduced.

As soon as the stomach has been relieved of the poison, raw egg albumen, milk, barley-water, arrowroot, or whatever mucilaginous fluid can be

most readily procured, should be given. Egg albumen, raw, is probably the best of all in all cases, as well as having a special action on corrosive sublimate. Salad oil may generally be given with good results, except in the case of phosphorus poisoning. The rest of the general treatment of irritant poison will be directed towards the symptoms of peritonitis and collapse. The pain must be subdued with full doses of opiates. The warmth of the body must be maintained, and the other signs of shock combated by such stimulation as the inhalation of ammonia or nitrite of amyl, the subcutaneous injection of liq. strychninæ or of ether and brandy, stimulant enemata, faradization of the extremities, etc. Morphia by hypodermic injection will also generally be indicated.

SPECIAL POINTS IN THE TREATMENT OF PARTICULAR IRRITANT & CORROSIVE POISONS.

1. *Irritant and Corrosive Acids.*—These comprise sulphuric, nitric, hydrochloric, oxalic, and carbolic acids ; the symptoms in the case of the first three will be similar, and in accordance with those results of swallowing any corrosive fluid which have just been described. The acuteness of the symptoms will vary directly with the strength of the solution, and inversely with the quantity of food in the stomach. In all, if a strong solution be actually swallowed, the symptoms will be of the most urgent kind, and will be rapidly fatal if not at once counteracted, so that time is of the utmost importance. The stomach pump may not safely be used. The charring in the case of nitric acid is yellow, and the vomit possesses a nitrous smell. In sulphuric and hydrochloric acids, the lips and mouth are whitish, and the vomit dark or black, containing charred shreds of mucous membrane.

The TREATMENT lies in diluting and neutralizing the acid as quickly as possible, so that all remedies should themselves be copiously diluted. Oxide of

magnesia and water, lime-water (the saccharated is the best), whiting and water, chalk and water, ordinary washing soda, or the bicarbonates of soda or potash, in solution, are all useful alkaline remedies. Some of them will almost certainly be at hand in any given case, and it should always be borne in mind that the nearest remedy is the best.

In addition to alkalies, milk, olive oil, and the other demulcents mentioned above are all useful.

After the antidote has been given in full amounts to neutralize the acid, it is best to avoid giving food by the mouth, but to give rectal injections of warm saline, and to keep the patient warm and guard against collapse as far as possible. Morphia hypodermically will be called for to relieve pain, and strychnine hypodermically for the collapse, with the addition of brandy if necessary.

In poisoning by *Oxalic Acid* or by *Salts of Sorrel* (the acid oxalate of potash) the main special point to bear in mind is that the alkaline oxalates are soluble and poisonous, so that chalk, whiting, or lime-water must be used to neutralize the acid, and not soda, potash, or ammonia, or the carbonates of any of these. Oxalic acid poisoning is rather common, and is frequently suicidal. The symptoms are those already detailed, save that collapse is often disproportionately marked, and that death may be very speedy.

The best antidote is a mixture of whiting with saccharated lime-water. After 'this, the stomach may be carefully washed out in a few minutes. Strychnine, and also brandy or spirits of ether, hypodermically, must be given to counteract the collapse. The patient must be kept warm, and oxygen given, and brandy by the mouth if necessary.

Carbolic Acid Poisoning is now perhaps the commonest of all forms of poisoning by misadventure, and is also used for the purposes of suicide. Its corrosive action is, in concentrated solutions, very conspicuous, but the destruction does not

extend deeply into the tissues. The mouth and jaws are usually covered with a white, leathery pellicle. The symptoms are those of poisoning by any corrosive fluids, but pain is less intense than in the case of other acids, owing to the anæsthetic action of the acid on the nerve terminations. The symptoms are less acute than in the case of the corrosive acids, but collapse is likely to occur early and coma to supervene. Suppression of urine may occur.

TREATMENT.—Saccharated lime-water should be given freely (one or two pints), since this converts the phenol into an inert compound (ordinary lime-water has the same effect, but more is necessary). The stomach should be washed out with warm water, or with the same alkaline solution, three or four times, half a pint or so of the solution being afterwards left in the stomach. In the absence of the stomach-pump, vomiting must be produced by mustard and water. Later on, demulcents, such as barley-water, olive oil, etc., may be given, or an ounce of castor oil.

Shock is very often marked, and must be treated by frictional warmth, ammonia, etc., as before stated. Hypodermic injections of strychnine should be administered, and oxygen inhalations.

The urine is often dark and scanty, and may be suppressed in acute carbolic acid poisoning. The carboluria is then a grave symptom, but it often happens in surgical cases that carbolic acid, not necessarily used in very large quantities, is absorbed and produces a similar inky urine. Some patients seem to be especially susceptible to this mild form of carbolic acid poisoning, which apparently does them no harm provided the source of the poison is removed as soon as possible.

2. For *Corrosive Sublimate* (perchloride of mercury), the acid nitrate of mercury, etc., albumen in any shape (even gluten of flour is better than none, but raw white of egg is best) should be freely given, as an insoluble albuminate is thus formed.

Emesis should be encouraged by warm water or mustard and water, if vomiting be not active without such aid. If the solution has been concentrated, the stomach-pump must only be used with great care. Afterwards the patient must be kept warm and morphia administered hypodermically, with starch and opium enemata if necessary to allay the purging which often occurs. Strychnine hypodermically may be required for collapse.

3. *Arsenical Poisoning* is generally effected by arsenious acid (white arsenic), sometimes given with criminal intent. The symptoms come on usually in one-half to one hour after taking the poison. The vomiting and purging resemble at first an intensely violent bilious attack ; afterwards the symptoms are more like acute cholera, and the diagnosis is often obscure. The emesis must be encouraged, and the stomach should be thoroughly washed out with warm water, and the contents removed. Freshly precipitated ferric hydrate should be given as an antidote : this may be prepared by diluting half an ounce of the tincture of perchloride of iron with half a tumblerful of water and adding half an ounce of a strong solution of carbonate of soda (until the mixture is definitely alkaline) ; the precipitate is well stirred up in the liquid, and the mixture given at once. In place of the ferric hydrate, drachm doses of the solution of dialyzed iron diluted with water may be administered. Saccharated lime-water freely given might be of service in the place of the iron preparations. For the collapse which follows, warmth and stimulants, e.g., brandy, and strychnine hypodermically, are necessary. Morphia hypodermically will be necessary for the diarrhœa and vomiting, and starch and opium enemata will relieve the tenesmus and purging.

If the diagnosis of the acute form of this poisoning is not generally easy, that of chronic arsenical poisoning is always difficult, but this condition does not fall under the heading of emergencies.

4. *Antimony* (*Tartar Emetic*).—The symptoms come on soon, and generally the vomiting is so violent that the whole of the poison is soon ejected. If not, the symptoms resemble those of arsenical poisoning, but there is more depression. The treatment is the same as in arsenical poisoning ; but in addition *tannin* should be given in the form of very strong tea or coffee, or by means of preparations of oak or cinchona bark, or of tannic acid itself.

5. *Phosphorus.*—This is usually taken in the form of beetle paste, or rat paste, or sometimes by swallowing the heads of lucifer matches. In these cases the symptoms declare themselves quickly after the poison has been taken, and are generally prolonged over days, or it may be weeks. The prominent symptoms are great thirst, with heartburn and violent vomiting, the vomit being phosphorescent in the dark, and frequently black and grumous from altered blood, and the breath smells strongly of the poison.

The result will mainly depend on whether the vomiting be sufficiently active to prevent an absorption of a really poisonous amount. If the quantity absorbed be large, the symptoms remain acute ; hæmatemesis and bloody purging are often present, with cramps, and finally coma. But if only a small, but still poisonous, quantity has been taken (say $\frac{1}{2}$ to 1 gr.), after the first indications of irritation have passed over, the symptoms usually subside for a day or two, and then symptoms like those of acute atrophy of the liver begin to declare themselves. The jaundice deepens, and a comatose, typhoid condition, with delirium, generally ends in death in a few days, although in some of the milder cases recovery may take place. The early treatment of the poisoning does not differ from that of other irritants, save that *oil*, in which phosphorus is soluble, *should never be employed* with the idea of soothing the intestinal mucous membrane. After the stomach has been

emptied of its contents, either naturally or with the stomach-pump, permanganate of potash solution (*vide* " Opium Poisoning ") should be given by the mouth, or Sanitas in 4-dr. doses well diluted, or the French oil of turpentine in doses of ½-dr. suspended in mucilage and frequently repeated. These antidotes contain nascent oxygen, which will convert the phosphorus into the non-poisonous phosphoric acid. The subsequent treatment is similar to that of arsenical poisoning in its later stages. *Chronic phosphorus poisoning*, phosphorus necrosis, etc., are not here discussed.

6. *Caustic Alkalies and their Carbonates.*—This form of poisoning is rare, but potash or soda lye is sometimes taken. The symptoms are those of ordinary corrosive poisoning, except that violent purging is generally a prominent symptom. In the treatment the use of the stomach-pump must be avoided. Weak acids, such as vinegar and water, or any of the dilute non-poisonous acids, such as citric or tartaric acids, 4 dr. dissolved in a pint of water, should always be given. The subsequent treatment is similar to that of corrosive acids in the later stages.

Poisonous Foods.—A form of acute gastro-intestinal irritation, often so severe as to justify the term poisoning, is not infrequent as a result of eating shell-fish, especially mussels.

In the treatment, an emetic should be given in the first place, and afterwards a full dose of castor oil with 20 min. of laudanum. Warmth and stimulants are necessary for the collapse. Morphia hypodermically for the vomiting and diarrhœa, and a starch and opium enema if necessary.

Mushroom Poisoning should not go without mention. Most fungi, edible or inedible, may produce, if improperly cooked, symptoms of a mild degree of irritant poisoning, similar to those which have been mentioned, and may be treated in a similar way. But cases of true *muscarine* poison-

ing exhibit a much higher grade of toxic symptoms. The fungi which contain muscarine or some similar alkaloid are not very numerous in England, the principal one being the fly fungus (*Amanita muscaria*). When the more actively poisonous fungi have been eaten, as a rule great cerebral excitement is caused, in addition to the more strictly irritative effects on the alimentary tract.

In the antagonism between *muscarine* and *atropia* we have perhaps the best example of this mode of the physiological action of drugs. Digitalis also, though in a less degree, is antagonistic to muscarine. Whenever, therefore, the symptoms of mushroom poisoning are grave, and especially if there be delirium or mania, atropia should be given, say 3 to 5 min. of the liq. atropinæ by the mouth, or 2 min. subcutaneously, or as an alternative treatment, full doses of the tincture or infusion of digitalis may be administered. In other respects the treatment should consist in removing the poison from the alimentary tract as soon as possible, by means of the stomach pump or an emetic, and by the administration of an ounce of castor oil as a purgative. Where there are marked gastro-intestinal symptoms, morphia hypodermically should be given, and starch and opium enemata, warmth, and stimulants are necessary for the collapse.

OF THE WASHING OUT OF THE STOMACH, AND OF THE USE OF THE STOMACH TUBE.

The use of the stomach tube in cases of poisoning has been already several times alluded to, but it is employed on many other occasions as well, as for the feeding of refractory patients, or in the treatment of some forms of dyspepsia.

The flute-key stomach pump was formerly much used; but the simple apparatus represented in *Fig.* 87 has almost entirely superseded it. This consists of a wooden mouth gag, and of a long stiff

indiarubber œsophageal tube to which a funnel is attached. The fluid is poured into the funnel when at (*a*). Then the funnel is depressed to (*b*) below the level of the stomach, when the fluid runs out again by siphon action. The process can be repeated as often as necessary. The tube must be sufficiently stiff to pass easily.

The important point in the use of the stomach tube is its insertion. In restless or refractory patients it will be necessary to use a gag, and although almost any form will do, the best is a piece of hard wood, that will lie across the mouth between the front molar teeth, and broad enough to allow of a hole being bored through its centre, through which the tube can be passed (*Fig.* 87).

In other cases no gag is required, and then the tube, which is made of india-rubber, having been warmed and lubricated with glycerin, can be passed with the right hand and guided by the left forefinger through the pharynx and down the gullet with much greater ease. As soon as the end of the tube enters the œsophagus the choking usually stops. Supposing the case to be one in which the removal of something hurtful from the stomach is the object of the operation:

Fig. 87.—Stomach Tube.

after the tube has been passed, not less than half a pint of warm water or of some special fluid must be injected into the stomach, before anything is allowed to return. The stomach may then safely be emptied, and the process of injection and syphonage repeated until the object is attained.

In cases of poisoning, a pint of water, or of some bland, soothing fluid, should be left in the stomach; as also in the case of simple drunkenness, unless it be desired to leave an emetic injection instead. If, however, the pump has been employed for the purpose of washing the mucous membrane and removing the fermenting secretions of water-brash or similar forms of dyspepsia, only that amount of fluid should be left behind which the pump will not readily remove.

OF THE HYPODERMIC SYRINGE.

There are a number of patterns of hypodermic syringes, but their varieties involve no real difference of principle. They are all graduated to deliver the fluid to be injected by measured drops, and it
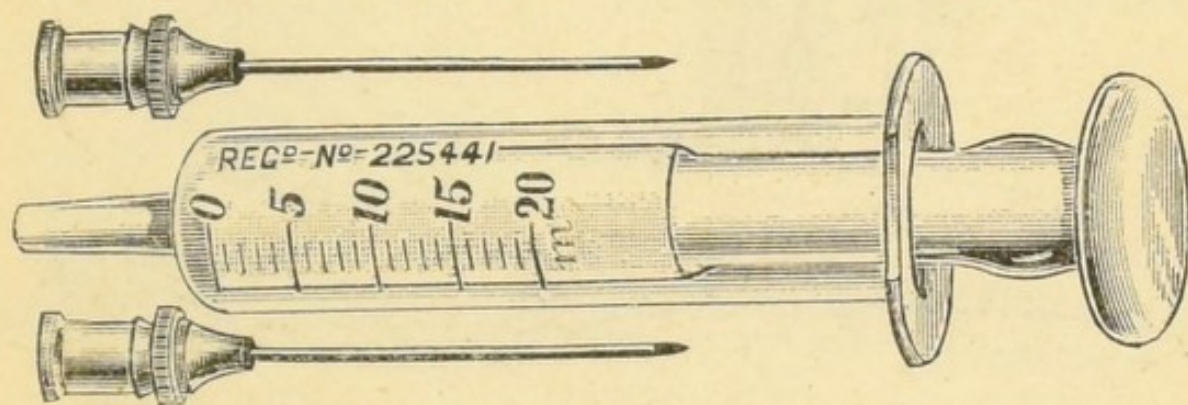
Fig. 88.—All-glass Syringe for Hypodermic Injection.

matters little if this be effected by a screw or a thrust piston. *Fig.* 88 is an illustration of a good form of the instrument.

In *Fig.* 89 we have shown the manner of inserting the hypodermic needle. The special points to be observed are:

1. Scrupulous attention must be paid to cleanliness. Those forms of syringe should be used which can be readily sterilized. The skin of the patient should be cleansed at the site of injection. Care should be taken that the solutions used are recent and are made with sterilized water, and that the needle is boiled before use. Special attention must be paid to the needle after it has been used for

injecting patients suffering from such infectious diseases as erysipelas, anthrax, etc. Numerous deaths have been recorded through inattention to this point, disease being conveyed from one patient to another by the infected hypodermic syringe.

2. That the needle should be thrust into the subcutaneous tissue at some place where it is loose and where the skin is free from veins. The back of the forearm is usually chosen.

3. The fluid having been injected, the needle should be withdrawn quickly, and then, the punc-
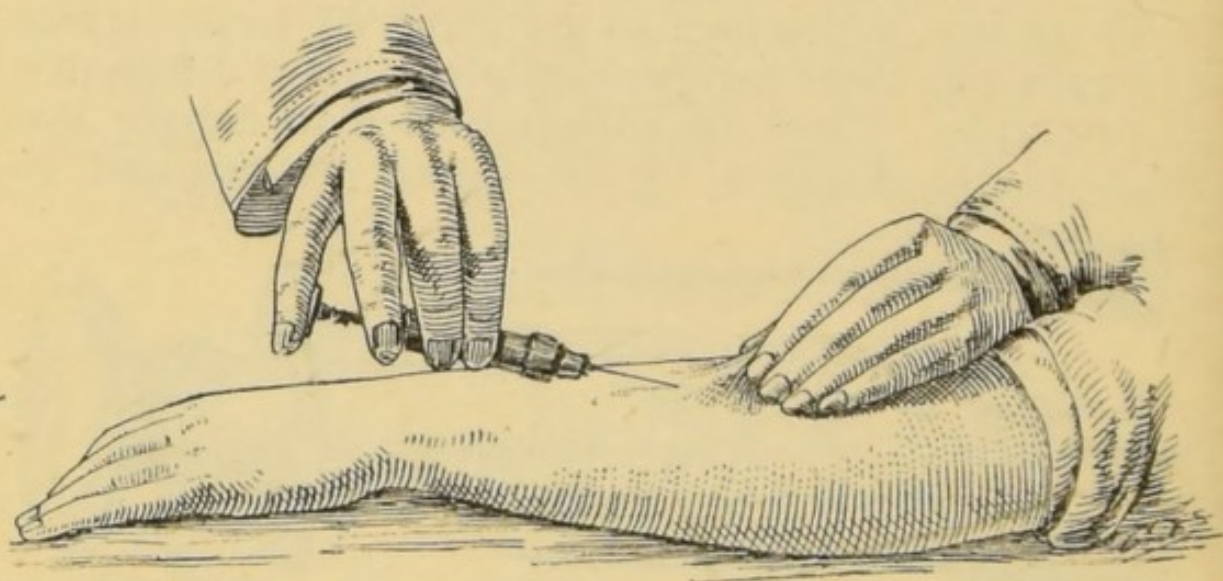
Fig. 89.—Method of Hypodermic Injection.

ture being covered by the point of the finger, the injected fluid should be dispersed into the tissues by gentle rubbing.

4. Lastly, and this point we would most strongly insist upon, no surgeon, house-surgeon, or dresser, should ever be induced to instruct a patient, or any one of the laity, in the art of self-injection. A syringe and a bottle of morphia are tools far too unsafe, and far too seductive, to leave in hands where they may be tampered with, and used, it may be unwittingly, as agents for self-destruction.

Chapter XII.

OF SURGICAL CASE-TAKING.

THE art of taking notes of surgical cases well is one not easily acquired, and for the notes to be of much value, something more than vague general notions upon surgical subjects must be pre-supposed. Yet in many hospitals, dressers who are beginning their work in the surgical wards, or clinical clerks in the medical ones, are expected to be able to write intelligible histories of cases which are themselves, very possibly, obscure to the last degree; and further, to write these so that their account shall stand for all time as being full, true, and particular, so that those who may, on some future occasion, require to look up the case-books of the hospital will find therein a trustworthy account of whatever case, or group of cases, may be under investigation.

Notes which will perfectly fulfil these conditions can hardly be expected, and will only exceptionally be obtained from dressers, at any rate during the first few months of their ward work; but nevertheless there is hardly any other part of a dresser's work which will be so useful to him educationally as his case-taking. *Litera scripta manet*, and he will find that every case which he intelligently records (and therefore studies because he *has* to record) will remain with him a lifelong experience.

What he must aim at in his case-taking must be, first and foremost, *absolute truth*, and it will be found that sometimes there is a strong temptation to make the facts square with a preconceived theory; and secondly, to present a clear story of the case, without introducing any personal opinions, letting the facts tell their own tale.

The notes of a case, then, should comprise :—

1. A description of the patient, and of the symptoms, objective and subjective, presented by him (or her) when he first comes under the notice of whomsoever has to record the case.

2. An account of those facts in his previous life history, and in his family history, which may throw light upon his present condition, and the sources of this information.

3. The previous story of the illness derived from the patient himself, his parents, or from other people, the source being, in all cases, stated.

4. A *diary* recording the measures, operative and other, which are adopted for the relief of his complaint after he has come under observation, and the subsequent course of events.

5. The *result* of such treatment, namely, cured, relieved, unrelieved, or died, and in the last event—

6. Whether or no a post-mortem examination was made, and if so, an account of the results of this examination.

The following scheme will be found a generally convenient and workable plan for recording cases upon the lines we have here laid down.

Ward. Name.	Sex.	Age.	No. of Register. Occupation.	Date of Admission. Residence.	Date of Discharge.	Result— Cured Relieved Unrelieved Died.
By whom taken.			Name of Surgeon.		Date of taking case.	

The patient's family history,
  i.e. (a) If the parents are alive or dead, if the latter, at what ages and how.
  (b) Brothers and sisters, No. of, whether alive or dead, etc.
  (c) Place of Patient in his family.
  (d) Results of enquiries about hereditary tendencies, as to gout, insanity, tubercle, etc.

The patient's previous history,
    including (*a*) Previous illness,
          (*b*) Habits of life (state source of information).
          (*c*) Other facts bearing on this part of the case.

History of the present illness, from its commencement up to the date of taking the case, as derived from the patient or from his friends or relatives (state the source), given in as nearly as possible the words actually used by them.

The patient's condition at the time of taking the case.
    (*a*) General description. Position of patient in bed. State of nutrition, local and general. Indications of a diathesis (i.e., strumous, syphilitic, etc.). The condition of the organs of circulation, respiration and digestion. The condition of the skin and of the glands. The temperature (noting time when taken). The appearance, sp. gr., and quantity of urine passed, and note of any abnormal constituents. The condition of the organs of motion and locomotion. Sleep, its amount and character.
    (*b*) Description of actual seat of disease, its locality, its *objective* physical appearances, and the *subjective* abnormal sensations connected with it.
    (*c*) Other noteworthy local abnormalities.

The " case " being thus taken, it will be the duty of the dresser, or of whomsoever is appointed to continue the record, to preserve a consecutive account of the course of events from the moment the patient comes under treatment.

If an operation be performed, it must be fully described, especial attention being paid to the following points :—The actual incisions and manipulation, and the condition of the patient at the close of the operation. The number and method of insertion of sutures (if any used). The position of the drainage tubes. The plan of dressing the wound, the position of the patient subsequently in bed, and the nature of the anæsthetic.

If the operation be of the nature of *a removal*, either of a growth or of a limb, the notes must always describe fully the parts taken away. For example, if the thigh be amputated in its lower third for disease of the knee, the details of the condition

of the joint and its ligaments, the muscles, etc., in its neighbourhood, the cartilages and the bones, must all be fully pictured. If the operation be one for the removal of a tumour or new growth, such as an epithelioma of the lip, in addition to the naked-eye appearances of the growth, its microscopic structure should also be given.

As the case goes on, it will probably be found unnecessary to make daily entries on the case paper, but however chronic the disease in question may be, and however slow the convalesence, it will be found convenient to make some note of the patient's condition, at the very least once, and, as a rule, twice in the week, upon the occasion of the surgeon going his rounds.

The patient's temperature is now commonly taken night and morning by a ward nurse, and entered upon a chart appended to the case-book. This plan is a good one in many ways, inasmuch as the observations are made every 12 hours, and at the most suitable times, but it involves a certain risk that this condition of the patient may be over-looked by the dresser. It should therefore be a rule that the temperature readings should be entered in the notes, as well as placed upon the chart, in all serious cases.

When the notes record a patient's discharge, the extent of recovery should always be noted, and in the case of death the actual cause should be care-fully stated, if it be apparent ; in those cases where a post-mortem examination is made, the results must be fully recorded, and the dresser should be especially careful not to lose this opportunity of clearing up obscurities, and verifying and correcting opinions formed during the patient's lifetime.

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