Surgical ward work and nursing : a handbook for nurses and others / by Alexander Miles.

Contributors

Lochhead, James, active 1988.
Miles, Alexander, 1865-
Royal College of Physicians of Edinburgh

Publication/Creation

London : Scientific Press, 1911.

Persistent URL

https://wellcomecollection.org/works/pcrt5v7c

Provider

Royal College of Physicians Edinburgh

License and attribution

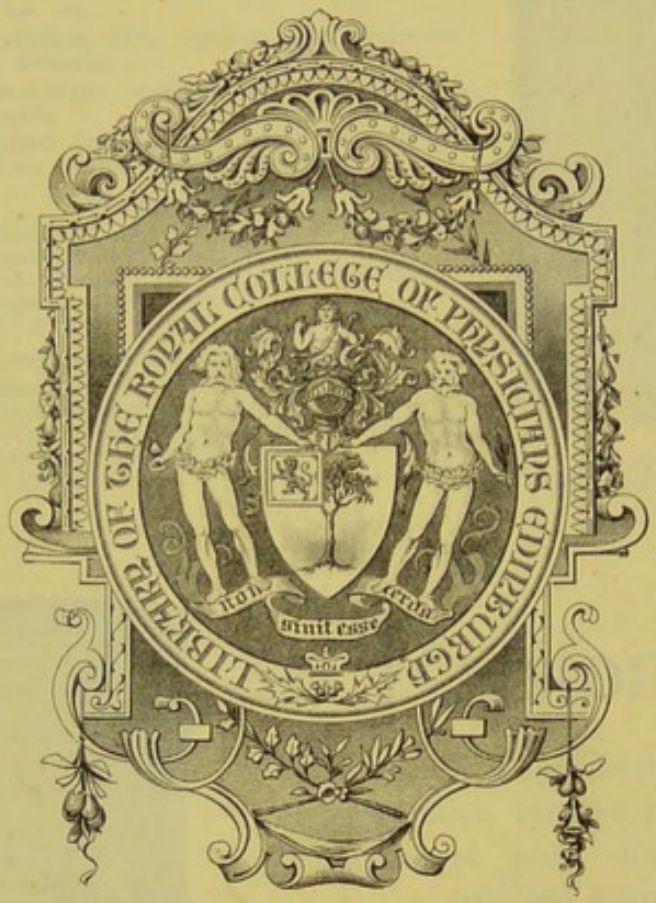
Wellcome Collection
183 Euston Road
London NW1 2BE UK
T +44 (0)20 7611 8722
E library@wellcomecollection.org
https://wellcomecollection.org

SURGICAL WARD WORK

MILES

Stack's Dressing Steriliser

Advantages claimed for this Steriliser



Allen & Hanburys Ltd.

Surgical Instrument and
Aseptic Furniture Makers,

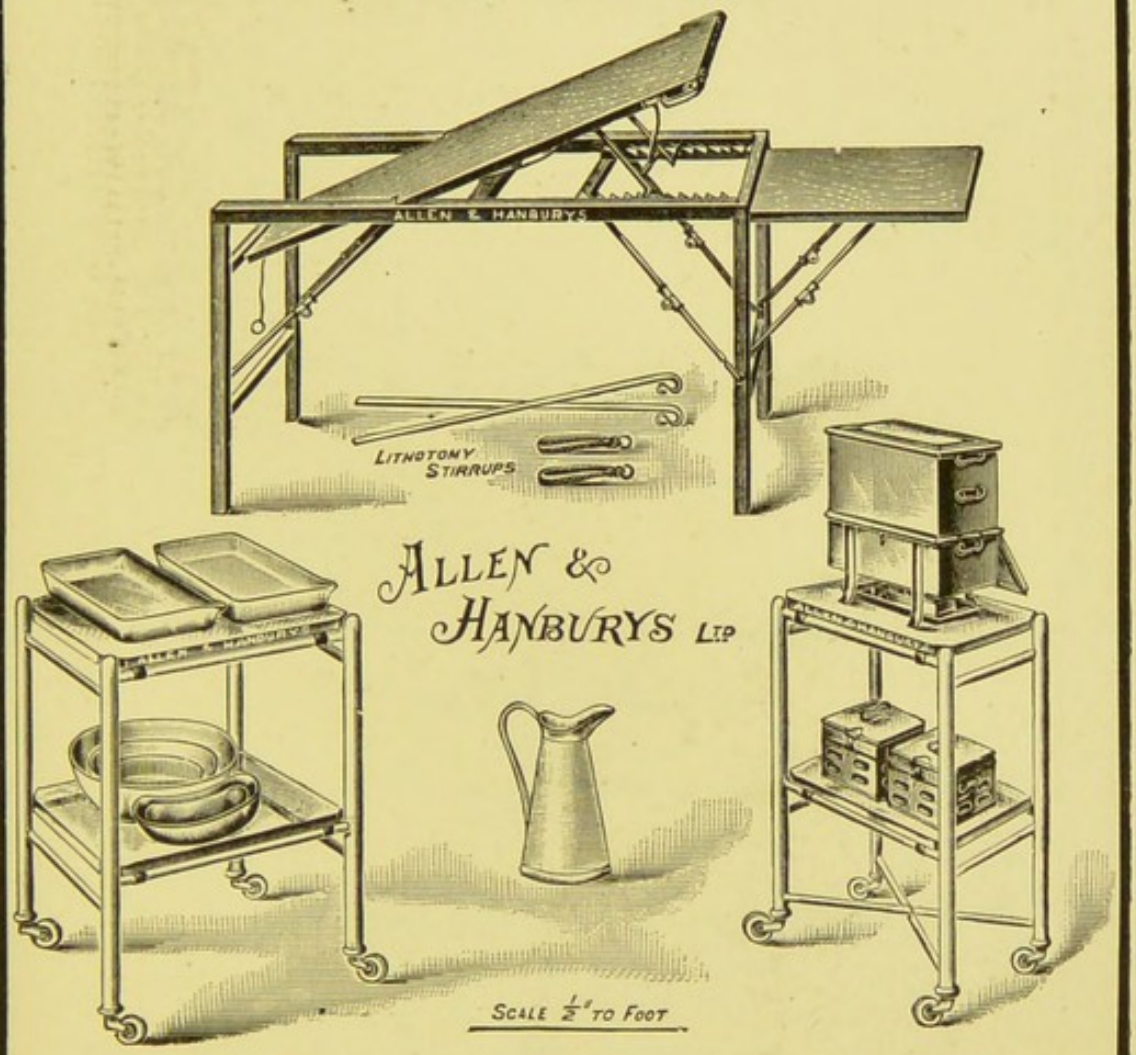
GMORE STREET, LONDON, W.

Operation Furniture on Loan

FROM

ALLEN & HANBURYS Ltd.

Comprising Lynn Thomas' Portable Operation Table, Dressing Table, Instrument Table, Steriliser, Water Jug, Trays, Dishes, etc.



The whole of the above Operating Requisites. as illustrated, can be had on hire for the moderate fee of **£1 1s.**

The Operating Table can be obtained separately for **10/6.**

Immediately on receipt of telegram or letter a complete outfit (or the table only) will be despatched to any part of the United Kingdom, carriage both ways being payable by consignee.

All kinds of Dressings may be had sterilised and packed in containers, ready for use, by stating on order what is required.

ALLEN & HANBURYS Ltd., LONDON.

SURGICAL WARD WORK

AND

NURSING

A HANDBOOK FOR NURSES AND OTHERS

BY

ALEXANDER MILES

M.D., F.R.C.S. Ed.

SURGEON, ROYAL INFIRMARY, EDINBURGH

REVISED AND LARGELY REWRITTEN WITH THE ASSISTANCE OF

JAMES LOCHHEAD

M.D., F.R.C.S. Ed.

SURGICAL TUTOR, ROYAL INFIRMARY, EDINBURGH

WITH NEARLY 400 ILLUSTRATIONS

THIRD EDITION

LONDON

THE SCIENTIFIC PRESS, LIMITED

28 & 29 SOUTHAMPTON STREET, STRAND, W.C.

1911

PREFACE TO THE THIRD EDITION.

SINCE this guide to surgical ward work was first issued eighteen years ago the methods employed in surgical practice have undergone many changes. A clearer conception of the principles underlying the Listerian idea and increased experience in their application have led to a gradual transition from the "antiseptic" to the "aseptic" phase of its evolution. The prevention of infection has now come to be recognized as the key to success in operative work, but a system which is essentially preventive involves great responsibility on all concerned in carrying it out. While the general tendency within recent years has been towards greater simplicity in technical methods, the necessity for greater attention to minute details has correspondingly increased.

Much of the responsibility falls upon the nursing staff, from whom as time goes on a higher and higher standard of efficiency is demanded. To meet the present-day requirements of surgical nurses, it has been found necessary in preparing a new edition to rewrite the greater part of the text, and generally to widen the scope of the work.

A new section has been added on General Methods of Treatment, in which the nurse's duties in regard to the administration of medicines, rectal infusions and enemata, the application of Bier's method

of treatment by artificial hyperæmia, and other matters are dealt with. The share taken by the nurse in carrying out the after-treatment has also been defined, and an attempt has been made to indicate the complications that may arise in the course of different surgical illnesses, in order that the nurse may be alive to the importance of observing and reporting their earliest signs.

Many of the old illustrations of instruments have been replaced by cuts of more modern patterns, and the line drawings of bandages have been replaced by half-tone blocks.

While this work is primarily addressed to nurses in training, it is hoped that it may continue to prove useful to House Surgeons, Sisters, and others who may be responsible for directing their studies.

To my friend, Mr. James Lochhead, on whom has fallen the greater part of the work of revision, I desire here to express my sincere thanks. I have also to acknowledge the kindness of Messrs. Wright & Sons, the publishers of Caird & Cathcart's "Surgical Handbook," in lending the blocks for Figs. 46, 48 and 160, and of the various instrument-makers who have granted the use of the illustrations of their surgical instruments.

20 WALKER STREET,
EDINBURGH, *April*, 1911.

CONTENTS.

SECTION III.

BANDAGING.

CHAPTER VII.

CHAPTER VIII.

SECTION IV.

TECHNIQUE OF OPERATION, AND THE AFTER-TREATMENT.

CHAPTER IX.

CHAPTER X.

CHAPTER XI.

CHAPTER XII.

CHAPTER XIII.

CHAPTER XIV.

CHAPTER XV.

CHAPTER XXVI.

CHAPTER XXVII.

CHAPTER XXVIII.

CHAPTER XXIX.

CHAPTER XXX.

CHAPTER XXXI.

SECTION VI.

CHAPTER XXXII.

SURGICAL WARD WORK AND NURSING

SECTION I.

WOUND TREATMENT.

CHAPTER I.

GENERAL PRINCIPLES OF WOUND TREATMENT.

THE system of wound treatment inaugurated by Lord Lister in 1867 completely revolutionized the practice of surgery, and to-day, after an interval of almost half a century, his principles still remain unchanged and unchallenged, though experience has led to a gradual modification in the methods of their application.

The first and most important lesson the surgical nurse has to learn is the principle underlying the present-day system of wound treatment.

The great aim in operative surgery is to obtain *primary union* of wounds—what used to be called healing by first intention—that is, without the occurrence of sepsis.

What is Sepsis?—Let us imagine two patients admitted to a surgical ward on the same day under similar conditions, and each requiring amputation of a limb. When the stump of the first patient is dressed on the fourth day, it is found that the deeper part of the original dressing applied at the time of the operation is stained with blood, but perfectly dry. The drainage-tube, on being withdrawn, is found to be filled with a pale-coloured blood-clot, having a faintly mawkish odour. The lips of the wound are in contact all

along the line, and there is no swelling or redness of the parts around. The stitches show no redness around them, although they may be somewhat tighter than when first introduced. Pain is absent, and there is little or no tenderness on pressure over the stump. The patient looks and feels well, and has a normal temperature, healthy pulse and good appetite.

It is very different with the other patient. The whole of the dressing, even out to the bandage, is moist with a yellow discharge which has a disagreeable odour. The stump is red, swollen and painful, and on pressure a quantity of thick yellow discharge escapes from the drainage-tube and from between the edges of the wound, which are gaping widely from one another. The stitches are tight, buried in the tissues, or cutting their way out, and discharge is seen oozing from their openings. The patient has been shivering, his temperature is 102° or 103° F., and his pulse 120, small and weak; he has no appetite, sleeps badly, and appears very ill.

The first is healing by *primary union;* the second has become *septic.*

On what does the difference depend? On the introduction of certain minute organisms, germs, microbes, or, as we prefer to call them, *bacteria*, into the wound.

It is an every-day experience that animal matter placed under certain conditions undergoes decomposition by putrefaction. These conditions are: (1) that the material is dead, or, at least, very much devitalized; (2) that it contains a certain amount of fluid; (3) that it is kept at a particular temperature; and, last and most important, that certain minute fungi or micro-organisms gain access to it.

Of this combination of circumstances essential to the septic process, it will be evident that, at least, the first three exist in every surgical wound. The tissues, in virtue of having been injured, are to some extent devitalized—"below par"—in some instances, indeed, actually dead. The discharges—blood and serum—and the normal fluids of the body tissues furnish the necessary moisture; and the ordinary temperature of the body, 98·4° F., is highly favourable. When the bacteria reach the wound, they find under these

conditions a suitable "nidus" for their growth and development, and the septic process is established.

Nature and Action of Bacteria.—So far as we are at present concerned with bacteria of surgical interest, it will suffice to say that they are divided into three different classes, according to their shape:—

1. Small *round* organisms known as *cocci*. Some occur grouped in masses like bunches of grapes, and are spoken of as *staphylococci* (Fig. 1); others form chains, and are known as *streptoccoci* (Fig. 2); others occur in pairs and are known as *diplococci* (Fig. 3).

Staphylococci give rise to localized inflammatory and suppurative conditions, such as boils, abscesses, and certain diseases of bone; streptococci produce spreading diseases, such as erysipelas and diffuse cellulitis; and diplococci produce pneumonia and gonorrhœa.

2. Short rod-like bacteria known as *bacilli* (Fig. 4). Many diseases are due to bacilli of different kinds, for example, tuberculosis, tetanus, diphtheria, and typhoid fever.

3. Long, wavy, thread-like organisms known as *spirilla* (Fig. 5). The most important spirillum is the spirochæte associated with syphilis.

Each micro-organism, to whatever class it belongs, is a small cell, consisting of a minute mass of protoplasm bounded by an envelope, and in some cases containing a quantity of coloured pigment, the commonest shades found being yellow, orange, red, and blue. These colours are best seen when the organisms are artificially cultivated in tubes containing gelatine, blood-serum, slices of raw potato, or other nutrient medium on which they may be grown, and many varieties are identified by the colour of the "colonies" which spring up under these conditions. The pus produced by certain organisms may also be coloured. Bacteria are all so minute as to require very high powers of the microscope to render them visible, and for the study of their structure and life changes.

Bacteria obtain their food by breaking up the elements of the tissues in which they find a suitable habitat, this breaking-up process being what we know as sepsis.

Not only do bacteria disorganize the tissues in which they live, and produce the local changes already described in the

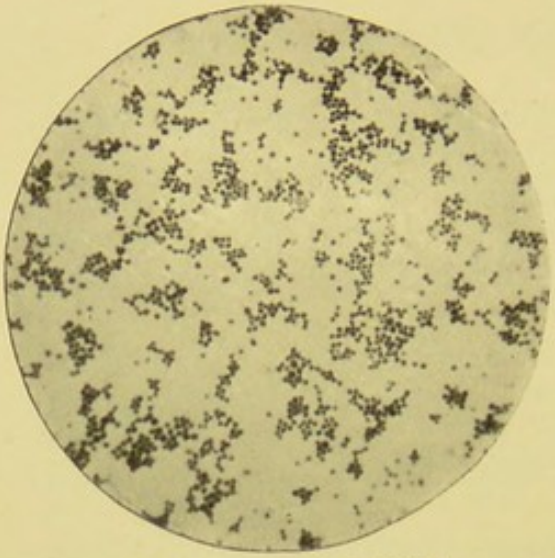


FIG. 1.—STAPHYLOCOCCI.

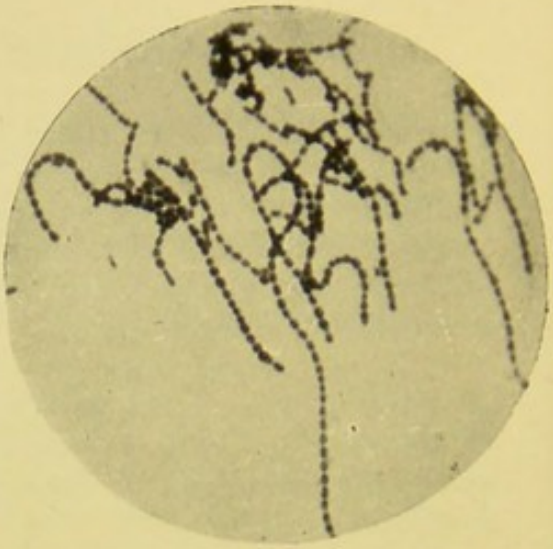


FIG. 2.—STREPTOCOCCI.

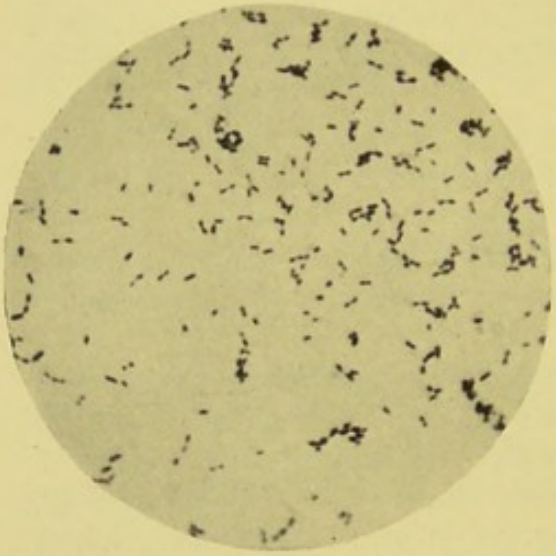


FIG. 3.—DIPLOCOCCI.

FIG. 4.—BACILLI.

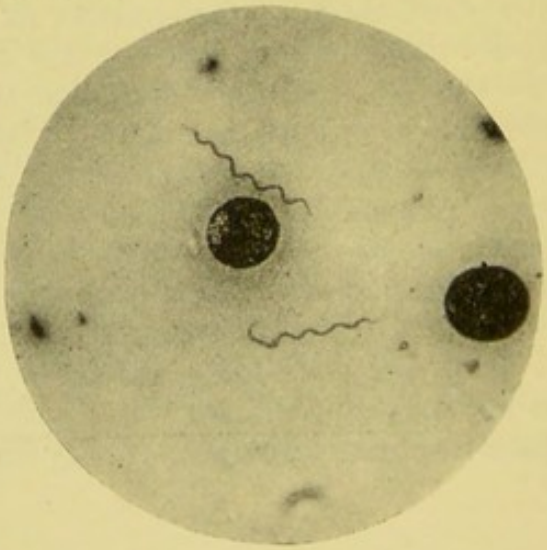


FIG. 5.—SPIRILLA.

wound, but in addition they manufacture poisonous chemical substances, known as *toxins*, which are carried to every part of the body by the blood. The circulation of these poisons in the blood-stream gives rise to the condition of *sapræmia* or *toxæmia*, which is popularly called "blood-poisoning". Unlike the toxins, the organisms usually remain in the neighbourhood of a wound to which they have gained access. But occasionally they also reach the blood and are carried to other parts of the body. There they settle down, and again produce local changes and manufacture toxins. This condition is known as *pyæmia*. Before the days of Lister it was the scourge of every hospital, but now it is seldom met with. In rare cases the bacteria, after reaching the blood, increase in numbers there, and continue to circulate instead of settling down at a fresh place in the tissues. This condition is known as *septicæmia*.

Toxæmia is associated with certain general symptoms which are the same whatever the organism is that has lodged in the wound. These are pyrexia (rise of temperature above 98·4° F.), and changes in the pulse and respirations. Observations in all three are made by the nurse, and because of their great importance to the surgeon much depends on the accuracy with which she makes her records.

The toxin produced by each micro-organism is peculiar to itself, and in many cases it gives rise, not only to the general symptoms just referred to, but also to special symptoms. By the recognition of the latter, we are able to distinguish different varieties of bacterial poisoning, for example tetanus by convulsions, and diphtheria by certain paralyses. In other cases, such as tuberculosis and anthrax, the local signs form the distinctive feature.

When organisms reach a wound, they do not necessarily increase in numbers, and produce "blood-poisoning". They may be deficient in *virulence*, that is, in the power of multiplying and of manufacturing toxins. Or, what is of greater importance, they may be destroyed by the tissues. Every part of the body has normally a *power of resistance* to the attack of micro-organisms. It is this property which prevents every accidental cut or scratch from becoming septic, although bacteria are invariably present on the edges of such

a wound. But if the power of resistance is lowered to a sufficient extent, either by the bruising around the wound or by poor general health, then the organisms are not killed off, and they increase in numbers and produce sepsis.

Further, after the septic process is established, it is resisted by the body. But for this every poisoned finger would be fatal. The most important agents in attacking bacteria and their toxins are the leucocytes or white cells of the blood, and for this purpose they are increased in numbers—a condition known as *leucocytosis*. The amount of the increase is determined by a "leucocyte count". In health, 8,000 to 10,000 leucocytes are contained in each cubic millimetre of blood, but, if sepsis is present, the number may be increased to 20,000 or over. The circulation of a toxin in the blood stimulates the leucocytes to form an antidote to the poison. This is known as the *antitoxin*. In addition, the bacteria themselves are destroyed by the leucocytes, being first stupefied by *opsonins* and then eaten up—a process known as *phagocytosis*.

The leucocytes often collect in large numbers at the infected spot, and, like an army of soldiers, attack the bacteria. In the fight many of the leucocytes are killed, and their dead bodies form *pus*. Thus it is that an abscess gradually forms in the vicinity of the bacteria. If the leucocytes win the fight, all the organisms are killed, and the pus becomes "sterile". Such a collection of pus may remain for years without doing any harm to the patient. But usually, when an abscess forms, it either bursts or is opened by the surgeon, the object being to get rid of the living bacteria which are lying among the pus-cells, and also the pus-cells themselves, so that a fresh battalion of leucocytes may take their place and continue the fight.

It is obviously important in combating sepsis to increase the patient's power of resistance to bacteria and their toxins. This may be done in different ways. In diphtheria and tetanus the antitoxin manufactured in the patient's body may be increased by injecting antitoxin obtained from the horse; or dead bacteria (*vaccines*) may be injected to increase the opsonins; or the number of leucocytes, the soldiers, may be increased in the neighbourhood of the bacteria by a hot

poultice or a blister, or by Bier's hyperæmic treatment (p. 66).

Distribution of Bacteria.—Bacteria of many varieties are exceedingly abundant under every condition of ordinary life—in the atmosphere we breathe, in the water we drink, on our clothes, our furniture, and even on our skin, so that, unless every precaution is taken to prevent it, they are almost certain to gain access to our wounds. Their omnipresence is a fact constantly to be borne in mind by all who have in their hands the treatment of surgical patients.

Surgical Cleanliness.—By surgical cleanliness alone can we hope to avoid infection of wounds, and so obtain primary union. Surgical cleanliness must be understood to mean something more than ordinary personal and domestic cleanliness. It means not only the absence of gross and visible dirt, but also the grease and superficial cells of the skin which harbour the ubiquitous germs.

Means by which a Wound may become Septic.—To illustrate the numerous ways in which bacteria may be introduced to wounds, take, for example, the case of a man who receives a scalp wound from a blow on the head with a stick. The organisms may pass directly into the wound: (1) from the *stick;* (2) from the patient's *cap;* (3) from the *hairs* in the vicinity of the wound; or (4) from the *skin* in the region. Failing these sources of infection, it may take place (5) from any *handkerchief* or *cloth* applied to the wound; (6) from *water* used to bathe it; or (7) from the *hands* of those rendering first aid. Should a doctor see the case, (8) his fingers or the *probe* used in investigating the extent of the wound may carry in organisms; (9) the *needle* or *thread* used in stitching it up; or (10) even the *dressings* he may apply, unless they are reliably antiseptic or aseptic. (11) It is not impossible that organisms may pass into such a wound with the *dust* of the air.

In the case of surgical operations, the chief sources of septic infection are: (1) The skin of the patient himself; (2) the hands of the surgeon, assistants, or nurses; (3) the instruments, ligatures, or stitches; (4) impure swabs or drainage-tubes; or (5) various other accidental sources.

The words *septic*, *aseptic*, and *antiseptic*, so constantly used

in relation to wounds and their treatment, will now be intelligible. A "septic" wound is one to which bacteria have gained access, and in which they are multiplying and producing ill effects. The term "antiseptic" is applied to anything that will counteract the process by destroying the vitality of the organisms causing it. It must be remembered that a wound may remain "aseptic" either because organisms have never gained an entrance to it, or because the tissues of the patient have been strong enough to combat the germs, and so to ward off their attack. It is a well-established axiom that "healthy tissue is our best antiseptic".

Importance of Asepsis in Wounds.—The importance of preventing sepsis in surgical wounds cannot be exaggerated. It makes the difference between successful and unsuccessful surgery, in many cases between the life and death of the patient. To mention that among septic diseases such affections as septicæmia, pyæmia, erysipelas, diffuse cellulitis, malignant pustule, and a host of others, are to be numbered, will indicate the desirability of guarding our patients from the attacks of organisms, or of destroying these should they be present.

Asepsis is the ideal of modern surgery, and in the light of recent discoveries and extended experience in the Listerian methods, it should be attainable in all cases in which the skin is unbroken when the patient comes under the care of the surgeon. Unfortunately, many patients have already been infected with septic organisms before seeking or obtaining surgical aid, and with them our endeavours must be directed to counteracting the effect of these, by improving the health of the tissues, and by a judicious use of antiseptic agents—external and internal.

As we go on, we shall find that it is only by attending to the minutiæ of antiseptic surgery, and by giving the most scrupulous attention to apparently trivial details, that we can hope to command success.

The chief *means adopted to prevent or combat septic infection* are :—

1. Ordinary personal cleanliness on the part of patient, surgeons, and nurses.

2. Surgical purification of the part to be operated upon.

3. Surgical purification of instruments, swabs, ligatures, and dressings coming in contact with the wound.

4. Surgical purification of the hands of surgeons, nurses, and others taking part in the operation.

5. Irrigation of the wound with aseptic or antiseptic lotions.

6. A surgically pure atmosphere.

7. Avoidance of all sources of contamination during the operation and at subsequent dressings.

It is important for the surgical nurse to learn at the very beginning that these precautions must be as rigidly enforced in a septic as in an aseptic dressing or operation. Otherwise organisms of different varieties would gain access by the wound, a condition spoken of as *mixed infection*, and the absorption of their various toxins would add to the patient's danger.

Such, briefly stated, are the principles on which the modern treatment of wounds is based. We now proceed to consider the methods by which they are carried out.

CHAPTER II.

LOTIONS, POWDERS AND UNGUENTS.

LOTIONS are used in various branches of surgical work—in the cleansing of the surgeons' and nurses' hands, in the dressing of septic wounds, in the preparation of the patient for operation, and in the course of the operation itself.

Two groups of lotions are in use—*aseptic* and *antiseptic*. In the preceding chapter, an aseptic wound was stated to be one in which bacteria were absent or, if present, were prevented from multiplying by the resistance of the patient's tissues. The great principle in wound treatment is to keep this power of resistance at, or bring it to, as high a level as possible. It is, however, certain that the resistance is lowered by the contact of antiseptics with the tissues. Hence, in an open aseptic wound, antiseptic applications do harm, and should not be applied. In a septic wound, in which the power of resistance is too low to prevent the increase of the bacteria, antiseptics must be used to kill the organisms, even though they lower the already deficient power of resistance.

Normal Saline Solution, or simply "saline," is extensively used in surgical practice. Its method of preparation is later described in detail (p. 61). Suffice it to say here that it is a solution of pure common salt in distilled water. It must be sterilized before it is ready for use. Unlike antiseptic lotions, it has the virtue of doing no harm to the tissues of the body. Hence it may be used in any quantity to irrigate a wound, and thus wash out bacteria which may have lodged in it. For example, it is valuable in the initial purification of a compound fracture, or for bathing

an operation wound. In addition, it is used by the surgeon to cleanse his hands or instruments of blood during an operation. The methods of its internal administration are described in chapter VI.

At an operation in a private house a supply of sterile saline solution, half of it hot and half cooled, can easily be prepared by the nurse. The salt is supplied by druggists in tablets, one to be added to a definite quantity of distilled water. But if time or opportunity does not permit of its careful preparation, boiled tap-water, with a teaspoonful of salt added for each pint, is the best substitute.

Antiseptic Lotions have within recent years been largely superseded at operations by normal saline solution, but they have many other uses in a surgical ward. As the nurse has to know something about those commonly employed, a few details about each must be given. It need hardly be said that antiseptic lotions are never to be taken by the mouth.

1. *Carbolic Acid Lotion.*—This agent is of much historical interest, being that employed by Lord Lister when he first introduced the antiseptic system in the year 1867. It is a substance derived from coal-tar by a complicated process of distillation, and in its pure, strong form is in long transparent crystals. To make a lotion, the crystals are liquefied with a few drops of glycerine, and hot water is added in various amounts. If to 1 part of the liquid carbolic acid 19 parts of water are added, the lotion is "1 in 20 carbolic". As a rule this is too strong for use, and a lotion half that strength, spoken of as "1 in 40," or even weaker ("1 in 60" to "1 in 100"), is of wider value. These lotions, if pure, are quite clear, and should they be the least turbid, impurities which will irritate the skin may be suspected.

Caution!—It must be borne in mind that carbolic acid is very poisonous, and the bottle should always bear a prominent poison label. Not only is it deleterious when taken by the mouth, but if a carbolic dressing is applied over a large area, say an ulcer or burn, it may be absorbed, and give rise to unpleasant symptoms, such as giddiness, nausea, and vomiting. As some people are peculiarly susceptible to the action of carbolic acid, it is always necessary to keep a sharp look-out on the patient, and if he shows any of these

unpleasant symptoms this lotion should be discontinued, and some other substituted. The first evidence that the lotion is being absorbed is often to be found in the urine, which is passed of an olive-green colour, and on standing becomes almost black. This in itself is not a dangerous condition, but should be accepted as a hint that the patient is intolerant of the drug, and as an indication for making a change.

The chief *advantages* of carbolic lotion are: (1) It is cheap; (2) it is reliable as a germicide; (3) it does not injure instruments or sponges.

Its *disadvantages* are: (1) It is poisonous on absorption; (2) it irritates the skin of some patients; (3) it sometimes produces gangrene of a finger or toe if applied as a wet dressing.

Uses.—Pure, liquefied with a few drops of glycerine: to sterilize septic sores, sinuses, fistulæ, the stump of an appendix, or divided bowel; to sterilize and arrest hæmorrhage from the cavity of the uterus after curettage; and in emergencies to purify instruments. *1 in 20:* to purify knives and other instruments which are damaged by boiling, the carbolic being removed by dipping them in saline immediately before use; to prepare and store towels, sponges, and drainage-tubes; and to sterilize iodoform. Weaker solutions may be used to purify the hands, or as a lotion for certain septic wounds.

2. *Corrosive Sublimate Lotion.*—This antiseptic is a preparation of mercury, and goes by various names—"corrosive," "perchloride," "bichloride," or "sublimate lotion".

The perchloride of mercury is a white crystalline substance, and is extremely poisonous. The lotion is made by dissolving the powder in distilled water or alcohol. The commonest strength in use is 1 in 2000. It is customary to keep the ward stock of 1 in 1000, and to dilute it with equal parts of hot water when 1 in 2000 is required. It is often tinted with aniline orange or other dye to distinguish it from other lotions. Corrosive sublimate in tablet form is most convenient for the private nurse, but she must know with certainty how much water to add to make a "1 in 2000" or "1 in 4000" solution. *Harrington's Solution* is 1 in 1000 corrosive in alcohol containing 6 per cent. of hydrochloric acid.

It is unfortunate that this lotion corrodes metallic instruments, as it greatly restricts its use. This property should always be borne in mind, as expensive and delicate instruments may be destroyed if placed in it. On this account, also, tin basins must not be used for corrosive lotion, the tin losing its polish, and turning the lotion black. Glass, porcelain, or enamelled dishes must be employed.

So also with syringes. A brass syringe should never be used with corrosive lotion, always a glass or vulcanite one.

Sponges should not be put into corrosive lotion, because, although it does not actually destroy, it permanently blackens them.

Corrosive lotion is at once rendered non-antiseptic by the addition of a quantity of blood or pus to it. The albumin of the blood or pus acts on the solution, forming an albuminate of mercury, which is not antiseptic. One can tell when this action has taken place by the thick brown deposit, resembling the sediment of strong beef-tea, which falls to the bottom of the basin.

Caution!—Corrosive sublimate is a most deadly poison if taken by the mouth. It should therefore bear a prominent poison label, and be placed in some position where children or delirious patients cannot reach it. It may also produce symptoms of poisoning by being absorbed through the skin, or from a wound. These symptoms are abdominal pain, diarrhoea, vomiting, and collapse, which may be followed by rapid death. A large wet dressing of corrosive sublimate should never be applied, because the contact of the lotion with the skin produces irritation, and absorption rapidly follows.

The chief *advantage* of corrosive lotion is its efficiency.

Its *disadvantages* are: (1) It is poisonous on absorption; (2) it corrodes metal instruments, tins, etc.; (3) it blackens sponges; (4) it is not antiseptic after it comes in contact with blood or pus, hence it is rarely used as a lotion for dressings.

Uses.—1 in 500: For sterilizing iodoform; for purifying the patient's skin; for purifying the hands, or the edges of an operation wound, when they have been contaminated with septic matter, e.g. pus or bowel contents. The alco-

holic solution is less irritating to the hands than the watery solution. *1 in 1000:* Same uses as 1 in 500. This is the strength which is usually kept in the stock-bottle. *1 in 2000:* This strength may be used for almost any purpose, being efficient, safe, clean, and readily procurable. *1 in 5000:* As an eye-wash; as a vaginal or uterine douche. It is prepared by adding four times as much water as 1 in 1000.

3. *Lister's Strong Solution.*—For purifying the hands of the surgeon and the skin of the patient before operation a lotion containing a mixture of carbolic and corrosive is used by some. It is prepared by making a 1 in 20 solution of carbolic acid in distilled water, and dissolving in every 500 parts of this one part of perchloride of mercury.

4. *Biniodide of Mercury.*—Within recent years this antiseptic has been gradually superseding corrosive sublimate. It is a less irritating and more powerful antiseptic than corrosive, and has the great advantages that it neither forms an inert albuminate with blood or other wound discharges, nor tarnishes instruments.

It is used in the same strengths and for the same purposes as corrosive lotion. It is prepared as follows: Dissolve 24 grains of perchloride of mercury in a pint of tepid water; also dissolve 2 drachms of iodide of potassium in a pint of tepid water; mix the two solutions and add other two pints of tepid water. This gives a 1 in 500 solution, which may be diluted as required. Like corrosive sublimate it may be dissolved in alcohol.

5. *Boracic Acid Lotion.*—This, which also goes by the name of boric lotion, has the great advantage over the mercurial and carbolic lotions of being practically non-poisonous. It is only a very weak antiseptic, which "may prevent but cannot eradicate sepsis". It is a saturated solution of boracic acid crystals in water. A "saturated" solution means one in which the water contains as much of the drug as it can dissolve. Hence it is impossible to use a lotion of boracic acid which is too strong, because the water refuses to take up more than 1 in 30, this forming the usual efficient lotion. To make it, add an ounce of the crystals to a pint of *boiling* water (because boiling water dissolves more than cold), and

allow it to cool, when the excess of acid falls to the bottom again in the form of crystals. The stock lotion bottle should always have a few crystals at the bottom, as an indication that it is saturated. In some hospitals the boracic lotion is coloured pink by adding rose-aniline to it. This is merely that it may be readily distinguished from other lotions by its colour, and is by no means necessary for its efficiency. In exceptional cases boric lotion acts as an irritant to the skin, producing an acute eczematous condition.

The *advantages* of boracic lotion are: (1) Its cheapness; (2) its safety; (3) it is non-irritating as a rule.

Its *disadvantages* are: (1) It is not a sufficiently powerful germicide in septic cases; (2) it sometimes produces eczema; (3) it produces symptoms of poisoning in rare cases.

Uses.—To clean and dress wounds; as an eye-wash; as an ear-wash; as a mouth-wash or gargle; as a nasal douche; for washing out the bladder; as a vaginal or uterine douche; as a bath in cellulitis of the arm or leg, or in extensive burns. For all these purposes it should be used tepid, and it is better to heat the full strength lotion than to add hot water, as the latter method diminishes its strength.

6. *Lysol*, and *Antiseptol* (a preparation used in the Edinburgh Royal Infirmary) are of considerable value. They are coal-tar derivatives, and contain substances analogous to carbolic acid. They are powerfully antiseptic. They form an opalescent solution with water, and possess the cleansing properties of a fluid soap.

Lysol is sold in a concentrated form, and is used in strengths of 1 in 100 to 1 in 400. For ward purposes it is best to keep a stock of 1 in 100, and dilute it with hot water when required. It should not be diluted with boracic lotion, which abolishes its soapy character. The pure lysol should be added to the water, and not vice versa.

The *advantages* of lysol are: (1) its soapy character, which enables it to remove grease and blood very rapidly; (2) its safety; and (3) its antiseptic efficiency.

Its *disadvantages* are: (1) When mixed with blood or pus it forms a slimy, sticky mixture, and thus is unsuitable for dressing a wound; and (2) it irritates the skin of many people.

Uses.—1 in 100: For purifying the skin of the patient, both before and after operation; for cleansing the hands of the surgeon and assistants; for removing blood from instruments and sponges after operation. A 1 in 400 solution may be used for vaginal and rectal douches.

7. *Izal*, *Creolin* and *Sanitas*, being powerful deodorants, are specially valuable antiseptics in foul-smelling ulcers and wounds. They are used in strengths of 1 in 100 to 1 in 500.

8. *Formalin*, 1 in 100, may be applied to wounds as a lotion or as a spray. It is also contained in *Septoform*, a fluid soap which is used for cleansing the hands or the patient's skin.

9. *Hydrogen Peroxide*, or simply "Peroxide," is a solution of a gas in water, and is used in strengths of 10 to 15 volumes of the gas in 1 volume of the fluid. It is of great value in disinfecting and deodorizing septic wounds. It is used as a lotion, but more commonly as a spray for penetrating to the foot of a cavity. When brought into contact with the tissues in a wound, it effervesces. This is due to its decomposition and the liberation of oxygen on which its antiseptic action depends. Peroxide is also used as an instillation in disease of the middle ear.

10. *Ichthyol* is a sticky, blackish substance with a tarry odour. A 1 in 10 or 1 in 20 lotion is a useful dressing for septic wounds and burns. As a wet dressing, covered with oiled silk or guttapercha tissue (p. 44), it is to be preferred to a carbolic poultice owing to the risk of gangrene with the latter. A solution in glycerine, strength 1 in 8, is used in vaginal plugging. Like boracic lotion it may be used as a bath, strength 1 in 20 to 1 in 100, in burns and in spreading cellulitis of a limb.

11. *Iodine*, in the form of the tincture, is used in the preparation of the skin before operation, in accidental wounds, and in the sterilization of catgut for ligatures.

12. *Potassium Permanganate* occurs as purple crystals which are readily soluble in distilled water. The solution is also purple. Like corrosive sublimate it loses its antiseptic property when it comes in contact with organic matter, and the change is indicated by the alteration of the colour to brown. It is, however, very useful as a deodorant, and it may be employed, in the strength of 1 in 5000, as a mouth wash

or gargle, nasal douche or vaginal douche. It is also used to wash out the stomach, especially in cases of poisoning by morphia.

13. *Picric Acid* lotion is made by dissolving 90 grains of the acid in 40 ounces of distilled water to which 3 ounces of absolute alcohol have been added. The lotion is yellow in colour. It is the most satisfactory of all antiseptic lotions for the primary dressing of burns. It is also used to cover the raw area left when skin has been taken for grafting.

14. *Red Lotion* is made by dissolving 2 or 3 grains of sulphate of zinc and 10 minims of compound tincture of lavender in 1 ounce of distilled water. It is coloured pink by the lavender and has a pleasant odour. It is used to stimulate the healing of ulcers when they have become indolent.

15. *Methylated Spirit* is used in the purification of the patient's skin before operation, and of the surgeon's hands.

16. *Lead and Opium* lotion is valuable for relieving the pain of a recent sprain.

17. *Protargol* and *Argyrol*, in solutions of 1 to 5 per cent., are useful in gonorrhœa, cystitis, and intestinal ulceration.

18. *Aluminium Acetate Solution*, 1 per cent., is widely used in Germany in the treatment of septic wounds.

ANTISEPTIC POWDERS.

1. **Iodoform.**—This substance is practically a preparation of iodine, and is met with in three forms: (*a*) Crystals, large, irregular, rough, and coarse; (*b*) powder, which is simply these large crystals crushed and broken down into small, golden-yellow particles; and, best of all, (*c*) precipitated powder, which is a fine flour-like impalpable powder.

In whatever form it occurs, it has a peculiarly persistent and somewhat disagreeable odour. It is said to have an anodyne action when applied locally, and on this account is sometimes used in the form of a suppository in painful affections of the rectum. It is not a powerful antiseptic, but has a specially beneficial action in wounds with a foul discharge, in tuberculous affections, and in certain venereal diseases. It seems to act by chemically altering the toxins in such a way as to render them less harmful. It is used to

dust over septic wounds, but in aseptic cases it is not only useless but harmful. Under no circumstances should it be applied to any wound, unless it has been sterilized by heat, or with 1 in 20 carbolic acid or 1 in 1000 corrosive.

Gauze or worsted charged with iodoform, 10 to 20 per cent., is used to stuff cavities. For this purpose, one long strip of gauze is preferable to a number of shorter strips, as it is more easily removed, and there is no risk of leaving any in the wound. A bundle of strands of iodoform worsted, wrapped round with oiled silk, or enclosed in a split drainage-tube is known as the *cigarette drain.* It is employed to drain deep septic wounds.

Iodoform should be kept in a cool, dry place.

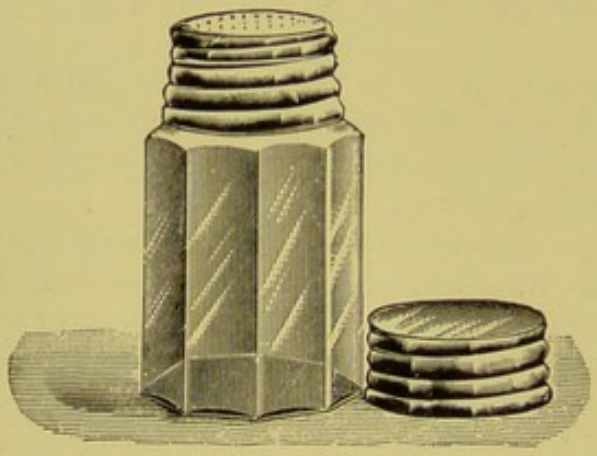


FIG. 6.—POWDER DREDGER.

Caution!—In children and in old weakly people, symptoms of iodoform poisoning sometimes occur when large quantities have been used, and especially if the powder has been blown into a cavity and left there. These symptoms vary much, and differ in the young and old. They are, loss of appetite, vomiting, giddiness, mental depression or excitement, and sometimes more grave brain symptoms. Should these occur, the drug must be discontinued, and starchy substances and stimulants administered. In susceptible patients even a small iodoform dressing may produce poisonous effects in the form of an intense redness or a pustular eruption in the surrounding skin.

Its chief *advantages* are: (1) Its special action in tuber-

culous and venereal diseases; (2) its deodorizing properties; and (3) its anodyne properties. Its *disadvantages* are: (1) Its persistent odour; (2) its poisonous properties; (3) the production of skin eruptions in certain patients; (4) it may contain germs in the dry state.

Uses.—(1) To dust on septic wounds, especially tuberculous and venereal; (2) to charge gauze or worsted for stuffing cavities, or draining septic wounds.

Iodoform in Ether.—A solution of iodoform in ether is sometimes brushed over wounds, or injected into cavities. When the ether evaporates, a fine coating of iodoform is left.

Iodoform Emulsion.—One part of sterilized iodoform in 10 parts of glycerine has been recommended by Lord Lister for injection into tuberculous joints and cold abscesses. Or a 10 per cent. solution in ether may be used.

Iodoform Insufflation, for blowing into various cavities, such as the nose, ears, or rectum, is made by mixing 1 grain of iodoform with ½ grain of powdered starch. The mixture shows less tendency to cake than iodoform alone.

2. **Aristol** is a proprietary dusting-powder which depends upon iodine for what efficiency it has. Its chief advantage over iodoform is that it has no penetrating odour. Its uses are the same.

3. **Loretin** is a non-poisonous unirritating substitute for iodoform, with marked deodorizing properties, and with less tendency to cake than most other dusting-powders.

4. **Boracic Acid Powder** is largely used as a dusting-powder for wounds and irritated or moist skin surfaces, as well as for insufflation into the nasal or aural cavities. It often causes pain when applied to raw surfaces, such as ulcers or burns, and is apt to cake when mixed with blood or serum on the surface of a wound. It is non-poisonous, but is only a feeble antiseptic.

Boracic Acid Powder and Starch in equal parts is a more generally useful dusting-powder than the pure boracic acid. It is useful to apply to parts subjected to pressure, and liable to become the seat of bed-sores.

Boracic Acid and Iodoform Powder is a most useful dusting-powder, combining the advantages of the two constituents, and diminishing their disadvantages.

Take of:—

Boracic acid powder	... ...	3 ounces
Iodoform in fine powder	... ...	1 ounce

Mix.

Boracic Acid, Zinc, and Bismuth Powder.—This forms an excellent powder for dusting over a skin surface which has been irritated in any way, for example by an antiseptic dressing or purulent discharge; also for keeping the skin of bed-ridden patients dry, and so preventing bed-sores.

Take of:—

Boracic acid powder
Oxide of zinc
Carbonate of bismuth } Equal parts.

Mix.

Boracic Acid, Zinc and Starch Powder, containing equal quantities of the three, may be used for the same purposes. It is one of the best preparations for powdering rubber gloves. It may also be applied to aseptic wounds when they are in an unsuitable place for a bandage, *e.g.* the cheek, or the groin in infants. This is an exception to the general rule that antiseptics should not be used in aseptic wounds, the object being to *prevent* sepsis.

5. **Calomel and Bismuth Powder** may be applied to any abrasion. It is specially useful in syphilitic sores.

6. **Charcoal and Iodoform Powder** is a valuable deodorizer in foul-smelling venereal sores.

ANTISEPTIC OILS AND OINTMENTS.

Carbolic Oil consists of 1 part of carbolic acid dissolved in 5, 10 or 15 parts of olive oil, according to the strength required. It is not to be recommended as an antiseptic, because after standing for some time it loses all its germicidal power, and is simply a plain oil.

Eucalyptus Oil is the oil distilled from the fresh leaves of the plant of the same name, a species of gum-tree. It is used in surgery mixed with olive oil in the proportion of 1

in 6. It is of a pale straw-colour, and has an agreeable aromatic odour. It is a fairly reliable antiseptic, and on this account, as well as because it is less irritating, it is preferable to carbolic oil.

Catheter Oils.—Reliable antiseptic oils for lubricating urethral and other instruments are prepared as follows :—

Pure carbolic acid	1 part
Castor oil	7 parts
Almond oil	8 parts

Eucalyptus oil	1 part
Olive oil	2½ parts
Castor oil	2½ parts

The following unguent has been found very useful for lubricating urethral instruments. It is a good antiseptic, and the cocaine seems to soothe the urethral mucous membrane, preventing subsequent spasm and urethral fever :—

Vaselin	2½ ounces
Oil of vaselin	2½ ounces
Eucalyptus oil	1 ounce
Cocaine	30 grains

For lubrication of catheters and bougies, some of the antiseptic oil is poured out into a dry sterilized vessel. The instrument must never be dipped into the bottle, and any oil left in the dish is to be rejected.

A **Paste** is a more convenient form of catheter lubricant. It is a semi-solid preparation, and is best put up in collapsible tubes from which it is squeezed out on sterile gauze. A satisfactory paste may be made with carbolic acid, glycerine and water, stiffened with tragacanth gum.

Ointments.—*Boracic Ointment* is a mixture of finely powdered boracic acid and paraffin. Spread on white lint, it may be applied to healing ulcers and burns, or as a dressing after an operation for hæmorrhoids.

Ichthyol Ointment, made with lanolin, in strengths of

10 to 40 per cent., is of great service in the treatment of erysipelas. It is good for allaying the smarting of a superficial scald or burn, and it may also be used for the dressing of ulcers.

Zinc Ointment is widely used in superficial wounds to prevent sepsis.

Beck's Paste is white vaselin containing 10 per cent. of bismuth subnitrate. It is used as an injection in the treatment of sinuses, fistulæ and cold abscesses. Occasionally it has given rise to symptoms of poisoning, and for this reason bismuth carbonate is preferred by some surgeons.

Some ointments, especially those containing mercury, are rubbed into the skin for absorption, and not merely applied to it to procure a local action.

CHAPTER III.

MATERIALS FOR DRESSINGS.

Wool.—Wool is largely used in surgery for padding splints and other appliances, and as a part of almost every dressing. There are different varieties of wool, some plain, others charged with antiseptic agents.

1. *Plain Wool.*—This is ordinary cotton wadding made up in sheets about half an inch thick, and having one side covered with a paste which keeps the wool together. This material is not charged with any antiseptic, nor is it absorbent, and must never on any account be used in dressing an open wound, for padding splints in the setting of a compound fracture, or for any part connected with a discharging sore. For these purposes antiseptic or aseptic absorbent wool must be employed.

Plain wool may only be used as padding for splints in cases of simple fracture, or in other injuries in which the skin is unbroken.

The paste backing should be peeled off before the wool is used, as it interferes with the escape of the skin secretions, which are apt to cause irritation when retained.

2. *Plain Absorbent Wool* may be sterilized like gauze by super-heated steam. It is non-irritating and is useful in the primary dressing of operation wounds.

3. *Corrosive Sublimate Wool.*—This is fine, white cotton-wool, which is highly absorbent, and has been rendered antiseptic by impregnation with corrosive sublimate. It is used in the dressing of all open wounds, and for padding splints and other appliances which are to come near sources of discharge. The advantage of this wool lies, of course, in its being antiseptic, and it is not necessary to sterilize it by steam, a

proceeding which damps and blackens it. Although corrosive wool is fairly absorbent, the discharge tends to pass in a straight line through it without much lateral diffusion. In some patients it produces redness and irritation of the skin, necessitating its discontinuance.

4. *Wood-Wool.*—This is made by subjecting chips of pine-wood to certain chemical processes, by which the oils and resins are removed, and the remaining substance is rendered highly absorbent. It is most conveniently employed in the form of wood-wool wadding or wood-wool tissue, to which a sufficient quantity of cotton-wool has been added to give the dressing cohesion. It is charged with corrosive sublimate to make it antiseptic, and has the advantage of being much more absorbent than ordinary corrosive wool. In wood-wool the discharge diffuses itself widely in every direction.

5. *Salicylic Wool* is fine cotton-wool charged with salicylic acid. Two strengths of the antiseptic are used, the stronger containing 10 per cent. by weight, the weaker 3 per cent. The excess of powdered acid which comes off the wool is apt to irritate the eyes and nasal mucous membrane of those around, setting up in some people a violent coryza. For this reason it has been almost entirely given up.

6. There are various other antiseptic wools available, such as *carbolized wool*, 6 per cent.; *iodoform wool*, 10 per cent. for wounds, or 50 per cent. for use in aural cases; *sal-alembroth wool*, 2 per cent.

Practical Points.—There are one or two points of importance in preparing the wool for a dressing or operation. Wool must never be allowed to lie exposed to the air and its inevitable dust and germs. It is best kept clean by being placed in well-closed tin boxes, rolled up in a sterilized towel. As it comes from the chemist, it is in long thick rolls, each weighing about a pound. It will be found convenient to cut these rolls into pads about a foot square, and place them one above another in the towel. At a dressing the pad should be split so as to obtain a fresh surface to apply on the top of the gauze. As wool will only tear in its *long axis*, it is easier, and wastes less wool, if the sheets are cut *across* with scissors.

Lint.—1. *Plain* or *Surgical Lint* is a soft material, made

by scraping linen cloth, and is used as a dressing in certain cases. It is not antiseptic, therefore it must be sterilized before it is applied to an aseptic wound. It may be covered with antiseptic ointments, oils, etc., and applied to open sores. The two sides of lint are different—one is plain, the other is woolly—and the question is often asked, which side should go next the wound? It is very much a matter of taste. It will be found that ointment can be spread more evenly and with greater ease on the plain side. The plain side is less apt to stick into a sore, and the dressing is thus removed more easily, and with less pain to the patient. On the other hand, when lint is applied to an unbroken surface, the woolly side is the softer, and absorbs skin secretions better.

2. *Boracic Lint* is ordinary surgical lint which has been soaked in a hot, saturated solution of boracic acid, and then hung up to dry. It is thus rendered mildly antiseptic, and, as the boracic acid is non-volatile, it retains this property. It should, however, never be applied next a wound *dry*, as its germicidal power is increased by moisture. It is usually tinted pink by means of litmus to distinguish it from ordinary lint, and is often covered with an excess of boracic acid crystals deposited as the lint cools. It is exceedingly absorbent of discharges. In every way boracic lint is a most valuable material, being cheap and handy, only requiring to be moistened to furnish a fairly efficient antiseptic dressing for all minor injuries, such as cut hands, scalp wounds, or small ulcers. Covered with oiled silk or rubber tissue, it forms a good wet dressing in septic wounds. It may also be used to cover the limb before applying a plaster case or extension strapping. For this purpose it is preferable to plain lint, as it is toxic to fleas and other body insects—a point of great importance in out-patient departments.

Advantages.—(1) Cheapness; (2) fairly efficient antiseptic; (3) almost universal applicability; (4) very absorbent; (5) toxic to fleas.

Gauze.—1. *Plain* or *Surgical Gauze* is a loose cotton cloth rendered absorbent by having its oily matter removed by boiling in soda. It is soft, open and porous, and for its bulk absorbs a large amount of discharge. After being stretched, it

is cut into lengths. Each length is folded into many-layered pads or "swabs" in such a way as to conceal all the cut edges, and so prevent loose threads being detached and left in the wound. In general the swabs should be about four inches square, but for special operations smaller or larger pads may be more convenient. They are packed in caskets and sterilized by steam (p. 110), after which they are ready for swabbing at an operation or for dressing a wound. Once a casket has been opened, and some of the swabs taken out, or even touched, the whole of them must be sterilized again before they can be used. For the dressing of septic wounds, the swabs may be soaked in boric, ichthyol, or other antiseptic lotion.

2. *Carbolic Gauze.*—This is a rough unbleached muslin, which has been rendered antiseptic by being charged with a mixture of carbolic acid, resin, and paraffin. It has now fallen into disuse.

3. *Double Cyanide Gauze or Mercuro-Zinc Cyanide Gauze.*—Lord Lister used plain gauze charged with the double cyanide of mercury and zinc, which is a fixed, non-irritating and reliable antiseptic. It should be kept in glass jars slightly *damp* with carbolic acid. If dipped in corrosive sublimate before being used, it forms a triple salt, which is but a feeble antiseptic, and is, moreover, exceedingly irritating, sometimes producing vesication of the skin.

4. *Sal-alembroth Gauze* contains 1 per cent. of sal-alembroth, which is a combination of corrosive sublimate with ammonium chloride. It is tinted with aniline blue, and should be wrung out of saline solution before being used.

5. *Iodoform Gauze* is prepared in varying strengths from 10 per cent. to 20 per cent. or higher. Its uses have already been described (p. 18). It can be readily prepared for ward use by sterilizing plain gauze and rubbing into its meshes sterile iodoform powder. In doing this, the nurse should wear rubber gloves previously purified by boiling. Even with these precautions, it is advisable to pack the iodoform gauze in glass cylinders, the ends of which are plugged with plain gauze, and place it for a few minutes in a sterilizer in which the temperature does not rise very high. With great heat, the iodoform is charred and blackened.

6. *Iodoform Worsted.*—For draining septic cavities, several lengths of plain four-ply white worsted, sterilized by boiling, and then impregnated with sterilized iodoform, are exceedingly useful (p. 18). This material drains better than iodoform gauze.

7. Gauze impregnated with *eucalyptus*, *salol*, or *thymol*, is used by some surgeons.

One or two other substances which are in constant use in surgical practice may be referred to here.

Oiled Silk or Green Protective consists of thin sheets of silk coated on both sides with copal varnish to render the silk impervious to fluid. Over this a layer of carbolized dextrine is painted, but as the carbolic soon volatilizes from the dextrine, it loses its antiseptic properties. Its object is to prevent adhesion of the other dressings to the edges and surface of the wound, to protect the raw edges of the wound from irritation, and to facilitate the escape of discharge, which soaks out all round its edges, and is thus more evenly distributed in the wool. This is still further aided by having the protective perforated with small holes. When a drainage-tube is being used, a hole is cut in the protective and the tube drawn through it. In the dressing of large *healing* ulcers of all kinds, especially those resulting from burns, it is of great importance that the margins should be very gently dealt with. It is here that the healing process is going on, and it is evident that if any dressing is applied which will adhere to the wound, this delicate epithelium will be removed at each dressing, and the healing process consequently retarded. To prevent this, the growing epithelial margin should be covered with thin strips of protective.

Thin sheets of *tinfoil* may be used for the same purpose. This material is specially useful for covering skin-grafts.

Gutta-percha Tissue.—As its name implies, this is a very thin sheet of gutta-percha. It is used to put outside deep dressings or fomentations when it is desired that these should remain moist, as it prevents evaporation of the fluid in the dressing. Such a dressing is technically called a "wet dressing," or "fomentation". Non-antiseptic, it requires purification before being used, but must not be dipped

into *hot* lotion, which shrivels it up and destroys it. Gutta-percha tissue is also manufactured into gloves and finger-stalls.

Mackintosh or Jaconette, invented by Syme, is thin cotton cloth with a layer of indiarubber waterproofing over it. Like gutta-percha tissue, it is used to prevent wet dressings becoming dry by evaporation. Its chief use, however, is to protect the patient's clothing and the bed during an operation or at a dressing. For this purpose it is cut into sheets about a yard square, the edges being left unhemmed. It must never be folded up while damp, as the adjacent surfaces adhere and it is spoiled. Carefully avoid sticking pins into mackintosh, as the holes made allow lotion to run through, and permit of evaporation from fomentations.

Sheets of *white mackintosh* are much used nowadays to cover over the area of operation. *Batiste* is preferable for this purpose, as it may be sterilized by steam.

Bandages and Slings will be treated of later. Suffice it now to say that there are certain bandage materials which are antiseptic—e.g., carbolized gauze, double cyanide of mercury and zinc gauze, and domette which has been impregnated with sal-alembroth, and others which are non-antiseptic, such as plain cotton and ordinary domette. One or other of these materials will be selected according as an antiseptic is indicated or not. Plain cotton and domette bandages may be sterilized in the steam sterilizer.

CHAPTER IV.

LOTION BASINS AND OTHER APPLIANCES.

IT may be convenient to mention at this stage the various tins, basins, and other appliances usually found in a surgical ward, and the uses to which these are put.

1. *Lotion Basins* (Fig. 7).—These may be made of glass or enamelled tin; they are of various shapes and sizes. They should never be filled more than half full with lotions.

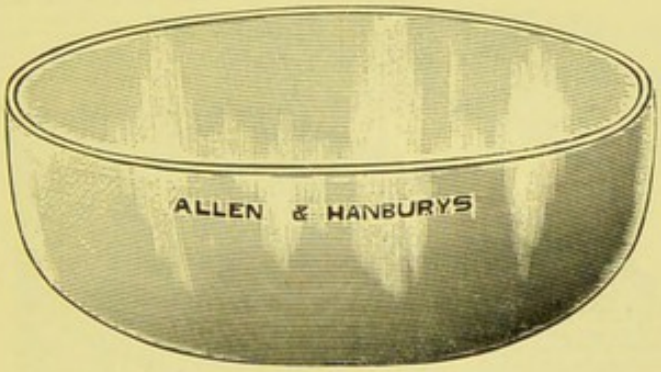


FIG. 7.—ROUND GLASS LOTION BASIN.

2. *The Kidney-shaped Basin* (Fig. 8) is described by its name. It is a shallow glass or enamelled vessel, used to catch discharges as they escape, e.g., pus from a large abscess. On account of its shape it can be accurately applied to the surface of almost any part of the body, so preventing any soiling of the patient's clothes or the sheets. A three-cornered dish is also useful for this purpose. These and all other dishes which are brought into contact with wounds should be thoroughly purified before being used lest they carry germs on to the wound. Enamelled vessels may be sterilized by boiling in a tank specially employed for the

purpose; or by soaking for an hour in a bath containing a 1 in 100 solution of lysol or similar antiseptic. In emergencies washing the dish with 1 in 20 carbolic is sufficient.

FIG. 8.—KIDNEY-SHAPED BASIN.

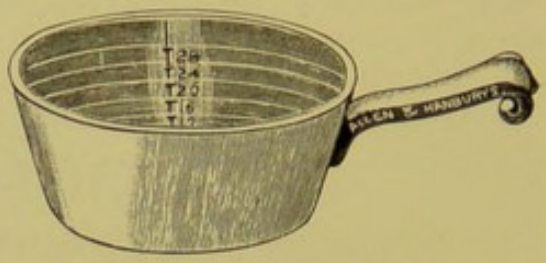


FIG. 9.—BLEEDING CUP.

3. *Bleeding Cups* (Fig. 9).—These small saucer-shaped dishes, although not now employed for their original purpose, are still very useful. They are made of glass or tin, and

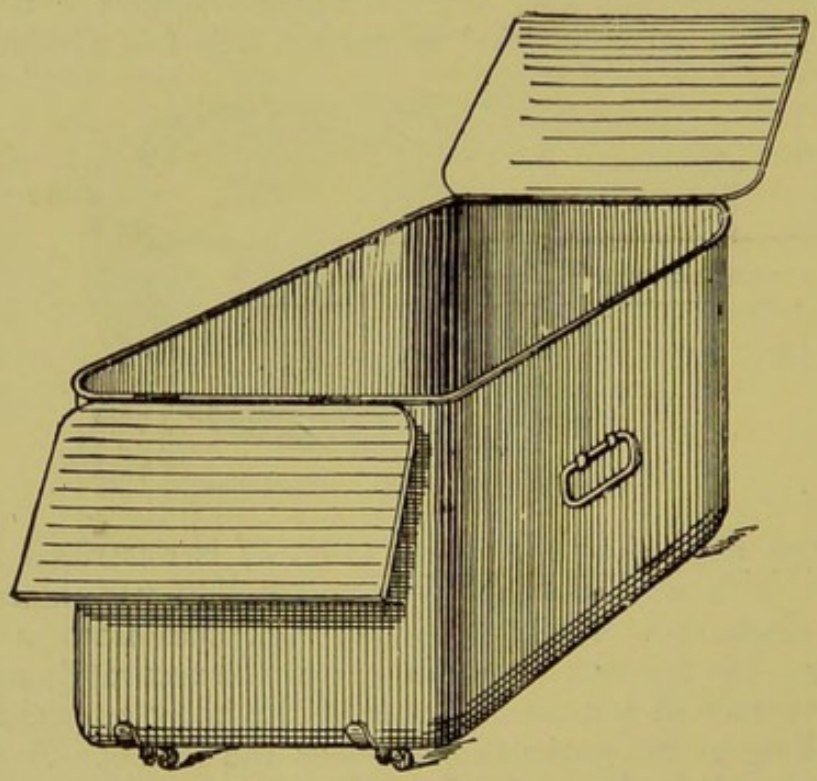


FIG. 10.—SOILED-DRESSING BOX.

are usually graduated, so that the quantity of discharge caught in them may be measured. They are often used in place of the kidney-shaped basin, the same precaution being

taken with regard to purifying them. They are useful receptacles for the parts removed at operations, e.g. excised parts of joints, tumours, and such like.

4. *Leg Tray.*—This is a long shallow, oval tray, used in dressing wounds of the leg. At the upper end is a broad flange hollowed out to permit of the thigh resting on it, while the lower part of the leg lies over the tray, into which the discharge and lotion escape.

5. *The Soiled-Dressing Tray* is a large shallow tray placed under the bed or operating-table to receive the dressing removed from the patient and any other refuse which may require to be disposed of during the procedure. When the dressing is finished, the tray should *at once* be removed from the ward and emptied into the *soiled-dressing box* (Fig. 10), which is kept outside the ward. The soiled dressings are afterwards burned, and the mackintoshes and bandages washed, purified, and dried.

6. *Instrument Trays* of glass, white porcelain or enamelled iron are used for placing instruments in during a dressing (Fig. 15).

7. *An Instrument Stand,* which is placed near the operator, is very convenient for holding instruments, swabs, and lotions when assistance is limited (Fig. 11).

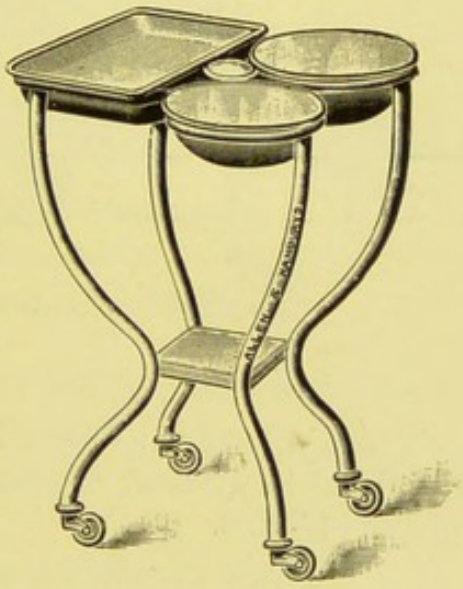


FIG. 11.—INSTRUMENT STAND FOR WARD USE.

8. *Ward Trolley.* — Having indicated the various materials and utensils in every-day use, and some of the more important practical points in connexion with each, it may be convenient to recapitulate in a tabular form the furnishings of a ward trolley (Fig. 12) and dressing tray. The arrangement of the ward trolley is so much a matter of individual taste that one cannot lay down rules with regard to it. On it should be found:—

A Winchester jar of carbolic lotion (1 in 20).
" " corrosive or biniodide lotion (1 in 1000).
" " boracic lotion, saturated.
" " lysol (1 in 100), or a bottle of pure lysol.

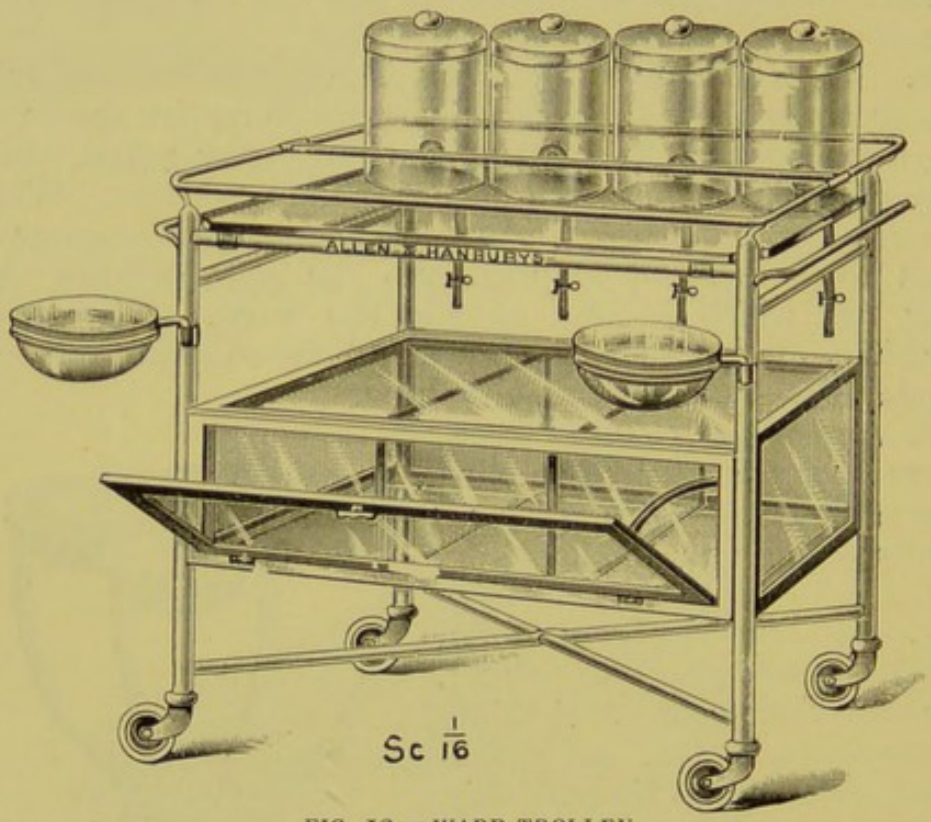


FIG. 12.—WARD TROLLEY.

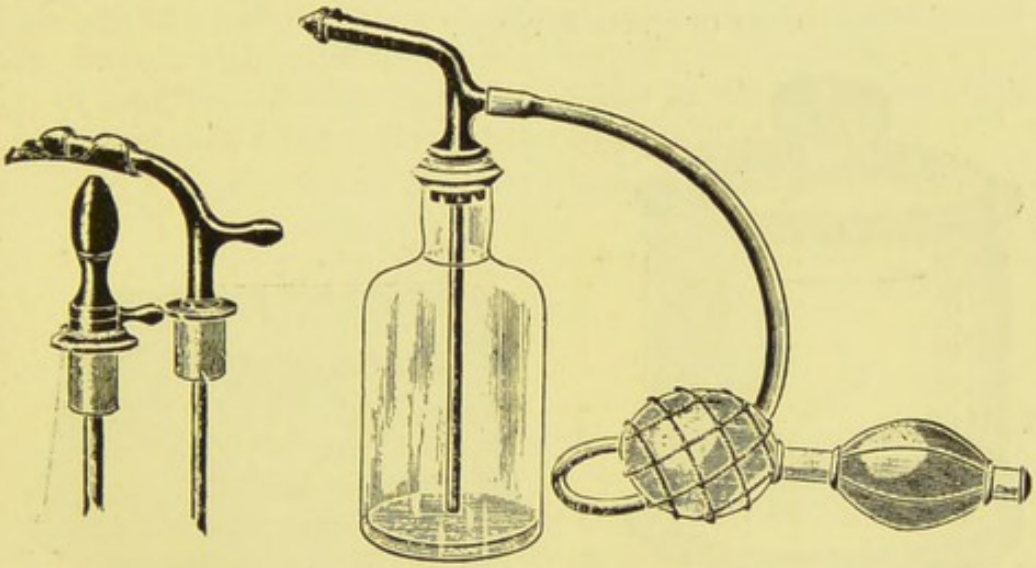
These should have glass stoppers, and be labelled. They should all be marked "Poison," and must be kept out of reach of the patients.

A wide-mouthed bottle of pure phenol (liquefied).
A 10-ounce bottle of red lotion.
A wide-mouthed glass bottle containing sulphate of copper (blue-stone).
Unguent for urethral instruments, in a collapsible tube.
Vaselin, sterilized and plain.
Boracic ointment.
Zinc ointment.
Glycerin.

The unguents should be in wide-mouthed glass bottles, each holding about 4 ounces.

Boracic powder.
Iodoform powder.
Boracic, zinc and starch powder.

These should be in powder-dredgers (Fig. 6), that is wide-mouthed glass bottles, covered with a perforated metal lid, or fine gauze firmly fixed on with an india-rubber band.



THE HOLBORN SURGICAL INSTRUMENT CO., LTD., LONDON.

FIG. 13.—ATOMIZER FOR HYDROGEN PEROXIDE.

Drainage tubes, glass and rubber, of various sizes, perforated and unperforated.
Iodoform gauze.
Iodoform worsted.
Sterilized safety-pins.
A box of finger-stalls.
An atomizer containing hydrogen peroxide (Fig. 13).

The tubes are best kept in wide glass jars (Fig. 14), about 6 inches high and 4 inches in diameter, containing 1 in 20 carbolic which should be renewed at intervals; the pins (to be used for transfixing drainage tubes) in a small stoppered bottle containing glycerine of carbolic acid or pure lysol.

Iodoform gauze and worsted should be kept in jars of blue glass, as they are discoloured by the daylight.

In addition there should always be at hand :—

Four to six lotion basins of different sizes.
Two kidney-shaped basins.
Two bleeding cups.
One leg tray.
One soiled-dressing tray or box.
One pail to hold soiled lotions.
One brass or glass syringe.

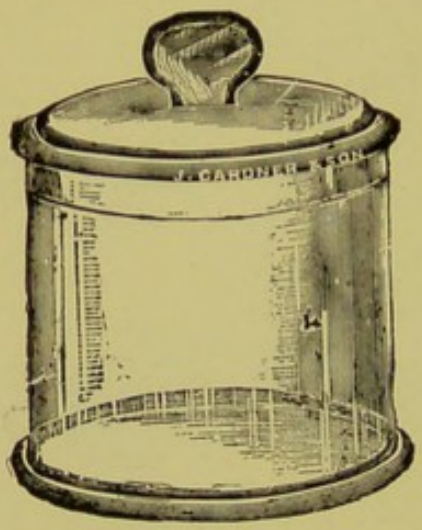


FIG. 14.—GLASS JAR WITH AIR-TIGHT GROUND GLASS LID.

FIG. 15.—GLASS INSTRUMENT TRAY.

Dressing Cabinet.—The materials used as dressings should be kept in a dust-proof cabinet or box, which should contain a supply of :—

Plain lint.
Boracic lint.
Oiled-silk protective, perforated and non-perforated.
Gutta-percha tissue.
Elastic bandage.
Gauze bandages (plain and double cyanide).
Domette bandages.
Cotton or linen bandages.
T-bandage.

Sling.
Adhesive plaster.
Safety-pins.
Measuring tape.
Corrosive wool and wood-wool tissue (in a separate compartment of the dressing-box).
Several mackintoshes.

In addition to the dressings on the trolley, aseptic dressings and towels are required. These are contained in the caskets in which they are sterilized, and they must not come in contact with anything that is not surgically clean.

9. *Instrument Tray* (Fig. 15).—For use in the wards, it is convenient to have a small glass tray to hold :—

A pair of stitch scissors (sharp-pointed).
A pair of dressing forceps.
A pair of sinus forceps.
A pair of dissecting forceps.
A probe.
A bistoury.

With the exception of the bistoury, which is purified in lysol, these should be kept boiling in an instrument sterilizer on the trolley, and taken out for each dressing, and placed in saline solution or boiled water on the tray.

Lastly, a plentiful supply of boiled water, both hot and cold, must be at hand to make lotions of the proper temperature and strength. They may be kept on the trolley in vessels fitted with a tap, or in large enamelled tankards. If the surgeon prefers saline solution, it may be stored in the same way.

CHAPTER V.

A WARD DRESSING.

A Ward Dressing.—Having now considered the general principles of wound treatment, and the means at our disposal of applying these principles, we shall go on to study the practice itself. It is the duty of the dresser or nurse to make all the preparations necessary for the dressing of a case by the surgeon when he pays his ward visit, and this includes the preparation not only of the patient himself, but of all the dressings, lotions, instruments, etc., that may be used. There is no way in which a nurse can show her capabilities better than in the performance of this apparently simple duty. She must take every precaution that the patient is not unduly exposed, or wearied more than is absolutely necessary; and she must make certain that she has everything at hand that can possibly be wanted, so that there will be no delay during the dressing by things having to be sent or searched for. She must also carefully watch the steps of the process as it goes on, and *anticipate* the surgeon's wants. This "faculty of anticipation" is one which must be cultivated by all who take part in surgical work, whether as assistant, dresser, or nurse. It should be the aim and ambition of a surgical nurse never to require to be asked for anything during the dressing, but always to have the required article ready to the surgeon's hand just at the moment it is needed. This is of importance to the patient as well as to the surgeon, because many people, and especially women and children, are much more frightened than pained by being dressed, and their fears are increased if there is a constant conversation going on between the surgeon and the nurse as to what is being done. The less

talking that goes on at the dressing the better. If by any chance the nurse has forgotten something, and notices her mistake when the dressing is beginning, she should take some opportunity of going to rectify it when her services are not required. She should not rush off immediately she notices the omission, just when she may be wanted to hold a limb, or remove a bandage, but should wait for some part of the dressing which will engage the surgeon's attention for some little time.

For a dressing, it is advisable for the surgeon to have two assistants, whom for convenience we may speak of as the first and the second assistant. While the surgeon and first assistant are making themselves "surgically clean," the second assistant "prepares the patient". Both of these processes require a detailed description.

Surgical Cleanliness means the absence of bacteria from everything that touches or even approaches the wound. It can be attained only with great care and trouble, but it must be attained. The slightest lapse into carelessness is fraught with danger to the patient. Various sources of bacterial contamination exist, and each has to be eliminated.

1. *The Clothes* of the surgeon and first assistant are not germ-free, and they should be covered with a sterilized cotton overall. During a series of ward dressings care must be taken that the front of it is not soiled with pus, nor comes in contact with anything else which is not aseptic.

2. *The Hands and Arms* are among the most fertile sources of wound infection, and *it is a matter of extreme difficulty to render them germ-free.* Indeed it is almost impossible if they have recently been contaminated with pus or other highly septic matter. Hence any nurse whose hands have been thus soiled is not fitted to act as first assistant at dressings. This is one of the reasons why rubber gloves should be worn both by surgeon and nurse at every septic dressing.

It is the nurse's duty to have ready on the ward table the necessaries for cleansing the hands. These are a basin of hot water, soap, a sterilized loofah and nail-brush, a second basin with methylated spirit or other antiseptic lotion.

Cold water should never be provided, even in warm weather, because it is not so good for cleansing the hands, and it cools them down and renders them uncomfortable to the patient.

To Cleanse the Hands.—The following is a satisfactory method: Cut the nails short. Then wash the hands and arms to the elbows for five minutes with soap and water. Scrub the nails, and perhaps the palms, with a soft nail-brush. The skin on the back of the hands and the arms is more tender, and is roughened by the brush, especially when the cleansing has to be repeated many times a day. As the tenderness and roughness increase the difficulties of sterilization, *the nail-brush should never be used for the back of the hands.* For them and the arms a sterilized loofah is most suitable.

The hands are next washed in methylated spirit. This dries them, and they may now be rubbed with glove-powder (p. 20) which has been sterilized by heat, and the gloves pulled on. Or if they are to be worn wet, they may be placed in weak lysol or spirit, and then put on. The gloves are next washed with hot water and soap, and now the surgeon and first assistant are ready to start the dressing. Every precaution must be taken to prevent the gloves, arms and overall from touching anything which is not surgically clean, for example the bandage and the bed-clothes. Hence the need for a second assistant, who prepares the patient during the interval when the others are cleansing their hands.

The Preparation of the Patient.—This must be done with as little discomfort to the patient as possible.

Let us suppose that the wound to be dressed is that resulting from a severe crush of the leg below the knee. The patient is to be protected from draughts, as well as from the gaze of other patients, by the ward screens. The nurse should be careful in arranging these to make sure that they stand firmly, and are not in danger of being knocked over; and also that plenty of room is left all round the bed, so that doctors and nurses may move about without knocking against the screens. She should arrange the doorway between the screens, so that those inside may reach it from either side of the bed without passing one another. The most convenient

place is usually opposite the foot of the bed. No more of the patient's body is to be exposed to the air than is absolutely necessary, especially in cold weather; the bed-clothes are to be arranged so that only the injured limb is uncovered, and only as much of it as is sufficient to render access easy.

To Remove the Bandage.—The second assistant then proceeds to remove the bandage. It is unnecessary to insist on the importance of gentleness in this, not only to avoid causing the patient pain, but also to prevent undue movement of the injured part, for example a fractured bone. Hence it is often an advantage to have an extra assistant to steady the limb during the removal of the bandage and the subsequent dressing. She must hold the limb in as comfortable a position as possible. In the case of the leg, it is best to seize it by the great toe, and support the heel with the other hand. More simply, the heel may be rested on a prop placed on the bed.

The bandage should be rolled off by reversing the movements of putting it on, gathering up all the slack in the hand. It should never be removed by seizing the loose end, and describing circles round the patient's foot, coiling it up into a rope. The deeper bandages may be cut off along the front of the limb by short snips of sharp scissors, as they are not to be used again. In the removal of the bandage, the nurse's hands should not touch the underlying wool as they are not sterile.

To Protect the Bed.—This is done by covering with mackintosh as much of the bed as comes within the area of operations; and it will be found an advantage to fold up the edges all round so as to form a gutter, that any lotion spilt on the mackintosh will not find its way on to the sheets. The same end may be attained by sewing a roll of wool into the edge of the mackintosh all round, forming a thick border. This is as far as the second assistant goes in the preparation of the patient.

Sterilized Towel.—Over the mackintosh the first assistant, now surgically clean, spreads a sterilized towel or "square," in order to have an aseptic surface next the wound. On it instruments, swabs, and dressings may be laid with safety. If an extra assistant is holding the leg in the position already

described, the towel should extend *over* her hands. She must not on any account touch its *upper* surface. When the leg tray is used, the mackintosh should be laid under it, and the sterilized towel over it, so that the former protects the sheets, while the latter provides an aseptic surface next the wound, without interfering with the escape of lotion into the tray.

Antisepticized Towel.—The district or private nurse, having no steam sterilizer at her command, must find a substitute for the dry sterilized towel. She may keep one soaked in 1 in 20 carbolic or 1 in 100 lysol. A towel boiled in water for ten minutes is also an efficient substitute. As with the sterilized towel, it must not be touched till the hands are purified.

The Lotions.—By this time the second assistant should also have the lotions ready. The choice of lotion rests with the surgeon, but in general a basin with boiled water or normal saline solution, and two with antiseptic lotion are necessary. Let us suppose that lysol is wanted. Take two enamelled lotion basins, pour into each about a pint of sterile warm water, and add a teaspoonful and a half of pure lysol. This makes a solution of about 1 in 100. The basins should never be more than half full. If corrosive, biniodide, or carbolic is preferred to lysol by the surgeon, half a pint of the double strength lotion is taken from the stock bottle, and the same amount of sterilized hot water added; if boracic is required, it is best to heat the full-strength lotion.

Removal of Old Dressing.—The surgeon or first assistant takes off the wool, as it was put on, in layers, and this should be done gently. It is more easily removed dry than wet, so that, unless it is sticking into the wound, no lotion should be put on it. In removing the gauze, or whatever has formed the deep dressing, raise the upper edge, and gradually float up the rest by a stream of lotion. If the deep dressing is sticking to the wound, it should be sprayed with peroxide of hydrogen by the second assistant. The effervescence which results separates the dressing without causing pain.

Drainage-Tubes.—These are usually removed at each dressing, cleansed, and re-introduced if necessary. In the

case of deep or tortuous wounds it is well to leave the tube in position for two or three days, otherwise it is often difficult to re-introduce it. When removing a drainage-tube, carefully note the exact direction it takes in the wound, so that you may know how to re-introduce it. On removal, the tube is placed in one of the basins containing antiseptic lotion. This alone is not sufficient to remove all the discharge, and it must be cleansed inside and outside by the first assistant when she has half a minute to spare. A stream of lotion, squeezed out from a wisp of cotton-wool, is run through it, and the interior inspected to see that no clot is still lodging in it. When the tube is clear, the outside is rubbed with the wool. Then it is placed in the basin of saline solution to remove the antiseptic. Should any difficulty be experienced in re-introducing it, it may be grasped by sinus or dressing forceps, and then inserted. Some means must be taken of preventing the drainage-tube slipping completely into the wound, especially when dealing with cavities like the pleura and peritoneum, but also in superficial wounds. Perhaps the simplest method is to transfix the tube with a sterilized safety-pin (Fig. 16). It is a safe rule to remove, or at least to shorten a tube, when the wound forms an exact mould of it, or when the granulations begin to push it out of the wound.

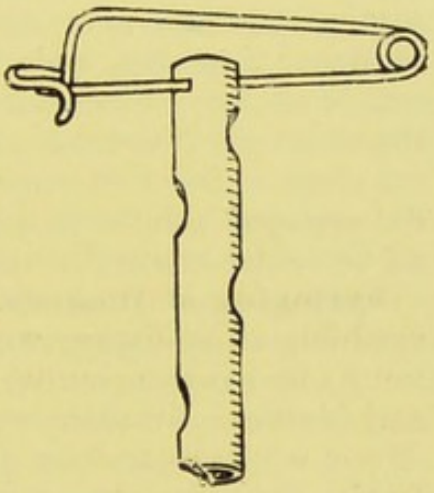


FIG. 16.—PERFORATED RUBBER DRAINAGE-TUBE TRANSFIXED WITH SAFETY-PIN.

Washing the Wound.—A very common mistake made by students and nurses in washing the wound is to clean up all the skin around the actual wound first, and then with the same swab to rub over the granulations. In other words, they carefully gather up all the refuse lying around, and deposit it on the raw surface of the wound. Of course, the proper method is to use a fresh swab each time the wound itself is washed. If the wound is aseptic, the washing may be confined to the surrounding skin, the wound itself being

left dry. In dressing a septic wound, it is a great temptation to squeeze out every possible drop of pus, in the hope that no more will form. This is a practice which is not to be recommended, as it tends to spread the infective process farther in the tissues. It is better only to press *lightly* around the wound with a swab, and mop up such discharge as appears at the surface. In suitable cases the pus may be washed out by syringing.

Removal of Stitches.—The through-and-through sutures may have to be removed. These may be of horse-hair, silkworm gut, silk or other unabsorbable material. In general they are removed from an aseptic wound on the eighth to the tenth day. In face and neck wounds, they should be removed on the fourth or fifth day on account of the disfiguring marks which they are apt to cause if left longer. In septic wounds, one or more of the stitches may have to be removed any day, and the wound opened to allow of the escape of pus. Fine, sharp-pointed scissors which cut well at the point are the most convenient. Each stitch should be cut close to the skin at one side, and then pulled out from the opposite side with dissecting forceps. It saves time if all the stitches are divided before any are removed.

Syringing of Wounds.—Without here discussing the advisability of syringing wounds, we shall only say that it is not to be made a routine practice in the dressing of wounds and cavities. In many cases it does more harm than good. A few words as to how it should be done when necessary. In the majority of cases the lotion employed is normal saline solution. There are many kinds of syringe available, but perhaps the most generally used is the Higginson (Fig. 18), fitted with a long, narrow metal or glass nozzle, which may be passed to the *bottom* of a wound. It must be soaked in antiseptic for some time before use. Of the barrel syringes, the best is that made of glass. It is cheap, can be sterilized by boiling, is easily kept clean, and the presence of air in it is readily detected. The nozzle should be fitted with a sterilized soft rubber tube for introduction into the cavity.

Whatever form of syringe is employed, it is important to expel all air from it before introducing it into the wound. With the Higginson syringe, the best way to make sure of

the absence of air is to keep the weighted end of the tube in a considerable depth of lotion, expelling all air from the tubes by running a stream through for a short time. When using the barrel and piston syringe, fill it very slowly, and when the piston-rod is withdrawn to its full extent, hold the nozzle straight up in the air. This enables air-bubbles in the barrel to rise to the surface. Now push up the piston-rod till a jet of fluid escapes and expels the air in front of it. Do not be deceived by a small jet which often comes at the very first push in a badly working syringe; wait till a full stream comes from the nozzle. Having filled the syringe and expelled the air, place it in the second basin with the nozzle well under the lotion, so that no more air may enter. In using the syringe, introduce the tube to the deepest part of the wound, so that the direction of the stream is from within outwards, and make sure that the fluid flows easily out of the wound and does not distend the cavity. Meanwhile the second assistant holds a kidney-shaped basin in a position to catch the lotion as it comes out. The syringing is continued till the fluid returns clear.

The Dressing.—The dressing varies with the nature of the wound, but in general it is made up of gauze over which is laid a pad of cotton-wool, the whole being kept in position by a bandage or binder. In many hospitals, the necessaries for dressing each important aseptic case are made up in a bundle, and sterilized by the theatre nurse the night before. The bundles go on the trolley next morning.

Operation wounds are usually covered with small pads of plain gauze which have previously been sterilized by steam in a casket (chap. X.). The second assistant opens the casket, and holds it near the first assistant. The latter then lifts out the swabs, one by one, *with sterilized forceps* and hands them to the surgeon. These pads of gauze, in addition to being aseptic, are highly absorbent of discharge, and at the same time they do not stick into the wound like wool. Sometimes the gauze swabs and lint for dressings are kept in 1 in 20 carbolic. If so, they should be wrung out of saline solution to remove the carbolic before they are used.

Protective.—Occasionally some form of protective is placed

between the wound and the gauze, and that most commonly used is Lister's *oiled silk* or *green protective.* As we have already seen, this is not antiseptic, and it requires to be soaked in lysol or carbolic to render it germ-free. The surgeon cuts off a piece of suitable size and shape, dips it in saline solution to remove the antiseptic, and applies it to the wound. Oiled silk should be perforated to allow of the escape of any discharge from the wound into the absorbent gauze.

Wet Dressing.—Though moist swabs, such as were mentioned above, are applied to a wound, they soon become dry, unless special means are used to prevent evaporation. For this purpose a layer of gutta-percha tissue, *unperforated* green protective, or mackintosh is placed over them. The layer must be larger than the dressing, and overlap it at least half an inch all round. This forms a "wet dressing," "fomentation," or "soak". When it is used for an open wound, perforated green protective may again be applied under the dressing. A valuable antiseptic fomentation or soak may be made with plain gauze or lint wrung out of ichthyol lotion, or with boracic lint moistened with saline solution. It is doubtful if a carbolic fomentation should *ever* be used. Certainly it should never be applied to a finger or toe, owing to the frequency with which it produces gangrene. Corrosive should never be used as a wet dressing because the mercury is absorbed from the skin into the body.

Cotton-Wool.—Next comes the cotton-wool. It may be plain absorbent wool previously sterilized by steam, or corrosive or other antiseptic wool. In either case it should be wrapped in a sterilized towel. The wool has been previously cut into large, thick squares, which are not, however, applied directly to the wound; always split it up so as to get a fresh surface. The object in thus splitting up the wool is threefold: (1) That a fresh surface, on which no dust or germs may have landed, is put next the wound; (2) that the wool may lie in more accurate apposition with the surface, so that it will not slip, and expose the wound to the air; and (3) that the wool, being loose and porous, will readily soak up the discharge, and not cake and form a hard, impermeable layer next the wound.

In cases in which a large amount of discharge is expected, it will be well to use a wood-wool dressing, with the same precautions to secure a fresh surface. It is more absorbent than ordinary corrosive wool. The large amount of dust which it gives off is an inconvenience, but this can be obviated by having it made up in sheets covered with fine gauze—wood-wool tissue.

Bandage.—Over the wool should be put some form of bandage to hold the dressing in position—a roller, many-tail bandage, or binder. If a roller is wanted, select a bandage of suitable width, and be careful to unroll a few inches of it before handing it up, as this enables the surgeon to get started with the bandage at once, a thing which is not easy when a firm roll is given him, and, as is very often the case, he has only one hand available for applying it. The usual length of a roller bandage is six yards, and for the trunk or a whole limb more than one may be required.

Safety-Pins.—The bandage is fixed by means of safety-pins, of which a liberal supply should always be ready, as it is often necessary to fasten the bandage at several places, especially about the head, chest and pelvis. The pin should run in the long axis of the bandage. If fixed across the bandage the tension twists the pin round, the last turn is loosened, and the other turns soon follow.

The dressing is now finished, the patient must be made comfortable again, and the soiled dressings and mackintoshes removed.

To Make the Patient Comfortable.—First remove the mackintosh and towel, and be careful in doing so to gather up the four corners, and then the intervening edges, to prevent the lotions and discharges soiling the sheets. Then quickly cover up the patient; see that the bed-clothes do not press on the injured limb; and if they do, put in a "cage" to prevent this. Should the patient complain of being cold, you may put a hot bottle beside him, taking care that it is not so hot or so near the limb as to do damage. Never put a hot bottle close beside an unconscious patient, a very old person, or one who has had a severe injury to his limbs, as it is liable to produce a burn. Never put a hot-water bottle next *any* patient without enclosing it in a flannel cover.

Disposal of Soiled Dressings.—What is to be done with the soiled dressings which have been taken off? The domette bandage should be at once removed from the ward to be washed. However clean it may appear to be, it must on no account be rolled up and put into the dressing-tray or used for another patient. If unstained, it may be used again for the same patient; but it is better never to use a bandage twice without having it thoroughly washed between times. Everything else should be at once burned, if this is possible; and if not, it should be removed to some place where it can contaminate nothing. On no account collect all the old dressings of the day in the ward, and remove them together at night. The towel should also be washed before being again sterilized, and the mackintoshes must be washed with carbolic and thoroughly dried before being folded and laid aside. The instruments are to be boiled and dried, and the trolley tidied and covered over with a clean towel till again required. In some hospitals it is the duty of the dresser or nurse to write on the chart at the proper place the word "Dressed," and any remarks necessary; this should be done *at the time*, otherwise it is apt to be forgotten.

SECTION II.

CHAPTER VI.

GENERAL METHODS OF TREATMENT IN SURGERY.

THE ADMINISTRATION OF MEDICINES.

It is an almost universal rule that drugs are ordered by the surgeon, and administered by the nurse. It is no part of a nurse's duty to give a medicine, even a "headache powder," on her own initiative. There are, however, one or two exceptions to this rule. When in the absence of the surgeon a patient suddenly develops symptoms which endanger his life, the nurse may administer drugs without orders, if she has a clear indication of the appropriate remedy.

Such *emergency drugs* are *spirit of sal volatile* (spiritus ammoniæ aromaticus), of which a teaspoonful in water may be given in a case of sudden faintness; *amyl nitrite* in a severe asthmatic spasm, or an attack of pain (called angina pectoris) in heart disease. This drug is put up in capsules of thin glass; one is placed in a handkerchief and crushed, and the contents are inhaled by the patient. In certain cases of poisoning, the nurse is justified in giving mustard and water or other emetic, and alcoholic stimulants.

In addition to prescribing the drug for a patient, the surgeon determines the dose, the frequency of administration, and the times at which it is to be given. Thus he may order five grains of soda (sodium bicarbonate) three times a day an hour after food. The time is quite as important as the dose, and it ought to be carefully adhered to.

Although a nurse may not order a medicine, she is often the means of having it prescribed. The appropriate drug is often suggested to the surgeon by the nurse's observation of a special symptom occurring during his absence. Nothing is to be considered too trivial to report. Headache, nausea, constipation, cough, sleeplessness—each may indicate the need for a new medicine, or the stopping of one previously administered.

It will readily be understood that the surgeon may, in the course of a single ward visit, order different medicines for many patients. The prescriptions may be noted on the charts by the house-surgeon, but in his absence the nurse should take each down in writing *at the time*. It is a needlessly severe tax on her memory to carry all the orders in her head, and the chance of one or more being forgotten is great. One of the gravest mistakes a nurse can make is to forget about a medicine which has been ordered.

The Action of Drugs.—Remedies may be given to act either *locally* or *through the blood-stream*. Picric acid, when applied to a burn, produces its effect at the place where it is applied. Similarly an eye-wash or a gargle acts locally. On the other hand, most of the medicines taken by the mouth and reaching the stomach are absorbed from its interior, and reach the blood. Circulating in the blood the drug is carried to every part of the body, and it selects one or more parts on which it acts. Thus digitalis stimulates the heart, strychnine the spinal cord, and potassium acetate the kidneys.

Channels of Administration.—Drugs may be introduced by other channels than the mouth. The mucous membranes which line various organs of the body are capable of absorbing drugs. Advantage is taken of this to administer some by the *rectum*, others by the *vagina*, others by the *conjunctiva*. A few drugs can be absorbed when rubbed into the *skin*. This method of administration is called *inunction*. Others are injected *hypodermically* or *intramuscularly*. Finally, volatile drugs may be inhaled and absorbed by the *lungs*.

Medicinal Preparations.—Drugs are administered in various forms, solid and liquid. The nurse should be familiar with the common forms :—

Mixtures are liquids consisting of one or more drugs dissolved in water or suspended in a solution of gum. They are for internal administration.

In giving a dose of a mixture, the nurse must take certain precautions. Each time and every time she picks up a bottle, *she must read the label.* In hospital the writing on it ought to indicate the name of the patient, the prescription, and the dose. If the wrong medicine is given to a patient, it may lead to the most serious consequences, for which the nurse is held liable. It is not sufficient to read only the name of the patient on the label, as he may have more than one medicine, or two patients in the ward may have the same name. Poisons are usually dispensed by the druggist in specially shaped and coloured bottles, which bear in addition a red label marked "Poison," and in the case of such medicines as liniments a second red label marked "For external use only". Such bottles are kept in a locked cupboard separate from the ordinary medicines. All medicines, whether poisonous or not, must be placed out of reach of patients. Further, they should be kept well corked and in a cool place. Hence in a private house the mantelpiece is *not* a suitable place.

To pour out a dose, shake the bottle, and turn the label upwards so that no drops trickle down and obscure the writing on it. Pour the required amount into a clean, graduated measure-glass of appropriate size. A minim-glass must be used if the dose is a small one. Replace the cork at once, and when the patient has taken the dose, rinse out the glass with water.

Pills are solid spheres, about the size of a pea, containing drugs, and they are meant to be swallowed whole. It is essential that they be dissolved in the gastro-intestinal canal, so that the medicinal agents may be freed and absorbed. Hence they should be freshly prepared. Old pills are apt to become so hard that they are not dissolved, and they are passed without having produced any effect. In a few cases pills are administered to act locally on the stomach, and they contain drugs which are not absorbed.

Powders consist of one or more drugs in the form of fine powder. As a rule those administered internally are insoluble in water, are placed on the tongue and gulped over with the

help of a draught of water. They may, however, be made into a paste with a small quantity of water, and then diluted with more water—this method is familiar to most in the preparation of Gregory's powder. A powder with a disagreeable taste may be wrapped up in a *cachet* of rice-paper and the whole mass swallowed. A powder is not so convenient as a liquid for administration, and for this reason soluble substances are usually prescribed as a mixture. Powders may also be applied locally to the skin.

Tablets are disks of compressed drugs. Some are administered by the mouth, others are dissolved in sterile water and injected hypodermically.

Capsules are made of gelatine, and each contains a definite quantity of a drug. They are swallowed whole so that nauseous drugs are not tasted.

Oils are frequently nauseating, and various methods are utilized to get rid of the taste. The two oils most commonly administered are castor oil and cod-liver oil. Though the modern preparations have little taste, the mere oiliness is apt to produce nausea. Apart from capsules, which are somewhat expensive, one of the best methods of administering oils is in the form of an emulsion. This is simply produced in the case of castor oil by shaking it up with milk and a little sugar, and the resulting emulsion is a convenient form to administer to children. For adults, the medicine-glass may be rinsed with lemon or orange juice, coffee or whisky; then the oil is added, and finally a layer of the beverage. The whole should be poured into the mouth, and gulped down without stopping.

Liniments or embrocations are oily preparations, usually containing camphor, which are rubbed into the skin. They are specially labelled "For external use only," and are employed to relieve pain or stiffness.

Ointments are semi-solid preparations consisting of active drugs mixed up with a fatty substance such as lard, wax, or lanolin. They may be spread over the skin when they are meant to act locally, or rubbed into the skin when absorption of the active ingredient is required. The latter treatment is called *inunction*, and is almost entirely restricted to the administration of mercury in syphilis.

Hypodermic Injections.—Drugs in solution may be injected into the subcutaneous tissues by means of a hypodermic syringe (Fig. 17) which is graduated in minims or cubic centimetres on the piston or the barrel. The syringe is sterilized by boiling, and filled with a solution of the required drug, so that no air-bubbles are retained. To effect this, draw up more than is required of the medicine, and hold the syringe with the hollow needle pointing straight upwards. Then push on the piston till a fine continuous stream of the liquid is forced out. All the air-bubbles are in this way removed, and then the piston is pushed still farther on, until no more than the desired amount is left in the syringe.

Besides the injection of air-bubbles, other dangers have to be avoided, and every nurse must be familiar with the methods of preventing them. In the first place, the syringe must be *tested* with sterile water to ensure that it is in good order. The commonest faults are a blocking of the hollow

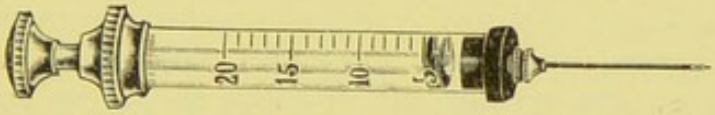


FIG. 17.—HYPODERMIC SYRINGE, GRADUATED IN MINIMS.

needle, and a badly-fitting washer on the piston-rod. When such a syringe is filled and the piston is pushed down, none of the fluid can flow through the needle, it escapes back behind the piston, and the patient gets none of it. This is by no means an uncommon occurrence. To prevent the blocking of the needle, a stilette must be introduced as soon as the syringe has been cleaned after use.

The fault in the washer may be caused by repeated boiling, by using the syringe to inject ether, or by drawing up ether to dry it. Ether should never be introduced into a syringe which has a leather washer, as it dries up the leather and makes it shrink. An *all-metal* or *all-glass* syringe should always be employed.

The next precaution is to see that the solution to be used is quite clear and has no solid particles floating in it or deposited at the foot of the bottle. The best way is to shake the bottle and pour the contents into a glass vessel—a Y-shaped

minim glass is convenient—and carefully inspect the fluid. If tablets are used, each must be thoroughly dissolved until no particles are visible.

The syringe, having been tested and found efficient, is filled with the prescribed amount of the drug in solution and the air-bubbles are expelled. The skin is then cleansed with cotton-wool soaked in sulphuric ether or lysol. Choose a spot on the upper arm, front of the chest, or other situation where the skin is lax and no vein is visible. Pinch up the skin between finger and thumb of the left hand, and push the needle sharply through the whole thickness of the skin in a slanting direction. It is important that the needle should penetrate to the subcutaneous tissue, and not remain in the skin where there is no loose space and the injection is painful. In the case of ether, it should be injected well into the fatty tissue and not immediately under the skin, where it may form a slough. When all the fluid has been introduced, withdraw the needle, close the opening with the point of a finger, and rub or stroke upwards from the site of the injection to diffuse the fluid and hasten its absorption. Then cleanse the syringe by drawing up sterile water once or twice. To prevent rusting, the needle may be dipped in methylated spirit and dried, before the stilette is inserted.

Intramuscular Injections.—Certain drugs which produce irritation and even sloughing of the skin, e.g. mercury and ergot, are introduced intramuscularly. In this case the syringe is filled, and the air expelled as before. Then the needle is detached and plunged straight in to reach the muscle. If a vein is penetrated, as is indicated by a flow of blood from the needle, the latter must be extracted and introduced at a different spot. The syringe is then fixed on, and the required amount of the drug injected. Owing to the risk of injecting into a vein, some surgeons advise that these precautions be also carried out in hypodermic injections.

Suppositories are solid, conical bodies for insertion into the rectum. They consist of certain drugs—morphia, glycerine, iodoform, etc.—mixed up with an inactive substance (usually oil of theobroma) which remains solid at room temperature but liquefies with the heat of the body after introduction.

Pessaries are made like suppositories and are of the same shape, but generally of larger size. They are for insertion into the vagina.

Bougies are solid cylinders for insertion into the male urethra.

Lamellæ are small, thin disks made with gelatine and glycerine, and containing atropin, cocaine or other active drug. They are for applying to the surface of the conjunctiva.

Inhalations may be ordered for their local effect, for example tincture of benzoin in laryngitis, or for an internal effect after absorption from the lungs, for example amyl nitrite in an attack of angina pectoris, or smelling-salts in sudden faintness. General anæthesia is usually produced by the inhalation of certain drugs—chloroform, ether, ethyl chloride, and nitrous oxide gas.

Weights and Measures.—A nurse must be familiar with the weights for solid drugs and measures for liquids. The British or Imperial system is used in this country, and the metric system on the Continent, but as certain foreign preparations are used in Britain, it is well to have some idea of both systems.

British System:—

Weights:	30	grains (gr)	= 1 scruple (℈)
	60	grains	= 1 drachm (ʒ)
	437½	grains	= 1 ounce (℥)
	16	ounces	= 1 pound (lb.)
Measures:	60	minims (♏)	= 1 fluid drachm (ʒ)
	8	drachms	= 1 fluid ounce (℥)
	20	ounces	= 1 pint (⊖)

One hundred grains by weight of water approximately equal 110 minims. Hence a 5 per cent. solution, say of potassium permanganate, in water is one in which 5 grains of the drug are dissolved in 110 minims of water.

Certain domestic substitutes for measure-glasses are sometimes used, but they are not accurate and should have no place in hospital practice:—

1 teaspoonful	= 1	fluid drachm	approximately
1 dessertspoonful	= 2	„ drachms	„
1 tablespoonful	= 4	„ drachms (½ ounce)	„
1 wineglassful	= 1½-2	„ ounces	„
1 teacupful	= 5	„ ounces	„
1 breakfastcupful	= 8	„ ounces	„

Nurses must be warned against using such domestic articles as a substitute for weighing solid powders which vary greatly in weight, bulk for bulk. For example, a teaspoonful of phenacetin weighs much less, and a teaspoonful of calomel much more than a drachm.

Under certain circumstances a nurse may have to calculate the dose. The surgeon may order 20 grains of potassium bromide for a patient, while the ward stock is kept in solution. Let us assume that the prescription on the bottle is :—

Potassium Bromide	gr. 120.
Distilled Water	℥ 6.

The whole bottle contains 120 grains, and therefore 20 grains are contained in a sixth of the whole bottle. Hence the required dose is one ounce.

Metric System :—

Weights :

1 milligram (mg.)	= 0·001	gramme
1 centigram (cg.)	= 0·01	gramme
1 decigram (dg.)	= 0·1	gramme
1 gramme (grm.)		
1 dekagram (dekag.)	= 10	grammes
1 hectogram (hectog.)	= 100	grammes
1 kilogram (kg. or kilo.)	= 1000	grammes

Measures : 1 cubic centimetre (c.cm.) = the measure of 1 grm. of distilled water at 4° Centigrade.
1 litre = 1000 cubic centimetres.

Since 1 gramme by weight of water corresponds to 1 cubic centimetre by measure, a 5 per cent. watery solution of a drug is one in which 5 grammes are dissolved in 100 cubic centimetres of water.

To convert from the British to the Metric System :—

Weights :	1 grain	=	0·0648 gramme
	1 ounce	=	28·3495 grammes
	1 pound	=	453·5924 grammes
Measures :	1 minim	=	0·059 cubic centimetre
	1 drachm	=	3·55 cubic centimetres
	1 ounce	=	28·417 cubic centimetres

To convert from the Metric to the British System :—

Weights :	1 milligram	= 0·015 grain	= $\frac{1}{60}$ grain approx.
	1 gramme	= 15·342 grains	= 15½ grains „
	1 kilogram	= 2 lb. 3 oz. 119·8 gr.	= 2¼ lb. „
Measures :	1 cubic cm.	= 16·95 minims	= 17 minims „
	1 litre	= 35·275 fluid ounces.	

PURGATIVES.

In general it may be stated that purgatives, like other medicines, are prescribed by the surgeon. It is true that the ward Sister controls their administration to most of the patients without a direct order in each individual case. But general orders are given by the surgeon for different *classes* of patients, and it is the Sister's knowledge of his rules which enables her to give purgatives apparently on her own initiative. A private nurse is not justified in giving a purgative without the doctor's directions.

In a surgical ward the patients may be grouped in three classes—those awaiting operation, those just operated on, and convalescents. For the majority of the first group the administration of a purgative is an essential part of the preparation for operation. In general the opening medicine is given the day before operation, and the bowels should be well cleared before evening, so that the patient's sleep is not disturbed. In operations on the rectum and perineum it may be given earlier, and the lower bowel should in addition be washed out by an enema some hours before operation. The purgatives most commonly ordered are castor oil

(½-1 ounce), Epsom salts (½ ounce) or Henry's solution (2 ounces), and calomel (3-5 grains) followed by salts or a Seidlitz powder. For children castor oil is usually to be preferred.

In emergency cases time does not permit of a purgative being given, and in special cases, such as appendicitis, and chronic obstruction of the bowel, the administration is controlled by the surgeon himself.

The choice of a purgative, and the time of its administration are of great importance after operation, and the guiding principle is to give it as soon as is compatible with safety. After slight operations and in operations on the limbs, it is usually given in twenty-four to forty-eight hours. After serious operations and in abdominal cases, the surgeon fixes the time in each individual case.

It has been the tendency within recent years to have the bowels moved early, and patients are now rarely kept for a week without a purgative. After the radical cure of hernia, most cases of appendicitis, operations on the gall-bladder, stomach, kidney and bladder, the purgative is not delayed beyond forty-eight hours. After operation for strangulated hernia or piles, excision of intestine, and perineal repair seventy-two hours may elapse before purgation is effected.

After operation one of three purgatives is usually selected by the surgeon—castor oil, salts, or calomel. The last-named is most easily taken by the patient, especially if he has post-operative sickness, and it causes little discomfort. It may be given in one dose of 3-5 grains, or in 1-grain powders every hour for four hours. It usually takes eight hours or more to act, and an enema is often required to complete the action. As calomel causes sickness and faintness in certain patients, it is advisable in every case to give a dose of salts four or five hours later to wash it out of the intestine. Castor oil is apt to cause sickness, but with encouragement from the nurse the patient usually manages to keep it down, especially if the oiliness is disguised by one or other of the methods already mentioned (p. 50). We have frequently found that troublesome sickness after operation was stopped by the administration of castor oil. It is perhaps the most reliable in its action of all purgatives, and is the most suit-

able for children. Magnesium sulphate (Epsom salts) or Henry's solution, which is a mixture containing Epsom salts, is apt to cause griping pains, but it is generally a satisfactory purgative, especially if fever is present. It may, however, fail to act in patients recently operated on.

For subsequent movements of the bowels, and during convalescence, there is a wider choice of purgatives, though none is better than the three already mentioned. Cascara in liquid form (1 drachm), tablets or capsules, ½-grain aloin pills or tablets, compound liquorice powder (60 to 120 grains), Gregory's powder (30 to 60 grains), syrup of figs (1 to 2 drachms), colocynth and hyoscyamus pills (4 to 8 grains), mineral waters, and a host of others may be employed.

The majority of patients require purgatives during the whole of their stay in bed, and as a rule one or other is administered every second night. The ward Sister or the private nurse may administer a purgative to a convalescent patient without orders from the surgeon. At the same time it is advisable for the nurse to obtain his approval of the medicine which she selects.

When the patient is unconscious, the administration of castor oil or salts is attended with the risk of choking, and a less bulky purgative must be given. One drop of croton oil placed on the back of the tongue is reflexly swallowed, and is sufficient to produce drastic purgation. At the same time, it is so irritating that it ought not to be administered to patients suffering from intestinal conditions, or more than once to any patient. If unconsciousness is so deep that even the swallowing reflex is lost, the patient must be left alone, or treated solely by evacuant enemata (p. 58).

RECTAL INFUSIONS AND ENEMATA.

Any fluid preparation introduced into the rectum is called an enema. If its object is to empty the bowel—*evacuant enema*—it is large in bulk (10 ounces to 2 pints); if it is to be retained—*nutrient enema*—it is small in bulk (2 to 10 ounces). A special enema, usually called the *flatus* or *ward enema*, is sometimes given after operation to empty the lower bowel of

gas. It consists of ½ ounce of Epsom salts, 1 ounce of glycerine, and 6 ounces of water. Though small in bulk, it irritates the wall of the bowel, and is soon expelled. It is better than the *glycerine enema*, which consists of 1 to 2 ounces of pure glycerine, as the latter causes severe pain and even in some cases a rigor.

Evacuant Enemata.—The commonest evacuant enema is *soap and water*. A measured quantity of warm water, 1 to 2 pints, is taken in a basin, and soap is rubbed down in it until a good lather is obtained. This is introduced slowly into the rectum by means of a Higginson's syringe (Fig. 18), which is filled with the liquid before the nozzle is inserted.

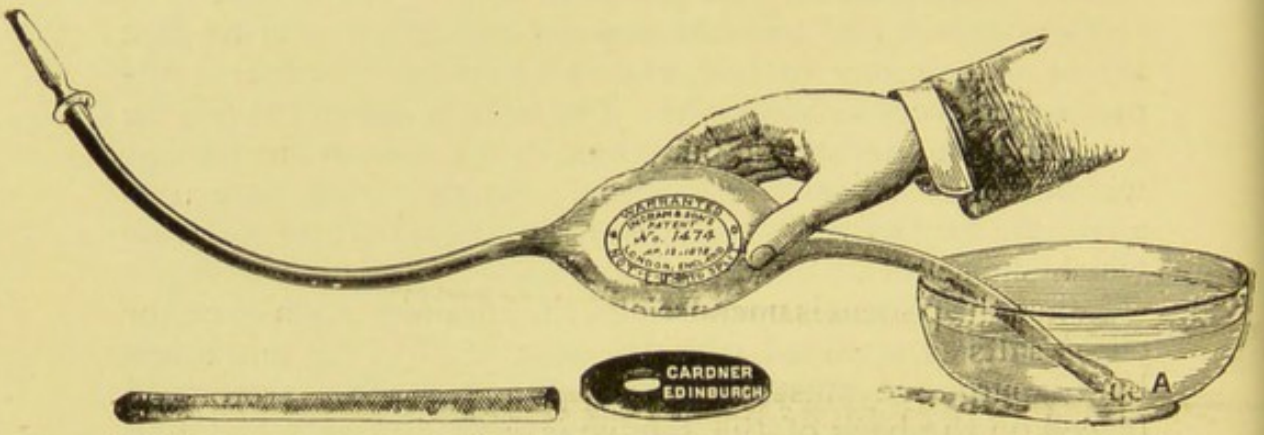


FIG. 18.—HIGGINSON'S SYRINGE, WITH RECTAL NOZZLE ATTACHED, AND VAGINAL NOZZLE BELOW.

Care must be taken to keep the other end of the syringe entirely covered by the fluid in the basin, to prevent air entering the syringe and being introduced into the rectum. The patient is directed to retain the enema for ten minutes. During this time it softens the bowel contents, and afterwards it is expelled with them.

Turpentine Enema.—The action of the soap and water enema is made more certain and effective by adding an ounce of *turpentine*, *glycerine*, or *Epsom salts* to it. Switch up the white of an egg in a cup. Stir in ¼ to ½ ounce of turpentine, and add 1 to 2 pints of soap and water; or the turpentine may be stirred up in a small quantity of strong soap-suds, and then added to the water. Glycerine

(½ to 1 ounce) and Epsom salts (½ to 1 ounce) are merely added to the soap and water and the mixture stirred.

An evacuant enema should not be given quickly. It may appear to be a great feat to administer over a dozen in half an hour, but it is bad nursing. When the rectum is rapidly distended, the patient immediately expels the fluid before it has had time to soften the contents of the colon. The same occurs if air is introduced into the rectum.

When an enema is returned, the nurse must always inspect the contents of the bed-pan to find out whether or not the result has been satisfactory.

Enema Rash.—In certain susceptible patients, soap enemata produce an erythematous rash on the body. Though it may last several days, and cause much itching, it is not serious. In such patients, soap should afterwards be omitted from the enema.

Nutrient Enemata.—If for any reason food may not be administered by the mouth, the patient has to be nourished by some other channel, and the rectum is usually chosen. There is a great difference of opinion regarding the amount of nourishment which a patient can absorb by the rectum, and it is certain that he cannot be kept alive indefinitely by nutrient enemata. At the same time, he does not lose weight as quickly as he would if he had no food at all.

Composition of Nutrient Enemata.—Nutrient enemata should contain the three food-stuffs which the body requires—protein, carbohydrate, and fat. The quantity that can be retained varies in different patients. If 10 ounces are too much, then try small enemata of 3 ounces, and gradually increase the amount, as the patient tolerates them better. Laudanum, 10 to 20 drops, is sometimes added to the enema to allay the irritation.

Useful nutrients are—

(1) Yolks of two eggs	
Sugar (pure dextrose)	1 ounce
Salt	8 grains
Digested milk	8 ounces
(2) Ox serum	3 ounces
Starch	2 ounces
Milk	6 ounces

(3) Dextrose 2 ounces
Milk 8 ounces

Administration of Nutrient Enemata.—Before the first enema, the rectum should be emptied by an injection of warm water or saline solution. When nutrients are being administered at regular intervals, say every six or eight hours, the cleansing should be repeated once a day.

Nutrients should never be given by means of a syringe. The best apparatus is an œsophageal tube with a funnel attached (Fig. 19). The enema is heated to 100° F. and the apparatus is filled with fluid, the catheter being meanwhile clamped between two fingers. Then the catheter,

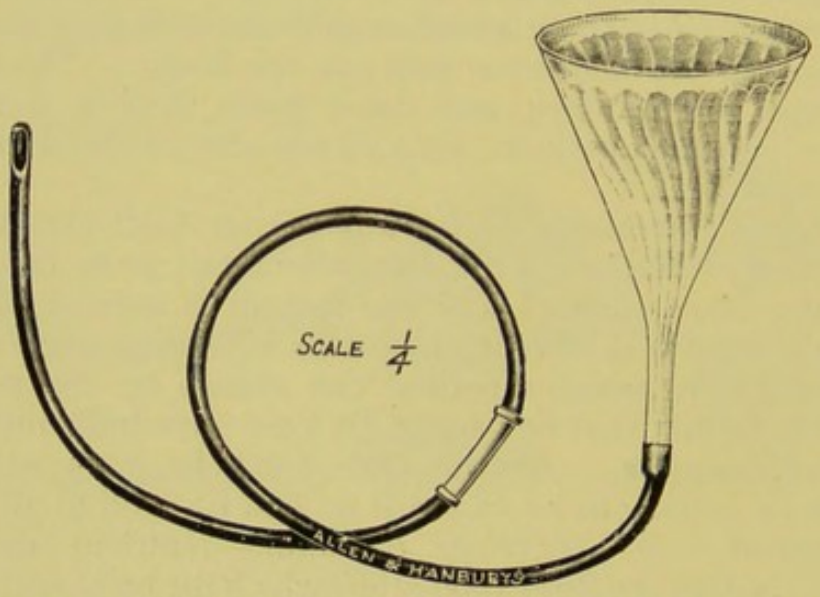


FIG. 19.—APPARATUS FOR ADMINISTERING ENEMATA BY GRAVITY.

previously lubricated (p. 20), is inserted well up into the rectum. This is most easily done if the patient lies on his side with the knees drawn up. The funnel is held 1 to 1½ feet above the level of the anus, so that the fluid flows steadily and slowly into the rectum by gravity. As the funnel empties, more of the fluid is poured in, and so on till the whole enema has been administered. The patient should then lie quiet for about an hour.

Saline Infusions or Enemata are very frequently given in the treatment of shock after operation, or of severe hæmorrhage, and to patients to whom fluids cannot be administered by the mouth. The amount of the enema should be 7 to

10 ounces, and this quantity may be introduced every four hours. Sometimes a pint can be retained without difficulty. The strength of the solution is a teaspoonful of common salt to each pint of water, and seven or eight drops of adrenalin (1 in 1000) may be added to the first saline. Saline infusions should always be given by means of the tube and funnel (Fig. 19).

Continuous Rectal Infusion, or Proctoclysis.—In severe shock and in peritonitis, the saline solution may be allowed to flow continuously into the rectum through a rubber catheter and tube connected with a douche-can (Fig. 209) placed at a level of six to twelve inches above the anus. The fluid should be kept at a temperature of 100° F., and flow at the rate of 10 to 15 ounces per hour.

SUBCUTANEOUS AND INTRAVENOUS SALINE INFUSION.

Normal Saline Solution has many applications in surgery. Mention has already been made of its use in wound treatment, and of its administration intermittently or continuously by the rectum. It is also used as a lotion at operations, and is frequently introduced into the peritoneal cavity for the prevention of shock in abdominal cases. It is employed in the irrigation of compound fractures, and open wounds of joints. It is used to make solutions of various drugs for inducing local anæsthesia, and to dilute adrenalin for application to a bleeding surface. It may also be introduced into the subcutaneous tissue or into a vein.

Preparation of Normal Saline Solution.—In the treatment of wounds, and for administration by the rectum, the saline solution may be readily made by adding a teaspoonful of common salt to each pint of water. For introduction into the peritoneal cavity, the subcutaneous tissues, or a vein, it must be prepared more accurately by dissolving 80 grains of pure salt (sodium chloride) in each pint of sterile distilled water at 100° F. Such a solution mingles with the blood without damaging its cells, and it is called "normal". Its preparation and sterilization are usually entrusted to the hospital dispenser, who supplies it in glass flasks sealed with

dry sterile cotton-wool which is fixed in with strips of adhesive plaster. The plug must on no account be taken out till the saline is to be used, and even when only a small quantity of it has been used the remainder should be poured out, and the flask sent back to be refilled.

Nowadays the preparation of normal saline solution is made easier, as salt is sold in the form of tablets containing the exact amount to be added to a definite quantity of distilled water.

It is sometimes stated that the salt solution should be kept of double strength, so that, when needed in a hurry, it may be at once brought to the proper temperature by adding an equal quantity of boiling water. But for infusion into a vein, it is distilled water that has to be added, and it must be boiled specially, so that no time is saved. In addition, we have seen nurses add more than an equal quantity of boiling water to obtain the proper temperature, with the result that the saline solution was no longer "normal".

The proper way to heat the saline is to place the flask in a basin of boiling water, loosening the wool stopper but not taking it out altogether. The temperature should be tested by pouring some of the solution over the forearm. At this stage, a few drops of adrenalin may be added.

Subcutaneous Saline Infusion.—A part of the body is selected at which the subcutaneous tissue is loose. In female patients, the most suitable place is behind the breast—*retro-mammary* infusion. The skin is cleansed with lysol, dried, and swabbed with ether.

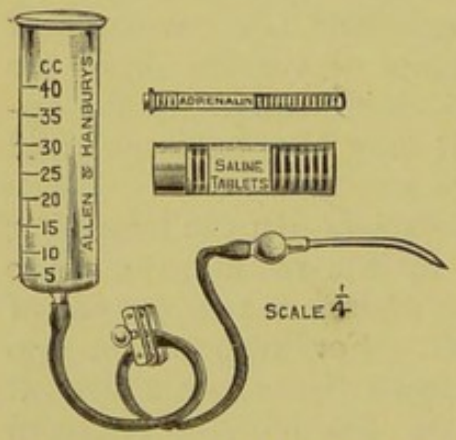


FIG. 20.—APPARATUS FOR THE SUBCUTANEOUS INFUSION OF SALINE SOLUTION.

The apparatus consists of a curved, sharp-pointed, hollow needle, connected by a rubber tube to a glass funnel (Fig. 20). The whole is sterilized by boiling in plain water or saline solution, and filled with normal saline so as to drive out all air-bubbles. The needle is then plunged obliquely through the skin, the funnel raised, and the liquid allowed to flow in slowly.

It gradually forms a swelling around the point of introduction, and this should be dispersed by stroking in different directions. It is not usually possible to inject more than half a pint at one place, and even with a smaller quantity severe pain may be produced. This is the great disadvantage of subcutaneous infusions.

Sometimes a double apparatus is used to introduce saline simultaneously at two points. It consists of a funnel and rubber tube as before, the latter being joined by a T-shaped tube to two rubber tubes each of which is attached to a needle.

Intravenous Saline Infusion.—The median basilic vein at the front of the elbow is usually selected for the infusion. The skin over it is cleansed, and a tourniquet may be applied above the elbow to make the vein prominent. The instruments required are: knife, dissecting forceps, dissector

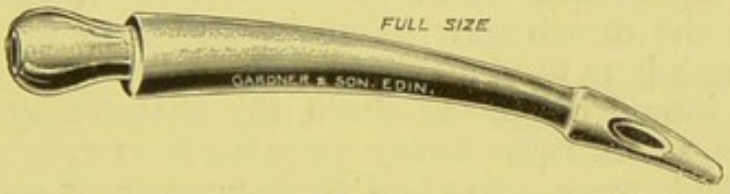


FIG. 21.—NOZZLE FOR INTRAVENOUS INFUSION OF SALINE SOLUTION.

(Fig. 63), aneurysm needle (Fig. 70), and skin needle. Catgut is used to ligate the vein, and horse-hair or silk-worm gut for the skin suture.

When the vein has been isolated, two ligatures are thrown round it at a distance of half an inch from each other. The lower one is tied tightly, and the upper is left loose. Then an opening is made in the wall of the vein, and the needle is inserted, and fixed in position by tightening the upper ligature over it. The apparatus is the same as for subcutaneous infusion, except that the needle is not sharp-pointed. It may be of metal (Fig. 21) or glass. The whole is sterilized by boiling, and filled with solution before the needle is inserted. One to two pints are allowed to flow in slowly. Then the needle is withdrawn and the upper ligature is drawn tight. The skin wound is closed by a stitch, and a dressing is applied.

The time required for the introduction of a pint of fluid is fifteen to twenty minutes. If the rate is greater or the temperature of the solution is too low, rigors and dyspnœa may occur.

LAVAGE OF THE STOMACH.

The stomach may be washed out for persistent vomiting, and in cases of poisoning with opium, alcohol, or other drugs.

The apparatus consists of a rubber stomach-tube attached by a glass connexion to a second rubber tube which has a funnel fixed in its outer end. The stomach tube, which is about two feet in length, is lubricated with glycerine or butter, and passed to the back of the mouth. If necessary the jaws are kept open by a gag. The patient is then directed to take full breaths rapidly, and the tube is pushed on down the œsophagus. The distance from the teeth to the stomach is 14 to 16 inches. If the patient is unconscious, the tube should be guided down the pharynx by the left forefinger, as otherwise it may enter the larynx.

The fluid, weak potassium permanganate or sodium bicarbonate solution, is then poured into the funnel, and allowed to flow down into the stomach. Not more than 10 ounces should be introduced at a time. Then the funnel is depressed and held over a pail, and the stomach contents are siphoned off. The process is repeated several times till the returning fluid is clear.

FEEDING BY STOMACH OR NASAL TUBE.

Food may be administered to patients by the stomach tube when they refuse or are unable to swallow. Milk, eggs, sugar, soups, meat juice, and many other liquids may be administered in this way.

Nasal feeding may also be practised, a tube being passed through the nose to the pharynx and œsophagus. This method is employed in lunatics who refuse food, and in certain patients who have had operations on the mouth and larynx.

MASSAGE AND MOVEMENT.

Massage is of great value in surgery in preventing wasting of muscles, in removing inflammatory swellings, and in preventing or dispersing adhesions.

The principal manipulations are:—

Stroking with the palm of the hand (*effleurage*). Each movement should be performed towards the heart, i.e. towards the hip in the lower limb, and the shoulder in the upper limb. This empties the veins and lymphatic vessels of the area, so that they are ready to be filled again with a fresh supply of fluid. Hence the circulation through the part is increased, and any accumulation of fluid in it tends to be swept away.

Kneading or rubbing (*pétrissage*). This consists in firm pressure over special areas, effected by the thumbs or knuckles, and is especially useful in getting rid of inflammatory swellings. It should be followed by stroking towards the trunk over a wide area, so as to dispel any fluids that have collected in the vessels.

Pinching up of muscles between the thumb and finger is useful in promoting the circulation. The pinching should be begun at the foot of the muscle and continued towards the trunk.

Tapping, *thrusting*, and *hacking* (*tapotement*). In tapping the finger-tips or knuckles are used as in knocking at a door, and in thrusting they are pressed in deeply. Hacking consists in striking the parts with the edge of each hand alternately. These manipulations are performed in a direction always approaching the trunk.

Duration of Massage.—In general, one sitting a day for ten to fifteen minutes is sufficient. Each manipulation should be begun gently, and gradually increased in force.

The chief surgical conditions in which massage is beneficial are: *Fractures*, to remove swelling and hasten the repair of the bone; *dislocations* and other injuries of joints, to remove fluids from the joint, and prevent adhesions; *stiff joints*, resulting from prolonged fixation after injury or in disease (in tuberculous conditions, however, massage may

cause a fresh outbreak, and is generally better left undone); *swellings*, due to inflammatory thickening or to hæmorrhage into the tissues.

Movement is usually combined with massage and it may be passive or active.

Passive Movement consists in the bending of the joints by the masseur, the patient himself making no effort. It prevents adhesions of the joint and of the tendons passing over it.

Active or Voluntary Movement is carried out by the patient. He is directed to move certain joints at a time, and he does so by repeatedly contracting the muscles. To prevent stiffness of joints during the treatment of a fracture or dislocation, and to cure stiffness, active movements are of greater value than massage or passive movements, and in such conditions they should be begun as soon as possible.

Special Exercises are set for certain deformities. Thus if the elbow is stiff, the joint may be moved by pulling on a weight strung over a pulley. Dumb-bell exercises and Swedish drill are also useful.

TREATMENT BY ARTIFICIAL HYPERÆMIA.

In inflammation and some other surgical conditions, a plentiful supply of fresh blood in the part is beneficial. It has been stated that a patient resists an attack of bacterial infection by means of the leucocytes of the blood and certain bodies contained in the blood-serum (p. 6). Hence if a part has been invaded by bacteria, the logical method of treatment is to increase the amount of blood in it, or as it is called, *induce an artificial hyperæmia.* Hot fomentations and poultices cause the vessels to dilate, and so increase the amount of blood in the subjacent area. Counter-irritants, such as mustard, cantharides, iodine, and the cautery, probably act in the same way.

Bier's Method of inducing Hyperæmia is the most valuable. By means of an elastic bandage applied some distance above the inflamed area, the flow of blood in the veins is obstructed and a *passive* hyperæmia is produced. The bandage must

not be so tightly applied as to interfere with the entrance of arterial blood to the part. Below the elastic bandage, the limb becomes somewhat swollen and œdematous, and is

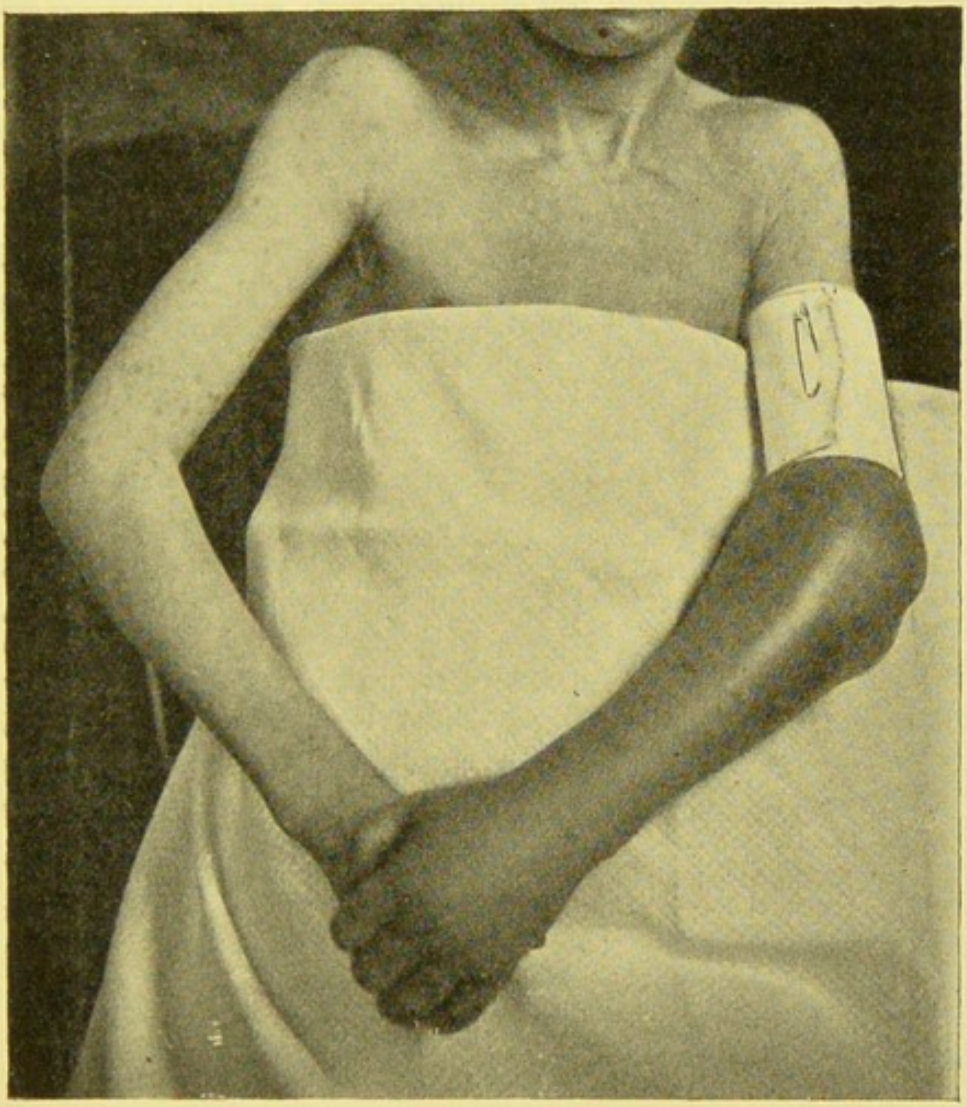


FIG. 22.—INDUCTION OF PASSIVE HYPERÆMIA IN ARM. THE ELASTIC BANDAGE HAS BEEN TOO TIGHTLY APPLIED.

bluish-red in colour, but the pulse is unchanged. It may become slightly colder than the opposite limb, but if the part is dead cold the bandage has been applied too tightly. The pain that is usually present in septic conditions is relieved.

Besides the decrease in temperature, other signs that the elastic bandage is too tight are blueness and increase of pain.

In acute septic conditions, the bandage is kept on for twenty hours out of the twenty-four, and in the intervals the limb is elevated to empty it of the impure blood. As the inflammation subsides, the bandage is kept on for shorter periods, and the intervals are lengthened.

Klapp's Suction Bells.—For inflammatory conditions occurring on the trunk, the elastic bandage cannot be applied above the area so as to obstruct the venous return. A Klapp's suction bell should then be applied. The bell is made of glass, shaped to fit round the affected area, and large enough to touch healthy tissue on every side. It is connected by a piece of thick-walled rubber tubing to a suction-pump. The rim of the bell is smeared with vaselin, and applied to the area so that no air is admitted round its margin. Then it is partly exhausted by one or two strokes of the pump, and the stop-cock is closed. In this way the amount of blood in the part is increased, slight swelling and bluish-red discoloration appear, and pain is removed. If the exhaustion of the air is carried too far, pain is increased, and small red spots, representing minute hæmorrhages, appear in the skin. Then air must be admitted to the bell by detaching the pump and opening the stop-cock. The bell must never be forcibly removed before air has been let in.

Suction is maintained for five to ten minutes at a time. Then the bell is left off for ten minutes, and again applied for the same period, and so on. Each sitting should last forty to sixty minutes.

Conditions in which Bier's treatment is employed.—The elastic bandage applied round the wrist is valuable in septic conditions of the bones, joints, or soft parts of the fingers and palm of the hand. If the whole hand, the wrist or the forearm is infected, it should be applied above the elbow. It is also of use in chronic tuberculous disease of the bones or joints, but it should not be kept on longer than four hours of the twenty-four. In the lower limb, the bandage may be applied round the ankle, knee, or thigh, according to the position of the infected area.

The elastic bandage may also be applied at some distance above a simple fracture in cases of delayed union, or above a compound fracture to diminish the risk of sepsis or fight it when it has occurred.

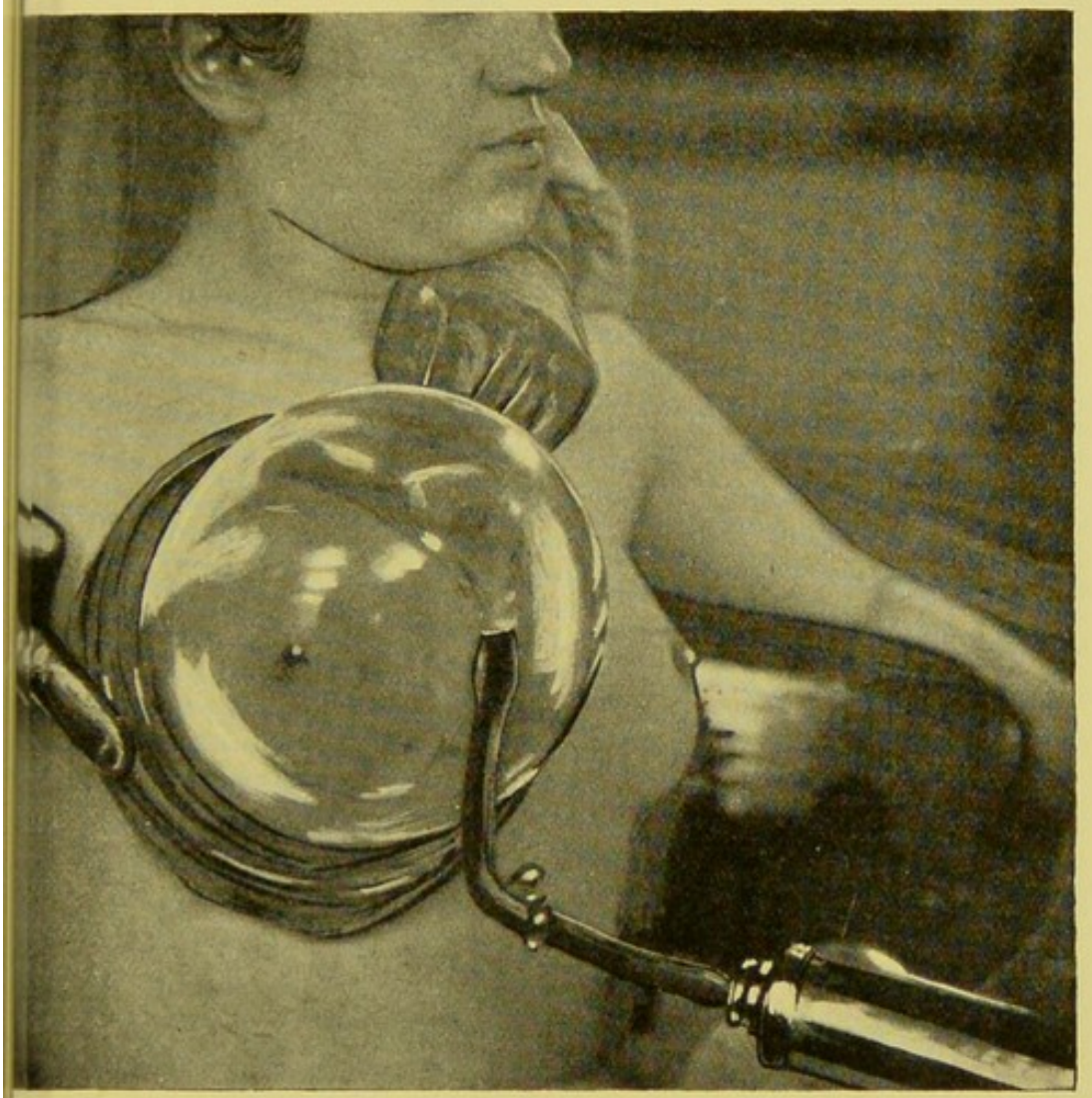


FIG. 23.—INDUCTION OF PASSIVE HYPERÆMIA IN BREAST BY SUCTION BELL.

The suction bell is applied in such septic conditions as a boil, an inflamed gland of the neck or groin, a superficial abscess in any locality, acute gonorrhœa, inflammation of the breast (Fig. 23). In addition, air-tight bells are made for use

in the limbs, and a finger, hand, foot, or larger segment of a limb may be enclosed. When the infected area is small in

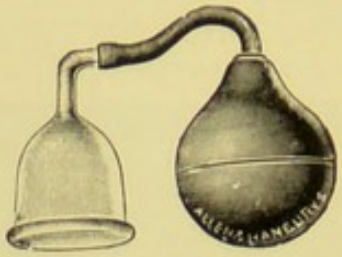


FIG. 24.—KLAPP'S SUCTION BELL WITH RUBBER BULB.

extent, as in a boil on the neck, the bell is also small, and the air in it may be sufficiently exhausted by means of a rubber bulb (Fig. 24).

SECTION III.

BANDAGING.

CHAPTER VII.

PRINCIPLES OF BANDAGING.

IT is scarcely necessary to indicate in any but the briefest manner the numerous uses to which the bandage is put in surgery. All dressings and fomentations are fixed and retained in position by one or other form of bandage, and almost all splints, whether applied to control fractured bones, to ensure immobility of joints, or to correct deformities, are similarly secured. Bandages are oftenest used alone, but are sometimes impregnated with various substances, such as starch and plaster of Paris, to give rest or stability to different parts. As a means of preventing and of arresting hæmorrhage, and of influencing the size of certain forms of swelling, different varieties of bandage are of great value.

Materials.—1. *Linen*, *cotton*, and *calico* form useful, strong bandages, varying in strength and stiffness according to the quality and newness of the material. They are softest and lie best when made of old cloth which has been frequently washed. These bandages are not antiseptic.

2. *Gauze.*—This material is sometimes charged with some antiseptic agent such as carbolic acid or the double cyanide of mercury and zinc, and used as a bandage.

3. *Domette* is a variety of soft, elastic flannel, and bandages made of this material fit nicely to the part, and do not tend to slip, as stiffer forms sometimes do. They may be rendered aseptic by dry sterilization, or antiseptic by being

charged with sal-alembroth, and as they wash well they may be used repeatedly. Domette is also used to make binders.

4. *Muslin*, strong and coarse, with wide meshes, is used in making plaster of Paris bandages.

5. *Elastic webbing* is a form of bandage in which the longitudinal strands are made of rubber, the transverse ones of cotton. Such a bandage is used to apply a moderate amount of pressure or elastic support to any part, e.g. a joint into which there has been effusion, or a limb with varicose veins. The open network has the advantage over the elastic bandage of permitting evaporation of the sweat, which if retained irritates the skin.

6. *Martin's Elastic Bandage* is made of a sheet of thin rubber. It is chiefly used in the treatment of varicose veins of the leg, but, as just mentioned, is objectionable in retaining perspiration.

7. In cases of emergency, *old household linen* (short of being rotten, the older the better) makes good bandages.

Varieties of Bandages.—The commonest form of bandage used in surgery consists of a length of material rolled tightly up from end to end, constituting a simple *roller bandage*. When rolled from one end only it is spoken of as a *single-headed roller;* when from both ends as *double-headed.* It will be necessary later to describe certain forms of compound bandage, such as the *many-tailed*, *four-tailed*, and T-*shaped*, each having a special use.

Certain names are used to indicate the various methods of applying a bandage to a part, depending on the arrangement of the turns of the bandage. For example, a *circular* bandage is one in which each succeeding turn exactly covers the one which preceded it; an *oblique* bandage simply takes its own course round the limb, covering parts, and leaving others bare; a *spiral bandage*, as its name implies, winds spirally round the limb, but each succeeding turn overlaps only two-thirds of its predecessor. An important modification of the last is the *spiral bandage with reverses*, in which the bandage is folded over on itself at regular intervals, to insure that no spaces are left uncovered between the turns. The *figure-of-eight bandage* consists of two almost equal circular turns, one being above, the other below, the point of

crossing. It is chiefly employed in covering in joints. Closely related to it is the *spica bandage*, so named from a fancied resemblance to a spike of barley. In it one circle is larger than the other, and it is employed in bandaging parts where two unequal cones meet, as at the shoulder or groin. The indications for selecting one or other of these forms will be pointed out later on, as well as the method of carrying out the manipulations.

Binders are frequently used for the trunk, as they can be undone and fixed again without moving the patient. A binder consists of a rectangular piece of domette or white flannelette, 6 to 12 inches broad, according to the age of the patient, and long enough to encircle the abdomen or thorax one and a half times. The end is secured by three or four safety-pins. Flannelette does not shrink with washing. A binder combined with a many-tailed bandage (Fig. 43) is a useful dressing which keeps its position better than either alone. To prevent a binder slipping up to the waist, it may be fixed down by two *perineal straps*, i.e. strips of domette passed round the top of each thigh.

Parts of a Bandage.—For purposes of description names are applied to different parts of a bandage. Thus, the part of a roller bandage which is still unrolled is spoken of as the *head*, and naturally the loose end is referred to as the *tail*. The *anterior surface* is that on which the head rests, and the opposite side is *posterior*.

Sizes.—It is obvious that different widths of bandage are necessary for different parts of the body, in proportion to the circumference of the part to which they are applied. The sizes usually recognized are :—

For upper extremities and head, 2½ inches wide.
For lower extremities and pelvis, 3 to 3½ inches wide.
For thorax and abdomen, 4 to 4½ inches wide.
They should all be 6 yards in length.

To Make Bandages.—"Procure 6 yards of calico about 1 yard in width, and remove the selvedges. Mark off with scissors short strips of the desired breadth; then grasp the alternate strips gathered in two separate bunches, and pull in opposite directions" (Caird and Cathcart). They are then rolled tightly and evenly either with the hand or with a winding

machine (Fig. 25). When the machine is used, some difficulty will be experienced in withdrawing the pin from the centre of the bandage unless the first few turns are made rather slack, and the handle reversed once or twice while the completed roll is firmly grasped by the hand. Tie a few threads from the edge of the bandage round the roll, or fix the last turn with a pin, to prevent it coming undone.

The Parts to be Bandaged.—The exact variety of bandage to be used in any given case depends entirely on the shape of the part to be covered in. Almost every segment of the body is a *cone* or part of a cone, or else is made up of the

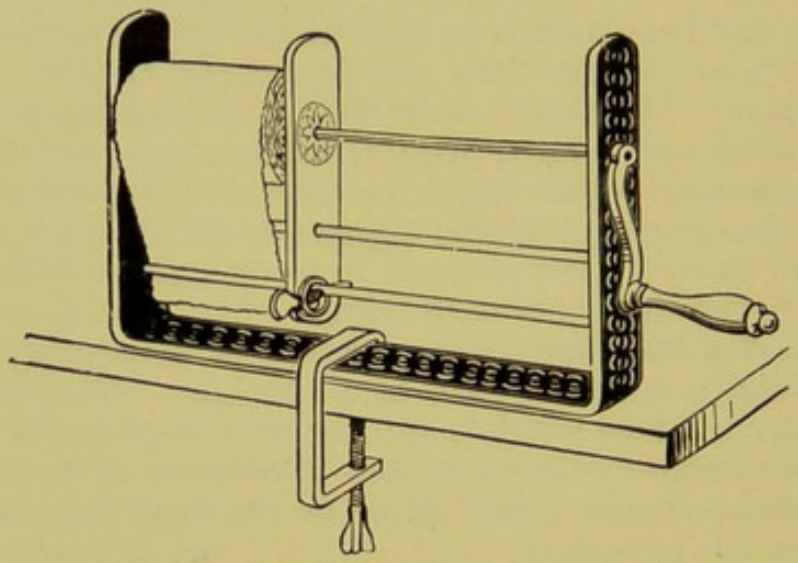


FIG. 25.—WINDING MACHINE FOR BANDAGES.

junction of two cones. Here and there short areas, more or less *cylindrical*, are to be met with, but these soon become conical. For example, take the upper extremity. From the finger-tips to the middle of the palm of the hand we have a slight cone, the base being at the latter level, and from this starts another with its apex at the wrist. Just above the wrist we meet with a short cylinder, which, however, soon expands into the cone of the forearm. At the elbow-joint this cone meets that of the upper arm, giving us a well-marked junction of cones. The lower extremity, the trunk, and even the head and neck are each capable of resolution into these geometrical forms.

For cylinders use the simple spiral bandage.

For cones use the reversed spiral.

For junctions of cones use the figure-of-eight.

Rules for Bandaging.—Certain general principles and special rules are always to be borne in mind in applying a bandage, and trifling and unimportant as some of them may appear at first sight, it is well to pay attention to them, as much of your success as a bandager, and still more of your patient's comfort, depends on the way in which they are appreciated and applied.

1. If possible, stand in front of your patient in applying a bandage.

2. Never put a bandage next the skin. Always have a layer of absorbent wool intervening, to prevent irritation and chafing by a hard, non-porous bandage. It is, however, allowable to use domette without wool except over a wound.

3. Never let skin surfaces be apposed. Thus, when the hand or foot is bandaged, the fingers or toes should be separated by layers of absorbent wool; when the arm is bound to the side, a pad should intervene between it and the chest wall; and, in females with pendulous mammæ, the adjacent skin surfaces should be similarly protected. The result of neglecting this precaution is that the decomposition of the sweat and other skin secretions is the source of irritation which may set up an inflammation and superficial ulceration of the skin.

4. In bandaging a limb, always place it in the position it is intended to occupy afterwards. By doing so you will avoid the risk of the bandage becoming too loose or too tight when the part is moved.

5. Fix the bandage to begin with. The reason for this is obvious. In a limb it is best done by making a figure-of-eight turn round the nearest joint.

6. Apply the bandage *from below upwards*, and *from within outwards* passing over *the front* of the limb. By proceeding from the distal extremity towards the trunk you avoid engorgement of the limb, which would inevitably happen if the direction was reversed. Passing from within outwards over the front of the limb is rather a matter of convenience than necessity.

7. Use equal pressure throughout. This is most important, as otherwise one part of the limb may be constricted, leading to congestion and œdema of the part beyond. All degrees of harm, from slight discomfort up to actual gangrene of a limb, have resulted from want of attention to this rule. A watch must always be kept on the tips of the fingers and toes, and on the appearance of the least œdema or discoloration, the bandage must be removed at once and re-applied more loosely or with more padding. These precautions are specially necessary in children.

8. Each turn of the bandage should overlap two-thirds of that which preceded it. This helps to insure equable pressure, and gives the bandage a certain amount of rigidity, in addition to making it look neat.

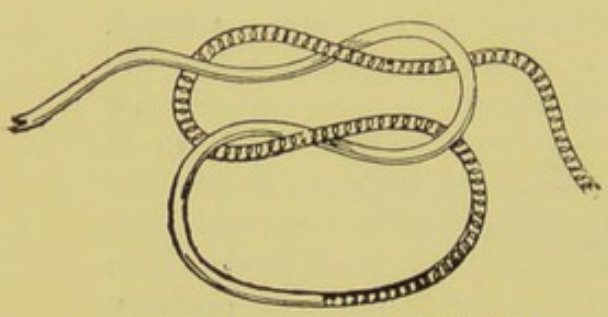


FIG. 26.—SQUARE OR REEF KNOT

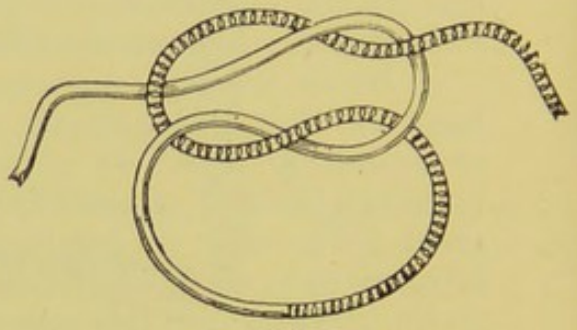


FIG. 27.—GRANNY KNOT

9. For neatness, keep all the margins parallel, and the crossings and reverses in the same line towards the outer aspect of the limb.

10. Finish the bandage by fixing it securely. This is best done by means of a safety-pin, which should be inserted in the long axis of the bandage, and not across it (p. 45). Or the end of the bandage may be slit into two tails, one being brought back round the limb and tied in a reef knot with the other.

Knots.—In bandaging, the only knot which is permissible is the *square or reef knot* (Fig. 26), in which both ends of the bandage pass in the same direction through each loop, and when tied the loose ends lie parallel with the turns of the bandage. In tying it, keep the end which is farther away in making the first turn, also the farther away in making the second.

The *granny knot* (Fig. 27) in which the loose ends lie at right angles to the bandage is less neat and more apt to slip.

The *surgeon's knot* (Fig. 28) is made by doubling the first turn of a reef knot. It is less likely to slip and become

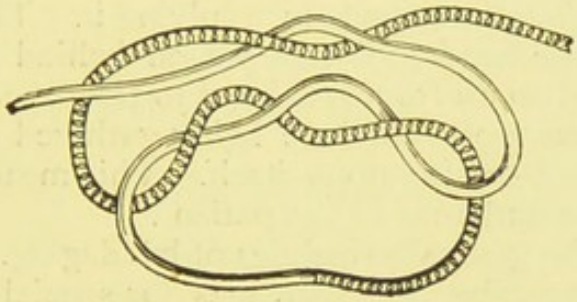


FIG. 28.—SURGEON'S KNOT.

slack while the second turn is being made. It is especially useful in ligating blood-vessels.

The *clove hitch* (Fig. 29) has the advantage of never becoming tight enough to constrict the limb injuriously, how-

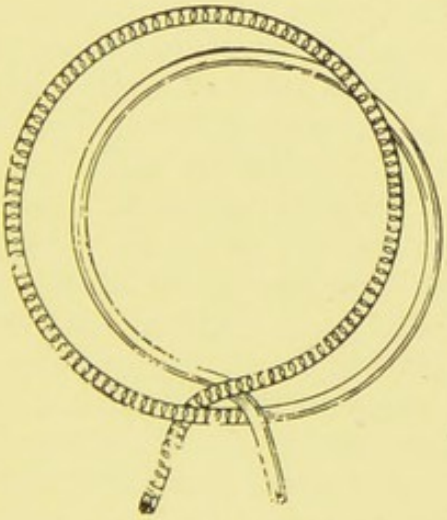


FIG. 29.—CLOVE HITCH.

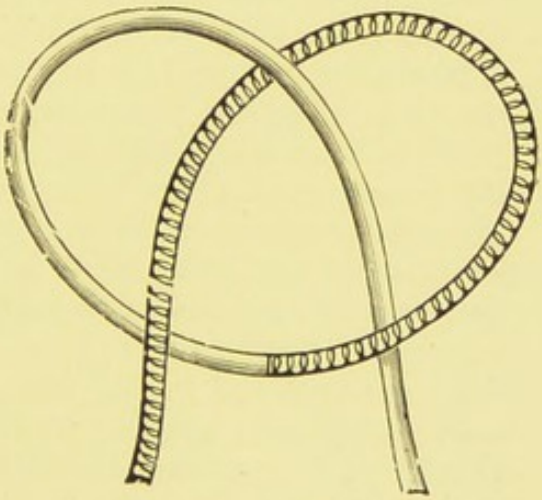


FIG. 30.—STAFFORDSHIRE KNOT.

ever much it is pulled upon. It is made as follows: "Grasp the bandage with the left hand supine and the right prone; now pronate and supinate the two hands respectively, and slide both loops into the left hand". "Another plan is to

make two successive loops in the same direction, and place one behind the other" (Caird and Cathcart).

Staffordshire Knot.—This knot is used chiefly in the ligation of piles or of the pedicle of a tumour (Fig. 30).

Removal of a Bandage.—This should be done by reversing the manipulations made in applying it. The end should be taken in one hand and then passed behind the limb into the other, and so on from one hand to the other as each turn is removed, the loose bandage being gathered evenly into a bundle, and not twisted upon itself. This means of removal causes least disturbance to the patient.

Such are the general principles of bandaging. In the next chapter are described the bandages for special parts of the body, and if the manipulations are actually gone through by the reader, the descriptions will be much more easily followed —in fact, without practice, the time spent in reading the directions will be wasted.

CHAPTER VIII.

SPECIAL BANDAGES.

Bandages for Lower Extremity.—*Bandage for the Foot and Leg.*—If we examine the shape of these parts of the body, we find that we have first to deal with a "cone" extending from the toes to the heel, and this will require to be covered in by a spiral bandage with reverses. At the heel this cone meets another, that from the heel to the ankle, giving rise to a "junction of cones," and here a figure-of-eight is indicated. At the ankle we have a short "cylinder," for which the simple spiral is employed; and higher up for the cone of the calf we return again to the reversed spiral. Bearing these points in mind, and applying the other rules already given, stand in front of the patient, having the limb held in the position it is intended to occupy, and carefully apply the wool. The initial end of the bandage must now be fixed. This is done by making a figure-of-eight turn round the ankle. To do so, (*a*) lay the tail of the bandage against the ball of the great toe, and fix it there with the thumb; (*b*) carry the bandage across the dorsum of the foot to the outer malleolus; (*c*) go behind the ankle to the inner malleolus; (*d*) across the dorsum again to the ball of the little toe; and (*e*) across the sole to the point of starting (Fig. 31). Now proceed to cover in the foot. Allow the bandage to go spirally round the foot, leaving one-third of each turn uncovered by the succeeding one, so long as the folds lie evenly. As soon as ever the bandage tends to "stray," i.e. leave a gap between two successive turns, reverses must be begun.

To make a reverse neatly, three points are to be attended to: First, fix the part of the bandage already applied by pressing on it with the thumb of the disengaged hand;

second, free about 3 inches of the tail, and allow this to remain *perfectly loose;* then, third, turn the head of the bandage down and allow the loose tail to fall into position (Fig. 38). Do not try to twist it into position, or you will fail to make a neat reverse.

Now pull the bandage tight, and proceed as before, repeating the reverses, keeping them all in the same line, and rather

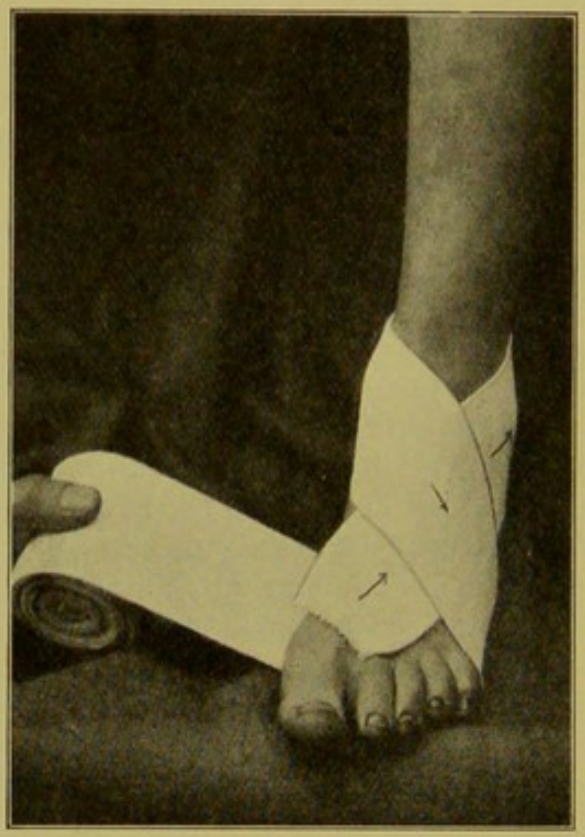


FIG. 31.—FIGURE-OF-EIGHT BANDAGE FOR FOOT AND ANKLE.

towards the outside of the foot, until the heel is reached. The figure-of-eight is now to be made. Instead of reversing let the bandage go across to the external malleolus, then carry it round the back of the ankle to the internal malleolus, then over the dorsum, keeping the crossing in the same line as the previously made reverses, and passing round the outer border of the foot, travel under the sole to the point at which the figure-of-eight started. This is to be repeated until the

heel is sufficiently covered in, and then the ankle and calf are to be bandaged after the appropriate methods. To finish the bandage a figure-of-eight turn is made round the upper part of the calf, and the terminal end fixed by inserting a safety-pin parallel to the edges of the bandage, or by tearing the end into two tails, and tying these in a reef knot.

Of course, should it be necessary to cover in *the whole of the lower extremity* right up to the groin, the bandage just described, instead of being finished at the upper end of the calf, is continued upwards over the knee, which is covered in by a series of figure-of-eight loops, on to the thigh, where the reversed spiral is employed; and to finish and secure the terminal end, a figure-of-eight turn is made round the pelvis.

To Cover in the Heel.—This is best done by what is called a *divergent spica*, that being merely a modification of the figure-of-eight. It is called divergent, because the first turn covers in the most prominent part of the heel, and from it the succeeding turns diverge. As elsewhere, the bandage must first be fixed. To do so, place the tail over one malleolus, carry the bandage downwards across the sole to the other malleolus, thence across the dorsum and round the ankle, catching in the tail with which you started. The bandage is now fixed. Carry it straight across the tip of the heel, and in doing so you will leave small pockets above and below (Fig. 32). The next turn goes a little lower than the last, catching up and covering the corresponding pocket, and the succeeding one, going higher, similarly disposes of the upper pocket. With one or two more turns diverging from the tip of the heel, that part is completely covered in.

Bandages for the Knee.—(*a*) *Divergent Spica.*—This is employed when it is desirable to permit of movement at the knee-joint, as the different layers of bandage glide over one another like the plates of scale armour. Slightly flex the limb, and begin by making a turn round the most prominent part of the knee, a second turn overlapping the lower part of this, and a third overlapping the upper part. Succeeding turns continue to diverge till the whole joint is covered in (Fig. 33). It is obvious that the anterior aspect of the knee is the least firmly supported by this bandage, but the presence of the patella renders many layers unnecessary here.

(*b*) *Convergent Spica* is simply a figure-of-eight applied so that the successive turns converge towards the centre of the patella (Fig. 34). It is used when fixation of the joint is aimed at.

Bandages for the Groin.—Bandages for the groin are used to retain any form of surgical dressing or apparatus in position. The spica is the form of bandage selected in

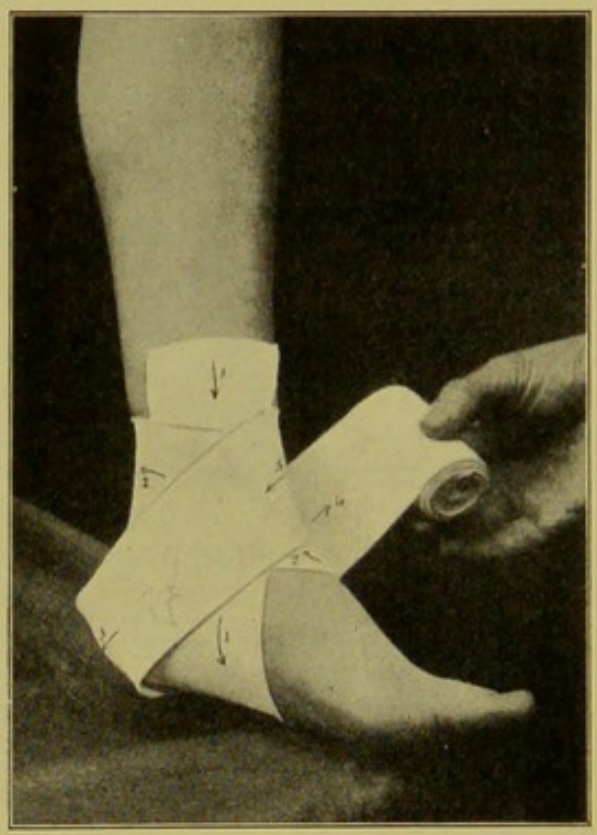


FIG. 32.—DIVERGENT SPICA TO COVER IN THE HEEL.

this region, and it may exert pressure either from below upwards or from above downwards, according as the ascending or descending spica is applied. The ascending spica, in which each succeeding turn goes higher up the limb than its predecessor, is that usually chosen to fix a splint or a dressing. In cases of hernia the ascending spica may be applied for the inguinal, and the descending spica for the femoral variety.

(*a*) *Ascending Spica of Groin.*—Place the tail of the bandage over the external abdominal ring—that is, at the upper and inner aspect of the groin, and thence carry a turn round the pelvis, going towards the *same* side, back to the point from which you started. This is one loop of the

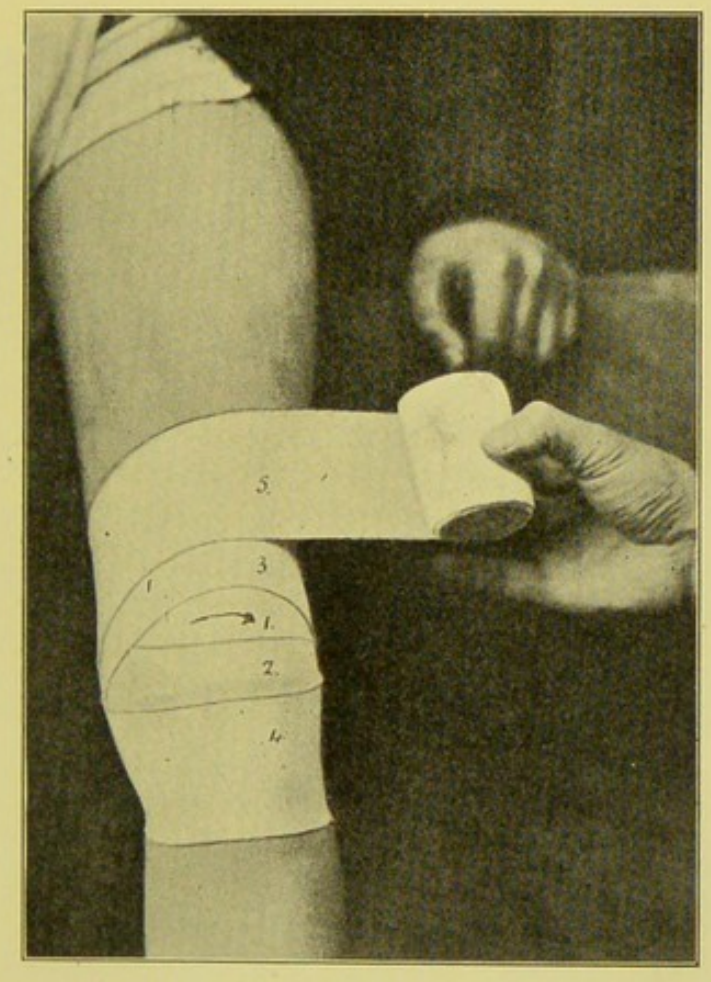


FIG. 33.—DIVERGENT SPICA OF THE KNEE.

figure-of-eight (Fig. 35). The other is made by continuing the bandage across the front of the thigh, round its outer and posterior aspects and into the perineum from behind, again reaching the starting-point. Each turn overlaps two-thirds of the one before it, and with three or four such turns the bandage is completed.

(*b*) *Descending Spica of Groin.*—Again begin with the tail over the groin but carry it round the pelvis on the *opposite* side, and so it will come across the front of the thigh and enter the perineum from the *front;* thence travel round the opposite side of the limb, back to the starting-point. The succeeding turns pass from above downwards (Fig. 36).

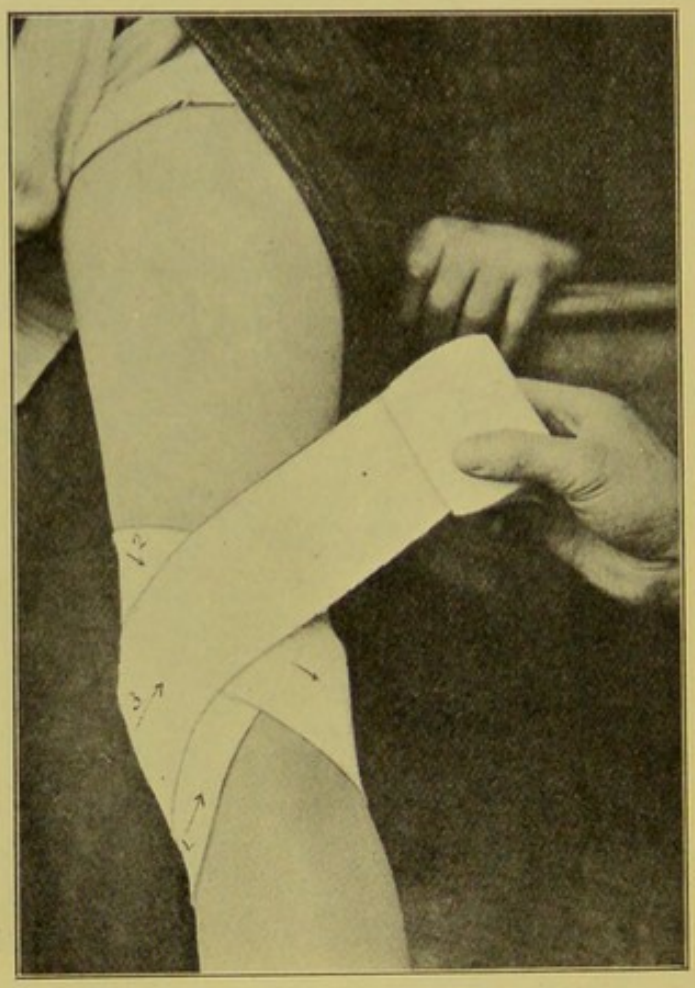


FIG. 34.—CONVERGENT SPICA OF THE KNEE.

(*c*) *Double Spica of Groin.*—This bandage may be used for fixing dressings to both groins, and is on one side an ascending, and on the other a descending, spica.

To apply the double spica, make one figure-of-eight turn as for an ascending spica, say on the left side, and then, instead of making a second, cross the middle line of the body

and make a figure-of-eight round the right thigh. This will be a descending spica. Repeat these turns alternately till both groins are covered in.

Bandages for the Perineum.—The *St. Andrew's Cross bandage*, or looped bandage, for the perineum, is useful for retaining dressings on that part. It consists of a series

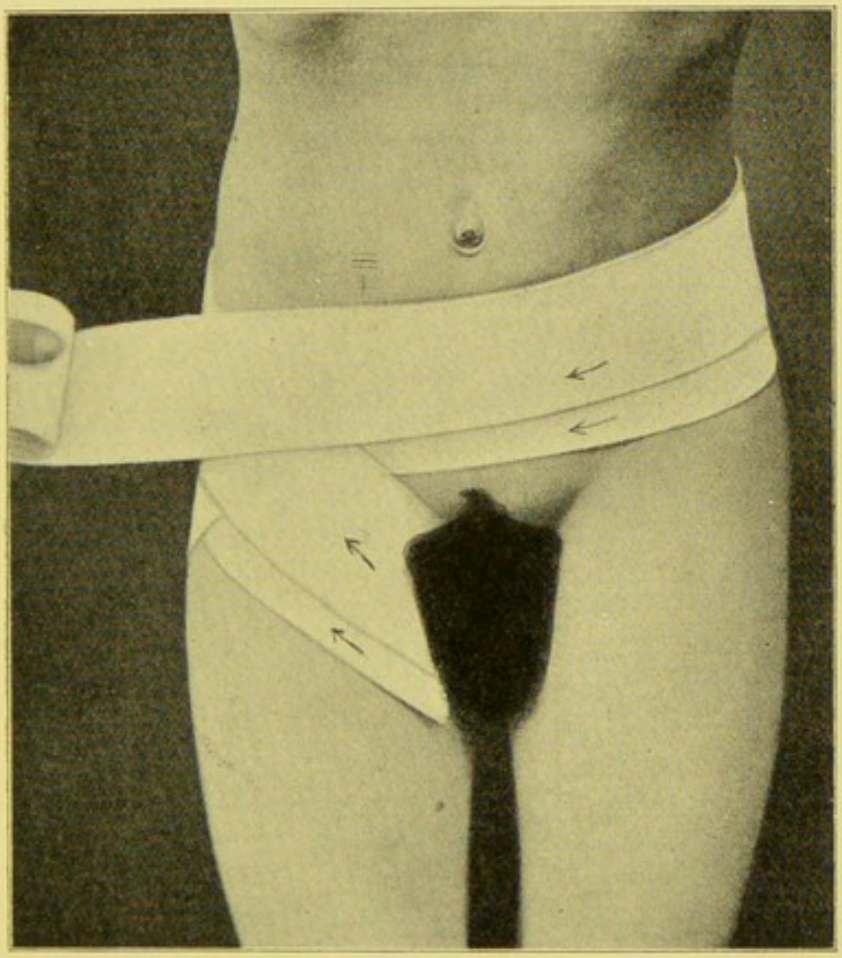


FIG. 35.—ASCENDING SPICA OF THE GROIN.

of loops applied alternately round the pelvis and across the perineum. Begin by laying the tail of the bandage over the right side of the pelvis, and make a turn round the body, so as to catch in and fix the tail. Now pass across the front of the right thigh into the perineum and, *crossing the middle line*, let the bandage pass round the back of the left thigh

and across the buttock to the pelvis, round which a turn is made. Then the second perineal turn is made in the same way as the first, only from the opposite side; the two turns, crossing in the centre of the perineum, form a St. Andrew's Cross. Similar turns are added till the dressing is secured.

The T-*shaped* bandage (Fig. 37) for the perineum is made

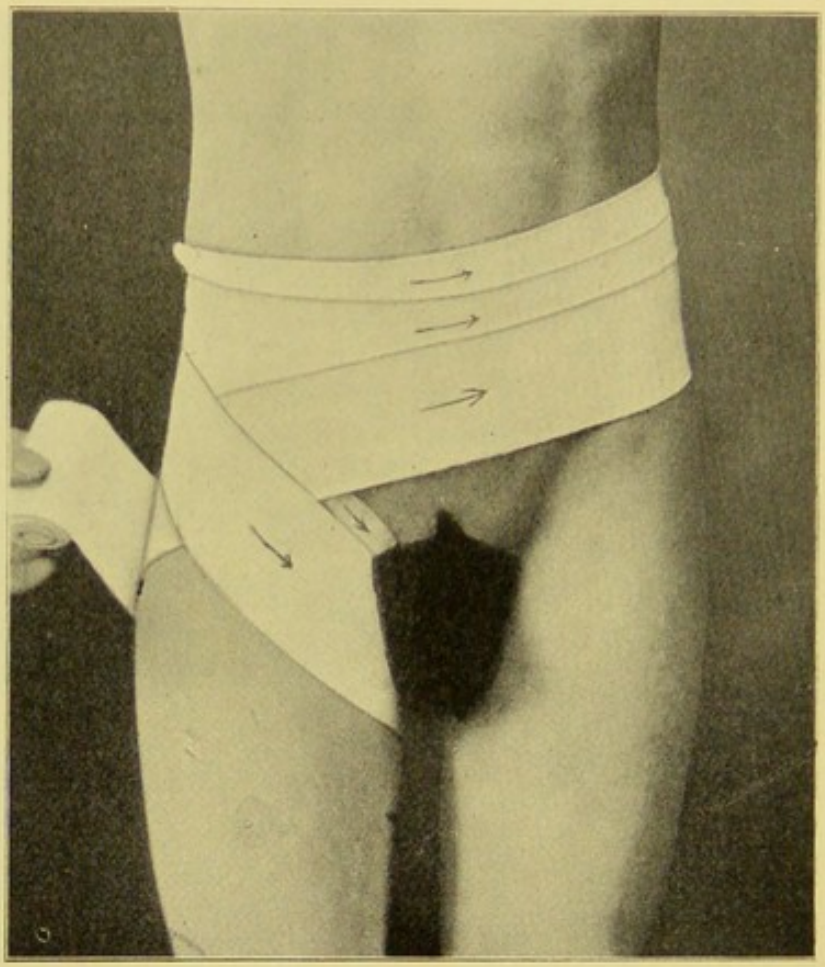


FIG. 36.—DESCENDING SPICA OF THE GROIN.

by sewing together two pieces of bandage so as to form a letter T. The horizontal part of the letter encircles the pelvis, and is tied in front. The vertical part is carried down behind the sacrum, and then forward between the thighs. The tail is split to avoid the scrotum, and fixed to the horizontal turn. A perineal dressing is thus retained in position,

and it can be frequently changed without much disturbance to a recumbent patient.

Two triangular handkerchiefs make a good perineal or suspensory bandage. One is applied round the pelvis as a belt, and to it the apex of the other is tied behind, the base being carried through between the legs, spread out, and fixed to the belt in front.

Note that the turns of these bandages go round the *pelvis*,

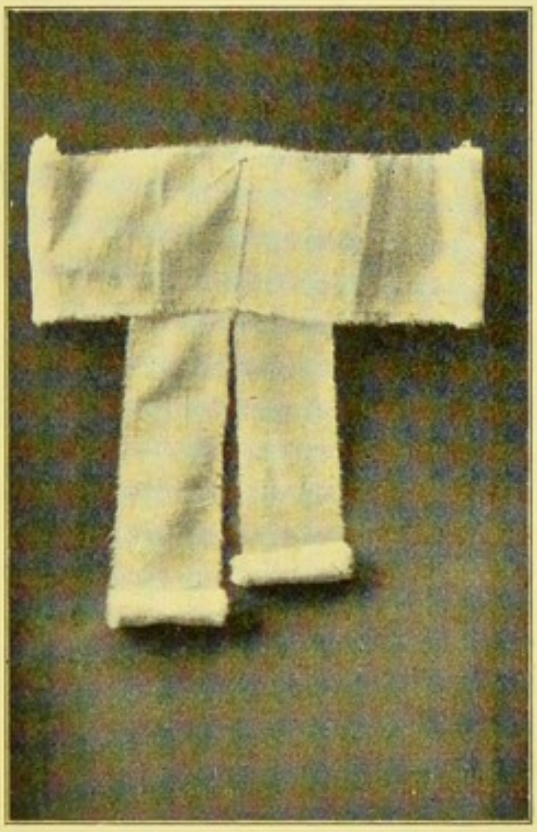


FIG. 37.—T-SHAPED BANDAGE.

which is a fixed portion of the body, not round the waist, where the movements of the patient soon permit it to become loose.

Handkerchief Bandages for the Lower Extremity.—The handkerchief bandage is particularly useful for temporary and emergency dressings, and is largely used in military surgery. The handkerchief may be square or triangular in shape, the latter being more generally useful. The base

of the right-angled triangle should be a yard and a half long, and the material from which it is cut should be at least one yard wide. The ends are tied into a reef knot, or fixed with a strong safety-pin.

For the Foot.—The base is folded up for a short distance *en cravatte*, and then the foot is laid on the handkerchief, the apex being well beyond the toes. The apex and edges are neatly folded up over the foot, the base passed round the ankle and instep, and the ends secured.

For the Knee.—The triangular handkerchief is laid over the dressing and the ends brought round and firmly tied, the loose edges being carefully folded in.

For the Hip or Buttock.—Two triangular bandages are required. The first is folded *en cravatte*, and tied round the pelvis as a belt. The second is held with the base downwards and the apex up, the intermediate part covering over and securing any necessary dressing. The base is fixed round the upper part of the thigh; the edges are spread out so as to cover in all the dressing; the apex is pushed between the patient's skin and the belt, then folded down and secured with a safety-pin.

Bandages for the Upper Extremity.—*Bandage for the Thumb* is simply a figure-of-eight, the turns going alternately round the ball of the thumb and the wrist till the whole of the former is covered in.

Bandage for the Fingers.—It is rarely necessary to bandage each finger separately. In doing so, however, the ordinary spiral bandage is employed, the ends being fixed by a figure-of-eight turn round the wrist. When all the fingers require to be covered in, it is better to pad them carefully, and apply a single bandage to support all of them together, than to apply a bandage to each individually.

Bandage for the Hand and Forearm.—Place the limb in the position of pronation—that is, with the palm turned towards the ground, so that it corresponds in position to the sole of the foot. The other parts of the upper extremity will then correspond to those of the lower. Thus the hand represents the foot, the wrist the ankle, and the forearm the leg. The forefinger corresponds to the great toe, the little finger to the little toe, and the thumb to the heel. The

bandage for the hand and forearm is applied in exactly the same way as for the foot and leg. The thumb is left free (Fig. 38).

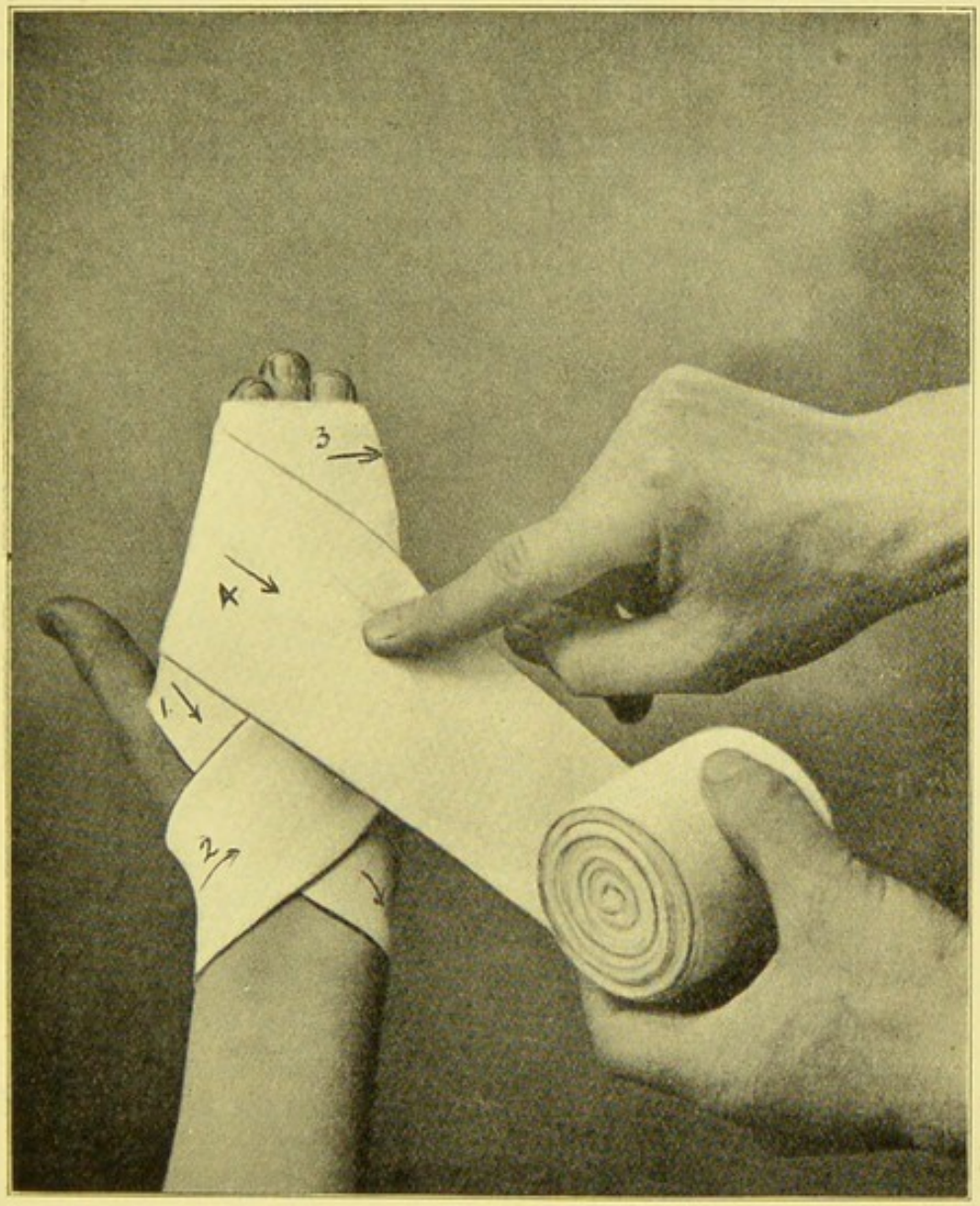


FIG. 38.—BANDAGE FOR THE HAND AND FOREARM, SHOWING HOW TO MAKE A REVERSE.

As in the lower extremity, the *whole upper limb* may be covered in by continuing the above bandage in the form of

a figure-of-eight over the elbow, a simple or reversed spiral as may be necessary over the upper arm, and a spica round the shoulder.

Bandage for the Closed Fist.—In treating fracture of the metacarpal bones by a pad in the palm of the hand, the best bandage is a series of figure-of-eight turns. The hand being closed and pronated, a series of figure-of-eight

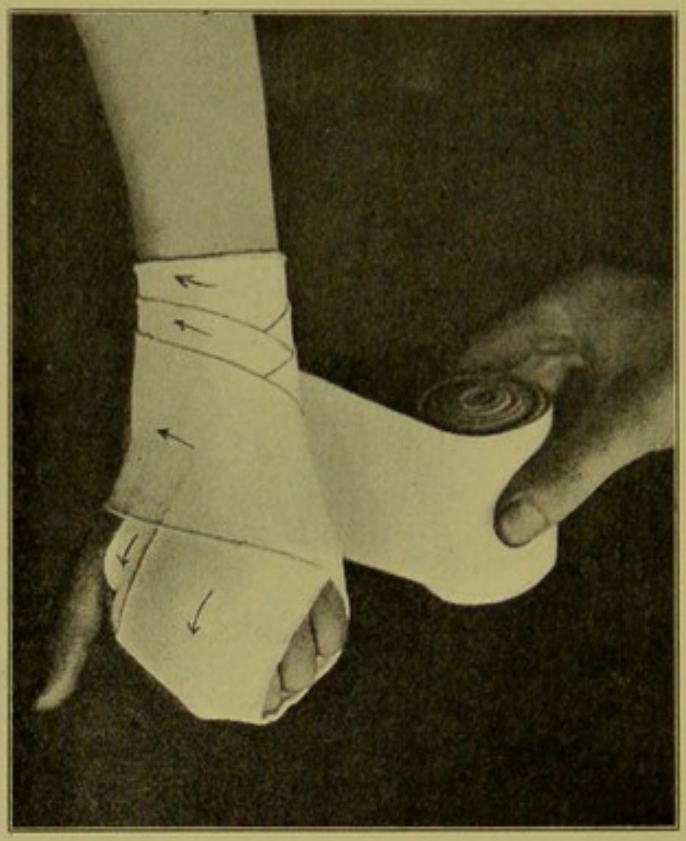


FIG. 39.—BANDAGE FOR THE CLOSED FIST.

loops are applied alternately round the wrist and the hand, passing from the little finger towards the index (Fig. 39). To finish off the bandage a turn is made circularly round the hand, and this catches in all loose pockets.

Bandages for the Elbow.—The most convenient form of bandage to employ here is the figure-of-eight or spica, which may be either *convergent* or *divergent*. The former is simply a figure-of-eight, the turns converging towards the

tip of the elbow; the latter is applied in exactly the same way as the corresponding bandage for the knee. Begin over the internal condyle, making the first turn cover in the tip of the olecranon process. The pockets left above and below are disposed of by the succeeding diverging turns. Such bandages are used to keep the elbow-joint at rest

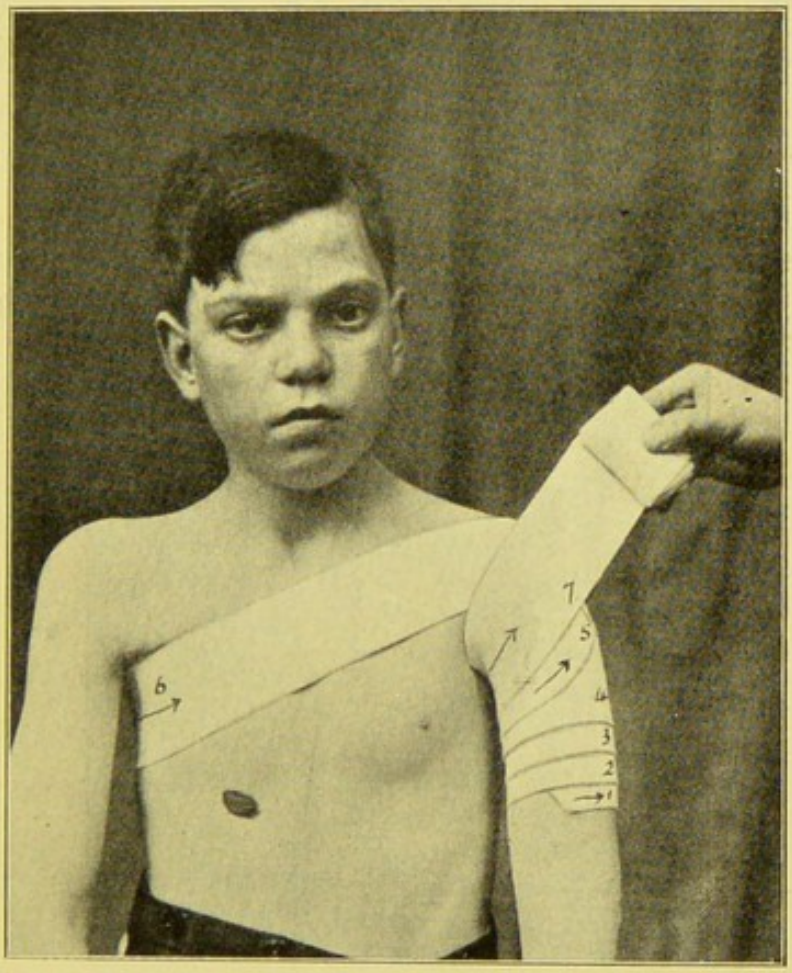


FIG. 40.—SPICA OF THE SHOULDER.

after operations or injuries, the converging spica being specially useful in cases of fractured olecranon, as it tends to approximate the fragments.

Bandage for the Shoulder.—Again the spica is used, the turns passing alternately round the arm and the chest (Fig. 40). It is not permissible to put the second turn of the

spica round the neck in place of the chest, as the movements of the patient's head would loosen the bandage. To apply this bandage, continue that of the upper arm as far as the axilla, then pass over the shoulder from before backwards, across the back into the opposite axilla, thence across the front of the chest and over the shoulder to the point of

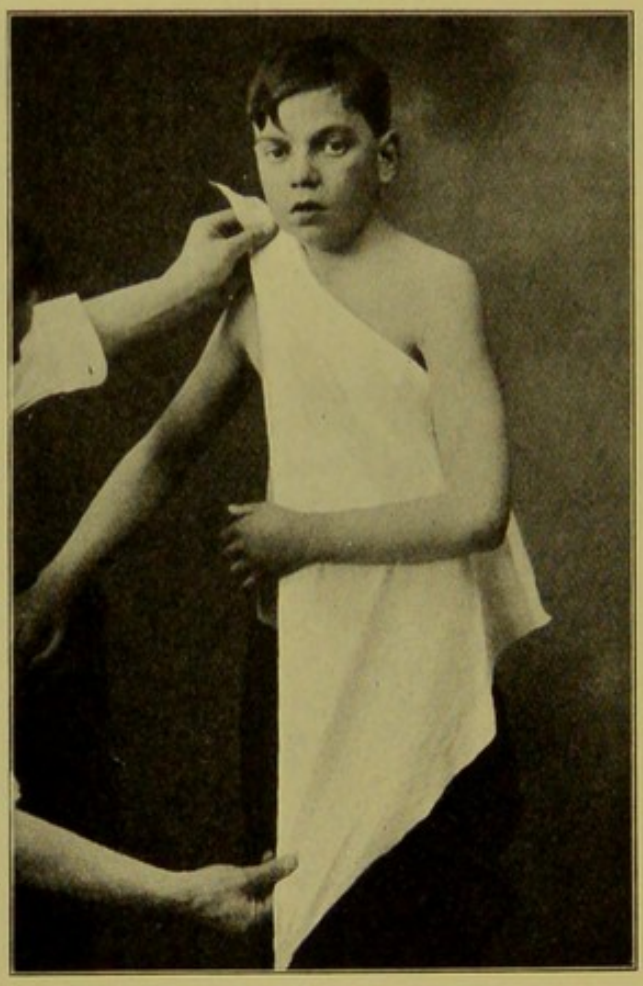


FIG. 41.—APPLICATION OF SLING TO SUPPORT WRIST.

starting. By three or four such turns, proceeding from below upwards, the whole shoulder may be covered in by an ascending spica. The descending spica is rarely, if ever, indicated in the region of the shoulder.

Bandage for a Stump.—To bandage a stump, begin by carrying a few turns antero-posteriorly across the face of the

stump, exerting pressure so as to give support to the long flap. Then fix these turns by a spiral series, carried well above the next joint to prevent the whole dressing slipping off.

Handkerchief Bandages for the Upper Extremity.—*For the Hand.*—A useful temporary bandage to retain a

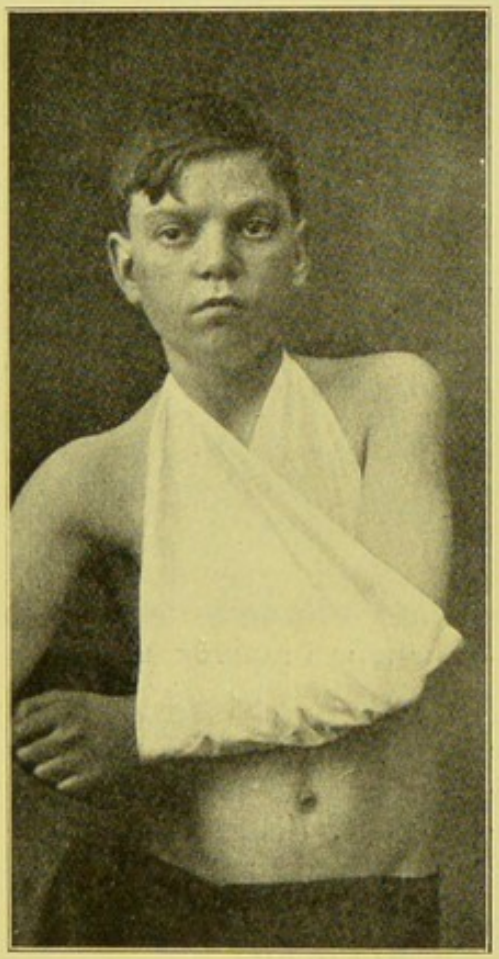


FIG. 42.—APPLICATION OF SLING TO SUPPORT ELBOW.

dressing on the *palm of the hand* is obtained by folding a triangular bandage *en cravatte*, laying the centre over the palm, carrying the ends across the back and then round the wrist, on the back of which they are tied. This obviously consists of a double figure-of-eight. This bandage reversed would retain a dressing on the *back of the hand.*

The *whole hand* may be covered in the same way as the foot.

For the elbow, the same method is adopted as for the knee.

For the shoulder, as for the hip, two bandages are required. The extra one crosses the chest obliquely, passing under the opposite axilla.

Slings.—These are used to support different parts of the upper extremity, and are in the form of triangular handkerchiefs. In applying a sling, place the base of the triangle towards the part to be supported, the elbow, wrist, or hand, as the case may be (Fig. 41). Carry one end across each shoulder, and fix behind the neck by a reef knot, the apex being folded up neatly and fixed by a safety-pin (Fig. 42).

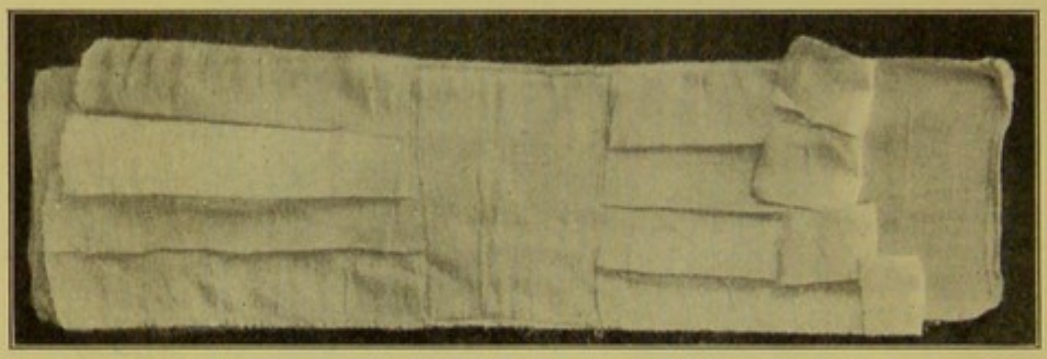


FIG. 43.—MANY-TAILED BANDAGE, BACKED BY A BINDER.

The Many-tailed Bandage of Scultetus is used when frequent dressing of a part is necessary, and it is at the same time undesirable to disturb the limb. It consists of a backbone of domette, to which four to eight strips are sewed at right angles. These are made to overlap one another for two-thirds of their width, and are long enough to encircle the limb one and a half times. The backbone is placed along the posterior aspect of the limb, the dressing applied, and the turns folded in succession across the front of the limb. The last turn is fixed by safety-pins. As often as is necessary, the turns may be unfolded, and the dressing reapplied without the limb being moved.

The stability of the many-tailed bandage is increased if a binder is sewed to the backbone behind the tails (Fig. 43).

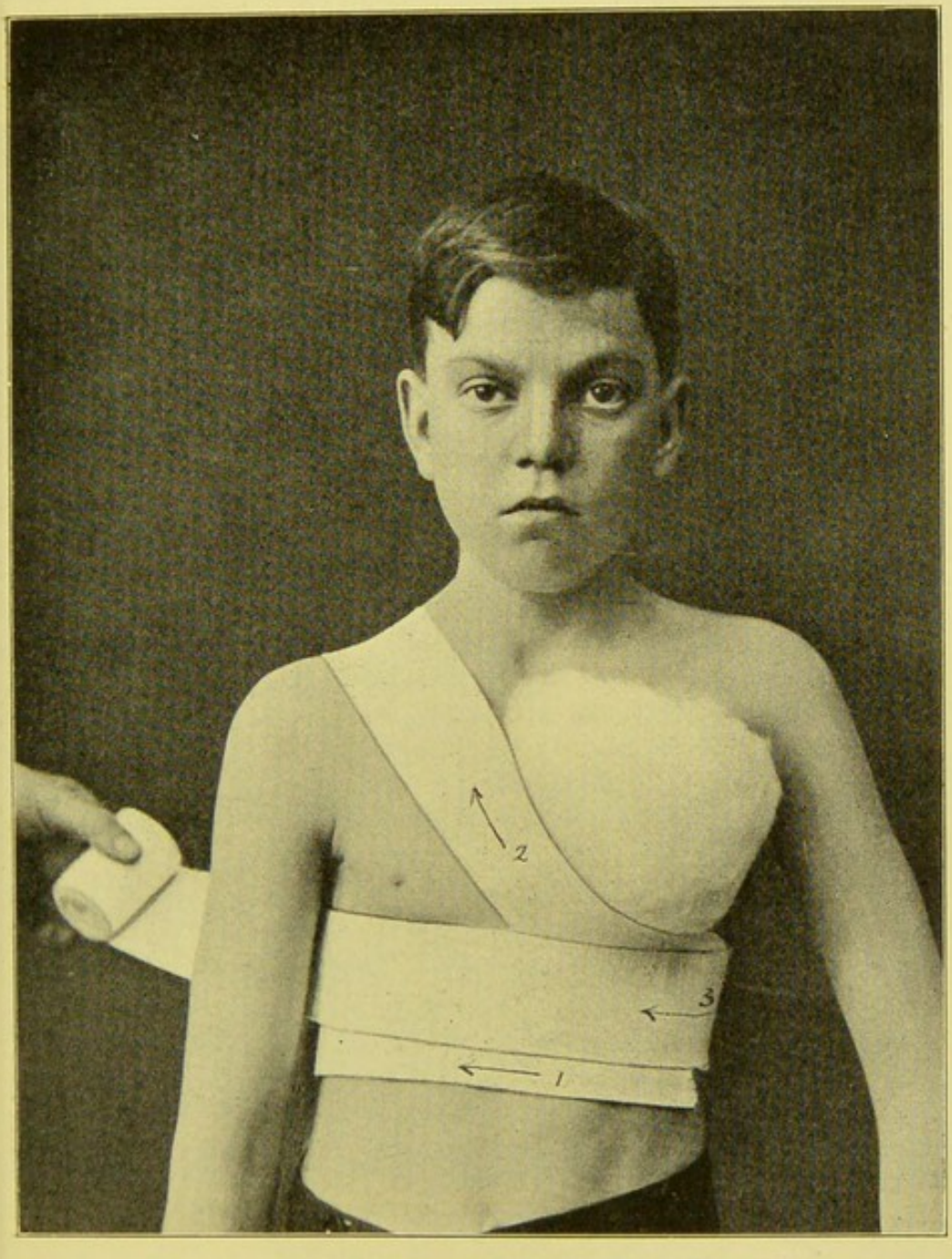


FIG. 44.—ASCENDING SPICA TO SUPPORT LEFT MAMMA.

Bandages for the Mammæ.—The *ascending spica* (Fig. 44) is the form of bandage selected when the object is to give support to the breast in cases of inflammation and suppuration. Supposing the *left* mamma to be the one affected,

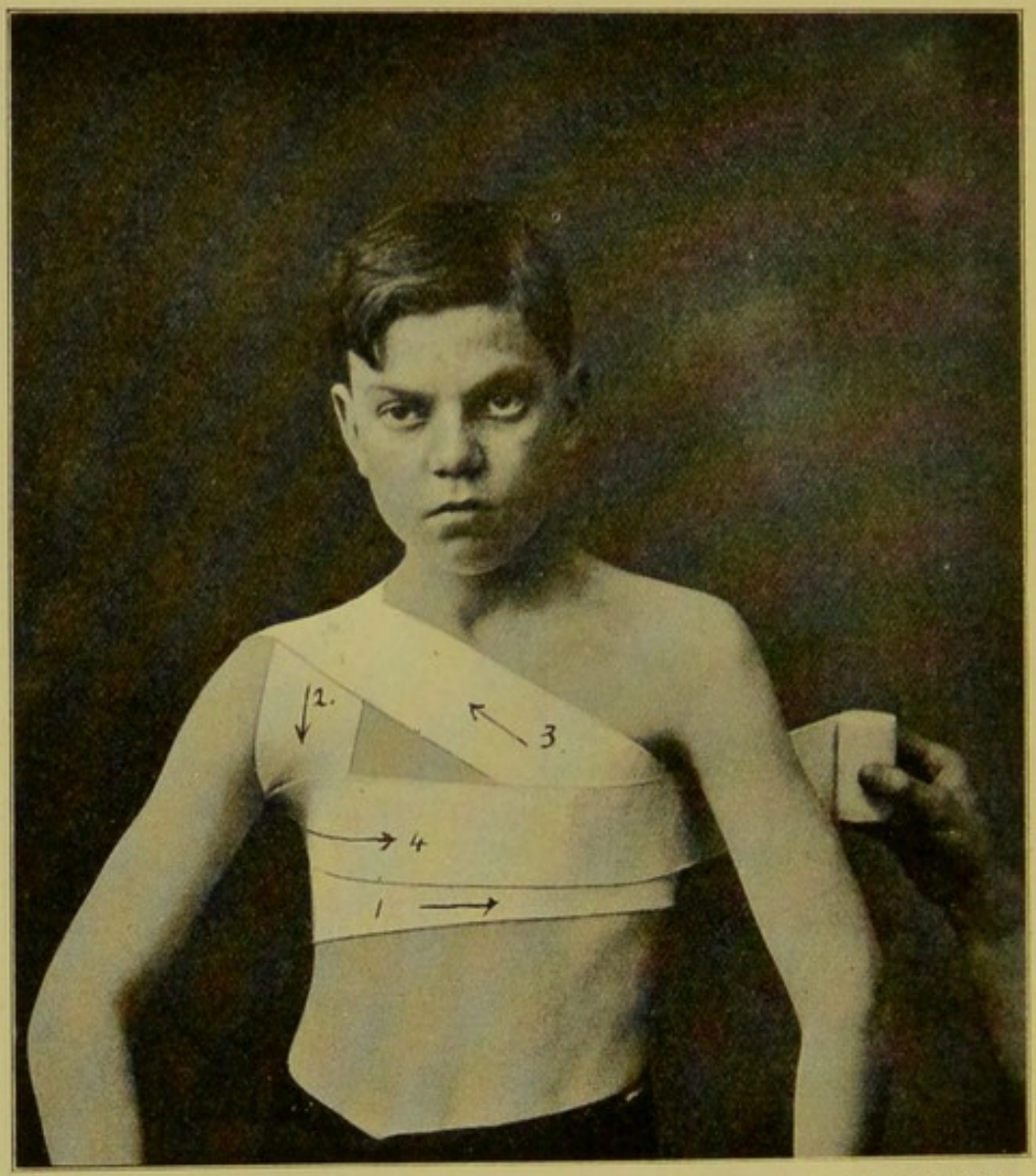


FIG. 45.—BANDAGE TO RETAIN DRESSING AFTER EXCISION OF THE BREAST

place the tail of the bandage against that side of the chest just below the breast, carry the bandage towards the right, and go round the body. As you reach the starting-point

catch in the tail, and, elevating the inflamed gland with the palm of the hand, carry the bandage obliquely across the chest, so that it will take the place of the supporting hand. Pass over the right shoulder and across the back to the starting point, thus completing the first figure-of-eight. Similar turns are applied, each going higher than the one preceding it, till the whole mamma is covered in and supported.

In cases in which both breasts are the seat of inflammation, two such bandages should be applied separately, rather than the double spica, in which the pressure on one side is necessarily exerted from above downwards.

Bandage to Retain Dressing after Excision of the Breast.—This bandage (Fig. 45) must be so applied that no turn completely encircles the upper end of the arm, as such would interfere with the circulation of blood through the limb.

Suppose that the right breast has been excised. Cover the gauze dressing with a thick pad of absorbent wool. Place a second pad in the axilla, while an assistant holds the arm well out from the side. Also cover the left breast and axilla with wool to avoid chafing of the skin. Begin in the right axilla, and carry the bandage across the front of the chest to the opposite axilla, then round to the back, and obliquely across it to the top of the right shoulder. Pass over its anterior surface, and swing round the right axilla to the back and across to the left axilla. Next travel obliquely across the front of the chest, and pass over the top of the right shoulder to reach the back of the right axilla. This was the starting-point, and the rest of the bandage is composed of a series of double turns identical with the first two. The arm is laid on a pillow in the abducted position.

Bandage for the Abdomen.—The most efficient bandage for the trunk is a many-tailed with a binder outside it (Fig. 43). If it tends to slip up, perineal straps should be applied, and fixed to the lower edge of the binder with safety-pins.

Bandages for the Head.—In the bandaging of the head, the various prominences of the skull are used as fixing points to prevent the bandage slipping. The chief projections are: (1) *the external occipital protuberance*, which is situated at the back of the head close to where the head joins the neck. It is a well-marked elevation, and a bandage

carried below it is prevented from slipping upwards; (2) *the parietal eminences*, which are placed right above the ears on the side of the head. They vary greatly in size in different persons, but are always sufficiently prominent to fix a bandage placed between them and the upper edge of the ear, and prevent it slipping upwards; (3) the *ear* prevents any downward displacement; (4) *the superciliary ridges* or upper margins of the orbit on which the eyebrows are placed prevent the downward displacement of the turns passing round the forehead; while (5) *the frontal eminences* or prominences of the brow prevent them passing upwards.

To Bandage the Fore Part of the Head.—The *divergent spica* is the type of bandage. Grasp the loose tail of the bandage in the left hand, leaving about 12 inches free (Fig. 46). From the right ear carry a turn (1) horizontally round the head, and at the starting-point pass the head of the bandage *below* the loose tail. Then, holding the tail tight with the left hand, swing the bandage up, and carry a vertical turn (2) over the crown of the head, down in front of the left ear, and under the chin to the starting-point. These two turns fix the bandage, and the divergent spica is now begun. Pass the bandage behind the loose tail, and swing forwards over the crown midway between the first and second turns (3), and round below the occipital protuberance. Then pass below the loose tail and across the crown farther forwards than turn 3, so as to overlap one-third of the latter (4). Again pass round the back of the head and below the loose tail, and swing the bandage over the crown (5) to overlap the posterior third of turn 3. Carry it to the occipital protuberance, and fixing it there by means of a finger, fold it over the crown of the head (6), and pin or stitch all the previous turns to it to secure the whole.

(From "A Surgical Handbook," Caird & Cathcart.)

FIG. 46.—BANDAGE FOR THE FORE PART OF THE HEAD.

To Bandage the Posterior Part of the Head.—The divergent spica may again be selected as the type of bandage, but

on account of the shape of the head greater difficulty is experienced in preventing the turns slipping. Turns must be made round the chin or forehead as is found necessary to give security to the bandage.

The Figure-of-eight Bandage (Fig. 47) is useful for fixing dressings on various parts of the head. From the right ear the first turn (1) passes horizontally round the head to the

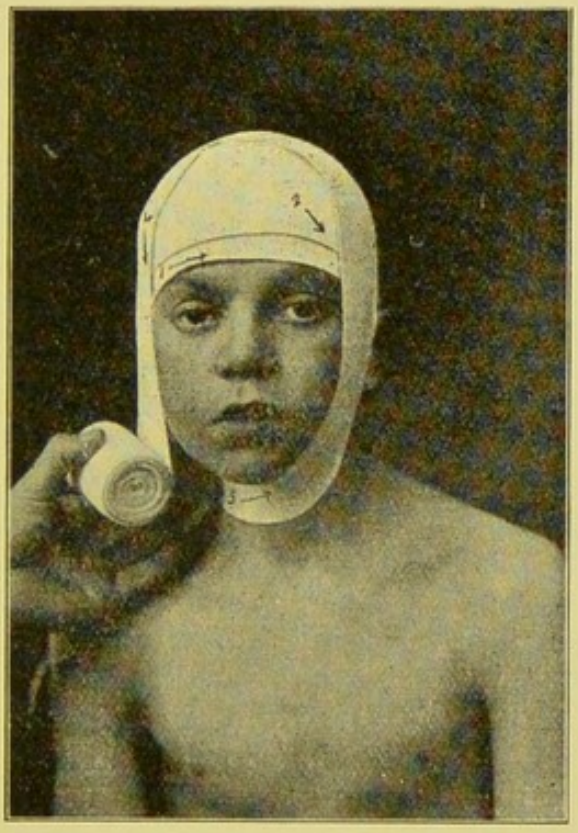


FIG. 47.—FIGURE-OF-EIGHT BANDAGE FOR THE HEAD.

starting-point, and is continued for another half turn to the left ear; then the bandage is carried round the back of the head, below the right ear and under the chin (2); up over the crown in a vertical turn (3), again under the chin, up behind the left ear, and horizontally round the head like turn 1 (4).

To Cover in the Whole of the Head.—The *Capeline or Double-headed Roller* is a secure bandage for this purpose,

but it has the disadvantage of heating the patient's head too much, and on this account is seldom used. To apply it begin by sewing together the tails of two ordinary 6-yard bandages. As one of the bandages should be somewhat longer than the other, roll about 1½ yards of one bandage on to the other. The shorter of the two bandages traverses the head from front to back, and the longer goes horizontally round the head, fixing in the antero-posterior turns. Stand behind the patient, who should be seated on a chair, and holding the larger roller in the left hand and the smaller in the right, begin by placing the bandage across the forehead, just above the root of the nose; carry both rolls to the back of the head, and then change hands, fixing the smaller one by passing it under the larger. Here the first antero-posterior turn is made by passing from the occiput forward across the centre of the head to the root of the nose, where the circular turn catches it in. From this mesial turn the succeeding ones diverge first on one side and then on the other, each being fixed in front and behind by the circular turns, till all the head is covered in (Fig. 48). By diverging slowly, and keeping the turns well down in front and behind, we obtain a very firm bandage. Pins or stitches may be inserted here and there to add to its security.

(From "A Surgical Handbook," Caird & Cathcart.)

FIG. 48.—CAPELINE BANDAGE.

The *Four-tailed Bandage* (Fig. 49) for fracture of the lower jaw consists of a piece of bandage about 1 yard long, split longitudinally, save for a short distance near the middle. In the centre of the unsplit portion a small diamond-shaped slit is made, and into it the tip of the chin is placed. The two anterior tails are carried backwards and fixed above the occipital protuberance, while the posterior ones are tied over the crown of the head. The ends of these two turns are now tied together to prevent slipping. If the bandage is properly

applied, the patient should have difficulty in opening his mouth.

Bandage for Side of Neck.—To fix a dressing on the side of the neck, a figure-of-eight bandage is frequently the most secure (Fig. 50). The first turn passes round the neck, and the second from the back of the neck above one ear, then

FIG. 49.—FOUR-TAILED BANDAGE FOR FRACTURE OF LOWER JAW.

round the forehead, and back above the other ear to the starting-point. The third turn is a repetition of the first, and the fourth of the second, and so on. To secure the lower edges of the dressing in a restless patient one or two turns may pass under the axilla.

Handkerchief Bandage for the Head.—A triangular band-

age is laid over the top of the head, so that the base passes straight across the forehead, the apex lying over the occiput. The ends are gathered up and carried to the back of the

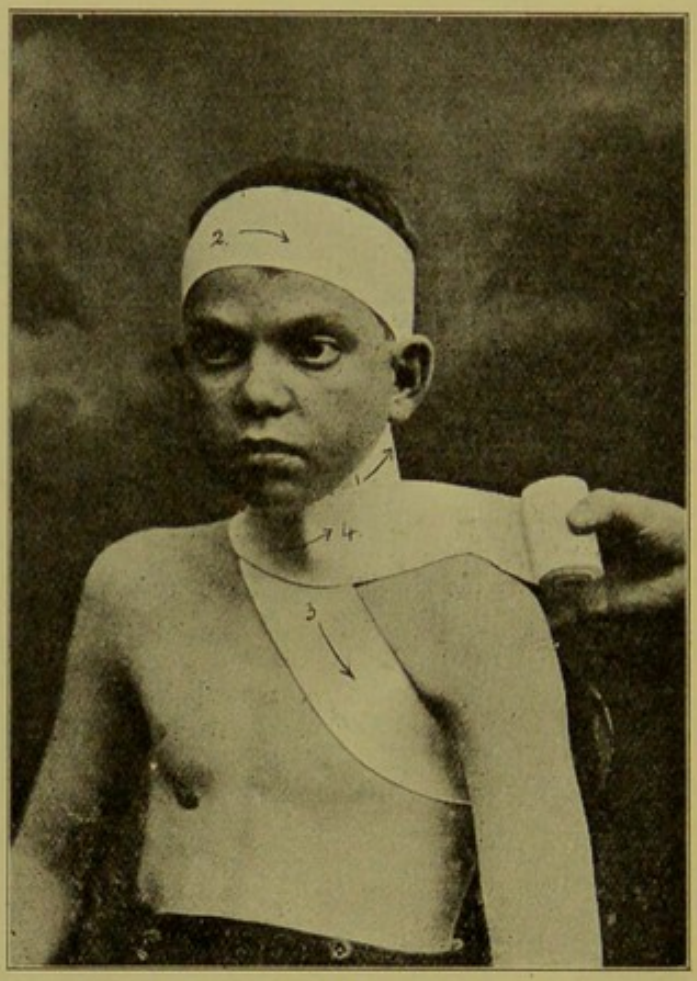


FIG. 50.—BANDAGE FOR SIDE OF NECK, WITH FOREHEAD AND AXILLARY TURNS.

head, where they cross below the occipital protuberance, and then pass above the ears to the front, and are there tied. The apex is turned up over the occiput, and fixed with a safety-pin.

SECTION IV.

TECHNIQUE OF AN OPERATION, AND THE AFTER-TREATMENT.

CHAPTER IX.

PREPARATION OF THE PATIENT FOR OPERATION.

THE technique of operations, as of wound treatment, has been gradually evolved from the antiseptic system. Lister himself realized that the perfect conditions for the surgeon would be such as procured the total *exclusion* of bacteria from the field of operation. But with the meagre knowledge of bacteria at their disposal, this exclusion was impossible for him and his contemporaries. Hence they were driven to the only alternative—to kill the bacteria which were always present at operations forty years ago. That was the reason why antiseptic sprays were kept going, and antiseptic lotions freely applied to the wound, while the surgeon was at work. Nowadays the conditions are altogether different, and Lister's ideal, the exclusion of bacteria from the field of operation, may be realized.

The difference between the old and the new method, the antiseptic and the aseptic, may be summed up in a sentence: the old method attacked bacteria during the operation and after it, the new exterminates them before it. In both, the underlying principle is the destruction of the bacteria, but the practice is different. Why is it better to attack before the operation than after it? The skin of the part is whole then, and it can be treated for the removal of bacteria with greater vigour and thoroughness than a wound. Secondly,

the patient's vitality is reduced by the operation. Hence we must aim at making the fight as easy for him as possible in the early post-operative days, and this is best done by excluding bacterial infection. Thirdly, all antiseptics lower the power of resistance of the tissues, and therefore should not be used in operations through unbroken skin. For this the previous exclusion of bacteria is essential.

The great principle in present-day surgery, then, is the exclusion of bacteria, or, in other words, the *prevention* of bacterial infection. We recognize that the patient may be infected from his own skin, from the dressings, instruments and ligatures, from the lotions, and from the surgeon's and assistants' hands, arms, clothing, or hair. In this section the preventive measures, which are now the preliminary to every operation, are described, and as nearly as possible in the order in which they are usually carried out.

Observation of the Patient.—At the same time we cannot neglect any other means at our disposal of increasing the patient's chance of recovery. Sepsis is the chief risk, but it is not the only one. Disease of any organ, for example the heart, lung, kidneys, or thyroid gland, though not of itself immediately dangerous, may become so when the patient's vitality is lowered by the operation. Such is taken into account by the surgeon in deciding for or against operation, and in his deliberations he is often aided by the nurse's observations—of attacks of breathlessness through the night, of fainting, of sleeplessness, of the amount of urine passed during twenty-four hours. The examination of the urine is of great importance, and a nurse must try to obtain some in every case. She often alleges that it was impossible to preserve a specimen, say, because the bowels were moving. This is rarely a valid excuse except in young children. The patient should be directed to pass urine first, or, in the case of a male patient, into a separate vessel.

The Bowels.—The care of the bowels is important. In the great majority of cases a purgative is to be administered if time permits (p. 55). It should be given about twenty-four hours before operation, so that its action finishes before bed-time, and the patient has the chance of a good night's rest. A sleepless night is a bad preparation for operation. In certain

cases the bowels need special treatment. Purgation clears out bacteria and toxins manufactured by them. These are present in great abundance in the large intestine, and the toxins, though they do no harm in health, may cause grave toxæmia when the resistance is lowered by operation.

The Diet.—The diet should be light on the day before operation—tea and toast for breakfast, milk and biscuits for lunch, soup and milk pudding for dinner, tea and toast in the afternoon, and a glass of milk at night. On the morning of operation no food should be given except a cup of tea and one or two fingers of dry toast at least three hours before.

Preparation of the Field of Operation.—One of the sources of infection is the skin of the patient. The surface layers of the skin, the sweat-glands and ducts, the hairs and hair-follicles harbour innumerable bacteria, which must be removed from the "field of operation". By this phrase is meant not only the skin immediately adjacent to the site of the future incision, but a considerable area around it. It is very important to cleanse a sufficient extent. For example, for an operation on the brain, the whole scalp must be cleansed; for a breast operation, not only half the chest-wall, but also the arm-pit and arm to the elbow or even the wrist; for an abdominal operation, practically the whole of the belly-wall; for an operation on the knee-joint, half the thigh and the whole of the limb below the knee.

The patient is "prepared" twelve to twenty-four hours before operation. Previous to this, gross dirt and grease should be removed by a hot bath and plenty of soap. Whether the preparation is carried out by the nurse or the house-surgeon, it is the nurse's duty to collect the necessaries on a dressing-tray, and place them at the bed-side. For the method of preparation here described, the following are required: Basin with soapy antiseptic lotion such as lysol, antiseptol or septoform; enamelled cup with a small quantity of fluid soap; shaving-brush; razor; loofah; basin with methylated spirit; smaller vessel with sulphuric ether; pledgets of cotton-wool, several gauze swabs, a pair of cotton gloves, the dressing and cotton-wool, all in the towel or casket (p. 110) in which they have been sterilized by steam;

one or more bandages, or a binder, according to the site of the operation; safety-pins.

The screens having been placed as for a ward dressing (p. 38), the field of operation is thoroughly exposed. If it is the abdomen, a warm wrap must be placed over the chest to prevent chilling of the patient. A mackintosh is then placed below the patient and covered with a sterilized towel.

The first essential is to remove any hair growing on the operation-area. It is impossible to render aseptic any part of the body which has hairs on it. Without exception, whether it is the scalp, chest, axilla, abdomen, groin or leg, the part must be shaved over a sufficiently wide area. Lather well with the fluid soap and shaving-brush, and remove the hair with the razor. Care has to be taken not to cut or scratch the skin itself. Then proceed to render the skin surgically clean. This is effected mainly by a thorough washing with the fluid soap and antiseptic lotion, and it is of advantage to use a loofah to remove gently the superficial scales. If the foot or hand has to be cleansed, a soft nail-brush should be used for the nails, and also for the palm or sole if the dirt is engrained. In such a case, it is sometimes necessary to soften the skin first by means of a soda soak. The washing with antiseptic is continued for a variable time, some parts of the body, such as the groin and scalp, being more difficult to cleanse than others, but in no case should less than five minutes be occupied with it. Then the skin is rubbed with pledgets of wool soaked in methylated spirit.

For the rest of the preparation, the hands must be surgically clean. Before washing them, open the towel or casket containing the sterile materials. Wash the hands as for a ward dressing (p. 37), and draw on the cotton gloves. Continue the washing of the part with methylated spirit, using now sterile gauze swabs. Finally stroke over the whole area with gauze soaked in sulphuric ether. Do this gently to minimize the smarting of the skin. Then apply the sterile dressing—gauze swabs, or a piece of lint of appropriate size; place over it the sterilized wool, and fix the dressing with the bandage.

Some surgeons insist on a repetition of the cleansing a few hours before operation, but it is advisable not to worry the patient at that time, and to wait till he is anæsthetized.

After the cleansing of the skin, the operation area may be painted with *tincture of iodine* which penetrates into the sweat glands and hair follicles, and so reaches bacteria which may have escaped the washing. Another advantage is that the yellow staining produced by the iodine shows the extent of the purified area. In some cases, however, acute irritation of the skin and œdema of the area result from its application.

Preparation of the Field of Operation in Emergencies.—The part should be shaved as before, washed as thoroughly as time permits, and covered with a towel wrung out of 1 in 40 carbolic. Even this hurried preparation may be impossible, and then the shaving and cleansing are carried out on the table.

In parts devoid of hair, the skin may be rapidly prepared by rubbing it with ether or iodine-benzene to remove the grease, and painting over it a layer of tincture of iodine. If soap and water have to be used to soften hairs before shaving, the iodine solution does not penetrate so deeply into the sweat-glands and hair-follicles; hence it should not be applied till the skin is thoroughly dried with methylated spirit and ether.

To Increase the Power of Resistance of the Patient.—We have already said that the leucocytes or white cells of the blood are important agents in fighting bacteria in the body (p. 6). Sometimes drugs are given before operation to increase their numbers, or, as it is called, to "induce a leucocytosis," and so increase the resistance to any bacteria that may have gained entrance in spite of the precautions. Such drugs are sodium nucleinate, and phagocytin, a proprietary preparation.

To Diminish the Shock after Operation.—Post-operative shock is a grave danger in many cases, and attempts are made to diminish it by hypodermic injections of morphin, alone or in combination with atropin or scopolamin, before operation. In giving these, the nurse must take all the precautions already mentioned (p. 51).

To Prevent Anæsthetic Poisoning.—Poisoning by the anæsthetic occurs in varying degrees, and one never knows when it is going to be severe. The earliest symptom is sickness, the treatment of which is referred to later (p. 182). So far no certain method of prevention has been discovered, though strict attention to the diet, the bowels, and the kidneys before operation helps to lessen its severity. The administration of morphin, or of sodium bicarbonate, has been recommended.

To Diminish Nervousness before Operation.—It is only in the minority of cases that anything more is required than a few comforting words from the nurse. One of the greatest advantages of administering morphin before operation is its quietening effect on the patient. A little stimulant, in the form of whisky, brandy or champagne, is often of value in specially nervous or feeble patients, but it should not be given as a routine practice before operation. The ward Sister is usually allowed to exercise her own judgment as to when it should be given, but the private nurse should not administer it without orders.

The Emptying of the Bladder.—The patient must empty the bladder immediately before he is taken to the theatre. If he is unable to do so, the house surgeon must be told, as it is then necessary to pass the catheter. In the case of a female patient, the catheter must be passed by the nurse.

The Arrangement of the Patient's Clothes.—The patient's clothes should be so arranged before leaving the ward that (1) the field of operation can be easily exposed, and (2) soiling by blood and lotions may be prevented. For example, when the operation is in the region of the shoulder or chest, the bedgown should be removed from these parts, a blanket take its place till the operation is begun, and a gamgee sleeve be put on the opposite arm. In abdominal cases the back of the gown is apt to be soiled unless it is well pulled up between the shoulder-blades. If pyjamas are worn, the jacket should be turned with the front to the back, and only the top button fastened. It can then be easily pulled out and arranged across the chest so that the patient's back is left bare. Sometimes the gown is taken off in the ward, and the patient rolled naked in a clean sheet, and wheeled to the theatre.

There long stockings and a gamgee jacket, both sterilized, are put on, and the patient lies on the operating table between sterilized sheets.

In operations about the face and neck, great care must be taken, especially in female patients, to prevent soiling of the hair with blood. This is most easily done by putting over the whole scalp a tight-fitting rubber bathing-cap. It should be arranged in the ward, where the nurse has more time to ensure that no straggling hairs are left out. In the theatre it is covered with a sterilized gauze or cotton cap, kept in position by tapes, or by a broad elastic band. In female patients the hair may be plaited in a pig-tail, which should not, however, be coiled on the back of the head, as it causes discomfort and pain when she has to lie for a long time resting on it.

Removal of Artificial Teeth.—It is the nurse's duty to ask every patient before he leaves the ward for the theatre whether he has any artificial teeth, and if so, to see that the plate or plates are removed. They should be put into a dish with water, and placed in a safe place as they are often of considerable value. If morphia is to be administered some time before operation, the plate should be removed at the same time.

CHAPTER X.

STERILIZATION OF SWABS, COTTON MATERIALS, AND MACKINTOSHES.

EVERYTHING that comes in contact with the field of operation before, during, and immediately after the operation must be free from bacteria. Only sterilized materials may be used to put over the bed-clothes, to cover the surgeon's and assistants' clothes, to swab up blood or pus, and to dress the wound; all these soft materials are rendered aseptic by "dry" or "steam" sterilization. They are packed in a *casket*, subjected to steam at a high pressure, and thus heated to a temperature sufficient to kill all bacteria.

The CASKET or DRUM (Fig. 51) is a round metal box, perforated at intervals, with a closely fitting lid. It is encircled externally by a sliding metal cylinder or collar, also perforated. It is so arranged that the holes, which are of the same size in the box and the collar, may be brought opposite each other, allowing steam to permeate and sterilize the contents of the casket. At the end of the sterilization, all communication with the exterior is shut off by rotating the collar so that the holes in it no longer fit over those underneath.

To Pack the Caskets.—The contents of the caskets must be arranged in the proper order, that is, the articles wanted first are to be packed last, and vice versa. The caskets vary in size with the type of sterilizer, but in general two are required to hold all the necessaries for an operation, and indeed are more convenient than one.

First Casket.—Before anything is packed, a layer of gauze or cotton wool is spread over the bottom of the casket. At the foot go the *gauze swabs*, made in the manner already

described (p. 26); sometimes they are placed in a gauze bag with a purse-string mouth. The number of swabs required varies widely in different operations, but in every case the supply must be plentiful, say eight or ten dozen in an extensive operation, and never less than three dozen even in a slight one. It is a good rule to pack more than can possibly be wanted. The excess is not wasted but can be again sterilized for a subsequent operation. For the majority of operations they should be four inches square, but for swabbing a small or deep cavity, such as the mouth or pelvic cavity, it is convenient to have a second supply of smaller size, say two inches square; these are generally used fixed on forceps—a "handled" swab.

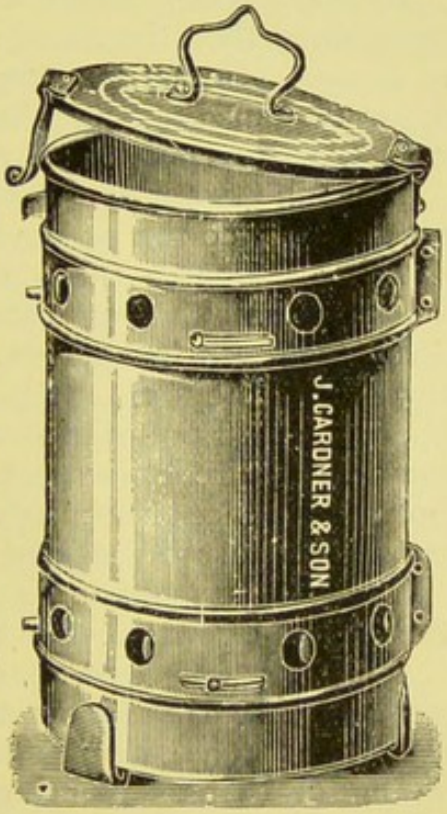


FIG. 51.—CASKET OR DRUM.

For abdominal, and perhaps for all, operations the nurse who packs the casket must know the number of swabs she has put in. At the operation they are counted again before the wound is stitched up, and the numbers must tally. Only thus can the surgeon be certain that he has left none in the peritoneal or other cavity. For convenience of counting, the swabs should be tied up in bundles, each containing a definite number, say ten or twelve, before they are packed. Other methods of preventing a swab slipping out of sight are not so certain. Many surgeons make a practice of fixing forceps on every swab which they put into the peritoneal cavity, but occasionally both have disappeared. Another plan is to have special "abdominal swabs," with long tapes sewn on one end which are left projecting from the wound. As long as the tapes do not slip into the cavity, there is no chance of a swab being overlooked. These abdominal swabs

are usually of large size, especially when they are used to keep the intestine out of the way. Strips about a yard long, and eight inches broad, are very convenient for this purpose in hysterectomy and other pelvic operations. Their edges should be stitched to prevent unfolding and the detachment of loose threads in the peritoneal cavity. A dozen abdominal swabs, made up in one or in two bundles, are sufficient for one operation.

It is important when the three different sizes of swabs are packed that the nurse should know exactly where each is placed. Sometimes the two-inch swabs are placed in a separate gauze bag, or they may be packed in the second casket, as is usually done with the abdominal swabs.

After the swabs are packed the *towels* or *squares*. They are made of cotton or linen, and should be about one and a half yards square. Four are required, of which one may be an "abdominal towel," that is one with a central, oval hole, about twelve inches by ten. In the packing, it is the second towel from the foot. It is useful in many besides abdominal operations. For an operation on a limb, an extra towel may be required to wrap round it below the field of operation. In a face or neck operation the mackintosh cap which is put on must be covered by a towel.

Over the towels a few swabs may be placed for cleansing the skin of the part while the patient is being anæsthetized.

Caps and *masks* come next. It has been shown that if anything brushes against the hair of those engaged in the operation, organisms are knocked off, and may fall on the wound or swabs. Hence gauze caps, fixed on by tapes, are often worn by the surgeon, assistant, and nurse in charge of the swabs. Face masks of gauze, with holes opposite the eyes, may also be worn.

Then the three *overalls* for the surgeon, assistant surgeon and instrument-clerk are packed. They are long wraps of cotton or linen, fastening at the back. The sleeves may reach the wrist and be fastened with tapes over the gloves, or they may come only to the elbows.

On the top come the *loofahs*, one for each basin, and *cotton-gloves* if they are required. They are sometimes worn in place of rubber gloves by the surgeon and assistants, and

in a head or neck operation by the anæsthetist. Two pairs at least should be packed for the surgeon himself.

The Second Casket.—At the foot goes a bundle of *absorbent wool*, wrapped in a towel. Next, this casket should contain three or four *emergency towels*, to replace any soiled during the operation by contact with something which is not aseptic, or to cover the bed-clothes if a further operation is decided on. Over the emergency towels are packed the *abdominal swabs*, and sometimes the *two-inch swabs* in a special gauze bag. Next come the *nurses' overalls*, usually three in number, being one each for the Sister, theatre nurse, and nurse in charge of swabs. On the top of them goes a *towel* for drying the surgeon's hands if he puts on the rubber gloves dry. Then come the *anæsthetist's overall*, especially in face, neck, and arm operations, and above it the *towel* for the instrument table.

If *sterilized sheets* are used for the operating-table, a third casket is required for them. They should not be packed along with swabs or towels, as the casket containing them has to be opened some time before the operation begins.

The caskets should not be packed so tightly as to interfere with the free circulation of steam through the contents. The lids are shut down, the holes in the box and the collar brought opposite each other, and the caskets placed in the sterilizer.

It is generally advisable to sterilize the contents of the caskets the day before operation, in case anything goes wrong with the sterilizer or steam supply.

In hospital, the theatre-nurse must always keep for emergencies several caskets which have been recently sterilized.

The High Pressure Sterilizer.—Various patterns are used according to the size required for the individual theatre, and the source of heat. The more elaborate sterilizers are too intricate to lend themselves to a detailed description, but the general features may be briefly mentioned. One of the simpler types is figured here (Fig. 52). It consists of a double-walled copper cylinder into which the two packed caskets are placed. Then the lid is tightly fixed. Between the two walls is a space about an inch in width, technically known as a water-jacket. This space is half-filled with

water through the funnel on the right of the figure; when the glass tube leading down from the funnel is half-full, the required quantity of water has been added. The water is boiled either by gas, as in the figure, or by steam circulating in a coiled pipe round the jacket. When the water boils, the steam escapes through holes near the top of the jacket, enters the cylinder, and travels through the contents of the casket. As it has no free outlet, the pressure inside the cylinder gradually rises, and at the same time the contents are heated sufficiently to kill all the bacteria. The amount of pressure required for efficient sterilization is attained when the indicator on the steam-gauge points to 15. To prevent the pressure rising indefinitely, and bursting the cylinder, a safety-valve, so constructed as to open mechanically and allow steam to escape when the indicator goes much above 15, is fitted on each sterilizer.

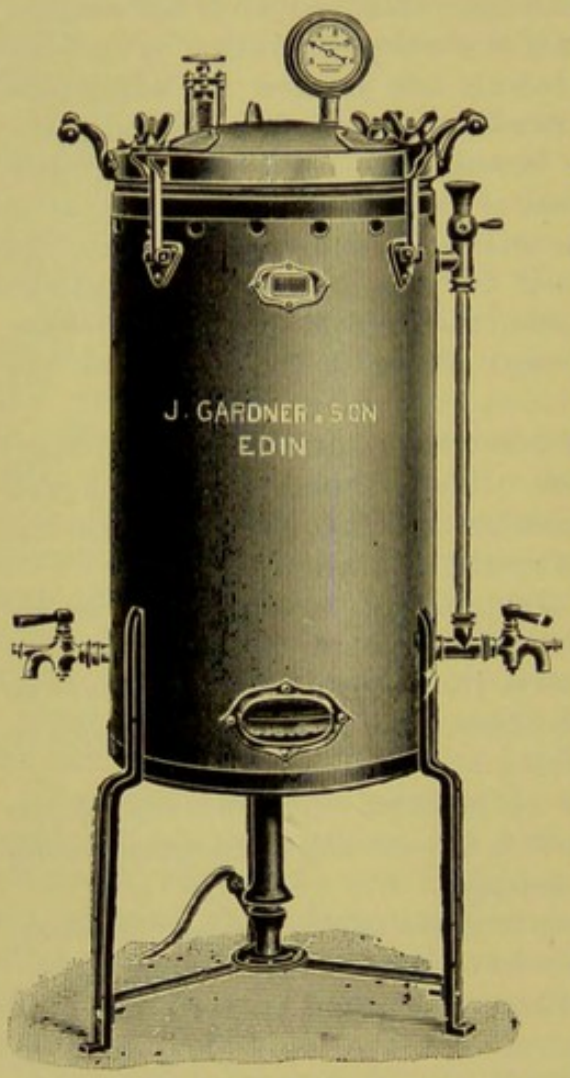


FIG. 52.—HIGH-PRESSURE STERILIZER.

Sterilization is completed in twenty minutes after the steam-gauge indicator has reached the figure 15. Then the gas or the steam is turned off, and the tap on the left side of the figure is opened to let the steam escape. When it has cooled, the lid is opened and the caskets are taken out. The collars are then rotated to close the holes, and the drums are put aside till they are to be used. By turning the lower tap on the right side, the jacket is emptied of water.

Purification of Mackintoshes.—Mackintoshes cannot be sterilized by steam or boiling water, hence they must be purified with antiseptic lotions. First they are washed with soap and water or lysol to remove blood and pus, and then thoroughly wiped with carbolic lotion, and hung up to dry. If they are folded wet, the surfaces may adhere.

Squares of *batiste*, which are sometimes used instead of mackintoshes, can be sterilized by steam. After an operation, they are sponged with cold water and dried, and then they are ready for sterilizing. They should not be immersed in water, as they soon become soft and useless.

CHAPTER XI.

A.—STERILIZATION OF INSTRUMENTS, RUBBER GLOVES AND DRAINAGE-TUBES.

THE instruments required for an operation can be selected only by one who is acquainted with the methods of the surgeon, the steps of the operation, and the complications and emergencies which may arise during its performance. Hence it usually falls to the lot of the house-surgeon or Sister to "put out the instruments," and for a morning operation this is generally done the night before. Twenty to thirty minutes before they are required they are put into the sterilizer. They are less liable to rust if the water is boiling; they should never be plunged into cold water and then heated.

Instrument Sterilizer.—Various forms are in use. One of the simplest is Caird's sterilizer (Fig. 53), constructed like a fish-kettle, with a perforated tray on which the instruments are placed. Hot water is poured in to cover the instruments, and a little lysol or washing-soda may be added. The source of heat may be methylated spirit, gas, steam circulating in a coiled tube round the sterilizer, or electricity. At the end of sterilization, the tray is held up till the water runs off, and then taken to the instrument table, which is covered with a sterilized towel. Between two operations, the instruments are again boiled. In hospital a larger sterilizer is used (Fig. 54).

All glass and metal instruments, except knives and perhaps scissors, can be repeatedly boiled without harm.

To Clean Instruments.—After an operation, the instruments are cleansed of blood or pus by steeping them in lysol and scrubbing them with a nail-brush. They are then boiled, thoroughly dried, and placed in their usual position in the instrument-cabinet.

To Sterilize Knives.—Knives should not be sterilized by boiling, as it destroys the temper of the blade. They may

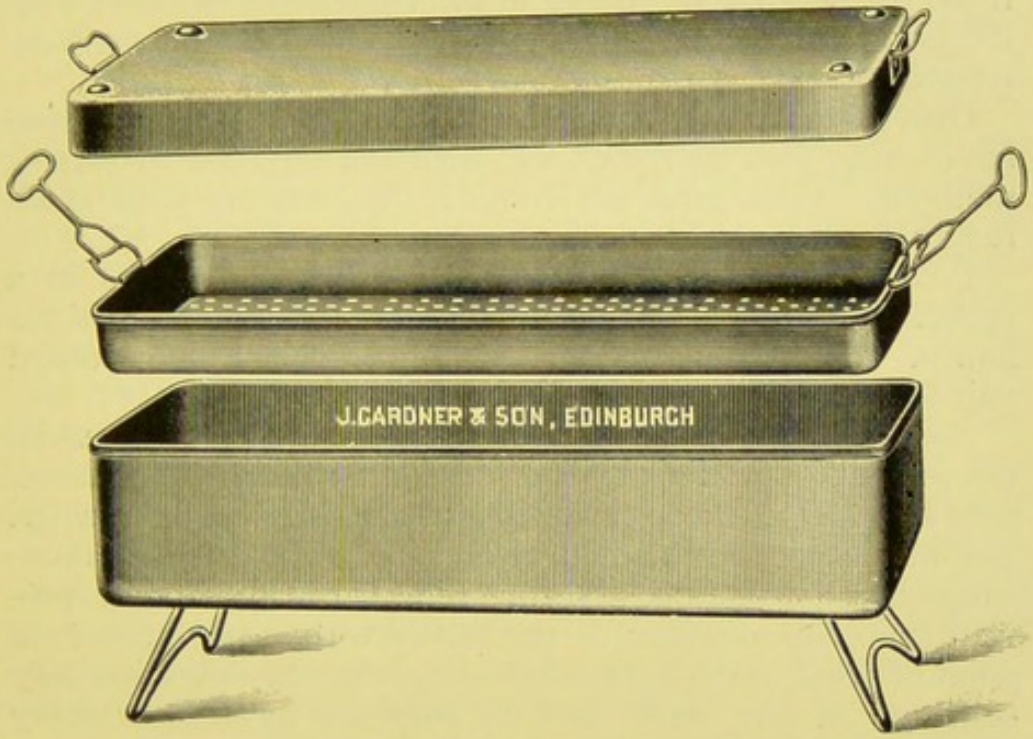


FIG. 53.—PORTABLE INSTRUMENT STERILIZER.

be dry sterilized in the steam sterilizer, each being placed in a glass-tube which is closed by a stopper of absorbent wool.

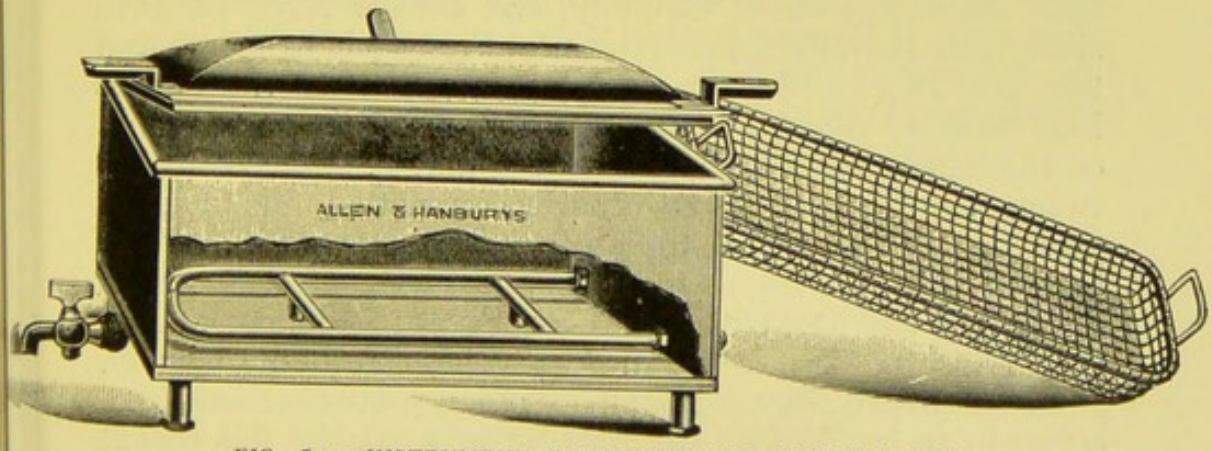


FIG. 54.—INSTRUMENT STERILIZER FOR HOSPITAL USE.

Wire racks are constructed to hold one or two dozen tubes. Or they may be placed in pure lysol or 1 in 20 carbolic for

ten to twenty minutes. Before use, the antiseptic is removed by dipping them in sterilized water or saline solution. Sometimes the handles are placed in the instrument sterilizer with the blades projecting and boiled, but this is an unnecessary refinement.

Gloves made of rubber tissue, cotton, or other material have come into everyday use with the advance in aseptic methods. Their great advantage is the certainty with which they can be rendered sterile.

Cotton gloves are sterilized along with the swabs in a casket, and put on by the surgeon after he has cleansed his hands. During an operation he may substitute a second pair for the first.

Rubber gloves, being non-porous, are more generally used, not only at operations by the surgeon and each of his assistants who has to "keep clean," but at the daily ward dressings. For the latter they should always be worn by the house-surgeon and the nurse assisting him, because (1) they prevent the contamination of the hands with septic matter—a point of great importance when an emergency operation may come on at any time—and (2) they are much more easily sterilized between dressings than the bare hands.

Rubber gloves require careful attention, and this is part of the nurse's work. Immediately after use they are boiled for two or three minutes—a more prolonged boiling impairs their elasticity—dried carefully, and then covered on both sides with a suitable glove powder—French chalk, starch and talc powder, or boracic, zinc and starch powder. This is best done by taking a small quantity of powder on the palm of the hand, bunching up the gloves and rubbing them between the hands, so as to cover them with a fine layer of powder. It is not a good plan to pour the powder into the interior of the gloves, as it collects at the tip of each finger, and any gritty particles may rub holes at the points. After powdering they are stored in a glass jar containing powder.

To Sterilize Gloves.—For an operation, gloves are sterilized, either in an instrument sterilizer, or in a special flat casket which goes into the high pressure sterilizer, according as the surgeon prefers to wear them wet or dry. If they are put on wet, they should be boiled for two or three minutes in

plain water. Lysol may also be used, but gloves do not last so long if they are repeatedly boiled in it. One important point must be attended to by the nurse in boiling gloves. An instrument sterilizer is usually employed, half or three quarters full of water. The gloves, when placed in it, fill up with air and rise to the top. If they come in contact with the metal *above* the level of the water, and if the flame spreads up the side of the sterilizer, the temperature of this part of the metal may rise high enough to melt the rubber. This is not an uncommon occurrence, and to prevent it gloves should always be rolled in a gauze swab, starting at the fingers so as to drive all the air out, and then boiled. At the end of three minutes the nurse lifts out the bundle with sterile forceps, and places it in a basin with sterile water. If they are worn dry, they should be thoroughly powdered, and each pulled over a wire frame shaped like a hand, or lightly plugged with gauze to keep the surfaces apart. They are then wrapped in gauze, laid in the glove casket, which should contain a supply of powder, and placed in the steam sterilizer. Before drawing them on, the surgeon dries his hands with a sterilized towel, and rubs them over with powder from the casket.

To Repair Holes.—Gloves should be examined for holes after each operation as they are liable to be pricked by needles. A hole must be patched with a piece of rubber tissue fixed on with solution.

Rubber Catheters and Drainage-Tubes may be boiled along with the gloves, or with the instruments if plain water is used. Silk, silk-worm gut, and linen thread are also boiled. Horsehair may be boiled for two or three minutes, or sterilized by steam, but it is apt to become brittle.

B.—GENERAL INSTRUMENTS.

There are certain instruments which should be in readiness at almost every surgical operation. The particular size, shape, or pattern will of course vary with the nature of the operation and the preference of the surgeon.

List of Instruments for any Surgical Operation.—Scissors, several pairs; Probe; Director; Dissector; Dressing Forceps; Sinus Forceps; Dissecting Forceps; Retractors; Aneurysm

Needle; Artery Forceps, many pairs; Knives, a selection, one being probe-pointed; Needles, triangular and rounded; Needle-holder.

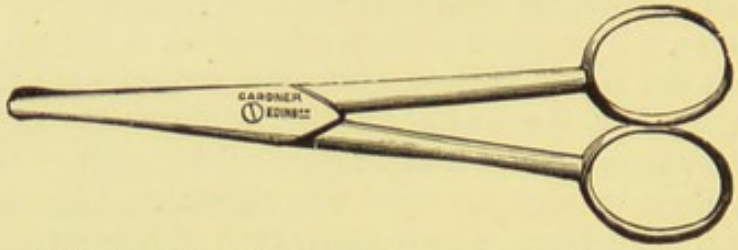


FIG. 55.—STRAIGHT SCISSORS WITH PROBE POINTS.

Scissors.—Various patterns are shown in the illustrations. The blades may be straight (Fig. 55), curved on the flat

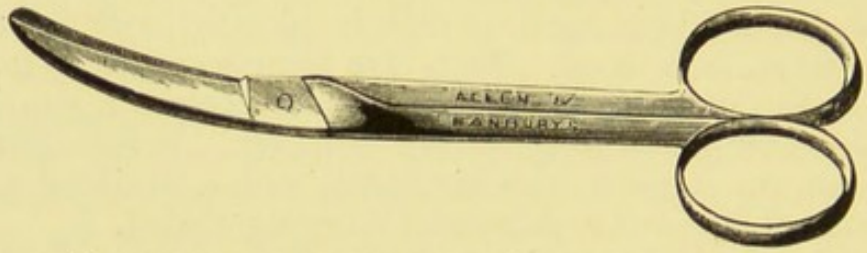


FIG. 56.—SCISSORS CURVED ON THE FLAT, WITH BLUNT POINTS.

(Fig. 56), or angled (Fig. 57); and the points may be sharp or blunt. Differences in the strength of the scissors and the

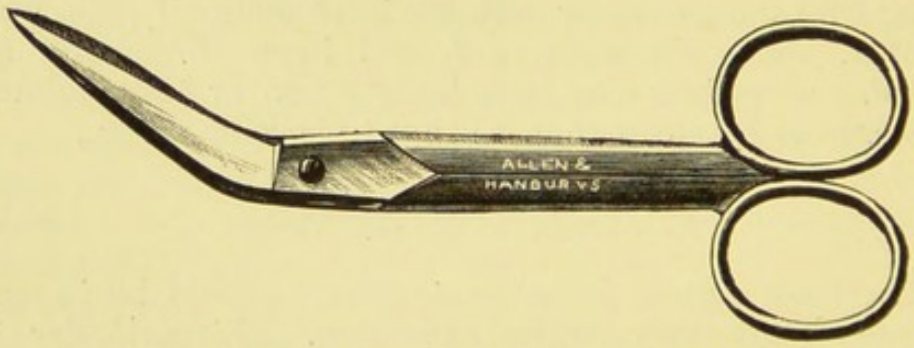


FIG. 57.—ANGLED OR ELBOW SCISSORS, WITH SHARP POINTS.

length of the blades and handles also exist, according to the purpose for which they are used. In the pattern devised by Mayo (Fig. 58), the blades are thick and strong, and the

points are rounded so that the closed scissors may be used as a dissector.

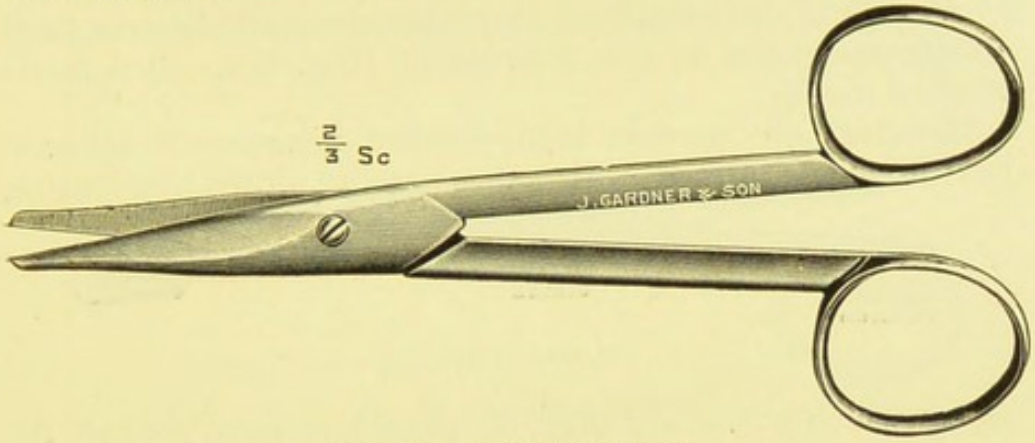


FIG. 58.—MAYO'S SCISSORS.

Probes.—These are used for various purposes, chiefly to explore sinuses to detect their extent, direction, and contents. They should only be employed when the sinus is too deep or too narrow to admit a finger.

This applies especially to such conditions as scalp wounds, in which it is of such importance to ascertain the condition of

FIG. 59.—ORDINARY SILVER PROBE.

the bone, that the surgeon may enlarge the wound in the soft tissues so as to admit a finger rather than trust to the probe as a diagnostic agent. The ordinary short silver probe (Fig. 59) is about 6 inches long, rounded, with

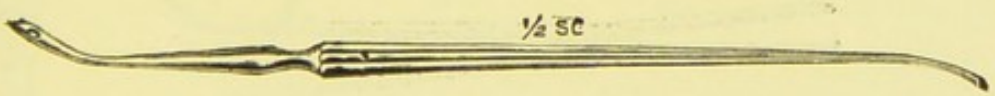


FIG. 60.—SHIELD'S PROBE.

a slightly bulbous point at one end, and at the other flattened out and furnished with a large needle-eye. Being of silver, it may be made to take any shape desired.

The *bullet probe*, tipped with porcelain which is blackened

by contact with lead, is not now used, since bullets can be more certainly located by means of the X-rays.

Shield's Probe combines a probe, grooved director, and aneurysm needle in one instrument (Fig. 60). It is made of rigid metal.

Directors are narrow, blunt-pointed instruments about 6 inches long, furnished with a deep groove down the centre,

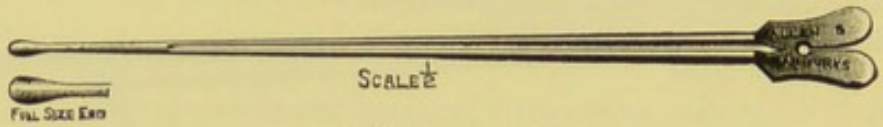


FIG. 61.—DIRECTOR.

along which a bistoury may be passed, so as to control the extent and direction of an incision. The *ordinary director*

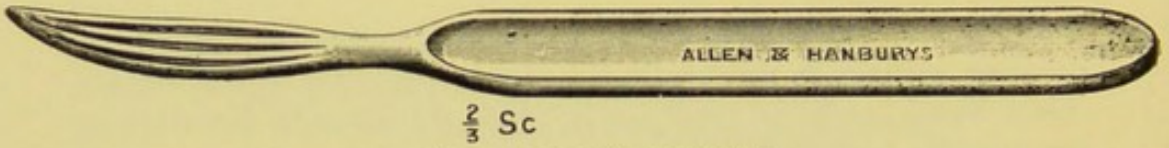


FIG. 62.—KOCHER'S DISSECTOR.

(Fig. 61) is used in slitting up a sinus, or in opening an abscess by Hilton's method.

FIG. 63.—MACDONALD'S DISSECTOR.

Dissectors are used to separate the tissues covering a structure to which the surgeon desires access (Figs. 62 and 63).

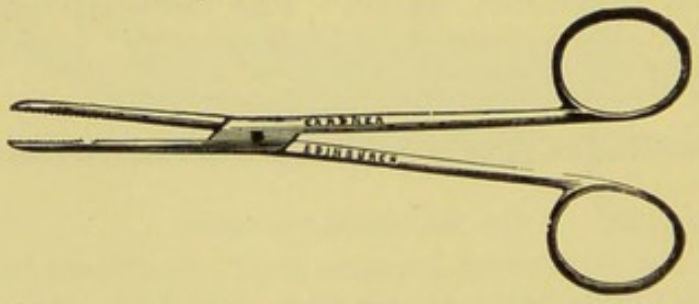


FIG. 64.—DRESSING FORCEPS.

Dressing Forceps are of various patterns, some resembling artery forceps, but without the catch on the handles, and others being curved on the flat (Fig. 64).

Sinus Forceps (Fig. 65) have long, narrow, tapering blades, serrated at the point for a short distance. They are used to pick out small substances, such as fragments of dead bone

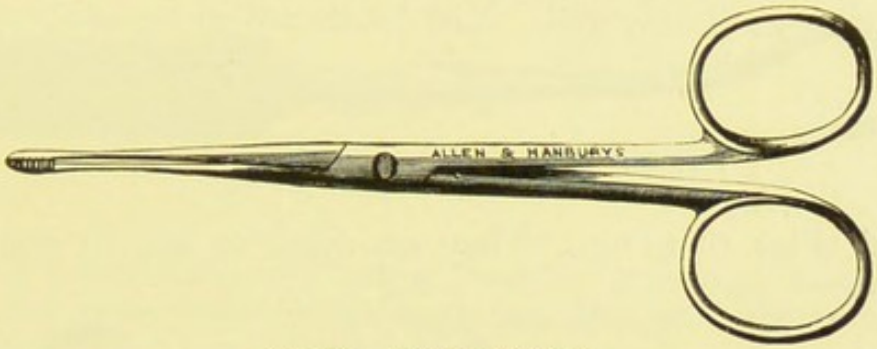


FIG. 65.—SINUS FORCEPS.

from a narrow, deep sinus, or to introduce a drainage tube into a deep wound.

Dissecting Forceps (Fig. 66) are sometimes required at operations.

FIG. 66.—DISSECTING FORCEPS.

Retractors are used to draw apart the edges of a wound during an operation, so that free access may be had to the

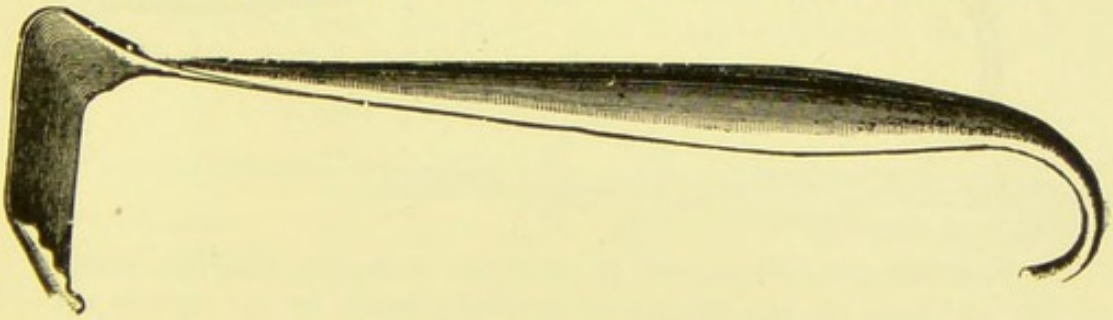


FIG. 67.—RETRACTOR.

deeper structures, to protect important vessels, nerves, and other tissues from injury, and to steady tissues while they are being freed by dissection. The simplest form of retractor is

a sheet of copper, which may be bent so as to form a hook of any size. Another is made of wire, which will also bend to any desired angle. Various forms of steel hooks are also

FIG. 68.—BLUNT HOOK USED AS RETRACTOR.

used (Figs. 67 to 69). They are made in sets of different sizes.

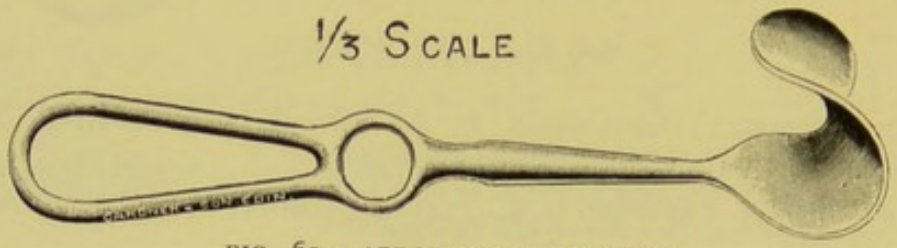


FIG. 69.—ABDOMINAL RETRACTOR.

An **Aneurysm Needle** (Fig. 70) should always be in readiness. It is a blunt-pointed, curved needle, mounted on a metal handle, and is used to pass a ligature round a blood-vessel, as well as for other purposes.

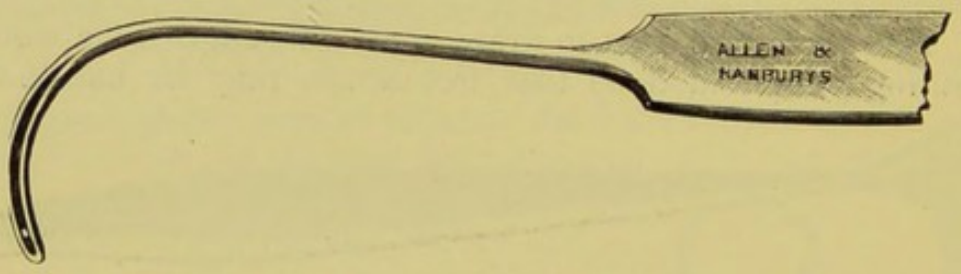


FIG. 70.—ANEURYSM NEEDLE.

Needles are employed to sew up wounds, whether made by accident or by the knife in the course of an operation. Some surgeons prefer a straight needle, which differs from an ordinary sewing needle in having a bayonet-shaped point, and the eye considerably larger. Many use the half-curved needle (Fig. 71), while perhaps that most frequently employed is the curved needle, on account of the greater ease

and rapidity with which sutures may be inserted by it (Fig. 72).

The needle may be rounded, flattened from side to side, or bayonet-shaped in the distal half. The first is used for in-

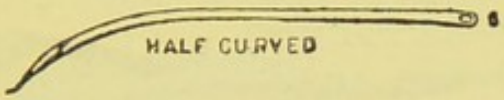


FIG. 71.—HALF-CURVED NEEDLE.

serting buried sutures of catgut and for intestinal stitching, and the other two for through-and-through skin sutures. To secure the thread, some needles are made with a double eye.

FIG. 72.—FULLY CURVED NEEDLE, WITH BAYONET-SHAPED POINT.

Handled Needles are now widely used for the stitching of superficial wounds. With them interrupted sutures can be rapidly inserted. The needle is pushed through both edges of the wound, threaded through the slot (Fig. 73) or eye which is placed near the point, and then withdrawn so as to leave the thread in position.

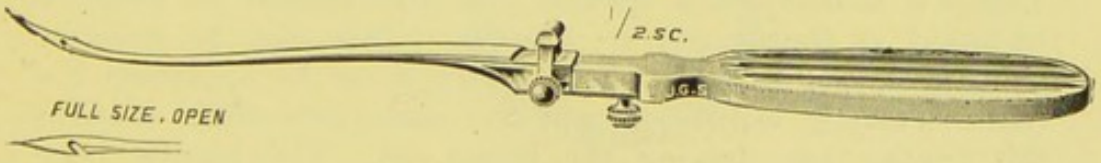


FIG. 73.—HANDLED NEEDLE.

Needle-Holders are useful in stitching at the bottom of a cavity such as the pouch of Douglas or the vagina. Many patterns have been introduced, characterized, however, more by the ingenuity of their mechanism than by their practical

utility. Some are made to be used with any form of needle, e.g. Fig. 74, representing a pair of artery forceps which may also be used as a needle-holder, being constructed with

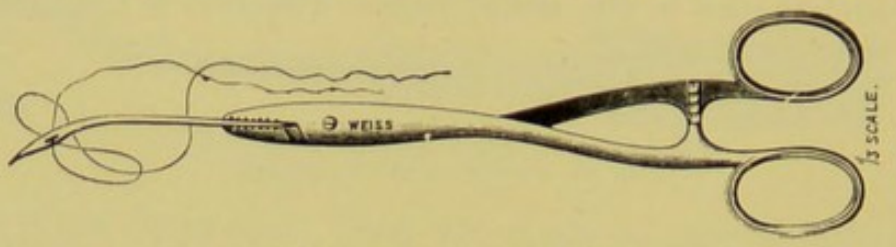


FIG. 74.—NEEDLE-HOLDER.

a longitudinal groove into which the needle fits. Fig. 75 shows a form of needle-holder favoured by many gynæcologists and surgeons. The Hagedorn pattern can only be used with the flat-bladed needles employed by that surgeon.

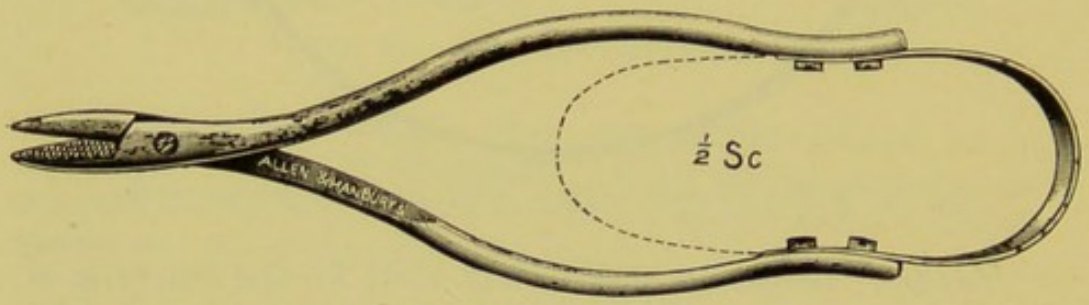


FIG. 75.—NEEDLE-HOLDER.

C.—INSTRUMENTS USED TO PREVENT HÆMORRHAGE.

Tourniquets are used to arrest or prevent hæmorrhage. Before a tourniquet is applied the limb should be emptied of blood as thoroughly as possible. This may be done by simply elevating it for a few minutes, or by applying Esmarch's elastic webbing from the distal extremity towards the trunk, thus driving the blood out. This having been done, the first turn of the tourniquet must be applied very quickly and firmly, so as at once to arrest all circulation through the limb. If this is not done, it will only arrest the venous return without interfering with the arterial supply, the result being engorgement rather than depletion of the part.

(*a*) *Esmarch's Tourniquet for the Bloodless Operation* (Fig. 76) consists of two parts—a strong elastic bandage and a thick piece of elastic tubing, fitted at one end with a few chain links, and at the other with a hook, by means of which it is secured. The elastic bandage is applied tightly round

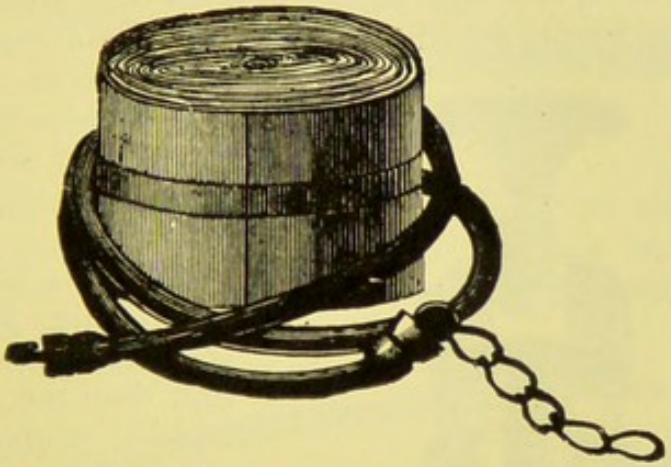


FIG. 76.—ESMARCH'S TOURNIQUET.

the limb from below upwards to drive all the blood out of the vessels. At the upper limit, above the seat of amputation, the powerful tubing is fixed, and so prevents the entrance of blood into the part on the removal of the bandage. The tubing should be applied over a few turns of *wet* lint to

FIG. 77.—FOULIS' TOURNIQUET.

prevent injury to the skin and slipping of the tourniquet. By this means the part to be removed is rendered exsanguine, and no blood is lost at the operation. The disadvantage of this instrument is that it cannot be slackened gradually like the screw tourniquet to ascertain if all vessels have been tied.

(*b*) *Foulis' Elastic Tourniquet* (Fig. 77) consists of a piece of strong indiarubber tubing about 2 feet long, on which is fixed a grooved block of wood. The tube is stretched and passed once or twice round the limb, and then slipped into the groove. The limb is elevated for a few minutes and the tourniquet is rapidly and tightly applied over a fold of moist lint. With Foulis' tourniquet severed vessels bleed a little, but this is an advantage, as it enables the surgeon to see and secure them before removing the tourniquet.

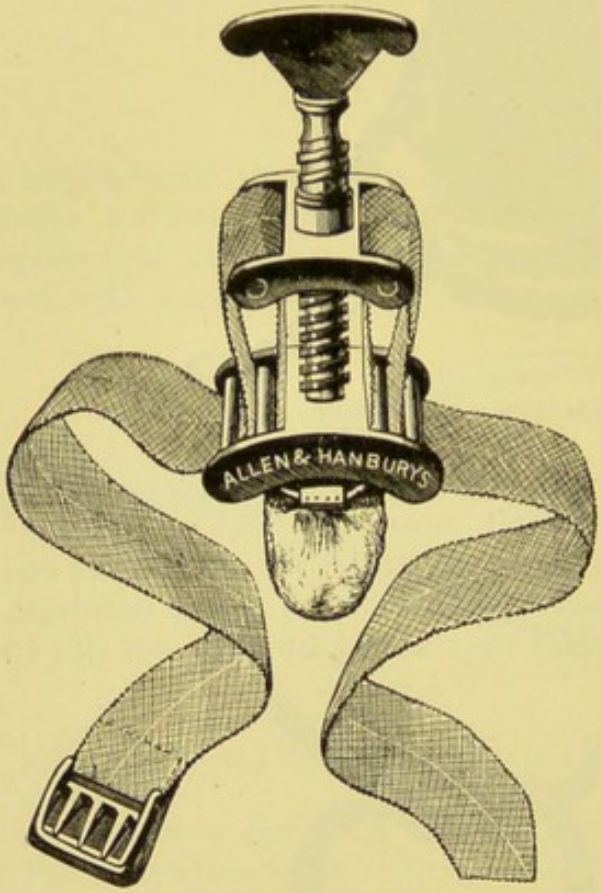


FIG. 78.—PETIT'S SCREW TOURNIQUET.

(*c*) *Petit's Screw Tourniquet* (Fig. 78) is more complicated in construction than the others, but equally simple in principle. It consists of a metal frame of two plates perforated by a screw, and threaded through these is a strong inelastic belt fitted with buckles, and with a pad to go over the main artery of the limb. One or two points must be attended to in fitting up this instrument. (1) To ensure that the band is properly threaded into the brass plates, pass it twice through each outer division in the under plate, and not at all through the inner division. If it is properly threaded, no brass is visible on the under surface of the instrument, while, if wrongly done, the inner bar on each side is seen. (2) Be careful before beginning to thread the tourniquet that the buckle is turned so that it will catch when placed on the limb. (3) Approximate the two plates before beginning to apply the instrument. This tourniquet is also applied over moist

lint, and the pad is placed over the main blood-vessel of the limb, so that when the screw is brought into action the blood-supply will be cut off as thoroughly as possible. The great advantage of Petit's instrument over most of the others

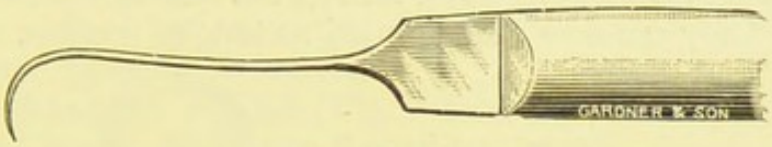


FIG. 79.—TENACULUM.

is that it may be slackened gradually, and so any vessels which have escaped the surgeon's notice may be seen, the screw tightened again, and these tied without undue loss of blood to the patient.

FIG. 80.—LISTON'S CATCH FORCEPS.

(*d*) *Elastic Webbing*, applied round the limb at the required level, may be used as a tourniquet, the point of importance being to apply the first turns rapidly and very tightly.

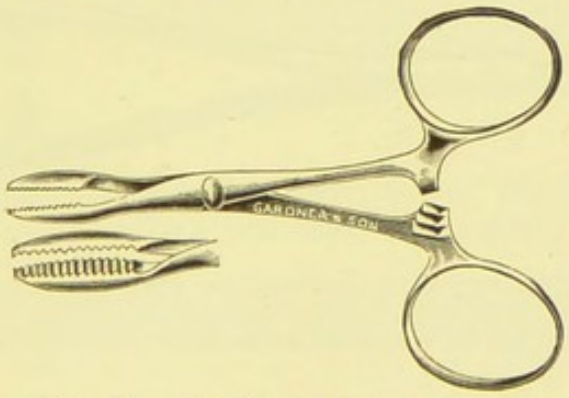


FIG. 81.—PEAN'S ARTERY FORCEPS.

Artery Forceps.—Of the older instruments used to arrest hæmorrhage may be mentioned the *Tenaculum* (Fig. 79), a sharp hooked instrument with a wide curve, with which the

bleeding artery is transfixed and pulled out of its bed while a ligature is applied.

Liston's Catch Forceps (Fig. 80) in shape resemble ordinary dissecting forceps, but they are furnished at the point with sharp interlocking teeth, and in the middle with a spring catch. They are now mainly used as tongue forceps.

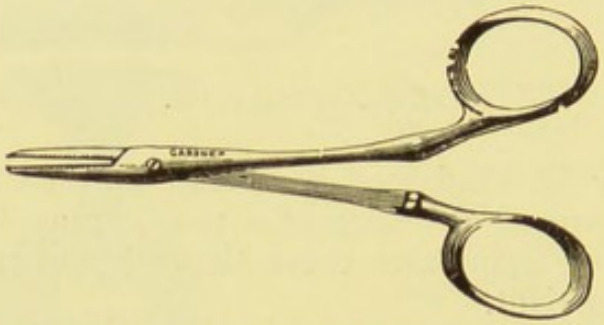


FIG. 82.—SPENCER WELLS' ARTERY FORCEPS.

Pean's Forci-pressure Forceps (Fig. 81) are clamped by means of a ratchet situated near one of the handles. They are furnished with a so-called "aseptic joint," that is the blades are separable to admit of more thorough cleansing.

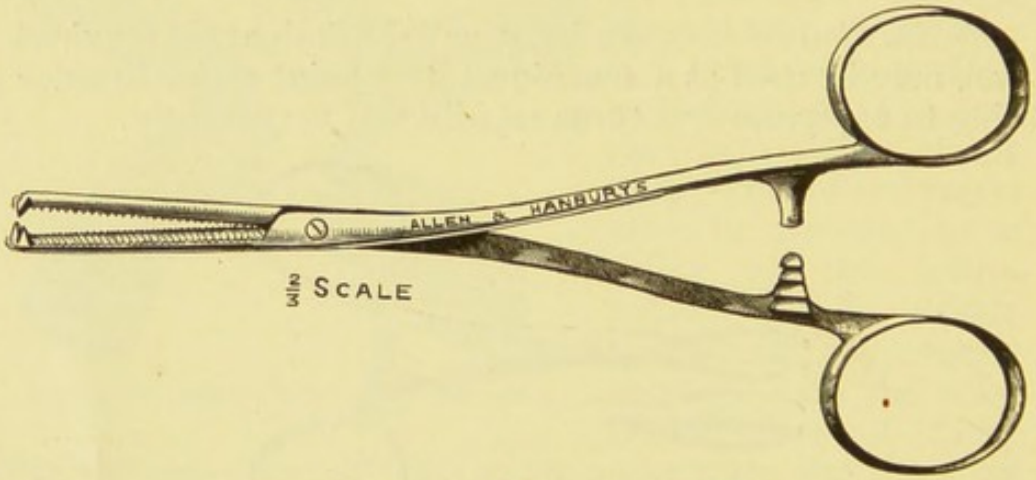


FIG. 83.—KOCHER'S ARTERY FORCEPS.

When left hanging, these forceps are more apt to spring off the vessel than those of Wells'.

Spencer Wells' Forci-pressure Forceps (Fig. 82) are widely used for the arrest of hæmorrhage. They are readily applied, and take a secure grip. If left on smaller arteries for a few

minutes, they exert sufficient pressure to arrest all bleeding. They may also be used as torsion forceps, or a ligature may be applied, according to the taste of the surgeon and the size of the vessel.

Kocher's Forceps (Fig. 83) have long, narrow, serrated blades, with a truncated end fitted with mouse-tooth catch. They are exceedingly useful.

Greig-Smith's Forceps (Fig. 84) have short, conical blades, grooved longitudinally on their inner aspect.

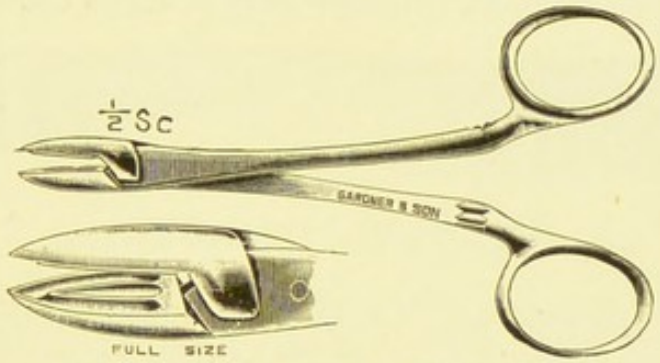


FIG. 84.—GREIG SMITH'S ARTERY FORCEPS.

Knives.—Of the various forms of knives used in surgery, some are known as *scalpels* and others as *bistouries*, but there is no definite dividing line between the two.

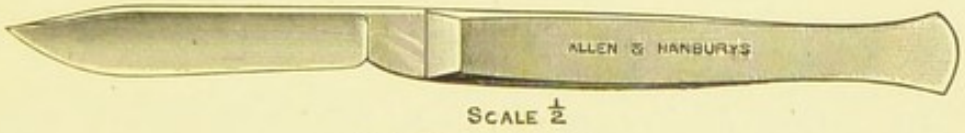


FIG. 85.—SCALPEL.

Scalpels have in general short, broad blades with sharp points (Fig. 85). They are used in making operation in-

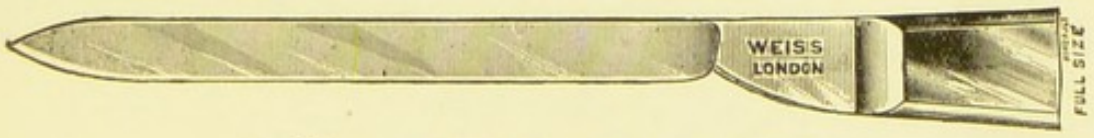


FIG. 86.—STRAIGHT SHARP-POINTED BISTOURY.

cisions when there is no great thickness of tissue to cut through, for example in the scalp or hand, and in dissecting close to important blood-vessels and nerves.

Bistouries have longer blades which are narrow in proportion to their length. They may be straight or curved, and

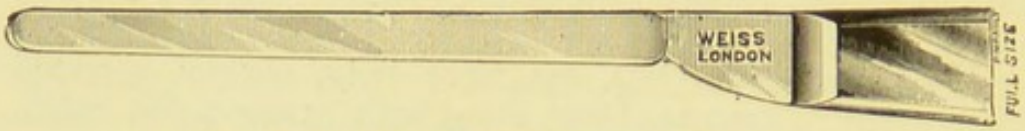


FIG. 87.—STRAIGHT PROBE-POINTED BISTOURY.

sharp-pointed or probe-pointed (Figs. 86 to 89). They are used to make incisions through such parts as the abdominal

FIG. 88.—CURVED SHARP-POINTED BISTOURY.

wall where the thickness of tissue is considerable, in laying open sinuses, and in performing small amputations as of fingers or toes.

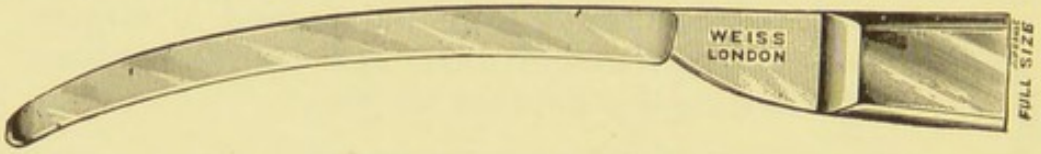


FIG. 89.—CURVED PROBE-POINTED BISTOURY.

Amputating Knives are of various sizes and patterns, some having a single cutting edge (Fig. 90), others cutting with both edges, some with sharp points, and some rounded, according to the operation and the taste of the operator.

FIG. 90.—AMPUTATING KNIFE.

Syme's Amputating Knife (Fig. 91) has a strong, broad blade, 3 inches long, with a thick back and a large handle, like other amputating knives. It is used in amputation at the ankle-joint.

Abscess Knives.—1. *Syme's Abscess Knife* (Fig. 92) has a short, sickle-shaped blade, which is bevelled off at the sides.

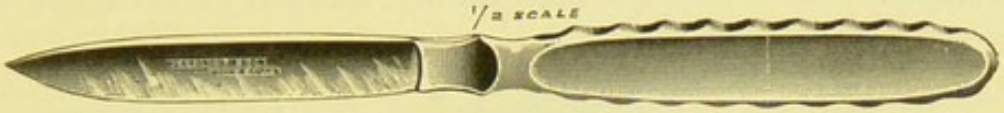


FIG. 91.—SYME'S AMPUTATING KNIFE.

When thrust into an abscess, the point always tends again to make its way to the surface.

FIG. 92.—SYME'S ABSCESS KNIFE.

2. *Chiene's Abscess Knife* (Fig. 93) consists of a thin, narrow, straight blade, attached to its handle by a thin metal stem.

FIG. 93.—CHIENE'S ABSCESS KNIFE.

3. *Von Graefe's Cataract Knife* (Fig. 94) is particularly suitable for opening small abscesses in children and nervous women, as its size does not alarm them.

FIG. 94.—VON GRAEFE'S CATARACT KNIFE.

Tenotomy Knives (Fig. 95), as their name implies, are used for cutting tendons, the operation being done subcutaneously. They may be sharp or probe-pointed, are short, thin, and narrow, and have only one cutting edge. Of course, the probe-pointed knife can only be used after the skin wound has been made. With it there is less risk of wounding blood-vessels and nerves.

Special *Hernia Knives* are seldom used, a curved probe-pointed bistoury serving the purpose equally well. Their function is to divide the constricting band in cases of stran-

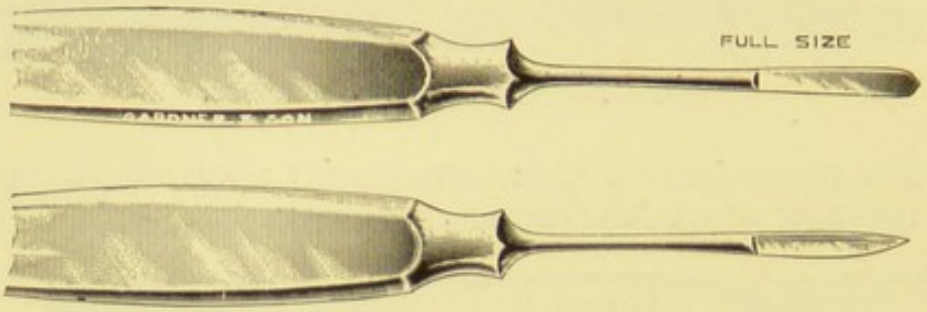


FIG. 95.—TENOTOMY KNIVES, SHARP- AND PROBE-POINTED.

gulated hernia, and for this purpose they are fitted with a long, curved, rounded stalk, about 4 inches long, having a very short cutting edge situated about an inch from the point, which is also blunt. On the back of the stem there is a

FIG. 96 —HERNIA KNIFE.

rough area, by which the surgeon may determine exactly the position of the cutting portion of the edge when he is using it (Fig. 96).

Lithotomy Knives are now rarely used (Fig. 97).

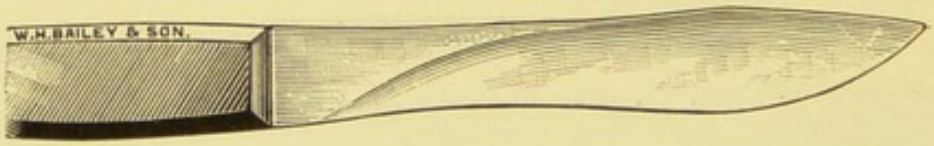


FIG. 97.—LITHOTOMY KNIFE.

CHAPTER XII.

PREPARATION OF LIGATURES AND SUTURES.

LIGATURES are used to tie blood-vessels, sutures to stitch up wounds. For ligatures catgut, and less frequently silk, are generally employed. For sutures different materials are in use according to the structure which is to be stitched, and the type of suturing which is adopted. Various technical names, which the nurse should be familiar with, are given to the different types of suturing. If the stitches penetrate the skin, they are called "through-and-through" sutures; if they do not penetrate the skin, they are called "deep" or "buried" sutures. If each stitch is tied separately, it is an "interrupted" suture; if a series of stitches are put in, as in hemming a garment, it is a "continuous" suture. As a variety of the last, the "button-hole" stitch is sometimes used.

The materials in common use are catgut, silk, silk-worm gut and horsehair.

Catgut.—This is made from the intestine of the sheep, which is first scraped so as to leave only the submucous layer, and then dried and cut in strips which are rolled into cords. Different thicknesses of catgut are used according to the strength required, and the sizes are denoted by numbers, 000 being the finest, 00 and 0 slightly thicker and stronger, and so on up to number 4, the thickest.

Sterilization of Catgut.—Much attention has been paid to the sterilization of catgut, which is always a matter requiring great care, and different methods have been devised for making and keeping it aseptic. The first essential, as in the purification of the hands, is to remove the fat which affords protection to the bacteria. This is done by immersing the gut in ether, boiling alcohol, or other fat solvent. Such fat-

free catgut is sold in hanks as *raw catgut* which is ready for sterilization; or it may be bought sterilized. In the larger hospitals the preparation of catgut is usually carried out in the laboratory, but in the smaller it may be left to the nurse, acting on the surgeon's instructions. A reliable method is to roll the raw catgut *loosely* on spools, place them in a strong brass receiver such as Jellett's sterilizer (Fig. 98), with a solution containing 85 parts of absolute alcohol, 10 parts of water, and 5 parts of carbolic acid. The lid is screwed on tightly and the receiver is immersed for half an hour in boiling water. When the lid is unscrewed, the spools are lifted out with

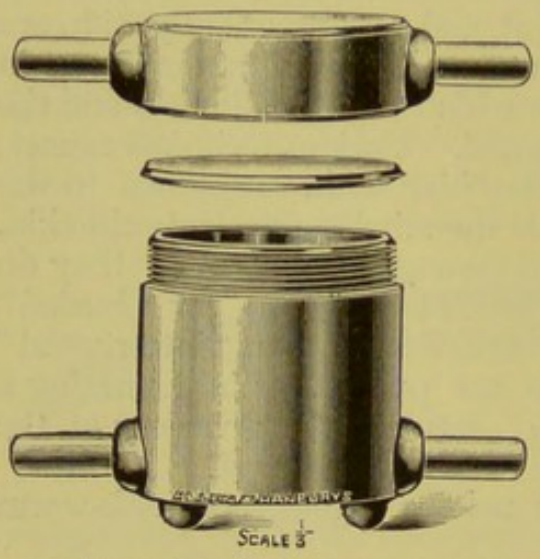


FIG. 98.—JELLETT'S CATGUT STERILIZER.

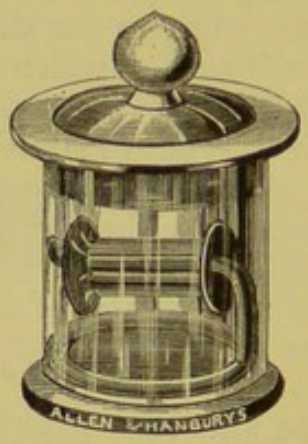


FIG. 99.—GLASS JAR FOR STORING CATGUT.

sterile forceps, and stored in glass jars (one pattern of which is shown in Fig. 99) containing 95 per cent. alcohol.

Iodine catgut is easily prepared by placing the raw catgut for eight days in air-tight jars containing one part of tincture of iodine and one part of proof spirit. It may be kept for some weeks in this solution without losing its tensile strength. A less expensive solution is: 10 per cent. solution of iodine in water, 1 part; distilled water, 3 parts; duty-free spirit, 6 parts. In this the catgut is placed for at least eight days, and then transferred with strict aseptic precautions to jars containing a solution with half the amount of iodine (Pearson).

Dry Iodine Catgut can be readily obtained by immersing it, after preparation as above, in 90 per cent. alcohol for a few hours, and then placing it on a sterile dish covered with an inverted funnel. The alcohol quickly evaporates, and the dark-brown catgut is left dry. It can then be stored for an indefinite period in sterile vessels.

Iodine-Formalin Catgut.—In certain cases, it is advantageous to use catgut which is not quickly absorbed from the tissues. It must then be prepared with formalin or chromic acid to render its surface *waterproof.* To prepare iodine-formalin catgut, place it for eight days in the iodine solution; then remove it, and wash off the iodine with running sterile water. Immerse it for twenty-four to forty-eight hours in 3 per cent. formalin solution, and wash again in sterile water for some hours to remove the formalin from the surface. Store it in a solution containing 50 per cent. alcohol, 0·5 per cent. iodine, and 5 per cent. glycerine. The glycerine renders the catgut more pliable (Pearson).

Chromic Catgut is also absorbed slowly. The catgut is placed for fifteen hours in a solution containing bichromate of potash, 15 grains, boiled distilled water, 1 ounce, and absolute alcohol, 15 ounces. Then it is transferred to the iodine-spirit solution, or to one containing 90 parts of absolute alcohol, 10 of glycerine and 0·5 of corrosive sublimate.

Cumol Catgut and *Oil of Juniper Catgut* are also prepared.

Advantage of Catgut.—The great advantage of catgut is that it is readily absorbed by the tissues. As already stated, the number of days that it takes to disappear varies with the method of preparation.

Precautions.—Great care must be taken to avoid contamination of the sterilized catgut at an operation. If it is kept in ordinary jars the spools should be lifted out with sterile forceps, and passed direct to the surgeon. Any portion left unused on a spool should be thrown away.

Uses.—Catgut is used for ligatures, for buried sutures, either interrupted or continuous, in muscle, fascia or fat, and for through-and-through sutures in a wound of mucous membrane, say in the mouth. It should be threaded on a round needle (p. 125).

Kangaroo Tendon is prepared from the strong tendon of

the tail of that animal. It is only slowly absorbed, and it forms an extremely strong suture material. The small size may be used in the radical cure of hernia (p. 218), the medium in the suture of ruptured tendons, and the large for holding the fragments of a fractured bone in position (p. 376). Its chief disadvantage is that it does not stand boiling, and it must be sterilized, after being rendered fat-free, by prolonged immersion in carbolic or corrosive lotion.

Silk Thread may be obtained, like catgut, in various thicknesses, the finest, usually known as "intestinal" silk, being finer and stronger than the finest catgut obtainable. For this reason silk is much used in suturing bowel.

For its sterilization, the fat is removed by soaking it in ether for twelve hours. It is then placed for other twelve hours in alcohol, and afterwards boiled for ten minutes in 1 in 1000 corrosive sublimate lotion. It is then wound on glass spools or wire reels (Fig. 100) by the nurse, with purified hands protected by sterilized gloves, and stored in air-tight jars containing absolute alcohol or 1 in 20 carbolic. Immediately before the operation it is boiled in plain water.

With the increasing popularity of catgut, silk has largely fallen into disuse except in intestinal surgery. Its great disadvantage is that its absorption by the tissues is extremely slow. Hence it is unsuitable for use in a septic operation, as it afterwards constitutes a septic foreign body, and is apt to keep up discharge from the wound till it is removed or ulcerates out. In aseptic cases it is occasionally used to ligate large blood-vessels, or as a continuous suture to effect accurate approximation of the skin edges of the wound.

Japanese Silk and **Linen Thread** are less expensive than silk. They are freed from fat and sterilized in the same way, and used for the same purposes.

Horsehair is an excellent material for through-and-through sutures when there is little tension on the wound, or when it is desirable to prevent permanent stitch-marks, say on the face. It is not used for buried sutures. Long, strong hairs should be selected, and for additional strength two strands may be twisted.

It is difficult to remove the grease with which each hair is coated. The method usually adopted is to wash it two

or three times in lysol with plenty of soap. It is then stored in 1 in 20 carbolic. Before use it is boiled for three minutes in plain water, or sterilized with the gauze and towels in the steam sterilizer. Prolonged immersion in carbolic lotion and repeated boiling tend to render it brittle.

Silk-worm or Fishing Gut is the fibre drawn from the silk-worm killed, when it is ready to spin the cocoon. It is stronger than horsehair, and it can be sterilized by prolonged

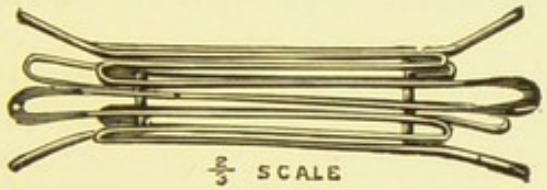


FIG. 100.—WIRE REEL FOR SILK.

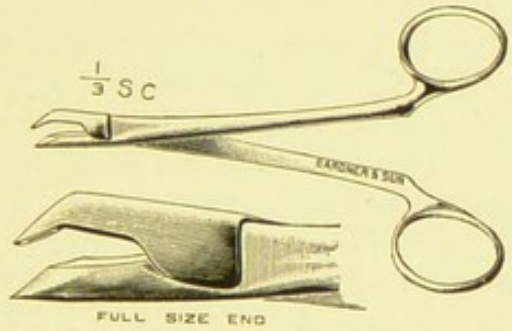
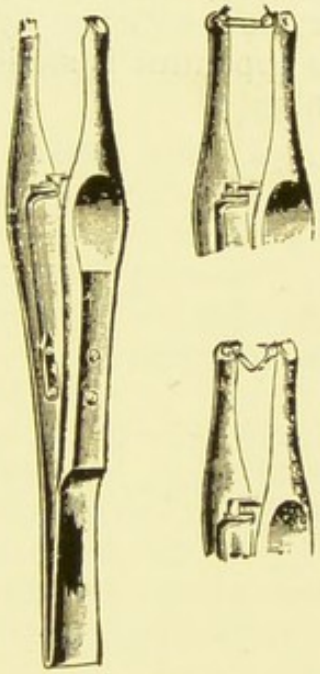


FIG. 102.—FORCEPS FOR EXTRACTING SUTURE CLIPS.



THE HOLBORN SURGICAL INSTRUMENT CO., LTD., LONDON.

FIG. 101.—FORCEPS FOR GRIPPING AND INTRODUCING SUTURE-CLIPS.

boiling. It should not, however, be repeatedly boiled, as it becomes brittle. It is not so pliable as horsehair, and therefore is less suitable for continuous suturing. Hence it is usually inserted as interrupted stitches, and its strength suits it for wounds in which tension exists. As it is not adaptable, it is not used for buried sutures. Its natural absorbability is whitish, and to make it more easily visible against the colour of the skin, it is dyed black or pink.

Wire is now rarely employed except to suture

bones. It is prepared by boiling in plain water before use. Silver filigree-wire is sometimes used in operations for the cure of hernia.

Michel's Suture-Clips are convenient for approximating the skin edges, if there is no tension on them. They are easily applied, and they leave little or no mark. The clips are supplied in sets of twenty-five fixed on a bent wire shaped like a hairpin. From it they are drawn off singly and applied to the edges of the wound by special forceps (Fig. 101). They are removed by means of the extractor (Fig. 102). The apparatus is sterilized by boiling along with the instruments.

CHAPTER XIII.

A.—SETTING THE THEATRE.

FOR operations in hospital and in a private house, it is an important part of the nurse's duties to prepare or "set" the operating room. The preparations necessarily vary widely with the available appliances and space, and no description can be written to fit every case. But with a knowledge of the essentials the nurse can do much for the surgeon's convenience and the efficiency of the operation.

The modern hospital-theatre is usually provided with an ante-room to contain the three sterilizers for gauze, instruments, and utensils (p. 29). It may also contain a chamber for warming blankets, or a steam sterilizer for sheets. The necessaries for each operation must, therefore, be transferred to the operating-room, and arranged conveniently, before the operation begins.

Heat and Light.—The theatre may be heated by steam or electric radiators. A coal fire is a source of dust, and a gas-fire or stove causes a smell. The temperature of the theatre should be 70°-75° Fahrenheit. For night operations, the best illuminant is electric light; gas and paraffin lights tend to decompose chloroform (p. 163).

Dusting and Scrubbing.—The theatre and its furniture must be kept free from dust. The corners of the room are usually rounded, so that they can be thoroughly dusted. The floor, which is usually made of close-fitting tiles, sloping to an open gutter, should be flushed with water at the end of the day's operations, and swept with mops to direct the water down the drain. For this work, the nurse should wear goloshes.

The Wash-hand Basins, three or four in number, are fixed in a stand or stands. The hot and cold taps are turned by the foot or the elbow. Above each basin is a glass-shelf,

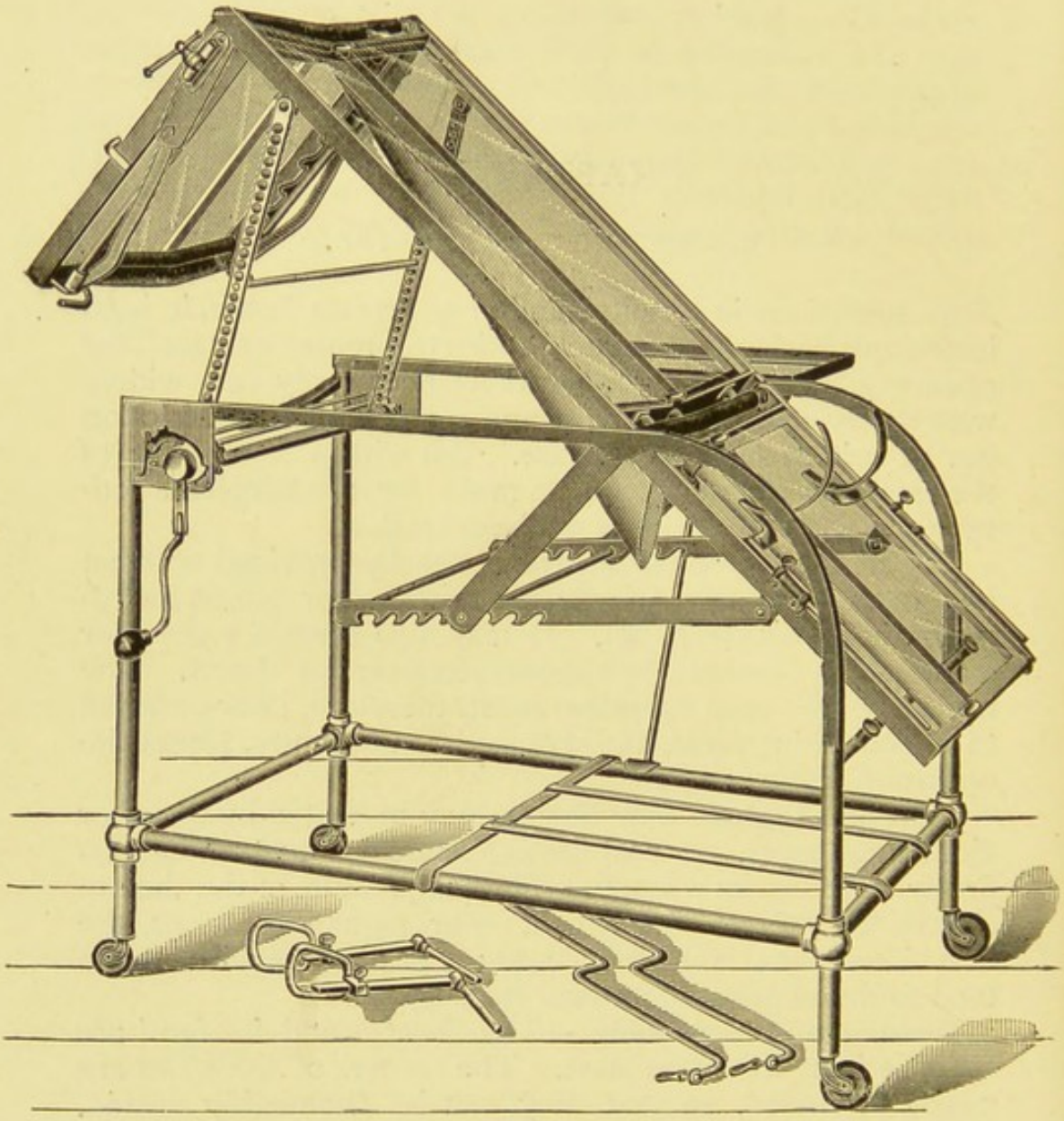


FIG. 103.—OPERATING-TABLE IN TRENDELENBURG POSITION.

supported on enamelled brackets, with bottles of lysol or other soapy antiseptic, fluid soap, and glycerine (each bottle should be distinctly labelled in enamel), glass-jar containing nail-

brushes purified in lysol or by boiling, a basin of methylated spirit and one of tinted corrosive lotion. The sterilized loofahs are obtained from the casket (p. 112). The towel-rail is made of white-enamelled metal.

The Operating-Table (Fig. 103) is constructed of metal, and the top is in three pieces adjustable to different positions. The main positions are: (1) *Level;* (2) *Trendelenburg*, in which the head- and centre-piece are tilted so that the pelvis is raised above the head, and the foot-piece is lowered, so that the legs drop and prevent the patient sliding down the slope. As an additional security, adjustable shoulder-pieces are fixed under the head-piece, and put in position before tilting. The amount of tilting may be slight, a useful position in the operation on an interval appendix, or more pronounced as in gynæcological operations; (3) *the hanging-head or Rose position*, in which the head-piece is lowered, to prevent blood flowing into the larynx in mouth and throat operations; (4) *the Hartley position*, in which the table gradually slopes down from the head to the foot, for operations in the interior of the skull. The patient is kept from sliding down by a vertical sheet of metal attached to the foot-piece of the table; (5) *the lithotomy position*, in which the legs are raised at right angles to the body, and supported on sliding leg-rests (Fig. 104) which fit into grooves at the sides of the table. In this position the foot-piece is lowered; (6) the foot-piece may be in two segments, so that one may be lowered while the other supports the leg to be operated on. In more elaborate

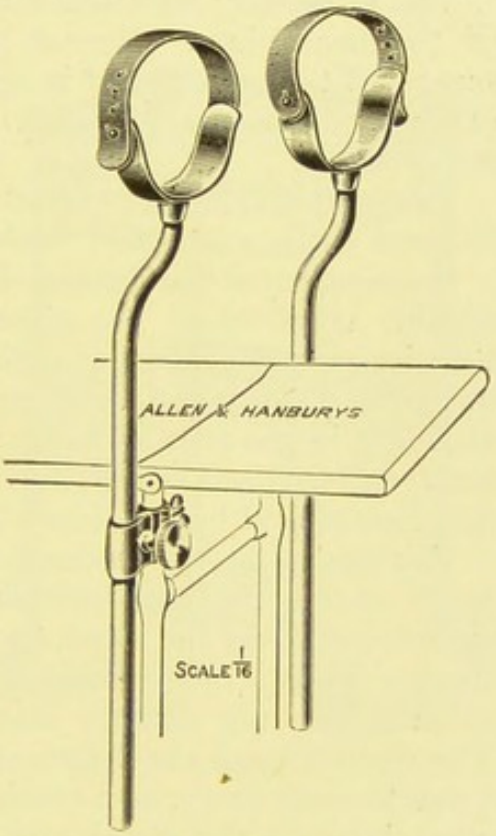


FIG. 104.—LEG-RESTS FOR LITHOTOMY POSITION.

operating-tables, other positions may be attained, as for operations on the gall-bladder and on the kidney. If the alterations of level are effected by means of screws, these should be adjusted beforehand so that any slope may be obtained with the least possible delay. The centre-piece may contain a copper tank for hot water, to keep the patient warm. It is not needed if the temperature of the theatre is over 70° F.

The table may be fitted with a wire-hoop near the centre of the head-piece. Round it is wrapped sterile gauze to screen off the anæsthetist in operations for goitre (p. 316), and other conditions in the neck. This goes by the name of a *goitre-screen.*

Under the table are placed deep enamelled *trays* or *pails* to catch fluids and soiled swabs.

Preparation of the Table.—On the operating-table blankets should, if possible, be dispensed with, as they are not aseptic. If the patient struggles, the towels and mackintoshes may be disarranged, and part of the blanket uncovered. Hence it is the custom in some hospitals to lay the patient between sterilized sheets, and keep him warm by the heat of the theatre and by sterilized wraps of gamgee tissue.

For the table, the necessaries are: Two large sheets, one small sheet, two mackintoshes and pillow. First place a mackintosh over the table, and cover it with a large sterilized sheet. Then arrange the second mackintosh and small sheet so that they are directly underneath the field of operation. The second large sheet covers the patient. The pillow is in a mackintosh cover, and outside it a clean pillow-case. For operations on the head and neck, the pillow-case may be sterilized. At the end of the operation, and before the outer dressings are applied, the small sheet and mackintosh are removed. For abdominal and perineal operations, *Kelly's pad* or *cushion* (Fig. 105) is better than the small waterproof sheet. It consists of a rubber apron, part of which is surrounded by an air-cushion which is placed directly under the region to be operated on. The tail of the apron hangs over the edge of the table, immediately above a pail.

Position of the Operating-Table.—For operations on the head, neck, breast and arm, and for the Trendelenburg

position, the head of the table is placed next the window. For perineal, rectal, and urethral operations, and for those on the lower limb, the foot of the table is turned to the light. In many operations the position of the table depends on the preference of the individual surgeon.

The Anæsthetist's Table and Stool.—The table is of enamelled metal, with a square top of plate-glass, and it may have a glass shelf half-way down (Fig. 106). The stool is also of metal, and it has a revolving top which can be raised or lowered by a screw. The table, which is set at

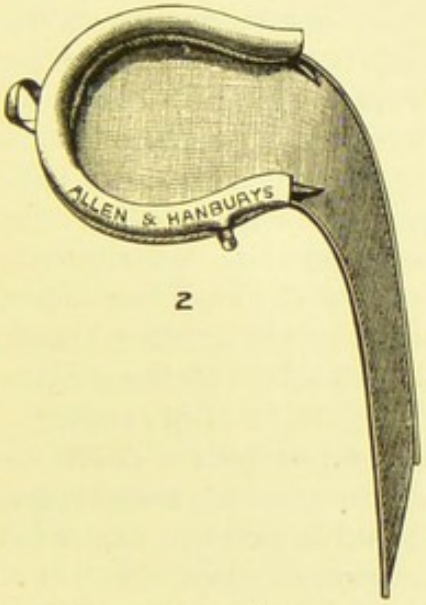


FIG. 105.—KELLY'S CUSHION.

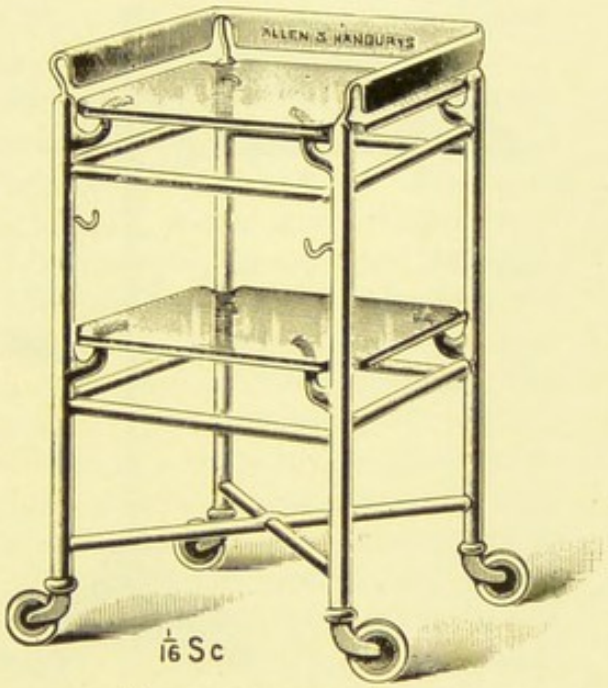


FIG. 106.—ANÆSTHETIST'S TABLE.

the right side of the head of the operating-table, should contain: Chloroform and ether, an eight-ounce bottle of each, and a mixture of chloroform and ether, if desired (all on the lower shelf); two or three graduated drop-bottles, with tapes long enough to go round the anæsthetist's neck; a Schimmelbusch mask (Fig. 109) for chloroform, or for ether administered by the open method (p. 163); several oval pads of lint to fit the mask; Junker's bottle (Fig. 110) for mouth and nose operations; ether apparatus (Fig. 111), or gas and ether apparatus (Fig. 112), as required; mouth-gag and

tongue forceps; sponge-sticks with small swabs or sponges attached; rough towel to rub the face if the patient becomes faint; small enamelled basin in case of sickness; two hypodermic syringes, charged with ether and strychnin or brandy; a small pot of vaselin for the patient's face (p. 159).

The Table for Caskets.—This is of white enamelled metal, and has two shelves, the upper one having two or more holes large enough for caskets to slip into. The under shelf supports the caskets.

Basin-Stands.—Two basin-stands must be placed within reach of the surgeon and his assistant during the operation. Each may hold one basin (for saline solution), or two (one for saline, and one for lysol or corrosive). The instrument clerk is also provided with saline to cleanse the instruments of blood, and the basin may be placed on a stand, or attached to the instrument-table (Fig. 107).

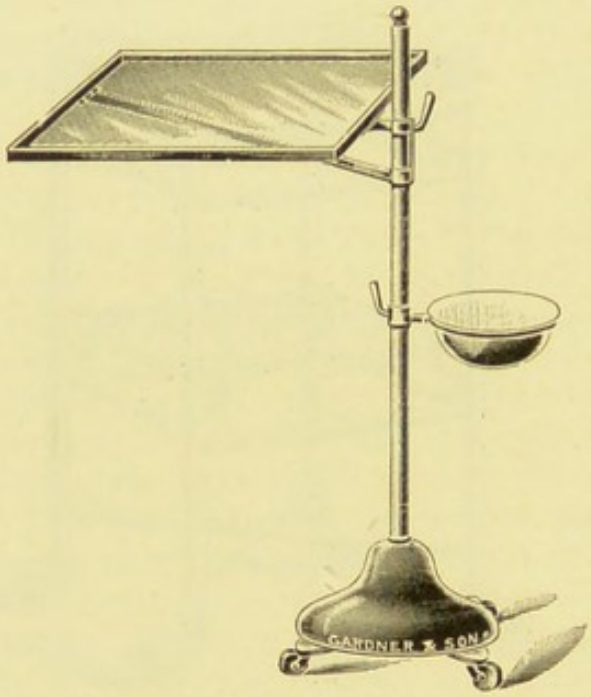


FIG. 107.—INSTRUMENT STAND.

Instrument-Table.—The most convenient table is perhaps one with a rough glass top on a metal base. Or a stand adjustable in height may be used (Fig. 107). The shelf is covered with a sterilized towel before the instruments are placed on it. A second table is usually required for the tray with knives, catgut jars, and suture materials. The instrument-table and the table for the caskets are placed on opposite sides of the operating-table.

Preparation Tray.—It is convenient to collect on a separate tray the necessaries for the cleansing of the field of operation. It should contain a razor, shaving-brush, and fluid soap if the area has not yet been shaved; a basin of lysol or other

soapy antiseptic, and one with ether or spirit. The cleansing is done with sterilized swabs. Some surgeons merely have the area painted with tincture of iodine (p. 107) after the patient is on the table.

Before the cleansing, the mackintoshes or squares of batiste are arranged above and below the field of operation, and after it the sterilized towels are put on. This preparation of the patient should be done by the nurse who afterwards attends to the lotions, or by the Sister if she does not take charge of the swabs.

Mackintosh aprons are worn under the overalls by the surgeon and his assistant. They are carbolized in the same way as the waterproof sheets (p. 115).

Lotion-Stand.—The lotions are usually stored in large glass jars with taps. The name and strength of each should be printed in enamel on the front of the bottle. The jars are kept at a convenient height on a metal stand with two or more rough glass shelves. The stand is placed near the wall, with the lotion jars on the top, and on the lower shelves the following: Glass drainage-tubes, all sizes and shapes (including Paul's tubes), boiled, arranged, and stocked in glass jars with corrosive or carbolic; rubber-tubing of various sizes, perforated and non-perforated, stored in the same way; glass nozzles and joints; glass syringe; glass funnel with rubber-tubing and catheter attached; sterilized safety-pins in glycerine of carbolic acid, pure lysol, or methylated spirit; sealed, sterilized test-tubes in a metal rack; flasks of sterilized normal saline solution; apparatus for intravenous saline infusions (p. 63).

Dressings-Table.—The dressings should be kept outside the theatre in air-tight cupboards. For operations the following should be arranged on a special table: Iodoform and plain worsted, some twisted for cigarette drains (p. 18); green protective, perforated and non-perforated; two rolls of adhesive plaster of different widths; boracic, zinc and starch, or other powder (p. 20); vaselin; bandages or binder and absorbent wool, if these have not been sterilized in a casket; safety-pins. Special dressings and bandages are required for certain cases; they are described in Section III.

Sand-Pillows, covered with mackintosh, should always be at hand, one oblong and one square.

Pelvic Rest.—This is useful in applying a roller bandage to the trunk of a heavy patient (Fig. 108). After the bandage is applied, the patient is raised, and the foot-piece removed. Then the top is slipped out at the lower edge of the bandage.

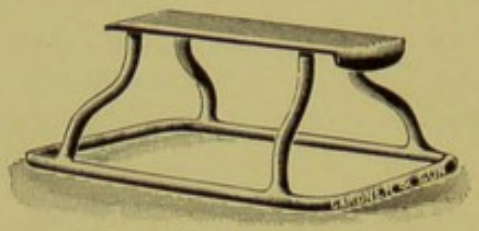


FIG. 108.—PELVIC REST.

A Stool, similar to that for the anæsthetist, is required by the surgeon for operations in the lithotomy position. With the Hartley position, in which the patient's head is raised, the surgeon may have to stand on a four-legged stool.

B.—PREPARATION OF THE OPERATING-ROOM IN A PRIVATE HOUSE.

Whatever the resources of the house, the nurse must try to bring the conditions as near those of the hospital theatre as possible.

Choice of Room.—If the house is large enough to permit of a choice of room, the nurse should select one that is airy and spacious and has plenty of light. If the patient is to lie in it during his convalescence, it should be near the bath-room for convenience of nursing.

Preparation of the Room.—All superfluous furniture—couch, ornaments, flower-pots, and so on—should be removed, and the curtains taken down. If the windows are overlooked, they may be obscured by rubbing them with soap. Some hours before operation the fire should be lit and the room dusted, but it is better to omit the latter if the dust has not time to settle. If possible, the carpet should be taken up and the floor scrubbed with lysol. If time does not permit of this, the nurse may cover the carpet with an old sheet or newspapers.

The table should be long enough for the patient to lie on, and narrow. As a rule the kitchen table with the leaves

down and the drawers removed is the most convenient—the typical dining-room table is too broad; the top is scrubbed with soft soap, and covered with a blanket over which is placed a mackintosh and a sheet. If the table is too short for the patient, a smaller table of the same height is required to increase the length.

One or two *small tables*, or *chairs* if tables are not to be had, should be placed in the room for the instruments and casket, and the anæsthetist's apparatus.

Two wash-hand basins are required for the surgeon and his assistant, and an enamelled basin for lotions. One or two large plates or ashets are convenient for holding knives and other instruments. All these must be purified by immersing them in lysol solution in a bath, or sometimes by boiling them in the washing-house boiler. For each basin, a cake of soap and a nail-brush should be provided. The sterile loofahs are at the top of the casket. *A pail* is required for the lotions after use, and if possible a second should be procured and placed under the operating-table.

The supply of *hot and cold sterilized water* must be plentiful. It may be stored in ewers, each covered with a clean towel, or, if there is only one ewer in the house, the hot water may be kept in the kettles in which it was boiled.

A chair is required for the anæsthetist, and one for the surgeon in perineal operations.

The **preparation of the patient's bed** should be done before the operation is begun, and several large books may be collected in case the foot or the head of the bed is to be raised. Hot-water bottles or bags must also be filled and placed between the sheets.

The **preparation of the patient** and the **sterilization of the instruments** are carried out exactly as in hospital.

CHAPTER XIV.

PREPARATION OF THE SURGEON AND ASSISTANTS.

THE surgeon, assistant surgeon, instrument clerk, nurse in charge of swabs, Sister, and in face and neck cases the anæsthetist, must all be surgically clean when the operation begins. As the preparation is essentially the same in all, it is sufficient to describe the purification necessary for the surgeon. He may already have donned a white linen suit.

First, he puts on a waterproof apron, previously rubbed over with 1 in 20 carbolic. If necessary, he cuts the finger-nails short—they should never be kept so long as to require the use of a nail-cleaner. Then he washes his hands and arms with soap under a stream of water from the hot tap. He now proceeds to make them surgically clean with soap and lysol or septoform lotion. For the nails, and perhaps for the palms, he uses a nail-brush, which has been soaked for some time in a jar of carbolic or lysol. The casket is now opened and a sterilized loofah picked out with sterile forceps. With this he cleanses the hands and arms. The washing is continued for about ten minutes, the antiseptic lotion being renewed at intervals. Then he removes the soap by laving the hands with sterile water or saline, and washes further with methylated spirit till he considers that his hands are sterile. Then he gets into his overall which is fastened at the back by a nurse. If he uses cotton-gloves, he now puts them on; if rubber gloves, he may put them on wet. One of the quickest ways is to fill each half-full of sterile water, and plunge the hand into it, letting the excess of water run out at the wrist. If he wears them dry, and his hands still feel moist in spite of the washing with

methylated spirit, he dries them with the towel sterilized for the purpose, powders them with sterile glove-powder, and then draws on the gloves. The bare forearm above the gloves may be bandaged with sterile gauze, or the overall may have sleeves long enough to overlap the top of the gloves, where they are tied with tapes. Lastly, the sterilized cap and mask are fixed on, and the surgeon should do nothing further till he takes up the knife to make the incision.

The assistant surgeon, instrument clerk, and nurse who has charge of the swabs go through exactly the same preparation. Meanwhile the Sister, helped by a nurse (usually a probationer), is arranging the patient on the table, and as soon as she has finished she proceeds to sterilize.

CHAPTER XV.

THE OPERATION: THE ANÆSTHETIC.

Removal of Patient from Ward to Theatre.—As a general rule it is not advisable to administer the anæsthetic in the ward before taking the patient into the theatre. In transit between the two places, any accident to the patient, such as fainting or choking on vomited matter, may happen and lead to serious results if the requisite means of treatment are unavailable. A wheeled trolley is the most suitable conveyance for transporting the patient, the wheels being fitted with india-rubber tyres. It is so balanced that the weight of the patient is never sufficient to cause it to tilt up.

If the patient is very ill or helpless, or if he has had morphin or scopolamin-morphin, he must be lifted on to the trolley. Three persons are required to lift a heavy adult, all standing *on the same side*, one supporting the head and shoulders, one the waist and pelvis, and one the legs. If the patient is unconscious, care must be taken to support the arm on the off side, to prevent it falling down and twisting under the body. The three assistants must all lift together, to keep the patient's body horizontal if he is unconscious, or prevent additional pain if he is suffering. An assistant should walk alongside the head to watch for faintness or sickness.

When a stretcher has to be used, the patient should be carried as steadily as possible, the bearers "breaking step" to lessen the uncomfortable swinging which results when they keep in step. Any rigid form of stretcher which is so constructed that the pelvis is more dependent than the head is unsuitable.

A child is most conveniently carried to the theatre in a

nurse's arms. After the operation, the method of holding the unconscious child is important. The nurse is apt to put one arm round his neck and the other behind his knees. The head hangs over the arm which supports it, and the limp body doubles up and hangs between the two arms. In this position, although the head is hanging, it is not, as it ought to be, the most dependent part of the body. The buttocks are the lowest parts, and in this position the blood collects in the pelvis and abdomen, so depleting the brain and causing fainting. Alarming accidents are sometimes brought about in this way. The child must always be carried with the head lowest. For the same reason, no patient should ever be propped up in a sitting posture immediately after an operation.

The Anæsthetic.—The anæsthetic may be administered in the theatre itself, or in an ante-room. In the former case, the patient may first be placed on the operating-table.

The anæsthetic is given to abolish pain, muscular rigidity and shock during an operation, and to prevent pain after it. The preparation of the patient for the anæsthetic has already been described (p. 103). Except in emergencies, and in certain intestinal cases, the bowels should be well opened by a purge; for slight operations, however, performed with local anæsthesia, this is not essential.

Three varieties of anæsthesia may be induced according to the nature and locality of the disease or injury, and the duration of the operation: *Local, spinal, general.*

1. **Local Anæsthesia** is induced either by application of the anæsthetic to the surface, or by injection into the tissues under the surface.

(*a*) The application to a skin or mucous surface is usually effected by spraying it with ethyl chloride. This is a clear liquid, with a low boiling-point, which produces intense cold by its evaporation. It is kept in a metal or glass capsule, ending in a fine tube which is sealed with a screw or spring cap. When the cap is unfixed, the heat of the hand volatilizes the ethyl chloride, and it appears as a fine spray. This vapour falling on the skin cools it down, and finally "freezes" it, the part becoming white from the contraction of the blood-vessels, and stiff. The capsule should be held 6 to 8 inches

from the area to be anæsthetized. It is important to remember that the grease of the skin should first be removed by washing it with sulphuric ether. While the freezing lasts, the skin is anæsthetic, and any small operation, such as the opening of a superficial abscess, may be performed. Mucous membranes may also be anæsthetized by ethyl chloride, and by this means a gum-boil may be painlessly lanced. Local anæsthesia may also be produced by spraying with pure ether, or in the case of a mucous membrane with cocain. Mucous membranes may also be rendered anæsthetic by contact with a 5 to 10 per cent. solution of cocain. It may be dropped on the part, for example the conjunctiva to remove a "fire" from the eye, or applied on a small pledget of cotton-wool to such parts as the mouth and nose, or as a bougie to the urethra.

(*b*) *Injection Method.*—In the injection method the drugs commonly used for inducing local anæsthesia are cocain, eucain and novocain, of which the last-named appears to be the least poisonous. They may be injected either into the part to be operated on (infiltration anæsthesia), or at a point in the course of the nerves before they reach the part (regional anæsthesia).

Infiltration anæsthesia is suitable for such operations as the removal of a needle from the hand or foot, the excision of a ganglion, the removal of a wart, mole, or other superficial tumour. It is also efficient for more extensive operations such as colostomy, radical cure of a hernia, or excision of a goitre.

The solution of the drug is injected into and around the part to be operated on, so as to abolish the sensation of pain in the area. The amount and strength of the injected solution vary in different cases, but in general weak solutions, such as $\frac{1}{10}$ to $\frac{1}{2}$ per cent., are to be recommended. They are made by dissolving the drug in sterile saline solution. No antiseptic should come in contact with the drug, hence the vessel in which it is prepared must be sterilized by boiling in plain water. The syringe should also be purified by boiling, and not by lying in antiseptic lotion. Cocain has the disadvantage that it is destroyed by repeated boiling. Eucain and novocain may, however, be kept in a stock vessel, say a thin glass-flask, and boiled just before use.

The action of these anæsthetics is aided by adrenalin. As this drug is destroyed by boiling, it must not be added to the stock supply, but to each dose after it has been sterilized and measured out.

Regional anæsthesia, or anæsthesia of a region, say a finger, hand or forearm, is produced by injecting one of the same drugs, with a few drops of adrenalin added to the solution, into or around the trunks of the nerves which supply the region. For instance, a finger may be rendered painless by injecting 20 minims of a ½ per cent. solution of novocain into each side of it at its base. By this method phalanges may be amputated, a whitlow opened, or a nail removed.

The injections must in every case be carried out with the precautions already described (p. 51). After the injection, ten minutes should be allowed to elapse before the operation is begun. For these forms of local anæsthesia, no special preparation of the patient is necessary, but it is of advantage that he should have no food immediately before, as the nervousness produced by the thought of operation may bring on sickness.

2. **Spinal Anæsthesia** is really a variety of local anæsthesia. It is induced by injecting a solution of tropacocain or stovain into the subarachnoid space of the spinal canal. Though generally used for operations below the level of the umbilicus, it is found by some surgeons to be efficient in producing complete analgesia for operations higher up.

The point selected for injection is the lumbar region of the spinal cord, that is, at the foot of the small of the back. This region should be sterilized the night before as carefully as the field of operation, and covered with a sterile dressing. The injection must be carried out with great precautions, as the occurrence of sepsis might prove fatal.

The preparation of the patient is practically the same as for general anæsthesia. The bowels must be well cleared the night before, to keep them from moving on the operating table. The diet, however, need not be so restricted on the previous day, though it is advisable to give little on the operation morning, not only because sickness sometimes occurs, but also because chloroform or ether may have to be administered if the anæsthesia is unsatisfactory.

The period of painlessness lasts from forty to sixty minutes. Hence extensive operations may be done by it, for example amputation through the knee or thigh, prostatectomy, or hysterectomy.

3. **General Anæsthesia** or **Inhalation Anæsthesia** may be induced by various drugs, of which the most commonly employed are chloroform, ether, nitrous oxide gas, and ethyl chloride. The two last-named give a very short period of anæsthesia and are only suitable for minor cases, such as the extraction of teeth, opening of a whitlow, tonsillectomy and excision of adenoids, reduction of dislocations or fractures.

On rare occasions, a private nurse may be required to administer the anæsthetic. Hence she must know the physiological action, the proper methods of administration, and the dangers likely to arise.

(*a*) *Chloroform.*—Its physiological action consists first in a stimulation, and later in a depression of the nervous system. It acts on the nerve-centres in a definite order, so that certain stages are to be recognized during its administration. It must not, however, be supposed that a sudden change marks the passage from one stage to the next; they merge into one another, and it is for this reason that the administration of chloroform by an unskilled individual is dangerous to the patient.

During the *first stage*, the stimulation of the nervous system is evidenced by the excitement and struggling of the patient. These phenomena occur almost at once in nervous people, and slightly later in alcoholics, but in both these classes they are specially well marked. At this time the patient often holds his breath till he becomes blue or cyanosed, and then he frequently takes several deep breaths, so that an excessive amount of chloroform may be quickly inhaled. When he holds his breath, the anæsthetic must be withdrawn till one full inspiration of pure air has been taken, and then re-applied with caution while the respirations are deep and rapid. By the neglect of this simple rule, many serious and even fatal accidents have been caused.

The *second stage* is the stage of "analgesia," or freedom from pain. The patient is placid, and his breathing is slow and shallow. He has "gone to sleep," and he may remain

in this state for a considerable time if he is not roused by pinching or slapping the skin, or vigorously rubbing the side of the chest. In labour advantage is taken of this stage by obstetricians, as the uterine contractions remain strong without causing any pain. It is often difficult to distinguish this stage from that of complete anæsthesia, as the pupils may be partly contracted, and the conjunctival reflex lost. If, however, the surgeon begins his incision, the patient is roused, moves his legs and arms, and breathes more deeply. As a result he inhales more chloroform and "goes under" more quickly.

The *third stage* is the stage of muscular rigidity. The patient is unconscious, but not deeply enough to remain quiet when sensitive parts are touched. The rigidity of the muscles is shown by the clenching of the hands, the tight shutting of the mouth, the grinding of the teeth and, even when these disappear, by the firmness of the abdominal wall. The pupil contracts still farther, and the heart-beats and respirations may be irregular.

The *fourth stage* is the stage of muscular relaxation. It is known as *complete anæsthesia*, which is the condition required for operation. The muscles of the limbs and abdominal wall are relaxed; so also are those of the soft palate, so that the respirations are snoring. The laryngeal reflex is not necessarily lost, that is, the glottis closes reflexly if any material touches it and threatens to suffocate the patient. In typical cases the pupil is contracted to the size of a pin-head, and it does not vary in size when the light falls on it. The conjunctival reflex, that is, the spasmodic closure of the eyelids when the conjunctiva is touched, is lost. The heart is regular, and the pulse-tension is normal or only slightly lowered. This stage may be prolonged indefinitely, but constant care is needed to prevent the next stage being reached. The undivided attention of the anæsthetist must be given to the patient, and he must not on any account try to watch the operation at the same time, or assist with anything else.

The *fifth stage* is the stage of deep coma. The pupils dilate widely, and the respirations are full and stertorous. Though the pulse-rate may remain unaltered, its tension is markedly diminished. Vessels divided in the course of the operation do not bleed freely, and the blood which does flow

is dark in colour. The face may be livid or white, and the lips are pale. The laryngeal reflex is lost, and the anal sphincter may relax. This stage is very quickly followed by the next, unless the chloroform is removed.

In the *sixth stage*, the heart becomes paralysed. The pulse cannot be felt at the wrist, the face is shrunken and deathly pale. The respirations are shallow and fluttering, and then they stop. The heart gives one or two irregular contractions, and then death occurs.

In many cases the whole duration of the fifth and sixth stages may be measured by seconds. Hence it is obvious that the anæsthetist must attend most faithfully to his duties, and must, in addition, possess sufficient knowledge of the

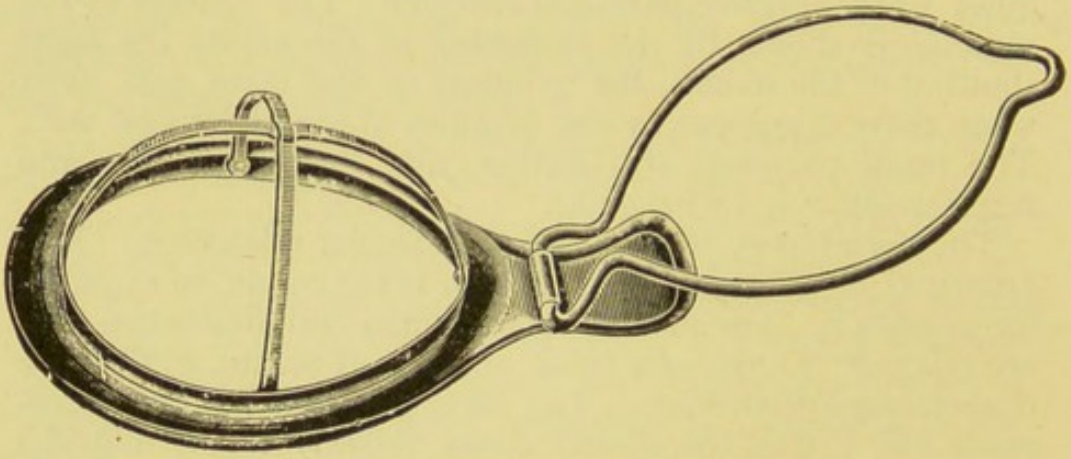


FIG. 109.—SCHIMMELBUSCH FRAME.

signs to recognize the exact stage of the anæsthesia at any given moment.

The Mode of Administration.—Chloroform is usually administered by the "open" method. A Schimmelbusch frame (Fig. 109) is covered with a layer of plain lint, and held over the face in such a manner that only a small part of it rests on the skin about the bridge of the nose. If it is pressed down all round its circumference, the patient does not inhale sufficient air along with the chloroform, and in addition is liable to be "burnt" by the contact of the wet mask with his skin. If the frame is not available, a towel folded into a cone is an efficient substitute. The chloroform is dropped on the lint from a graduated dropping-bottle. It need

scarcely be repeated that the patient must have nothing loose in his mouth. Artificial teeth should have previously been removed, and even a very loose tooth should be extracted. Everything about the neck and waist should be loose to facilitate respiration. To prevent irritation of the skin, vaselin may be smeared on the parts around the mouth. This should not, however, be necessary if the anæsthetist takes care to prevent any of the liquid touching the face.

A few drops of chloroform are poured on the lint, and the patient is told to take deep breaths. To distract his attention, it is a good plan to ask him to repeat the figures one, two, three, etc., after the anæsthetist. With a young child, the best way is to tell him to blow it away, as this makes him expire fully, and a deep inspiration of the chloroform vapour follows. For the same reason, crying may be encouraged.

When the struggling begins, the patient must be held to prevent him falling off the table. His movements should be guided and to a certain extent restrained, rather than resisted altogether. Patients who have been addicted to alcohol exhibit an exaggerated and prolonged struggling stage, which usually is immediately followed by the stage of complete anæsthesia. Hence care must be taken to administer less chloroform as soon as the struggles cease.

No one sign that the patient is "fully under" is infallible, and he must be tested in several ways:—

Muscular relaxation is tested by raising a limb, and seeing whether or not it falls limp on being left unsupported. For the anæsthetist himself, it is more convenient to find whether the lower jaw comes forward without resistance when pulled by a finger behind the ascending ramus. In abdominal cases, the finger-tips pressed into the belly-wall enables the surgeon to distinguish when the muscles become relaxed.

The *loss of reflexes* is most conveniently tested by touching the conjunctiva of the eyeball. No spasmodic closure of the lids takes place when the patient is under, but, as already stated, this reflex may be lost earlier. We have found it more reliable suddenly to pull up the upper eyelid. If the patient is not completely under, this movement is resisted,

and at the same time the under eyelid quivers. This test is less harmful to the patient than the frequent touching of the conjunctiva, which may in consequence become inflamed.

The *pupil* is, as already stated, contracted to the size of a pin-head in complete anæsthesia. But this is not a constant sign. If the pupil begins to dilate, it requires much experience to tell whether the patient is "coming out," or is too deeply under, and is passing into the danger-zone.

The *respirations* are regular when the patient is under. Again it may be difficult to tell, if respiration stops, whether the patient is coming out, or is too deeply under.

Immediately the stage of complete anæsthesia is reached the surgeon should be ready to make his incision. Hence the preparations which are necessary before this can be done must be completed while the anæsthesia is being induced.

During the whole period when the patient is under, the head should be turned to one side, and the jaw held well forwards by a finger behind the ascending ramus. By this simple device, the root of the tongue is also pulled forward, and the entrance to the windpipe is kept open. At the same time it is well to remember that this manipulation closes the mouth so that air can gain entrance only by the nostrils. In many patients, the nasal passages are not wide enough to let in sufficient air, and as a consequence the patient has a bad colour during the whole of the operation. This can be obviated by a finger keeping open the lips, and, if necessary, the jaws as well. A mouth-gag is not required.

For operations on the nose, the mask is in the surgeon's way, and another mode of administration may be necessary. A convenient method is to have the chloroform in a graduated *Junker's bottle* (Fig. 110), from which two tubes go, one to the mouth, and one to a rubber bulb. By this means, chloroform vapour mixed with air can be pumped into the mouth. The apparatus must always be tested before use to ensure that liquid chloroform is not pumped in, as a poisonous dose might be administered by one compression of the bulb. For operations on the mouth and throat, the same apparatus is convenient, the tube being inserted into one nostril, or through a special channel in the gag into the mouth. In extensive operations on the mouth, throat or upper jaw, the anæsthetic

may be administered through a tracheotomy tube. It is advisable to open the trachea two or three days before the main operation, that the patient may become accustomed to breathing through the tube.

Chloroform Dangers, and their Treatment.—Difficulty in respiration may be due to the paralysed tongue falling back and closing the entrance to the windpipe. This ought not

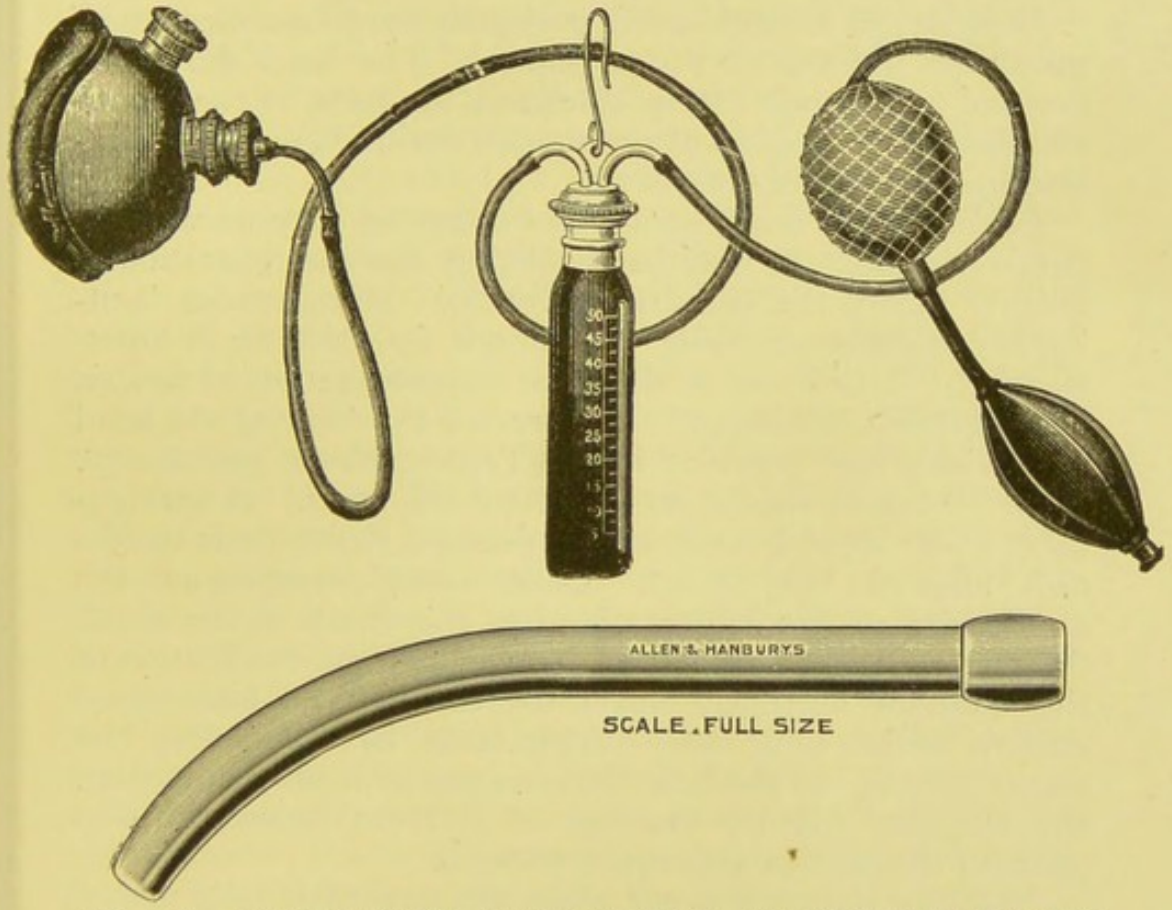


FIG. 110.—JUNKER'S BOTTLE, WITH FACE-PIECE. THE CURVED TUBE IS FOR INSERTION THROUGH A SPECIAL CHANNEL IN THE GAG DURING OPERATIONS ON THE MOUTH.

to occur if the head is kept to one side, and the jaw held well forwards. If it does occur, the same manipulation is usually sufficient to correct it. But if respiration does not start at once, the mouth must be opened by a gag, the tongue seized with forceps, and rhythmically pulled on till breathing is resumed. This is seldom, if ever, necessary if

the anæsthetist notices the difficulty in respiration *at once*, and tongue forceps should always be avoided if possible, as the wound in the tongue is apt to cause pain for several days. If even the rhythmical dragging on the tongue is inefficient, artificial respiration must be performed, the first movement being invariably the compression of the chest to dislodge the chloroform-laden air from the lungs, and stimulate the heart by the pressure.

Difficulty in respiration may also be due to a collection of mucus at the top of the windpipe. The head should be lowered and turned to the side, and the back of the mouth swabbed out. In cases of pressure on the trachea, the respiration may be gravely impeded.

Failure of the heart sometimes occurs in very nervous or feeble patients. It may be avoided by the administration of brandy before the operation (p. 108). More serious fainting is caused by propping the patient up while he is anæsthetized. This is one of the most common causes of sudden death under chloroform. It is treated by lowering the head and raising the pelvis as in the Trendelenburg position (p. 143). A child should be raised by the heels. A syringeful of ether should be at once injected; strychnin is useless as it takes too long to act. Other useful measures are the application of hot fomentations to the front of the chest, flipping with wet towels, and, if available, the application of the constant current. Never use the induced interrupted current which only does further harm by stimulating the vagus nerves. If the heart has stopped or is only fluttering, the surgeon may try massage of it from below the diaphragm through an abdominal incision.

Vomiting does not occur when the patient is fully under. When it threatens, it is a sign that he is coming out, and it is usually avoided by quickly administering a more concentrated chloroform vapour. The careful anæsthetist can in most cases anticipate it by noting the signs of faintness, especially pallor of the lips, which precede it. At this stage, a vigorous rubbing of the face with a rough towel is an excellent stimulus to the circulation, and a preventive of sickness. If vomiting does occur, and this is usually at the end of the operation, when the patient is beginning to come out,

it is only dangerous if foreign matter gets into the windpipe. For this reason the patient should have no solid food in his stomach, as was previously mentioned when the preparation for the anæsthetic was described. During vomiting the jaw must *not* be held forwards, as thereby the risk of particles entering the larynx is increased.

Decomposition of Chloroform.—When the illuminant in the operating-room is a paraffin-lamp or an open gas-flame, chloroform readily decomposes into phosgene and then into hydrochloric acid. The fumes become extremely irritating, and cause persistent coughing and sneezing.

(*b*) *Ether.*—The physiological action of ether resembles that of chloroform in its effect on the brain centres. The same stages are passed through in the induction of anæsthesia, but they differ in some of the details. The first stage of excitement and struggling is usually much more marked with ether than with chloroform The second stage of analgesia cannot be indefinitely prolonged with ether as with chloroform, hence the former is not so well suited for the prevention of pain during labour. But the chief difference between the two pertains to the effect on the heart. Chloroform tends to weaken the heart if given in too great concentration, or over a prolonged period, while ether has practically no such effect. For this reason, ether is generally held to be a safer anæsthetic than chloroform. On the other hand, it produces more irritation of the air-passages, and serious consequences may follow its administration in patients who already suffer from respiratory troubles. When bronchitis, empyema, or asthma is present, chloroform is the anæsthetic of choice. In operations on the brain, venous oozing is worse with ether, hence chloroform is preferred by the majority of surgeons.

The signs of complete anæsthesia with ether are the same as with chloroform, but the respirations are deeper, and the pupil is not so contracted. Indeed it is often necessary to proceed till the pupil is dilated, before muscular relaxation is attained.

Methods of Administration.—Ether may be administered by the "open" method or by the "close" method.

In the *open method*, a Schimmelbusch mask is used as for chloroform. It is, however, better to cover it with eight or

ten layers of gauze than with lint. As ether evaporates more quickly than chloroform, and more is required for the induction of anæsthesia, the entrance of air between the mask and the mouth is diminished instead of being encouraged. A ring of gauze is placed around the mouth and nose, and on this the mask rests. Ether is dropped on to the gauze at the rate of 30 to 90 drops a minute to maintain anæsthesia. Hence this method is often spoken of as the "drop method". It is excellent for the induction of complete anæsthesia in children, but it is slow in adults, and it even frequently fails in strong or alcoholic patients. For this reason chloroform is used by many anæsthetists to procure complete anæsthesia, and then "open ether" to maintain it. We believe this to be a safer method than the use of a mixture of the two substances. Such mixtures are the C. E., and the A. C. E. The former consists of one part of chloroform and two parts of ether, the latter of one part of absolute alcohol, two of chloroform and three of ether. They should be mixed just before use, as the difference in the rate of evaporation quickly alters the percentage composition of the mixture. With both the type of anæsthesia is that of chloroform, but the respirations are fuller.

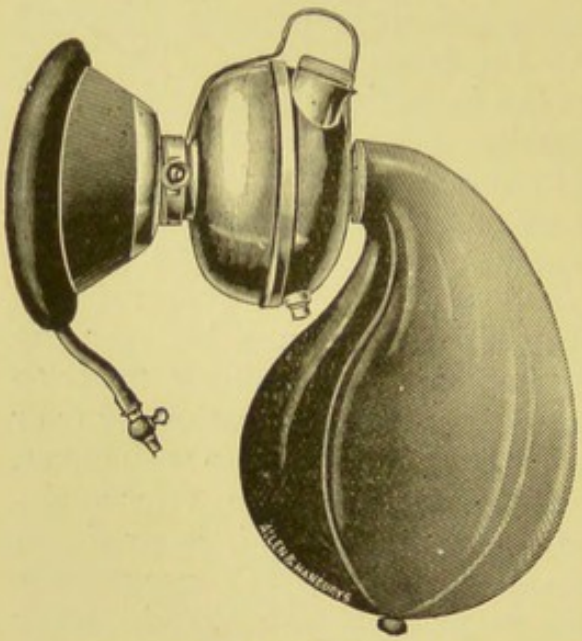


FIG. 111.—ETHER APPARATUS.

The "Close" Method.—For this method a special inhaler (Fig. 111) is required. This consists of (1) a face-piece with a pneumatic pad; (2) an ether chamber, in which is placed about an ounce and a half of ether, and (3) a rubber bag of about one gallon capacity, to catch the expired air. This the patient breathes repeatedly, and the apparatus can

be so arranged as to give any desired concentration of ether vapour with it.

In practice, the administration of ether is usually preceded by two gallons of nitrous oxide gas (Fig. 112) or a small dose of ethyl chloride. The induction period is thus shortened, and the excitement stage is practically lost.

Ether vapour is highly inflammable and must not be used near an open flame, or a cautery, or even an electric glow lamp.

(*c*) *Nitrous Oxide* or *Laughing Gas* is a safe anæsthetic, and may be administered to the patient in the sitting posture. The gas is stored in metal cylinders, and by the opening of a valve the desired amount can be allowed to escape into a rubber bag, from which it is inhaled by the patient. The most noticeable feature of anæsthesia is the cyanosis, which is due to the exclusion of air during the administration. Other signs are stertorous breathing and muscular relaxation. The induction period is measured by seconds, and the anæsthesia lasts for half a minute. Nitrous oxide gas is much used in dental surgery. The patient should have

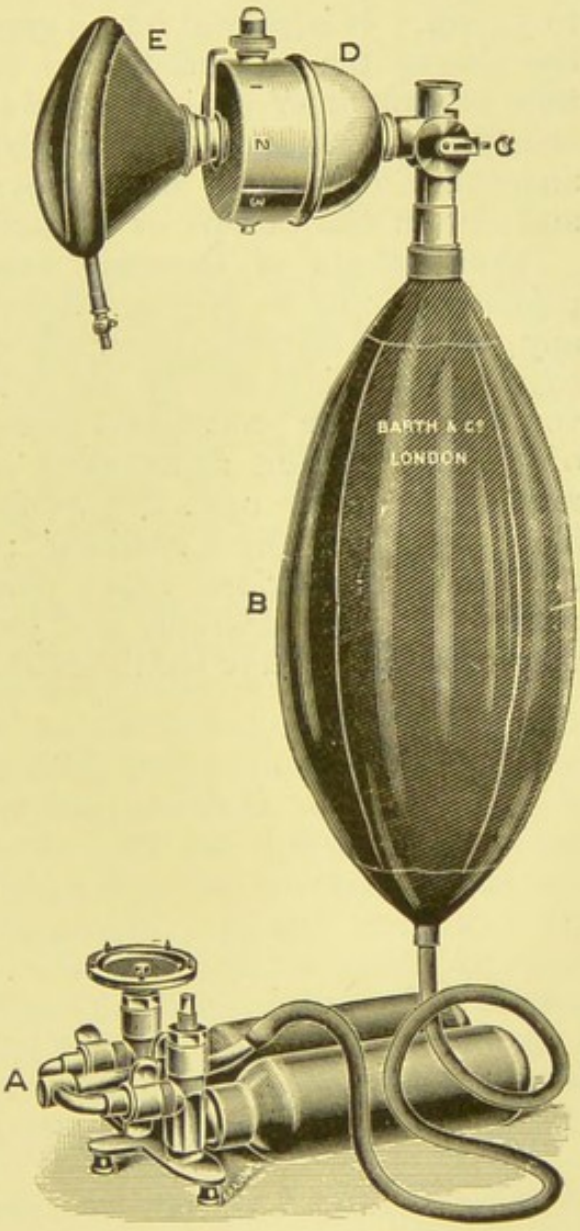


FIG. 112.—GAS AND ETHER APPARATUS.

had no food for at least two hours before, and then only a light meal.

(*d*) *Ethyl Chloride*, which is also used as a local anæsthetic (p. 153), is not so safe as gas. The dose for inhalation is 3 to 5 c.cm. It is poured into a graduated glass-tube fixed on the side of the face-mask, and evaporated by dipping the tube at short intervals into hot water. The duration of the anæsthesia is slightly longer than with gas. It is a convenient anæsthetic for opening an abscess, reducing a Colles's fracture and certain dislocations, or extracting a tooth.

After-Effects of General Anæsthetics.—Symptoms of poisoning occur in varying degrees in many patients after any general anæsthetic, especially chloroform and ether. In slight cases, it is shown by one or two attacks of retching and vomiting. More pronounced cases show persistent vomiting of greenish matter, restlessness, and increase in the pulse-rate. In a graver case, the vomited matter is mixed with blood—"coffee-ground vomiting"; the pulse races and often the temperature rises, rapid emaciation ensues, and the patient becomes delirious and jaundiced. This condition may be fatal. Nerve paralyses are referred to on p. 202.

CHAPTER XVI.

THE OPERATION: THE NURSES' DUTIES.

In hospital, four nurses are usually employed at an operation —the Sister, the theatre-nurse and the nurse who "*does* swabs," both of whom are senior nurses, and a junior nurse. The apportionment of the work amongst them varies in different wards. In a teaching hospital, the instruments are very commonly in charge of a student, the "instrument clerk," while in the smaller hospitals the Sister usually looks after the instruments and ligatures. In the following description we assume that there is an instrument clerk.

If the anæsthetic is being administered in an ante-room while the patient is still on the trolley, he may be wheeled in before he is completely under and lifted on to the operating table. The Sister sees that his clothing and the bed-clothes are properly arranged for the particular operation. The nurse in charge of the swabs and the theatre-nurse should finish their preparations some time before the surgeon and his assistant, and don their gloves, caps and overalls. The instrument clerk has already sterilized his hands, arranged his instruments, and perhaps prepared some of the sutures. During these preparations, there should be as little stir as possible, and each nurse must avoid brushing against the sterilized coats of others, and coming against anything with her own.

Then the Sister removes the sterilized dressing from the operation area. It is most convenient to cut each turn of the bandage, to avoid movement of the patient at its removal. She then puts on the mackintoshes, one to cover the bed-clothes above, and one below the field of operation. She also puts in position any sand-pillow which is required; it

should be rolled in a purified mackintosh. After this she proceeds to sterilize.

The theatre-nurse then cleanses the part, the lotions being brought to her on a tray (p. 146) by the junior nurse. Sterilized swabs are used for the cleansing. Then one swab is opened out, and laid over the purified area. Next she puts on the sterilized towels in such a way that they cover the mackintoshes and bed-clothes completely. If an abdominal towel is used, the central hole must be over the site of the future incision.

If the patient is to go in the Trendelenburg position (p. 143), the table is tilted by the anæsthetist and the junior nurse.

As soon as the patient is under, the knife is handed to the surgeon and he makes the incision. The nurse who hands swabs should pick them out with sterilized forceps, and not with her hands although they are gloved. With tongs the junior nurse picks up the swabs as they are discarded by the surgeons, and counts them (p. 111). She also removes any instrument that falls accidentally, and, if requested, puts it into the instrument sterilizer. The theatre-nurse gets lotions as they are required. As already stated, saline solution is almost universally used by the surgeon to cleanse his hands of blood or pus during the operation. Sterilized water may also be used. The lotion is kept in a steamer at a temperature of about 120° F., and poured into basins which are placed in stands at the side of the surgeon and his assistant.

The Sister superintends the work of the other nurses, and sees that everything is going smoothly. In abdominal cases she ought to heat the normal saline solution to blood-heat, in case it is wanted for introduction into the peritoneal cavity. It is kept in sealed flasks and has been previously sterilized. The stopper should be loosened but not extracted before heating.

In certain cases a nurse may be required to hold a limb or an instrument in a certain position. Her hands ought to grasp it *under* and not over the sterilized towel.

At the end of the operation, the surgeon may leave the application of the dressing to the Sister and his assistant.

If strapping is to be applied to keep the dressing in position, the gloves should first be taken off.

When the patient has been put back to bed, the theatre-nurse cleans up the theatre. She collects the instruments, washes all the blood off them with lysol, boils and dries them, and puts them back in their usual position in the instrument cupboard. If the operation has been a clean one, the gauze may be washed free of blood, and used again for ward dressings after sterilization. The floor must be cleaned soon, and other preparations made, in case an emergency operation has to be performed.

CHAPTER XVII.

GENERAL PRINCIPLES OF NURSING AFTER OPERATION.

AT the conclusion of the operation, the patient is carried or wheeled back to the ward. As he is still under the influence of the anæsthetic, careful watch must be kept for fainting or sickness. In addition, he must be well wrapped up in blankets to prevent a chill.

Meanwhile his bed has been prepared and warmed by means of several hot bottles. He is gently lifted on to it (p. 152), and the hot bottles are replaced at once, one at his feet, and one at least on each side. A layer of blanket must always intervene between each bottle and the patient, as otherwise he may be severely burned without feeling any pain while he is still unconscious or semi-conscious. As an additional security, every bottle should have a flannel cover. If necessary, a cage is put over the wounded part, to remove the weight of the bed-clothes. It may go either over or under the top sheet. At first the head should be kept low, and if the patient can breathe freely without a pillow, it is advisable for him to do without one except after special operations. A pillow may, however, be needed elsewhere—under the knees in an abdominal case to lessen the strain on the wound, to support the arm in a breast case, or under the leg after an operation on the foot. Wooden blocks should be in readiness to raise the foot of the bed if faintness occurs, or the head of the bed in cases of actual or threatened peritonitis. A nurse must stay constantly at the bed-side till the patient becomes conscious again. Often he wakes up partially soon after he is put back to bed, and he may then become restless and shift about. The nurse's duty is to soothe him,

and try to keep him from kicking and tossing. As a rule he soon drops off to sleep, and he should be allowed to do so undisturbed. The nurse must, however, pay attention to the patient's countenance. Pallor, especially round the lips, is usually a sign of sickness, and it does good to rub the face with a rough towel. Pallor of the whole face, and coldness of the extremities in spite of the hot bottles, indicate a greater degree of shock than usual, and special treatment may be called for (p. 179).

The Pulse.—The pulse is of extreme importance after operation, and the nurse must count it at intervals, and note any irregularity of rhythm or strength. During the early stages after a severe operation, it should be taken every half-hour, and at any time when the nurse thinks a change has come over the patient. Any sudden alteration in rate or rhythm must be at once reported to the Sister or surgeon. The nurse should write down on paper the pulse-rate each time she takes it. At the appropriate times, she notes it on the chart, marking the first record "after operation". In a serious case it should be charted every two hours for eight to twelve hours after operation. On the next day or two days it may be charted four-hourly. Afterwards, except in special cases, it is sufficient to take it at a certain hour morning and night, as is done each day with every hospital patient.

The normal pulse is from 70 to 80 in adults, and 80 to 100 in children. Soon after operation it may be abnormally slow owing to shock. The usual practice is to feel it in the radial artery at the wrist, and the nurse should always take it on the same wrist, as the arteries frequently differ in size on the two sides.

The Temperature.—The temperature has also to be taken and charted at the same time as the pulse. The mercury is shaken down, and the thermometer placed in position and left for half a minute to five minutes according to the delicacy of the instrument. The temperature may be taken in the mouth or in the axilla. For purposes of comparison it should always be taken in the same place for a given patient, as the temperature is normally higher in the mouth than in the axilla. In the mouth, the end of the thermo-

meter is placed under the tongue, and the patient is told to close the lips and not the teeth on it. It should never be placed in the mouth of any patient who is partly under the influence of an anæsthetic, as the glass may be broken by a sudden clenching of the jaws. The axilla must be dried before the thermometer is put in, and care must be taken that the point is in contact with the skin fold and not with the clothing. The arm is then folded across the chest and kept still. In the case of a child or a restless patient, the nurse has to hold the arm all the time. It is often more convenient to put the thermometer in the groin in young children, and bend up the thigh to hold it in position. Owing to the variations in the temperature of the skin, and even of the mouth, from accidental causes, some surgeons insist on the rectal temperature being taken in every case.

The temperature should always be charted at once, as the exact figure is apt to be forgotten. The normal temperature of the body is 98·4° Fahrenheit, or 36·8° Centigrade, and in disease it may be either lower, when the temperature is "subnormal," or higher when it is said to be "above normal," or "raised". Immediately after operation, a low temperature is an important indication of shock, and the nurse must be careful to record it properly, as a mistake may easily be made. She is apt to think it sufficient if she shakes the mercury down to 97° F. If the temperature is below that figure, the mercury does not fall lower during the time it is in position, and a false record is given. In every case the mercury should be shaken down to 95° F.

The glass must never be left in for too short a time, as the reading then indicates too low a temperature. In cases in which the temperature is raised, the most accurate method of recording it is as follows: Leave the thermometer in for the time which is supposed to be necessary for that special instrument. Note the figure at which the mercury stands. Then re-insert it for half a minute, and again look at it. If the second reading is exactly the same as the first, it is the correct record. If the second is higher, then insert the instrument for another half minute, and so on till two successive readings are the same. The nurse frequently finds that the reading is very low, though the patient is not suffering

from shock. The explanation is that the thermometer has not been properly placed in contact with the warm skin, and the mercury has not risen. It must be re-inserted and left for the full period.

The Respirations.—In many cases it is necessary to record the number of respirations a patient takes in a minute. This is done by placing the hand on the chest, and counting the number of times it rises during the interval. The patient should not know what is being done, as the breathing is so much under the control of the will that he may, consciously or unconsciously, vary the frequency. It is a good plan to hold the patient's wrist, as if counting the pulse, and lay his arm across the chest. The normal rate is from twelve to twenty respirations per minute.

Diet after Operation and Treatment of Thirst.—Here we enter on a vexed question. Different opinions are expressed by different surgeons, and we can only record our personal opinions. It is a safe rule not to give a patient anything by the mouth for six to eight hours after operation. Thirst is in almost every case the chief complaint, but if a draught of water is given soon, it is practically certain to be retained in the stomach for a longer or shorter period, and then vomited. The dryness of the mouth may be alleviated by swabbing it with a mixture of glycerine and lemon water. Ice is only of temporary benefit, and invariably leads to an increase in the dryness of the mouth and tongue, and to flatulence. The mouth may be rinsed at intervals with hot water, but it must be impressed on the patient that he is not to swallow any of it. Undoubtedly the only satisfactory method of treating thirst is by the introduction of fluid into some part of the body whence it can be absorbed into the circulation. In abdominal cases this may be accomplished by pouring a pint of normal saline solution into the peritoneal cavity just before the wound is completely stitched up. In other cases it is best administered by the rectum, five to ten ounces being given every two or four hours (p. 60).

If there is no sickness six or eight hours after operation, the nurse may give sips of warm water at intervals, starting with a tablespoonful and gradually increasing the amount. Cold water is more comforting at the moment, but it has a

less permanent effect in alleviating the thirst. Four hours later, in the absence of sickness, small quantities of albumin water (p. 226), milk alone or mixed with soda-water, chicken-tea, or beef-juice may be given. Next morning he may have for breakfast a cup of tea and a finger of dry toast. Milk, switched egg, milk-pudding, and chicken-tea or beef-tea should form the rest of the diet until the bowels have been well opened, when fish and chicken are added. In certain cases, a special diet is prescribed.

The Urine.—As the result of the previously restricted diet and the anæsthetic, a diminished quantity of urine is secreted after operation. For the first twenty-four hours twenty ounces is quite a common amount instead of the usual sixty ounces. Hence the bladder does not, as a rule, require to be emptied for twelve hours after operation. At the same time it is the nurse's duty to see that urine is passed in the second period of twelve hours, especially as the inclination to make water is often absent after operation. If the patient fails to pass it at the first trial, repeated attempts must be made. The nurse is often led to suspect distension of the bladder by the patient's general restlessness, and an increase in the pulse-rate, even though he complains of no discomfort, and she must report to the Sister. The passage of a catheter may be necessary as a last resource, especially after operations on the pelvic organs. The urine must be measured and kept for examination. The quantity passed in the first period of twenty-four hours, and longer in special cases, should be charted.

The Bowels.—The passage of flatus after operation should be noted, especially in abdominal and pelvic cases.

In general the bowels do not move spontaneously after operation, and a purgative has to be given. It is usually administered after forty to forty-eight hours, and the best time is, in most cases, the early morning, so that it acts at the end of the night's rest. In special cases the surgeon orders the purgative; otherwise the Sister gives it on her own initiative (p. 56). If the medicine does not act in eight hours, an enema consisting of a pint and a half of soap and water, to which a tablespoonful of turpentine may be added, is usually sufficient to procure a good evacuation.

The motion should always be inspected by the nurse, to make sure that it has been satisfactory. If it is abnormal in any way, say from the presence of blood, pus, or mucus, it should be kept till seen by the surgeon, and the fact reported to the Sister. The motions of the bowels should be regularly charted.

CHAPTER XVIII.

COMPLICATIONS AFTER OPERATION, AND THEIR TREATMENT.

THE convalescence of a patient after operation is normally uneventful. Frequently, however, this ideal progress is interrupted by the onset of complications. They may come on at any stage, and the nurse must ever be on the watch for them.

Syncope or Fainting is due to sudden anæmia of the brain as the result of weakening of the heart's action. It may occur during the administration of the anæsthetic, especially if the patient is not completely under and tends to be sick (p. 162). If he actually vomits, the faintness is usually relieved. It frequently occurs in patients who have been subjected to pain, say in the reduction of a dislocation or the incision of a whitlow. Even in the absence of pain, the mere knowledge that an operation is being done may cause fainting. Thus it is a common occurrence when local anæsthesia is used. For this reason, it is advisable in these cases to make the patient lie down, rather than sit on a chair, as the brain is more easily supplied with blood when the patient is horizontal. The dressing of a trivial wound, or the sight of another patient being dressed, is sufficient to cause fainting. It may occur in any type of patient, even in the strong man who has little the matter with him, hence the nurse must keep a watchful eye on every one, and be ready if signs of faintness appear. The patient becomes pale and giddy, and feels sick. His vision is hazy, and beads of perspiration appear on his forehead—a "cold sweat". His pulse is small and almost imperceptible, and he gradually loses consciousness, and may collapse on the floor.

In a few seconds, the fainting attack begins to pass off. He sighs or gasps, his pulse becomes stronger, and he gradually recovers his senses.

The first step in the treatment is to lower the head. If the patient is sitting on a chair, his head is forced quickly down between his knees; if lying, his head must be lowered over the end or edge of the table. A child may be held up by the heels. Tight clothing round the neck, chest, or waist must be loosened. Carried out early, these measures are usually sufficient to ward off the faint. Give him a draught of cold water, adding a teaspoonful of sal volatile (aromatic spirit of ammonia), if it is at hand, and tell him to keep quiet for a minute or two. If the patient has actually fainted, dash cold water over his face, and rub it vigorously with a towel. Apply smelling salts to the nostrils, and when he has begun to recover, give him sal volatile, whisky or brandy. In a severe case, say after the loss of a large quantity of blood, the nurse is justified in giving ether hypodermically, taking care not to inject it immediately under the skin (p. 52).

Surgical Shock is a more lasting and, in its severe degrees, a graver complication. It is characterized by a lowering of all the vital functions, and the patient lies in a state of prostration, but does not actually lose consciousness till death is near. While syncope results from a temporary weakening of the heart, shock is due to a change in the tone of the blood-vessels. Normally it is so regulated by a nerve centre in the brain—the vasomotor centre—that the circulation is maintained, and every part of the body is nourished by the blood flowing through it. But if the centre is disturbed, the circulation is also interfered with, and the blood stagnates, a great part of it collecting in the abdominal veins. The chief causes of disturbance are: severe injury to any part of the body, especially the brain, spinal cord, testis, face, abdomen, or hand; an extensive burn; great loss of blood; exposure to pain; intense mental emotion, for example the fright of a railway collision, especially in nervous people. Lastly, a serious degree of shock may follow on any extensive operation.

The patient lies flat on his back, and takes no interest in his surroundings, unless he is purposely roused. His face is

pale and drawn, his eyes sunken, and his lips pallid. His body is cold and clammy. The pulse is 120 to 140 or more, and often almost imperceptible, the respirations are shallow and irregular, and the temperature is subnormal, falling in a severe case to 96° F. or lower; while the shock lasts, the patient is almost insensible to pain even after a severe injury or a superficial burn, but pain comes on when he begins to recover.

In an ordinary case, shock tends to last a few hours. Then the "reaction" begins, and the patient takes notice of his surroundings. The pulse becomes full and bounding, the respirations deeper and more regular, and the temperature may rise above normal.

It is important to recognize the presence of shock after an accident, as it influences the treatment. For example, if the patient has sustained multiple fractures nothing should be done till the shock passes off, and this may not be for a day or two. The only operations which are permissible during shock are for such urgent conditions as the stoppage of hæmorrhage, and the prevention of septic infection of the peritoneal or other serous cavity.

The *prevention of operation shock* is a matter of great importance in surgery, and various precautions are taken with this object. The preparation of the patient must be such as will not exhaust him; for this reason drastic purgation and prolonged fasting before operation have been abandoned. If he is nervous at the thought of operation, morphia (gr. $\frac{1}{6}$ to $\frac{1}{4}$), which may be combined with scopolamin (gr. $\frac{1}{100}$), is of use in lessening shock, but it can only be administered in certain cases. Before a severe operation, one or more rectal infusions of normal saline solution, half a pint at a time, may be given up to an hour before. During an abdominal operation saline may be poured directly into the open peritoneal cavity; in other cases, it may be administered subcutaneously or intravenously. Saline solution is undoubtedly the best agent we possess for the prevention and cure of shock, and its action is strengthened by the addition of adrenalin (p. 61).

Care must also be taken to prevent chilling of the patient, which is specially apt to occur while his vital functions are

depressed by the anæsthetic. For this reason the operating theatre must be heated to 70° F. at least, and the bed-clothes warmed either with hot bottles or by a hot-water tank set into the table. Similarly no more than the field of operation should be exposed, and if this is impossible, the extra part should be wrapped up in cotton-wool or gamgee tissue, which may be either previously sterilized by steam, or covered with a sterilized towel. All the lotions must be at blood-heat or a little over it, and nothing is to be left undone which can hasten the completion of the operation. On the other hand, the patient should not be so warm that he is bathed in perspiration.

Treatment.—When shock is present after injury or operation, the foot of the bed may be raised to assist the outflow of blood from the abdominal veins. Artificial respiration is also useful in sucking the blood towards the heart from these veins. Surround the patient with cotton-wool, warm blankets and hot bottles. If hæmorrhage is associated with shock, bandage the four limbs firmly from below upwards, in order that as much of the circulating blood as possible may be kept in the trunk. Start rectal infusions of saline at once, and continue them at intervals of two hours. It is of advantage to add ten to fifteen drops of adrenalin chloride (1 in 1000) to the first infusion. Continuous rectal infusion (p. 61) may be used, three quarters of a pint being allowed to flow in each hour. In an urgent case the saline solution, to the amount of two or three pints, with adrenalin added, should be introduced intravenously. Subcutaneous and rectal infusions are not so good, as the fluid has little chance of being absorbed. The introduction of saline does good by raising the blood pressure. It also relieves the distressing thirst which is so constant a symptom of shock. Recent investigations seem to show that strychnin, strophanthin, and digitalin, which were formerly much favoured, do no good, and may even be harmful. If the injections are absorbed, they exhaust the already depressed vaso-motor centre; if they are not absorbed when injected, but lie stagnant at the point of injection, then an improvement in the patient's condition leads to the absorption of all at the same time, and he may be poisoned by an over-dose.

If severe pain or hæmorrhage is accountable for the shock, morphia (gr. $\frac{1}{8}$ to $\frac{1}{4}$) along with atropin (gr. $\frac{1}{120}$) should be injected hypodermically, the latter being added to counteract the depressing effect of the opiate.

When the shock has lasted some hours, it is imperative that the patient should receive nourishment. Easily digested and non-stimulating food, such as peptonized milk, should be given by the mouth if he can swallow, or by the rectum, or by both channels.

Some degree of shock exists after every operation performed under a general anæsthetic, but, if slight, it should not be actively treated, but rather left to pass off naturally. It keeps the patient quiet, and diminishes the risk of reactionary hæmorrhage.

Collapse is most frequently met with in surgery as a sequel to severe shock, especially when septic infection is added, and it is often the signal that death is approaching. It is seen after a perforation of the stomach or intestine, and in other conditions which produce peritonitis. It also follows the withdrawal of large quantities of fluid from the body, as in severe diarrhœa, persistent vomiting, or sudden, profuse hæmorrhage. Apart from the treatment of the cause, the introduction of fluid, in the form of saline solution, into the body is most beneficial. In cases resulting from severe hæmorrhage, ether may be given hypodermically, followed by strychnin and digitalin injections alternately, but at sufficiently wide intervals to ensure that the patient is not poisoned in the manner described above.

Anæsthetic Poisoning, though not so great a source of danger as shock, is one of the most troublesome complications in operative surgery. Independent to a great extent of the age of the patient, and the nature and severity of his illness, it often occurs when it is least expected, and may be absent even after prolonged anæsthesia. In other words, the special circumstances in which it arises are not yet understood. The poisoning is associated with a fatty infiltration of the liver, decreased alkalinity of the blood, and increased acidity of the urine, the last named of which is due, in part at least, to the presence of fatty acids.

The most prominent symptom of anæsthetic poisoning is

sickness. In individual patients it varies greatly in degree. It may be only a feeling of nausea, or slight vomiting which passes off within twenty-four hours. On the other hand, it may be sufficient to endanger the life of the patient, and may persist for several days. The vomited matter consists at first of mucus, and sometimes of blood if any has reached the stomach during the operation. Slight cases do not go beyond this stage. Then it often becomes greenish, and yellow from the presence of bile if there is much retching. In grave cases, it becomes brownish from admixture with blood from the mucous membrane of the stomach—"coffee-ground" vomiting.

The vomiting may begin before the patient has regained consciousness, or it may be delayed for twelve or even twenty-four hours. The amount vomited on each occasion varies with the intervals between two ejections, and also with the amount of fluid administered by the mouth, but it is usually considerable. It gradually accumulates in the stomach for some hours, during which time the patient is oppressed with a feeling of unwellness, and then it is brought up with more or less retching. Some relief is obtained for an hour or two till the collection of liquid in the stomach again begins to trouble the patient. The frequency of the vomiting is also variable. It may occur once an hour, or only once in twelve hours. Hence it is often difficult to tell, except by the physical examination of the stomach, whether or not the sickness has stopped.

In forming a prognosis, the surgeon must know the character of the vomited matter, and it is the nurse's duty to keep a specimen, and more than one if its character changes. She should also note whether retching is present or absent. The mere regurgitation of fluids taken by the mouth, though it is serious if long-continued, can often be stopped by propping up the patient in a half-sitting posture, or raising the head of the bed on high blocks.

Comparison between Chloroform and Ether Sickness.—The general opinion is that after-sickness occurs more frequently with ether, but is not so serious as with chloroform. Fatal cases have, however, occurred with both. For young children ether by the open method is to be preferred, as it less fre-

quently causes sickness than chloroform. Old people suffer little from anæsthetic sickness, but if they are diabetic the administration of chloroform or ether is frequently fatal. Chloroform is said to be contra-indicated in acute abdominal affections with peritonitis present or threatened, but the danger is probably exaggerated.

Other symptoms of anæsthetic poisoning are mentioned on page 166.

Prevention of Anæsthetic Sickness.—The care of the patient's diet and bowels, before and after operation, is of great importance in the prevention of anæsthetic sickness. Sodium bicarbonate and glucose have been recommended with the same object, but their efficacy is still doubtful.

During the administration, the patient should be kept sufficiently under the influence of the anæsthetic to abolish the swallowing reflex; otherwise mucus, which is saturated with chloroform or ether as it collects in the pharynx, reaches the stomach, and is almost certain to cause after-sickness. Blood must not be allowed to enter the stomach in operations on the mouth, nose, pharynx, œsophagus or stomach.

At the end of the operation, the removal of the patient to bed must be done quietly and gently, and his head should not be raised above the rest of the body.

Treatment of Anæsthetic Sickness.—No sovereign remedy for anæsthetic sickness has yet been discovered. The restriction of food, and even of water, in the first hours after the operation has already been mentioned. For many patients, it is best to give nothing at all by the mouth for twelve hours, if a large quantity of the anæsthetic has been inhaled. This treatment, though trying for the patient, is often efficacious in reducing sickness to a minimum in those who have suffered severely from it after previous administrations of chloroform or ether. On the other hand, in the cases in which the vomiting of a little mucus with a considerable effort is the prominent feature, the best method of stopping it is to give copious draughts of hot water at intervals. To make up for the loss of fluid from the body, saline solution should be given by the rectum.

One of the most frequent causes for the continuance of sickness is distension of the bowel with gas, a condition

known as meteorism. Its treatment is described on page 210. If the vomited matter consists of foul-smelling material, for example after intestinal obstruction, or if the vomiting is persistent, the stomach should be washed out with weak Condy's fluid or potassium bicarbonate solution, and an opiate administered hypodermically to quieten the irregular peristalsis. If pain is keeping up the sickness, treat it (p. 186). Hot flannel compresses, a mustard-leaf or even a fly-blister, applied to the epigastrium, may be useful, especially in neurotic patients. Alcoholic stimulants are not now in vogue for sickness, but occasionally half an ounce of brandy or whisky in the rectal salines is indicated in patients who are becoming exhausted by the sickness.

As in shock, it is important that the patient should have nourishment if the sickness is persistent, and it must be administered as an enema (p. 59), given every six hours.

The worst cases of sickness are associated with sepsis. The prognosis in such entirely depends on the septic condition.

Restlessness, Pain, and Sleeplessness.—It is imperative that the patient should not have more than one sleepless night after operation, and even that should be avoided, if possible, by simple means. Excluding shock and sickness, the factors which most frequently interfere with sleep are pain and general restlessness.

Restlessness is often met with apart from pain. It may be due to a slight cause which is easily removed, or it may be associated with such grave conditions as internal or external hæmorrhage and peritonitis. The tightness of the dressing, or the chafing of the bandage, or a full bladder is a frequent cause of restlessness and loss of sleep. For such the nurse must be on the look-out, as the patient may be too young or too ignorant to mention it. Excess of bed-clothes, causing unpleasant perspiration, is a frequent source of uneasiness, and must be avoided, either by removing some of them or inserting a cage. Change of position may bring the greatest comfort to the patient. He frequently says he could go to sleep, if only he might turn on his side. After an abdominal operation, the surgeon may or may not allow this, but it is gradually being recognized that the treatment of such cases in the dorsal position is unnecessarily trying to the

great majority of patients. At the same time, the nurse is not yet justified in turning a patient on his side after an abdominal operation unless she has the consent of the surgeon. Short of this, she may, however, do much to relieve discomfort by placing a pillow under the knees, or under one shoulder and flank, by inserting an air- or water-cushion to relieve pressure on the tender area, by raising a limb on a pillow, or by changing its position from time to time.

Thirst is a frequent cause of restlessness, and should be treated at first by rectal salines, and later by draughts of hot water, warm milk, or beef-tea. During shock, the patient, whether restless or not, does not get much sleep, and similarly in anæsthetic poisoning in which the sleep is disturbed by the vomiting. The most extreme degree of restlessness and sleeplessness is met with in cases of post-operative peritonitis, and after a severe hæmorrhage, even though the patient feels well and is entirely free from pain. Similarly in certain cerebral conditions—the reaction stage of concussion, delirium, mania, and melancholia—the unrest may be extreme.

The degree of pain sufficient to cause sleeplessness varies widely in individual patients. A nurse must always bear in mind that even a slight pain is of importance if it interferes with rest, and she is not to neglect it, or be impatient of apparently trivial complaints.

As with restlessness, pain may be due to different causes. The wound itself may be painful, but usually for not more than twenty-four hours if it is aseptic. The throbbing produced by too tight a dressing is almost intolerable. The position of a limb is often accountable for pain, which disappears if it is raised on a pillow, or flexed, or otherwise moved. After all operations, but especially abdominal, irregular peristalsis of the intestine may be intensely painful; sometimes it may be relieved by removing the bandage and cotton-wool (but not the gauze dressing), and massaging round about the wound, or placing a hot-water bag over the part. Muscular cramps and jerkings may make the patient toss about, and keep him in dread of the next spasm. They are not so apt to occur if the muscles are not stretched, hence flexion of a limb should always be tried. Traction on the abdominal muscles is avoided by placing a pillow under the

knees. Pain is a constant feature after certain operations, for example the removal of diseased ovaries and Fallopian tubes, the treatment of hæmorrhoids by ligation, and operations on bone. In such cases an opiate is usually necessary to allay it. In septic conditions, pain is often persistent after operation, if any tension still remains from the congestion of the tissues, or the tightness of stitches or dressings. The pain is more severe in dense tissues which have a rich nerve supply, for example the pulp of the finger in whitlow. In such cases, the pain may be relieved by Bier's hyperæmic treatment, if the affected area admits of its application.

For sleeplessness from any cause, the most certain, and in some ways the least desirable, drug is opium in one or other of its many forms. It may be given as the tincture of opium (laudanum), in 5 to 15 minim doses; as a pill containing $\frac{1}{2}$ to 2 grains of powdered opium; as a hypodermic injection of morphia, $\frac{1}{8}$ to $\frac{1}{2}$ grain; as a suppository containing $\frac{1}{2}$ to 1 grain of morphia. In almost every case it removes pain and restlessness whilst its effect lasts, and the patient is transferred from misery to contentment. But it has several disadvantages. In certain individuals it invariably produces nausea, and it may prolong anæsthetic sickness. It diminishes intestinal peristalsis, and so causes constipation. These disadvantages may be in part prevented by combining atropin sulphate, $\frac{1}{150}$ to $\frac{1}{100}$ grain, with the hypodermic injection of morphia, or extract of belladonna with the opium pill. But the chief objection is the risk of inducing the opium or morphia habit in the patient. He knows that an opiate will relieve his pain, take away his worries, and bring a feeling of peace and sleep. Hence he takes it secretly and continuously, gradually increasing the dose when the former amount has lost its effect. Then the drug reacts on his body, produces chronic poisoning, and makes him a mental, moral, and physical wreck.

For these reasons, opium and its derivatives (morphia, codein) or compounds (nepenthe, Battley's solution, Dover's powder) should not be lightly ordered. In acute abdominal pain, the administration of opium masks the urgent symptoms, and should therefore not be given before the diagnosis has been made. For patients after operation who are suffering

from persistent sickness or severe pain, increasing the shock and preventing sleep, an opiate is frequently necessary and should not be withheld. But it should not be given continuously for more than a day, except in the agonizing pain of inoperable cancer, or other incurable condition. Other means must first be tried to cure the sickness or pain.

The simpler measures for the relief of restlessness, such as the nurse may carry out, have been already mentioned. She should never forget that a cup of hot milk or beef-tea is often an excellent hypnotic. Drugs are only to be given if ordered by the surgeon. Potassium bromide, 15 to 30 grains, is often useful for allaying peripheral irritation, and, combined with chloral hydrate, 10 to 15 grains, it rarely fails to induce sleep. Trional, 15 to 30 grains, is also fairly reliable. Sulphonal is not now often prescribed, owing to the uncertainty of the time which it takes to act. Many other hypnotics, e.g. paraldehyde, veronal, tetronal, are occasionally given, but none is so certain as opium to produce sleep, especially if severe pain is present.

For the milder degrees of pain hot fomentations, turpentine stupes, a mustard-leaf, or a fly-blister may be tried. Among drugs, aspirin, 10 grains six- or eight-hourly, is sometimes beneficial, especially in rheumatic cases. Headache is best relieved by a powder containing phenacetin, 6 grains, caffein, 2 grains, and antifebrin, 2 grains, but many patients are kept from sleeping by it.

Delirium is a severe and serious complication which occasionally occurs during certain diseases, and after an injury or operation. In a large proportion of cases it comes on in the course of acute septic conditions, and is due to poisoning of the brain cells by toxins. Thus it may be associated with any of the acute pyogenic infections: with meningitis; with erysipelas, especially of the face or head; with chronic septic disease of the kidneys. It is a not uncommon sequel of head injuries, of severe hæmorrhage, and of poisoning by cocain, alcohol, iodoform, and certain other drugs.

Delirium Tremens is the usual form of delirium found in alcoholic patients who are confined to bed by injury or after operation. The symptoms manifest themselves in the first few days—refusal of food, depression, constant restlessness,

sleeplessness, and incoherent mutterings. Associated with these mental disturbances are muscular tremors especially of the tongue, lips, and hands. The patient has hallucinations of sight, imagining that he sees rats or snakes or other horrors. The pulse is soft and rapid, and the temperature is slightly raised. Sometimes pain is not felt, so that the patient may move a fractured limb as freely as if nothing was wrong with it. The symptoms usually begin to pass off in a few days, but occasionally death ensues from want of rest and exhaustion.

Traumatic Delirium may occur after injuries and operations in neurotic or neurasthenic patients. It is specially liable to follow operations on the face, genito-urinary organs, and thyroid gland. The mental symptoms are of the same nature as in delirium tremens, and they come on in two to five days. Muscular tremors are usually absent, and the patient may not be alcoholic.

Acute Mania or *Melancholia* may follow on injury or operation. Indeed, there is no strict dividing-line between these and traumatic delirium. Also, an attack may be determined by the operation in patients who have formerly been insane.

Treatment of Delirium.—The treatment of these conditions is carried out on the same lines. There are two great principles —the patient must have nourishment, and he must have sleep. If he refuses to take food, it must be introduced by the stomach or nasal tube, or by rectal feeding. The bowels must be carefully attended to. Sleep is induced by one or other of the hypnotics already mentioned, but opium should not be given unless all the others fail.

Precautions in Nursing of Delirious Patients.—In all the nurse has grave responsibilities, as such a patient may develop suicidal or homicidal tendencies, or may inadvertently do himself harm. He is never to be left alone for a moment during the whole twenty-four hours. Even if the nurse is absent only for a few seconds, the patient has sufficient time to throw himself over a window, set his clothing on fire, or attack another patient. Care must be taken in using the thermometer that it is not broken. It should never be put in the mouth, but always held in the axilla or groin. The food

should be served in enamel dishes, as crockery may be broken and injury inflicted by a sharp edge. No knife or fork must be given to the patient. It need hardly be said that lotions and other drugs are not to be left within his reach. The nursing of such cases is often very trying and exhausting to the attendants, and strapping of the patient may become necessary. It should, however, be avoided if possible, as it excites him and increases his struggling.

Hæmorrhage may be a grave complication after injury or operation. The nurse must be familiar with the various terms which are applied to hæmorrhage according to its site, its origin, and the time of its occurrence.

The hæmorrhage is said to be *external* or *internal* according as the blood does, or does not, appear on the surface. In the latter case, if the blood is poured out into any tissue under the skin, it is known as an *extravasation*, or, if such bleeding is confined within definite boundaries, it is a *hæmatoma*. Little areas of hæmorrhage under the skin, varying in size from a pin-head to a split pea, are known as *petechiæ*.

The vomiting of blood from the stomach is *hæmatemesis;* the coughing of blood from the lung is *hæmoptysis;* fæcal matter mingled with dark blood and passed by the rectum is *melæna;* and the passage of urine containing blood is *hæmaturia*.

Hæmorrhage is *arterial*, *venous*, or *capillary*, according as it flows from divided artery, vein, or capillaries. Arterial hæmorrhage is normally bright red in colour, and spouts intermittently from the proximal end, i.e. the end nearer the heart, of the divided artery. On the other hand, venous bleeding occurs in a continuous stream, and is more copious from the distal end. If it comes from a varicose vein, however, most of it may be from the proximal end. The blood is darker in colour than the last. In capillary hæmorrhage the blood oozes steadily from numerous cut capillaries in the wound. As a rule it stops before the loss of blood is sufficient to cause danger, but in "bleeders" and to a less extent in jaundiced patients it is a grave condition. After operation, capillary oozing may soak the gauze, which then acts as a poultice and keeps up the bleeding. It soon stops after the dressing is removed.

According to its time of occurrence, hæmorrhage is spoken of as *primary*, *reactionary*, or *secondary*. Primary hæmorrhage is that which occurs as soon as a blood-vessel is divided by an injury or during operation. Reactionary or recurrent hæmorrhage occurs during the period of reaction after an injury or operation. The commonest causes are an increase of blood pressure, causing vessels to bleed which did not do so during the operation while the action of the heart was weakened, and the slipping or loosening of a ligature. Secondary hæmorrhage is due to sepsis burrowing into the wall of the vessel, or to pressure leading to necrosis of it. The bleeding may at first be slight, but if the septic process is continued, it makes a bigger hole in the vessel wall, and the hæmorrhage recurs in greater amount, till finally it may prove fatal.

The prevention of hæmorrhage is important for the patient's strength and vitality. At an operation, blood-vessels are bound to be divided, and the cut ends are seized with artery forceps before or immediately after division. If the blood is coming from the bottom of a cavity and its exact source cannot be seen, the cavity is packed tightly with gauze till the flow is diminished. Such packing may be kept in for a day or two. It is all that is required to stop venous or capillary oozing.

In cases in which it is known before the operation that a big vessel must be divided, bleeding may be prevented by a tourniquet (p. 126) placed so as to constrict it at a higher level, or it may be ligated above. Both methods are frequently employed in amputations. The application of a tourniquet is the common mode of arresting primary hæmorrhage which results from an accident. At the same time it must be remembered that it is only a temporary measure, because a tight tourniquet cannot be kept on long for fear of causing gangrene of the limb. If the tourniquet is not applied with sufficient tightness, it is almost certain to cause a continuation of the hæmorrhage, and so to endanger the life of the patient.

Reactionary and secondary hæmorrhage more nearly concern the nurse, as either may come on suddenly after operation. On her quick recognition and treatment of it, the life of the

patient may depend. Arterial hæmorrhage is controlled by pressing the artery against a bone on the proximal side of the bleeding point. Later, when assistance is obtained, a tourniquet is put on, and then the surgeon is sent for to stop the hæmorrhage permanently. Venous and capillary bleeding are stopped by firm pressure over the bleeding point with the finger or fist, or a pad of gauze covered by a bandage. The gauze may first be soaked with one of the drugs which stop bleeding. Such drugs are called *styptics*. The most potent of them is adrenalin which is sold in a strength of 1 in 1000. Others are turpentine, ergot, and perchloride of iron. It must not be forgotten that this treatment is sufficient to stop even arterial bleeding if pressure can be exerted against bone, for example in bleeding from the scalp.

Control of Hæmorrhage in the Limbs.—In bleeding from the hand and forearm, the thumb or closed fist is applied on the inner side of the upper arm, so as to press the artery against the humerus. If the source of the hæmorrhage is near the shoulder-joint, the artery may be compressed against the first rib by means of the thumb pressing down behind the clavicle. In bleeding from the lower limb, the femoral artery must be compressed against the pubic bone at the top of the thigh, until a tourniquet is applied.

The control of hæmorrhage in other parts of the body is described in Section V.

Internal Hæmorrhage.—The nurse's duties in internal hæmorrhage are usually confined to the recognition of the condition, and do not include its treatment. It is only in exceptional cases that she can do anything to arrest it.

Internal hæmorrhage is a complication of operations, apart from the loss of circulating blood to the patient, as it interferes with the healing of the wound. Its presence under the skin may cause tension and pain, and, if the tension is sufficiently great, it interferes with the nutrition of the skin over it. In addition, it delays the natural process of healing which is not completed till the blood-clot has been absorbed. Hence it is important, in cases in which hæmorrhage is likely to occur, to ensure that the blood escapes on to the dressing. This is managed by inserting a drain—usually a rubber or glass tube—at the operation. It is kept in till all

chance of reactionary hæmorrhage is past, twenty-four hours being usually sufficient.

Symptoms of Hæmorrhage.—The loss of a large quantity of blood from the circulation is accompanied by certain effects which are the same whether the bleeding is external or internal. As so much depends on the early stoppage of the bleeding, the nurse must know the symptoms of hæmorrhage well enough to recognize it at once, so that the surgeon may be sent for. The surface of the body becomes pallid, and the extremities cold. The skin is moist and clammy. The pulse is feeble, soft and rapid, the respirations rapid, shallow and sighing. There are flashes of light before the eyes, and buzzing in the ears. The patient complains of intense thirst, and may be very restless and uneasy.

In severe hæmorrhage "air-hunger" ensues, the patient gasping for breath, and throwing his arms about. He becomes faint and giddy, his muscles twitch, and he may have convulsions shortly before death.

Apart from the stoppage of the hæmorrhage, the symptoms must also be treated. Morphia should at once be given to quieten the patient, and so favour the cessation of the bleeding. The foot of the bed should be raised, and the limbs bandaged from below upwards to drive as much blood as possible to the trunk. Fluid must be at once supplied to the body by rectal salines till the surgeon arrives. At the same time the nurse should make preparations for intravenous transfusion (p. 63). If no operation under a general anæsthetic is necessary to stop the hæmorrhage, fluids should be freely administered by the mouth. The inhalation of oxygen may tide the patient over a crisis.

Later a diet and drugs which aid in the formation of blood are given.

Phlebitis, or inflammation of one or more veins, is occasionally met with after operation. The cases fall into two groups: (1) one in which a thrombus or clot in the vein is the chief feature, and sepsis is not evident; (2) one in which the clot is septic.

(1) The *thrombotic* variety, which is known as *thrombo-phlebitis*, occurs in the lower limb, usually in weakly or anæmic patients. It is most commonly met with after pelvic opera-

tions or injuries, the radical cure of hernia, and the removal of a diseased appendix or enlarged prostate gland. According to some authorities, it is specially liable to ensue on operations performed during menstruation. It comes on typically in the second or third week.

The attack is usually ushered in by a severe pain in the limb, which may be either above or below the knee. It may be accompanied by shivering or an actual rigor. The pulse-rate is increased, and the temperature is frequently raised to 100° or 101° F., indicating that sepsis may be present even in the thrombotic variety. If the vein is superficial, there are marked tenderness and swelling along its course, and the skin over it is dull red. The whole limb feels stiff and tight, and the leg and foot are often œdematous. The pain may pass off in a few days, but the swelling usually remains for another week or longer.

When the deep veins are thrombosed, the whole limb is greatly swollen and painful, and white in colour, a condition known as *phlegmasia alba dolens.*

During the first week or ten days after the formation of the thrombus the patient is in danger, because of the risk of part of the clot being detached. The name *embolus* is given to the detached part. It enters the circulation, and is carried to the heart and thence to the lung. There it lodges, giving rise to the condition of *pulmonary embolism.* Its occurrence is marked by sudden, distressing symptoms—intense breathlessness with rapid respirations and increased pulse-rate, faintness, and cyanosis—and death is often immediate. A small embolism may simulate pleurisy.

The treatment of thrombo-phlebitis is mainly directed towards the prevention of embolism. The limbs are to be gently wrapped in cotton-wool, and elevated by raising the foot of the bed on 10-inch blocks. Sand-bags are placed alongside the limb to prevent movements. If pain is severe, lead and opium fomentations should be applied. Great care must be taken with the nursing of the patient. Sharp purgation is to be avoided, and in looking after the skin of the back, the nurse must see that the patient does not raise himself by putting a strain on the muscles of the thrombosed limb. The diet should be liquid and nutritious, with-

out much milk, which is supposed to increase the tendency to thrombosis. If anæmia is present, iron is usually prescribed by the surgeon.

Treatment of Pulmonary Embolism.—When pulmonary embolism occurs and is not immediately fatal, the patient must sit up to get breath. Oxygen inhalation is to be given, and a stimulant—half an ounce of brandy, or $\frac{1}{60}$ grain of strychnin—administered. In five or ten minutes, when the respiration improves, prop the patient up with pillows, and keep him quiet. Start the administration of ammonium carbonate or other alkali. In cases in which the embolism causes immediate cessation of respiration, perform artificial respiration to try and tide over the crisis.

(2) *Septic Phlebitis.*—When the clot is septic, it tends to soften, and therefore the risk of embolism is greater. Moreover, the detached parts of the clot are themselves septic, and usually set up abscesses at the places where they come to rest. The lung is the commonest site, but small emboli may be carried farther and reach any part of the body through the blood-stream. A not infrequent site of such is under the skin of the back, leading to the formation of an acute bed-sore.

The *treatment* of septic phlebitis is for the surgeon. He may tie the vein on the proximal side to prevent embolism, or amputate the limb.

Fat Embolism.—After injuries of and operations on the bones which contain marrow, an excessive amount of fat may reach the blood, and cause symptoms of pulmonary embolism by settling in the lung—dyspnœa, faintness, cyanosis. If cerebral embolism occurs, the patient becomes delirious and then comatose, and death rapidly ensues.

Air Embolism sometimes follows injury to a vein in operations on the neck, thorax or axilla. Air is sucked in, reaches the heart, and makes the blood frothy. The patient becomes deathly pale, and may die in a few minutes. Ether should be administered hypodermically, and the head lowered to prevent syncope. Artificial respiration is probably useless.

Sepsis.—Though sepsis is a less frequent complication of operations to-day than it was fifty years ago, it must always

be kept in mind that it may be no less serious. The great difference is that sepsis is now a preventable complication in the majority of cases. If it occurs after a clean operation, it is certain that some one has blundered. Each and every person engaged at the operation has his or her responsibilities, and conscientious adherence to the principles and practice of asepsis is essential for the safety of the patient.

Sepsis varies widely in degree in individual cases. It may be so trivial as to have no obvious effect except delay in the healing of the wound, or it may cause the death of the patient within forty-eight hours. The differences depend on :—

(1) *The Virulence of the Infection, and the Power of Resistance* of the patient. It was stated in Section I. that the power of resistance depended on the access of leucocytes and certain bodies present in the body-fluids to the infected area. If they are denied access, the bacteria multiply and manufacture toxins without check. In a joint cavity the viscid synovial fluid retards the circulation of fresh tissue-fluids, and sepsis becomes a grave complication. Any collection of fluid, such as extravasated blood in the operation wound, acts in the same way.

(2) *The Efficiency of the Drainage.*—The importance of efficient drainage will now be understood. The wound is to be drained when the operation is for a septic condition, to get rid of dead leucocytes and so make room for a fresh supply. It is also to be drained when there is a risk of reactionary hæmorrhage, so that the blood may escape, and not form a clot in the tissues.

(3) *The Site of the Operation* determines to a large extent how far the sepsis endangers the life of a patient. Its occurrence in one of the cavities—cranial, thoracic, peritoneal, or joint cavity—is in general more serious than on the surface of the body.

Signs of Sepsis.—The signs of sepsis also vary with its virulence, its situation, the patient's power of resistance, and the efficiency of the drainage. The four cardinal signs are *heat*, *redness*, and *swelling* of the part, and *pain* in it, but they vary in degree, and one or all may be absent. The constitutional disturbances, produced by the absorption of toxins, are more reliable indications of sepsis :—

(1) *Rise of Temperature.*—With a few exceptions, post-operative sepsis produces a rise in temperature. It may come on within forty-eight hours, or not until the second week. The rise may be small or great, and the temperature may remain up constantly, or it may fall to normal at intervals. But in certain cases, e.g. post-operative peritonitis, the most serious sepsis may be associated with a persistently sub-normal temperature.

(2) *Pulse-rate.*—This is probably the most constant indication of sepsis. It may be said that, except in abscess of the brain and certain rare abdominal conditions, the pulse-rate is always increased when sepsis occurs, even although the temperature is subnormal. It may be anything between 90 and 140 or 150, the higher rates indicating a serious condition. With the pulse, however, as with the temperature, sepsis is not the only cause of disturbance.

(3) *The Number of Respirations* per minute is often increased by sepsis.

(4) *Disturbances of the Stomach and Bowels* are usually present in the form of sickness and vomiting, loss of appetite, thirst, furred tongue, and constipation or diarrhœa.

(5) *The urine* is scanty, sometimes amounting only to ten ounces or even less in the twenty-four hours, and it may contain albumin.

Sources of Septic Infection in the Wound.—Anything which is not germ-free and comes in contact with the wound or its surroundings is a possible source of sepsis. If the sterilization of the instruments or contents of the caskets has not been perfect, infection may be implanted in the wound. More frequently sepsis is due to:—

(1) *Contact with a Septic Part of the Patient.*—The patient may have a septic sore in the operation area. At the beginning it should be touched with pure carbolic, and sealed with collodion or "new skin". More frequently the infection comes from a mucous membrane, say of the nose, mouth, or stomach, which cannot be rendered aseptic before operation. Again, the disease may be septic in itself, and lead to infection of the wound. In such a case the great object is to prevent mixed infection (p. 9).

(2) *The Hands of the Surgeons.*—The hands may be

contaminated during the operation by contact with a mucous membrane. Hence fresh gloves are often put on before the stitching up of the wound.

(3) *The Ligatures and Sutures.*—Infection from catgut which has not been thoroughly sterilized during its preparation shows when it begins to dissolve, and this may not be until the second week. As a rule it is of a mild type, but it may have serious consequences, for instance in the radical cure of hernia, by preventing the primary union of the deep layers of the wound.

A stitch abscess is in general of little consequence. It is mostly due to bacteria left in the sweat-glands or hair-follicles after the preparation of the operation-area, or implanted there during the operation.

Treatment of Sepsis.—With the onset of sepsis, the patient's bowels must be well cleared. For this purpose calomel (4 or 5 grains) is one of the best drugs. It should be given in the early morning, and followed by a dose of Epsom salts in four to six hours.

In severe sepsis, stimulants are usually required—saline solution by the rectum, whisky or brandy by the mouth or rectum.

The wound has to be examined. Several or all of the stitches should be removed, and the edges of the wound opened for some distance by a probe or sinus forceps. This allows pus to escape. The cavity may then be gently washed out with saline solution, plain boiled water, or very weak antiseptic lotion, and sprayed with peroxide of hydrogen. Then free drainage of all the pockets in the wound must be procured. It is rarely advisable to apply a wet dressing over the drain. If the drainage is imperfect, the patient enters the dangerous region of toxæmia, septicæmia and pyæmia, and heroic measures may be required to save his life, e.g. amputation of a limb.

When the wound is of a limb, the sepsis may be treated by placing it in a bath through which saline solution or ichthyol lotion (1 per cent.) at blood heat is slowly flowing.

In recent years serum and vaccine treatment have been used to counteract sepsis.

Complications of the Alimentary Tract.—Various post-

operative complications arise in the alimentary tract, and the glands in association with it.

Parotitis, or inflammation of the parotid gland, occurs after various operations, but especially those on the pelvic organs, or for suppurative appendicitis or perforated gastric ulcer. One or both glands may be inflamed, and in some cases the submaxillary glands also become swollen and tender.

The condition is probably due to a spread of infection from the mouth to the glands by way of the ducts. After the administration of chloroform or ether, the secretion of saliva is greatly diminished, and the ducts are not flushed out. Hence the bacteria are not dislodged, and they multiply and gradually spread to the gland. The special frequency of parotitis after abdominal operations may have been related to the starvation treatment formerly practised before and after those operations, which reduced the patient's power of resistance more than was necessary.

The chief symptom is pain on movement of the lower jaw. Hence he cannot masticate solid food, or open his mouth widely. The swelling is situated at the side of the face in parotitis, and just under the lower jaw if the submaxillary gland is affected. The temperature is not as a rule above 101° F., unless suppuration occurs.

The treatment consists in the local application of hot fomentations, and frequent spraying of the mouth with hydrogen peroxide. As in other septic conditions, a purgative should be administered. These measures usually lead to a subsidence of the inflammation. If the condition goes on to suppuration, the abscess is opened by Hilton's method, that is, a small incision is made, sinus forceps (Fig. 65) are introduced into the cavity, and the blades separated.

Gastric Complications.—With the exception of anæsthetic sickness, gastric complications as usually met with after abdominal operations, and are later described (p. 209). Vomiting may, however, arise after any operation if the patient has at the same time disease of the stomach or intestine, or it may be due to the existence of pregnancy. Acute post-operative dilatation of the stomach, hæmatemesis and hiccough are mentioned later.

Liver Complications.—Jaundice may arise in any case of grave anæsthetic poisoning. If the liver is cirrhosed, the irritation that occurs after the administration of chloroform or ether may make it unable to carry out its functions, and a serious and often fatal condition arises, resembling uræmia in its main features.

Intestinal Complications are described in Chapter XIX.

Complications of the Respiratory Tract.—*A Common Cold* may come on after operation. In itself it is of little importance, but it may spread to the larynx or bronchial tubes.

Laryngitis produces a hoarse or whispering voice. It is treated by the inhalation of tincture of benzoin (Friar's balsam), two teaspoonfuls of which are added to a pint of boiling water in a steam kettle (Fig. 113).

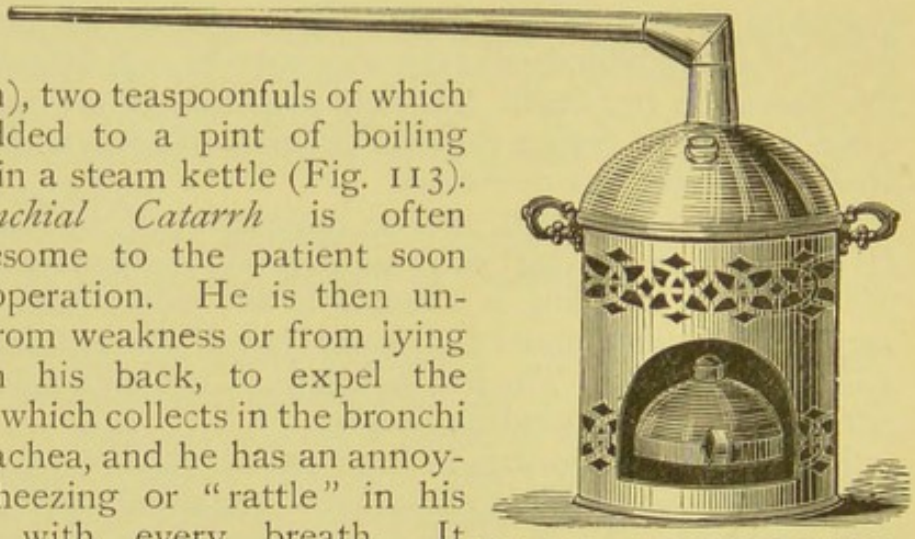


FIG. 113.—BRONCHITIS KETTLE.

Bronchial Catarrh is often troublesome to the patient soon after operation. He is then unable, from weakness or from lying flat on his back, to expel the mucus which collects in the bronchi and trachea, and he has an annoying wheezing or "rattle" in his throat with every breath. It passes off when he can once more contract his abdominal muscles and so force out the mucus by coughing.

Bronchitis is a serious complication, especially at the extremes of life. To treat it, a steam-tent should be erected. A folding-screen is placed to surround the head of the bedstead and part of the sides. It is then covered with blankets. A "bronchitis" or steam kettle (Fig. 113) is placed on a stool at the side, and the long spout directed towards the head of the bed. The water in the kettle is kept boiling by means of a spirit-lamp, and the steam condenses under the tent, and keeps the air moist. Drugs may also be prescribed by the surgeon.

Broncho-pneumonia sometimes follows bronchitis, and is a grave complication. *Lobar pneumonia* has also been observed. It was formerly believed to be due to ether, and was spoken of as "ether" pneumonia. These inflammatory conditions are more frequently met with after ether than after chloroform. They are specially liable to occur if the patient is exposed to cold air immediately after the operation, say in the hospital corridor or the ward. All possibility of chilling of the patient must be avoided.

Septic or Inhalation Pneumonia is referred to later.

Hypostatic Congestion and Pneumonia are serious complications after operation. They occur in aged or debilitated patients with a feeble heart who have to lie night and day on their backs. So grave is the danger if it occurs that the appropriate treatment of the disease or injury, say a fracture of the femur, is considered of secondary importance, and the prevention of hypostatic congestion is the first consideration. The patient should be propped up in bed in a sitting position, or even allowed out of bed altogether.

Hæmoptysis, or the spitting of blood, may occur after operation on a patient suffering from phthisis or malignant disease of the lung, or from pulmonary embolism.

Pleurisy with Effusion and *Empyema* sometimes occur during convalescence after a severe operation. Pleurisy may exist without any definite symptoms. All that the patient may be aware of is a short, irritating cough. The pulse-rate is usually increased, and strength is not regained as quickly as usual after operation.

Empyema is more acute in its onset, and is usually met with after operations for septic abdominal conditions. The temperature and pulse-rate rise, and the respirations are increased in frequency to 30, 40, or even 60. Immediate surgical treatment is necessary.

Heart Complications.—Apart from syncope (p. 176), cardiac complications rarely occur except in patients who suffer from disease of the heart or from severe sepsis. In deciding for or against operation, the existence of heart disease is of importance, hence the heart should be examined in every case.

Complications of the Urinary Tract may be due to the operation or to pre-existing disease. The recognition of the

latter is of immense importance before the operation is decided on, and an examination of the urine must be carried out in every case. A specimen of the first urine passed after operation must always be kept by the nurse. For the first forty-eight hours the amount of urine passed each time should be measured and charted.

Albuminuria, or the presence of albumin in the urine, is a prominent sign of Bright's disease. It may also occur after any operation in severe anæsthetic poisoning or grave sepsis. In such cases it is associated with a decreased amount of urine, and if death is approaching none may be secreted, a condition known as *anuria*.

When the kidneys are not working properly, and the substances which ought to be got rid of by this channel are retained in the blood, they act as poisons to every organ in the body, and give rise to *uræmia*. This is one of the chief causes of death after certain surgical operations.

Uræmia.—The chief signs of uræmia are vomiting, breathlessness and convulsions. The patient gradually becomes comatose as death approaches. It is, however, more important for the nurse to be familiar with the early symptoms. These are severe headache, foul, heavy breath, dirty tongue, great restlessness, and mental wandering. In association with scantiness of urine, these symptoms are to be looked on as extremely grave.

The treatment consists in making the skin and the bowels act freely so as to get rid of the poisons in the blood. Epsom salts or some other saline purgative is to be freely administered, and copious sweating induced by giving hot drinks, injecting pilocarpin ($\frac{1}{3}$ grain) hypodermically, and wrapping the patient in blankets and surrounding him with hot bottles. If this treatment is not sufficient to cause sweating, the patient is given a hot-air bath or placed in a hot pack.

To apply a hot pack, place a bed mackintosh over the mattress, and cover it with a blanket. Put two blankets in a bath with hot water and wring them ; over each pour a kettleful of boiling water and again wring them. Wrap them round the naked patient, so that one encircles his whole body up to the arm-pits, and the other surrounds his chest and neck. Then apply a dry blanket, and on it place six hot

bottles. The pack should be left on for twenty to thirty minutes, and the patient is then wrapped in dry, warmed blankets.

Diabetic Coma.—Sugar in the urine is a serious omen before operation, and its presence or absence should be determined in every case. The surgeon hesitates to perform any operation on a diabetic patient, unless it is one of extreme urgency, owing to the risk of bringing on diabetic coma. This is induced in part by shock, and in part by the poisoning effects of chloroform or ether.

The symptoms are: Heavy, sweet odour of the breath; cyanosis, with a weak and rapid pulse; breathlessness, or, as it is usually called, *air-hunger*. The patient gradually sinks into coma and dies.

Treatment, except in rare cases, is of no avail. The bowels must be kept acting freely. Intravenous transfusions of saline or sodium bicarbonate are usually carried out by the surgeon.

Retention of Urine is a troublesome complication after operations, especially those on the rectum, perineum, vagina and pelvic organs, and for hernia. It may, however, occur after any operation.

Every patient must be told by the nurse to pass water within eight hours after he is put back to bed. It is to be remembered that he may not have any desire to pass it, but he must try to do so. A large proportion of patients cannot empty the bladder within the first few hours after an abdominal operation, as they are unable from pain to contract the muscles of the belly-wall. But as more urine collects in the bladder, and the pain of straining wears off, the urine is usually passed all right. Hence after one failure, the patient must be asked to try again, say at intervals of two hours. Except in abdominal cases, the patient may, if he is not too weak, be allowed to turn in a kneeling position, as he may not be able to urinate lying on his back. A hypodermic injection of strychnin is sometimes successful, probably in great part from its moral effect on the patient.

It is impossible to fix any set time at which the catheter has to be passed. The only rule is never to pass it if it can

be avoided, owing to the great danger of setting up cystitis, i.e. inflammation of the bladder. There are, however, two signs which indicate the necessity for the catheter. The first is distension of the bladder above the symphysis pubis, which the surgeon makes out by palpation and percussion. The other is restlessness, and the nurse must always keep in mind the non-passage of urine as a cause of this, and report the fact to the surgeon or Sister at once, as the permission of the one or the other is necessary for the use of the catheter. The instrument is, as a rule, passed by the nurse in female patients, and by the surgeon or house-surgeon in male patients. The preparations for catheterization and the precautions to be adopted are given on page 245.

Incontinence of Urine is a complication of certain special operations, and is referred to later (p. 260). But the nurse must not forget that the dribbling of urine in bed may be due to over-distension of the bladder. In such a case, the catheter is to be passed at once.

Nerve Complications.—*The Circumflex Nerve* is liable to injury if the arms are tied in a certain position on the operating-table. To keep them out of the way during an abdominal operation, it was formerly the custom to place them alongside the head and fix them to the legs of the table. But this must never be done as the circumflex nerve may be compressed between the humerus and the edge of the table, and paralysis of the deltoid muscle result. The patient cannot then lift his arm from his side. The proper way is to place the arms across the chest, and fix them there by folding up the bed-gown or pyjama-jacket.

The External Popliteal Nerve has also suffered injury in certain positions on the operating-table, especially the Trendelenburg position. The nurse must see that, when the head of the table is lowered, the patient is not suspended by the knees, because the nerve may be compressed between the neck of the fibula and the end of the table. If this occurs, the result is "drop-foot," in which the toes fall down, the patient being unable to raise them. For the Trendelenburg position, the operating-table should be furnished with shoulder-rests to prevent the body from sliding down and being suspended by the knees.

The external popliteal nerve may also be injured by the pressure of a tight splint or tourniquet at the back of the knee.

The treatment of these nerve injuries is massage and movements of the limb, and the galvanic current.

Skin Complications.—The occurrence of rashes on the skin after operation may be due to various causes. Iodoform, boric acid, and corrosive sublimate dressings may produce a rash. Many other drugs, such as potassium iodide and bromide, belladonna, antipyrin, chloral, copaiba, quinine, and morphia, produce skin eruptions in some patients.

The onset of scarlet fever, measles, or typhoid fever after operation is associated with the appearance of a rash. Of more interest in surgical cases are the septic rashes which usually appear within four or five days after operation, especially in children. It is accompanied by the other symptoms of toxæmia, but the superficial wound may show no sign of sepsis. The rash may closely resemble scarlet fever or measles, but as a rule it does not last longer than a few days.

Enema rashes are of more immediate importance to the nurse (p. 59). They come on, either before or after operation, some hours after the enema has been given. The nature of the rash varies, being in some cases like scarlet fever, and in others like measles. The most troublesome form is that which is accompanied by severe itching.

The cause of these rashes is the soap or the turpentine which is used in the enema. Apart from the application of cold cream to itchy spots, no treatment is required. In some patients the rash appears only after the first enema; in others it appears after each one.

Bed-Sores.—A bed-sore as a post-operative complication is the dread of the nurse, because she is usually responsible for its occurrence (p. 364). In a hospital and private house alike, one of the nurse's most important duties is to look after the skin of the patient and prevent the formation of bed-sores. There is a tendency to their formation after operations in which the patient is kept on his back, because the bony prominences constantly press on the tissues over them and prevent the proper circulation of blood and lymph.

Prevention.—Twice daily, or oftener in debilitated patients, the nurse must attend to the skin of the back. It should be washed with soap and water, dried with a towel, and then rubbed with methylated spirit. A little powder may afterwards be applied. The great object is to keep the skin dry. Hence the draw-sheet must be "pulled" at once if it is wet from urine or other fluid. If the patient suffers from incontinence of urine, the sheets have to be changed frequently each day. Every time the back is washed and dried, the nurse must inspect the skin, and note any red areas. When the parts are thoroughly dried, and stimulated by the rubbing with spirit, all wrinkles in the bed-gown and under-sheet are to be got rid of, as they increase the pressure on special areas of the skin.

When red spots appear, and persist even after the application of spirit, the pressure must be relieved by a change of posture, so that the red area no longer touches the bed. Or a ring-shaped air- or water-cushion (Fig. 114) may be placed to surround the red area.

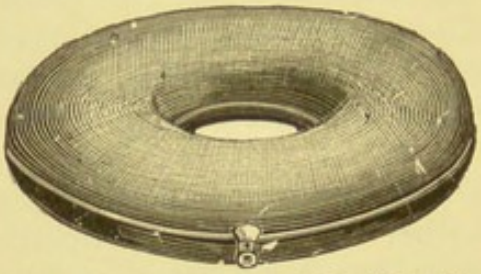


FIG. 114.—RING-SHAPED AIR- OR WATER-CUSHION.

Water-Beds.—In cases of extreme debility or of spinal disease (p. 364), in which bed-sores are specially apt to occur, a water-bed should always be used. This is a large, flat bag of rubber, fitted with a screw valve and funnel like a hot-water bag. It should be placed empty on the top of the mattress, and then partly filled with warm water at 100° F., or thereabouts. It should be only half-filled; then the empty part is raised by grasping the funnel, and folded to press out the air, and the screw-tap is tightened up before it is let go. Over the water-bed are placed a blanket, sheet, and draw-sheet.

The benefit of the water-bed lies in its mobility, so that the pressure is equalized over the whole surface resting on it. Though especially useful in the cases already mentioned, it is a great comfort in many others in which the patient complains of sore back after operation.

Treatment.—When a bed-sore actually forms, it is usually slow to heal, and it requires active treatment. It must be relieved of pressure by turning the patient on his side or almost on his face, or by ring cushions. The sore should be frequently washed with a *very weak* antiseptic, and sprayed with peroxide of hydrogen. As the tissues around it are devitalized, strong lotions are harmful. It should then be dried by methylated spirit which evaporates quickly, and covered with a dry sterilized absorbent dressing.

If there is much sloughing, an antiseptic dressing is required to prevent spreading of the sore. The best is sterilized gauze wrung out of peroxide of hydrogen. When the sloughs have separated, the surgeon may hasten healing by skin-grafting.

Disturbances of the pulse and temperature are of such importance in forming an opinion on the patient's condition after operation that they must be considered separately. Of the two, the pulse is more valuable as an indicator.

Pulse.—Immediately after operation, the pulse-rate is frequently slow if the degree of shock is considerable, falling to below 70, and in some cases below 60. Later it increases in frequency to normal and then to 90 or 100 or higher. As shock passes off, the pulse gains in strength, and its rate decreases. The pulse is a more certain guide to the degree of shock than the temperature or any other single sign.

In hæmorrhage, whether internal or external, the pulse immediately becomes feeble, soft and rapid, and the nurse must always be on the look-out for such a sudden change, and suspect hæmorrhage when it occurs. Distension of the bladder leads to a rapid pulse, and is a frequent cause of such in the second twelve hours after operation. The onset of sepsis is associated with an increase in the pulse-rate whether the temperature rises above normal or not. In post-operative peritonitis, no elevation of temperature may ever be present, but the pulse-rate is usually over 120. Pain, restlessness and flatulence also increase the frequency of the pulse. In general the surgeon depends chiefly on the condition of the pulse after operation in forming a prognosis. To the nurse it is equally important, and she must never neglect to study it carefully. It should be counted for at least a minute. If she

finds in a nervous patient that it slows down as she goes on counting, she must continue for another minute, and record the second count.

The pulse is never unduly frequent without a cause, and the determination of the cause is sometimes by no means easy. In addition to the conditions already mentioned, all of which are directly associated with the operation, the increase in the pulse-rate may be due to excitement or fright, or to some other abnormality, such as pleural effusion, cardiac weakness which has been accentuated by the operation, or exophthalmic goitre. The surgeon does not rest satisfied till he discovers the cause.

Temperature.—The patient's temperature after operation is also to be recorded every twelve hours, or oftener in special cases. As with the pulse-rate, the causes of variations are numerous, and they may or may not be directly associated with the operation.

Causes of Rise of Temperature after Operation.—1. An hour or two after the operation, the temperature occasionally goes up suddenly, and the rise may be ushered in by a rigor. It may occur even after a "clean" operation, such as hernia. In some cases the patient has previously suffered from malaria.

2. A rise of temperature is common on the night of operation, but it need not cause anxiety. Certain operations, such as those on bone or the ligature of hæmorrhoids, are normally followed by a rise. In children the temperature is more easily disturbed than in adults, and it is frequently above normal soon after operation.

3. In certain patients, a distended bladder may produce a rise in temperature, though more frequently the pulse alone is upset.

4. Constipation is one of the commonest causes of pyrexia on the third or fourth day after operation, or even earlier if the preliminary preparation of the patient has not been thorough. If in doubt, the surgeon usually orders a purgative, and watches the effect on the temperature.

5. Tension is another common cause of elevation of temperature. Even in the absence of sepsis, a collection of blood under the skin or in a closed cavity such as the skull, or tight packing in a cavity may cause some degree of fever.

In septic cases, anything which interferes with the free escape of discharge leads to an absorption of toxins, which is quickly manifested by an increase in the pulse-rate and rise of temperature. In the absence of tension, sepsis frequently causes no elevation of temperature. Hence it is important to ensure a free escape of discharge, if such is present, by removing one or more stitches, or by inserting a drain.

6. Apart from the wound, a septic condition such as erysipelas or septicæmia may arise, and be ushered in by a rise of temperature.

7. Excitement and fright are apt to cause a rise of temperature in nervous patients.

8. Some condition other than the surgical affection may be the cause of the high temperature—a chill, influenza, the onset of bronchitis, pneumonia, nephritis, malaria, whooping-cough, measles, the presence of a tuberculous lesion, and many others.

The Indications for Dressing an Operation Wound.—Aseptic wounds theoretically require no dressing till it is time to remove the stitches. But it is advisable to look at them earlier, especially to ensure that no blood has collected under the skin as the result of reactionary hæmorrhage. Septic wounds, on the other hand, should be dressed once a day or oftener, according to the severity of the poisoning. The main indications for dressing a presumably aseptic wound are:—

(1) *Feeling of Discomfort in the Wound.*—If the dressing becomes caked with blood or serum, its renewal adds greatly to the patient's comfort. This may be done twenty-four or forty-eight hours after the operation. If the wound appears swollen, it should be probed to allow any effused blood to escape.

(2) *Appearance of Discharge on the Surface of the Bandage.*—If the dressing has been soaked through with blood or serum, organisms readily multiply in the discharge, and gradually spread inwards to the wound. It is not enough to put a fresh pad of sterile or antiseptic wool on the outside of the original bandage. The bandage must be loosened and the wool replaced by dry, sterile or antiseptic wool. If the amount of hæmorrhage is great, or if it occurs in cases in

which it is not expected, the surgeon must be at once informed.

(3) *Escape of Urine on to the Dressing.*—In children, and in patients with an opening into the bladder, the dressing may be soaked with urine. In such the only chance of keeping the wound aseptic is by frequently changing the dressing.

(4) *The Removal of a Drainage-tube.*—If a drainage-tube has been inserted, for example when reactionary hæmorrhage is thought probable, it should be examined within twenty-four hours, to ensure that it is not plugged with blood-clot, and removed as soon as it has served its purpose—in twenty-four to forty-eight hours.

(5) *Much pain in the region of the wound*, especially after the first twenty-four hours, is an indication for dressing the wound. If a stitch is too tight, or being dragged on by the dressing, if tension has ensued from a collection of fluid under the wound or the blockage of a drainage-tube, the pain is generally relieved by removing these sources of irritation.

(6) *If the dressing has a disagreeable odour*, it ought to be renewed.

(7) *A rise of temperature* at any time after the first twenty-four hours is a condition calling for an inspection of the wound. As previously stated, other causes of rise of temperature besides sepsis are possible, but it is advisable to examine the wound in every case.

(8) *An increase of pulse-rate* may indicate the presence of sepsis, especially in the peritoneal cavity, without any pyrexia. Again the wound should be examined and dressed.

(9) *The removal of stitches* calls for the dressing of the wound, usually on the eighth to the tenth day. In face and neck wounds, they should be removed on the fourth or fifth day to diminish the marks caused by the stitches.

(10) *After the removal of the stitches*, a wound which is running an aseptic course, need not be dressed oftener than once or twice a week. A rare accident is the bursting open of a wound after the removal of the stitches when the healing power is low. The treatment is to close up the wound by sutures—"secondary" sutures (p. 215).

SECTION V.

SPECIAL OPERATIONS: PREPARATION AND AFTER-TREATMENT.

CHAPTER XIX.

ABDOMINAL CASES: TREATMENT AND NURSING.

THE **general instruments** to be sterilized for an abdominal operation include those mentioned in the list on page 119, and in addition intestinal needles, and intestinal silk. The preparations for abdominal operations and the after-treatment of the patients vary so widely that it is necessary to consider individually the main operations. But such complications as are liable to arise after any laparotomy, i.e. any operation in which the peritoneal cavity is opened into through the abdominal wall, may be first considered.

COMPLICATIONS OF LAPAROTOMY.

Shock in its more serious degrees is met with more commonly in abdominal operations than in any others. The more the bowel is handled, the greater in general is the degree of shock; and the higher up in the abdomen the operation is, the greater the shock tends to be. The precautions taken to prevent it as far as possible, and the means taken to combat it when it does occur, have already been described.

Hæmorrhage is described with the individual operations.

Anæsthetic sickness is often troublesome after laparotomy (p. 180). It is sometimes very like commencing peritonitis.

Pain is rarely entirely absent after an abdominal operation. It is usually spasmodic, and is mainly due to irregular peristalsis of the intestine, which continues until the bowels have moved. The entire absence of pain is a common feature of post-operative peritonitis, and, as such, is a serious sign.

The present tendency in the treatment of pain is to avoid giving morphin. The administration of saline solution by the rectum is useful in relieving it. If the pain is excessive, and especially if it is accompanied by cramps of the abdominal muscles, morphin, $\frac{1}{6}$ to $\frac{1}{3}$ grain, should be injected hypodermically. Short of this degree of pain, it is best to try the effect of an evacuant enema, as described below for flatulence, or some of the measures mentioned on p. 185.

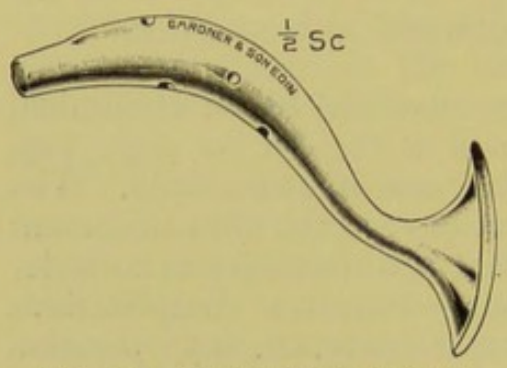


FIG. 115.—GLASS FLATUS TUBE.

Flatulence and Meteorism.—The presence of an excess of gas in the intestine is often known as flatulence, but this word is so commonly used to denote repeated eructations of gas from the stomach after operation that it is perhaps advisable not to apply it to the intestine. The intestinal gases irritate the bowel, and are the main cause of the irregular peristalsis and spasms of pain. When they are in such amount as to cause obvious distension of the abdomen or part of it, the condition is known as *meteorism* or *tympanites*. The increased formation of gas in the bowel is associated with the decomposition of the intestinal contents. It gradually increases in amount, as in the early stages none of it is got rid of by the rectum. It is one of the nurse's duties to note the passage of flatus in every abdominal case, and she should always instruct the patient to let her know each time he passes flatus until the first movement of the bowels.

Treatment.—The inability to pass flatus may be due to spasm of the anal sphincter, and in such a case the passage of a flatus tube of strong rubber, vulcanite, or glass (Fig. 115) into the rectum is of service in allowing gas to escape. But

more frequently the inability to pass flatus is due to the absence of the power to expel it by contractions of the abdominal muscles. Then we have found that the flatus tube does no good. If the gas is accumulated in the large intestine, the most certain method of getting rid of it is to give an enema. This may be either the usual soap and water enema, one to two pints, with an ounce of turpentine added to stimulate the contraction of the bowel, or the small "ward enema" or "flatus enema," consisting of an ounce of glycerine and half an ounce of Epsom salts dissolved in six ounces of water. It ought to be administered by tube and funnel, and not by a ball syringe (p. 60). One or two hypodermic injections of physostigmin (eserin), $\frac{1}{30}$ grain, or atropin, $\frac{1}{120}$ grain, are sometimes useful in stimulating the intestine to contract.

Constipation is usually present after laparotomy, and must be counteracted by the administration of a purgative. It should be given soon, usually on the second or third day. Castor oil, 1 ounce, calomel, 4 grains, or Henry's solution, 2 ounces, is most commonly selected. In certain patients, however, calomel produces sickness and faintness, and has a depressing effect. It should be followed by a saline purge, such as Epsom salts, in every case, as it is apt to keep the bowels moving all day if it is not washed out of the intestine. Whatever purgative is administered, if it does not act in eight to ten hours, an enema of soap and water with turpentine, or of heated olive oil, 10 ounces, should be given, and repeated if necessary.

Sepsis occurs in various forms. The least serious degree is a *stitch abscess*, due to skin organisms which have escaped at the preparation of the skin, or to organisms implanted during the operation, growing along the line of the stitch. If the infection is confined to one stitch, this should be cut and removed. It is the chief advantage of the interrupted suture method that this can be done without interfering with the rest of the stitches.

A *subcutaneous infection* of the wound may also occur from the introduction of organisms from the outside. But a more frequent source is from the inside, for example by contamination of the wound with the contents of divided bowel or of an appendix abscess. It is well established that the tissues

of the wound are more liable to septic infection than the peritoneum, and for this reason many surgeons take the precaution of putting on a fresh pair of sterile gloves before they proceed to stitch up the wound.

The infection may not be obvious for three or four days or even a week after the operation, and there may be little or no constitutional disturbance. In other cases, when the bacteria are virulent, the infection may be accompanied by severe pain in the wound, high temperature and pulse-rate, and symptoms of general toxæmia.

A special variety of infection of the wound is due to catgut which has not been thoroughly sterilized. It does not show till the seventh to the tenth day, and it is generally of a mild type. It is not usually necessary to open up the wound from end to end. One or two stitches should be removed, the collection of pus tapped by inserting dressing or sinus forceps and opening their blades, and a drain of rubber tubing, gauze, or rubber tissue inserted.

Post-operative Peritonitis is the most serious form of sepsis met with in the abdomen. It may be due to micro-organisms introduced at the operation, or to the spread of the disease for which the operation is performed. The two most constant symptoms are increasing distension of the abdomen and increasing frequency of the pulse. The distension is due to paralysis of the intestine, which is unable in consequence to drive out the accumulating gases. No flatus is passed, and the bowels do not move in spite of strong purgatives and enemata. In addition, spasms of pain are very frequently absent, and the patient often says he feels very well. Always suspect peritonitis if the patient has no discomfort after an abdominal operation, a rapid pulse, and a distended belly. Although he may feel well, his face is drawn and has an anxious expression. The temperature is often subnormal throughout, but in other cases it is raised. Vomiting usually occurs at some stage. It may be almost continuous, and then it is simply a regurgitation of the brown fœtid intestinal contents without any retching. In other cases, the decomposing material may collect in the stomach without being ejected oftener than once a day. Occasionally no vomiting occurs till just before death, when a large

quantity of brown foul-smelling material, often mixed with blood, is brought up.

The *treatment* of post-operative peritonitis is unsatisfactory. The general custom is to try and get the bowels to move by purgatives and enemata. It is doubtful, however, if purgatives administered by the mouth ever get beyond the stomach when peritonitis is well established. Food has little chance of being absorbed, and probably it only increases the amount of decomposition in the stomach and bowel. Stimulants such as strychnin, digitalin and strophanthin are also of doubtful benefit.

The most recent form of treatment in cases of diffuse peritonitis is to keep the intestinal canal at rest. No food or drug is administered by the mouth, but the stomach may be washed out at intervals if regurgitant vomiting is present. Saline solution is administered by the rectum to counteract the severe degree of shock which is invariably present. It may be administered four-hourly or continuously (p. 61); if the former, 6 to 10 ounces are sufficient for each infusion; if the latter, it should flow at the rate of 15 ounces each hour. The patient is propped up by high blocks at the head of the bed, or by pillows into a half-sitting posture. This is called the Fowler position, in which any fluid in the abdominal cavity falls down into the pelvis, from the peritoneum of which the absorption of toxins is least active. If the tympanites is very severe, the surgeon may open a distended coil (enterostomy) to empty it.

If the patient is going to recover, the first distinct sign is usually the passage of flatus or fæces. The pulse becomes slower and fuller, the temperature rises to normal, the vomiting diminishes, and the distension lessens. With these signs present, the patient should be fed with a nutritious and stimulating diet, and rectal salines should be continued.

Acute Dilatation of the Stomach, or **Acute Gastro-mesenteric Ileus,** is a grave condition which may arise after abdominal operations, especially those on the gall-bladder, kidney and appendix. It is probably due to obstruction of the third part of the duodenum by traction on the root of the mesentery. It is characterized by the vomiting of large quantities of dark green or brown material at shorter or

longer intervals. The patient rapidly becomes emaciated, and complains bitterly of thirst. The treatment consists in giving nothing by the mouth, frequently washing out the stomach, and making the patient lie on his belly. Gastro-enterostomy has occasionally been performed.

Localized Peritonitis may occur either from the original disease, or from infection introduced at the operation. The commonest varieties are the abscess which forms in cases of appendicitis and the sub-phrenic abscess. The spread of the infection to the whole peritoneal cavity is prevented by the formation of adhesions around the infected area. These adhesions may, however, break down as the result of the sepsis, and general diffuse peritonitis occur. Hence it is important that the surgeon should at once open and drain any collection of pus in the abdominal cavity. The symptoms of localized peritonitis vary in degree. They may be almost as severe as in the diffuse form, or they may be so slight that the condition is overlooked.

Sinus.—An abdominal wound that has been drained may not close up entirely when the drain is removed. The track that persists is called a *sinus*. After long-continued drainage, the walls of the track may become densely fibrous, and unable to contract and close. For this reason, drainage-tubes should be shortened and reduced in calibre every few days. Never continue to use a drainage-tube which completely fills the track. If a sinus persists in spite of careful treatment by dressings, the only method of dealing with it is to dissect out the fibrous wall.

The other common cause of a persistent sinus is the presence of an unabsorbable septic substance at the foot of the wound, for example a concretion, a gauze swab, or a silk ligature. The sinus usually closes when the source of irritation is removed.

Fæcal Fistula.—A track which leads from the skin down into a hollow viscus such as the intestine or bladder, is called a *fistula*. If bowel contents escape on to the dressing, it is called a fæcal fistula. It is due to imperfect closure of an opening in the bowel at the operation, or to the subsequent formation of an opening as the result of sloughing. The dressing should be frequently renewed, and the track washed

out gently with saline solution and lightly packed with gauze. Fæcal fistulæ usually close by such means, but in a few cases surgical interference is necessary.

If the opening in the bowel is in the small intestine, the contents are irritating to the patient's skin, and the surgeon or nurse must prevent irritation by frequent dressing, by thorough washing each time the wound is exposed, and by the application of vaselin to the surrounding skin.

If the fistulous opening is high up in the small intestine or in the stomach, and much of the contents escape, the nutrition of the patient becomes a serious problem. Nutrient enemata must then be administered till the fistula is closed, or at least diminished in size.

Rupture of the wound after the stitches are removed is most frequently met with as a complication of abdominal operations. It may affect the whole length and depth of the wound, or only part of it. In the former case, the patient himself usually knows that something has given way, and the nurse may either send for the surgeon at once, or first inspect the wound. She will discover that coils of intestine are lying on the surface, and others make their appearance after the bandage is loosened. The dressing should be at once re-applied and the bandage fixed. On no account is the nurse to touch the bowels with her fingers. The dangers of such an accident are shock and peritonitis. It is treated by stitching up the wound afresh, and confining the patient to bed for other three weeks.

Gaping of the more superficial layers of the wound is usually caused by extravasation of blood into them or by septic infection. If the skin and subcutaneous tissue are alone affected, the edges should be approximated by strips of adhesive plaster, but if the aponeurosis has not united, *secondary sutures* of silk-worm gut give the best chance of complete union. These stitches must include the aponeurosis on each side, and not merely penetrate the skin and fat. The application of strapping, though frequently sufficient, may fail to prevent the occurrence of a ventral hernia.

Ventral Hernia is the protrusion of a loop of intestine or a part of some other organ through a gap in the deep layers of an abdominal scar. The gap results occasionally from

reactionary hæmorrhage into the wound, or from the catgut stitches giving way too soon, but more commonly it is due to sepsis and sloughing of part of the aponeurosis. The treatment consists in dissecting out the scar tissue, and closing up the wound in layers.

Intestinal Adhesions.—Adhesions between intestinal coils, and between the intestine and the wall, occur after the majority of abdominal operations. They may cause no trouble, or give rise to intestinal obstruction or, in lesser degree, to chronic pain and constipation. To prevent the formation of adhesions, the introduction of sterilized vaselin oil into the peritoneal cavity at the time of the operation is recommended.

Parotitis and **Hypostatic Pneumonia** were referred to on pages 197 and 199.

HERNIA.

HERNIA or RUPTURE is a protrusion of a portion of bowel or omentum through an abnormal opening in the abdominal wall. The commonest situations are the groin, the top of the thigh, and the navel, in which cases the rupture is called respectively an *inguinal*, *femoral*, or *umbilical* hernia.

At first the herniated loop of bowel may go back into its proper place if the patient lies down, and later it may be pushed back by *taxis*, i.e. manipulation by the fingers. In both these conditions the hernia is said to be *reducible*. A reducible hernia may in many cases be "kept up" by a suitable truss which requires to be specially made for each patient.

TRUSSES.—A truss is a belt, containing a strong spring, which encircles the body, and is fitted with a pad by means of which the force of the spring is applied accurately over the opening through which the bowel protrudes. The pad is made of cork covered with chamois leather.

The commonest and most generally useful truss is that known as the *Circular* or *Spring Truss*, which may be adapted for one side or for both (Figs. 116, 117).

The truss should be applied before the patient gets out of bed in the morning, and should not be taken off till he has

lain down at night. In this way the hernia is never permitted to come down, and the opening has a chance of becoming permanently occluded.

The Mocmain Lever Truss (Fig. 118) is very comfortable to the patient, but less secure than the spring truss.

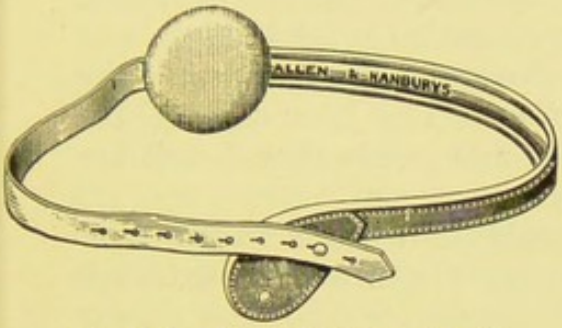


FIG. 116.—SINGLE SPRING TRUSS.

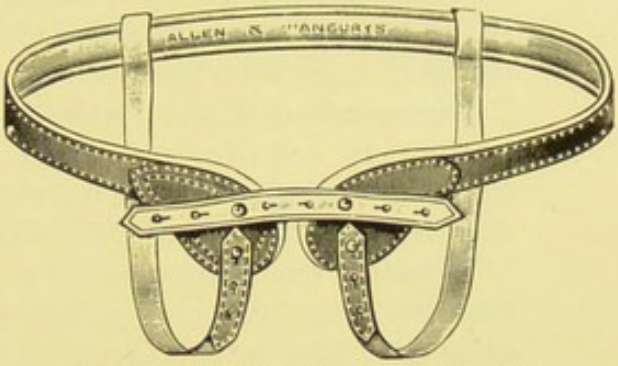


FIG. 117.—DOUBLE SPRING TRUSS.

Salmon and Ody's Truss (Fig. 119) has its pad fitted on a ball-and-socket joint, which admits of close application, and prevents its displacement by movements of the patient. It has a posterior pad, which rests on the spine, and the spring passes round the side *opposite to* the hernia.

For umbilical hernia various belts and trusses are employed.

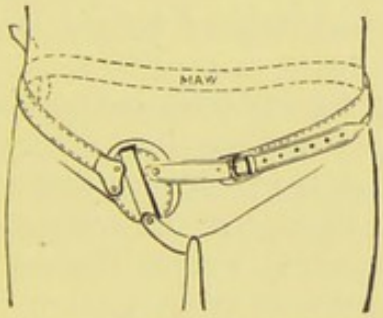


FIG. 118.—MOCMAIN LEVER TRUSS.

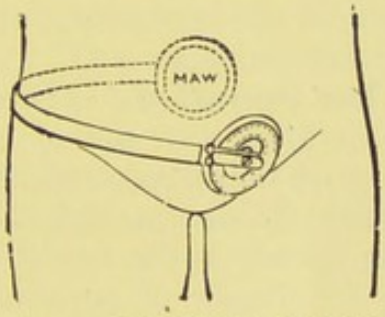


FIG. 119.—OPPOSITE-SIDED TRUSS.

Trusses are not now so frequently worn as in former years. The patient with a hernia, even if it is reducible, is becoming more anxious to have it completely and permanently cured. The operation which is necessary is called the radical cure of hernia.

RADICAL CURE OF HERNIA.—In many cases the surgeon recommends operation for rupture even when the patient is unwilling to submit to it. If it cannot be completely controlled by a truss, or if the patient is going to live in a district in which he will be out of reach of a surgeon, he should be operated on, owing to the risk of strangulation. Again, if the hernia is *irreducible*, i.e. if the bowel cannot be manipulated back into the abdomen, operation is advisable.

Preparation of the Patient.—No special preparation of the patient is required in these cases. The diet, care of the bowels, cleansing of the operation area, and other details are the same as described in Chapter IX.

Special Instruments.—In addition to the instruments used in other surgical operations (p. 119), the *Hernia Knife* (Fig. 96) may be sterilized.

Macewen's Needles (Fig. 120), right- and left-handed, are

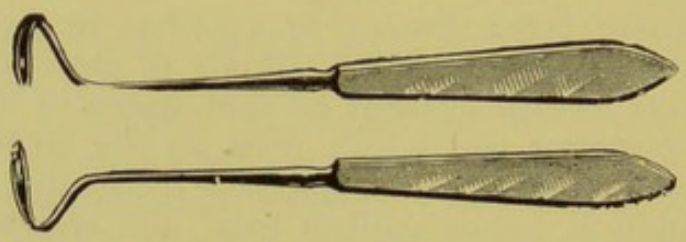


FIG. 120.—MACEWEN'S HERNIA NEEDLES, RIGHT- AND LEFT-HANDED.

used in the operation for the radical cure of hernia devised by that surgeon.

The Operation.—The operation for radical cure consists in obliterating the sac of parietal peritoneum into which the loop of bowel protrudes, and in closing the opening or reducing its size, so that there is no chance of recurrence. In this operation the bowel is little touched, so that there should be no chance of peritonitis, the gravest complication of all abdominal operations.

It is necessary, in the case of inguinal or femoral hernia, especially in children, to keep the dressings dry. It has already been stated that the soaking of the dressing with urine is, owing to the risk of sepsis, an indication for dressing the wound (p. 208). In very young children, it is advisable not to apply a bandage. The wound may be simply smeared

with a paste of bismuth subnitrate, 2 parts, and iodoform, 1 part, purified in 1 in 1000 corrosive, or covered with a small gauze swab which is kept in position by adhesive strapping or collodion. When a bandage is used, the attempt is sometimes made to keep it dry by pinning a square of jaconette over it, but we have not found it convenient. A good plan is to strap the legs to a cross-bar, as in fracture of the femur in children (Fig. 398). In older patients, the bandage for inguinal and femoral cases is applied as a spica of the groin (p. 83).

After-Treatment.—It is an advantage to raise the foot of the bed slightly, or place a pillow under the knees, to take the strain off the abdominal wound. The diet should be fluid till the bowels have moved. The first purgative is usually administered about forty-eight hours after the operation. According to the wishes of the individual surgeon, the patient is to be kept in bed for two, three, or four weeks.

Special Complications.—*Retention of Urine* frequently occurs after the operation. If the bandage is loosened, the patient may be able to empty the bladder, but if not, it is better to pass a catheter than risk any strain on the wound by allowing the patient to sit up.

Persistent vomiting is occasionally met with after the radical cure of large herniæ. It seems to be due to the replacement of the large quantity of intestine into the abdominal cavity, where there is not enough room for it to lie without causing too great pressure. The main indication in the treatment is to empty the bowel of its contents, and so make more room.

Sepsis is a trying complication, as it sometimes results in sloughing of the deep layers of the wound, and recurrence of the hernia.

Strangulated Hernia.

In strangulated hernia we have the same sac, and the same loop of bowel contained in it, but something has happened at the neck of the sac which prevents the bowel going back into the abdomen. The results are twofold: (1) The onward passage of the fæces is arrested, a condition

known as *intestinal obstruction*; (2) the circulation of blood in the herniated loop of bowel is stopped, the loop is not nourished, and it soon becomes gangrenous or dead; then bacteria escape from its interior, and set up peritonitis. Hence strangulation of a hernia is a condition dangerous to life, and an immediate operation is usually performed. If, however, the patient is seen early, the effect of rest and raising the foot of the bed may be watched for a few hours, as these measures may suffice, especially in children, to remove the strangulation.

The Preparation of the Patient is confined to the preparation of the operation-area, and even this may require to be done on the operating-table. No purgative is to be administered even if time does permit, e.g. in the case of a patient who lives far from a surgeon. Even the rectum should not be washed out by an enema. If the intestinal obstruction has lasted some time before the operation is carried out, and fæcal vomiting has set in, the nurse must have in readiness the necessaries for washing out the stomach (p. 64) before the operation is begun.

Special Instruments.—In addition to the special knife (Fig. 96) and needles (Fig. 120), a hernia director may be put out, but it is now little used. Intestinal clamps (Fig. 126), fine, rounded or right-angled, intestinal needles, and No. 0 silk, as well as one or two Paul's tubes (Fig. 131) must be ready sterilized, in case resection of the damaged loop of bowel or enterostomy is necessary.

Spence's Hernia Director (Fig. 121), used to guide the knife to the constricting-band in the operation for strangu-

FIG. 121.—SPENCE'S HERNIA DIRECTOR.

lated hernia, is about three times as broad as the ordinary director (Fig. 61), and the groove is not so deep.

Key's Hernia Director (Fig. 122) is also broad with a shallow groove, and in addition has a distinct curve on the blade.

The operation is undertaken to save the patient's life by relieving the obstruction of the bowels. The radical cure of

the hernia is a secondary matter, though it is usually performed in early cases after the strangulation has been relieved. In late cases, with distension of the bowel and fæcal vomiting, it may be necessary to perform enterostomy in order to get the bowel emptied as quickly and completely as possible. If the loop of bowel has already become gangrenous, it may either be excised (enterectomy), or, if the patient is *in extremis*, merely brought to the surface and opened above the dead area. Then a second operation is necessary at a later date to close the bowel and deal with the sac and opening in the abdominal wall. In early cases, when the radical cure is performed, the dressing is the same as for the radical cure of ordinary hernia. If enterostomy has been necessary, the dressing is as described on p. 234. The nurse must have everything ready for either event.

After-Treatment.—Formerly it was the practice to keep the bowels closed for eight or ten days; but it is now recognized

FIG. 122.—KEY'S HERNIA DIRECTOR.

that if the constricted loop of bowel is going to recover at all, it will do so soon. Hence the purgative, preferably castor oil, is given in twenty-four to forty-eight hours according as the patient has suffered to a greater or a less extent from toxæmia before the operation. If he is badly poisoned or the bowel is much distended, a soap and water enema, with a tablespoonful of turpentine, may with advantage be given twelve hours after the operation. If fæcal vomiting has been present, and continues after the operation, the stomach should be repeatedly washed out. Once the patient has passed flatus and the bowels have moved, the treatment is the same as for any ordinary operation, except that the fluid diet may be continued for one or two days more than usual to prevent the formation of solid fæces, and so favour the complete recovery of the damaged loop of bowel.

The **special complications** are not related to the operation, but to the damage done to the loop of bowel by the strangula-

tion. If the condition has gone on for some time before operation, the contents of the loop decompose and *toxæmia* is produced by the absorption of the poisons. *Peritonitis* may result from the escape of bacteria through the damaged walls of the gut. Occasionally *rupture of the loop*, which becomes gangrenous from the cutting off of its blood supply, occurs, and peritonitis ensues.

Operations on the Stomach.

Shape and Size of the Stomach.—It is important in certain conditions to know the shape and size of the stomach before operation; for this purpose, the blue-paper powder of a Seidlitz powder may be given first, and ten minutes later that in the white paper. The gas which forms when the two mix distends the stomach and shows up its size and shape. The same purpose is served by passing a stomach tube, to the outer end of which a ball syringe is attached, and gently pumping in air.

A Test Meal is often ordered by the surgeon when he wants to know the characters of the digestive juice secreted by the stomach. A cupful of tea without milk or cream, and a slice of dry toast are given, and the contents of the stomach are withdrawn in an hour and a half and tested.

Gastroscopy is the direct inspection of the mucous lining of the stomach by an instrument known as the gastroscope. This is composed of short segments of metal tubing, so connected that the whole forms a flexible tube which can be straightened after it has been passed to the stomach. Then air is pumped in to distend the stomach, and the small electric light contained in the beak of the gastroscope is switched on.

Gastrostomy.

This operation consists in the making of an opening in the stomach, by which food may be poured in. It is done in cases in which the channel leading from the mouth to the stomach is blocked, so that the patient cannot swallow enough food to nourish his body.

Preparation for Gastrostomy.—These patients are usually half starved, and the first meal is given on the operating-table. Hence the nurse must prepare food—usually 6 to 10 ounces of warm milk to which a peptogenic powder is added ten minutes before it is introduced into the stomach.

The Instruments are the same as for any abdominal operation, with the addition of a sterilized rubber tube, eighteen to twenty-four inches long, and of the calibre of a number 10 rubber catheter; a metal clamp is required to occlude the tube between meals. In specially feeble patients, the surgeon may do the operation under local anæsthesia.

The After-Treatment is important. Fluid food only is administered—through a funnel fixed into the outer end of the tube. Peptonized or malted milk, thin custard or corn-flour, beef-juice, beef-tea, switched eggs, and many other stimulating and nourishing preparations may be given, at intervals of two, four, or six hours. The quantity of each meal depends on the size of the stomach, which is often very small in these patients, and it should be determined by the surgeon. The greatest care must be taken by the nurse not to displace the tube during the first four or five days, as it is difficult to re-insert it. After the first week the tube should be removed and cleaned at intervals of a day or two.

Special Complications.—(1) *Shock* sometimes proves fatal in the early days after operation. The patients have not been properly nourished before operation, and they have feeble recuperative powers.

(2) *Leakage of stomach contents* along the outside of the tube is a source of irritation to the skin. The frequent application of vaselin or other simple ointment spread on lint, or of a dressing soaked in sodium carbonate or bicarbonate to neutralize the acid, is required in such a case.

(3) *Pneumonia* may occur, but not so frequently after gastrostomy as after gastrectomy (p. 228).

Gastro-Enterostomy and Gastro-Duodenostomy.

Gastro-enterostomy, or Gastro-jejunostomy, is the formation of a new opening between the stomach and jejunum. In *gastro-duodenostomy*, the new opening is between the stomach

and the duodenum. These operations are performed in cases in which the outlet of the stomach, called the pylorus, is narrowed to such an extent that the free escape of the gastric contents into the small intestine is interfered with. They are usually performed for pyloric ulcer or cancer. In addition, gastro-jejunostomy is performed in some cases of duodenal ulcer.

Preparation.—In cases of gastric and duodenal ulcer, the excessive acidity of the stomach should be counteracted for several days before operation by avoiding stimulating articles of diet, such as soups, red meat, coffee, and condiments. Milk, milk puddings, bread, eggs, easily digested fats, fish and chicken are allowed, but as little salt as possible should be taken with them. Sodium bicarbonate, 10 to 15 grains

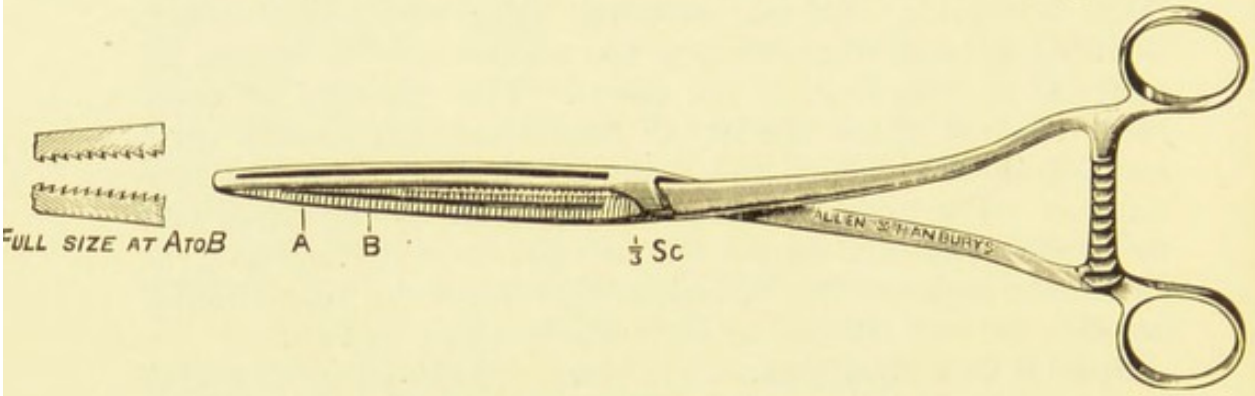


FIG. 123.—MOYNIHAN'S STOMACH CLAMP.

thrice a day, should be administered an hour and a half after meals. If the stomach is dilated, and its contents are decomposing, it should be washed out at intervals with a weak solution of Condy's fluid or sodium bicarbonate.

Special Instruments.—Some surgeons use clamps (Fig. 123) for holding the segments of stomach and jejunum in apposition during the stitching. A pair of tissue-forceps (Fig. 124), fixing the two organs together at each end of the suture line, take up less room.

The After-Treatment is of the utmost importance for the cure of the ulcer. When the patient has recovered from the shock of the operation, he is propped up in bed with pillows to assist the flow of the gastric contents through the new dependent opening. If he cannot sleep in this position, he

may be turned on his right side and his head lowered. For the first fortnight, the diet must be carefully regulated, and this is done by the surgeon himself. The diet should be non-stimulating, so as to diminish the acidity, and in some cases sodium bicarbonate, 5 to 10 grains thrice a day, may be given. If at any time there are pain and a feeling of weight and distension in the stomach, a symptom which is apparently due to spasmodic contraction of the new opening, soda should first be tried. If this fails, the stomach tube is passed carefully, and the contents siphoned off. At the same time, the diet should be reduced in quantity.

On the other hand, if the operation has been performed for cancer, in which the acidity of the gastric juice is usually lowered, dilute hydrochloric acid may be required, 20 minims

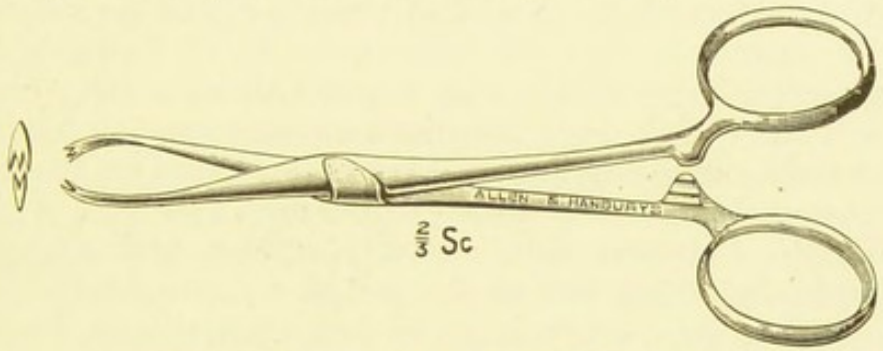


FIG. 124.—TISSUE OR PERITONEUM FORCEPS.

of a 5 per cent. solution being added to each ounce of fluid. In some cases, however, it increases the pain and has to be stopped. Bitter tonics, such as infusion of quassia and tincture of nux vomica, and a stimulating diet, including roast beef, salted meat, beef-juice, strong soups, and fruits should be given to tone up the digestive powers.

Diet after gastro-enterostomy for ulcer.—The after-treatment of gastro-enterostomy varies in different hospitals, but the presence of an unhealed ulcer must always be kept in mind. As in the medical treatment of gastric and duodenal ulcer, the most certain method of healing the ulcer is rest to the stomach, and this is best attained by rigidly restricting the patient's diet. In a typical case, with no anæsthetic sickness or other complication, the following diet may be recommended, each period being of twelve hours: *First period*,

½ pint of saline solution by the rectum four-hourly, these infusions being continued for four or five days; *second period*, 1 drachm every hour of sterilized water or albumin water (see below); *third period*, 1 drachm of the same two-hourly alternating with 1 drachm of weak chicken tea two-hourly; *first half of fourth period*, double quantities of the same; *second half of fourth period*, if patient is well, ½-ounce feeds two-hourly. As weakness is gradually increasing, during the fourth and subsequent periods the patient should, if necessary, be roused from sleep at the meal-times; *fifth period*, 2 drachms of milk diluted with 2 drachms of water four-hourly, alternating with ½ ounce of chicken tea or albumin water four-hourly; *sixth period*, 1-ounce feeds of the same four-hourly; *seventh period*, 1½ ounces of Benger's food once instead of one meal of milk and water; *eighth period*, ditto. For the next two days the same quantity of Benger's food along with a finger of dry toast is given thrice a day; on the seventh and eighth days the meals are increased to 2 ounces four-hourly, one being replaced by custard, and on the ninth day pounded chicken is added to the diet, and milk is given undiluted. Pounded fish, rusks, cornflour and arrowroot are gradually added, and at the end of a fortnight the four-hourly meals may be replaced by breakfast, dinner, tea, and supper.

To Make Albumin Water.—Take two cups and place the white of an egg in one. Pour it slowly into the other, clipping it all the time with scissors so as to divide the thin membrane that surrounds the white and prevents it mixing with water. Repeat the process for several minutes, and then add water to make half a pint.

Special Complications.—(1) *Hæmatemesis* sometimes occurs as the result of reactionary bleeding after the operation, or of hæmorrhage from the ulcer, the blood collecting in the stomach, and causing vomiting of dark brown or black material. If the hæmorrhage is severe and is vomited at once, it may not show these changes in colour. The withdrawal of all food by the mouth is usually sufficient to stop the bleeding. Many give ice to suck, or ice-cold water to sip, but it is doubtful whether these do any good. If the patient is anxious or restless, morphia, ¼ to ⅓ grain, should be injected hypodermically.

Less commonly the blood escapes into the peritoneal cavity, and the usual signs of internal hæmorrhage appear (p. 191).

(2) *Persistent vomiting* after the operation, is due to the irritability of the stomach after the handling, and to the after-effects of the anæsthetic. It is treated as formerly described (p. 182). It may also be due to the formation of the so-called *vicious circle*, in which bowel contents regurgitate into the stomach through the new opening. This condition is now rare, but if it occurs it is usually necessary for the surgeon to operate again.

(3) *Regurgitation of bile* into the stomach probably occurs after every gastro-enterostomy, and occasionally causes vomiting. In general, however, it does no harm, and it may do good by neutralizing the excessive acidity of the stomach.

(4) *Infection of the wound* may occur from contamination with the contents of the stomach or jejunum.

(5) *Acute dilatation of the stomach* is rare after gastro-enterostomy. It may be due to kinking of the jejunum, or to a strangulated hernia through the aperture in the meso-colon.

(6) *Leakage* from the new opening into the peritoneal cavity is sometimes found when the operation is performed for cancer. It gives rise to peritonitis, localized or diffuse.

(7) *Gastro-jejunal* and *jejunal ulcer* are usually met with as a late complication. They are in some instances due to the escape of excessively acid material from the stomach into the jejunum. Hence they are best prevented by giving sodium bicarbonate and a non-stimulating diet till the acidity has been reduced to normal.

Gastrectomy.

Gastrectomy, or the removal of the whole or a segment of the stomach, is performed for cancer.

Preparation.—The operation is a severe one, and every effort must be made to improve the patient's strength and nutrition before it is undertaken. If vomiting of the food has been going on for some time, rectal feeding must be adopted before the operation.

Special Instruments.—Kocher's clamp forceps (Fig. 125) are most commonly used for clamping the stomach. Other intestinal clamps (Figs. 126 to 128) are required—one for the stomach, and two for the duodenum.

After-Treatment.—The main points to be attended to are the necessity of giving plenty of nourishment, and the small size of the stomach cavity. Hence rich food is necessary, and it must be given in small quantities at frequent intervals. The stomach may not hold more than 1 or 2 ounces.

Special Complications.—(1) *Shock and Exhaustion* is a frequent cause of death after the operation.

(2) *Gangrene of the transverse colon*, with symptoms of intestinal obstruction and peritonitis, may ensue from interference with its blood-supply (middle colic artery).

(3) *Peritonitis* from leakage may be fatal.

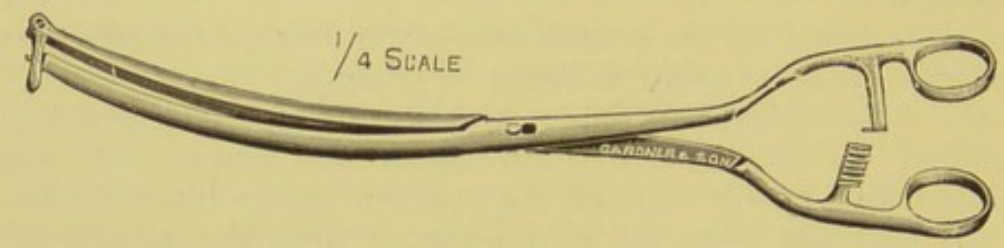


FIG. 125.—KOCHER'S CLAMP FORCEPS FOR USE IN GASTRECTOMY.

(4) *Pneumonia*, either lobar or hypostatic, sometimes develops after gastrectomy, as also after gastro-enterostomy in feeble patients, and other stomach operations. It is more apt to occur if the patients are kept lying flat on the back; hence they should be propped up as soon as possible.

Perforated Gastric and Duodenal Ulcer.

An ulcer may perforate into the general peritoneal cavity, or into the "lesser sac of peritoneum," or into a mass of adhesions. The first condition is the most serious. The rupture may be small, when nothing gets out of the opening but gas and a little mucus containing organisms, or large enough to admit the tip of a finger, when food may also escape. There is a rapid effusion of fluid from the peritoneum which collects in the pelvis. The patient has severe pain and is in a

profound state of collapse for some hours, and then improves so much that the doctor or nurse may be deceived as to the gravity of his condition. Soon the symptoms of peritonitis become obvious, and he goes rapidly downhill.

Preparation for Operation.—If perforation is suspected, no food or purgative is to be given by the mouth, even when the patient appears to improve. Morphia should not be injected to relieve the pain till the diagnosis has been made with certainty. The operation must be undertaken at the earliest possible moment. It consists in opening the abdomen, closing the perforation in the stomach or duodenum, and washing out, or at least draining, the septic material in the peritoneal cavity through a second wound made at the lower part of the belly-wall. The patient has usually to be prepared on the table.

Special Instruments.—The tube and funnel to wash out (Fig. 19), and two or three pints of normal saline solution must be sterilized, and kept in readiness. A large perforated glass or rubber drainage-tube is required for the second opening to drain the pouch of Douglas.

In some cases gastro-enterostomy must also be performed, if closing of the ulcer results in great narrowing of the pylorus or duodenum.

After-Treatment.—The patient should be propped up as soon as possible after operation. The nurse must always keep in mind that the stomach is in an unhealthy condition. There is a row of stitches closing up the perforation, and if the stomach is distended these may give way. Hence copious draughts of fluids must be withheld. If there is no sickness, the wound in the stomach is usually sealed in three or four hours, and then a teaspoonful of albumin water may be given every hour. Later on, the diet should be the same as after gastro-enterostomy (p. 225). If peritonitis is well established, the treatment of it must take precedence (p. 213).

Special Complications.—*Vomiting* may be of food taken before the perforation occurred, of blood which collected at the time of perforation, or of bile which has regurgitated into the stomach. The quantity may be large each time, and the distension of the stomach and straining may tear out one or

more stitches and lead to a return of the leakage. Hence vomiting is a serious complication.

Leakage may occur as above, or as the result of imperfect closure of the perforation. The latter occurs in some cases of duodenal ulcer when the perforation is in an inaccessible situation. In such a case, a large drainage-tube is inserted down to the region of the ulcer. The nurse must look after the skin around the wound, and may have to feed by the rectum if much food escapes (p. 215).

Peritonitis is the commonest cause of death. It is especially fatal in cases in which the operation is not done within twelve or eighteen or at most twenty-four hours after perforation, and those in which perfect closure of the opening is impossible.

Sub-phrenic abscess is more commonly met with after perforated gastric and duodenal ulcer than after any other condition. *Empyema* also sometimes occurs.

Operations for Obstruction of the Bowels.

Obstruction of the bowels may be due to many different causes, of which one has been already mentioned—strangulated hernia. The most obvious symptoms are "stoppage of the bowels," pain, regurgitant vomiting, and distension of the abdomen. The obstruction may be acute or chronic.

In acute obstruction the cause is often not discovered till the abdomen is opened, as is done in every case as early as possible. The operation is called "exploratory laparotomy for relief of obstruction".

Preparation.—There is usually little time for preparing the field of operation. If vomiting is excessive, the stomach should be washed out just before the anæsthetic is administered.

The operation varies with the cause. When the obstruction has been relieved, if the circulation of blood is restored in the affected part of the bowel, and the coats are not irretrievably injured, the abdomen may be closed up again. In such a case, the after-treatment is as in strangulated hernia.

ENTEROTOMY.—On certain rare occasions, the blockage of the bowel is due to a foreign body such as a gall-stone. If the operation is done early, it may then be enough to do enterotomy, i.e. to open the intestine, and close it up again after removal of the stone.

If the affected loop of bowel is so badly damaged that it is unlikely to recover, it is excised—enterectomy.

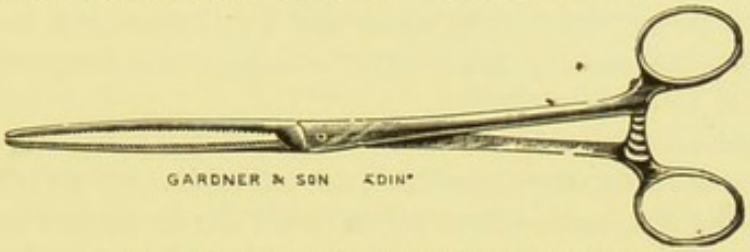


FIG. 126.—DOYEN'S INTESTINAL CLAMP.

ENTERECTOMY OR RESECTION OF BOWEL.—The portion of bowel excised may be only one or two inches, or several feet in length. No special preparation is required.

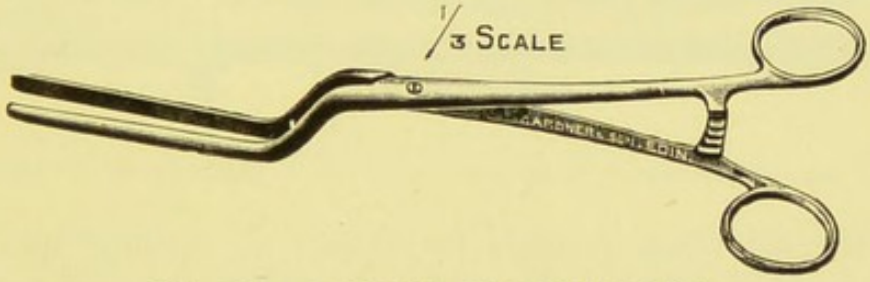


FIG. 127.—BRONNER'S INTESTINAL CLAMP.

Of course no purgative can do any good, and morphia should not be given, at least until the diagnosis has been made, and even not then if the operation can be begun immediately.

FIG. 128.—MAKIN'S INTESTINAL CLAMP.

Special Instruments.—Four intestinal clamps are required, two for each end of the loop to be excised. Many patterns of clamp have been devised. Those in general use are shown in Figs. 126 to 128. Numerous pairs of artery forceps should

be sterilized, as many are usually required in the division of the mesentery. The nurse should have at hand some liquefied carbolic acid to apply to the cut ends of the bowel.

After-Treatment.—This is the same as for a typical abdominal operation. If necessary for regurgitant vomiting, the stomach is washed out. The diet should be fluid—albumin water, milk, and water—till the bowels have moved. The purgative is administered thirty-six to forty-eight hours after operation, but a soap and water enema may be given earlier if there is much distension.

Special Complications.—There are no special complications soon after the operation. Shock may of course be fatal, and also septic absorption from the bowel or peritonitis if the operation has been too long delayed.

At a later period, *stenosis* or *narrowing of the new aperture* may occur, and give symptoms of chronic obstruction, but this is rare.

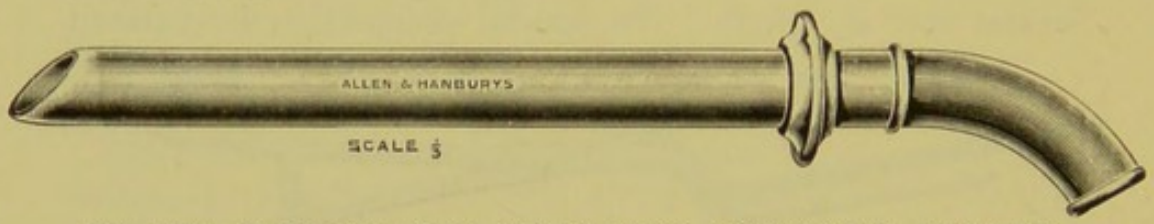


FIG. 129.—MOYNIHAN'S TUBE FOR EMPTYING A SEGMENT OF INTESTINE.

ENTEROSTOMY consists in making an opening into the bowel which is to be kept patent for some days or permanently. It is sometimes all that can be done at the operation for obstruction. If the patient is *in extremis*, and unable to stand a severe and prolonged operation such as enterectomy is, the surgeon contents himself with opening the bowel above the obstruction, in order to empty it of gas and fluid contents. The quickest method of emptying a large segment of the intestine is to insert Moynihan's tube (Fig. 129) into an opening, and pull over it inch after inch of the bowel above the obstruction. A rubber tube is attached to its outer end to direct the contents into a receptacle (Fig. 130). According to the part of the bowel which is thus opened, it is called jejunostomy, ileostomy, or colostomy. At the same time the whole of the affected loop may be brought to the surface for excision at a later date.

JEJUNOSTOMY is performed either for obstruction at a lower level, or for cancer of the pylorus in which food cannot get through into the bowel. In the latter case, the operation is done to provide an opening through which to feed the patient, the first meal being given on the table as in gastrostomy (p. 223). For a jejunostomy, however, the nurse must prepare pancreatized instead of peptonized milk, as all food poured directly into the jejunum must be alkaline. The same precautions are necessary with regard to the tube as in gastrostomy.

In ILEOSTOMY, which is done for obstruction at a lower part of the ileum, or in the cæcum or ascending colon, the instruments required are as in colostomy.

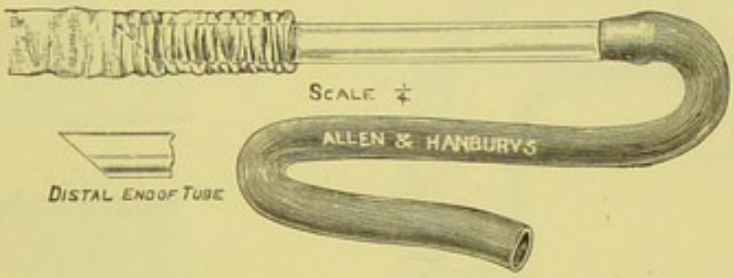


FIG. 130.—MOYNIHAN'S TUBE IN USE.

The main object of the after-treatment is to get the bowels well emptied. A purgative should be administered by the mouth as soon as the sickness stops. The lower bowel should also be well cleared by repeated enemata of soap and water. When the bowel is sufficiently emptied, and the patient has got rid of toxæmic symptoms, the surgeon may proceed to excise the affected loop, and suture the bowel again—enterectomy. In other cases this is impossible. He may then make a new communication between the ileum and colon—ileo-colostomy—the after-treatment being as in enterectomy, or leave the enterostomy opening permanently. Then the nurse must take care of the skin around, as it is irritated by the intestinal contents. This is best done by applying ointment dressings (p. 215). Alkaline dressings are of no advantage, as the contents low down in the ileum are already alkaline. If the opening is high up in the

ileum, great difficulty will be experienced in maintaining the nutrition of the patient.

Colostomy.

Colostomy is the most frequently performed of all enterostomies. It is usually a palliative operation in cases of inoperable cancer of the rectum or some part of the colon, to provide an outlet for the fæces. It is often done as the first step in the excision of cancer of the colon or rectum.

Preparation.—Though the abdomen is often greatly distended at the time of the patient's admittance to the ward, no purgative or enema must be given without the surgeon's

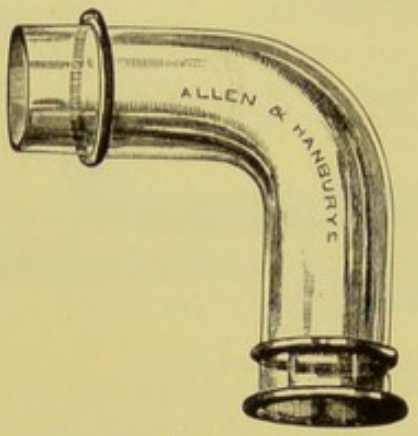


FIG. 131.—PAUL'S COLOSTOMY TUBE.

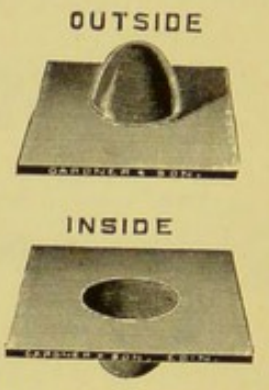


FIG. 132.—RUBBER CAP FOR COLOSTOMY OPENING.

orders. If the operation is to be done at once, no food should be given. If not, then liquid food is alone allowable, as it forms less bulky fæces than solid food.

Special Instruments.—Intestinal clamps (Figs. 126 to 128) are necessary, if the bowel is divided completely. Several *Paul's tubes* (Fig. 131) of different sizes must be boiled and kept in readiness. Sometimes a *straight glass-rod*, about three or four inches in length, is required to insert under the affected loop of bowel which is brought to the surface. Iodoform gauze in a long strip, several layers in thickness, is often used to pack round the loop, and the gauze dressing is smeared with vaselin.

After-Treatment.—The first purgative should be given as soon as the anæsthetic sickness disappears. In case an

enema is also necessary, the nurse must know which is the upper end of the divided bowel, and insert the tube into it. After the bowels move, a rich diet, containing milk, eggs, and meat should be given. Twice or thrice a week, the bowel below the "artificial anus," as the new opening is often called, should be washed out with hot water, boric lotion, or, if it is foul-smelling, creolin or other deodorant. If the skin around the opening becomes irritated by contact with the fæces, it must be protected by an ointment dressing. When the patient is able to move about, a rubber cap (Fig. 132) may be worn over the artificial anus to keep the parts clean.

Special Complications.—*Shock* sometimes causes death soon after operation, if the patient is feeble and suffering from septic absorption as the result of obstruction.

Prolapse of the mucous membrane of the colon through the opening sometimes occurs. Its treatment is the surgeon's duty.

Pneumonia or Bronchitis may ensue, as in debilitated patients after any abdominal operation.

Operations on the Appendix.

Three types of operation are performed on the appendix: (1) removal of the appendix without drainage; (2) removal of the appendix with drainage; (3) appendicostomy.

Appendicectomy without Drainage is performed in cases in which the attack of appendicitis is just beginning, and there is no peritonitis or abscess. It is also performed after the attack has settled down, to remove the so-called *interval appendix.*

No special preparation is required for an interval appendix. During the early stages of an attack, the operation is performed at once, and there is little time for preparation. In such a case a purgative should not be given.

Special Instruments. — None is absolutely necessary, though some surgeons employ a specially strong pair of crushing forceps (Fig. 133) to clamp the appendix near its

base. The nurse should have in readiness a small quantity of pure liquid carbolic acid with which to purify the stump of the appendix. It may be applied on a wisp of wool attached to forceps. The knife used to cut off the appendix and the crushing-forceps must not be used again during the operation.

It is a good rule to have a tube and funnel and normal saline solution sterilized in every operation for appendicitis, as it may be necessary to wash out an abscess cavity. Finally, it is often an advantage to the surgeon to have the patient's pelvis slightly raised, and the nurse should be ready to tilt the table when requested. In an operation in a private house, thick books are handy for raising the foot of the table.

After-Treatment.—The progress should be as uneventful

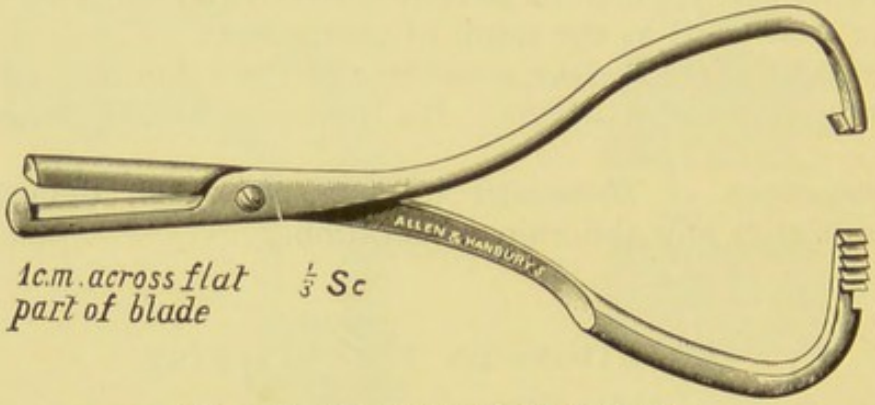


FIG. 133.—CORNER'S APPENDIX CLAMP.

as after the radical cure of hernia, and the after-treatment should be on the same lines.

Special Complications are rare. *Phlebitis* of the femoral vein (p. 191), *pulmonary embolism* and *sub-phrenic abscess* are occasionally met with, but much less frequently than after appendicectomy with drainage. In general they are due to the disease, and not to the operation.

Leakage from the stump may occur. When it does, it may give rise to localized or diffuse peritonitis, or to fæcal fistula.

Adhesions may form in the region, and later give trouble by causing pain and constipation, or even obstruction of the bowel.

APPENDICECTOMY WITH DRAINAGE is usually performed

as an immediate operation to save life. Hence there is little time for the preparation of the patient.

The **instruments** are as for appendicectomy without drainage.

The Operation.—If the case is one of appendicitis with an abscess, then localized peritonitis is present, but the general peritoneal cavity is more or less efficiently shut off by adhesions of the intestine and omentum. The great aim in the operation is to evacuate the abscess and remove the appendix without breaking down these adhesions. The abscess cavity must then be drained, and various methods of doing so are employed. A perforated tube of glass (Fig. 134) or rubber is often used. It is an advantage to pass a wick of sterile gauze or wool or worsted down the glass tube to aid the drainage. The rubber-tube may be cut along one side of its whole length for ease of insertion of the wick. The

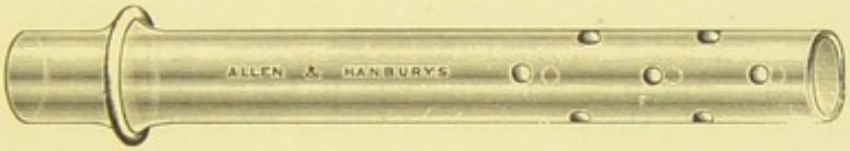


FIG. 134.—KEITH'S GLASS DRAINAGE-TUBE.

"cigarette drain" (p. 18) may also be used. It is not good to use gauze alone for drainage, as the intestine and the edges of the wound adhere closely to it.

The After-Treatment.—The head of the bed should be raised on 18-inch blocks when the effect of the anæsthetic wears off. A purgative of castor oil or calomel is given towards the end of the second twenty-four hours, the latter being followed as usual by a dose of Epsom salts.

The wound should be dressed once each day, or even oftener, till the discharge stops. If a glass tube has been used, it should be replaced after three or four days by a rubber tube or cigarette drain, which is gradually shortened as the cavity diminishes in depth.

Special Complications.—*Imperfect drainage* is one of the commonest. It is usually signalized by a rise of temperature to 101° or 102° F., and the nurse should at once report such an occurrence. The wound must be dressed immedi-

ately. The cause may be blockage of the tube, which is easily rectified, or a collection of pus in a separate pocket which has to be tapped. The great danger in such cases is that the pus is under tension, continues to produce symptoms of septic absorption, and may at any moment give rise to general peritonitis, or sub-phrenic abscess.

Infection of the wound is naturally a likely complication, but it is surprising how seldom it occurs, except in the immediate neighbourhood of the drain.

Strangulation of a corner of bowel or omentum through one of the holes of the drainage tube, whether rubber or glass, is sometimes met with. To prevent it, the tube should be turned round two or three times at each dressing—one turn is not enough—to made sure that nothing is caught in it. If it is a minute knuckle of bowel that has been snared, the condition is serious, especially when it cannot be pulled up to the surface without the danger of tearing it or breaking the glass tube. The best way to free it is to cut the glass with a glazier's diamond at the level of the hole. A rubber tube is more easily divided by means of a knife or scissors. The surgeon has then to deal with the damaged area, usually by invaginating it with silk or catgut sutures. When it is omentum that is caught in, the tube can usually be brought up to the surface, as more force may be exerted without danger. A catgut ligature is then placed round the omentum, and the tag cut off.

A fæcal fistula is most commonly found after this operation. In most cases it closes spontaneously, but the surgeon has occasionally to operate to close it. It is due to sloughing at the buried stump, and leakage.

Ventral hernia may occur at the wound (p. 215).

Sub-phrenic abscess and *empyema* sometimes follow, as also *femoral phlebitis* and *pulmonary embolism.* At a later stage *adhesions* may cause trouble.

APPENDICITIS WITH GENERAL PERITONITIS is a much more dangerous condition, but its treatment is in all respects the same as the last. Again appendicectomy with drainage is performed. Opinions differ as to whether the peritoneal cavity should or should not be washed out with saline solution,

but the necessaries should be prepared—rubber tube, funnel, and flasks of normal saline. In the after-treatment, the Fowler position is of great benefit.

APPENDICOSTOMY AND CÆCOSTOMY.—Appendicostomy is performed in cases of ulceration of the large intestine. The abdomen is opened, the appendix is brought out at the wound and fixed there. Then it is opened at its tip, and a rubber catheter is fixed in its interior. To the other end of the catheter a funnel is attached each time irrigation is to be carried out. The fluids most commonly used are saline solution and dilute protargol solution (1 in 100), two to four pints being used thrice a day.

If the appendix has previously been removed, or cannot be brought out at the wound, a similar operation may be done with the cæcum—cæcostomy.

OPERATIONS ON THE BILIARY PASSAGES.

The chief operations are cholecystostomy, cholecystectomy, choledochotomy, and cholecystenterostomy.

CHOLECYSTOSTOMY is the establishment of an opening in the gall-bladder in order to drain the bile through the wound; CHOLECYSTECTOMY is excision of the gall-bladder; CHOLEDOCHOTOMY is the opening of the common bile-duct, usually for the removal of a stone. CHOLECYSTENTEROSTOMY is the establishment of a permanent opening between the gall-bladder and some part of the intestine. It is performed when the common bile-duct is blocked, in order that the bile, which is pent up in the gall-bladder, may once more reach the bowel.

Jaundice sets in when the outflow of bile is interfered with. It is marked by yellowness of the skin and mucous membranes.

Preparation of the Patient.—It is important that specimens of the fæces and the urine should be preserved by the nurse, as the surgeon often wants to know (1) if any bile is entering the bowel, and (2) if the urine contains bile. A patient suffering from long-continued jaundice should be carefully watched, as delirium and convulsions or coma may set in

at any time. In other cases, the jaundice causes intense itching of the skin which prevents the patient from sleeping. Hypnotics may then be necessary to prevent the patient becoming melancholic.

Before operation, free purgation should be effected by calomel followed by Epsom salts, even when diarrhœa is present, as it is due to decomposition of the intestinal con-

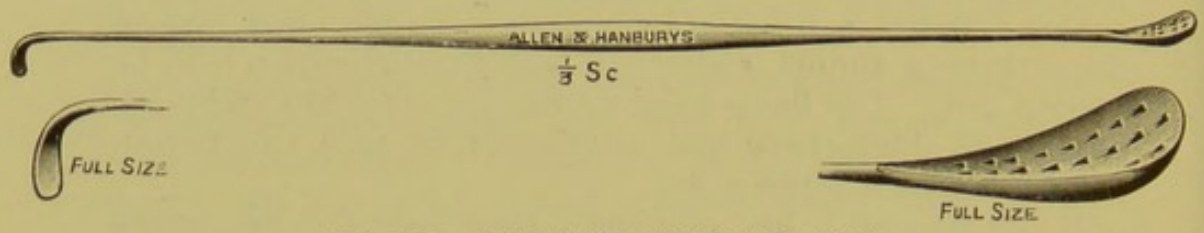


FIG. 135.—GALL-STONE SCOOP AND HOOK.

tents. More commonly constipation exists, and some trouble may be experienced in getting the bowels well moved.

Special Instruments.—Gall-stone scoops (Fig. 135) and forceps (Fig. 136) must be sterilized. For cholecystostomy a rubber-tube, of the calibre of a number 10 rubber catheter, and two feet in length, is required. It is stitched into the gall-bladder, and the bile drains through it into a vessel.

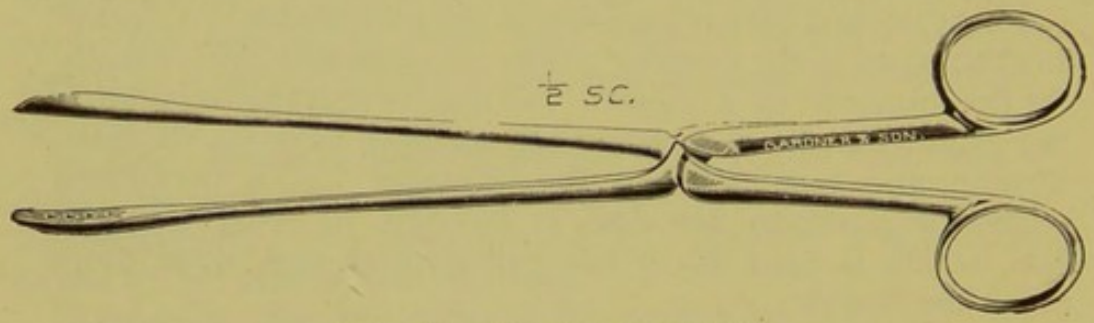


FIG. 136.—GALL-STONE FORCEPS.

In cholecystectomy, Moynihan's forceps (Fig. 137) are convenient for clamping the cystic duct. The gall-stone probe (Fig. 138) is used to investigate the common duct.

After-Treatment.—In cholecystostomy the bile may not begin to flow for some hours after the operation. But when the patient is put back to bed, the tube should be dipped into a vessel to receive any discharge. An ordinary 6-ounce

medicine bottle, with a tape tied round its neck and fixed by safety-pins to the side of the binder, is convenient.

If necessary, a soap and water enema may be given on the day after operation. The purgative, usually calomel, should be given on the second day. Each day the nurse should keep a specimen of the urine. The motions should also be kept for inspection.

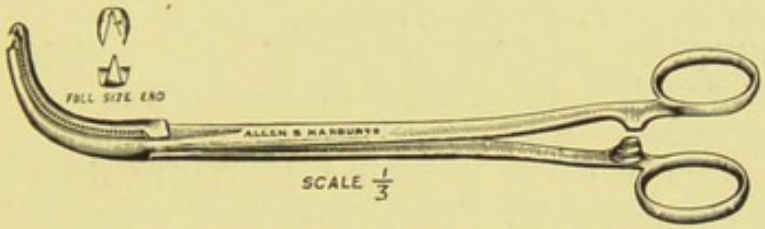


FIG. 137.—MOYNIHAN'S CHOLECYSTECTOMY FORCEPS.

Special Complications.—(1) *Hæmorrhage:* In jaundice of long duration, the blood does not coagulate so well as normally. Any oozing points may go on bleeding for hours, and prove dangerous to life. The bleeding may appear on the dressing, or it may take the form of a hæmatoma in the wound. To prevent it, the surgeon is careful to stop all bleeding at the time of the operation, tying even the smallest vessels instead of merely compressing or twisting them.

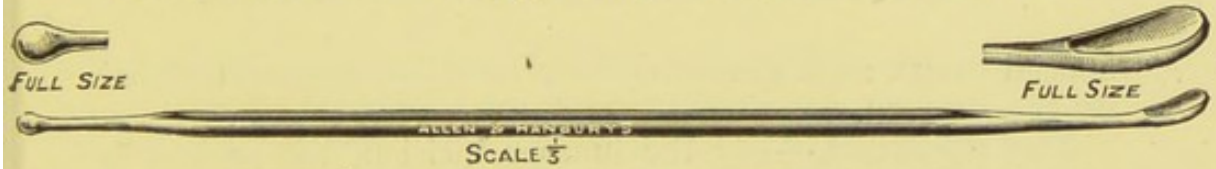


FIG. 138.—MOYNIHAN'S GALL-STONE PROBE AND SCOOP.

While the hæmorrhage is going on, pressure with gauze soaked in adrenalin may be effectual in stopping the bleeding. Calcium chloride, 30 to 60 grains thrice a day, is also useful in some cases.

(2) *Biliary Fistula.*—In cholecystostomy when the drainage-tube is removed, the opening in the gall-bladder usually closes spontaneously in several days. Occasionally it does not close, and a permanent fistula results, through which bile constantly escapes. This is not of serious consequence apart from the distress and annoyance caused to the patient.

It is due to blockage of the common bile-duct, and a second operation is necessary to cure it.

Operations on the Kidney.

The chief operations are NEPHROTOMY, incision of the kidney; NEPHROSTOMY, opening and draining of the kidney; NEPHRO-LITHOTOMY, removal of stone from the kidney; NEPHRECTOMY, excision of the kidney; and NEPHRORRHAPHY, fixation of a movable or floating kidney.

Preparation.—In all renal cases, not only must a specimen of each day's urine be preserved, but every drop must be measured and charted. These rules hold good both before and after operation. A preliminary course of treatment by

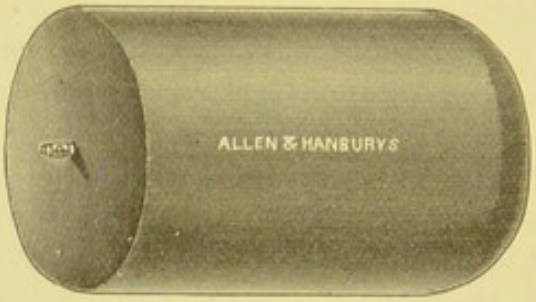


FIG. 139.—EDEBOHL'S AIR-CUSHION FOR KIDNEY OPERATIONS.

special drugs, such as urotropin or helmitol, may be ordered by the surgeon.

The Operation.—For the lumbar incision, the patient is placed in the semi-prone position, i.e. half on his face, with the knees bent up and that of the affected side drawn forwards over the lower. A sand-bag or air-cushion (Fig. 139) is placed under the loin. For the abdominal incision, he lies on his back. In some cases, the skin of both areas should be prepared for operation.

Special Instruments.—An ordinary *darning needle* or *hat-pin* should be sterilized. It is useful in probing for a stone. A fine trocar may be used in the same way, or to evacuate an abscess or cyst. *Calculus forceps* may also be included (Fig. 140).

After-Treatment.—In cases in which the kidney is drained,

the dressings must be frequently renewed by the nurse as they soon become soaked with urine. If the wound is in the loin, the patient need not be kept on his back, but may turn on his sound side. As usual, the purgative is given on the second day. If the amount of urine is unsatisfactorily small, Epsom salts should be administered as they produce a very watery motion. The diet should be bland until the secretion of urine is proved to be adequate. Milk and barley water, milk puddings, bread and fruits are usually given. All meat must be avoided in the first few days, as it throws extra work on the kidneys.

Special Complications.—*Uræmia* or *Suppression of Urine* (p. 200) is the great danger after operations on a diseased kidney. The quantity of urine becomes less and less, and may finally be nil. In such a case, the skin must be made

FIG. 140.—RENAL CALCULUS FORCEPS.

to perspire freely, as toxic substances are excreted in the sweat. Saline infusions, by the rectum or intravenously, are of the greatest value, not only in making the skin perspire, but also in stimulating the kidneys. For the bowels, if the danger is urgent, croton oil, 1 to 3 drops on sugar, or placed on the back of the tongue if the patient is only semi-conscious, or compound elaterin powder should be given, as they act rapidly. Sometimes the surgeon resorts to bleeding, 10 to 20 ounces of blood being allowed to escape from a vein in the arm.

Hæmorrhage appears in the urine, a condition known as *hæmaturia*. It occurs to a greater or less degree after every operation in which the kidney is incised. The bleeding usually ceases in one or two days. If severe, it is difficult to treat as no drug is of any use, but an ice-bag may be applied over the wound.

Pain is found in varying degrees after kidney operations. It may be confined to the kidney region, or it may shoot down to the groin—renal colic. It may be due to the passage of a blood clot or of "gravel" down the ureter. Occasionally it is due to the inclusion of a nerve in the suture of the wound. Morphia may have to be given, but it must be avoided if possible, as it tends to reduce the urinary secretion.

Pyrexia and Rigors may occur after kidney operations. They are sometimes associated with the passage of blood-clots down the ureter. A high temperature may be found even after a simple nephrorrhaphy, just as in other slight operations on the urinary passages, but it is not necessarily a sign of sepsis. Quinine, 2 grains 6-hourly, may be administered.

Persistent vomiting may accompany the high temperature.

Sepsis may be very dangerous if it attacks the kidney itself. The temperature swings between 98° and 104° or 105° F., and the patient is extremely ill. The wound may become infected, especially when the kidney is drained and the urine is already septic at the time of the operation.

CHAPTER XX.

ABDOMINAL OPERATIONS ON THE URETER, BLADDER AND PROSTATE GLAND.

Operations on the Ureter.

Like the kidney, the ureter may be reached through an abdominal or a lumbar incision, and for the latter the semi-prone position is used (p. 242), but no sand-pillow or air-cushion should be inserted as it prevents the intestine falling away from the area of operation.

In most cases in which the ureter is incised, drainage is necessary, and a glass or rubber tube, loosely packed with gauze or strands of worsted, may be employed. The skin around the wound must be frequently washed with soap, and rubbed with methylated spirit, to prevent the formation of bed-sores. When the ureter is grafted into the bladder, the latter should be kept empty by suction drainage (p. 256). After implantation of the ureters into the pelvic colon or rectum, the urine escapes into the bowel and is evacuated through the anus. The morning urine is mixed with fæces, but usually at other times it is clear. At first the patient has a frequent desire to go to stool, but gradually he acquires the power of retaining urine in the rectum for some hours and passing it at will.

Passing the Catheter.

A catheter is a hollow instrument employed to drain off the urine. It may be made of soft rubber, gum-elastic, silk coated with shellac, metal, or glass. The opening is placed on the beak near the tip of the catheter, and not at the

extreme end. With the exception of soft-rubber (Fig. 141) and glass catheters, each instrument is provided with a stilette which keeps the interior of the tube clear. The nurse must always replace the stilettes after the instruments have been used.

The beak joins the stem at different angles in the various instruments. In the *coudé* (Fig. 142) the beak is short, and joins the stem at an open angle. In the *bi-coudé* (Fig. 143) there are two bends. These two instruments are made of

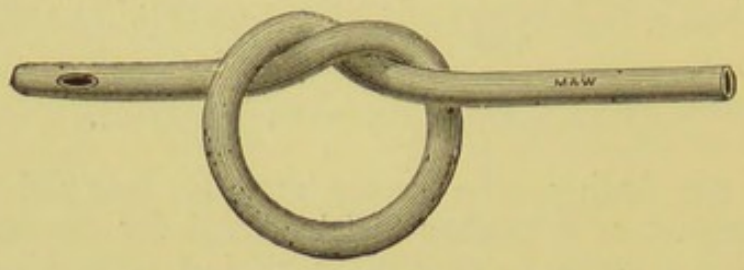


FIG. 141.—SOFT RUBBER CATHETER.

gum-elastic or silk-web. Metal catheters are made of silver or German silver. In them, the angle between the stem and the beak is rounded (Fig. 144). An instrument with a specially wide curve is often useful in cases of enlarged prostate (Fig. 145).

Female catheters need not be so long, though the soft-rubber male catheter is often employed. They may be constructed of metal or glass (Fig. 146).

FIG. 146.—FEMALE GLASS CATHETER.

Sterilization of Catheters.—The rubber, metal, and glass catheters are sterilized by boiling; gum-elastic and silk catheters by suspension in formaldehyde vapour, or by prolonged immersion in 1 in 1000 corrosive.

After use, a catheter should be at once sterilized, and stored in a sterilized glass cylinder with an air-tight vulcanite top (Fig. 147).

Catheter Lubricants have been already described (p. 20). They should be put up in collapsible tubes from which the

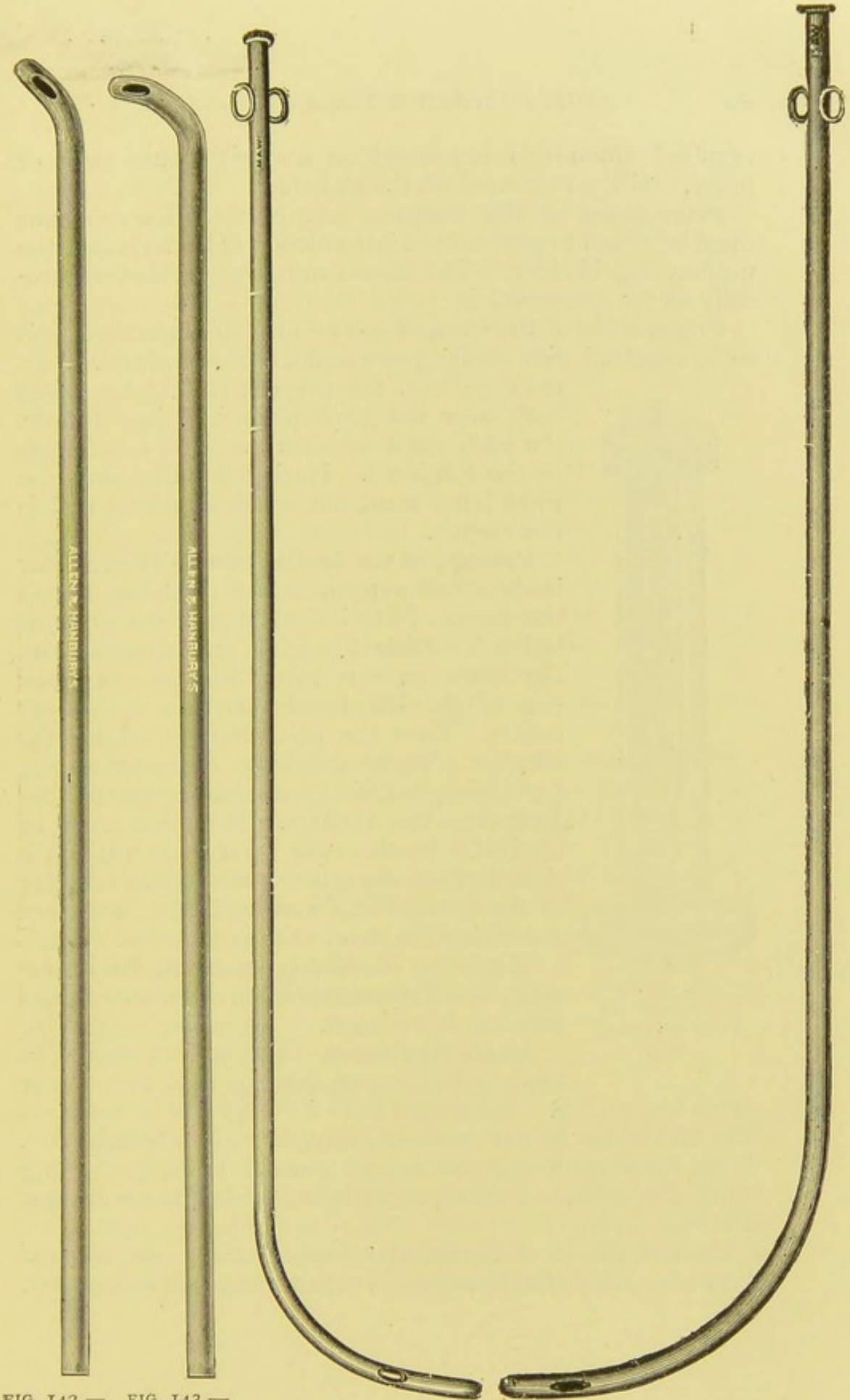


FIG. 142.—COUDÉ CATHETER.

FIG. 143.—BI-COUDÉ CATHETER.

FIG. 144.—SILVER CATHETER.

FIG. 145.—SILVER PROSTATIC CATHETER.

required amount is expressed on a sterile gauze swab or towel, and then smeared on the catheter.

Preparation of the Surgeon and Nurse.—Every means must be taken to prevent the introduction of bacteria into the urethra and bladder. The hands must be purified as carefully as for an operation.

Preparation of the Patient.—The meatus of the urethra is to be cleansed with sterile gauze soaked in weak lysol. In a male patient, the prepuce should be pulled back over the glans penis, and in a female, the labia must be separated with two fingers of the left hand. During the cleansing, the right hand must not touch anything that is not aseptic.

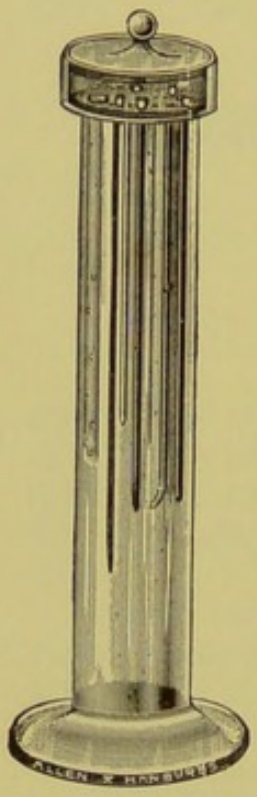


FIG. 147.—CATHETER JAR WITH AIR-TIGHT TOP.

Passage of the Instrument.—The catheter is then taken up with the right hand from the basin of sterile saline solution or boric lotion in which it is lying, and smeared with the lubricant. In doing this, do not make use of the left hand which is no longer sterile. Then the point is inserted into the meatus without touching the surrounding parts, and *gently* insinuated along the urethra and into the bladder. No force must be applied. In the case of a male patient, a right-handed operator stands at the left side of the bed. For a female patient, it is more convenient to stand at the right side.

When the bladder is evacuated, the instrument is withdrawn with the same care as was taken in inserting it.

After-Treatment.—The patient should be kept in bed for an hour or two, with one or more hot bottles. He should have a draught of warm milk, and this must be got ready in every case of catheterization. Some surgeons also give a 2-grain powder of quinine along with the milk. These precautions are taken to prevent urethral fever.

Complications of Catheterization.—*Catheter* or *urethral fever* may follow the passage of a catheter or other instrument.

The temperature runs up to 103° F. or higher, and a rigor or a series of rigors occurs, the patient's tremors shaking the bed. Recovery is rapid, but a similar attack may occur at a succeeding catheterization. Catheter fever can usually be prevented by taking the precautions already mentioned. The rigor often occurs the next time the urine is passed, but with less frequency if urination is delayed for a few hours.

Catheter fever must not be confounded with the continued fever and rigors which occur in some septic cases. This condition is much more serious, and is apt to be followed by suppression of urine and uræmia (p. 200).

Sepsis.—The risk of introducing bacteria in passing the catheter must never be forgotten. It is reckoned as a disgrace if *cystitis*, i.e. inflammation of the bladder, results, and the nurse can only prevent it by paying strict attention to asepsis in every case. Cystitis is characterized by the frequent desire to empty the bladder, and by the presence of pus in the urine. Even if cystitis is already present, the same care must be taken, in order to prevent mixed infection. In cases of injury to the spinal cord, the prevention of sepsis is specially difficult.

Cystitis is treated in the early stages by the administration of "urinary antiseptics," i.e. antiseptic drugs which appear in the urine. Such are urotropin, 7 grains three times a day, and salol, 10 grains three times a day. In addition, the patient should be given copious draughts of barley-water and milk. If this does not cure the cystitis, the bladder should be washed out once a day or oftener with boric lotion, or other weak antiseptic. In cases of long standing the surgeon may open and drain the bladder, or try a course of vaccine treatment.

Washing out the Bladder.

Washing out of the bladder is done by a catheter and funnel. If no stricture of the urethra is present, an ordinary rubber catheter to which a rubber tube is attached by means of a short glass-tube, is passed into the bladder. On the rubber tube is placed a clip, and a glass or metal funnel is inserted in its outer end. The whole apparatus must be

sterilized by boiling, and the tubing should be filled with lotion before the catheter is passed. This is done by letting some of the lotion run through, and then clamping the tubing with the clip while it is still full of fluid. The lotion may be

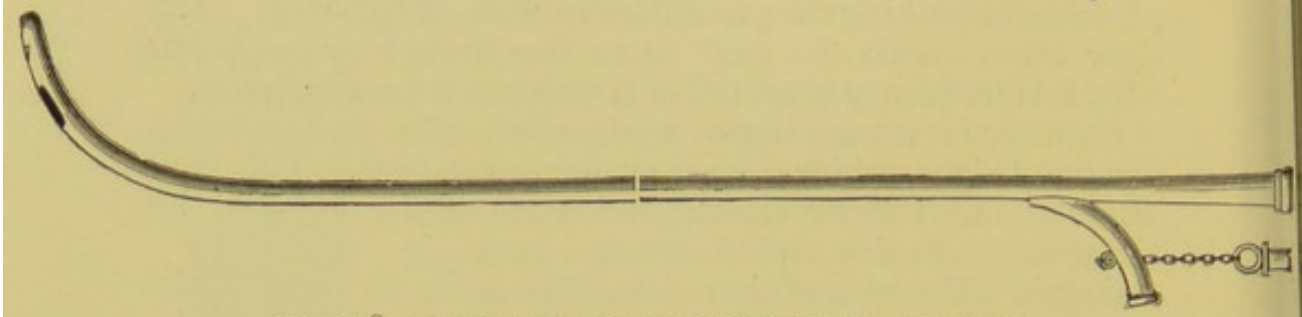


FIG. 148.—DOUBLE-CHANNELLED OR TWO-WAY CATHETER.

either boric lotion or weak Condy's fluid. It should be contained in a graduated glass vessel, holding two or three pints. The funnel is held several inches above the level of the patient, and lotion is poured in. Then the clip is released so as to allow the fluid to flow in slowly. The

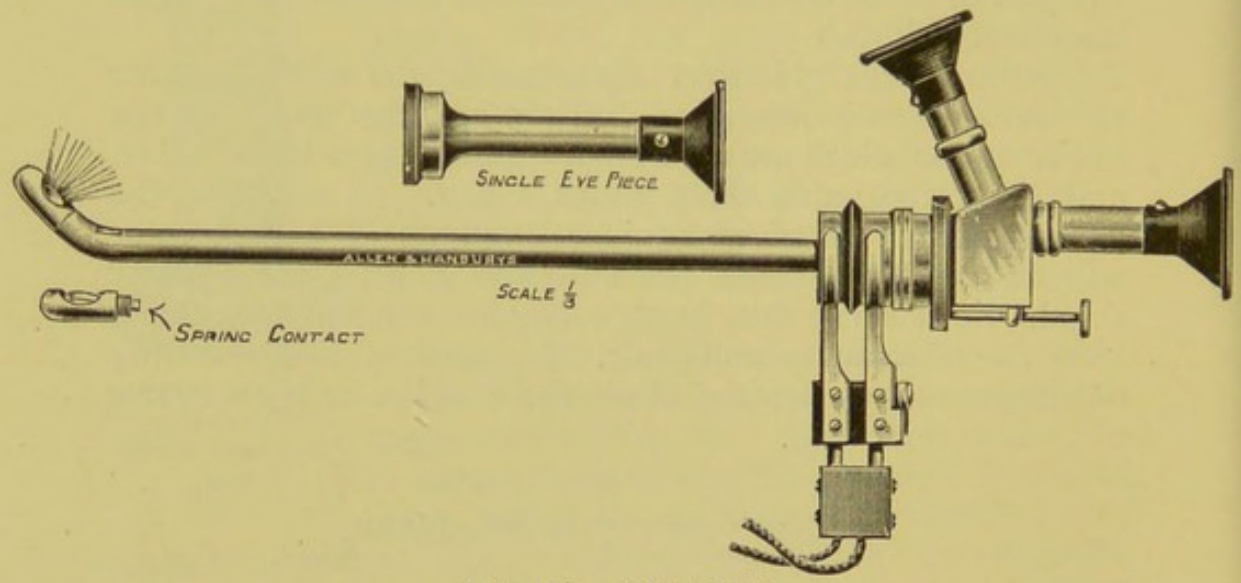


FIG. 149.—CYSTOSCOPE.

funnel is filled up again as required, care being taken that it is never quite empty, as otherwise air-bubbles might reach the bladder. The amount of lotion allowed to flow into the bladder varies with its size and irritability. As soon as the

patient complains of discomfort it is time to stop, whether two ounces or ten ounces have entered. In any case, the amount should not exceed twelve ounces. Then the funnel is lowered below the level of the patient, the clip is released, and the fluid allowed to escape. The procedure is repeated several times until the returning fluid is clear or nearly so. If pus is entering the bladder from the kidneys, it may never be quite clear.

Instead of the rubber catheter, a *two-way* or *double-channelled catheter* of metal (Fig. 148) may be used. When the desired amount of fluid has been introduced through the rubber tube attached to one channel, the tube is clamped. The clamp on the tube from the other channel is then opened, and the patient is directed to empty the bladder.

Examination of the Bladder.

The bladder is examined by means of the *Cystoscope* (Fig. 149). In shape resembling a sound, this instrument consists of a beak, a shaft, and a window. The beak is about an inch long, and contains near its tip an electric lamp by which the interior of the bladder is illuminated. The wires from the lamp run along the shaft, and are connected by two insulated wires to a battery or accumulator. The shaft is hollow, and is in effect a telescope with magnifying lenses. At the junction of the beak and the shaft is a window in which a glass prism is set. By it the rays of light reflected from the lining of the bladder are refracted along the shaft, and so reach the surgeon's eye as he looks

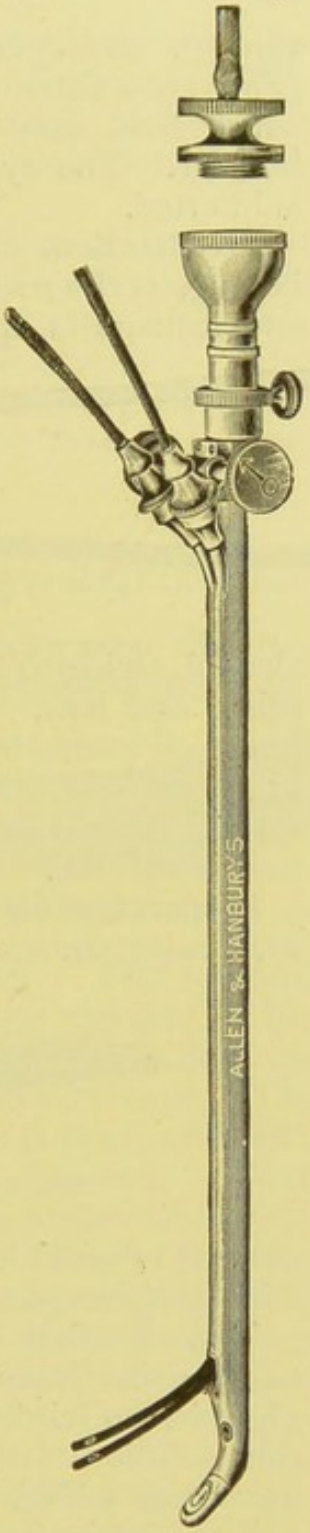


FIG. 150.—IRRIGATING CYSTOSCOPE CARRYING TWO URETERAL CATHETERS.

through the eye-piece. In the "irrigating cystoscope" (Fig. 150), there is a second channel in the shaft through which fluid may be poured into or withdrawn from the bladder. The cystoscope should always be tested before it is inserted.

Sterilization.—The cystoscope cannot be sterilized by boiling, as the metal and glass parts do not expand equally, and leakage is apt to result. Nor should it be soaked in

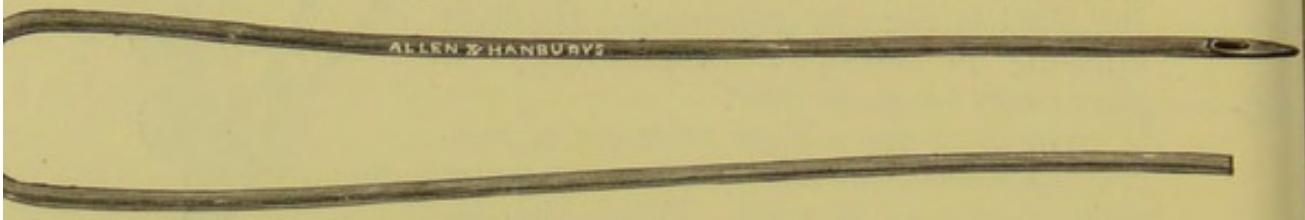


FIG. 151.—URETERAL CATHETER.

alcohol, owing to its action on the cement used to fasten the prism and lens. The instrument may be subjected to the fumes of formaldehyde in a specially constructed apparatus, or placed in 1 in 20 carbolic lotion for twenty minutes. The carbolic should be removed by dipping in sterile saline solution before use.

Preparation for Cystoscopy.—In male patients, the surgeon must ascertain some time before whether the urethra is large

FIG. 152.—KELLY'S URETHRAL CALIBRATOR.

enough to admit the cystoscope. If not, it must be dilated with bougies (p. 268), or otherwise widened.

The essentials, in addition to the cystoscope, are the apparatus and lotion for washing out the bladder, sterilized glycerine to lubricate the instrument, and ½ ounce of a 1 per cent. solution of novocain, to which 8 or 10 drops of adrenalin have been added.

The bladder having been washed out till the fluid returns clear—an essential if the examination with the cystoscope is to be successful—and 8 or 10 ounces of the lotion left in,

the instrument is passed. The examination of the bladder-wall and ureters is made, and perhaps the ureters are catheterized. When the examination is finished, the light is switched off, the beak is allowed to cool for half a minute, and then the cystoscope is withdrawn.

Ureteral Catheters are made of silk (Fig. 151). They are sterilized by boiling in a saturated solution of ammonium sulphate, and are stored dry in sterilized glass cylinders. Before use they are lubricated with sterile glycerine. The catheters are fixed alongside the cystoscope (Fig. 150), and are inserted into the ureteral openings when these have been brought into view.

Direct Cystoscopy and Ureteral Catheterization.

In the female, the bladder may be inspected directly. The patient is placed in the knee-elbow position, or in the

FIG. 153.—KELLY'S URETHRAL DILATOR.

lithotomy position with the pelvis raised. The *urethral calibrator* (Fig. 152) is passed to determine the size of the urethra, and, if necessary, to dilate it sufficiently to admit the speculum; or special *dilators* (Fig. 153) may be used. The *urethral speculum* or *cystoscope* (Fig. 154) is made of metal. It consists of a straight tube fitted with an obturator. When the point has reached the bladder, and the obturator is withdrawn, air rushes in and balloons the bladder-wall, which is then illuminated by means of a frontal mirror (Fig. 230) reflecting sunlight or electric light. The ureteral openings can be seen at the base of the bladder, and catheterized directly.

Sounding the Bladder for Stone.

The patient should be confined to bed for some hours before the examination. A rubber catheter is passed, and the

urine drawn off. Then 6 or 8 ounces of boric lotion or saline solution are run in, and the catheter is withdrawn. The patient is put in the Trendelenburg position (p. 143) to make the stone accessible, and the *bladder sound* (Fig. 155), after being lubricated, is passed. The presence of a stone is

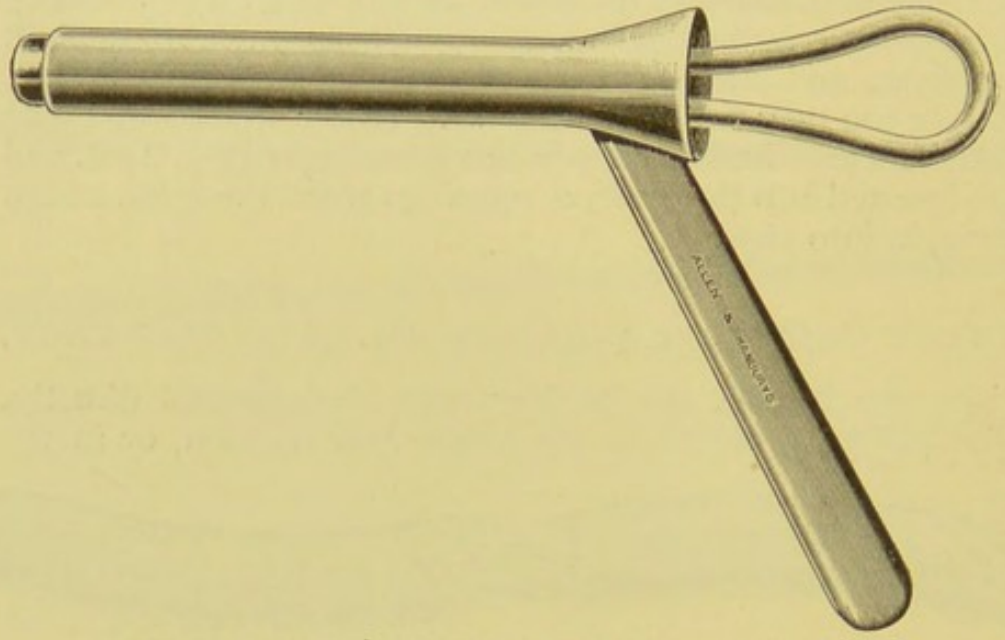


FIG. 154.—KELLY'S FEMALE CYSTOSCOPE OR SPECULUM.

recognized by the click given when the metal instrument comes in contact with it. A *combined catheter and sound* is convenient for carrying out the whole procedure with the passage of only one instrument.

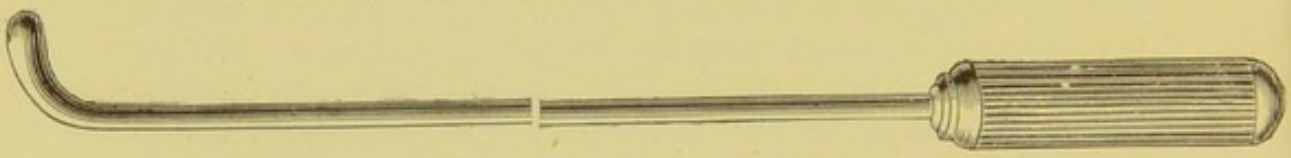


FIG. 155.—BLADDER SOUND.

Operations on the Bladder.

The bladder may be opened above the pubes, through the perineum, and in females also through the vagina. These operations are called respectively *supra-pubic*, *perineal*, and *vaginal cystotomy* or *cystostomy*.

SUPRA-PUBIC CYSTOTOMY, LITHOTOMY AND PROSTATECTOMY.—The operation of opening the bladder is performed for drainage in obstinate cases of cystitis; for the removal of a stone from the bladder (*supra-pubic lithotomy*) or lowest part of the ureter; for the removal of a tumour of the bladder, or an enlarged prostate gland (*supra-pubic prostatectomy*); and in some cases of stricture of the urethra associated with retention of urine.

Special Preparation of the Patient.—The preparation is in general the same as for laparotomy. The nurse must be careful to measure and chart the amount of urine passed each time, and to preserve a specimen every day for examination by the surgeon. If the operation is not urgent, and the bladder is already infected, it may be washed out for some

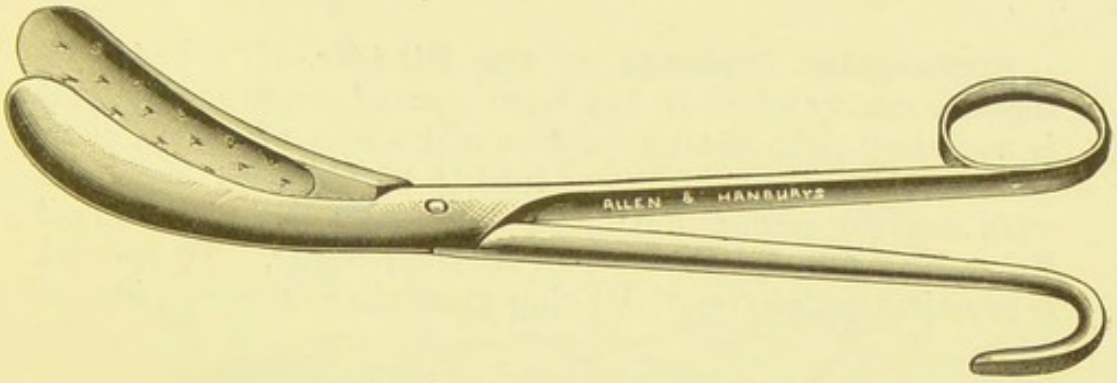


FIG. 156.—LITHOTOMY FORCEPS.

days with boric lotion or weak Condy's fluid. In certain cases of enlarged prostate and stricture of the urethra, this is impossible. Or the surgeon may make a cystoscopic examination, or sound the bladder for stone. In prostatic cases, cardiac disease and arterial sclerosis frequently require preliminary treatment.

If the patient has an enlarged prostate gland with retention of urine, and no form of catheter can be passed, the operation must be begun without the previous emptying of the bladder.

Special Instruments.—In every case in which the urethra is patent, the apparatus and lotion for washing out the bladder must be prepared. The surgeon may leave 8 or 10 ounces of boracic lotion or saline solution in the bladder.

To prevent the escape of the fluid when the patient is anæsthetized, a soft-rubber catheter or a piece of rubber tubing is tied tightly round the penis. If the operation is for the removal of stone, *lithotomy forceps* (Fig. 156) and *scoop* (Fig. 157) should be ready. To grasp tumours of the bladder, *bladder forceps* (Fig. 158) may be required. In the majority of cases it is not advisable to close the wound in the bladder, and it is necessary to drain it.

FIG. 157.—LITHOTOMY SCOOP.

Supra-pubic Drainage of the Bladder.—To keep the bladder empty when it has been opened supra-pubically, it is necessary to have an apparatus which keeps up continuous suction (Fig. 159). A glass tube, 4 to 6 inches long, and with several perforations near the lower end, is inserted through the wound to the foot of the bladder. To prevent it pressing unduly on the lining membrane, a short piece of

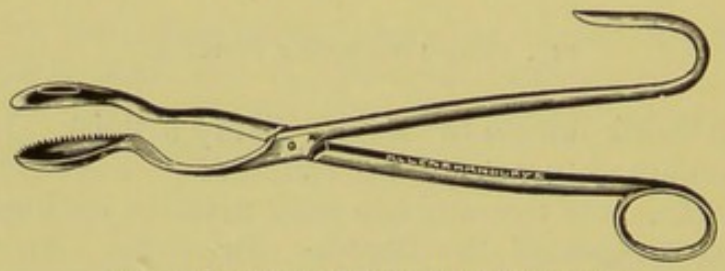


FIG. 158.—BLADDER TUMOUR FORCEPS.

rubber tubing may be stretched over it, so as to overlap the lower end of the glass tube by a quarter of an inch. The glass tube is connected to a flexible rubber tube, the other end of which is attached to a T-shaped glass tube pinned to the edge of the bed. One limb of the T is connected by a tube to a douche-can which hangs above the patient at the head of the bed. The other limb is attached to a rubber tube which in turn is connected with a glass tube bent like a

double S. Below it is placed a pail to catch the dropping water and urine. The outflow of water from the reservoir into the upper tube is regulated by a screw clip, which is tightened so that only one drop escapes every few seconds.

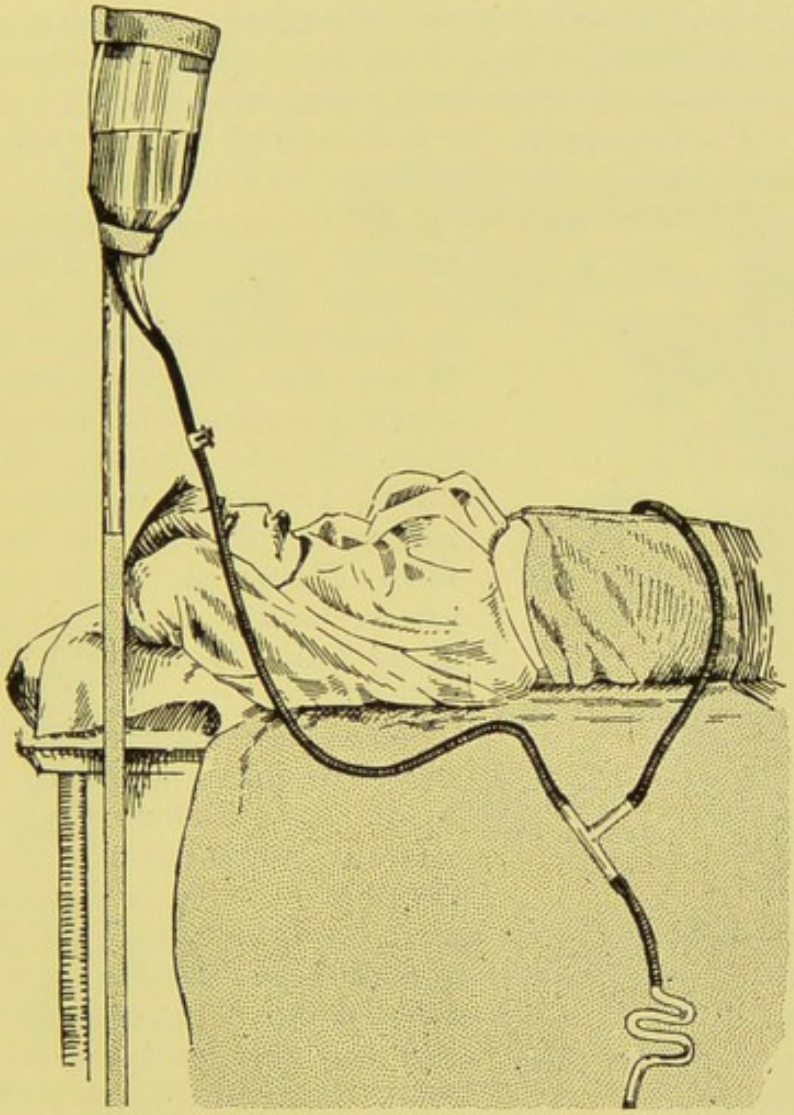


FIG. 159.—CATHCART'S DRAINAGE APPARATUS FOR USE AFTER SUPRA-PUBIC OR PERINEAL CYSTOTOMY.

Four to six pints of water are required in the douche-can for twenty-four hours' drainage.

This apparatus can also be fitted to a tube after perineal cystotomy, or to a catheter passed by the urethra into the

bladder. In these cases, a pint of water is sufficient for twenty-four hours.

Continuous suction may also be maintained by Bunsen's vacuum pump (Fig. 160). A drainage-tube similar to the one described on p. 256 is inserted through the wound into the bladder. Its outer end is connected by tubing to a bottle (B), which serves to catch the urine. Another tube connects B to a reservoir (A) into which is poured about half a gallon of water. The large water-jar is fitted with an outlet tube at the foot, which leads to the third bottle by a tube carrying a screw clamp (X). The third bottle stands on a lower level than the jar, and B and A are fitted with air-tight rubber corks, perforated to allow the tubes to pass through. When the clamp is unscrewed, water flows from the second to the third bottle by gravity. This produces a partial vacuum in the former as the level of the water falls. Hence suction is exercised on th· bladder, and urine flows along and falls into the bottle provided for it.

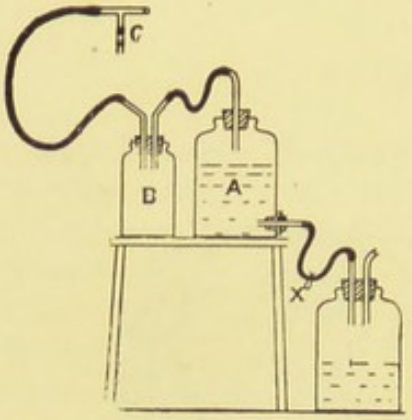


FIG. 160.—BUNSEN'S VACUUM PUMP.

By kind permission of Messrs. Griffin & Co., publishers of "Surgical Handbook," by Messrs. Caird and Cathcart.

After-Treatment.—For the first two days, the urine in part escapes to the surface alongside the tube, and the wound must be frequently dressed. At each dressing, the drainage-tube should be raised from the floor of the bladder and rotated once or twice to make sure that it is not blocked. Further, the skin of the back should be frequently washed and dried, rubbed with spirit and powdered, to prevent the formation of bed-sores. Subsequently little or no leakage occurs, and the dressings need not be so often changed.

Drainage is kept up for a week or a fortnight according to the condition of the urine. Then the tube is removed, and the wound is allowed to close. To encourage the urine to flow by the urethra, a full-sized metal bougie (Fig. 173) may be passed two or three times if necessary, or the bladder may be drained for a few more days by means of a catheter tied in the urethra.

If the urine is foul, the bladder may be douched with saline solution, boracic lotion, or other weak antiseptic through the drainage-tube.

When the operation has been performed to relieve the symptoms in inoperable cancer of the bladder or prostate gland, the drainage must be permanent. To keep the patient dry and allow him to move about in the open air, an apparatus (Fig. 161) may be fixed to the drainage-tube.

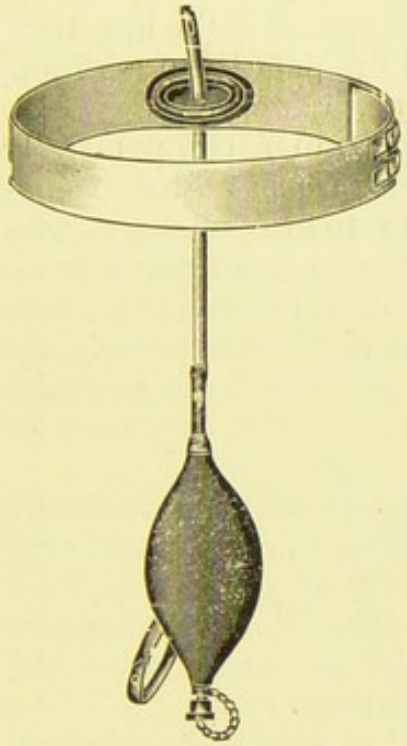


FIG. 161.—APPARATUS FOR A PATIENT WITH A PERMANENT SUPRA-PUBIC OPENING INTO THE BLADDER.

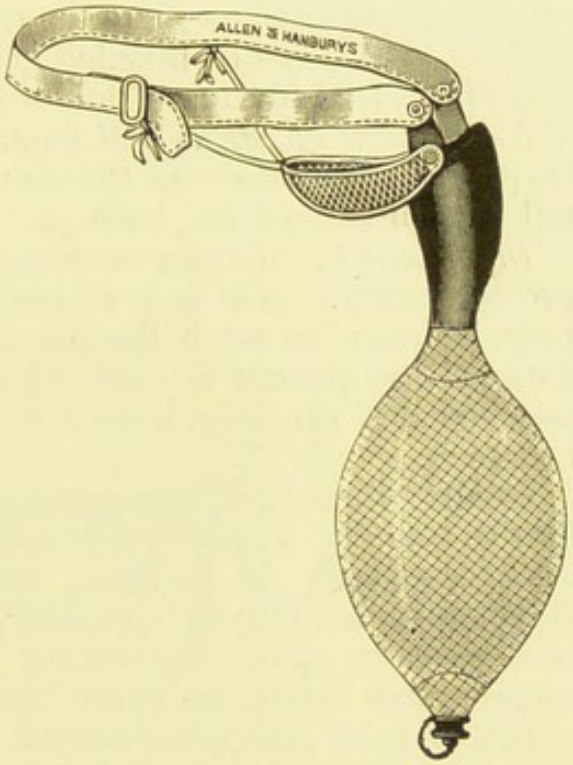


FIG. 162.—APPARATUS FOR A PATIENT SUFFERING FROM INCONTINENCE OF URINE.

Special Complications.—*Hæmorrhage* from the bladder sometimes occurs after supra-pubic cystotomy for the removal of a tumour of the bladder or an enlarged prostate gland. The clots must be washed out through the wound, and the bladder douched with saline solution at a temperature of 115° to 120° F., to each pint of which half an ounce of adrenalin (1 in 1000) has been added. About a drachm of adrenalin diluted with seven drachms of saline may be left

in, and the foot of the bed should be raised on high blocks. If this does not stop the hæmorrhage, a finger should be passed into the rectum to compress the base of the bladder against the symphysis pubis for ten to twenty minutes, or against the other hand placed on the abdominal wall. If the bleeding still persists, a general anæsthetic must be administered, and the bladder firmly packed with gauze.

Cellulitis.—The septic urine may infect the cellular tissue around the bladder. This is a serious complication, especi-lly in old patients, owing to the rapid spread of the infection, and the difficulty of obtaining good drainage. In addition, it is apt to lead to suppression of urine.

Suppression of Urine and Uræmia form a comparatively frequent complication, as the result of sepsis added to pre-existing disease of the kidneys. For treatment, see p. 200.

Incontinence of Urine sometimes results from supra-pubic prostatectomy. If it is permanent, an apparatus (Fig. 162) may be worn to catch the urine as it dribbles away. As long as the patient is confined to bed, his back must be watched and carefully treated to prevent the formation of bed-sores.

Urinary Fistula.—The supra-pubic wound is occasionally long in healing, a small track remaining open and allowing urine to escape. In the great majority of cases it closes if the wound is carefully dressed, and a full-sized bougie is passed once or twice along the urethra. In persistent cases, the surgeon may excise the wall of the fistulous track.

Epididymitis sometimes occurs. It is treated by ichthyol fomentations applied to the scrotum. It rarely goes on to suppuration.

Recto-Vesical or Recto-Urethral Fistula.—Owing to the close proximity of the rectum to the base of the bladder and the commencement of the urethra, it may be opened into during the enucleation of an enlarged prostate gland. The communication thus established between it and the bladder or urethra may result in a permanent fistula.

CHAPTER XXI.

PERINEAL OPERATIONS ON THE BLADDER, PROSTATE GLAND, AND URETHRA.

FOR perineal operations, the patient is placed in the *lithotomy position*, i.e. with the knees widely separated and bent up towards the abdominal wall. To keep the legs in this position the nurse may apply Clover's crutch (Fig. 163), or fix the calves of the legs on the leg-rests (Fig. 104) which fit on the operating-table. Under the patient's buttocks is placed a *rubber apron* or *pad* (Fig. 105) to direct all fluids into a pail.

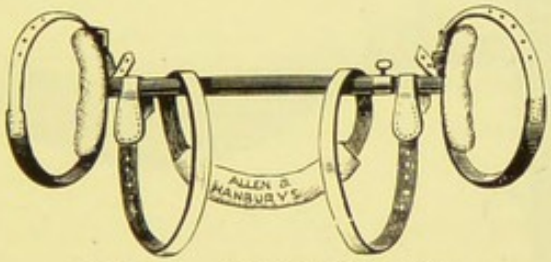


FIG. 163.—CLOVER'S CRUTCH.

LITHOTRITY or LITHOLAPAXY, is the operation of crushing a stone in the bladder and removing the fragments. No special preparation is required. The patient is placed in the exaggerated lithotomy position, i.e. with the legs flexed, and the pelvis raised.

Special Instruments.—The apparatus and lotion for washing out the bladder are required (p. 249). If necessary, the urethra is dilated with bougies (Fig. 173).

The *lithotrite* (Fig. 164) is inserted after the urethra has been dilated, and the stone has been "sounded" either with the bougies or the *bladder-sound* (Fig. 155). The lithotrite has two blades, the inner of which slides in a groove of the

outer blade. When the stone is caught between the two limbs, it is slowly crushed by approximating them by means of a screw. When the fragments of the stone have

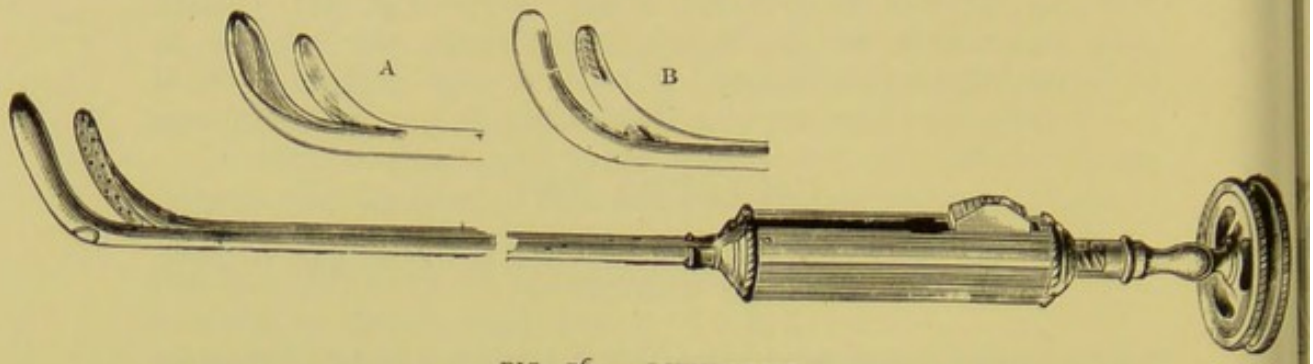


FIG. 164.—LITHOTRITE.

been repeatedly crushed, they are removed through an *evacuating catheter*, which has a specially large eye, by

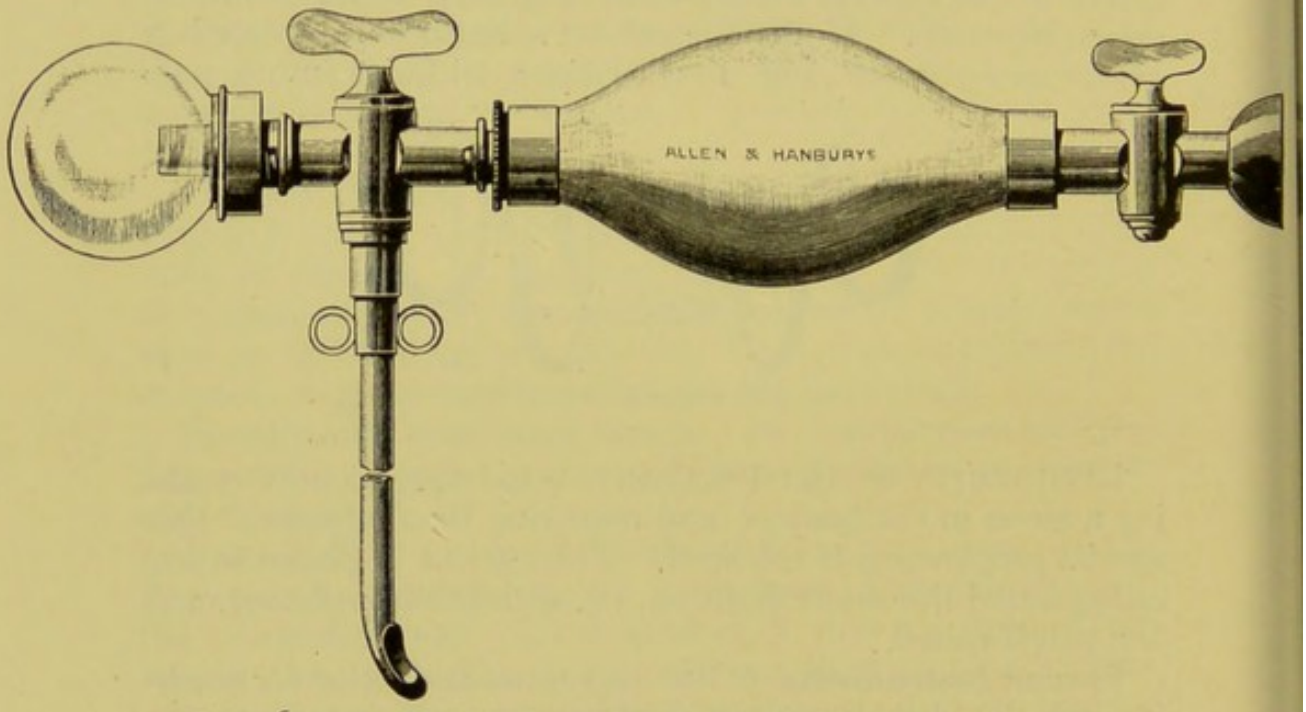


FIG. 165.—EVACUATING CATHETER FIXED TO SUCTION-PUMP. THE FRAGMENTS OF STONE ARE CAUGHT IN THE GLASS BULB.

means of a *suction-pump or aspirator* (Fig. 165). Fluid is poured into the bladder, and then sucked out along with the debris, the particles of stone dropping into a trap so that

they are not forced into the bladder again with the ingoing stream of lotion. To ensure that all the fragments are removed, the bladder may be inspected with the cytoscope (Fig. 149).

For the bougies and lithotrite, catheter lubricant is required.

After-Treatment.—The patient is kept in bed for a few days. The catheter may be required once or twice after the operation, but first he should be allowed to turn on his side or sit up to try and pass urine.

Special Complications.—Lithotrity may be followed by *catheter fever*, which is to be treated as already described (p. 248). If *pain* is severe, morphia should be given hypodermically unless the kidneys are seriously deranged.

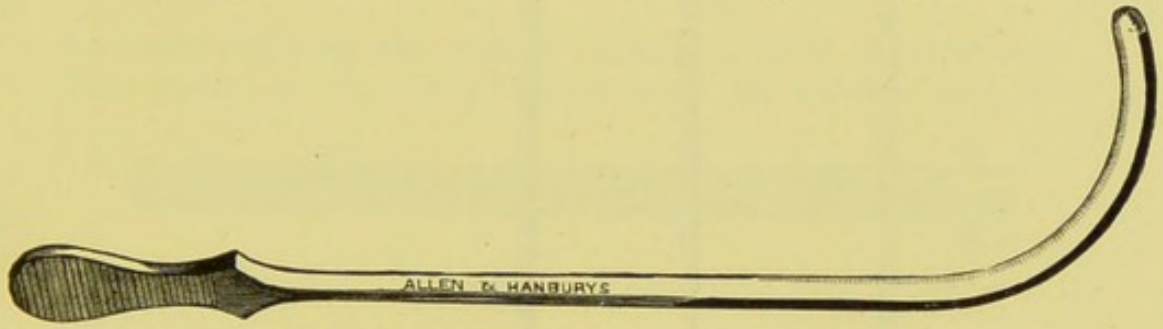


FIG. 166.—LITHOTOMY STAFF WITH CENTRAL GROOVE.

PERINEAL CYSTOTOMY, the opening of the bladder through a perineal incision, is performed in severe cystitis, or for the removal of a stone (*perineal lithotomy*). *Perineal prostatectomy* is the operation of removing an enlarged prostate gland through the perineum.

Special Instruments.—A bladder sound (Fig. 155) is required. The *lithotomy staff* (Fig. 166), which is passed along the urethra into the bladder, acts as a guide to the surgeon. It is a large, curved instrument of steel with a broad, roughened handle. Throughout its lower half it has a deep central groove which guides the knife into the bladder. For the operation of *lateral perineal lithotomy*, which is now rarely performed, the groove on the staff is placed laterally (Fig. 167). Special *lithotomy knives* (Fig. 97) are sometimes used. The cutting edge extends only along the anterior two-

thirds of the blade, and the point may be sharp or blunt. The *lithotomy forceps and scoop* (Figs. 156 and 157) must also be sterilized. A *gorget* (Fig. 168) is rarely used. The small

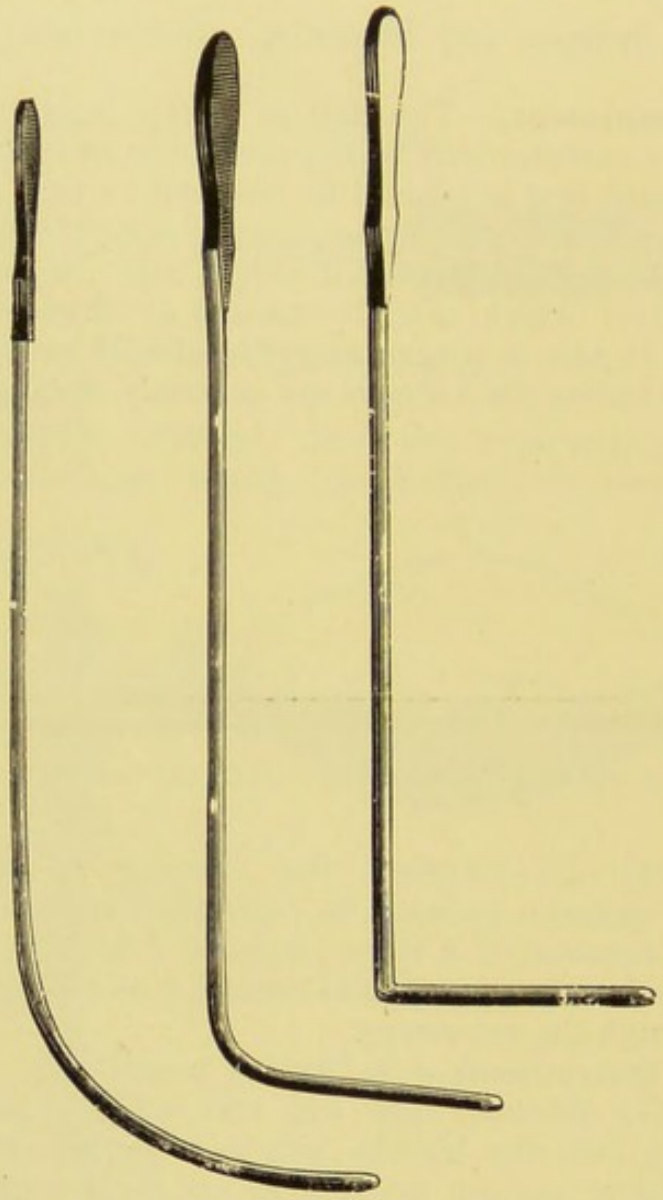


FIG. 167.—LITHOTOMY STAFFS WITH LATERAL GROOVES—CHESELDEN'S, CHIENE'S AND BUCHANAN'S FROM LEFT TO RIGHT.

button at the point is fitted into the groove in the staff, and as it is pushed on into the bladder it dilates the incision in the prostate gland.

The bladder is drained through the perineal wound. The

drainage-tube may be of gum-elastic or metal (Fig. 169). It is short and straight, and has two metal rings for fixing tapes. The tube must be stiff, because it is sometimes

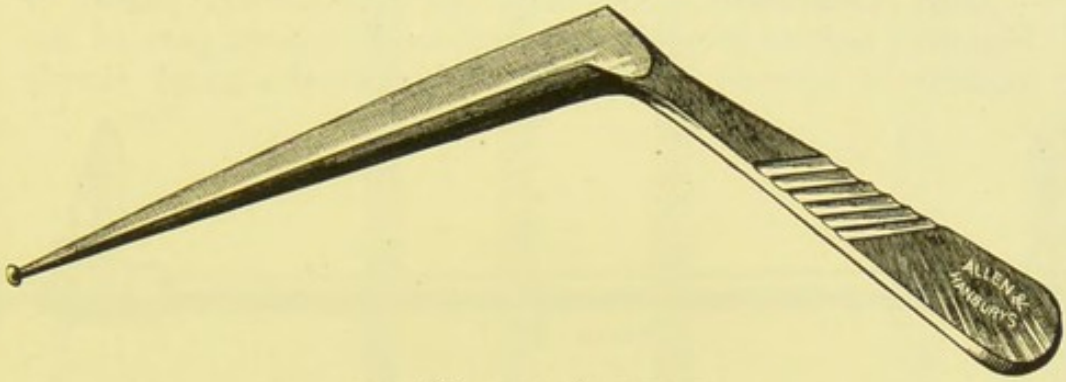


FIG. 168.—TEALE'S GORGET.

necessary to plug the wound tightly to stop hæmorrhage. The gauze or lint for plugging may be fixed round the

FIG. 169.—GUM-ELASTIC PERINEAL DRAINAGE-TUBE.

tube near its inner end and hang loosely round the rest of it—*petticoated tube*. Into the cul-de-sac thus formed, wool

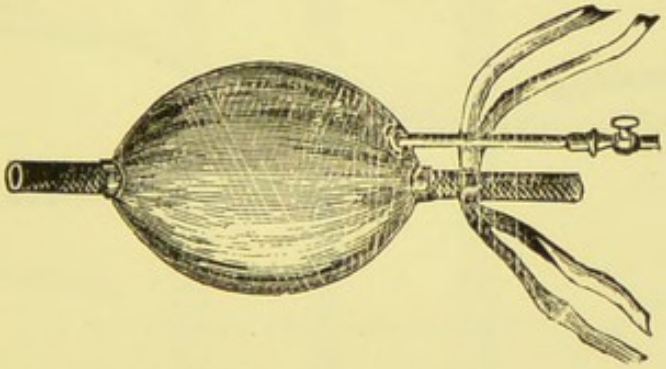


FIG. 170.—INDIA-RUBBER TAMPON TO STOP HÆMORRHAGE AFTER PERINEAL CYSTOTOMY.

is tightly packed to press on the bleeding vessels. With the same object, an india-rubber tampon (Fig. 170) which may be inflated is sometimes used.

For *perineal prostatectomy*, the *prostate retractor* (Fig. 171) is useful, and some surgeons use special *prostate scissors* (Fig. 172).

After-Treatment.—Drainage by the suction pump or Bunsen's bottles is rarely required, as the lowest part of the bladder is opened in the perineal operation, and simple

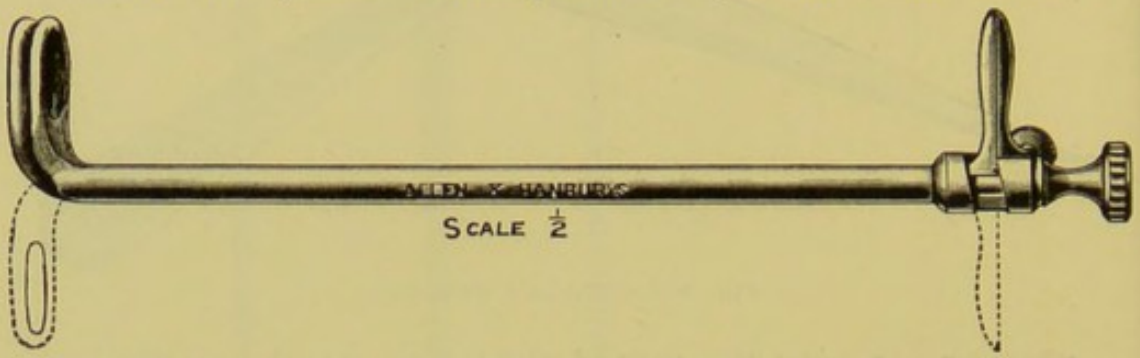


FIG. 171.—YOUNG'S PROSTATE RETRACTOR.

drainage by gravity is efficient. If severe cystitis is present, the bladder should be washed out several times a day, care being taken not to introduce more than four or six ounces of fluid at a time. The tube is kept in for four days to a week, and a bougie may then be passed to encourage urina-

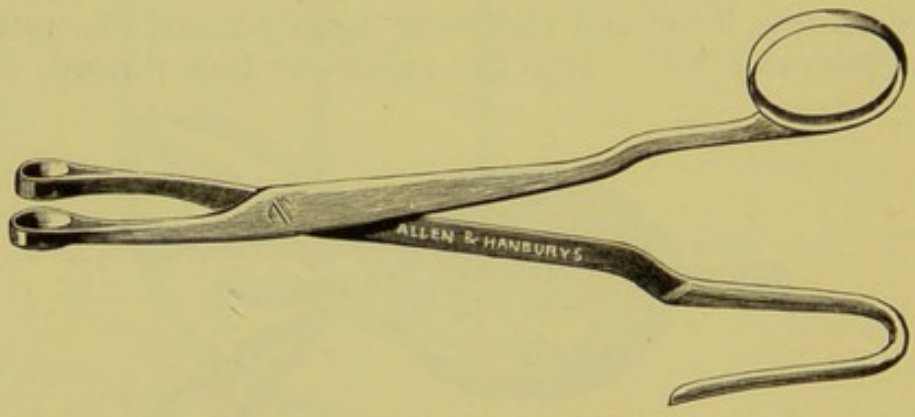


FIG. 172.—PROSTATE SCISSORS.

tion by the urethra. Until the perineal wound closes, bed-sores must be guarded against.

The **Special Complications** are the same as after supra-pubic cystotomy. In perineal prostatectomy, incontinence of urine and injury to the rectum are more apt to occur than in the supra-pubic operation.

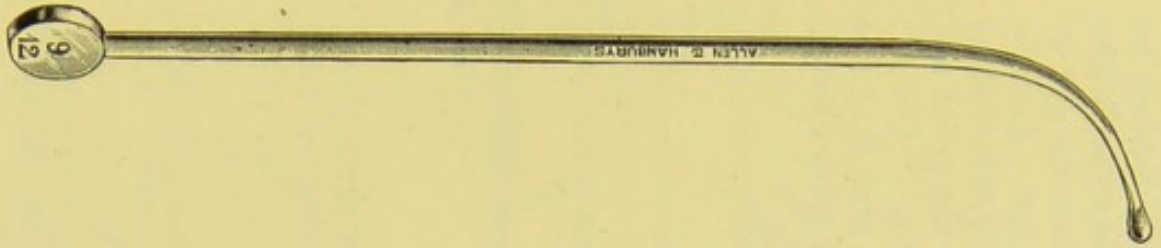


FIG. 173.—LISTER'S BOUGIE.

FIG. 174.—ENGLISH GUM-ELASTIC BOUGIE.

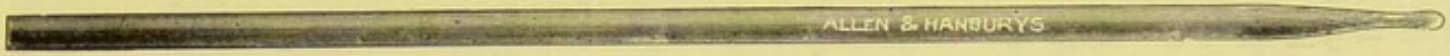


FIG. 175.—FRENCH GUM-ELASTIC BOUGIE.

FIG. 176.—ACORN-HEADED BOUGIE.

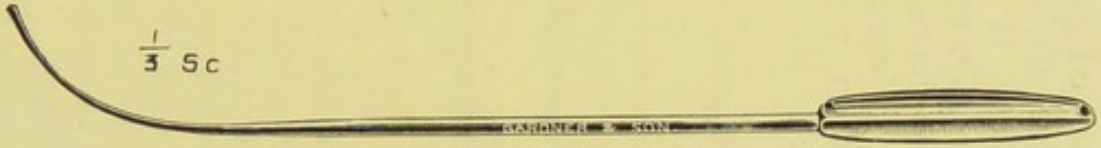


FIG. 177.—MILLER'S BOUGIE.

FIG. 178.—FILIFORM BOUGIE.

DILATATION OF A URETHRAL STRICTURE.—This may be performed by passing in succession a series of lubricated *bougies* of gradually increasing size. These are shaped like catheters, but are not perforated for the escape of urine. They are about twelve inches long, and vary in diameter according to a set scale, each instrument having its size marked on it. The *ordinary silver bougie* is exactly like the silver catheter (Fig. 144), except that it has no eye at the point. It is of the same diameter throughout. *Lister's bougies* (Fig. 173) are of solid steel. They are graduated so that the diameter increases by three sizes from the point upwards. Hence their size is referred to as "2 to 5," "3 to 6," and so on, 3 being the diameter at the point, and 6 at the middle of the shaft. Bougies are also made of gum-elastic,

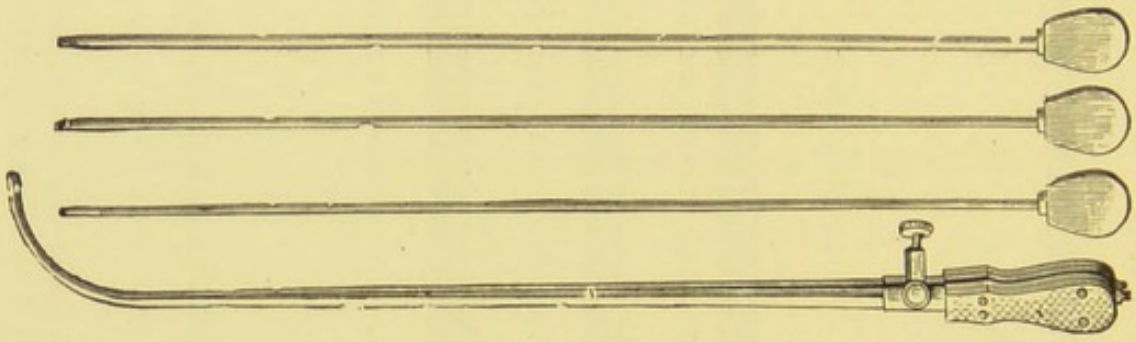


FIG. 179.—HOLT'S URETHRAL DILATOR.

the English bougie being of the same diameter throughout (Fig. 174), and the French bougie gradually tapering towards the extremity and ending in a rounded bulb (Fig. 175). The *acorn bougie* (Fig. 176) and *Miller's bougie* (Fig. 177) are mainly used to determine the site and calibre of a stricture. The *filiform bougie* (Fig. 178) is of small diameter; it is used in cases of tight stricture. Or, a *dilator* (Fig. 179) may be employed. This is a bougie constructed in two halves, with a central rod to push between the two parts and increase the diameter.

THE REMOVAL OF A FOREIGN BODY from the urethra may be accomplished by means of urethral forceps (Fig. 180) with crocodile jaws. If the extraction produces laceration of the urethra, a stricture may result.

URETHROTOMY is the operation of cutting a urethral stricture. The knife may be passed along the urethra to cut from

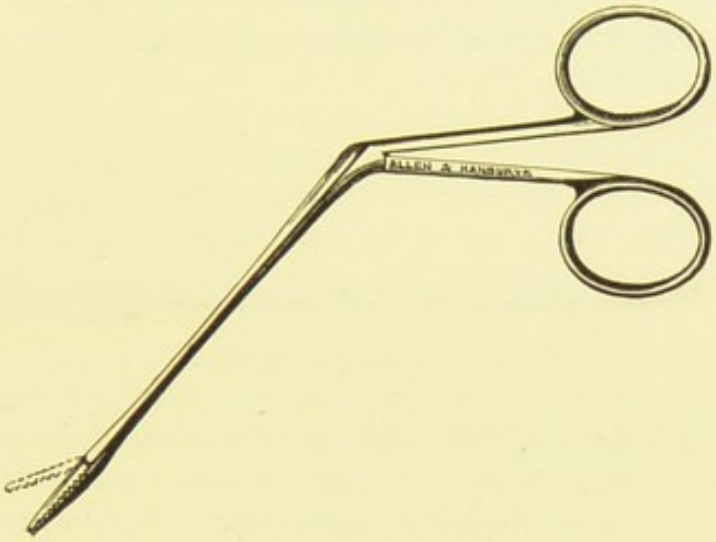


FIG. 180.—URETHRAL FORCEPS.

within out—*internal urethrotomy*—or the incision may be made from the perineum inward to the urethra—*external urethrotomy*. A special knife, the *urethrotome* (Fig. 181), is required for the former. It is shielded in a staff while it is being

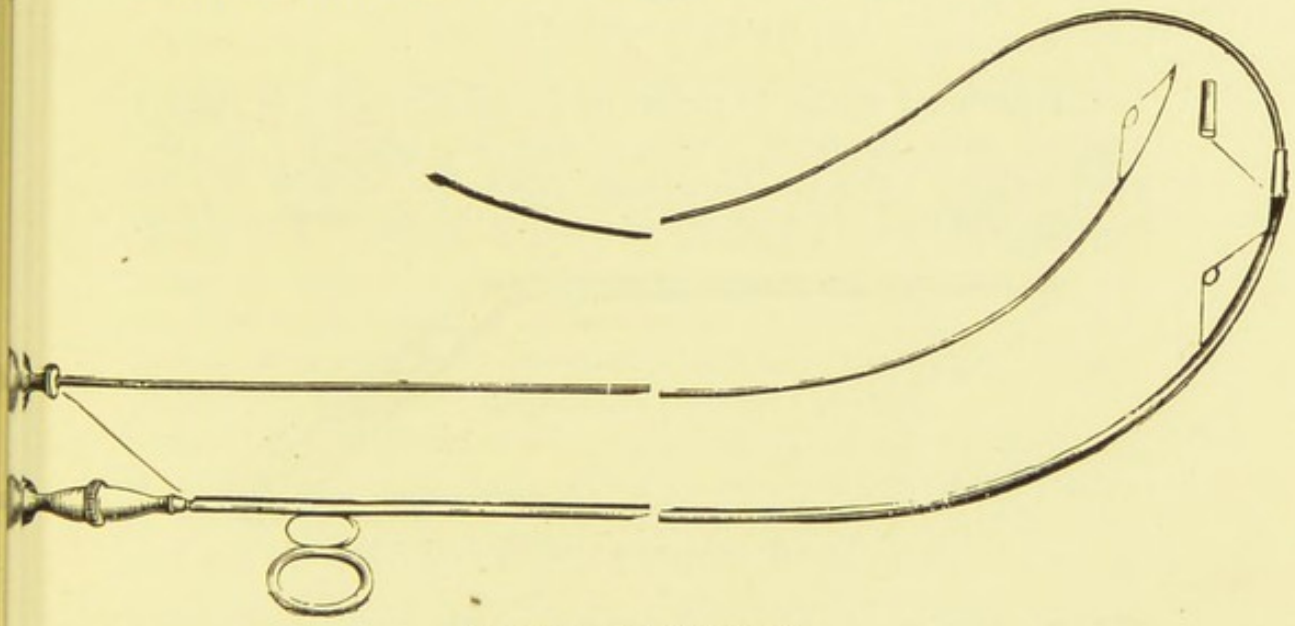


FIG. 181.—URETHROTOME.

passed, and uncovered when the stricture has been reached. In external urethrotomy, *Syme's staff* (Fig. 182) is passed through the stricture if it is permeable. When no instrument can be passed through, *Wheelhouse's staff* (Fig. 183) is passed

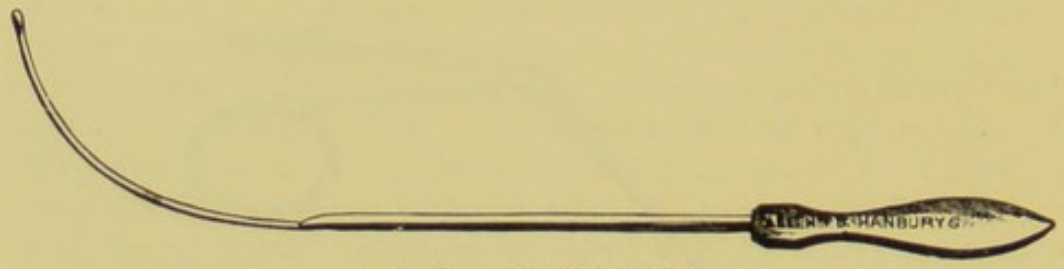
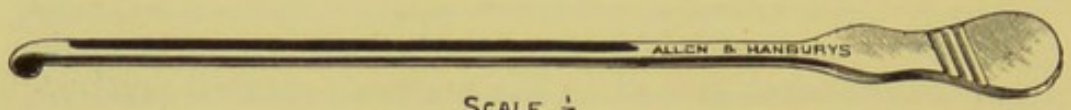


FIG. 182.—SYME'S STAFF.

down to the stricture. Once either of the staffs is in position, the surgeon cuts down on the groove, and divides the stricture. In Wheelhouse's operation, a *probe-director* (Fig. 184) is used to determine the lumen of the stricture.



SCALE $\frac{1}{3}$

FIG. 183.—WHEELHOUSE'S STAFF.

The perineal wound is closed up in aseptic cases, or lightly plugged with gauze if septic sinuses are present. A full-sized rubber catheter is passed from the meatus to the bladder and tied in position ; or a self-retaining catheter (Fig.

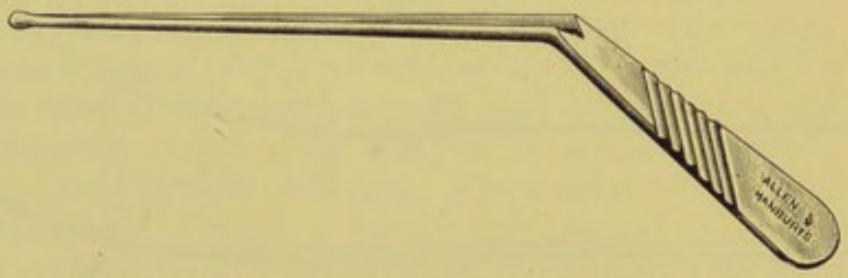


FIG. 184.—WHEELHOUSE'S PROBE-DIRECTOR.

185) may be employed. In certain septic cases, the bladder must be frequently douched, and the catheter changed every two or three days as it becomes coated with a hard scum of phosphates. In severe cystitis, the bladder is drained through

the perineal wound. After the cystitis has subsided, bougies are passed at intervals of one to three months to prevent contraction of the stricture.

Special Complications.—*Hæmorrhage* is rarely serious. It is treated by tying in a rigid catheter, and then placing a pad of wool over the perineal wound and compressing it against the catheter by a firm bandage. *Catheter fever* may occur (p. 248), and infection of the surrounding cellular tissue—*cellulitis*. *Suppression of urine* may occur in old patients with diseased kidneys and septic urine.

CIRCUMCISION.—The private nurse should watch in infants that the opening in the prepuce is large enough to permit the free escape of urine. If not, the prepuce is ballooned out, the urine cannot escape freely, and the child cries with pain.

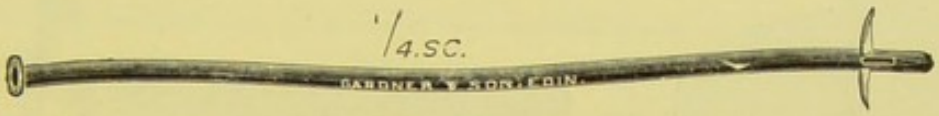


FIG. 185.—SELF-RETAINING CATHETER.

Operation.—In circumcision, part of the prepuce is removed, and the remaining part is widened so that it is easily drawn back over the glans.

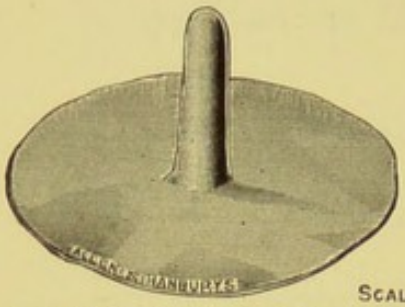
After-Treatment.—The nurse has often to dress the wound. This is most conveniently done by wrapping a narrow strip of gauze round as if bandaging. If the dressing tends to adhere closely to the wound, the gauze may be smeared with sterile vaseline before it is applied. An adherent dressing may be soaked off in a hot bath. Adult patients may require potassium bromide at night.

Special Complications.—*Hæmorrhage* if severe can only be arrested by ligating or stitching under the bleeding vessel. A nurse may transfix under the vessel with a sterilized pin, and put on a figure-of-eight thread. If a general oozing is going on, the part should be bathed with water at 115° F. *Sepsis*, if severe, may result in sloughing of the prepuce.

CHAPTER XXII.

OPERATIONS ON THE RECTUM.

EXAMINATION OF THE RECTUM.—The surgeon may examine the rectum by the finger, and the nurse should have



SCALE $\frac{1}{4}$

FIG. 186.—PETTICOATED FINGER-STALL.

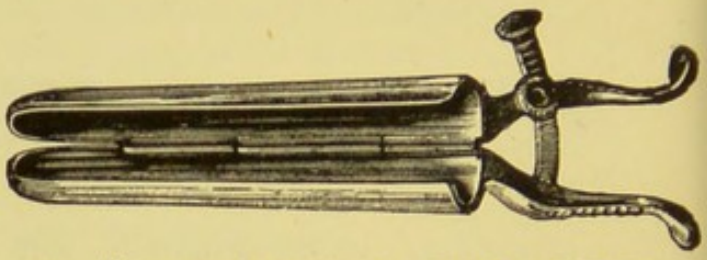


FIG. 187.—PROCTOSCOPE OR RECTAL SPECULUM.

ready a rubber finger-stall with petticoat (Fig. 186) or a glove, and vaselin or other lubricant. Or a visual examination

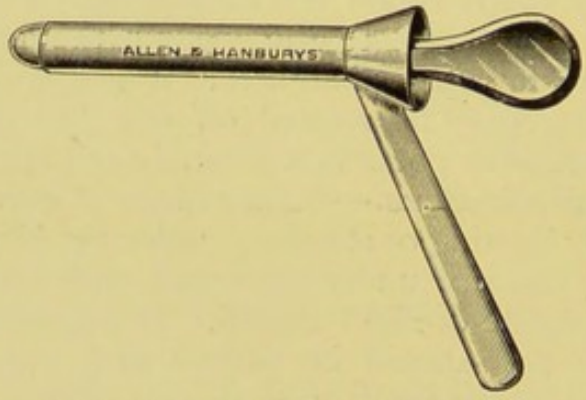


FIG. 188.—KELLY'S PROCTOSCOPE.

may be made by means of a proctoscope or rectal speculum (Figs. 187 and 188), the patient being placed in the knee-

elbow position. A bright light is reflected into the interior from a forehead mirror. A longer instrument, carrying an electric lamp like the cystoscope (p. 251)—the *sigmoidoscope* (Fig. 189)—is used for the examination of the bowel above the rectum.

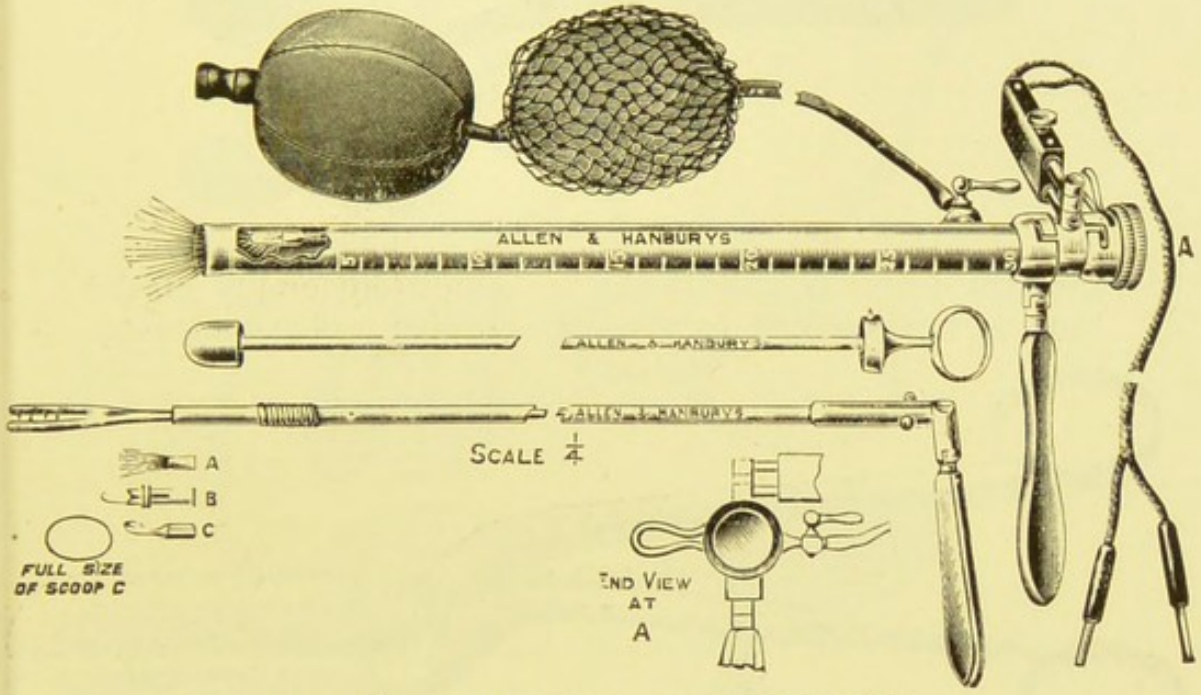


FIG. 189.—SIGMOIDOSCOPE WITH ACCESSORIES.

DILATATION OF THE RECTUM in cases of stricture may be effected by stiff *gum-elastic rectal bougies* (Fig. 190), graduated in size, or by a *rectal dilator* (Fig. 191). The bougies are lubricated with vaseline.

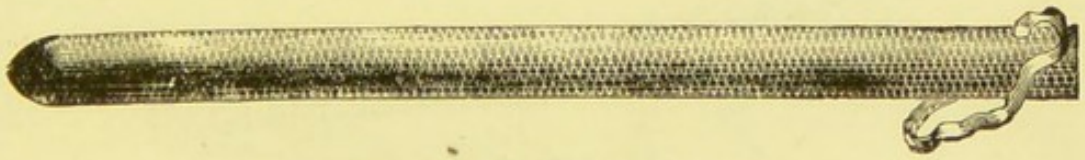


FIG. 190.—GUM-ELASTIC RECTAL BOUGIE.

REMOVAL OF HÆMORRHOIDS.—The most frequent operation on the rectum is the removal of hæmorrhoids or piles. The preparation of the patient is the same as in other minor operations on the rectum.

Preparation of the Patient.—The purgative is administered as usual the day before operation. As it is essential

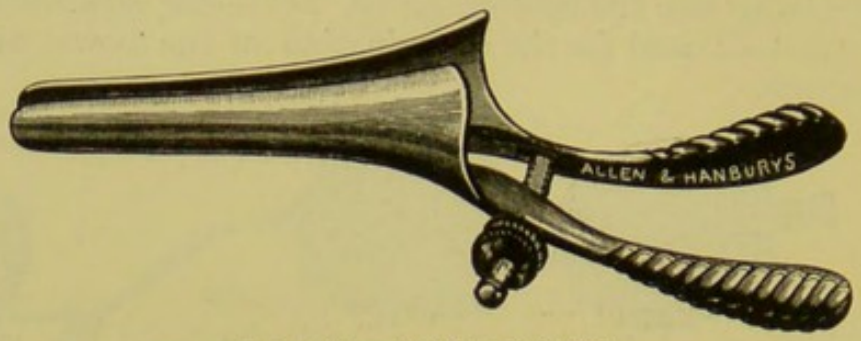


FIG. 191.—RECTAL DILATOR.

that the lower bowel should be completely empty at the time of operation, it is advisable to give a soap-and-water

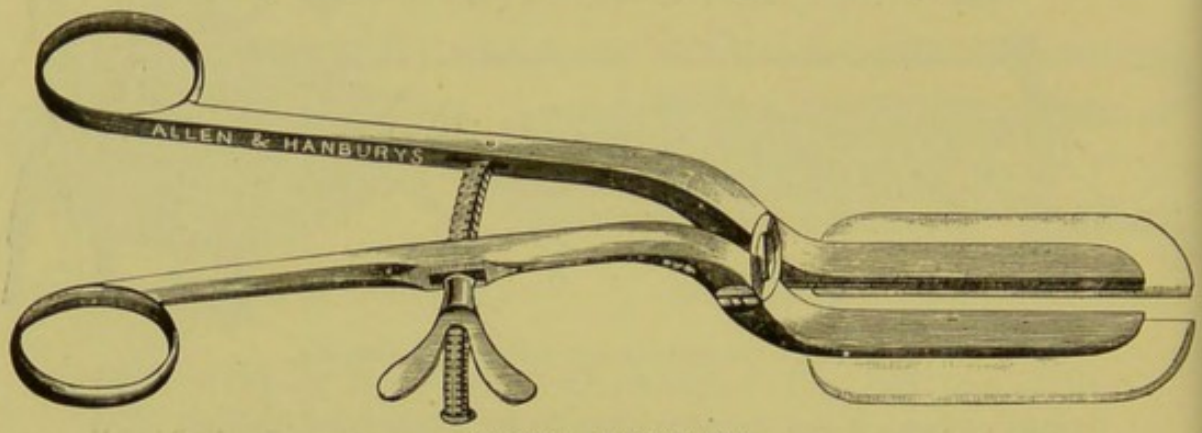


FIG. 192.—PILE-CLAMP.

enema two or three hours before, and follow it up by a wash-out with boric lotion given by the tube and funnel.

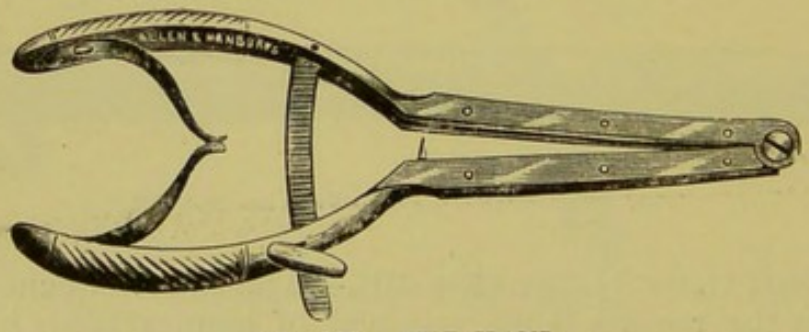


FIG. 193.—PILE-CLAMP.

The perineum may be shaved and cleansed the night before operation, or on the operating-table.

Special Instruments.—The surgeon may use the *pile-clamp* (Figs. 192 and 193) to crush the masses, which are

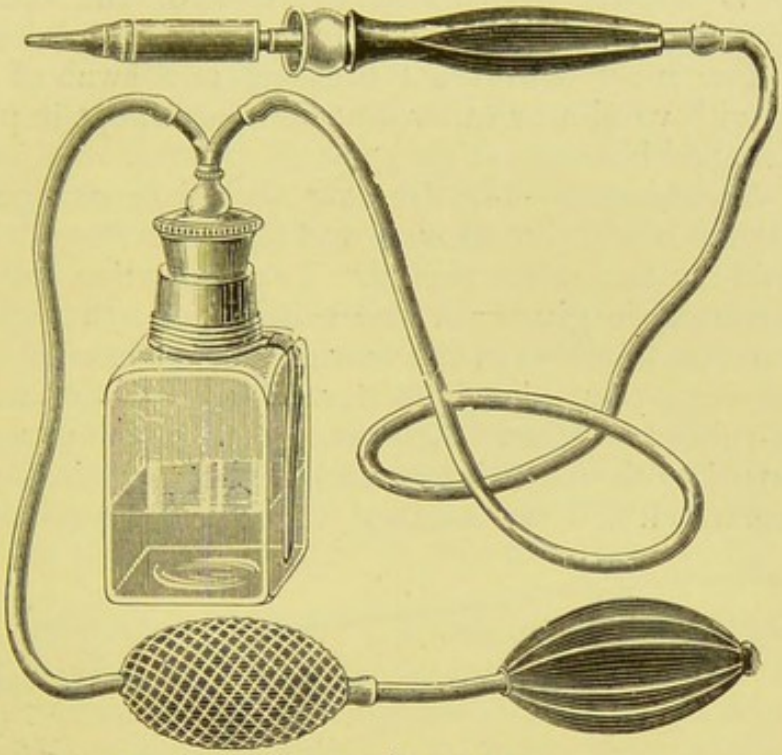


FIG. 194.—PAQUELIN'S THERMO-CAUTERY.

burned off with the *cautery* (Fig. 194) at a dull-red heat. Or he may ligate the masses, seizing each with *pile-forceps*

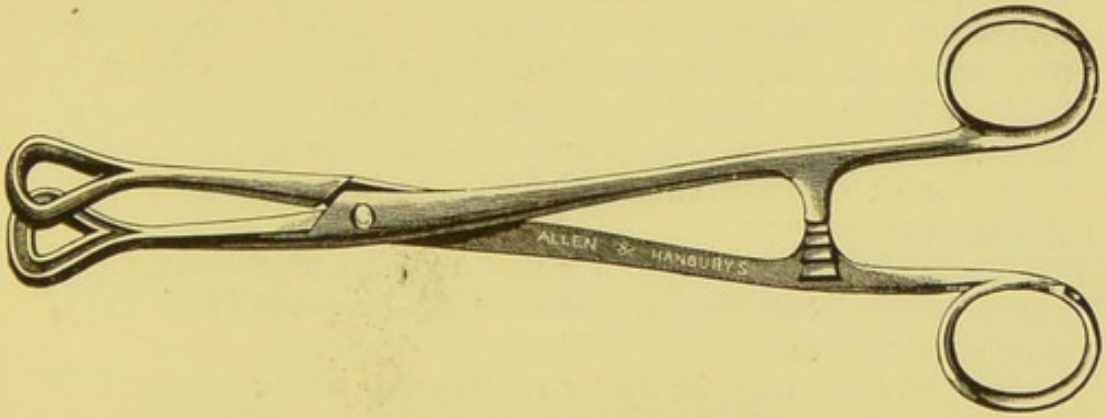


FIG. 195.—PILE-FORCEPS.

(Fig. 195) and transfixing it with the *pile-needle* (Fig. 196). If he excises the hæmorrhoids, no special instruments are

required, but scissors curved on the flat (Fig. 56) are sometimes convenient. A ¼-grain or ½-grain morphia suppository is usually inserted at the end of the operation. The nurse should have one of each at hand, and lubricant for it. The most convenient dressing is a swab of gauze, smeared with vaselin or other ointment, and kept in position by a T-shaped bandage (Fig. 37).

After-Treatment.—The dressing should be changed once a day till the bowels are moved, and the diet should be entirely fluid for the same period. The purgative, castor oil for preference, is given on the third or fourth night after operation, and followed in the morning by an enema of half a pint of warm olive oil administered by means of a funnel and soft-rubber catheter. After each motion, the part should be cleansed with weak lysol, and a fresh dressing applied. The patient should be confined to bed for a week at least,

FIG. 196.—PILE-NEEDLE.

during which time the bowels are kept acting loosely by saline purgatives or enemata.

Special Complications.—*Retention of urine* is frequently met with, but the catheter should not be passed till it is evident that the patient cannot overcome the difficulty of micturition. He may be allowed to turn on his hands and knees, or sit up to attempt urination, before recourse is had to the catheter.

Accumulation of gas in the rectum may be troublesome and painful. A *flatus-tube*, of gum-elastic or glass (Fig. 115), should be inserted.

Hæmorrhage may be either reactionary or secondary, and it may appear externally or remain concealed in the rectum. Hence the nurse must be ready to recognize the symptoms of internal hæmorrhage (p. 190). As a rule an anæsthetic must be administered to clamp the bleeding point. If this is

impossible, a short petticoated tube (p. 265) should be inserted to plug the anal canal. The outer end of the tube must be transfixed with a safety-pin to prevent it slipping in. Secondary hæmorrhage is the result of sepsis and ulceration, and may occur at any time from one to three weeks after the operation. It is best treated by plugging. In female patients, bleeding can be temporarily controlled by the pressure of a finger in the vagina backwards against the sacrum. In a male patient pressure with a finger in the rectum is often successful.

Swelling at the anal orifice occurs in a large number of cases. It usually disappears spontaneously with healing, and need not cause worry.

One or more rigors may occur after the bowels are moved for the first time. They are probably due to septic absorption, and they are specially apt to occur if the bowels are not moved till the catgut begins to separate, say on the fifth or sixth day.

Ulceration is an evidence of sepsis. It may lead to secondary hæmorrhage, or end in stricture of the anal canal. The existence of ulceration is suspected when the patient suffers from tenesmus or straining. It is treated by frequently douching the lower bowel with weak antiseptics.

Stricture of the rectum is treated by dilatation with graduated gum-elastic bougies (Fig. 190).

Incontinence of fæces is a rare complication.

SLITTING OF FISTULA IN ANO.—The preparation and after-treatment are the same as for the removal of hæmorrhoids. A *fistula bistoury* (Fig. 197) may be used to lay

FIG. 197.—FISTULA BISTOURY.

open the track, or a *fistula director* and *scissors* may be used (Fig. 198). The wound is firmly packed at the operation. This packing is removed in forty-eight hours, and loose packing substituted and renewed till the granulations have grown

almost to the level of the surrounding skin. Incontinence of fæces occurs if the internal sphincter is cut, and it may be permanent if this muscle is divided at more places than one.

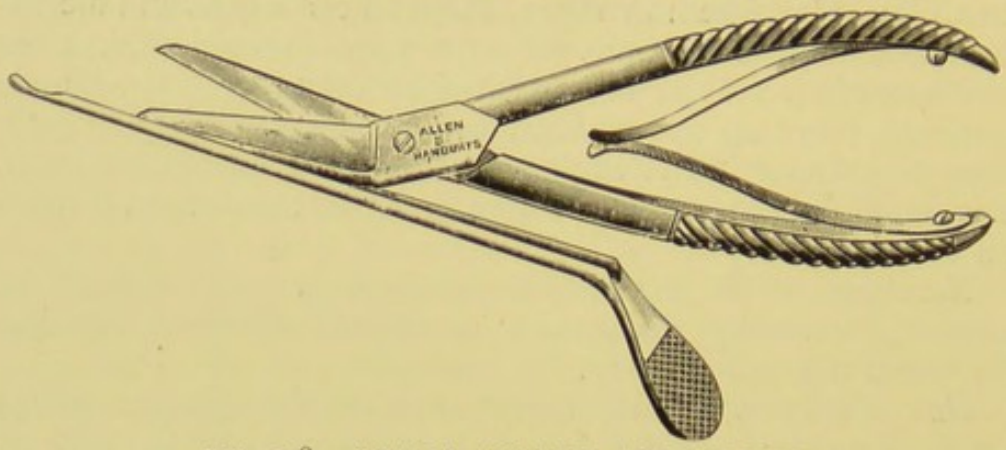


FIG. 198.—FISTULA DIRECTOR AND SCISSORS.

EXCISION OF THE RECTUM is performed for malignant disease.

The **Preparation of the Patient** varies with his condition. If the rectum is patent, and the bowels can be moved, then a purgative should be given. If the bowels only move with difficulty, it may take several days to empty them completely. Some surgeons give a strong purgative eight days before operation, and follow it up with salines by the mouth, and soap-and-water enemata each day till the operation. If the nurse has any doubt about the complete emptying of the lower bowel, she should inform the surgeon. In such an event, the operation is likely to be postponed, as the escape of fæces at the time of operation increases the risk of sepsis. If complete obstruction exists, purgatives are useless, and a preliminary colostomy (p. 234) will probably be performed to empty the bowel, the excision of the rectum being delayed until four to six days afterwards. On the morning of operation, the rectum is washed out once or twice with boracic lotion.

The operation area varies with the site of the disease. If it is low down, the incision is made in the perineum, and this region must be shaved and cleansed the night before. On the table, the patient is placed in the lithotomy position (p. 143). If the disease is situated higher up, the sacral route

is chosen. Then the skin of the lower end of the back as well as of the perineum must be cleansed. The patient is placed on his right side, and turned half on his face—the semi-prone position. If the tumour extends still higher, then the abdomino-perineal operation is performed, and the abdomen is prepared as for any laparotomy, and the perineum shaved and cleansed. If removal of the tumour is impossible, then colostomy (p. 234) is performed as a palliative operation.

Special Instruments.—*Intestinal clamps* (p. 231) are required. The necessary instruments for removing bone (p. 371) should always be ready, as the coccyx and part of the sacrum may have to be removed. In the end-to-end suture of the cut ends of the bowel, a large-sized rectal bougie (Fig. 190) is convenient.

After-Treatment.—The wound should be dressed daily to prevent sepsis and hasten healing. The bowels are not moved till the fourth day, and the diet is to be entirely fluid until that time. Later, bougies may have to be passed occasionally to counteract the tendency to stricture.

Special Complications.—*Shock* is generally marked. It is treated by intravenous infusions of saline solution.

Hæmorrhage may be reactionary or secondary. If it is severe, a general anæsthetic must be administered to secure the bleeding point, or insert firm plugging.

Retention of urine may occur (p. 201).

Sepsis may lead to peritonitis, as the peritoneal cavity is frequently opened during the operation. Or it may result in the stitches giving way. Then healing is attended with the formation of much granulation tissue, and stricture is apt to result. If less severe, sepsis usually leads to incomplete closure of the intestinal wound posteriorly, and the establishment of a fistula there. This condition is so frequent after the sacral operation that some surgeons leave the posterior intestinal edges unstitched, and close the gap at a subsequent operation.

Incontinence of fæces may occur if the disease extends low down and necessitates interference with the external sphincter muscle for its removal. When it is present, the nurse must be specially careful to prevent the formation of bed-sores (p. 204).

CHAPTER XXIII.

GYNECOLOGICAL OPERATIONS.

A.—ABDOMINAL OPERATIONS.

OVARIOTOMY is performed for the removal of a tumour of the ovary. The **preparation** of the patient is the same as for any other laparotomy (p. 103).

Special Instruments.—In former years, gynecologists were in the habit of puncturing cystic tumours by the *trocar* and *cannula* (Fig. 199) or the knife, to reduce their size before removal. Now they usually remove them entire. To grasp

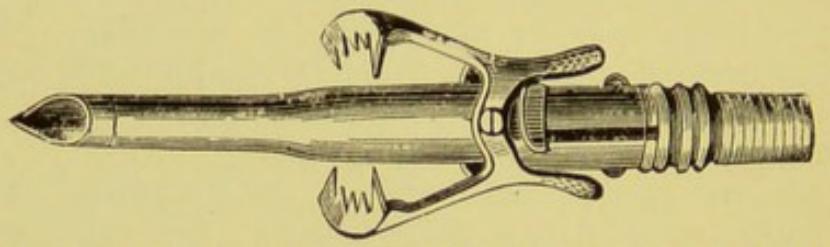


FIG. 199.—TROCAR AND CANNULA FOR TAPPING OVARIAN CYST.

the wall of the cyst, *cyst forceps* (Fig. 200) are occasionally used. To ligature the pedicle, a blunt-pointed *pedicle needle* (Fig. 201) or *pedicle needle forceps* (Fig. 202) should be sterilized.

The After-Treatment and Complications are the same as after laparotomy (p. 209). In general, if the tumour is not adherent to other organs, the effects of the operation are slight, but if adhesions are present, the operation is more difficult, and the efforts to separate them may rupture the bowel, bladder, or ureter. In a few cases the pedicle has

later become adherent to the intestine, and formed a band through which a loop of bowel has been strangulated.

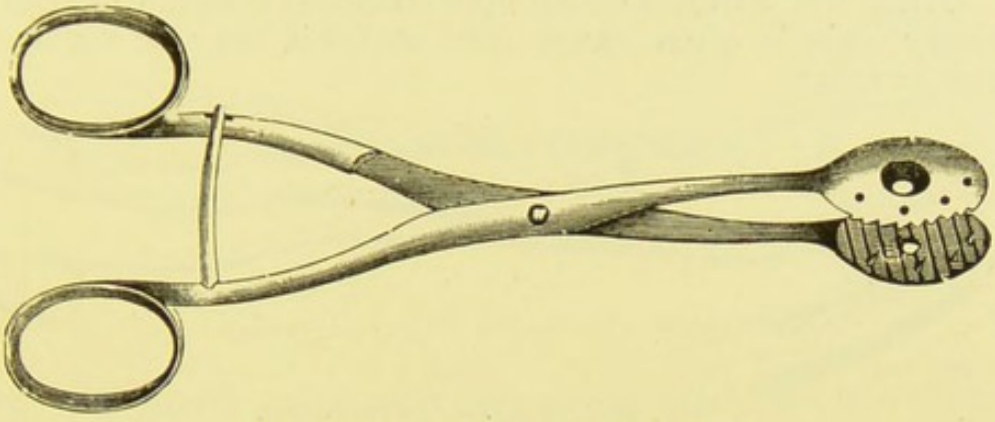


FIG. 200.—NELATON'S CYST FORCEPS.

REMOVAL OF A FALLOPIAN TUBE AND OVARY, or of both tubes and ovaries, does not call for special mention. If the Fallopian tube is distended with pus—pyosalpinx—the

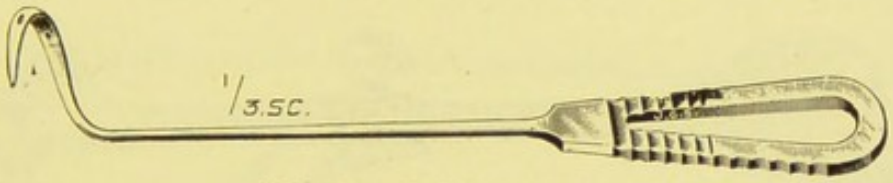


FIG. 201.—PEDICLE NEEDLE.

pelvis may need to be drained, either through the abdominal wound as for an appendix abscess (p. 237), or through the

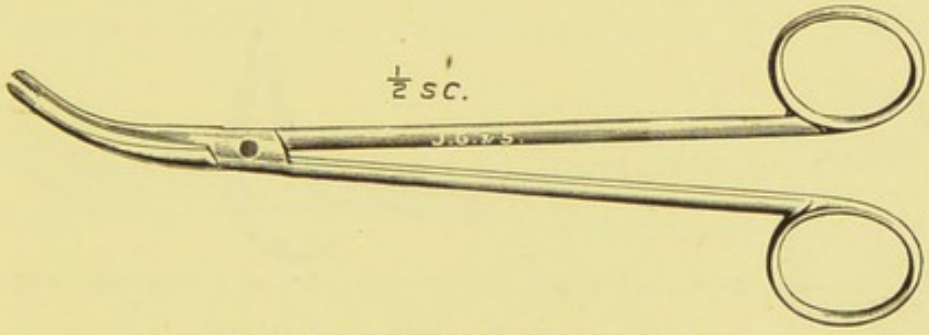


FIG. 202.—PEDICLE NEEDLE FORCEPS.

vagina. In the latter case, the vaginal roof is perforated by a knife cutting down on long, curved *vaginal forceps* or

perforator (Fig. 203) passed from the vaginal orifice by an assistant.

After the removal of the appendages (Fallopian tube and ovary) pain is often severe, and morphia may be required for its relief.

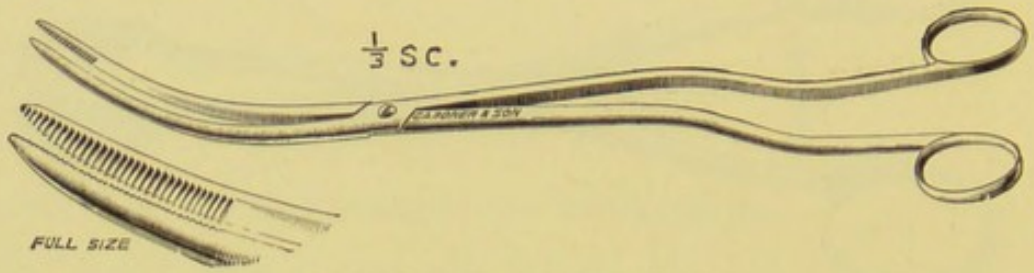


FIG. 203.—VAGINAL PERFORATOR.

ABDOMINAL HYSTERECTOMY is the operation of removing the uterus. It may be complete—*hysterectomy* or *panhysterectomy*—or incomplete—*supra-vaginal hysterectomy*—the neck of the uterus being left.

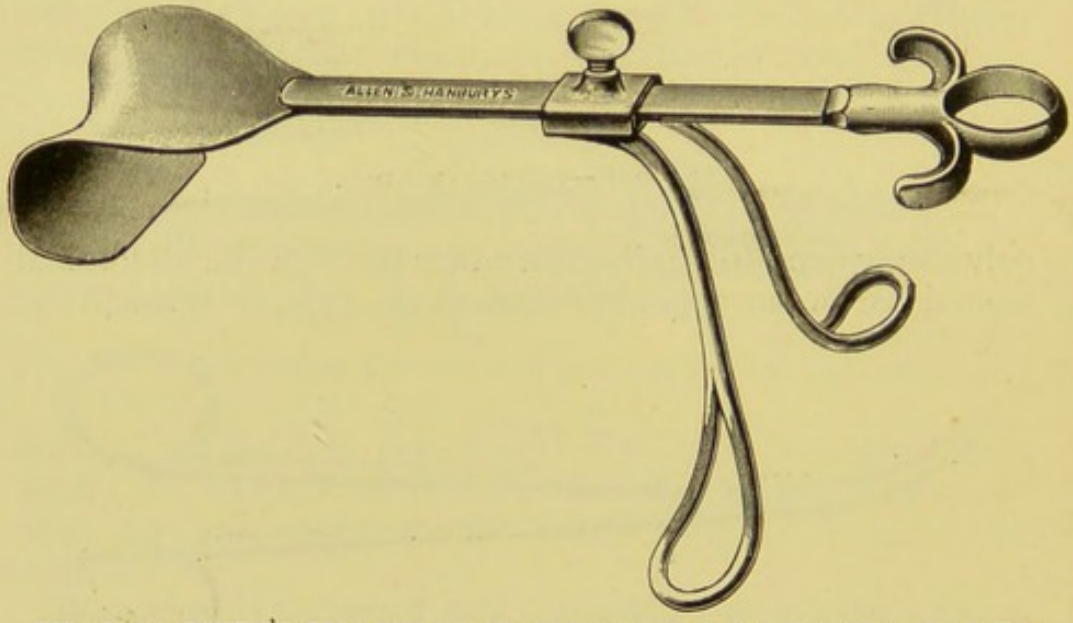


FIG. 204.—DOYEN'S SELF-RETAINING RETRACTOR FOR ABDOMINAL WOUNDS.

Special Preparation.—For the complete operation the vagina should be cleansed by douching (p. 285) twice a day for several days.

Special Instruments.—A *broad retractor* (Fig. 204) is of

great service to the operator. It is provided with two dependent limbs to fix it automatically to the patient's thighs,

FIG. 205.—STRONG VULSELLUM FORCEPS.

but it is usually found more convenient when held by a nurse. In grasping it, she must slide her hand *under* the sterilized

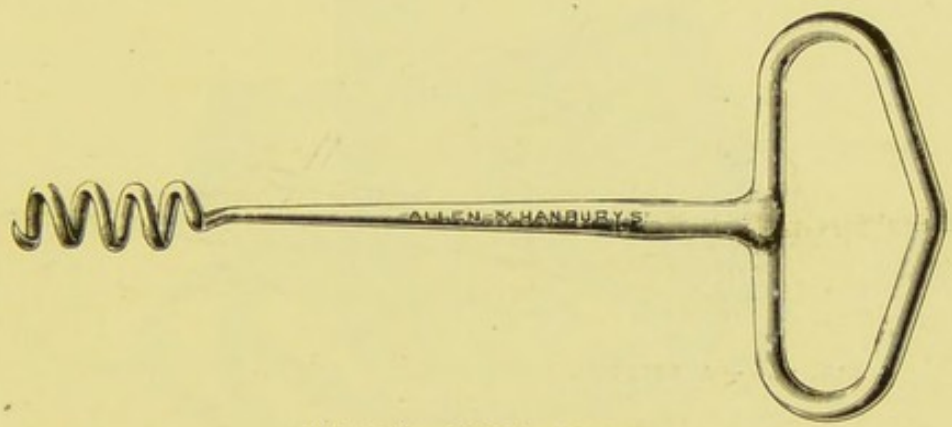


FIG. 206.—MYOMA SCREW.

towels. To pull the uterus up to the wound, strong *vulsellum forceps* (Fig. 205) or a *myoma screw* (Fig. 206) may

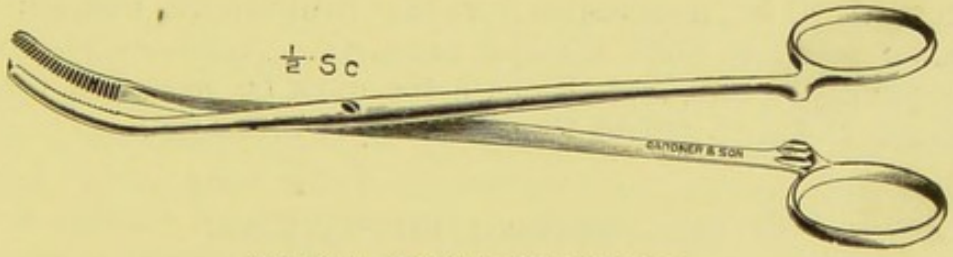


FIG. 207.—PERITONEUM FORCEPS.

be used. The pedicle needle (Fig. 201) or needle forceps (Fig. 202) are employed to transfix the broad ligament, and

scissors curved on the flat (Fig. 56) to separate the peritoneum from the surface of the uterus. Fine-toothed *peritoneum forceps* (Fig. 207) facilitate the stitching of the peritoneum after the removal of the body of the uterus.

After-Treatment.—Rectal infusions of saline may be administered four-hourly. The bowels are moved on the third day by a dose of castor oil, followed by a soap-and-water enema to which a tablespoonful of turpentine may be added. If flatus accumulates and causes much pain before the usual time for administering the purgative, the ward enema (p. 57) will be found of great value. The patient is kept for two or three weeks in bed, and the surgeon may recommend her to wear a specially fitted *abdominal belt* (Fig. 208) for a year afterwards.

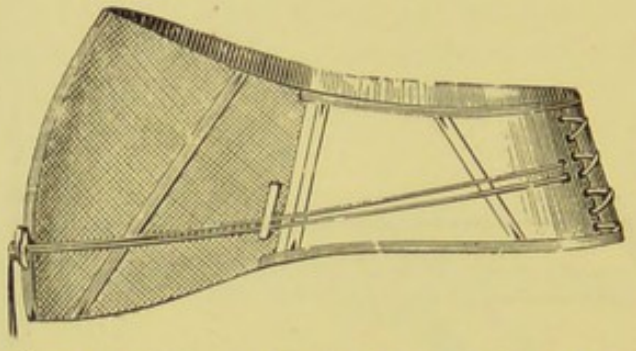


FIG. 208.—ABDOMINAL BELT FOR USE AFTER LAPAROTOMY.

Special Complications are described in Chapter XIX. In all gynecological laparotomies the nurse must be ready to recognize signs of *internal hæmorrhage*. If it is severe, the wound must be opened at once, and the bleeding point secured. The necessaries for the intravenous infusion of saline solution must also be prepared. *Retention of urine* frequently occurs, and the catheter must be passed if other measures fail to relieve the difficulty of urination.

B.—Perineal Operations.

Vaginal Examination.—A nurse must always be present when the vaginal examination of a patient is being made. If necessary, she must loosen the patient's clothing

beforehand, so that the doctor may have free access to the perineum and the anterior abdominal wall. The patient is usually placed first on her left side, and then asked to turn on her back and draw up her knees. She is covered by a sheet. The nurse should stand at the patient's head, and soothe her by conversing with her. Vaselin should be at hand for the lubrication of the doctor's fingers, but soap is now more generally used.

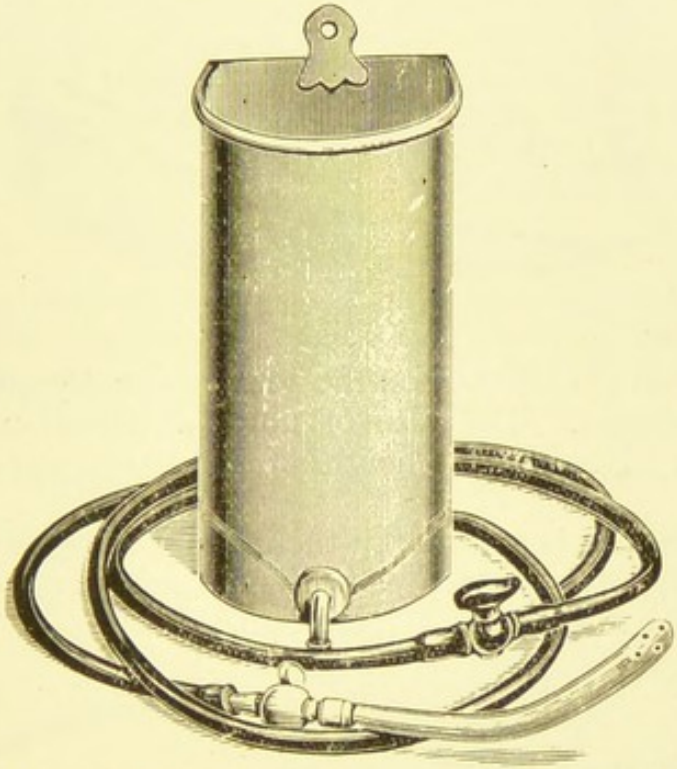


FIG. 209.—DOUCHE-CAN WITH CONNECTING TUBING AND VAGINAL NOZZLE.

VAGINAL DOUCHING.—This is an important part of the nurse's work in a gynecological ward. The apparatus consists of a *douche-can* to hold two to eight pints, *rubber tubing* with a stop-cock or screw clamp, and a *vaginal nozzle* of vulcanite or glass which is sterilized by boiling (Fig. 209). In a private house, the vaginal nozzle may be fixed to a *Higginson syringe* (Fig. 18), the outer end of which dips into the lotion-basin, but the douche-can is preferable.

Various lotions are used for douching—hot water at 110° to 120° F., boracic lotion, potassium permanganate 1 in 5000,

corrosive sublimate 1 in 4000 or 5000, carbolic acid 1 in 80, copper or zinc sulphate 1 in 80, and alum 1 in 80.

The patient being placed on a *slipper bed-pan* (Fig. 210), the nurse cleanses her hands, and the vaginal orifice of the patient. Next a measured quantity of the lotion, which should be at a temperature of 110° to 120° F., is poured into the douche-can, and the stop-cock opened, to allow some of the fluid to escape and heat the nozzle, after which the stop-

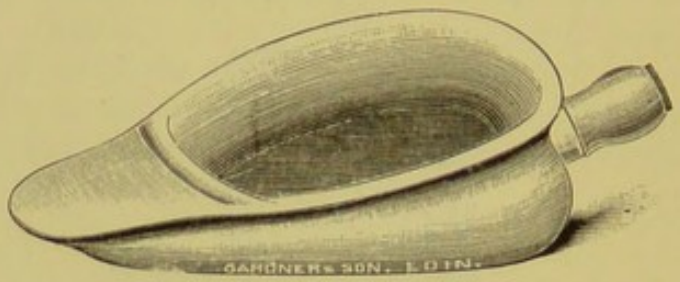


FIG. 210.—SLIPPER BED-PAN.

cock is again closed. Then the nozzle is gently inserted well into the vagina. The rate of flow, which should not be great, is regulated by the height of the douche-can above the patient.

If the douche is given with the patient lying on her back, she should, unless prevented for some special reason, sit up to expel the last drops of the lotion.

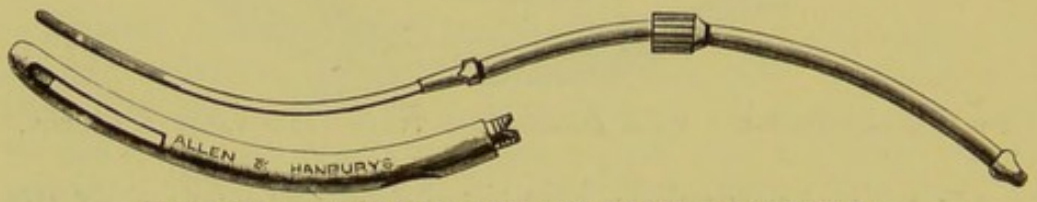


FIG. 211.—DOUBLE-CHANNELLED UTERINE CATHETER.

UTERINE DOUCHING is performed with the same douche-can, and a sterilized *uterine catheter* (Fig. 211). This is an S-shaped metal tube with a double channel, so that a free outlet is provided for the fluid. The same lotions are employed. A nurse is seldom asked to give a uterine douche.

VAGINAL PLUGGING.—The *vaginal tampon* or *plug* is made of absorbent cotton-wool soaked in glycerine, or ich-

thyol and glycerine (1 in 20). A thin square of wool, the size of the palm, is placed on the open hand, and ½ ounce of glycerine is poured on its centre. Then the corners are folded in, and the wool is lightly compressed so as to

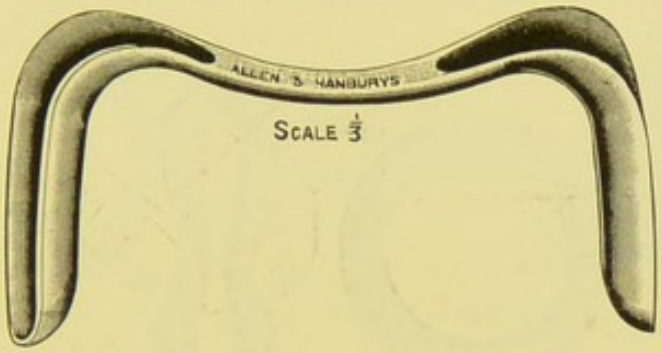


FIG. 212.—SIMS' VAGINAL SPECULUM.

saturate it, and tied with a piece of thin cord eight inches long. The plug may also be made of a thin sheet of cotton-wool, ten inches by four, soaked in a 1 in 20 solution of ichthyol in glycerine and twisted like a rope. A tape is attached to one

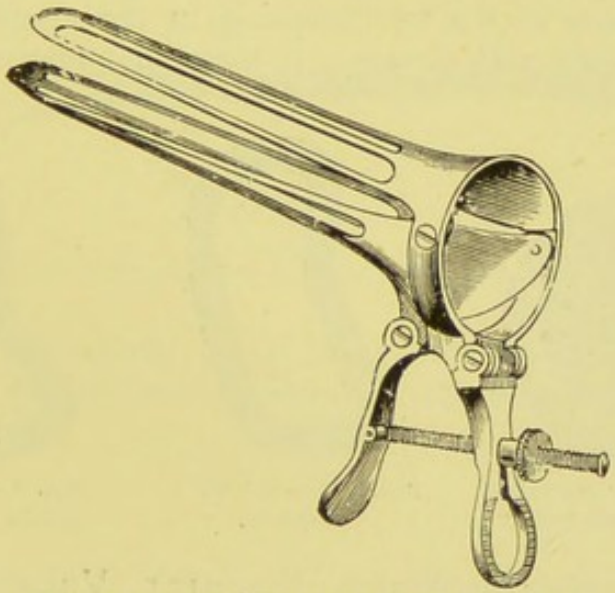


FIG. 213.—DUCKBILL VAGINAL SPECULUM.

end. Tampons of compressed, medicated sponge may be bought. If the vaginal orifice is small, a *vaginal speculum* (Figs. 212 and 213) should be passed. Then the plug is inserted up to the vaginal roof.

The plug is left in for about twelve hours, during which time the patient wears a diaper, as it induces a watery discharge. When it is removed, the patient is douched. A series of plugs may be inserted, one every second night, each being left in for twelve hours. Douching should be carried out twice a day.

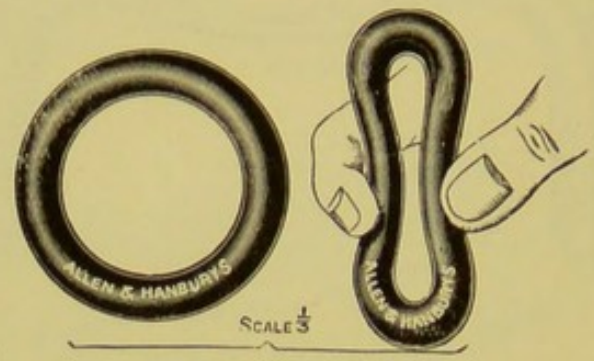


FIG. 214.—RING PESSARY.

Vaginal pessaries are employed to rectify various displacements of the uterus. They are made of rubber, vulcanite, wood, or metal. The *ring pessary* (Fig. 214) is a circular band of rubber with a watch-spring in the centre, rendering it compressible and elastic. It may be constructed with a

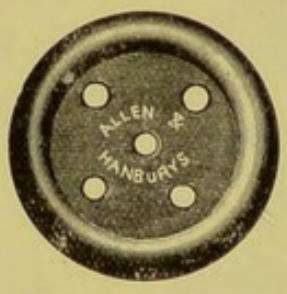


FIG. 215.—RING PESSARY WITH DIAPHRAGM.

FIG. 216.—HODGE'S PESSARY.

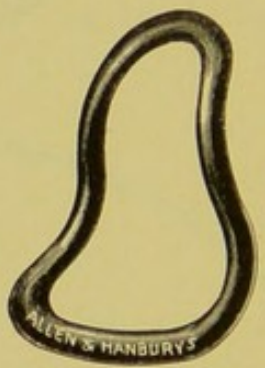


FIG. 217.—ALBERT SMITH'S PESSARY.

perforated rubber diaphragm (Fig. 215). Vulcanite pessaries are rigid, and shaped to the curve of the pelvic outlet, but they may be softened in hot water to allow of alterations in their curve. Some of the varieties in common use are Hodge's (Fig. 216), Smith's (Fig. 217) and Thomas's (Fig. 218). The ball-shaped pessary (Fig. 219) is occasionally used.

Patients who wear these instruments should have a vaginal douche once a day. Rubber pessaries should be removed

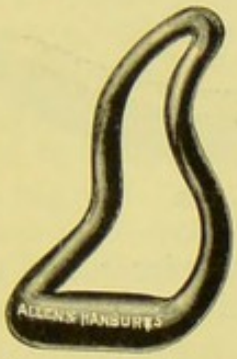


FIG. 218.—THOMAS'S PESSARY.

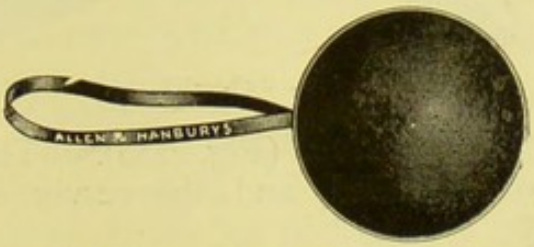


FIG. 219.—BALL-SHAPED PESSARY.

once every three or four weeks, and cleansed with lysol and a brush. When the surface becomes roughened, they should be replaced. Vulcanite pessaries may remain in position for

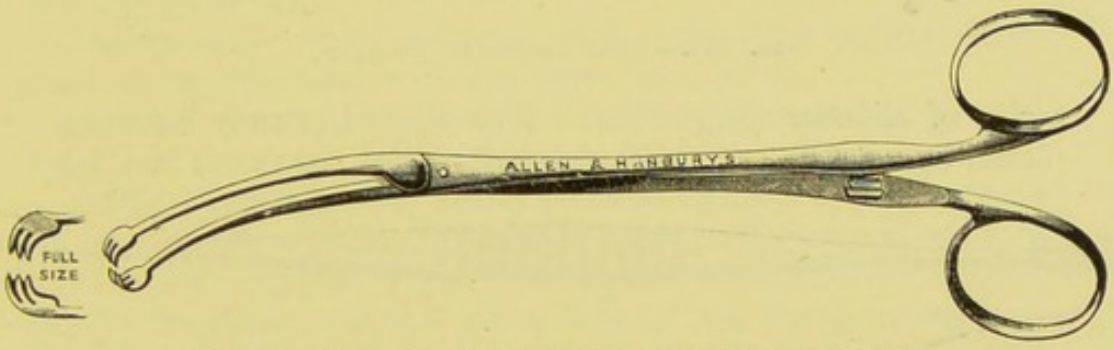


FIG. 220.—VULSELLUM FORCEPS FOR GRASPING CERVIX.

two months without being taken out. In every case the instrument should be removed if it sets up vaginal irritation and discharge.

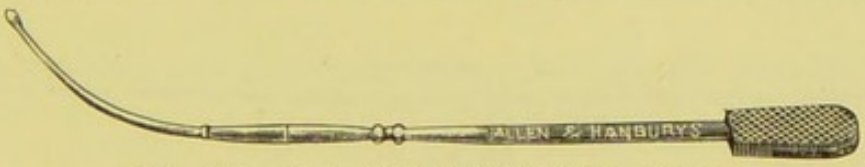


FIG. 221.—A. R. SIMPSON'S UTERINE SOUND.

CURETTAGE OF THE UTERUS is the operation of scraping away the mucous lining of the uterus.

Special Instruments.—The vagina having been douched, a *Sims' speculum* (Fig. 212) is passed, and the cervix seized

FIG. 222.—HEGAR'S CERVICAL DILATOR.

with a *vulsellum* (Fig. 220). Then a *uterine sound* (Fig. 221) is passed, and the cervix widened by a graduated

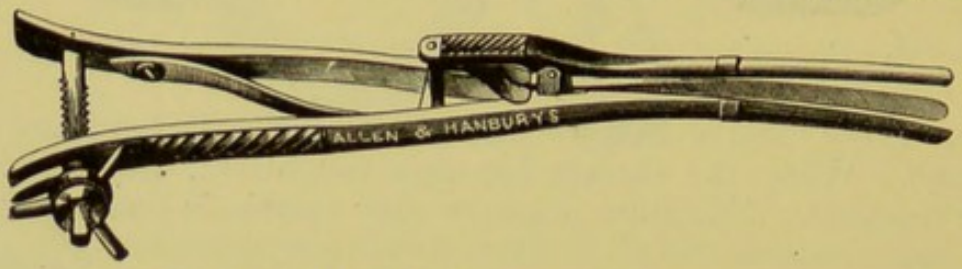


FIG. 223.—SIMS' CERVICAL DILATOR.

series of *dilators* (Fig. 222). The dilatation may be completed by means of a *Sims' dilator* (Fig. 223). Then the

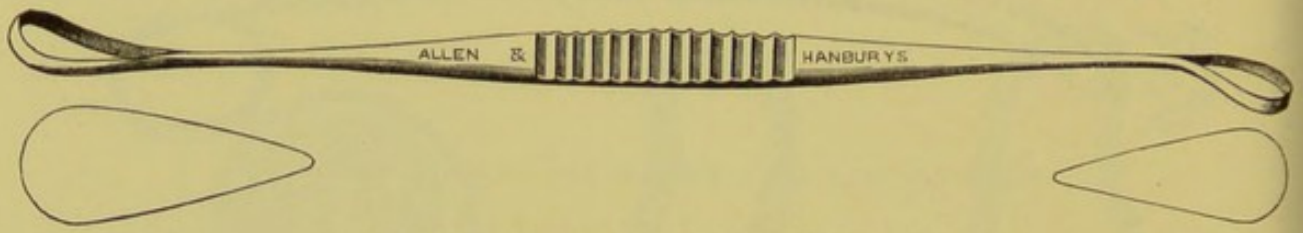


FIG. 224.—SPOON-SHAPED UTERINE CURETTE.

curette (Figs. 224 and 225) is employed, the interior of the uterus is cauterized with formalin, pure carbolic, or a mixture

SCALE $\frac{1}{2}$

FIG. 225.—RING-SHAPED UTERINE CURETTE.

of pure carbolic and iodine, applied on a "dressed sound," and drained with iodoform gauze. The "dressed sound" is a

uterine sound, roughened on its anterior three inches, round which a thin wisp of cotton-wool is spirally wound. The gauze for drainage should be several plies in thickness, about one and a half inches broad, and three to six feet long. The end is placed inside the uterus, and the remainder used to plug the vagina. Thus it is all in one piece, and at the time of its removal there is no chance of part of it being left in the vagina.

After-Treatment.—The plugging may be removed in twenty-four hours, and the vagina douched. Douching is subsequently continued twice a day for a week, during which it is advisable that the patient should be confined to bed. The purgative is given on the second day after operation.

Special Complications.—*Retention of Urine* frequently occurs, especially when the vagina is tightly packed. Before recourse is had to the catheter it is well to remove the plugging, and turn the patient on her hands and knees to try and pass water.

Hæmorrhage rarely occurs. It is treated by vaginal plugging, or by douching with hot water at 120° F.

Sepsis is a rare complication, but it has occasionally proved fatal. It is treated by uterine douching (p. 286).

Fœtid discharge may occur from sloughing of the uterine lining, or from a piece of packing which has been accidentally left in the vagina. Hence a vaginal examination should always be made. It is a good rule for the nurse to measure the packing when she takes it out, to ensure that all of it has been removed.

Irregular menstruation for one or more periods may follow curetting.

PERINEAL REPAIR or PERINEORRHAPHY is performed in cases of torn perineum.

The Preparation of the Patient.—It is of the utmost importance that the lower bowel should be empty at the time of the operation. The purgative, castor oil 1 ounce, or Henry's solution 2 ounces, should be given the day before operation. On the morning of the operation, a large soap-and-water enema is administered, followed in one or two hours by a boracic wash-out.

The perineum is shaved and cleansed the night before operation, and covered with a sterile dressing kept in position by a T-bandage. The cleansing and dressing are repeated after the enema and wash-out.

Vaginal douching may be performed once or twice, preferably with hot water unless a fœtid discharge is present, when antiseptics should be employed till the condition is improved.

Special Instruments.—Sharp-pointed *elbow scissors* (Fig. 57) are the most suitable for separating the flaps. The instruments for curetting should always be ready, and for suturing after amputation of the cervix, one or two short fully curved needles and a *needle holder* (Fig. 75).

At the end of the operation, a morphia suppository, ½ grain, is useful for the relief of pain and to prevent early movement of the bowels. A pessary of iodoform is sometimes inserted into the vagina. The dressing, of sterilized or iodoform gauze, is fixed in position by a T-bandage. The knees may be tied together, as restless movements tend to cause tension on the stitches.

After-Treatment.—To keep the wound dry, it is advisable to pass the catheter for the first three days after operation. It should be passed at regular intervals of eight hours. The nurse must use aseptic precautions (p. 248), and at the same time avoid disturbing the wound by a wide separation of the labia.

Douching is not advisable, and syringing the external wound should not be practised till the bowels move. It is better to dress the wound with dry gauze, a single thin strip being carefully inserted into the vagina to drain its secretion.

The purgative is not administered till the fourth day, but it may be necessary to give a flatus enema (p. 57) earlier. The purgative should be followed after five or six hours by a warm olive-oil enema, to ensure an easy motion and diminish straining.

After each motion, the wound should be freely syringed with boracic lotion or soap and water. If silk-worm gut has been used, the stitches are taken out on the eighth to the tenth day. The patient should be kept in bed for three weeks.

Special Complications.—*Hæmorrhage* is rare, and is not

severe. If the blood collects under the skin it should be allowed to escape through a small opening, as its presence interferes with the healing of the wound.

Sepsis is the chief trouble, and, if severe, it interferes with the success of the operation as the wound breaks down. Douching and syringing with antiseptics, and the judicious removal of one or more of the stitches may check the process, and prevent this unfortunate catastrophe. For the prevention of sepsis, much depends on the after-treatment, and the nurse cannot be too careful in obtaining asepsis.

Retention of urine often occurs, but is of little consequence, as the catheter is passed as a routine.

CHAPTER XXIV.

VENEREAL CASES.

THOUGH few nurses have the opportunity of attending to venereal cases in hospital, every one should be familiar with the precautions necessary to prevent self-infection. The dangers are all the greater that they usually arise unexpectedly.

GONORRHŒA is difficult to diagnose in female patients. It is most frequently characterized by painful and frequent micturition. The great danger to the nurse is infection of the conjunctiva—gonorrhœal conjunctivitis or ophthalmia—from which total blindness may result. In douching such a patient, rubber gloves must be worn, and, to prevent all risk of infection from a patient in whom gonorrhœa is not suspected, she must never touch her eyes with her fingers after the douching of *any* patient until her hands have been cleansed.

The same precautions are to be taken in dressing a Bartholinian abscess after it has been opened, as in the majority of cases it is gonorrhœal in origin.

SYPHILIS may be contracted by a nurse. An infant with hereditary syphilis may have snuffles, and sores on the lips and in the mouth, all of which are infective. The nurse may have to make a vaginal examination of a syphilitic woman in labour, and run the risk of being infected on the finger.

The first appearance of the disease is a hard nodule or fissure at the infected spot. Subsequently the glands become enlarged, and rashes appear on the skin.

If a nurse is in danger of coming in contact with syphilitic patients, for example in district work, she must be careful to cleanse her hands after attending to *every* case, and to avoid touching any other part of her person till this has been done. She should never fondle young patients as her lips may be infected. In attending to a known syphilitic patient, she must wear rubber gloves.

Finally, if a nurse contracts a sore which is hard, or one which does not quickly improve with ordinary methods of treatment, she should at once consult a doctor. If she waits until the glands are enlarged and skin-rashes appear, the disease may be more difficult to get under control.

CHAPTER XXV.

OPERATIONS ON THE CHEST.

Fracture of Ribs.

Fracture of Ribs is the most frequent surgical condition of the chest-wall. The nurse has to prepare the materials for treatment. The surgeon may use strips of adhesive plaster, 1½ to 2 inches broad, and long enough to reach more than half-way round the chest. The number of strips required varies with the number of ribs that are fractured. They are put on so as to overlap, and each should be applied during full expiration. Over the strapping is fixed a broad domette bandage or a binder. The plaster strips keep the one side of the chest at rest, and they should not be removed for three weeks. If strapping is not at hand, a roller bandage, applied firmly round the chest, serves the same purpose. To keep it from slipping, it should be put on over a thin jersey to which each layer is stitched.

Special Complications which the nurse has to watch for are:—

Shock.—This is due, not to the fractured ribs, but to the crushing of the thorax and its contents at the time of the accident.

Breathlessness or *Dyspnœa.*—This may be due to the inability to expand the chest, as in cases in which several ribs are fractured on both sides. It may also be due to *pneumothorax*, i.e. air in the pleural cavity, caused by a fragment of bone piercing the lung, or *hæmothorax*, i.e. hæmorrhage into the pleural cavity.

Aspiration of the Pleural Cavity.

Aspiration of the Pleural Cavity is usually performed in the medical wards in cases of pleurisy with effusion. It is also sometimes done by the surgeon in *empyema*, i.e. pus in the pleural cavity, especially in children, or in adults in whom the condition is present on both sides.

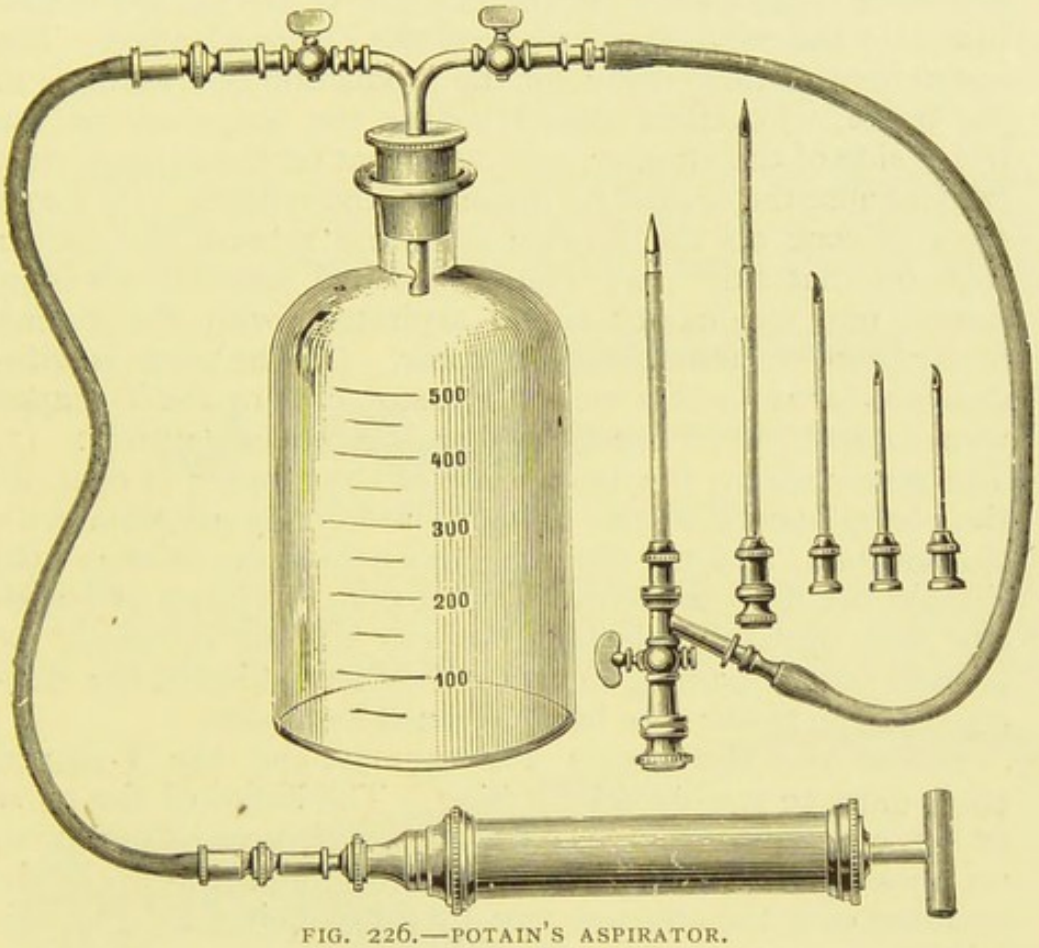


FIG. 226.—POTAIN'S ASPIRATOR.

The **Instrument** used is the *Aspirator* (Fig. 226), and it is important that the nurse should be able to fit it up.

(1) Begin by fixing the stopper firmly into the bottle. (2) Notice that one of the terminals attached to the stopper is in the form of a socket, and the other in the form of a peg. (3) Now take the two india-rubber tubes, in one of which the terminals are pegs, and in the other sockets. (4) Attach them to the opposite ends of the metal tubes which

pass through the stopper. (5) The free end of the rubber tube which has a socket is for the reception of the nozzle of the exhausting pump. (6) Next take the small Y-shaped metal tube, on which are two sockets and a screw. (7) Take a cannula of the appropriate size for the purpose in view, and screw it on to this Y-shaped piece. (8) Then pass the corresponding trocar into the socket which is furnished with a stop-cock. (9) Lastly, fix the free end of the second rubber tube into the remaining socket on the Y-shaped piece. The instrument is now ready for the production of a vacuum in the bottle. To effect this, (1) close the stop-cock on the trocar side of the stopper, and open that on the syringe side. (2) Exhaust the bottle by means of the syringe. (3) Close the stop-cock on the syringe side, and remove the rubber tube on that side. (4) The trocar and cannula are now passed into the cavity to be aspirated, with the thumb firmly pressed on the *end* of the trocar. (5) The trocar is withdrawn as far as it will come, and the stop-cock on the Y-shaped piece closed. (6) Then the trocar is removed entirely. (7) The stop-cock on the trocar side of the stopper is opened; the pleural cavity is thus brought into communication with the vacuum, and the fluid is drawn into the bottle. (8) Should the flow suddenly cease, a plug of lymph or blood-clot has probably blocked the trocar, and it should be cleared out by passing in one of the blunt stilettes, the stop-cock on the trocar side being meanwhile closed.

Before use, the trocars and cannulæ and the Y-shaped piece must be sterilized by boiling. The hands of the nurse or surgeon must, of course, be surgically clean before fixing on these pieces. The skin of the patient must also be cleansed over the affected area by rubbing it with sulphuric ether.

Aspiration of the fluid must be done slowly.

Complication.—*Fainting* is due to too sudden withdrawal of a quantity of fluid from the pleural cavity. The position of the heart and great vessels is thus suddenly altered, and the cardiac action is interfered with. The fainting may go on to collapse and death. The nurse should have a hypodermic injection of ether ready in every case of tapping the chest.

Exploring-Needles of various sizes are used to withdraw fluid for diagnostic or for therapeutic purposes (Figs. 227, 228). They must be sterilized before use, and their introduction must be performed with aseptic precautions.

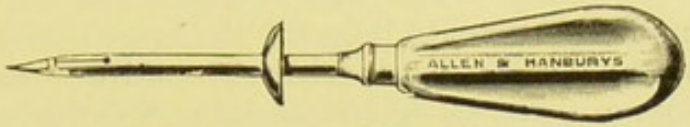


FIG. 227.—EXPLORING TROCAR AND CANNULA.

EMPYEMA.

ACUTE EMPYEMA is an urgent condition for which operation is usually performed immediately. The patient may not be able to breathe unless he is propped up in a sitting

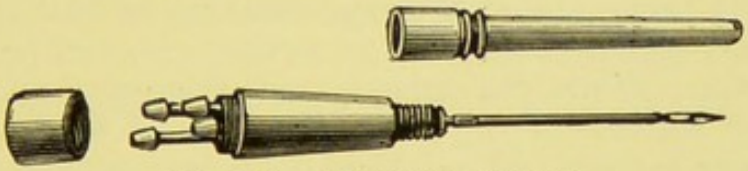


FIG. 228.—SOUTHEY'S TROCAR.

posture. Hence the administration of the anæsthetic is sometimes attended with difficulties. The best position of the patient on the operating-table is on his back, with the

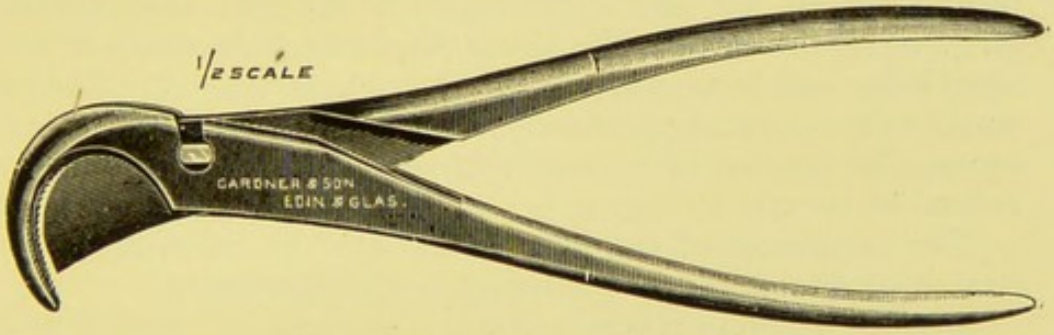


FIG. 229.—RIB-CUTTING FORCEPS.

affected side of the chest projecting slightly beyond the edge of the table.

Special Instruments.—In addition to a strong periosteum detacher (Fig. 336), rib-cutting forceps (Fig. 229) are necessary.

Drainage-tubes must also be ready. Two pieces of large-bored rubber-tubing, 2 to 3 inches long, with large perforations near their inner end, are the most convenient. The outer end of each is transfixed by a sterilized safety-pin.

After-Treatment.—The patient should be encouraged to lie on the affected side, to help the drainage of the pus. At first the wound should be dressed two or three times a day, as the tubes are apt to be blocked by the thick, flaky discharge which is so commonly met with in empyema. For this reason, also, it is advisable to have two drainage-tubes, as there is a greater chance of one remaining clear. For the first twenty-four hours the tubes should not be removed, as it is often difficult to replace them. To clear them of discharge, a syringe may be fixed on to each tube in turn and the piston pulled out. At the later dressings, one tube should be taken out at a time. In three or four days both tubes may be taken out at once, as they can then be replaced with ease. While the tube is out, the patient should be carefully turned on the affected side, and held up by the nurse over a basin. The discharge then comes away more freely, especially if the patient coughs.

The great object in the after-treatment of a case of empyema is to restore the full expansion of the lung. Hence the suction of air through the drainage-tubes into the pleural cavity should be prevented, by applying over them oiled-silk protective to act as a valve, or a Klapp's suction-bell (Fig. 23) from which the air is partially exhausted at intervals by one or two strokes of the exhaust-pump. Sometimes valved drainage-tubes which close during inspiration are employed, but, if the discharge is semi-solid, they tend to retard its escape.

The expansion of the lung should also be encouraged by breathing exercises or by blowing a wind instrument.

Special Complications.—Fatal *Toxæmia* or *Septicæmia* may occur in spite of the operation, especially when the disease has existed for some days before the pus is let out. It may also result from imperfect drainage. The temperature is persistently high, or swings between 98° and 102° or 104° F. The surgeon must probe with a catheter or other such instrument, to tap any collection of pus that is not being drained.

Chronic Empyema.—When the lung does not expand sufficiently, a space is left between its surface and the chest-wall. From this space discharge continues to flow, and the wound does not close completely. This is the condition known as chronic empyema. It requires a more serious operation for its cure, several of the ribs being removed—*thoracoplasty*—to enable the chest-wall to sink in and obliterate the space. An extensive area of skin has to be purified on the front and back of the chest.

Empyema of the opposite side sometimes occurs. It is best treated by aspiration for a few days, and then by operation.

Septic Pericarditis is a dangerous complication which may be indicated to the nurse by the extreme rapidity and weakness of the pulse.

Cerebral Abscess may ensue, and cause death, in a case of empyema in which the drainage is inefficient.

Operations on the Lungs and Heart.

Operations on the lung itself and on the heart are only now becoming possible. The great difficulty in performing such operations is to prevent collapse of the lungs and asphyxia when the chest is opened. Hence an elaborate apparatus is necessary. A special room, in which there is a partial vacuum, may be used to contain the body of the patient, the surgeon, the assistants and all the necessary instruments, caskets and lotions. The head of the patient projects through an aperture in the room, and the anæsthetic is administered outside. Or the lungs may be kept from collapsing by pumping air into them ; in this case, the anæsthetic is mingled with the ingoing stream of air.

Operations on the Breast.

The most frequent operations on the breast are excision of a cyst or innocent tumour, and complete excision for cancer. The former need not be further referred to, as no special points arise in the preparation and after-treatment. In acute abscess of the breast, a small incision should be made into the abscess cavity, and a suction-bell applied (Fig. 23).

Complete Excision of the Breast.

The nurse must understand that the field of operation extends widely beyond the breast itself—into the axilla in all cases, and sometimes up above the clavicle and down to the abdominal wall. Hence an extensive area of the front of the chest must be prepared, the axilla shaved, and part of the arm to the elbow or even to the wrist made surgically clean.

Instruments.—No special instruments are required, but a *broad-bladed knife* is convenient. When a large area of skin has to be removed from the chest-wall, a strong pull is needed to bring the edges of the wound together. Hence silk-worm gut should always be ready. Sometimes the edges cannot be brought together, and a razor should be put out, as the surgeon will probably fill up the gap by a skin-graft.

After-Treatment.—The surgeon bandages the patient with the arm out from the side (p. 97), and it should be kept in this position and supported on a pillow when she goes back to bed. As reactionary hæmorrhage may occur, a drainage-tube is usually inserted into the axilla. This is removed in twenty-four to forty-eight hours. The purgative may be given early. As a rule the operation causes little shock or disturbance, and the patient is allowed up at the end of a week.

Special Complications.—*Reactionary Hæmorrhage* cannot always be prevented, as firm compression by a bandage is impossible in the axillary space without interfering with the circulation of blood in the arm. In general the amount of bleeding is not sufficient to produce any symptoms. It must, however, have a free exit, as otherwise it would collect under the skin and delay the healing of the wound.

Sloughing of the Skin-flaps is due to too great interference with the circulation in them, as the result of dividing the arteries in the incision, of pressure of a blood-collection under them, or of sepsis. The raw area should be covered with skin-grafts to hasten the healing.

Stiffness of the Arm is due to the formation of adhesions. It is best prevented by bandaging the wound with the arm in the abducted position.

Œdema of the Arm is due to the removal of the axillary lymphatic vessels which drain away the lymph from the hand and arm, to injury of the axillary vein during the operation, to thrombo-phlebitis of this vein soon after operation, or at a later date to pressure on the vein by adhesions. As new lymphatic vessels become formed, the swelling sometimes gradually diminishes.

Sepsis in the wound or axilla is serious, and may lead to fatal blood-poisoning. Even in less severe cases, it leads to great delay in the healing of the wound and to the formation of adhesions.

Lung Complications, such as bronchitis and hypostatic congestion, are sometimes troublesome in old patients (p. 199). Hæmoptysis is usually an evidence that the cancer has spread to the lung; less frequently it results from pulmonary embolism.

Mental Complications arise in some cases if the patient broods over the existence of cancer. If she becomes melancholic, she must never be left alone day or night, as she might try to commit suicide.

Recurrence of the Cancer may appear as nodules in the scar of the wound, or as a swelling in the axilla or root of the neck. It may also affect the internal organs, for example the lung or brain. A common situation for a recurrence is the vertebral column, and this condition usually gives rise to agonizing neuralgic pain, necessitating the continued administration of increasing doses of opium.

CHAPTER XXVI.

OPERATIONS ON THE NECK.

EXAMINATION OF THE LARYNX, TRACHEA, AND BRONCHI.

LARYNGOSCOPY.—For the examination of the larynx, the

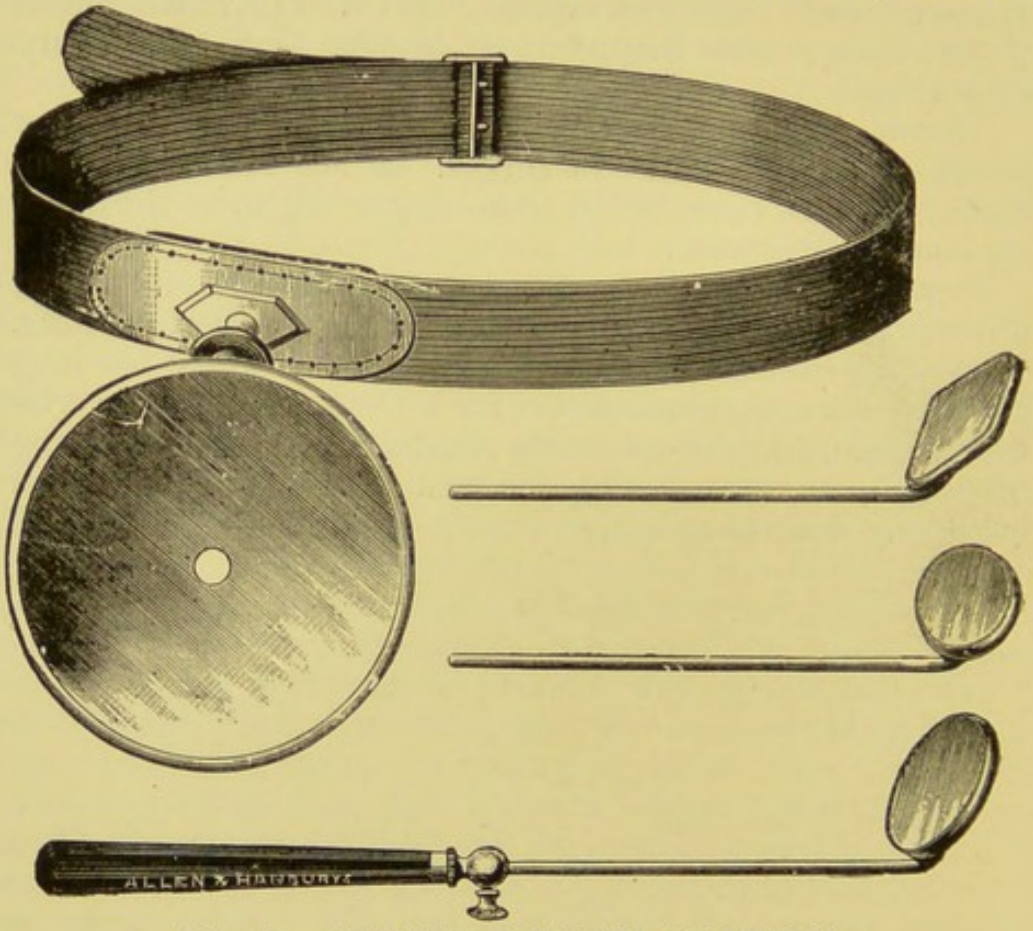


FIG. 230.—LARYNGEAL REFLECTOR AND MIRRORS.

surgeon requires a laryngeal reflector with tapes for fixing it on the forehead, one or two sizes of laryngeal mirror

(Fig. 230), and a tongue cloth (towel, handkerchief, or gauze). The examination must be conducted in a good light. Usually the room is darkened, and an electric lamp, placed near the patient's left ear, is employed. The laryngeal mirror must be warmed before it is inserted in the

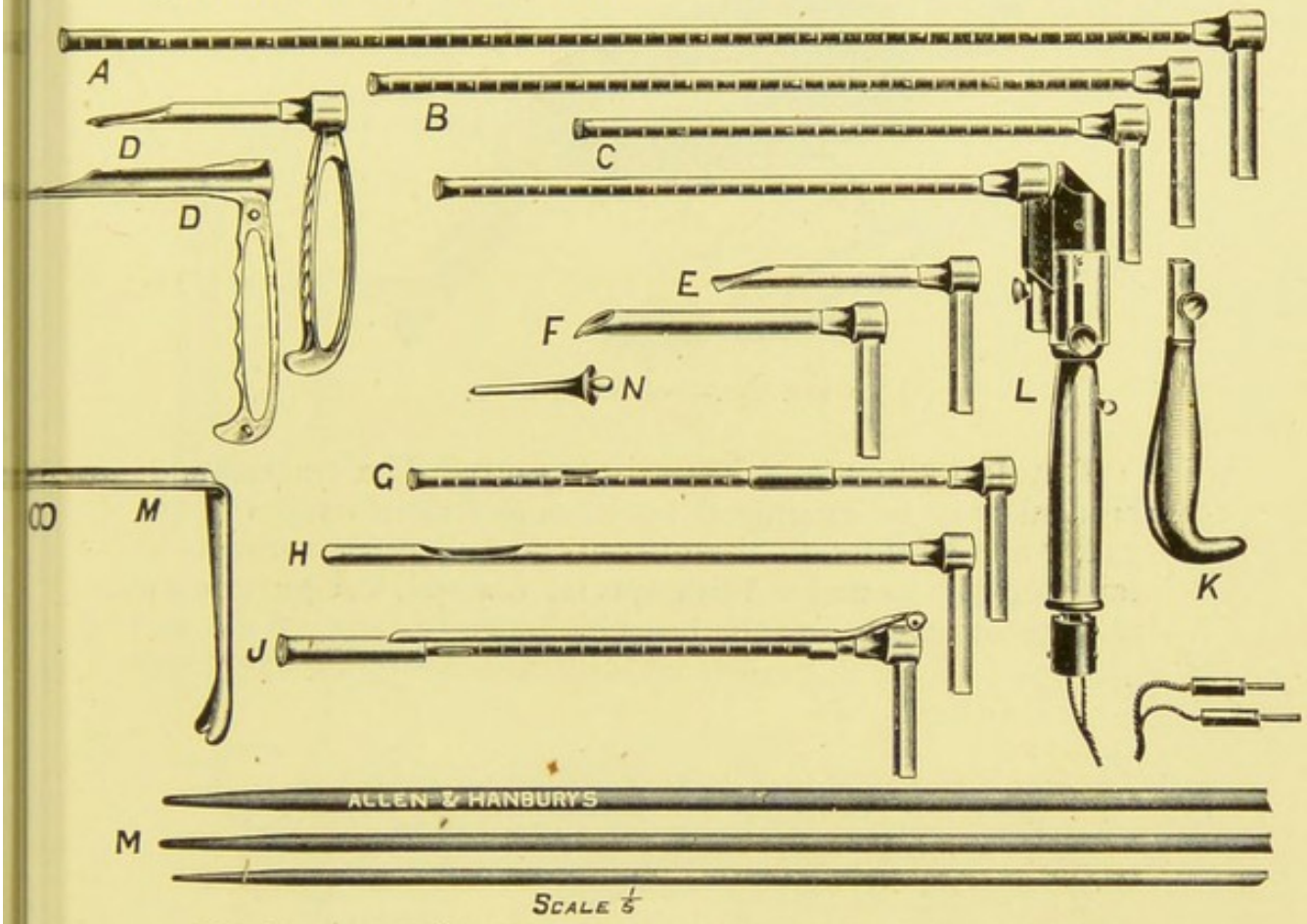


FIG. 231.—KILLIAN'S APPARATUS FOR EXAMINATION OF AIR PASSAGES.

mouth, to prevent dimming of it by the patient's breath. Hence the nurse must not forget to have a spirit lamp at hand.

The larynx may also be examined by the direct method by means of Killian's fish-tail spatula (Fig. 231, D), the light being obtained from a small lamp placed on the surgeon's forehead (Fig. 232), or in the handle of the instrument.

A *laryngeal syringe* (Fig. 233) is used to inject substances such as menthol into the larynx, and *laryngeal*

insufflators are employed when it is desired to apply a powder to the parts. *Laryngeal forceps* (Fig. 234), such as those of Mackenzie, are employed in various operations on the larynx. Some open laterally, and others antero-posteriorly.

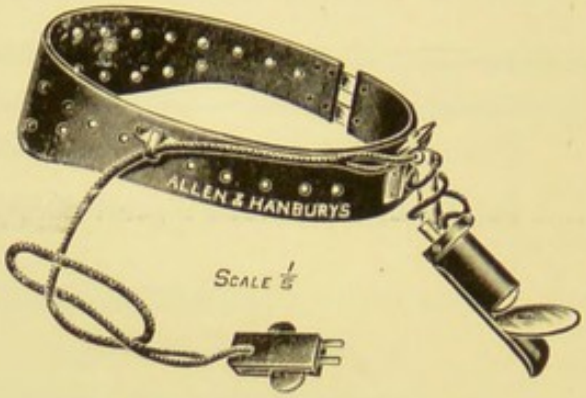


FIG. 232.—FOREHEAD LAMP.

TRACHEOSCOPY and BRONCHOSCOPY.—The trachea and bronchi may be examined by passing Killian's tubes (Fig. 231, C and B) through the mouth and larynx, or through a tracheotomy wound. With special forceps, foreign bodies may be removed from the bronchi.

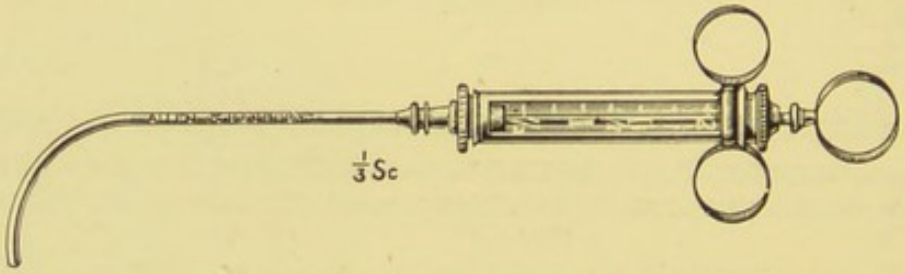


FIG. 233.—LARYNGEAL SYRINGE.

LARYNGOTOMY AND TRACHEOTOMY.

LARYNGOTOMY and THYROTOMY are the operations of opening the larynx, say for the removal of a tumour or a foreign body. Laryngotomy is also the emergency operation performed in cases of choking. Once the foreign body is removed, the larynx may be closed again, or a tracheotomy tube may be inserted and left for a few days. Before certain

operations on the mouth and throat, a *preliminary laryngotomy* is performed, and a metal tube inserted through the opening in the air-passage. The patient breathes, and the

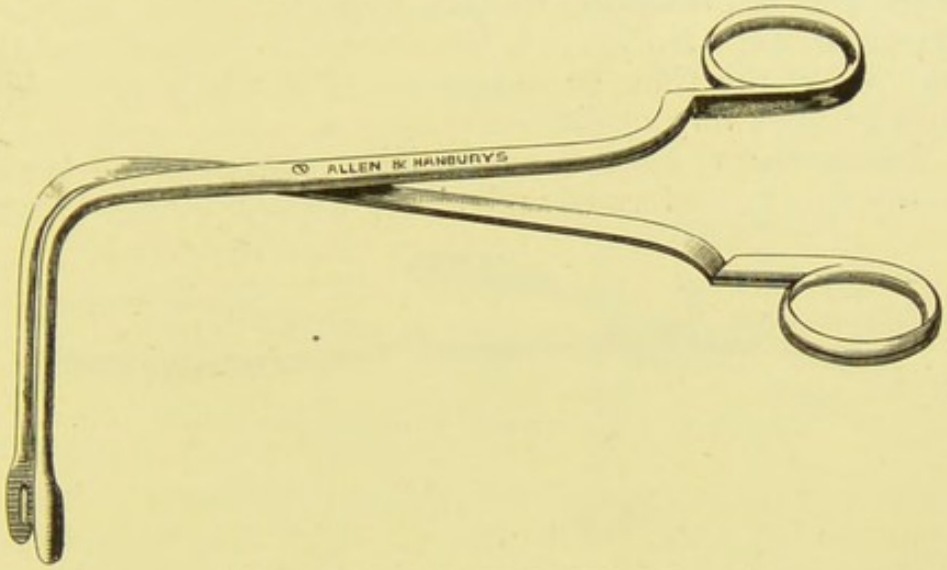


FIG. 234.—LARYNGEAL FORCEPS.

anæsthetic is administered, through the tube. Round the top of the tube packing is placed to prevent blood or pus flowing down from the seat of the operation to the lungs, as

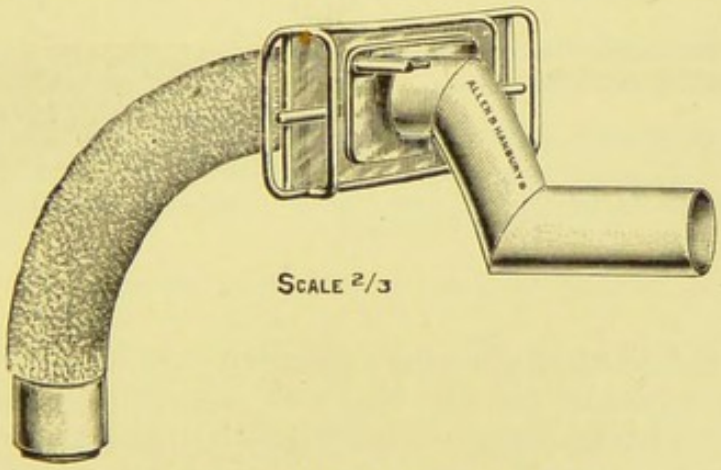


FIG. 235.—HAHN'S TAMPON TUBE.

this occurrence is apt to lead to aspiration pneumonia. For the same purpose, the tube may be surrounded by compressed sponge (Fig. 235) which swells with moisture.

TRACHEOTOMY is sometimes performed as a preliminary to mouth and face operations, but more frequently in cases of diphtheria, in which a membrane is present in the air-passages, and is preventing the patient getting in the necessary amount of air. No special preparation is required, nor as a rule would the time be available. The whole proceeding must be done very quickly.

Tracheotomy Instruments.—The operation of tracheotomy may be performed with a very small number of instru-

FIG. 236.—DOUBLE HOOK RETRACTOR.

ments, and the less specialized these are the better. A short, broad-bladed knife, the handle of which may be used as a *dissector*, several pairs of *artery forceps*, *retractors*, *dissecting forceps*, a *director*, and the *tracheotomy tube* are the essentials. Laryngeal forceps (Fig. 234) are useful for pulling the diphtheritic membrane out through the wound. A supply of hen's feathers should also be put out by the nurse, to clear the tube when it becomes blocked with fragments of the mem-

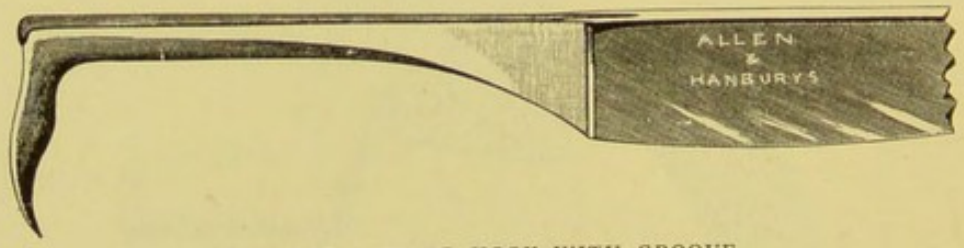


FIG. 237.—SHARP HOOK WITH GROOVE.

brane coughed up during the operation in cases of emergency. A useful retractor for the edges of the incision may be extemporized by bending two sterilized hairpins to the shape of the letter **S**, attaching one loop of each to an elastic band, and inserting the other loops under the edges of the wound. The elastic passes round the back of the patient's neck, and its tension holds the wound open.

Other retractors in the shape of double hooks (Fig. 236) are used when assistants are available.

A *sharp hook* (Fig. 237) is used to fix the trachea while it is being opened, and, being grooved, it also serves as a director.

To open up the wound in the trachea in order to introduce the tube, various *tracheal dilators* have been invented (Figs. 238 and 239).

Of patterns of tracheotomy tubes there is no end, but the following are among the best: The *ordinary bivalve tube* (Fig. 240), which consists of an outer and an inner tube, the latter a little longer than the former. The outer tube is fixed in position by tapes passed through the slits in its shoulder, and tied round the patient's neck. The inner tube is not fixed.

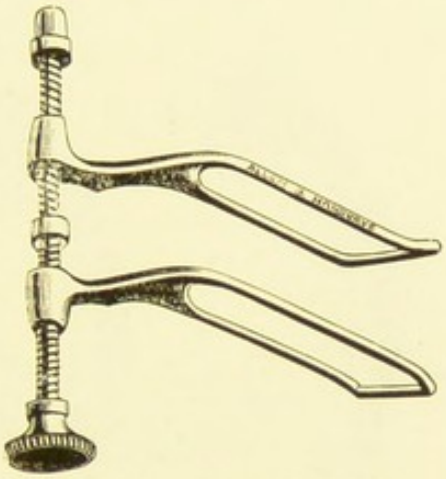


FIG. 238.—GOLDING BIRD'S TRACHEAL DILATOR.

Durham's Lobster-tail Tube (Fig. 241) is provided with a vertebrated inner tube.

Parker's instrument (Fig. 242) has an angle on it to prevent the point pressing on the trachea and causing ulceration. For the same purpose, a tube made of india-rubber or of flexible silver (Fig. 243) may be used.

If time permits, the instruments should be boiled; if not,

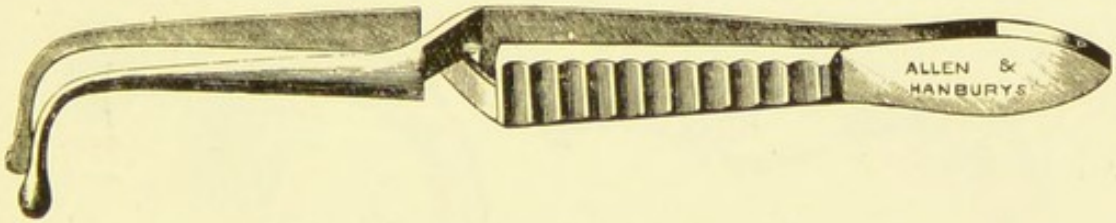


FIG. 239.—LUER'S TRACHEAL DILATOR.

they may be placed in 1 in 20 carbolic or strong lysol, and dipped in saline solution before use.

The Operation.—For the operation, the nurse should at once inquire whether the necessaries for local anæsthesia are to be prepared, as the breathlessness is frequently so great

as to render the administration of a general anæsthetic dangerous. She should have ready a roller pillow, of suitable size for the individual patient, wrapped in a sterile towel. It is placed beneath the neck to put the parts on the stretch. Finally, a small quantity of glycerine should be poured into a medicine-glass, as it is required to lubricate the inner tube.

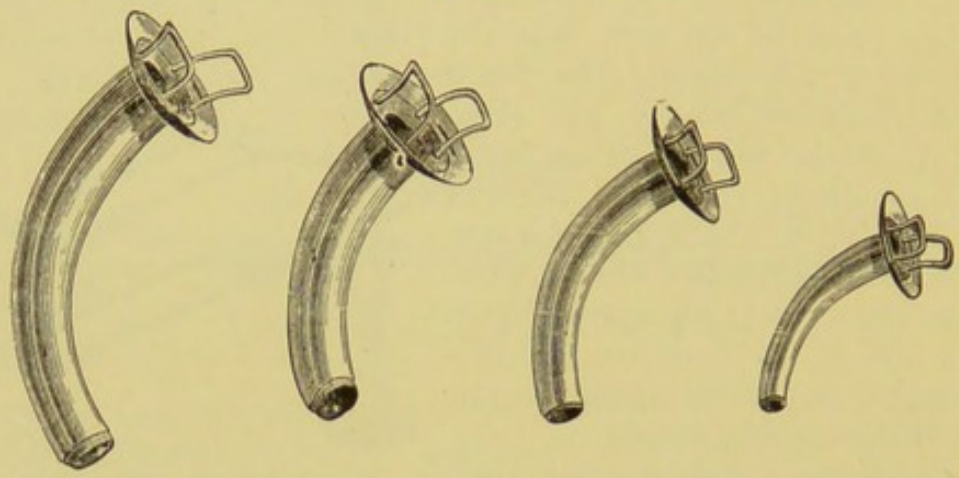


FIG. 240.—TRACHEOTOMY TUBES.

At the end of the operation, the surgeon may in a case of diphtheria inject *antitoxic serum.* Hence the nurse should have a serum syringe sterilized. The serum must be fresh; if it is turbid it is useless. The initial dose is about 3000 units, and a second dose of 1500 units may be given.

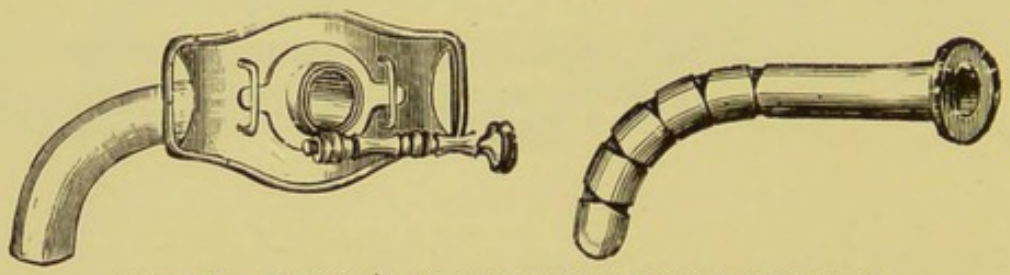


FIG. 241.—DURHAM'S LOBSTER TAIL TRACHEOTOMY TUBE.

After-Treatment.—The success of tracheotomy depends as much on the after-treatment as on the performance of the operation itself. After the operation the patient is put into a bed surrounded by a tent, readily extemporized by screens and blankets, and the air in this is kept moist by one or two

bronchitis kettles placed beside it (Fig. 113). The temperature inside the tent should be 65° to 70° F., and draughts are to be studiously avoided. The keeping of the tracheotomy tube clear is the most important part of the nurse's duty. The tube is double, the outer one being tied into the trachea,

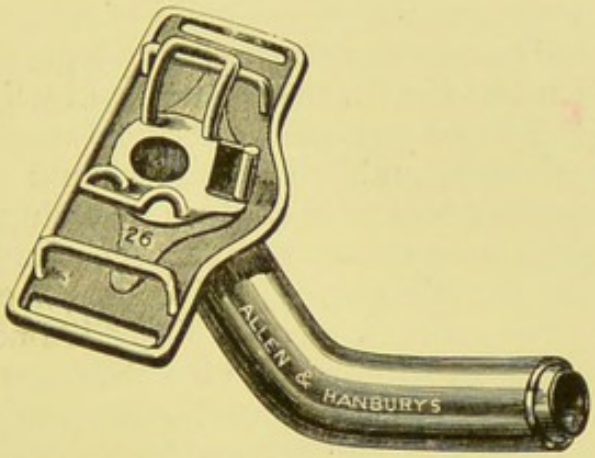


FIG. 242.—PARKER'S TRACHEOTOMY TUBE.

while the inner one is loose inside it, that it may be removed and cleaned; or should it get blocked, the patient can cough it out, and so breathe through the outer one alone. At first the inner tube should be removed frequently, say every twenty minutes, and washed in carbolic lotion, the lumen

FIG. 243.—FLEXIBLE TRACHEOTOMY TUBE.

being cleared with a feather. At the same time the outer tube should be cleansed with a solution of sodium bicarbonate (baking soda) and a feather, without being removed. The excess of carbolic lotion should be dried off, and the inner tube lubricated with glycerine before being reintroduced. One or two layers of gauze spread over the mouth of the

tube filter the air, and prevent the inhalation of dust. In the removal or insertion of the tube, care must be taken not to awaken the patient. Any fragment of membrane that is coughed out within reach must be at once removed by a feather or a swab of gauze wrung out of 1 in 20 carbolic. The tube is left in as long as it is required, a point which will be settled by the surgeon.

Caution!—The nurse must take every precaution against being herself infected with the disease from which the patient is suffering. To this end she must avoid unnecessary handling of the patient, and, above all, should never get into direct line with his breath when he is coughing. She should frequently gargle her throat with Condy's fluid, and spray it with peroxide of hydrogen, and, of course, she should never take food in the patient's room. There is one great danger peculiar to cases of diphtheria of which warning must be given, and that is, sucking the tracheotomy tube. If it becomes blocked, and all attempts with the feather fail to clear it, the temptation to relieve the acute distress of the patient by sucking the tube is very great. Such a procedure, however, is quite irrational and highly perilous. Not a few valuable lives, both of nurses and surgeons, have been lost in this way.

If the obstruction is not relieved by removal of the inner tube, a soft rubber catheter may be pushed into the outer tube, and suction made by means of a syringe fixed to its outer end.

The feeding of the patient is often difficult, especially when swallowing is painful. Only fluids are to be given, and these should be beef-juice, strong soups, and other stimulating foods. They should be served in a feeding-cup with a rubber tube attached to the nozzle. The tube is placed at the back of the throat, and the liquid allowed to trickle down the gullet. Should this cause choking, food must be given by a tube passed through the nose into the pharynx—*nasal feeding*.

Special Complications.—The greatest danger is *heart failure* resulting from the absorption of diphtheria toxins. If the pulse becomes rapid and feeble, the surgeon should be at once informed. The best stimulants which he can order in such cases are whisky and brandy.

Pressure-necrosis of the trachea may be caused by the pressure of a badly fitting tube, or by keeping a tube in too long. The tube should always be removed as soon as the patient can breathe by the mouth. If it is required for more than five or six days, the metal tube should be replaced by a rubber one.

Sepsis may be due to infection by the diphtheria bacillus, often along with other organisms—a mixed infection. It sometimes leads to *sloughing of the wound.*

Surgical emphysema is a rare complication. If the opening in the trachea is larger than the tube, while the superficial wound grips the tube, air may be forced into the tissues under the skin, giving rise to surgical emphysema. It is marked by swelling of the neck, and by crepitation or crackling on pressure.

Aspiration pneumonia may occur. It is best avoided by filtering the ingoing air through gauze, and by keeping the patient in a warm, moist atmosphere.

For INTUBATION OF THE LARYNX, a complicated and expensive apparatus (Fig. 244) has been introduced by O'Dwyer. A small metal or vulcanite tube, through which the patient breathes, is passed by means of a specially constructed guide into the larynx. During its passage, the mouth is held open by a gag. A special extractor is also necessary. If a string is left attached to the tube, and brought out at the mouth, the patient's hands must be fixed so that they cannot reach it. The tube should be changed in forty-eight hours.

The same end may be attained by means of a large-sized gum-elastic catheter, with a terminal aperture, and a stilette to give the instrument the proper curve. To prevent the patient biting and so occluding the tube, it is passed through a rounded piece of wood, such as an empty thread-spool.

TUBERCULOUS GLANDS OF THE NECK.

When the patients come for treatment, the glands may be in the quiescent stage when they are enlarged and firm, or

they may be *liquefying*, each forming a little bag of pus. In the latter case, the surgeon is often content with making a small incision over each suppurating gland, letting out the pus, scraping the lining membrane of the sac, and closing the incision by a stitch. For drainage, one or two strands of horsehair, silk-worm gut, or catgut may be employed. The operation is simple, and no special treatment is required before and after it.

If the glands are in the quiescent stage, and only a few

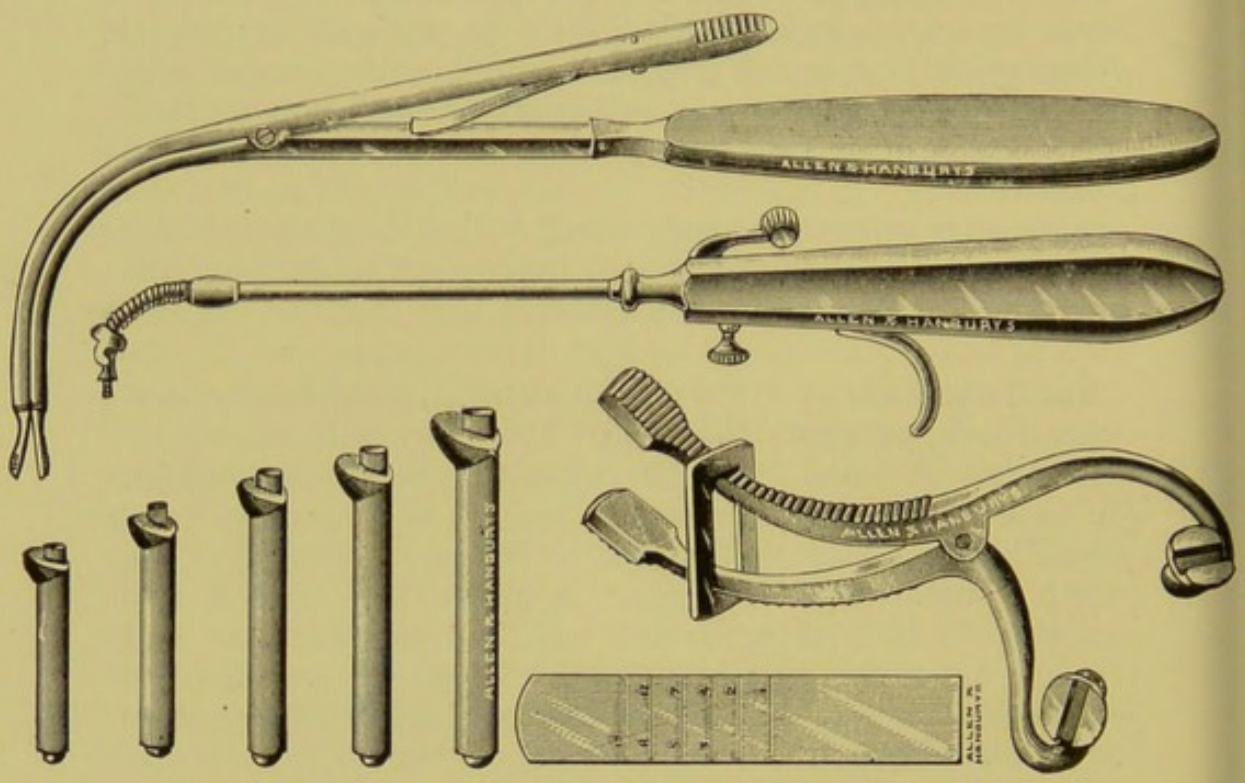


FIG. 244.—O'DWYER'S INTUBATION APPARATUS.

are enlarged, passive hyperæmia, induced by means of a Klapp's suction-bell (p. 68) for an hour twice a day, should be tried. In some cases the swelling decreases; in others the glands liquefy and can be cured as above through a small incision, which leaves a less noticeable scar on the neck.

EXCISION of tuberculous glands of the neck is usually performed when many are enlarged, and it may be a long and difficult operation.

The **preparation of the patient** is the same as already described. The head must be wrapped in mackintosh and a sterilized towel (p. 109) to prevent infection from the hair. The mackintosh should be applied before the patient leaves the ward.

No special instruments are required, but it is necessary to have a good *dissector*—Kocher's (Fig. 62), or McDonald's (Fig. 63). For reactionary hæmorrhage, the surgeon may drain with a perforated rubber tube, or sterile gauze.

The **After-Treatment** must include the constitutional treatment of tuberculosis, as well as the treatment of the wound. If the operation has been extensive, movements of the head should be restricted by placing a sand-bag on either side of it. The drainage-tube can usually be removed in twenty-four to forty-eight hours, and the stitches in four or five days as the healing of wounds in the neck is rapid. It is essential that the patient should have nourishing food as soon as possible after the operation, and plenty of fresh air. The bed may be wheeled to an open window or out on a balcony, or the patient may be carried outside. Care must be taken to wrap him up well and prevent a chill.

Special Complications.—*Anæsthetic sickness* is often troublesome after this operation. The nurse must take care that the vomited matter does not soil the dressing. This is best done by pinning a towel round the neck over the bandage. *Reactionary hæmorrhage* is occasionally a serious complication if the wound is not drained, or if the drainage-tube is blocked by a clot. As the blood collects, it presses on the large veins of the neck, and interferes with the circulation of blood through the brain. The patient's face becomes blue and congested, and he feels as if he was choking. If the surgeon is not at hand, the nurse must immediately cut the bandage and examine the neck. If it is tight and swollen, she should snip one or two of the stitches and squeeze out the blood, wash the wound with weak antiseptic, and apply a temporary dressing.

Division of the spinal accessory nerve may occur during the operation, and result in the complete or partial paralysis of the sterno-mastoid and trapezius muscles, or of the latter alone.

Sepsis may be serious if efficient drainage is not obtained, as it may then cause cellulitis of the neck, and even spread down into the thorax.

Operation for Goitre.

Goitre is any non-inflammatory enlargement of the thyroid gland.

Preparation of the Patient.—In exophthalmic goitre, Kocher recommends that the patient should have absolute rest for a week or two before operation, and should take small doses of iodine and sodium phosphate. In other cases

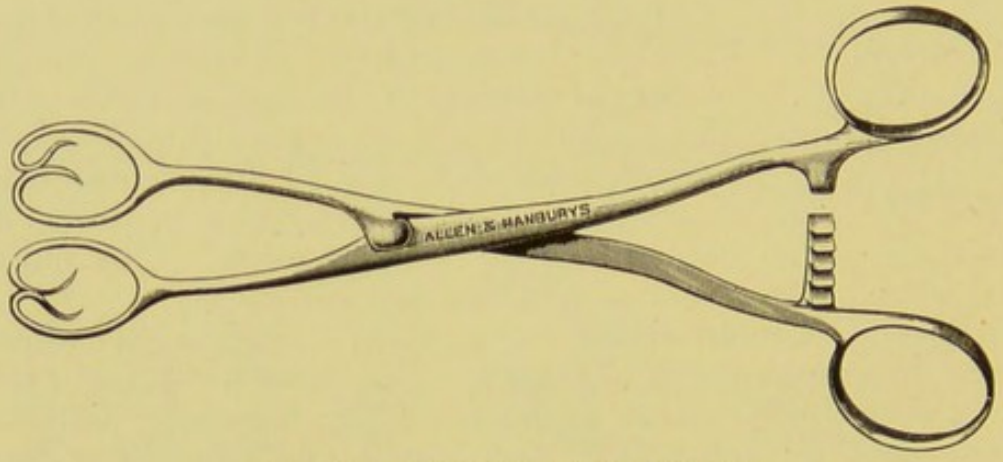


FIG. 245.—KOCHER'S GOITRE FORCEPS.

of goitre, no special preparation is required. The neck is cleansed in the ordinary way, and a sterile dressing is applied. A cap should be fixed on the head to cover all the hair. The nurse must find out whether the surgeon intends to do the operation with a local or a general anæsthetic. On the Continent, local anæsthesia is usually employed. In this country, ether by the open method has been found to be safe. The table may be fitted with a goitre screen (p. 144).

Special Instruments.—Several instruments have been devised by Kocher for goitre operations. His *dissector* or *tissue-separator* (Fig. 62) should be put out, as well as the *goitre-crushing forceps*, *goitre forceps* (Fig. 245), and for releasing intra-thoracic goitres the *goitre spoon*. Tracheotomy

tubes, and the other instruments required for tracheotomy should also be in readiness. A small glass- or rubber-tube is usually inserted to drain any blood or thyroid secretion. During the operation a narrow sand-bag is placed under the neck.

After-Treatment.—The drainage tube should be removed after forty-eight hours. The patient may be allowed up after a week.

Special Complications.—*Heart failure* is the chief danger of the operation. The goitre may have pressed on the trachea or the large veins of the neck for a prolonged period, and led to degenerative changes in the heart. In these cases, the patient suffers from breathlessness, and his face is cyanosed.

Acute thyroidism may ensue during the first few hours after operation, if the gland has been much torn or squeezed. It is due to absorption of large quantities of thyroid secretion. The symptoms are high temperature, very rapid pulse (150-200) and respirations, breathlessness, flushing of the face and muscular twitchings. It is best prevented by avoiding rough handling of the goitre, and by draining the wound to allow the secretion to escape.

Reactionary Hæmorrhage, if it does not escape, but forms a hæmatoma under the wound, may press on the trachea, and cause severe breathlessness especially when the trachea is softened.

Kinking of the trachea is said sometimes to occur, if it is much softened, when the patient's head is turned to the side. It is prevented by removing the pillows and placing the head between sand-bags.

Tetany, or cramps and twistings of the fingers and toes, is supposed to be due to interference with the para-thyroid glands, which lie close beside the thyroid gland.

Operative myxœdema arises if too little of the thyroid gland has been left after the operation. On no account may the whole of the gland be removed, as this leads to death. The most obvious symptom is tetanic contractions of the muscles of the body; if the spasm attacks the larynx, severe dyspnœa sometimes requiring tracheotomy occurs. The patient usually dies of exhaustion. The only treatment is to administer an extract of the thyroid gland of the sheep or

other animal, and the patient may have to take it regularly for the remainder of his life.

Aphonia, or loss of voice, is the result of injury to the recurrent laryngeal nerves during the operation. The voice becomes whispering and hoarse, and there may be spasms of breathlessness. These symptoms come on at once after the operation. If they come on later, they are caused by pressure on the nerve by the scar.

Sepsis may lead to cellulitis of the neck, a dangerous condition unless free drainage can be established.

Pneumonia may result from the division of the recurrent laryngeal nerve, preventing the coughing up of any irritant—an *aspiration pneumonia*.

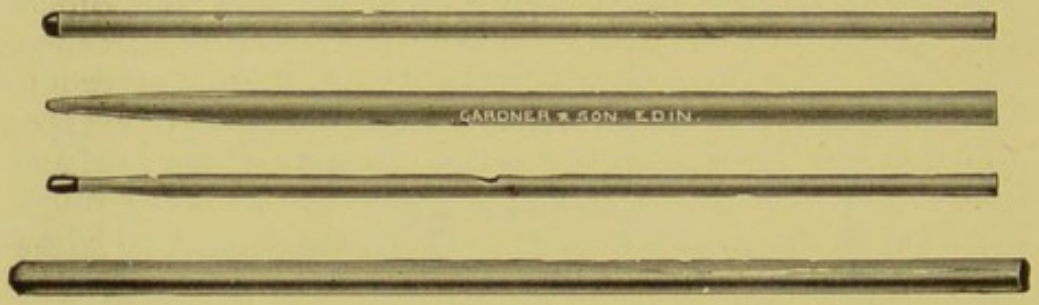


FIG. 246.—ŒSOPHAGEAL BOUGIES, WITH ROUNDED, CONICAL, AND BULBOUS POINTS.

Examination of the Œsophagus.

Œsophageal bougies or probangs are used to detect a stricture or narrowing of the œsophagus, or a foreign body. The bougie may be made of gum-elastic or silk-web (Fig. 246),

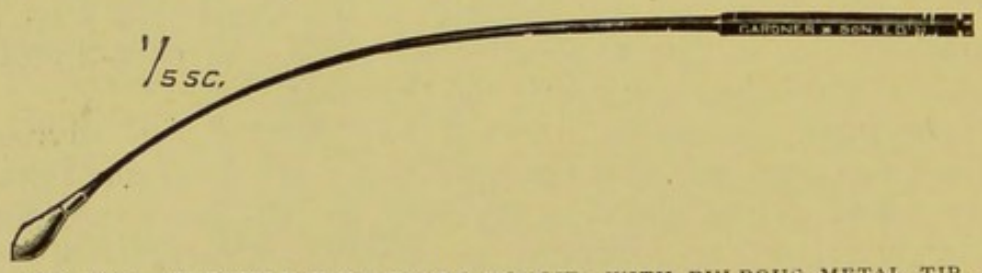


FIG. 247.—FLEXIBLE WHALEBONE BOUGIE, WITH BULBOUS METAL TIP.

or flexible whalebone to which one of a graduated series of aluminium or steel bulbs is screwed (Fig. 247). For the

removal of a fish-bone, a *sponge probang* (Fig. 248) or an *umbrella probang* (Fig. 249) may be used. A *coin-catcher*, as its name implies, is convenient for the removal of a coin,

FIG. 248.—SPONGE PROBANG AND COIN-CATCHER

usually a halfpenny, which has been accidentally swallowed and has caught in the œsophagus.

For the passage of these instruments, the patient should be seated on a chair with the head thrown back. The nurse

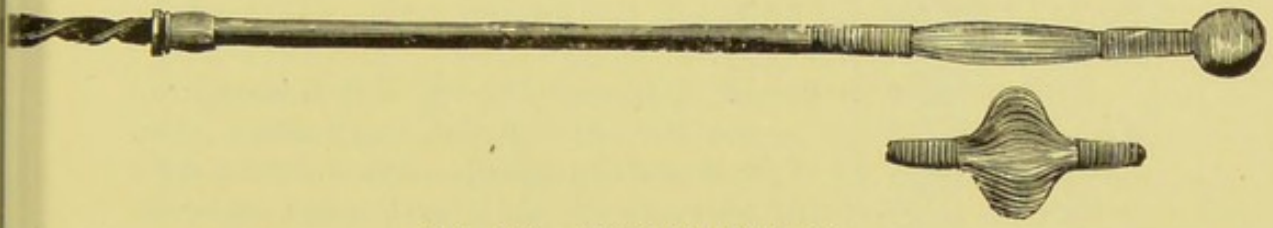


FIG. 249.—UMBRELLA PROBANG.

must have a small supply of glycerine in a glass vessel to lubricate the bougies. When the instrument engages in the opening of the œsophagus, the chin is brought down to the chest, and the patient is directed to swallow the bougie. It

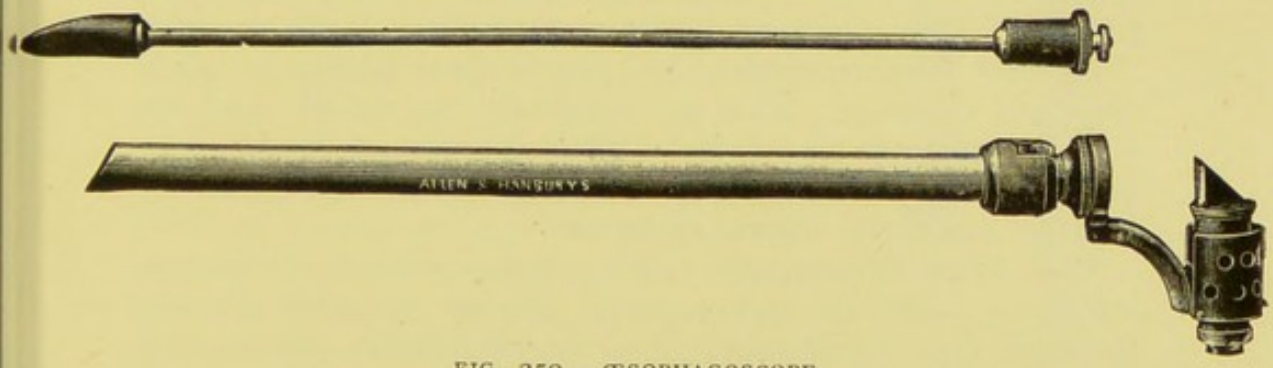


FIG. 250.—ŒSOPHAGOSCOPE.

will then be readily carried down. The same directions apply to the passage of a stomach-tube, a duty which sometimes falls to the nurse (p. 64).

The Œsophagoscope (Fig. 250) is a tube constructed for the inspection of the interior of the œsophagus. The illumination is obtained from an electric lamp, the rays of light being reflected by a concave mirror to the point of the instrument. The patient is placed on his back or right side, and it is advisable to anæsthetize the throat and gullet by painting with 5 per cent. cocaine.

Foreign Body in the Pharynx —When a piece of meat or bread sticks in the gullet, the entrance to the larynx is also blocked, and the patient cannot get breath. The nurse must never forget that in such a case the bolus of food is usually within reach of the finger from the mouth. If the patient does not immediately dislodge it by coughing, the mouth must be forced open, and a finger inserted and pushed well down the throat to hook out the foreign body. If this fails, laryngotomy is necessary.

After the removal of a foreign body, if it has injured the mucous lining of the throat or gullet, the patient often has a sensation as if it was still present. On swallowing a few drops of glycerine of borax, he may be relieved, and convinced that it has really been removed.

ŒSOPHAGOTOMY is the operation of opening the œsophagus in the neck. It is performed for the removal of sharp and irregular foreign bodies, such as a tooth-plate, which cannot be got out through the mouth. The incision is made on the left side of the neck, but if time permits the whole neck should be cleansed, and covered with a sterile dressing.

Special Instruments.—An œsophageal bougie of gum-elastic is required. It is passed from the mouth, and the surgeon cuts down on it. When the foreign body is removed, the opening in the œsophagus is usually closed up, but the superficial wound is drained.

The After-Treatment.—Anæsthetic sickness is troublesome, as some of the vomited matter is liable to leak through the œsophageal incision, and infect the wound. Hence the wound should be frequently dressed till sickness stops. The patient should be fed by the rectum for a day or two. After that a tube may be gently passed through the mouth or nose to the stomach, and fluids administered by it.

The patient may usually be allowed to swallow fluids in eight or ten days. The mouth should be frequently washed with Condy's fluid, and sprayed with hydrogen peroxide.

Special Complications. — *Sepsis* is the great danger. It is almost impossible to prevent leakage, and, if the drainage is not efficient, *cellulitis of the neck* results.

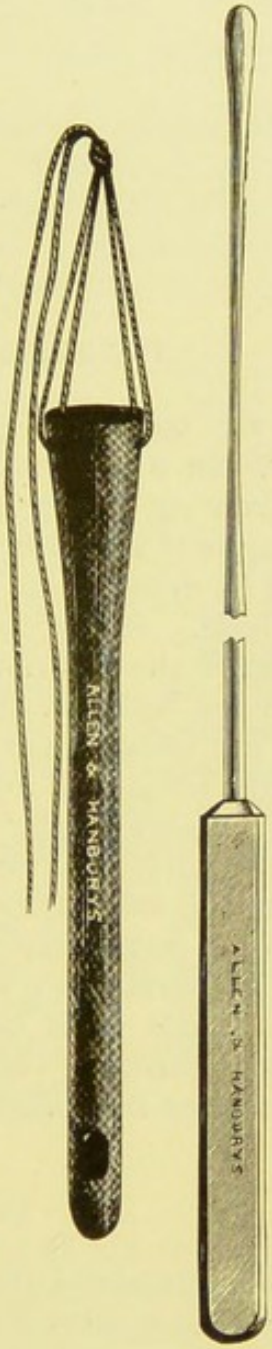


FIG. 251.—SYMOND'S TUBE AND WHALEBONE GUIDE.

DILATATION OF AN ŒSOPHAGEAL STRICTURE may be effected by graduated bougies or by *Symond's Tubes* (Fig. 251). The latter are made of gum-elastic, and each measures about 6 inches in length, the calibre varying with the size of the stricture. The tube is passed through the stricture by means of a whalebone guide, and rests against it by its upper funnel-shaped end, to which a silk thread is attached. The thread is brought out through the mouth, and fastened to prevent the tube passing down into the stomach. The patient is fed through the tube with liquids, pounded beef, and thin custard. When it has remained in for thirty-six hours, another of larger size may be substituted, and so on till the stricture is fully dilated. In cases of stricture due to cancer of the œsophagus, a Symond's tube may be worn permanently by the patient, being taken out to be cleaned once or twice a week, or even at longer intervals.

CHAPTER XXVII.

OPERATIONS ON THE FACE AND MOUTH.

IN the treatment of wounds of the face, the great object is to leave as slight a scar as possible. This is attained by preventing sepsis, carefully suturing the edges of wounds, using fine suture material, and removing the stitches early.

The dressing of face wounds in the ordinary way is often difficult. If the part cannot be bandaged in such a way as to leave the nostrils and the mouth free, the gauze dressing may be fixed in position by adhesive plaster or collodion. Or the wound may simply be dusted with a powder of zinc oxide, boric acid and starch, and left without a dressing.

In wounds near the mouth, or communicating with it, that cavity must be kept as free from bacteria as possible by spraying with hydrogen peroxide. In infants, it is better to swab it frequently with glycerine of borax.

In operations on the face, mouth and neck, the anæsthetist's hands must be sterilized, and he is to be provided with sterile gloves. The mouth-gag and tongue-forceps which he uses must be boiled along with the other instruments.

INJURIES OF THE FACE.

In wounds of the face, bleeding is usually free at first, but as a rule it soon stops. If the facial artery is cut, it should be compressed against the lower jaw. Paralysis of the face muscles on one side results from division of the facial nerve, which reaches the face near the lobe of the ear. If the duct of the parotid gland is divided, a salivary fistula may form.

In injuries from explosions, particles of stone or coal or grains of gunpowder may be driven into the tissues. Owing to the unsightly mark which they leave, each individual particle should if possible be removed.

Fine bayonet-shaped needles, or Hagedorn needles (Fig. 71), should be selected for stitching. The best suture materials are fine silk-worm gut or horsehair, and Michel's clips (Fig. 101) are useful. If the wound reaches into the mouth, its edges should be drawn together from the inside by catgut stitches.

After-Treatment.—Wounds of the face heal quickly, and as a rule the stitches can be removed as early as the third or fourth day. This is a great advantage, as the stitch-marks have not had time to become prominent.

Complications.—*Sepsis* may show as a stitch abscess, or an infection of the whole wound. *Erysipelas* is specially prone to attack face wounds, but, unless suppuration occurs, the stitches need not be removed till the usual time. The face should be smeared with ichthyol ointment (p. 21), and covered with a mask of lint saturated with the same substance. *Tetanus*, which is marked by convulsive spasms of the muscles of the body, is the result of infection with a special bacillus. The edges of the wound must be completely excised. Pure carbolic should then be applied, and the wound left open and dressed with iodoform gauze.

The nurse must note that all instruments used in a case of infection with tetanus must be purified *for a long time and repeatedly* before they are used again. They should be boiled for twenty minutes on three successive days.

HARE-LIP.

Hare-lip is usually operated on in infants of six to twelve weeks. If cleft palate also exists, it is operated on later.

Preparation of the Patient.—Before the operation for hare-lip is undertaken, care has to be taken to have the child in as good condition as possible. He should be in charge of a trained nurse, who has to feed him with a spoon as he is generally unable to suck. If in spite of constant supervision he is not thriving, the operation should be no longer delayed.

For some days beforehand, the mouth should be cleansed with glycerine and borax. The field of operation cannot be efficiently cleansed till the child is anæsthetized. As at all

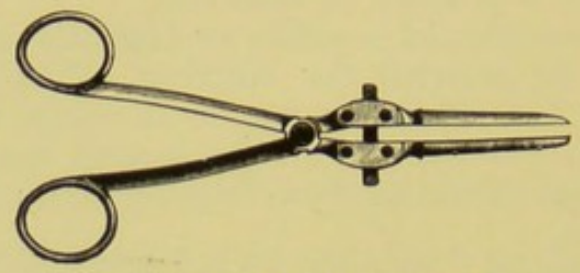


FIG. 252.—HARE-LIP FORCEPS.

other operations on young children, the infant should be wrapped in cotton-wool to prevent chilling.

Special Instruments.—*Hare-lip forceps* (Figs. 252 and 253) of various patterns have been devised to keep the edges

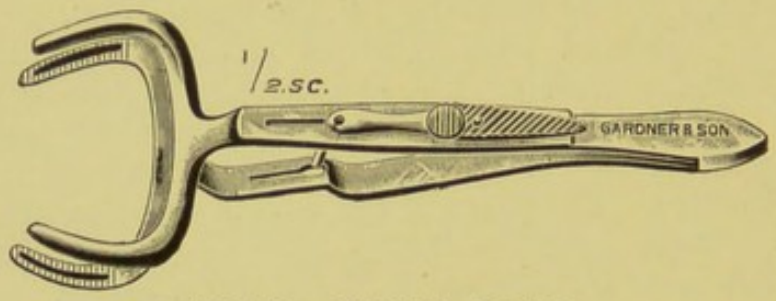


FIG. 253.—HARE-LIP FORCEPS.

of the gap in position while the sutures are being applied. *Hare-lip pins* (Fig. 254), with glass or metal heads and triangular points, may be used to transfix the edges, which

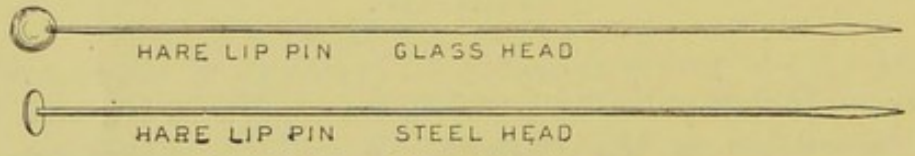


FIG. 254.—HARE-LIP PINS.

are then drawn together by a figure-of-eight thread. The excess of pin is snipped off with pin-cutting forceps (Fig. 255). Silk-worm gut is usually employed for the deep

stitches, and horsehair for the superficial ones which bring the edges into exact apposition. A small piece of sterile gauze is applied, and covered with collodion to seal the wound against infection from the child's hands and nose.

After-Treatment.—The success of the operation depends on the avoidance of sepsis. Milk is given with a sterilized spoon, and the mouth should be swabbed with glycerine and borax after each meal.

For the dressing, the nurse and surgeon should sit facing each other, with the infant's head placed between the surgeon's knees. With one hand, the nurse controls the patient's limbs, and with the other presses forward the cheeks. Hare-lip pins should be removed on the second day, the deep stitches on the fourth or fifth day, and the superficial ones on the eighth day. A strip of adhesive plaster applied from

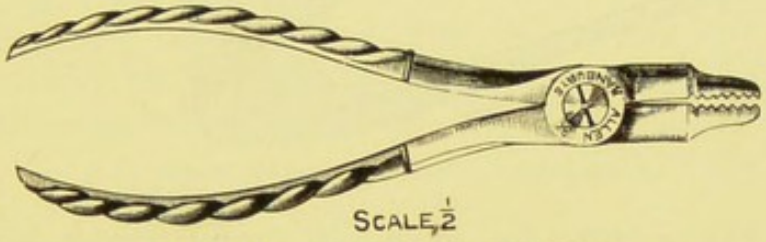


FIG. 255.—PIN-CUTTING FORCEPS.

cheek to cheek across the lip and renewed at intervals, may be worn for some weeks to prevent stretching of the scar when the baby cries. If, however, it irritates the skin and causes pain, it should be removed.

Special Complications.—*Sepsis* may show as a stitch abscess, necessitating the immediate removal of the infected suture, or as an infection of the deeper parts of the wound. In the latter case, the edges may not join, and the operation is a failure ; if they do adhere, the resulting scar is prominent.

Dyspnœa.—If the infant has been in the habit of breathing through the cleft in the lip, its closure may produce difficulty an hour or two after the operation. The nasal passages are probably small, and the effort to inspire sufficient air irritates them and leads to a free secretion of mucus. This tends to dry up and block the passages, and sudden dyspnœa, which may be fatal if no one is near, occurs. Hence the nurse must

watch for any difficulty in respiration, and gently open the mouth with her finger to allow air to enter.

Bronchitis and Pneumonia may occur in poorly nourished children.

Mouth Operations.

Special Instruments.—For operations in the mouth, a *gag* is employed to separate the jaws. If the patient resists open-

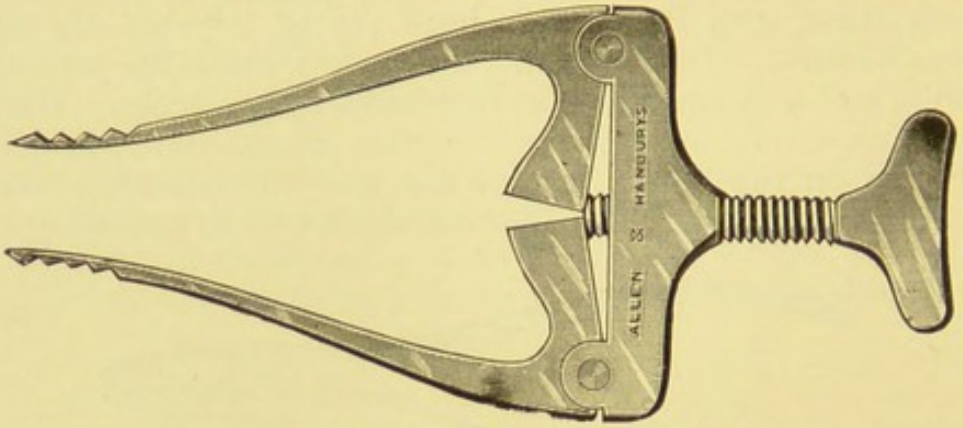


FIG. 256.—DILATING MOUTH WEDGE.

ing of the mouth, for example during the induction of anæsthesia, a *dilating wedge* (Fig. 256) is first inserted to

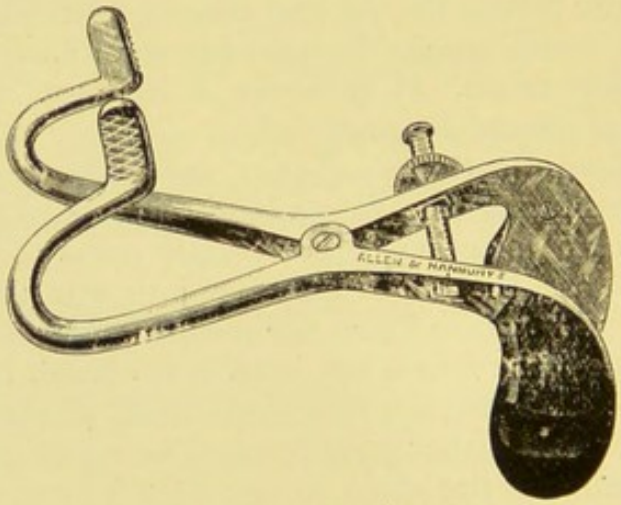


FIG. 257.—CROFT'S GAG.

lever the jaws open. Mouth gags are of various patterns, of which these figured (Figs. 257 to 259) are in everyday use.

Hewitt's gag (Fig. 258) is useful in operations on the cheek or jaw in which the head must be turned completely on its side. Cotterill's gag (Fig. 259), with cheek retractor adjusted by means of a head strap and buckle, is a convenient self-

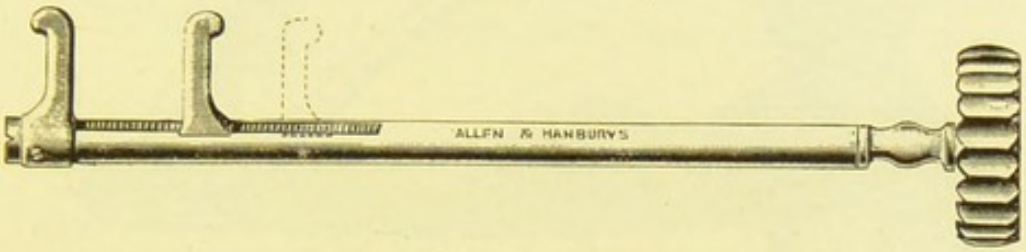


FIG. 258.—HEWITT'S GAG.

retaining instrument. During the administration of an anæsthetic, many anæsthetists keep the mouth open by a *prop* (Fig. 260), to ensure that the patient gets plenty of air. The prop may be perforated (Fig. 261) for use with Junker's inhaler (Fig. 110); to serve the same purpose, Croft's gag may be made with a metal tube attached.

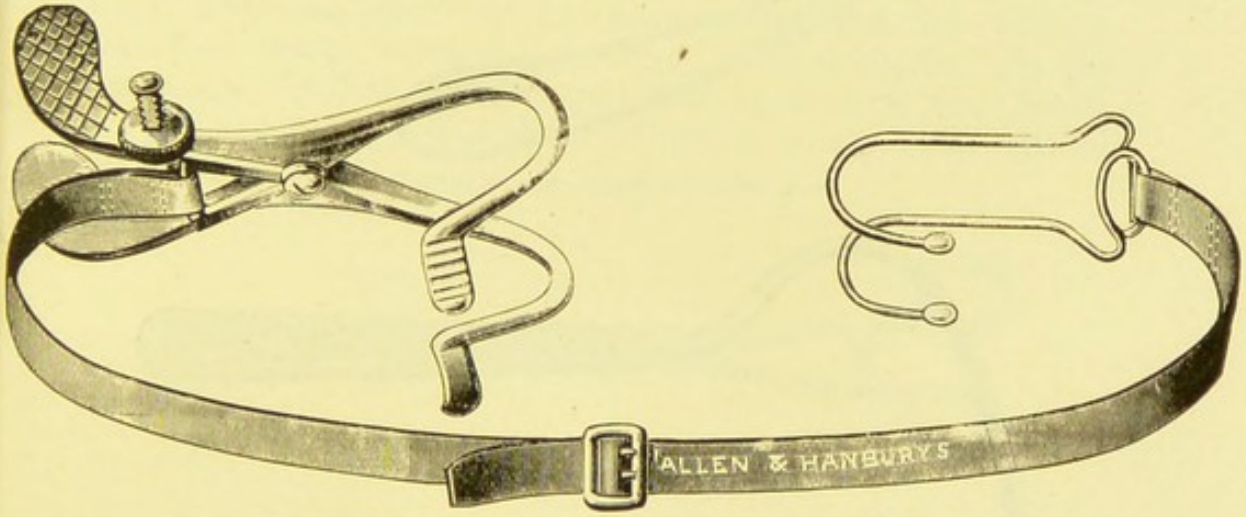


FIG. 259.—COTTERILL'S GAG AND CHEEK RETRACTOR.

For examination of and operations on the palate, tonsils, and other neighbouring structures, the tongue is depressed by a *tongue-depressor* or *tongue-spatula* (Figs. 262 and 263). Some instruments carry at the tip an electric lamp to illuminate the throat (Fig. 264).

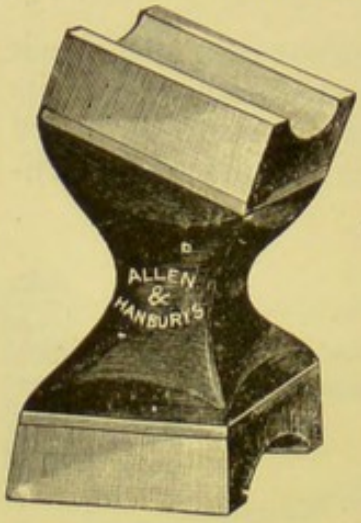


FIG. 260.—MOUTH PROP.

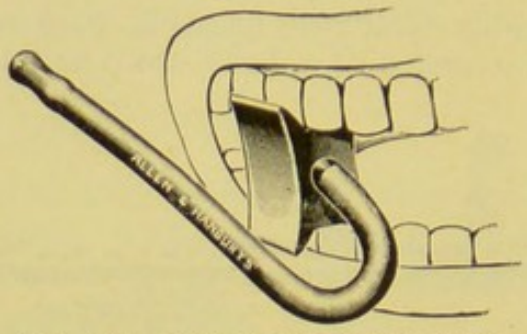


FIG. 261.—MOUTH PROP WITH TUBE, FOR USE WITH JUNKER'S BOTTLE.

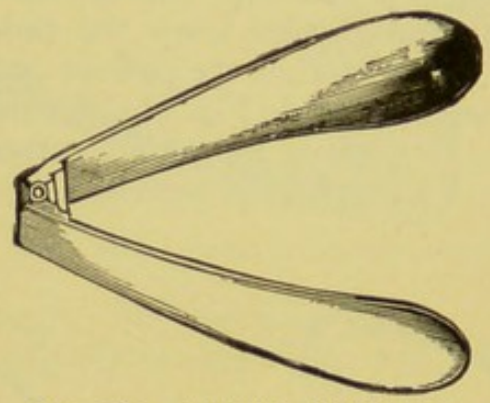


FIG. 262.—TONGUE DEPRESSOR.

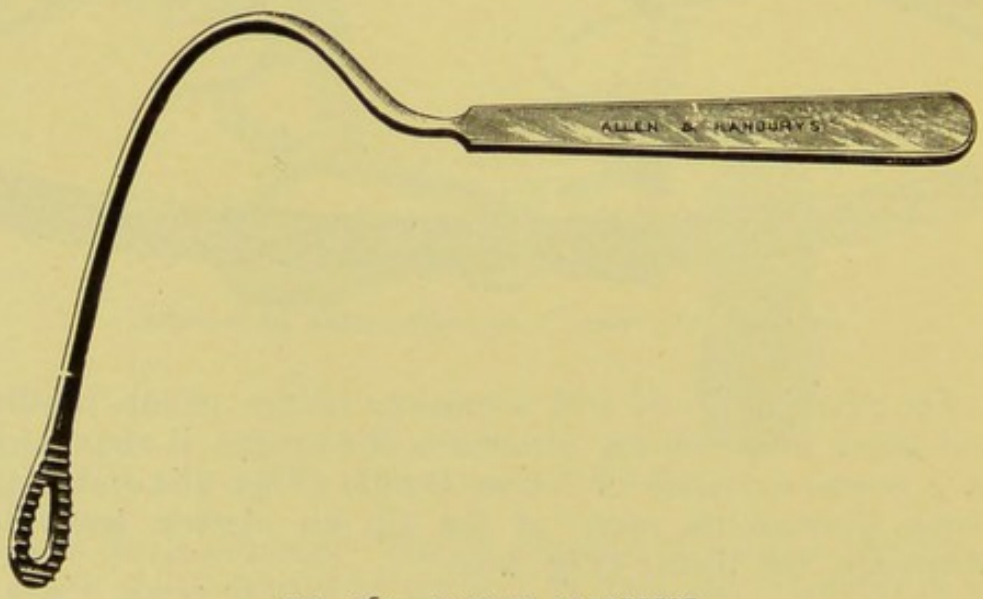


FIG. 263.—TONGUE DEPRESSOR.

Sponges.—Small *mouth sponges* or gauze swabs fixed on *sponge-holding forceps* (Fig. 265) are used for swabbing. The purification of sponges after an operation is a matter of considerable difficulty. Of various complicated methods, the following has been found satisfactory: Wash in salt solution, place in strong Condy's fluid until they are deep brown

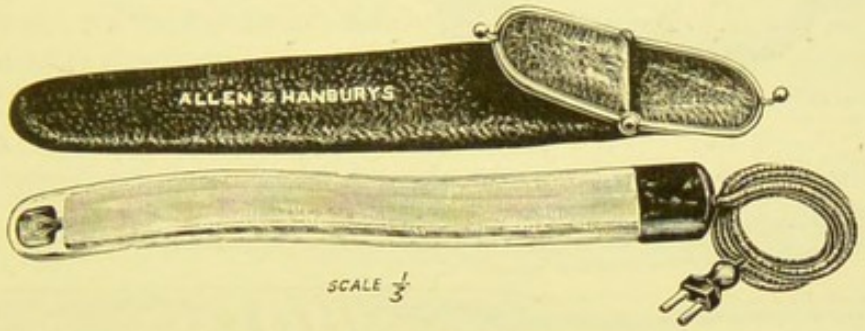


FIG. 264.—TONGUE DEPRESSOR WITH ELECTRIC LAMP.

(about twenty-four hours), wash in oxalic acid, and then in plain water, place then in hydrochloric acid for quarter of an hour, wash out the acid in sterile water and dry with a sterilized towel, store dry or in 1 in 40 carbolic. At an operation, fix half a dozen or more in forceps and lay in boracic lotion. To free them of blood, wring them out of saline solution.

FIG. 265.—SPONGE-HOLDING FORCEPS.

Cleft Palate.

Various operations are performed for cleft palate according to the extent of the cleft and the age of the patient.

Preparation of the Patient.—The nurse should be with the patient a few days before the operation. She may experience great difficulty in feeding him, as he cannot suck

properly. She may use a spoon, or a bottle with a special teat (Fig. 266) which has a fold to form a partition between the mouth and nose. The mouth is particularly liable to be infected with thrush, and this must be treated by swabbing with glycerine of borax. In older children, the mouth may be cleansed by spraying with hydrogen peroxide. If catarrh of the air-passages is present, causing hoarseness and cough, the child should be kept in a warm, moist atmosphere till these symptoms disappear.

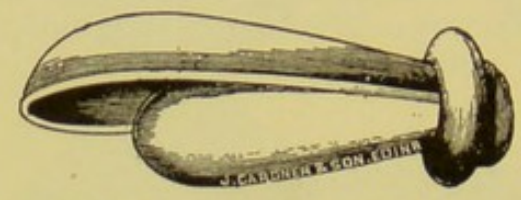


FIG. 266.—CLEFT PALATE TEAT.

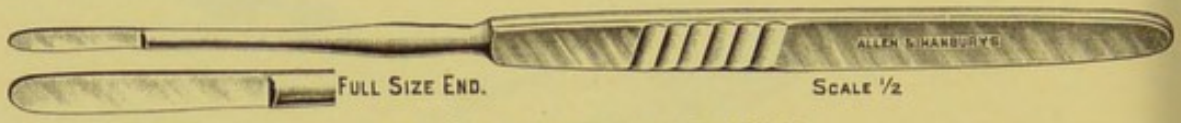


FIG. 267.—CLEFT PALATE KNIFE.

Special Instruments.—Most of the special instruments are characterized by their long handles. The mouth is kept open by a *gag* (Figs. 257 to 259). The fine *knives* (Fig. 267)

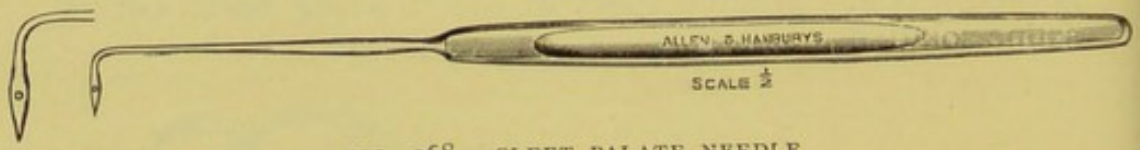


FIG. 268.—CLEFT PALATE NEEDLE.

used for paring the flaps are sharp- or blunt-pointed, and the blade may be straight with the long stem or at an angle

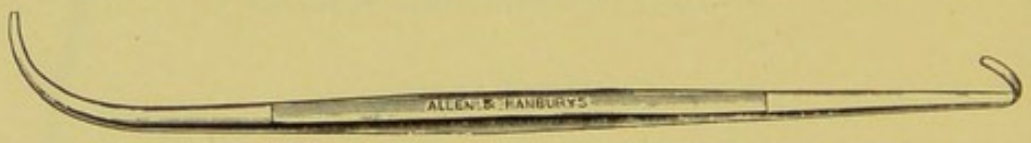


FIG. 269.—CLEFT PALATE RASPATORY.

to it. Many surgeons use an ordinary bistoury with a long blade. The *needles* (Fig. 268) are more or less curved. Some have a double curve, and are in pairs, right and left.

Raspatories or *separators* (Fig. 269) are used to detach the soft tissues from the bone. *Toothed forceps* (Fig. 270) are helpful in steadying the flaps while the stitches are being inserted. If silver-wire is used for stitching, each suture is twisted with a *wire-twister* (Fig. 271) and cut short.

The **operation** may be performed in one stage or in two. The anæsthetic is administered by means of Junker's apparatus. The patient may be placed with the head hanging, this position being now more generally adopted than that with the shoulders raised and the head extended.

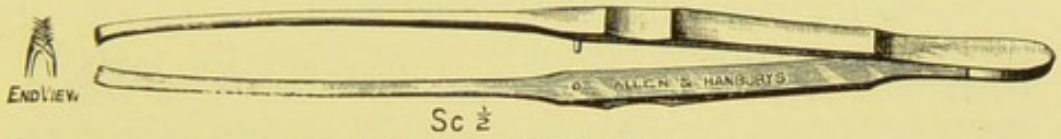


FIG. 270.—CLEFT PALATE FORCEPS.

The sutures may be of silver-wire, silk, or horsehair. To take the strain off them, a thin strip of aluminium may be passed round the two flaps so as to hold them together.

After-Treatment.—Vomiting, crying, and coughing must if possible be prevented. The child's hands are tied down so that he cannot put them up to his mouth. The best way is to apply bands round the wrist and fix them to a piece of webbing stretched across the bed. Fluids alone are given

FIG. 271.—WIRE-TWISTING FORCEPS.

at first, and they are to be administered carefully with a spoon. The mouth should be swabbed with glycerine of borax, or in older patients sprayed with hydrogen peroxide, after each meal. The nurse must not on any account open the mouth wide enough for inspection until the stitches are due to come out. This will be in about a fortnight, some perhaps being left for another week till the wound is firmly united. Only then may food that requires mastication be given.

Voice-training and *breathing exercises* are important items of the after-treatment. The child must be made to practise breathing with the mouth closed. In speaking, he must be trained to send the stream of air through the mouth. Otherwise he will always "talk through his nose".

Mechanical appliances such as *obturators* may be of use in aggravated cases of cleft palate in grown-up patients, or in cases in which repeated operation has been unsuccessful. They are plates of vulcanite or gold which are fixed to the teeth and form a roof for the mouth.

Complications.—*Shock* may be severe after operation, owing to the mal-nutrition resulting from the difficulty of swallowing. *Hæmorrhage* may occur from the posterior palatine artery, and is to be treated by inserting a spill in the posterior palatine foramen. *Sepsis* may lead to suppuration around one or more of the stitches, and the formation of gaps along the junction of the flaps. These are closed at a subsequent operation.

Removal of Tonsils.

Enlarged tonsils are usually met with in children between 5 and 10 years of age, but adults sometimes come for operation because of repeated attacks of quinsy (suppurative tonsillitis).

Preparation of the Patient.—Attention to the general health, plenty of fresh air, and avoidance of chills may cure a young child without operation. If operation is necessary, for example when the condition is causing deafness or interfering with the development of the chest, it may be performed under local or general anæsthesia. In the former case, the tonsils are painted with 5 per cent. cocaine, and in the latter chloroform or ethyl chloride may be selected. The mouth should be sprayed for a few days with hydrogen peroxide, and decayed teeth attended to.

Special Instruments.—The tonsils may be seized with *vulsellum forceps* (Fig. 272), and shaved off with a curved probe-pointed bistoury, or the *tonsillotome* (Fig. 273) which acts like a guillotine may be used. Soft tonsils may be

shelled out with the finger-nail, or an *artificial nail* of metal (Fig. 274). In all cases, a *tongue-depressor* (Fig. 263) and *mouth-gag* (Fig. 257) are required.

FIG. 272.—VULSELLUM FORCEPS.

The Operation.—Hæmorrhage is occasionally severe at the operation. It is to be treated by firm pressure with gauze soaked in adrenalin, the child being propped up in the sitting

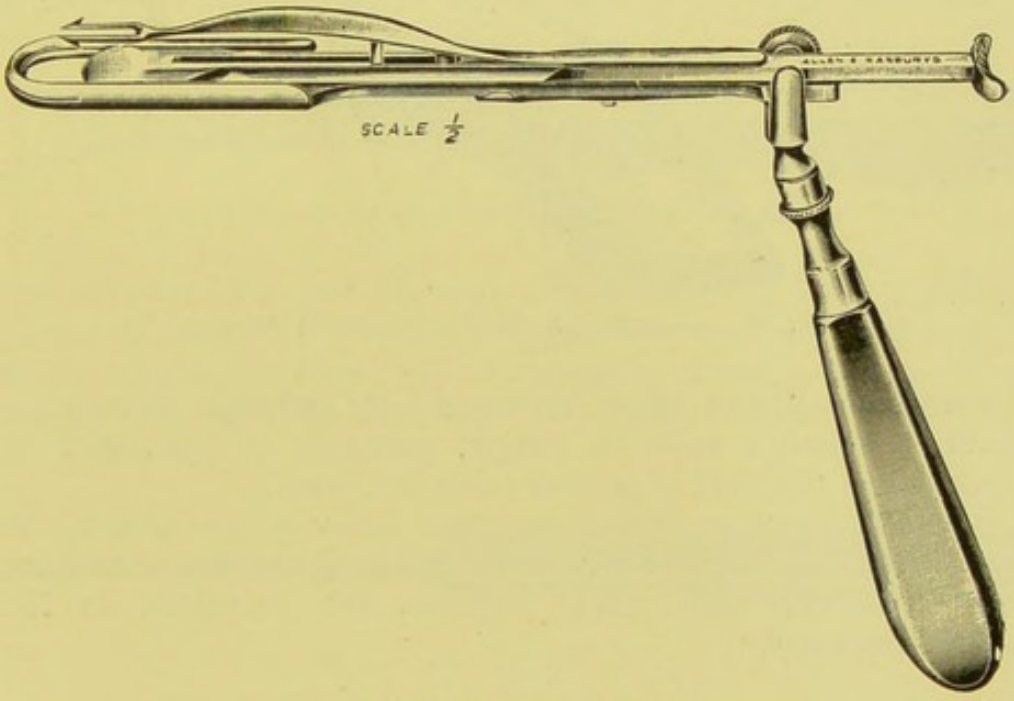


FIG. 273.—TONSILLOTOME.

posture. If this is not sufficient, the bleeding point should be caught with forceps which are left on for some hours.

After-Treatment.—The after-treatment aims at keeping the mouth as clean as possible, by frequent syringing with

warm boric lotion and spraying with hydrogen peroxide. Swallowing is painful, and the child has to be encouraged to do so. It is found that semi-solids such as jelly and custard are often better taken than milk. In a fortnight the child should have a change of air.

Special Complications.—*Aspiration pneumonia* is due to blood trickling down into the air passages. It is best prevented by avoiding deep anæsthesia. *Sepsis* is serious in that it may lead to *secondary hæmorrhage*, *septic sore throat*, or *septic pneumonia*. For slight *hæmorrhage*, the patient should sit at an open window and breathe deeply with the mouth open. For more severe bleeding, firm pressure with a gauze pad wrung out of adrenalin is required. It may be necessary to apply artery forceps to the bleeding point.

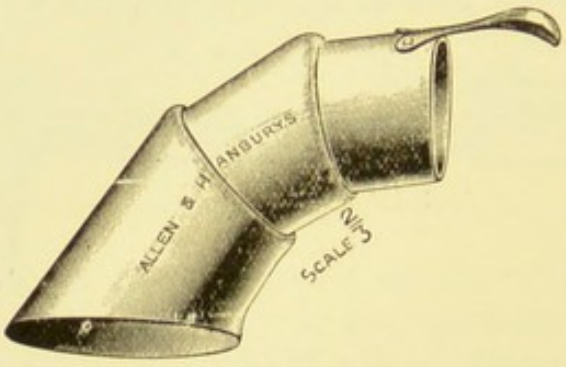


FIG. 274.—ARTIFICIAL NAIL AND FINGER SHIELD.

Septic sore throat must be treated by suitable antiseptics, such as Condy's fluid to gargle, peroxide of hydrogen to spray, and chlorate of potash tablets to suck.

Scarlet Fever or *Diphtheria* may occur by infection of the raw surfaces on the tonsils. Hence the operation should not be performed when these diseases are prevalent in the neighbourhood.

Removal of Adenoids.

Adenoids form a soft, velvety mass at the back of the nose, and are due to over-growth of the lymphoid tissue in that region. They often occur along with enlarged tonsils and are most common between the ages of 5 and 15.

The mass interferes with breathing through the nose, more especially at night, hence the child usually snores, and his sleep is disturbed. The mouth is kept open for breathing, and a chronic cough frequently results.

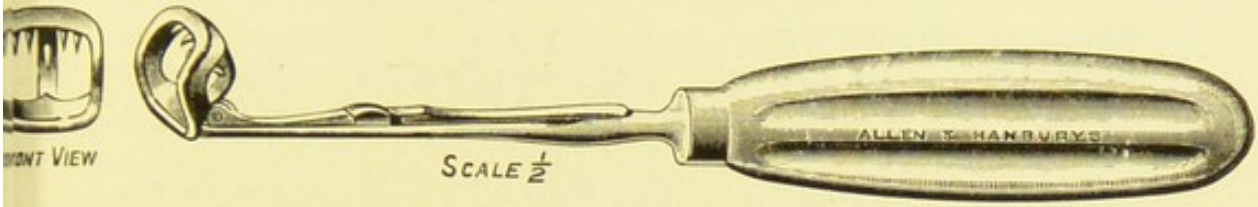


FIG. 275.—ADENOIDS CURETTE, WITH CRADLE AND HOOKS.

The adenoids should be thoroughly removed under general anæsthesia, with the patient's head hanging over the end of the table.

Special Instruments.—These are: Two *adenoid curettes*, one provided with a cradle and hooks (Fig. 275), and the

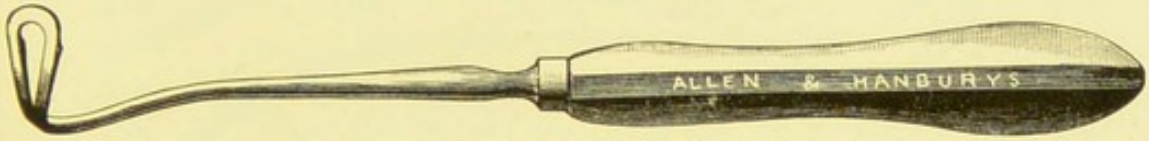


FIG. 276.—ADENOIDS CURETTE WITHOUT HOOKS.

other without (Fig. 276), lateral *ring knife* (Fig. 277), a pair of *adenoid forceps* (Fig. 278), a *tongue-depressor*, a *mouth-gag*, and one or two *throat sponges* on forceps or holders. Adenoid growths may also be removed by means of an artificial nail (Fig. 274).

FIG. 277.—HARTMANN'S RING KNIFE.

After-Treatment.—The head should be raised at once to diminish hæmorrhage, and the patient rolled well over on his side to let the blood escape from the mouth. If any blood is swallowed, it is almost sure to be vomited later, a

fact of which the friends should be warned, as they become alarmed at the vomiting of dark blood. The diet is the same as after the removal of tonsils. The throat should be sprayed with hydrogen peroxide, or gargled with sodium bicarbonate to remove blood and mucus. Douching through the nose is not to be recommended, as it may lead to infection of the middle ear. An aperient should be given on the day after operation; the child may be allowed to run about in the sick-room.

It is very important to train the child to breathe with the mouth shut, and to speak without any nasal twang.

Special Complications.—Complications are rare after the removal of adenoids. In general they are the same as after the removal of enlarged tonsils.

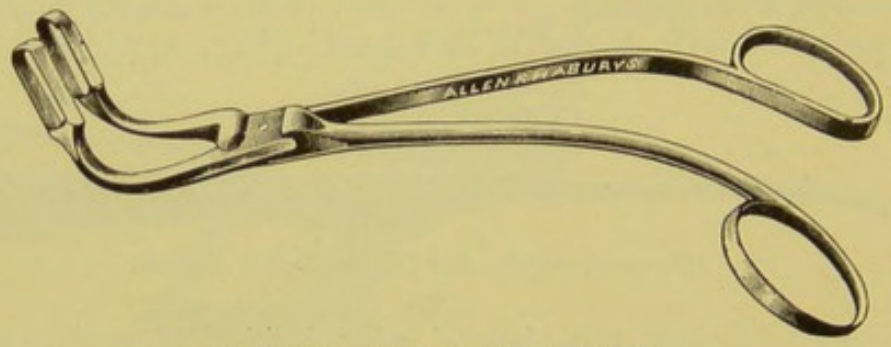


FIG. 278.—POST-NASAL FORCEPS.

If *hæmorrhage* continues after the operation, or occurs during the period of reaction or as the result of sepsis, a small sponge wrung out of adrenalin or turpentine should be pressed by a finger against the posterior wall of the pharynx. If the bleeding is severe, compression of the common carotid artery against the carotid tubercle in the neck should be tried.

Acute Infection of the Middle Ear is a rare sequel of the removal of adenoids. It is due to the spread of sepsis along the Eustachian tube. The naso-pharynx must then be douched with hydrogen peroxide, weak Condy's fluid, or carbolic lotion, 1 in 80, to which a little sodium bicarbonate is added, and if suppuration occurs, the pus must be let out by an opening in the membrana tympani.

Adhesions between the soft palate and the posterior wall of the pharynx may form, if the soft palate is injured.

Removal of the Tongue.

The most frequent operation on the tongue is its removal in whole or in part for cancer, and this procedure may be accompanied or followed by the removal of the corresponding lymphatic vessels and glands from the neck.

The **preparation of the patient** is directed towards the cleansing of the mouth, which may be extremely foul in these cases. Carious teeth should be stopped or removed, and the mouth frequently syringed with warm boric lotion, and sprayed with peroxide of hydrogen. Before operation the moustache and beard should be shaved.

Special Instruments.—The *instruments for laryngotomy* (p. 308) must be put out, as it may be done as a preliminary operation in cases of extensive disease. Occasionally the lingual artery is ligated at the outset to prevent hæmorrhage when the tongue is being removed, and an *aneurysm needle* (Fig. 70) must be sterilized. One or two strands of *silkworm gut* are also required to transfix the tongue and steady it during the operation. A strand is also used to transfix the stump, and prevent it falling back and choking the patient.

The ends of the thread are brought out at the mouth, and secured with a pair of artery forceps. For snipping the mucous membrane at the side of the tongue, *blunt-pointed scissors*, straight or curved on the flat (Fig. 56), are the best. A *gag* which opens the mouth widely is essential, and, as in all operations on the mouth and face, it must be sterilized beforehand. If the disease has spread beyond the tongue, the *bone instruments* (p. 371) may be needed to remove part of the lower jaw.

The **After-Treatment** consists in frequent syringing and spraying of the mouth to keep it sweet. In syringing, the nurse should sit facing the patient who sits up and holds a basin under the chin. Nourishing fluid food is given from a feeding-cup with a rubber tube attached. The patient should sit up as soon as he has recovered from the shock of the

operation, and be allowed out of bed as soon as possible, say on the fourth or fifth day.

Special Complications.—The chief dangers are secondary hæmorrhage, septic pneumonia, and œdema of the larynx. *Secondary hæmorrhage* usually occurs seven to ten days after the operation, and results from septic sloughing in the stump. The nurse must know how to control it till the surgeon arrives. She should at once make the patient sit up, and tell him to open his mouth. Then she passes one or two fingers down over the stump of the tongue, and hooks it forwards so as to compress the arteries against the lower jaw. Meanwhile another nurse collects artery forceps, sponges, and sponge-holders. If the surgeon is unable to seize the bleeding point a knife, aneurysm needle, dissector, and scissors are required to ligate the lingual artery on the corresponding side. If he cannot discover on which side the bleeding is taking place, he must tie both arteries.

Septic pneumonia is best prevented by avoiding any congestion in the lungs. For this reason the patient must be propped up with pillows into a sitting posture. The cleansing of the mouth is also important in the prevention of this dangerous complication.

Œdema of the larynx, with gradually increasing dyspnœa, may require tracheotomy. It arises in virulent infections of the stump of the tongue.

Removal of the Upper Jaw.

The upper jaw is removed in cases of malignant disease confined to that bone. The preparation is the same as for operations on the tongue.

Special Instruments.—A preliminary laryngotomy is as a rule performed, and the essentials (p. 308) must be ready sterilized. When the tracheotomy tube is inserted, the anæsthetic is administered through it, and the pharynx should be plugged with sterile gauze to prevent the entrance of blood into the air-passages. The external carotid artery may also be ligated or temporarily compressed. In the latter case, a *clamp* such as that devised by Crile (Fig. 279) is required.

The usual *bone instruments* (p. 371) are to be boiled—periosteum detacher, bone forceps, straight and angled, lion forceps, a small finger-saw, and a broad chisel. A pliable *copper-spatula* retractor should also be at hand to place between the periosteum of the orbit and the bone so as to protect the eye

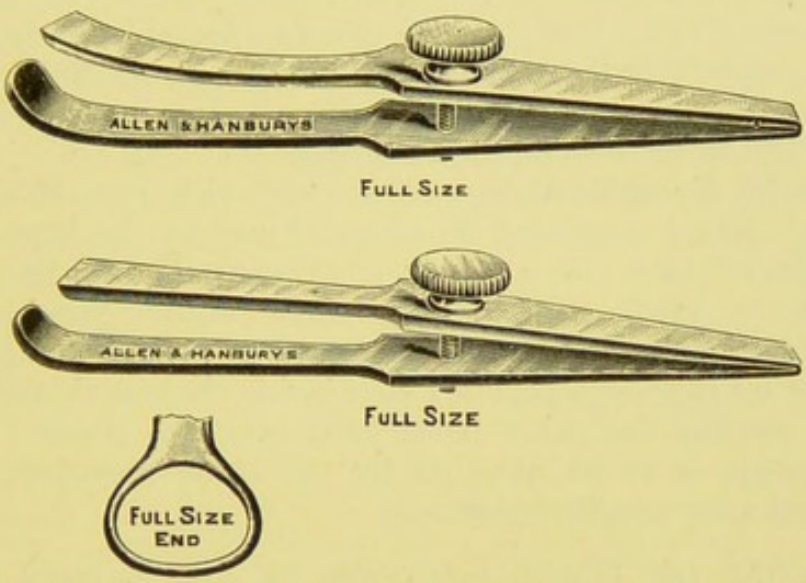


FIG. 279.—CRILE'S CLAMPS FOR THE CAROTID ARTERY, STRAIGHT AND CURVED.

from injury. *Tooth forceps* (Fig. 280) to remove the central incisor tooth on the affected side are required.

The Operation.—When the bone has been wrenched out with lion forceps, hæmorrhage must be quickly stopped. This is usually done by firm pressure with gauze-pads soaked

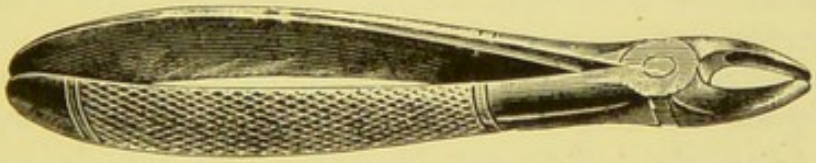


FIG. 280.—TOOTH FORCEPS FOR CENTRAL INCISOR.

in turpentine. The bleeding is not severe if the external carotid artery has been previously clamped. As the clamp is gradually slackened, the individual bleeding points are secured with artery forceps. The cavity is then plugged with gauze brought out through the mouth, and the skin-wound is stitched up.

After-Treatment.—Discharges must not be allowed to accumulate in the mouth. The plug of gauze may be removed in twenty-four to forty-eight hours, and replaced by a smaller plug gently inserted. The mouth is frequently sprayed with hydrogen peroxide, and douched with Condy's fluid, or weak carbolic lotion to which a little sodium bicarbonate has been added. Healing is rapid, and little deformity is left, especially if a suitable obturator with artificial teeth is fitted. This should be done in three or four months if there is no sign of recurrence of the disease.

Special Complications.—The chief risks are shock and sepsis. *Shock* is treated in the usual way by the introduction of saline solution with a few drops of adrenalin into the rectum or into a vein. *Sepsis* may cause *septic pneumonia* or *secondary hæmorrhage.* The latter is to be temporarily treated by placing a pad of gauze inside the mouth and pressing it against the other hand held over the cheek. Septic pneumonia is to be avoided by the same measures as are adopted after tongue operations.

Partial or Total Excision of the Lower Jaw.

Preliminary laryngotomy and clamping of the external carotid artery may be done. *Gigli's wire-saw* (Fig. 291) and its *introducer* (Fig. 292) should be put out in addition to the special instruments for excision of the upper jaw. Strands of silk-worm gut must be sterilized for transfixion of the tongue, as it tends to fall back when the muscles attaching it to the lower jaw are divided. If only the central part of the jaw is excised, a metal or wooden prop is required to keep the remaining parts from falling together.

After-Treatment.—The feeding of the patient is troublesome when the tongue muscles have been separated from the jaw. Choking is then apt to occur, and liquids trickling down the air passages may give rise to septic pneumonia. When the wounds have healed, a denture may be fitted to reduce the deformity.

The operation on the jaw may have to be followed up a fortnight later by the excision of the lymphatic vessels and glands of the neck.

The **complications** are the same as after excision of the upper jaw.

Fracture of the Lower Jaw.

Fracture of the lower jaw scarcely calls for special mention. It is nearly always compound, hence sepsis must be guarded against by frequent cleansing of the mouth with hydrogen peroxide and Condy's fluid. As the fracture is generally treated by closing the mouth, and keeping the lower jaw fixed against the upper by means of the four-tailed bandage (Fig. 49), the diet must be fluid or semi-solid for four or five weeks. It is given through a soft tube which is slipped through any gap between two teeth, or, if no gap exists, pushed along the inside of the cheek to the back of the teeth.

CHAPTER XXVIII.

OPERATIONS ON THE SCALP, SKULL, AND BRAIN.

THE **preparation** in scalp operations, such as the *removal of a wen, i.e.* a sebaceous cyst, necessitates shaving off the hair over the field of operation. Female patients frequently object to this, but it must be insisted on. The thorough cleansing of the skin is difficult, and it is best to wash the whole head and hair with liquid or soft soap first, and then cleanse the shaved area with soap followed by methylated spirit and ether. A sterile dressing is then applied. At the operation, the whole of the hair should be protected by jaconette which has a hole corresponding to the shaved area. Over the jaconette, a sterilized towel, also with a hole in it, is wrapped round the head and fastened by a sterile elastic bandage.

No special instruments are required. Drainage is dispensed with in operation cases, but is usually employed in ragged wounds resulting from a blow or fall.

Special Complications.—*Hæmorrhage* from a vessel of the scalp may be primary, reactionary or secondary. In nearly every case it can be controlled by a pad of gauze or wool and a tightly applied bandage.

Sepsis.—If the wound becomes septic, the pus may burrow over a wide area. The scalp becomes puffy, and the swelling may extend to the forehead and eyelids, a condition which closely resembles erysipelas. In such a case, several openings should be made at the dependent parts of the swelling, and drainage-tubes inserted. Once the drainage is free, the scalp heals rapidly. If it is not free, the suppuration may spread to the brain or its membranes, and seriously endanger the life of the patient.

Cranial Operations.

Operations on the bones of the skull, are undertaken in a variety of conditions, for example, the removal of a bony tumour, the elevation of a depressed fracture, the relief of compression of the brain, or the evacuation of an abscess of the brain. In every case, the strictest attention must be paid to asepsis owing to the danger of infecting the inside of the skull. The operation most frequently performed is trephining, but, before discussing it, it may be well to describe the nurse's duties in a case of head-injury. If the patient has been rendered unconscious by the accident, he is suffering from concussion of the brain or something even more serious.

Effects of Head Injuries.

Concussion of the brain varies in degree in different cases. Sometimes the patient regains consciousness before he is brought to hospital, but even then he should be put to bed, and given a free purge of Henry's solution, or calomel followed by Epsom salts. The object is to remove fluid from the body, and so lower the blood-tension, and diminish the risk of hæmorrhage in the injured brain. The pulse is usually slow, but in general no stimulant is to be administered even although the rate is under twenty per minute. The patient must be kept absolutely quiet, and undisturbed by visitors; the room should be darkened, and talking forbidden. Only fluid food, and that in small quantities at a time, is given. The application of ice to the head is frequently made, but it probably is of no real benefit.

If the patient is still unconscious when he is admitted to the ward, he is not deeply so. He takes no notice of his surroundings, but he can be roused by pinching or by loud talking. If he is going to recover, the "reaction" soon sets in, and its onset is frequently signalled by the occurrence of vomiting. The pulse-rate and temperature quickly rise, and the face becomes flushed.

During the stage of unconsciousness, the patient cannot swallow a dose of salts or castor oil, but one or two drops of fresh croton oil placed on the back of the tongue will usually

produce purgation (p. 57). As a rule, no food need be given till the patient is conscious, but, if necessary, nutrient enemata may be administered. The patient's head should be raised to diminish the congestion of the brain, and he should be kept absolutely quiet.

Cerebral irritation is an occasional sequel of concussion. The patient becomes restless, and turns about in bed, usually keeping his arms and legs flexed, and his temper is irritable. The urine is passed in bed. This condition, which may continue for two or three weeks, is treated in the same way as concussion.

Compression of the Brain.—If hæmorrhage takes place inside the skull as the result of the accident, the brain is compressed, and trephining of the skull is required as an immediate operation. The hæmorrhage may come on at the time of the accident, or not till the period of reaction, which may be some hours later. The unconsciousness is now deep, and the patient cannot be roused.

Trephining the Skull.

Trephining may be, as has just been said, an immediate operation, or it may be performed for a more chronic condition such as the relief of symptoms in cerebral tumour.

Preparation of the Patient.—If time permits, the whole scalp should be shaved owing to the great importance of securing asepsis. Even in an urgent case, a wide area should be shaved, and the rest of the scalp covered with a sterile towel, which is stitched to the scalp around the operation area.

The operation consists in the removal of a circle of bone from the skull. If hæmorrhage is still going on, an attempt is made to ligate the bleeding point. When the patient is deeply unconscious, no anæsthetic is required; in other cases, chloroform is preferable to ether as the latter produces more congestion of the cerebral vessels.

Special Instruments.—The *trephine* (Fig. 281) is the instrument used to saw out the bone circle.

It consists of a small round saw, varying in diameter from $\frac{1}{4}$ inch to 1 inch, mounted on a strong hollow metal shaft

about $3\frac{1}{2}$ or 4 inches long, to which is attached at right angles a thick, strong handle (Fig. 281) or a brace handle (Fig. 282).

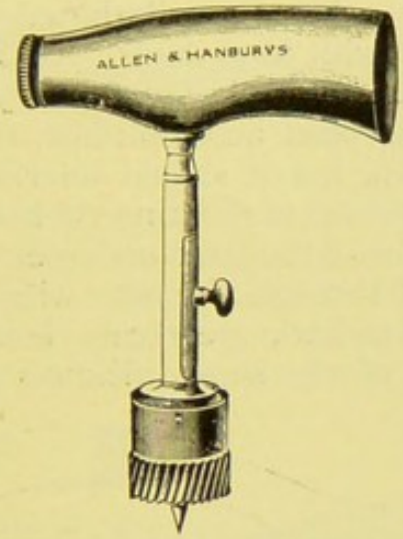


FIG. 281.—TREPHINE.

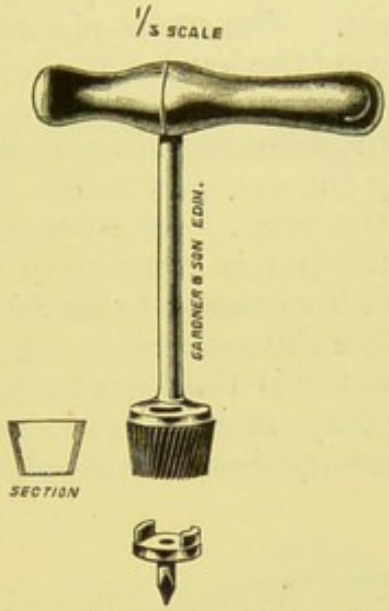


FIG. 283.—TREPHINE WITH PIN FIXED ON DISC.

Running down through the hollow of the shaft is a movable centre-pin, which may be made to project beyond the level of the saw teeth, or be entirely withdrawn, as required. It is

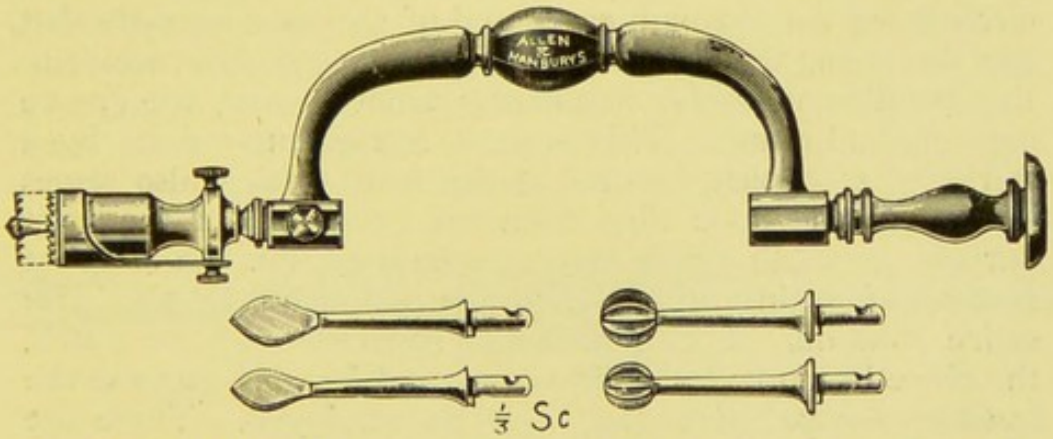


FIG. 282.—TREPHINE IN BRACE HANDLE, WITH TWO BURRS AND TWO DRILLS.

fixed in the desired position by a screw on the side of the shaft. In other instruments (Fig. 283) the pin is fixed on a

metal disk which fits inside the saw, and can be removed when necessary. Only the free edge of the blade may be serrated, or the serrations may be carried along the outer aspect of the blade. The centre-pin is first projected from $\frac{1}{16}$ inch to $\frac{1}{8}$ inch beyond the level of the saw. The point of it is then pressed into the centre of the area of bone to be removed, the edges of the skin wound being held apart with *blunt hooks*. In this way the saw is steadied until it has made a groove for itself in the bone. As soon as this has been accomplished, the centre-pin is completely withdrawn, lest it should interfere with the onward progress of the saw, or, perforating the bone before the saw, injure the membranes of the brain underneath. The saw is then gradually worked through the bone with a rotatory motion, as in using a bradawl, great care being necessary because the skull is not of the same thickness all

FIG. 284.—TREPHINE FORCEPS.

over, and there is consequently a danger of one part of the circle being cut through early, and of the saw opposite that part damaging the membranes. To prevent such an accident, the trephine must be frequently removed, and the groove measured all round. This is most conveniently done by a sterilized toothpick, blunted at the point, which also serves to remove the bone dust from the groove. For the latter purpose, a small brush may also be used, but the simplest method of getting rid of the dust is to douche the bone with saline solution. The bone being sawn through all round, the circle has now to be lifted out, and for this purpose the *trephine forceps* (Fig. 284) may be employed. These are made on the same principle as dissecting forceps, but the blades are rounded so as to adapt themselves to a curved object. An instrument called the *lenticular* (Fig. 285) is sometimes used at this step of the operation to plane the

edges of the hole in the bone. It has a stem with sharp edges which scrape off any projections, and these fall into a small basin-shaped button at the foot. When the operation is performed for fracture of the skull, it is often necessary to

FIG. 285.—LENTICULAR.

saw off projecting ledges of bone, and this is done by means of *Hey's saw* (Fig. 286), which consists of two small saws of different shapes fixed on to a long, strong handle. Another instrument also used in cases of fracture is the *elevator* (Fig. 287), which is used to raise any depressed fragments of bone

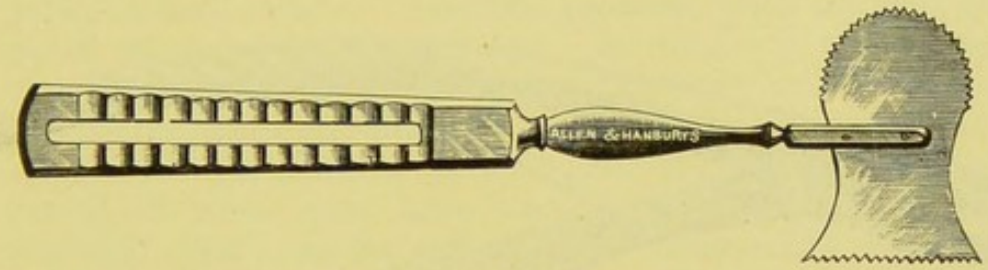


FIG. 286.—HEY'S SAW.

which are pressing on the subjacent brain. A *periosteum separator* (Fig. 336) is required at an earlier stage of the operation to remove the pericranium, as the covering membrane of the skull-bones is called. The other instrumentsused in the operation will depend on the object for which it

FIG. 287.—SKULL ELEVATOR.

is being performed, e.g. the removal of a tumour or foreign body, the evacuation of an abscess, or the elevation of depressed bone. Figs. 288 and 289 illustrate different forms of *rongeur forceps* used for cutting away pieces of the skull.

To retract the brain from the opening in the skull, Horsley's *brain spatula* (Fig. 290), of which the blade can be bent to any angle, is of great service.

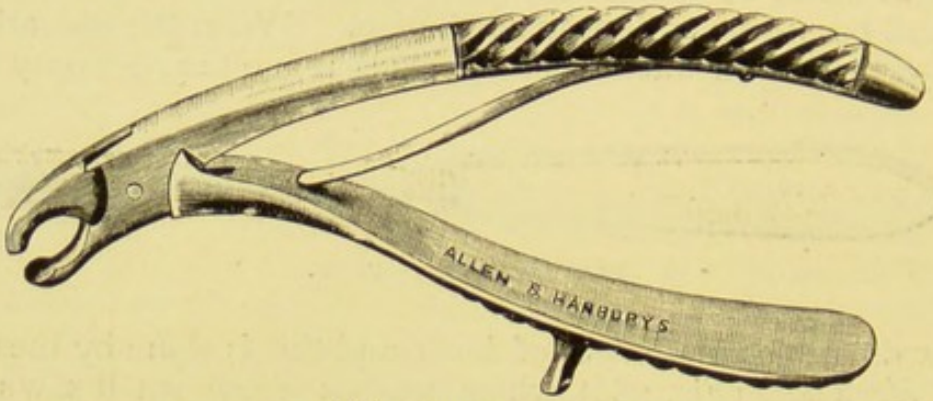


FIG. 288.—NIBBLING FORCEPS.

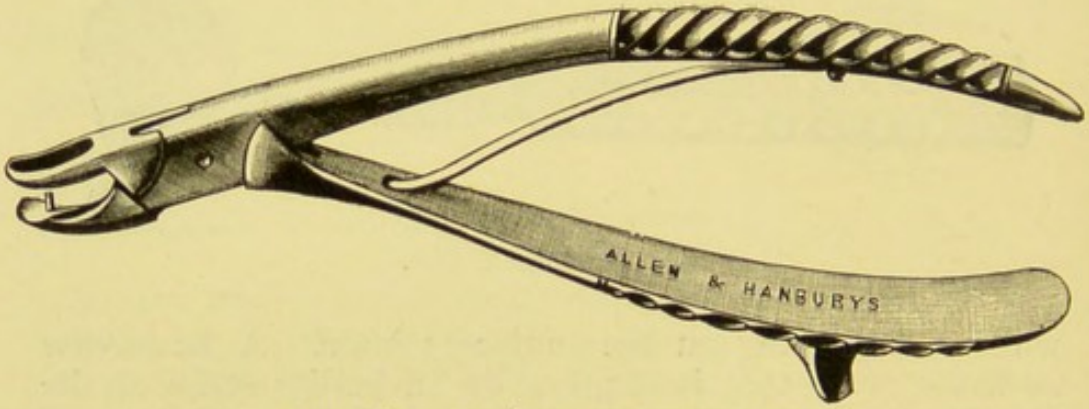


FIG. 289.—KEEN'S RONGEUR FORCEPS

For the control of hæmorrhage from the scalp, a *strong rubber band* is sometimes used. It may be sterilized in the casket, or purified in carbolic (1 in 20) or lysol lotion.

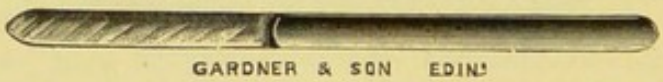


FIG. 290.—HORSLEY'S PLIABLE BRAIN SPATULA.

For bleeding from the bone, Horsley's *antiseptic putty* (carbolic acid 1 part, oil 2 parts, and wax 7 parts) should be in readiness, and also a pair of strong *necrosis forceps* (Fig.

352) with which the bone may be crushed to control the hæmorrhage.

For bleeding from the membranes and the brain tissue, one or two *intestinal needles* should be ready threaded with the finest catgut. To stop oozing of blood, normal saline solution at a temperature of 115° or 120° F. is to be ready, and a cylinder of oxygen should also be placed in the theatre, as the inhalation of this gas tends to diminish bleeding.

Special Preparations.—In every trephining operation, care must be taken to diminish shock, and it is the nurse's duty to see that the temperature of the operating theatre is not less than 70° F.

The operating-table must be such that the head-piece can readily be raised if bleeding is excessive, or lowered if syncope threatens.

The Operation.—An assistant is required to hold the patient's head steady. Another assistant does nothing but watch the pulse and respirations. In disease of the cerebellum especially, the patient may temporarily stop breathing, though the heart continues to beat. The respirations start again when the skull is opened. For the circle of bone removed, the nurse must have warm saline solution ready in a sterilized vessel, as the surgeon may afterwards replace it. Saline is also required (1) to cleanse the trephine and the wound of bone-dust, (2) at 115-120° F. to stop hæmorrhage, and irrigate the brain surface, and sometimes (3) to flush an abscess cavity in the brain.

In aseptic cases the cranial cavity is not drained. Even an abscess cavity can seldom be drained, so quickly is it obliterated by the expansion of the brain. In a few cases, the superficial wound is drained with a glass tube or a few strands of worsted, so that if infection has taken place the discharge may escape and tension is prevented. If there is no sign of sepsis, the worsted should be taken out in four or five days. In general, however, drainage should be avoided if possible, as it increases the risk of infection at the subsequent dressings. The capeline (Fig. 48) or the figure-of-eight (Fig. 47) bandage is applied; in restless and delirious patients, it should be covered with a close-fitting skull-cap of lint.

The **After-Treatment** is carried out on the same lines as

in cases of head injury. Absolute quietness is essential, and the patient should, if possible, be placed by himself in a side-room with the blinds drawn. The bowels are to be kept acting freely, and no stimulants are to be given. If the pulse is full and bounding, the head of the bed should be raised to diminish the amount of blood in the brain. If the case is one of head injury with extra-dural hæmorrhage, the patient may soon be treated as a convalescent if he shows signs of recovery, and no sepsis occurs. After every operation for severe head injury or for disease of the brain, the patient should be free of all mental work or business worries for several months.

If the trephining has been done for the removal of the Gasserian ganglion, the eye on the same side may be protected from dust by fixing a watch-glass over it for some weeks.

Special Complications.—*Retention of urine* occurs in certain cases, and the catheter must be passed at regular intervals.

Incontinence of urine and fæces occur more frequently. In such a case, much depends on the nurse's care in changing the bed repeatedly, and keeping the skin dry. Otherwise bed-sores are liable to develop.

Bed-sores arise in certain cases in spite of careful nursing. The surgeon knows as a rule the cases in which the skin is apt to slough, and he orders such patients to be placed on a water-bed, and to be frequently turned so as to avoid constant pressure on the same spots. In all head cases the skin of the back should be frequently washed, rubbed with methylated spirit, and dusted with powder.

Reactionary hæmorrhage is a dangerous complication if the blood is pent up in the cranial cavity, as it may lead to compression of the brain. When it occurs, the wound must be opened up to remove the effused blood.

Persistent vomiting may occur if the tension inside the cranial cavity is raised, whether by reactionary hæmorrhage, or by œdema of the brain, or otherwise. Rectal feeding must be adopted if enemata can be retained. If not, the patient's condition is extremely serious. The treatment is directed towards the cure of the increased tension.

Œdema of the brain usually comes on about a week after the operation, and it may disappear in a few days, or the softening process may spread over a wider area, and prove fatal. The patient complains of headache, and paralysis of some part of the body may ensue. In severe cases the patient becomes unconscious. The treatment consists in free purgation. If this does not produce any improvement, the surgeon must attempt to procure drainage of the œdematous fluid.

Hernia cerebri, or protrusion of part of the brain through the opening in the skull, occurs in some cases in which the bone is not replaced. It is due to increased tension in the brain, and it is especially apt to occur if infection has taken place. The protruded brain usually sloughs, and can be removed piecemeal. Great care is to be taken throughout to avoid mixed infection. To prevent a hernia increasing in size, pressure should be effected over it with strips of adhesive plaster over sterilized gauze or tin-foil.

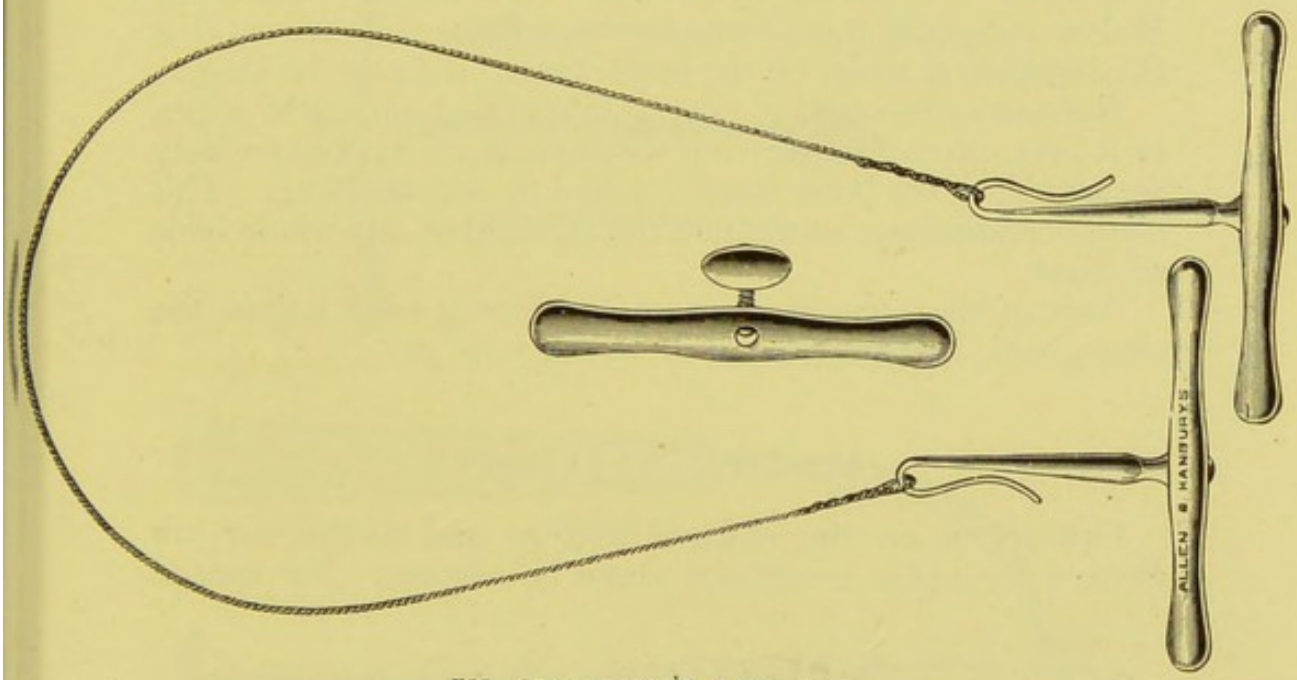


FIG. 291.—GIGLI'S WIRE SAW.

Osteoplastic Flap Operation.

In the osteoplastic operation, a large four-cornered piece of bone is temporarily removed to expose an extensive area of the brain, and is later replaced in position.

The preparations and precautions are the same as for trephining. In addition to the instruments required for the latter operation, a set of *Gigli's saws* (Fig. 291) should be put out. These are strands of fine, rough wire, with a loop at each end which fits into a hook on the handles. The special *introducer* (Fig. 292), made of pliable metal and with an eye near its extremity, has also to be sterilized. One or more small trephines, cutting out a ½-inch disk of bone, are to be selected for this operation.

The after-treatment is the same as after trephining.

FIG. 292.—INTRODUCER FOR GIGLI'S SAW.

Special Complications.—*Depression of the bone segment* may occur, and lead to symptoms of irritation of the brain. It does not occur if the bone has been sawn obliquely so that the segment is wider on the outer surface than on the inner.

Bone-necrosis, when it occurs, may affect only the edges, or it may extend further in if the periosteum has been widely separated, or the bone much crushed to stop bleeding. This complication may necessitate the removal of the whole bone segment.

Any of the complications of trephining may follow the osteoplastic operation.

Mastoid Operations.

Operations on the mastoid antrum and middle ear are always for septic conditions, acute or chronic. No special

FIG. 293.—MASTOID GOUGE.

preparation is required beyond shaving an area of the scalp above and behind the ear.

Special Instruments.—A *periosteum-detacher* (Fig. 336) must not be forgotten. The instruments for mastoid operations are characterized by their small size—*gouges* (Fig. 293), *chisels* (Fig. 294), *mallet* (Fig. 295), *burrs* (Fig. 296), *protector*

FIG. 294.—MASTOID CHISEL.

FIG. 295.—MALLET.

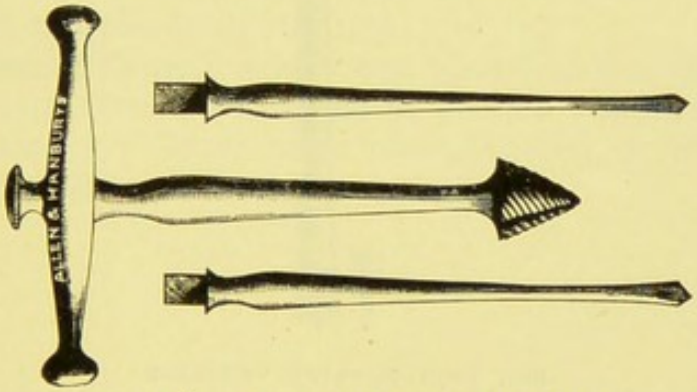


FIG. 296.—MASTOID BURR AND DRILLS.

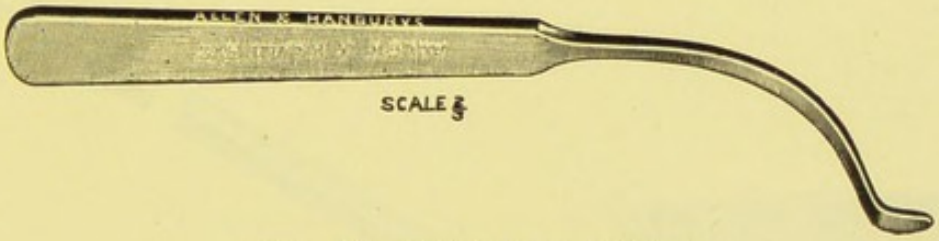


FIG. 297.—STACKE'S PROTECTOR.

(Fig. 297) to prevent injury to the facial nerve, *hook* (Fig. 298), *probe and scoop* (Fig. 299), and *trephine* (Fig. 300). In addition, Ballance's *instruments for skin-grafting* (Figs. 301 and 302), and a razor may be required.

FIG. 298.—MASTOID HOOK.

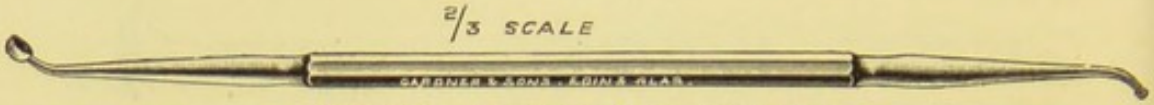


FIG. 299.—MASTOID PROBE AND SCOOP.

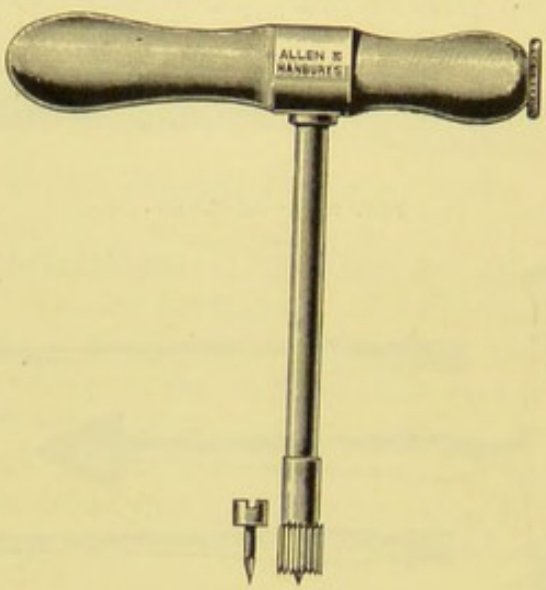


FIG. 300.—MASTOID TREPHINE.

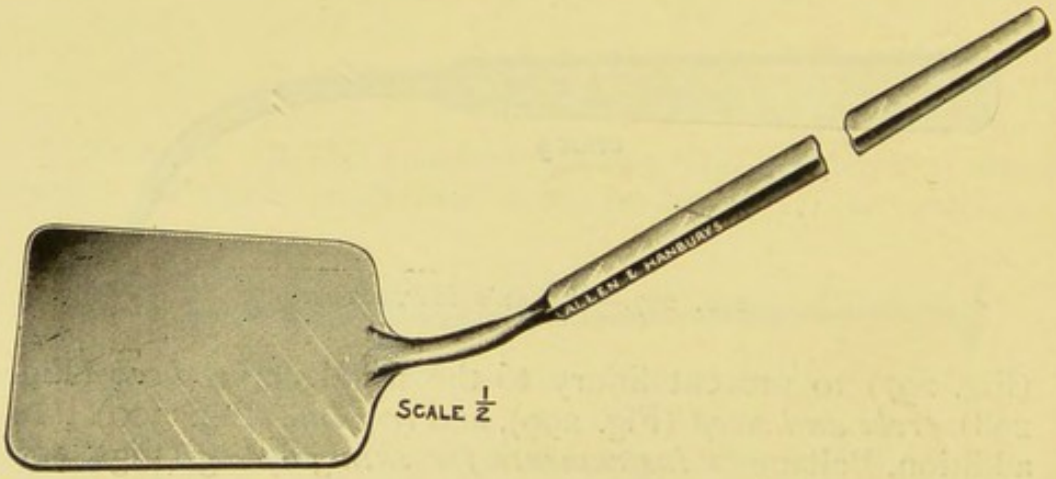


FIG. 301.—BALLANCE'S LIFTER FOR GRAFTS AND GOLD-LEAF.

After-Treatment.—The wound is to be kept open by gently plugging it with gauze till the exposed bone is covered with granulations. The patient may have to remain under treatment for many months, especially in tuberculous cases. At the operation, it may be found that pus has burst through

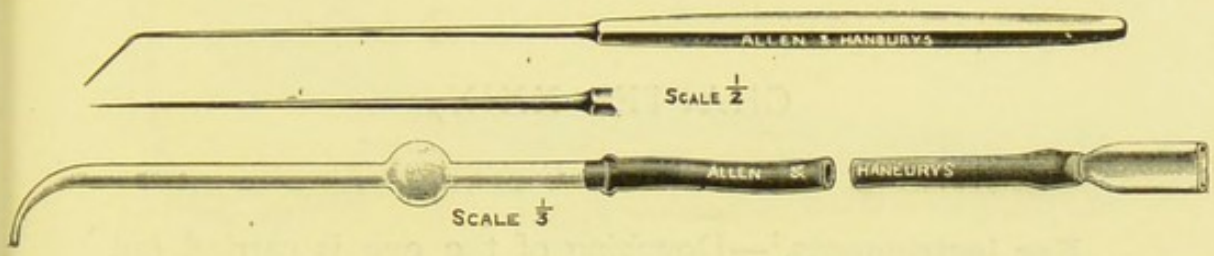


FIG. 302.—NEEDLES AND PIPETTE FOR GRAFTS AND GOLD LEAF.

the bone, and formed an abscess in the neck. This must be opened and efficiently drained.

The **Special Complications** are related to the disease, and not to the operation. The septic process may extend and produce *abscess of the brain* or *sinus phlebitis*, or it may lead to *facial paralysis.*

CHAPTER XXIX.

EYE, EAR AND NOSE INSTRUMENTS.

Eye Instruments.[1]—Douching of the eye is carried out with a special *nozzle* attached by rubber tubing to a glass reservoir (Fig. 303). The eyelids are kept open by the *spring*

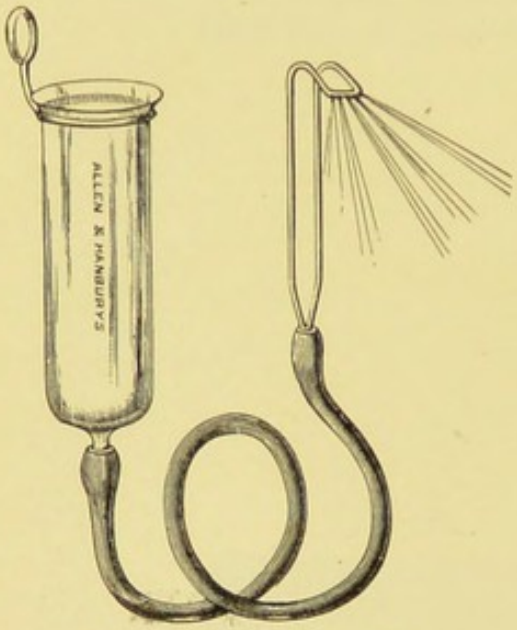


FIG. 303.—EYE DOUCHE.

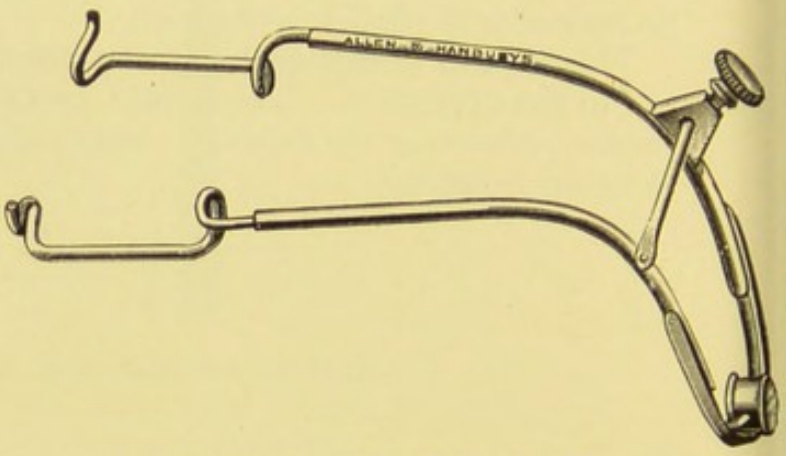


FIG. 304.—SPRING SPECULUM.

FIG. 305.—EYE-LID RETRACTOR.

speculum (Fig. 304), or Desmarre's *retractors* (Fig. 305). The uses of fine-toothed *fixation forceps*, *entropion forceps* (Fig.

[1] For details, see "Ophthalmic Nursing," by Sydney Stephenson, M.B., F.R.C.S.E., etc. (London: The Scientific Press, Limited).

306), and *iris forceps* (Fig. 307) are sufficiently indicated by their names.

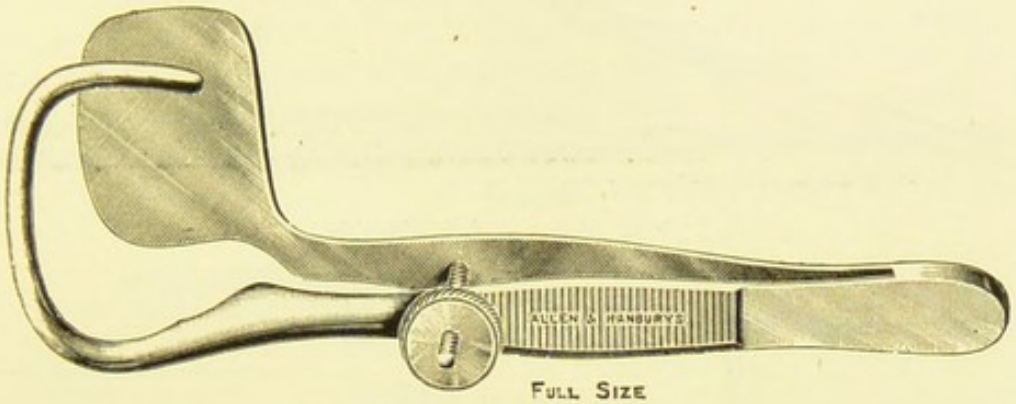


FIG. 306.—ENTROPION FORCEPS.

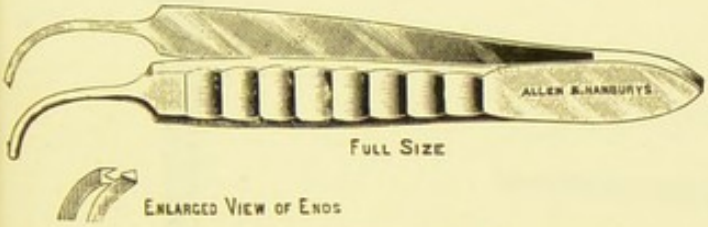


FIG. 307.—IRIS FORCEPS.

FIG. 308.—CANALICULUS KNIFE.

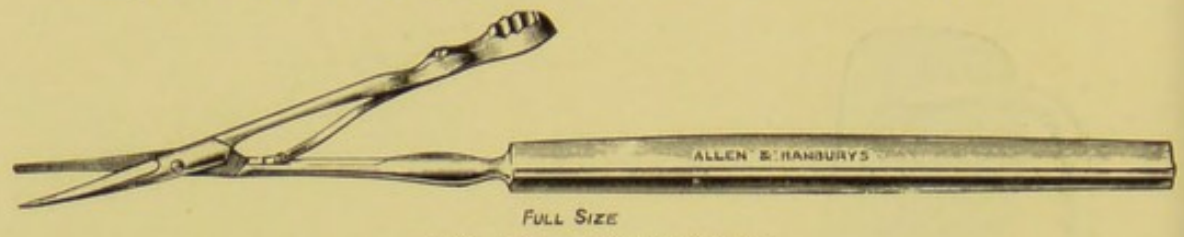
FIG. 309.—CATARACT KNIFE.

FIG. 310.—IRIDECTOMY KNIFE.

FIG. 311.—CAPSULAR SCISSORS.

Of knives, we have the following: *Canaliculus knife* (Fig. 308), *cataract knife* (Fig. 309), von Graefe's *linear cataract knife* (Fig. 94), and *iridectomy knife* (Fig. 310).

Scissors are suitably shaped for the different operations: *Capsu'ar scissors* (Fig. 311), and *iris scissors* (Fig. 312).



FULL SIZE

FIG. 312.—IRIS SCISSORS.

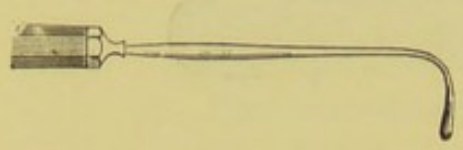


FIG. 313.—STRABISMUS HOOK.

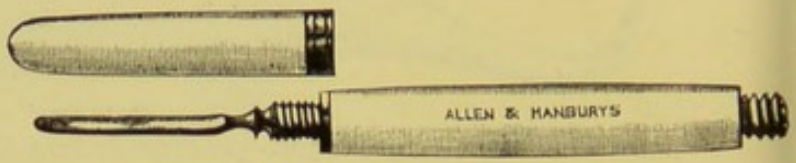


FIG. 314.—CORNEAL SPUD.

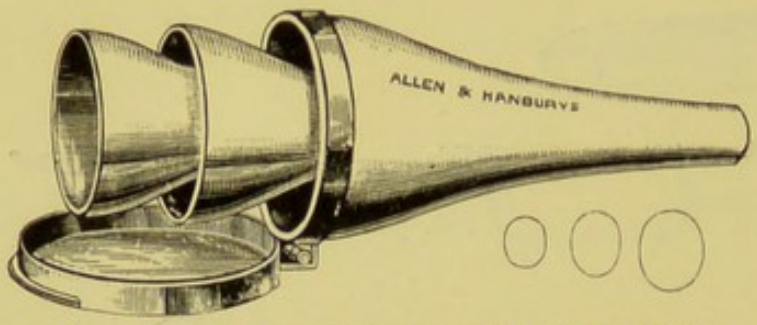


FIG. 315.—AURAL SPECULA OF DIFFERENT SIZES.

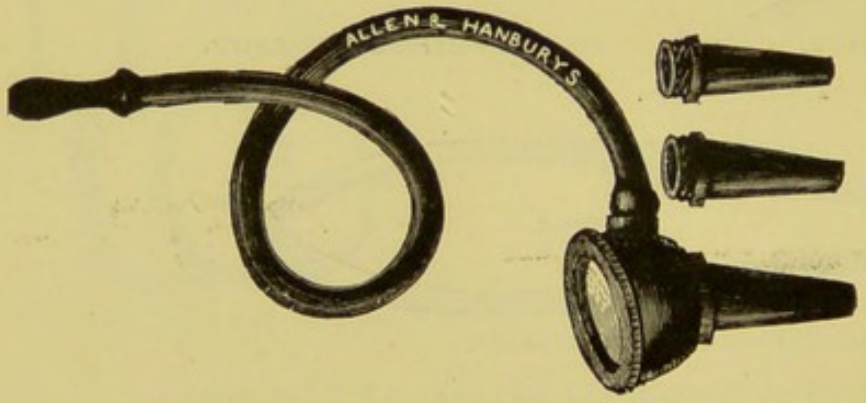


FIG. 316.—AURAL PNEUMATIC SPECULUM.

FIG. 317.—MIRROR.

The *strabismus hook* (Fig. 313) is used to catch up the tendon requiring division in the operation for squint. The

corneal spud (Fig. 314) is for removing foreign bodies from the cornea.

Ear Instruments.—*Aural specula* (Fig. 315) are short conical tubes of different sizes. They are used in the examination of the outer ear and the tympanic membrane, and to facilitate this, the speculum may be mounted on a handle, and have separable blades. *Pneumatic specula* (Fig. 316) are also used. A *mirror* (Fig. 317) is usually employed to

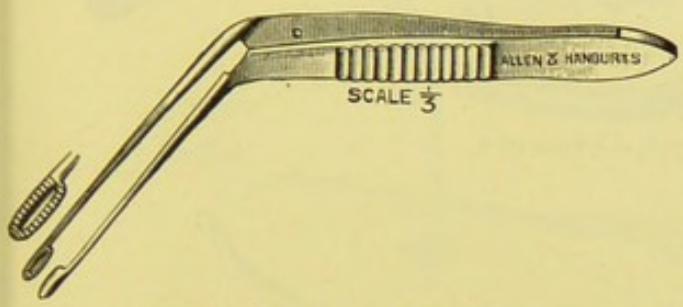


FIG. 318.—AURAL FORCEPS.

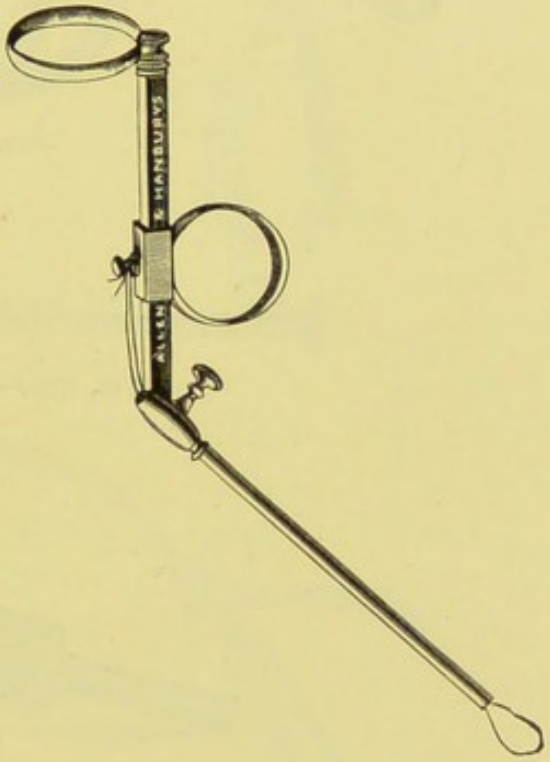


FIG. 320.—AURAL SNAKE.

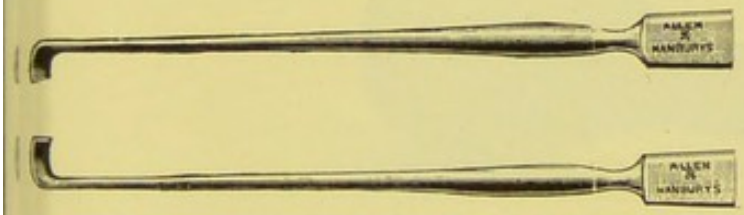


FIG. 319.—AURAL HOOKS.

reflect the rays of light into the ear. *Aural forceps* (Fig. 318) are used to remove foreign bodies from the ear, and for the same purpose a *hook* (Fig. 319), *scoop*, or *screw* may be employed. In every case, however, an attempt should first be made to dislodge the foreign body by syringing the ear. For this an ordinary brass or glass syringe may be used, the ear being drawn upwards and backwards with the left hand, and the nozzle placed against the roof of the canal.

For removing polypi, the *aural snare* (Fig. 320) is convenient. For inflation of the middle ear, and for use with the *otoscope* (Fig. 321), the *Eustachian catheter* (Fig. 322)

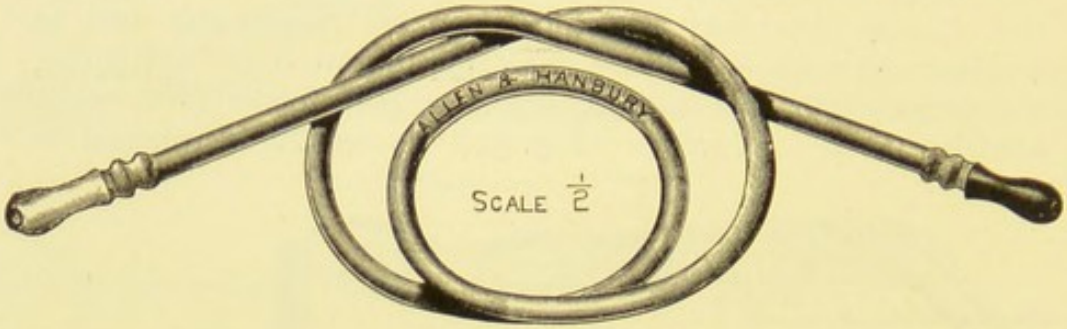


FIG. 321.—OTOSCOPE.

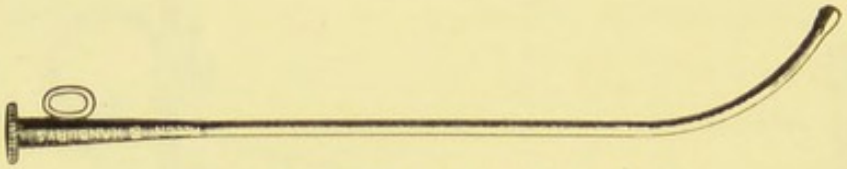


FIG. 322.—EUSTACHIAN CATHETER.

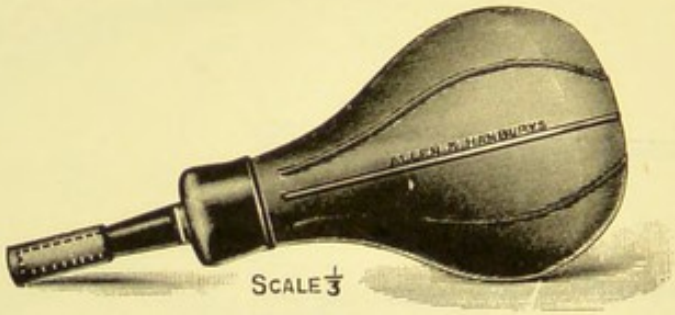


FIG. 323.—POLITZER'S BAG.

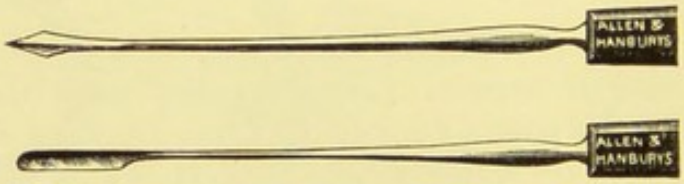


FIG. 324.—AURAL KNIVES.

is passed through the nose into the Eustachian tube, and attached externally to *Politzer's bag* (Fig. 323). *Aural knives* (Fig. 324) are for perforating the tympanic membrane.

Nasal Instruments.—*Nasal specula* are shown in Fig. 325. The posterior nares are examined by the *rhinoscope*

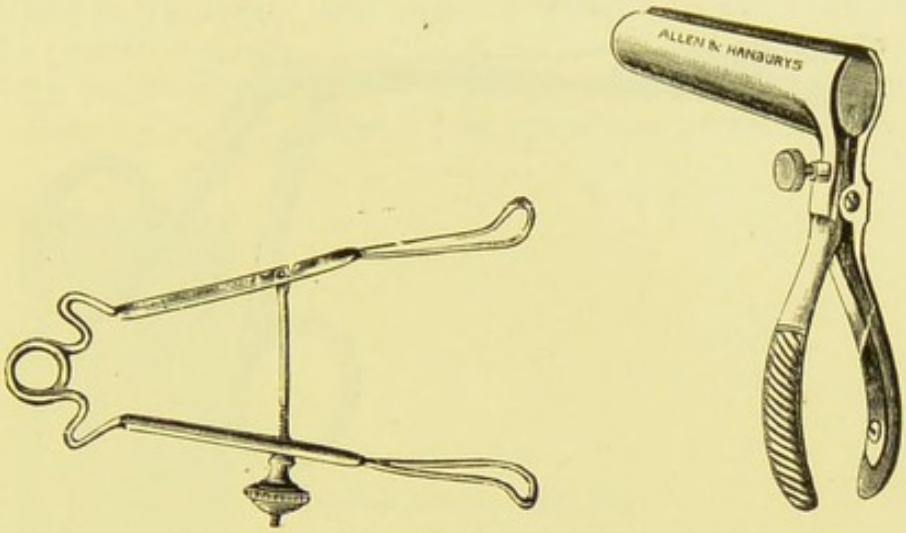


FIG. 325.—NASAL SPECULA.

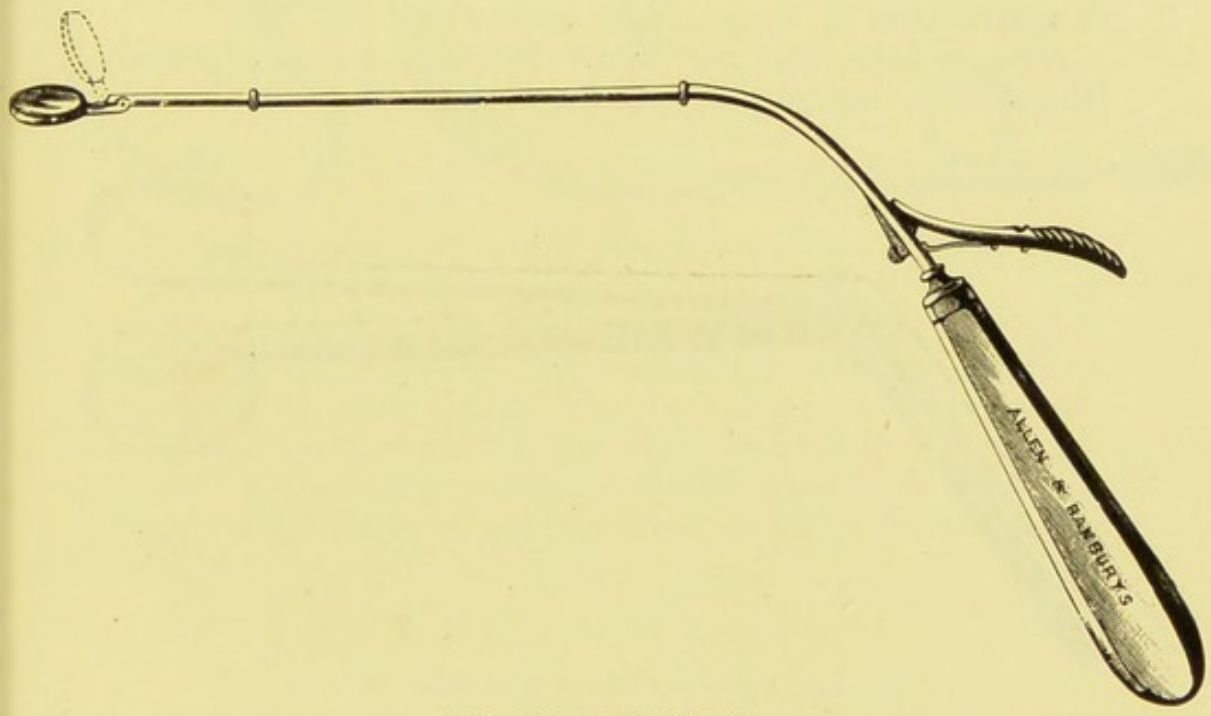


FIG. 326.—RHINOSCOPE.

(Fig. 326), in which the angle of the mirror may be altered by pressing a lever. It is warmed before it is introduced

into the mouth; the tongue is kept down by a *depressor* (Fig. 262). Various forms of *nasal scissors* (Fig. 327) and *polypus forceps* (Fig. 328) are in use. The *nasal snare* re-

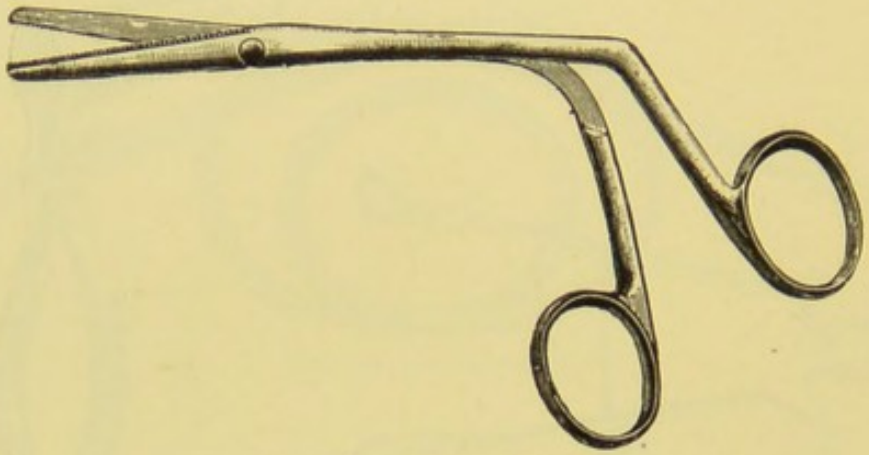


FIG. 327.—NASAL SCISSORS.

sembles that for removing polypi from the ear (Fig. 320). A simple form of *nasal douche* is shown in Fig. 329.

Hæmorrhage from the Nose.—Bellocq's *sound* or *cannula* (Fig. 330) is used in plugging the posterior nares for hæmor-

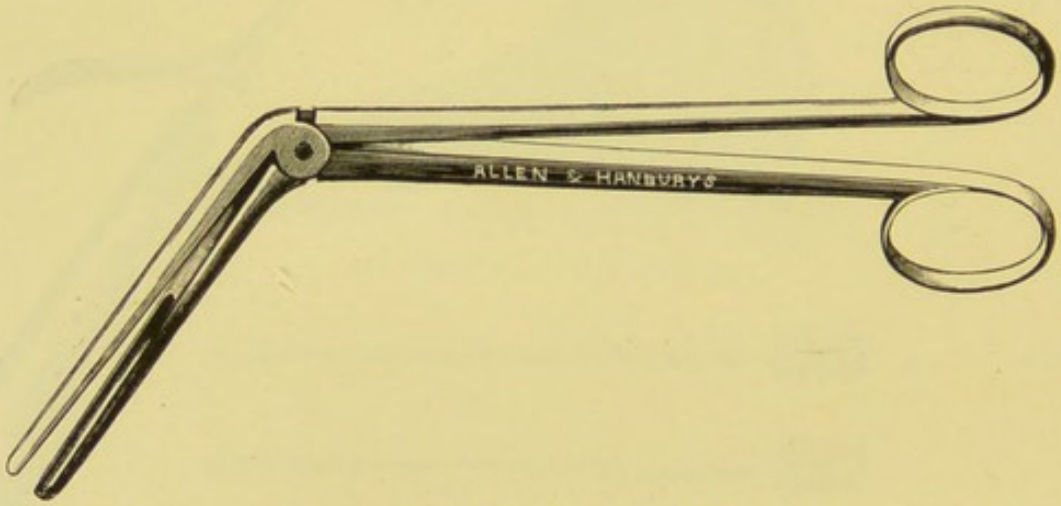


FIG. 328.—NASAL POLYPUS FORCEPS.

rhage. It consists of a curved, hollow stem, containing a piece of watch-spring. To the latter a thread is attached, and the sound is passed along the anterior meatus of the nose.

Then the spring is released by a screw at the end, and it curls into the mouth carrying the thread with it. The thread is seized and the sound withdrawn. A suitable plug is now attached to the string, and pulled forwards so as to plug one of the posterior nares.

More frequently nasal hæmorrhage arises farther forwards, and plugging of the posterior nares is not required. First the

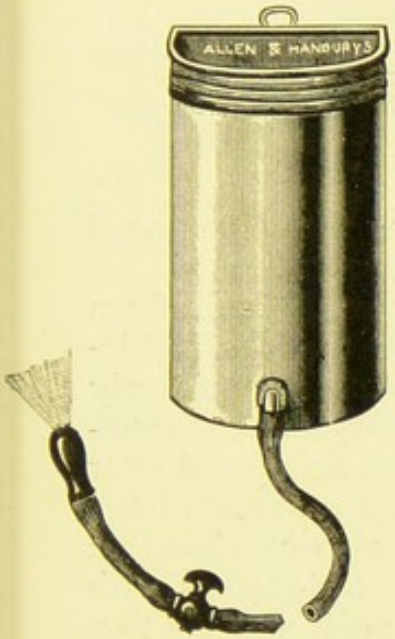


FIG. 329.—NASAL DOUCHE.

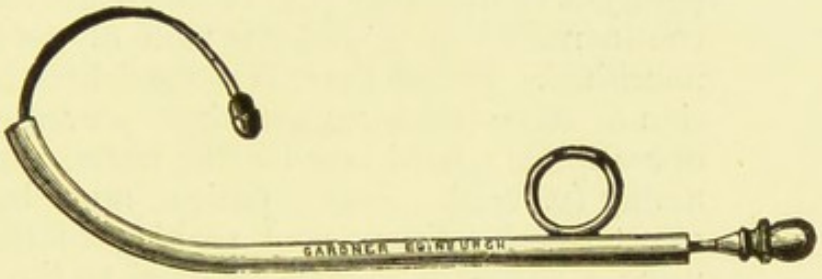


FIG. 330.—BELLOCQ'S SOUND OR CANNULA.

nose should be douched with boric lotion or saline solution at 110° to 120° F. This is often sufficient to stop the bleeding, but, if not, the nasal cavity may be sprayed with adrenalin, or the alae nasi compressed for some time between finger and thumb. If the bleeding still continues, the nostril should be plugged with a strip of gauze soaked in adrenalin or turpentine.

CHAPTER XXX.

OPERATIONS ON THE SPINE.

LAMINECTOMY.

LAMINECTOMY is the operation for opening the spinal canal by removing the laminæ of one or more vertebræ.

Special Preparation.—The patients frequently suffer from paralysis of the lower part of the trunk and the legs, and incontinence of urine, and the skin of the back is imperfectly nourished. Hence there is a special tendency to the formation of acute bed-sores, and their prevention before and after operation is a hard task for the nurse, and a stiff test of her ability (p. 203). Such a patient must be at once placed on a water-bed. To prevent soaking of the bed-clothes with urine, a rubber tube may be fixed to the penis and led to a pail at the side of the bed; or in adult males a urinal may be permanently kept in the bed with the penis projecting into it. If the patient has no control of the bowels, an enema of soap and water should be given every morning, and the patient supported on the bed-pan till the lower bowel is cleared. He ought not to lie without support as the pressure on the pan may cause a bed-sore.

The skin of the back is to be washed with soap and water, dried, rubbed with methylated spirit, and then powdered with zinc, boracic and starch powder. This treatment is carried out three or four times a day. In many cases, it is dangerous to turn the patient over; then the nurse raises the patient with one hand placed under his back, and carries out the manipulations with the other.

The treatment of bed-sores is described on page 205.

Special Instruments.—*Bone forceps* (Fig. 343) are used to

snip off the spines of the vertebræ, and the laminæ may be cut away piecemeal by *rongeur forceps* (Fig. 331), or sawn across by the *laminectomy saw* (Fig. 332). A drainage tube is usually inserted down to the gap in the bone.

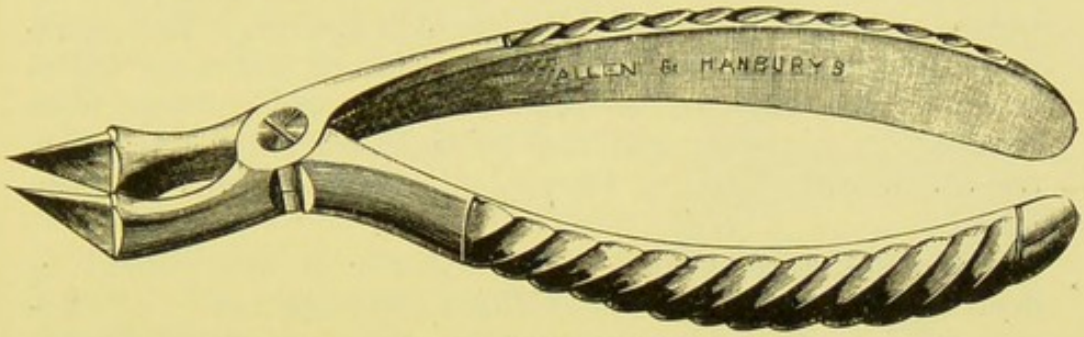


FIG. 331.—LAMINECTOMY FORCEPS.

After-Treatment.—The superficial wound is frequently slow in healing because of the imperfect nutrition of the skin. This tendency is increased by constant pressure on

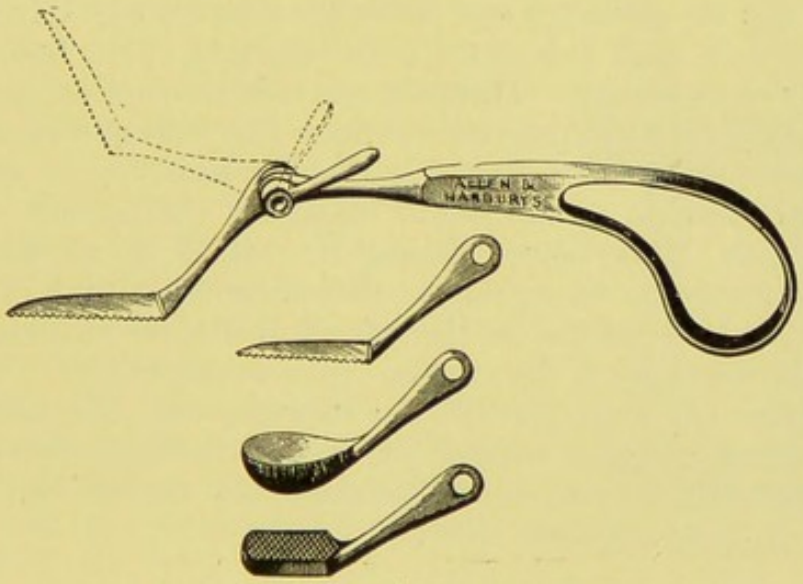


FIG. 332.—MACEWEN'S LAMINECTOMY SAW.

the wound with the patient lying on his back. The pressure may be relieved by dressing with a thick pad of wool, and by inserting a ring-cushion (Fig. 114) with its aperture opposite the wound. The drainage-tube is removed in forty-eight

hours. Only very weak antiseptics are to be employed in dressing the wound, and great care must be taken to dry the skin thoroughly before the dry dressing is re-applied. Wet dressings are not to be used, even when the wound is septic, as they increase the risk of bed-sores. If the catheter is required, cystitis must be rigidly guarded against. The measures already described for the prevention of bed-sores are to be conscientiously carried out. The muscles are kept from wasting by massage and the galvanic current. The after-treatment may have to be prolonged for months or even years.

Special Complications.—*Acute bed-sores* are treated as described on page 205, and *cystitis* as on page 249. *Incontinence of fæces* is common, especially when, as often happens, diarrhœa is present. An evacuant enema should be given each morning.

Bronchitis.—If the paralysis extends far enough up the cord to paralyse the intercostal muscles, respiration is laboured and coughing is impossible. Hence mucus is apt to accumulate in the air-passages and suffocate the patient. He should be turned on each side in turn, and the foot of the bed raised, to allow of its escape. Hypodermic injections of atropin, $\frac{1}{120}$ grain, may be administered to check the secretion of mucus.

Distension of the intestine is due to paralysis of the abdominal muscles, as the result of which the patient cannot expel flatus. The bowel should be cleared by an enema of soap and water. In giving it, the nurse must take care not to wet the bed-clothes, as the risk of bed-sores is thereby increased, especially if the enema contains turpentine. Then a flatus-tube (p. 210) should be inserted, and the abdomen compressed to expel some of the gas. The compression may be effected by a many-tailed bandage, the crossed ends being pulled on from opposite sides.

Pott's Disease.

Pott's disease consists in infection of one or more of the vertebræ with the tubercle bacillus. The bones are eaten into by granulation tissue, and the spinal column thus

weakened tends to bend at the diseased part. This is the common cause of hump-back.

Treatment.—During the acute stage the patient is confined to bed, and extension and counter-extension are applied (p. 388). Lateral movements are restricted by sand bags placed at either side of the patient. Later a *double Thomas's splint* (Fig. 333) may be fitted to admit of moving the patient into the open air. When the disease is cured, the tendency to deformity is counteracted by an appliance to support the weakened segment of the column.

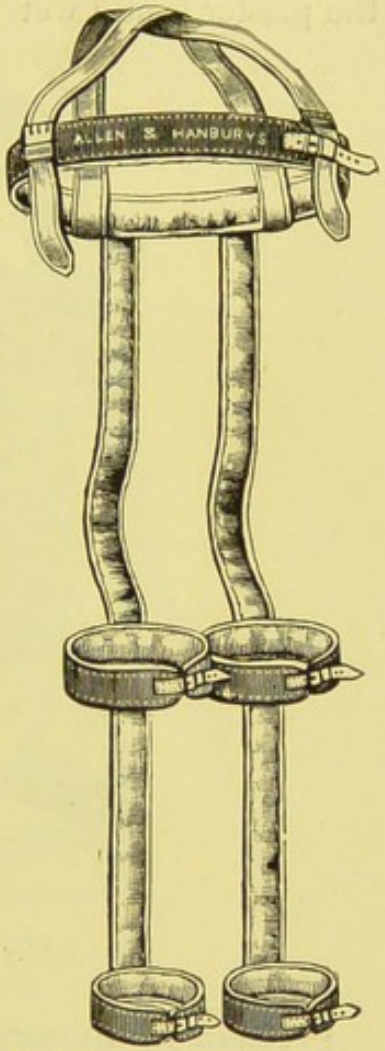


FIG. 333.—THOMAS'S DOUBLE SPLINT.

When the disease affects the vertebræ of the neck, during the acute stage, extension is best applied by elastic straps attached to the head of the bed and fixed to each side of the patient's head by a bandage. The head of the bed being raised on blocks, the weight of the body produces counter-extension. Later a double Thomas's splint, prolonged to support the head, may be fitted. When the patient is allowed to get up, a poroplastic collar is to be worn as a support to the head.

When the disease affects the thoracic vertebræ, extension is applied to both legs (p. 388); counter-extension is obtained by raising the foot of the bed on high blocks, and by fixing a band passed round the top of the chest to the head of the bed with straps of elastic webbing. Later the spine may be supported by corsets (Fig. 334), or a plaster of Paris jacket. For the latter, the patient is partially suspended by means of Sayre's tripod (Fig. 335), so that the tips of the toes

just touch the ground. Cotton-wool pads are temporarily placed over the bony prominences, and acetic plaster bandages (p. 386) are applied, from the waist down to the pelvis and up to the arm-pits. At the top and bottom, segments may have to be cut out to avoid pressure on the axilla and the pelvis. That should be done with strong scissors while the plaster is still wet.

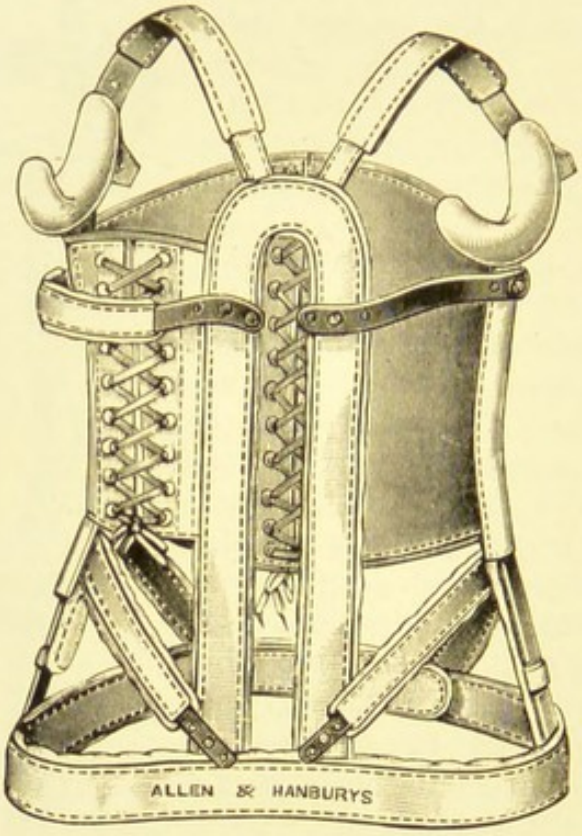


FIG. 334.—SPINAL SUPPORT.

Precautions in nursing Patients with Pott's Disease.—The great danger in these cases, especially when the disease is situated in the neck, is that the ligaments which protect the spinal cord from pressure by the bones may become softened and useless, and that any movement of the patient may produce displacement of the bones. In the lower part of the column this causes paralysis, and in the neck it may result in instant death. This has not infrequently occurred

when the nurse has moved a patient against the orders of the surgeon.

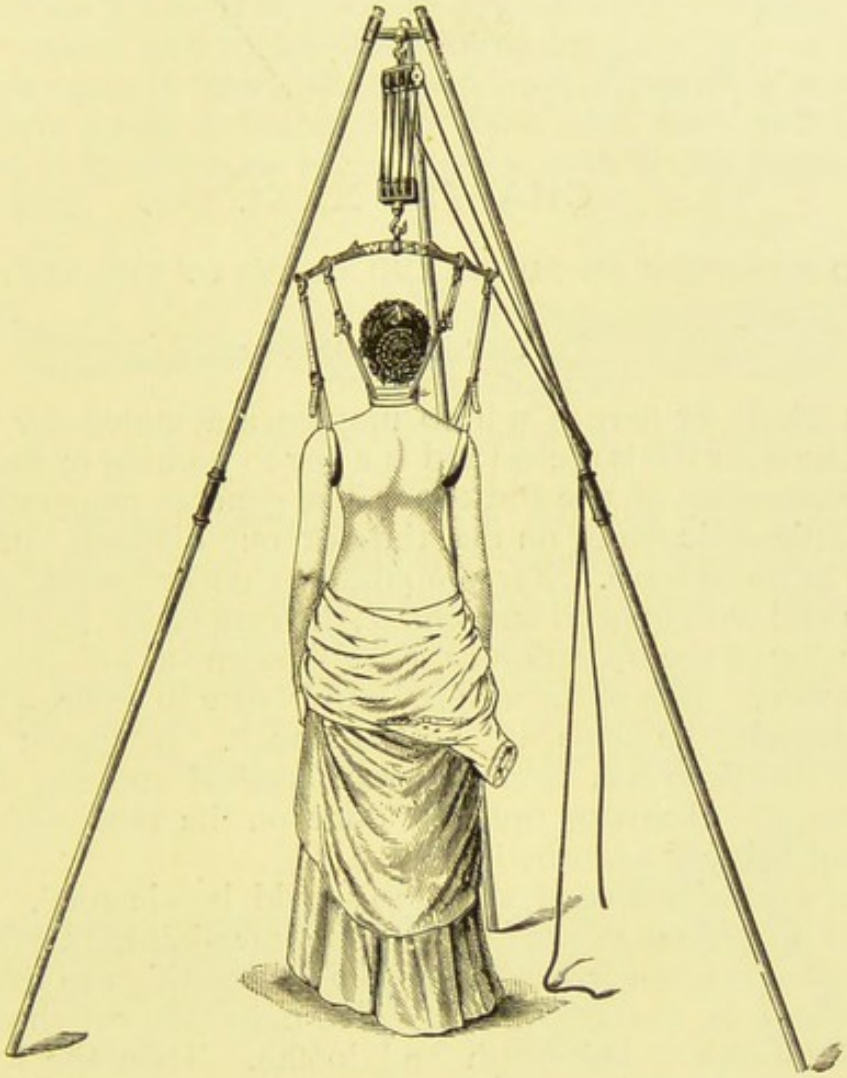


FIG. 335.—SAYRE'S TRIPOD.

FRACTURES OF THE SPINE.

Fractures and dislocations of the spine frequently result in pressure on the cord and paralysis. These in turn produce a tendency to cystitis and bed-sores, and the careful nursing described on page 364 is again required.

CHAPTER XXXI.

OPERATIONS ON BONES AND JOINTS OF THE LIMBS.

AMPUTATIONS.

THE whole or part of a limb may be amputated for injury or disease, or if it is useless and is a bar to working or walking.

Preparation of the Patient.—The general preparation of the patient depends on the time at our disposal, and the form of anæsthesia. For amputations under aseptic conditions and with general anæsthesia, the care of the bowels and cleansing of the operation-area are the same as for operations in general. It is of the utmost importance to secure asepsis, as otherwise the flaps are apt to slough. In urgent cases, when the limb has been severely crushed and the skin is broken, the cleansing must be done on the table while the patient is being anæsthetized.

An extensive area of the limb should be cleansed. Thus for an operation at the level of the knee-joint, the field of operation reaches from the middle of the thigh to the toes. The hair is shaved, and the toe-nails are cut short and cleansed with a nail-brush and loofah. Then the limb is wrapped in a sterilized dressing. In emergencies, it is convenient to remove gross dirt with benzine or methylated spirit and ether, and paint with tincture of iodine. When the sterilized dressing is removed on the operating-table, the limb below the site of the incision is wrapped in a sterile bandage or towel. An extra assistant may be required to hold up the limb.

Prevention of Hæmorrhage.—An amputation through a limb some distance from its extremity, for example above the knee, would result in the loss of much blood if certain

precautions were not taken. The blood-vessels are of considerable size, and their division is followed by a gush of blood. This hæmorrhage may be prevented by a tourniquet (p. 126) applied at a higher level before the incision is made. In certain cases in which the arteries are diseased, it is not advisable to apply a tourniquet. Then the main artery is compressed against bone higher up the limb by the finger of an assistant.

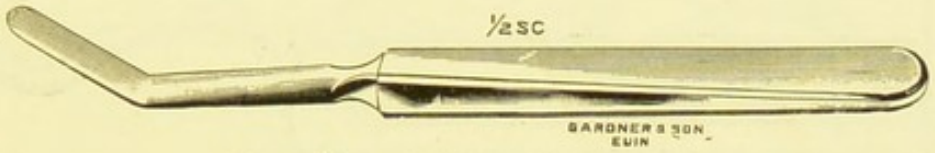


FIG. 336.—PERIOSTEUM SEPARATOR.

The part of the limb which is to be removed may contain a considerable amount of blood in its vessels. This blood is *conserved* for the body by elevating the limb, and so emptying it of blood, before applying the tourniquet.

Special Instruments.—*Amputating knives* (Fig. 90) have long blades, sharpened on one or both sides, and large metal handles. The length of the blade varies according to the

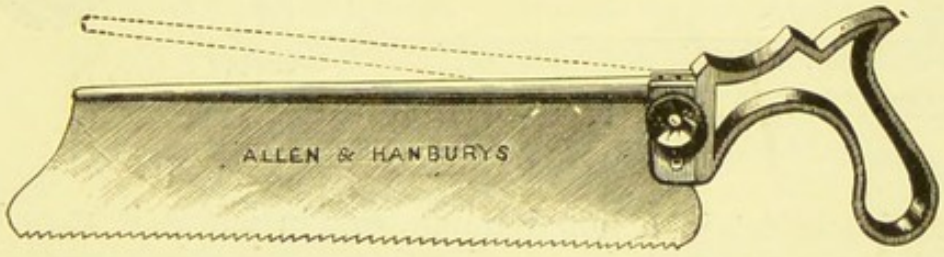


FIG. 337.—SURGEON'S SAW.

diameter of the limb at the level of the operation. A short, strong three-inch blade (Fig. 91) is most suitable for amputation of the ankle-joint, while an eight- or nine-inch blade may be required for amputation at the hip.

The *bone-instruments* may or may not be used according as the amputation is performed through a bone or through a joint. They should, however, be ready in every case. The *periosteum separator* (Fig. 336) must be strong. *Saws* are

made of various sizes and shapes for amputations at different levels. The *ordinary surgeon's saw* (Fig. 337) is suitable for sawing the bones of the forearm or leg. The blade is

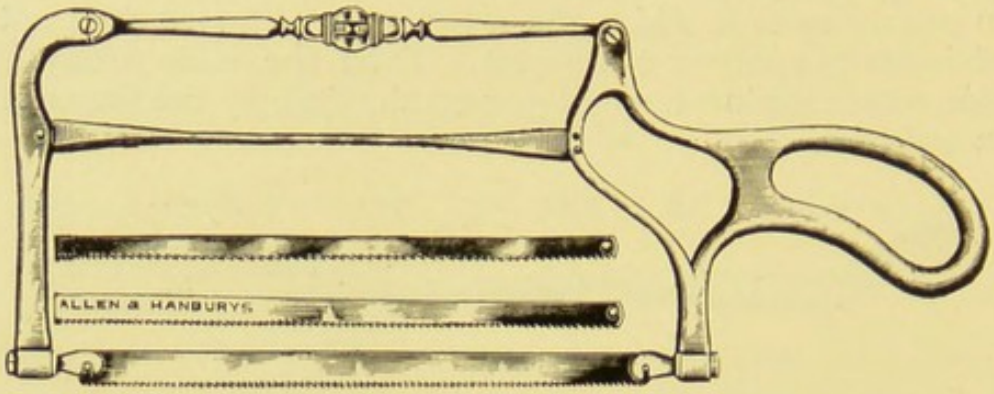


FIG. 338.—BUTCHER'S SAW.

broad, and the back is detachable. *Butcher's saw* (Fig. 338), named after the surgeon who introduced it, has a narrow,

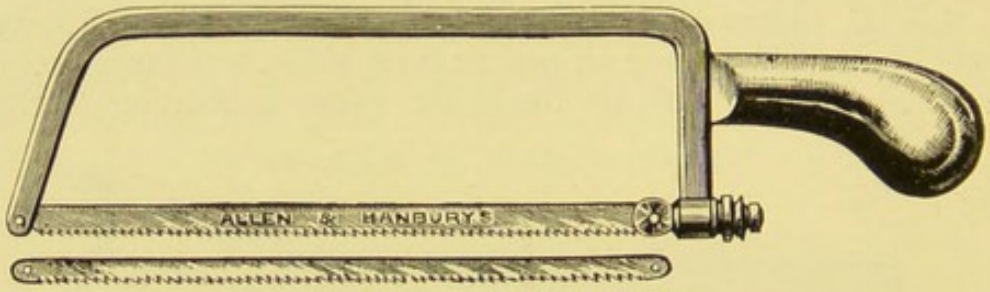


FIG. 339.—BOW-SHAPED SAW.

steel blade set in a metal framework in which it may be angled so as to work in any direction. It is chiefly useful in

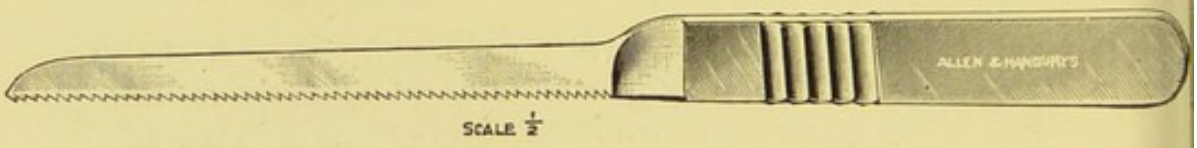


FIG. 340.—FINGER SAW.

excising joints, but it is also employed in amputations. The *bow-shaped saw* (Fig. 339) is of similar shape, but the blade is fixed and cannot be set at an angle to the frame. It is

suitable for dividing the metacarpal and metatarsal bones, for which narrow straight saws, called *finger saws* (Fig. 340), are also used. *Hey's saw* (Fig. 286) is described along with skull instruments. *Adam's saw* (Fig. 341) is used specially for the operation of dividing subcutaneously the neck of the femur. The serrations are limited to the anterior

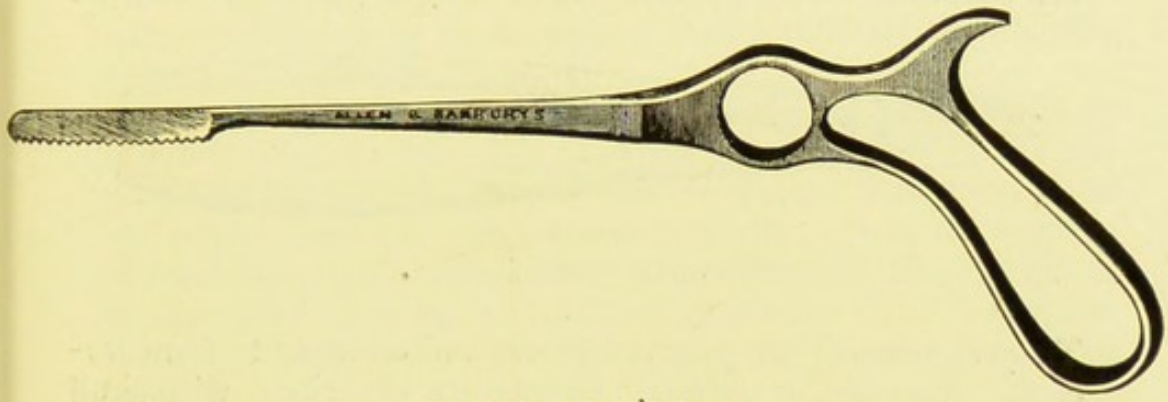


FIG. 341.—ADAM'S SAW.

third of the stem, the remaining two-thirds being smooth and rounded so as to avoid injury to the soft tissues. *Gigli's wire-saw* (Fig. 291) is used for dividing bones such as the lower jaw which are not suitably placed for a saw with a rigid blade, and for the osteoplastic operation on the skull (p. 351). It may, however, be used to divide any bone. The special

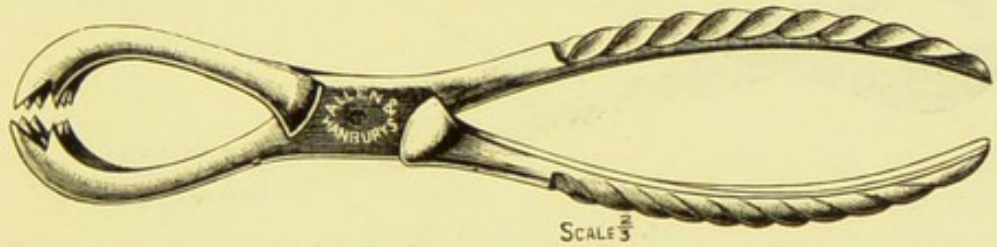


FIG. 342.—LION FORCEPS.

introducer (Fig. 292) is first passed beneath the bone, the end of the wire-saw is fixed in its eye, and drawn back, and the handles are applied. The *laminectomy saw* (Fig. 332) is used for operations on the spinal column. It is so constructed that it may be worked at various angles in the deep wound.

Lion forceps (Fig. 342) are used to take a firm grip of bone, for example to steady it while it is being sawn. Each blade ends in strong teeth, those of the two blades being opposed. *Bone forceps or pliers* (Fig. 343) are used to divide small bones, or to remove any projecting fragment of bone. They may be straight or angled. *Gouge forceps* (Fig. 344) are also suitable for the removal of bony fragments piecemeal.

FIG. 343.—BONE FORCEPS.

They consist of two grooved blades united so as to form forceps. *Rongeur* or *nibbling forceps* are described with skull instruments (p. 348). A long pliable *probe* should always be sterilized for bone operations. The wound after amputations is usually drained with a perforated rubber-tube.

After-Treatment.—The limb is placed on a pillow so that it is slightly raised above the level of the body. A wire-

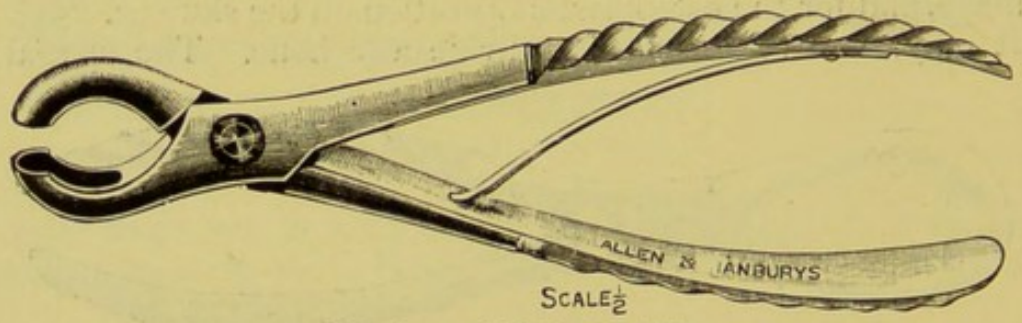


FIG. 344.—GOUGE FORCEPS.

cage is placed over it, and the bed-clothes so arranged that the dressing may be frequently examined without disturbing the patient.

If the operation has been performed through unbroken skin, and no signs of sepsis are present, the tube may be removed in two or three days. Previous to this, the wound should be dressed every twenty-four hours, and the tube

syringed with sterile saline to displace any blood-clot. After the removal of the stitches, broad strips of adhesive plaster are sometimes applied over the end of the stump to prevent stretching of the scar. If the stump is septic, all tension must be got rid of by removing some of the stitches.

The purgative is given on the second or third day. In amputation high up in the thigh, the patient may have difficulty in defæcating, as he cannot firmly contract the abdominal wall.

If the patient wants to have an artificial limb, it should be fitted as soon as the scar is firmly healed, and before the muscles have wasted. He should be warned that some time will elapse before he can use it efficiently. In the majority of cases, the stump subsequently shrinks, and the bucket of the artificial limb has to be filled up with cork. A knitted stocking should be worn on the stump to prevent chafing of the skin.

Special Complications.—*Shock* is apt to occur after an extensive amputation, and to be increased if it existed beforehand. The conservation of the blood in the limb and the prevention of hæmorrhage during the operation serve to diminish shock. If a patient with a crushed limb requiring amputation is suffering from shock when he is brought to hospital, the operation is usually postponed till he recovers to some extent.

Hæmorrhage may be primary, secondary, or reactionary. The prevention of primary hæmorrhage has already been described. *Reactionary hæmorrhage* after an amputation must always be zealously looked for by the nurse, bleeding taking place when the patient rallies from the shock of the operation. The dressing must be frequently inspected, including the part resting on the pillow, and as soon as a stain is visible the surgeon should be informed. *Secondary hæmorrhage* is the result of septic sloughing, and usually occurs after the first week. If severe, it calls for prompt and cool-headed action on the part of the nurse. She must at once raise the limb and compress it at or above the bleeding point till a tourniquet is obtained. The necessary instruments for the ligation of the artery must be sterilized. These are knife, dissector, dissecting forceps, artery forceps,

scissors, aneurysm needle, strong catgut, skin needle and horsehair. Sometimes the surgeon decides to amputate at once at a higher level, so the bone instruments may also be prepared.

Pain immediately after the operation is often severe. It may be relieved by raising the foot of the bed, dressing the wound, or cutting a tight stitch. If these measures fail, opium in the form of Battley's solution or an injection of morphia should be given.

Pain may come on late after amputations. It is then due to the involvement of divided nerves in the scar, and is more liable to occur in septic cases. The pain is neuralgic in character and it may be most distressing and persistent. Counter-irritation over the nerves at a higher level may do good, but if the condition does not improve after some months, operation may be required. Opium should never be given.

Adherent scar causes constant aching and tenderness over the end of the stump. It should be prevented in every case by moving the scar over the deeper tissues for a few minutes each day. After adhesion has occurred, the scar may be freed by means of a *tenotomy knife* (Fig. 95).

Sepsis, if it is severe, is a serious complication, as it may produce *sloughing of the flaps*. In less severe cases, it may lead to an adherent scar, or the involvement of nerves in the scar. If it leads to *necrosis of bone*, persistent sinuses, leading down to bare bone, may be present.

Sloughing of the flaps may also occur without sepsis if they have not a sufficient blood-supply to nourish them, or if the soft tissues have been severely bruised at the time of the accident. For this complication, amputation at a higher level may be required.

Operation for Fracture of a Bone.

Under certain circumstances, which it is not necessary to enumerate, the surgeon may decide to fix the fragments of a fractured bone in position by screw-nails and *plates* (Fig. 345), wooden or bone pegs, or sutures of silver wire or kangaroo

tendon. In every case, rigid precautions are necessary for the prevention of sepsis.

Special Instruments.—Special *forceps* (Figs. 346, 347) are

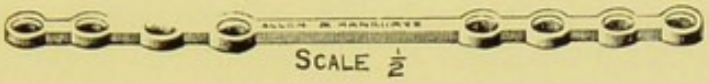


FIG. 345.—LANE'S PLATE FOR FIXING FRACTURED BONE.

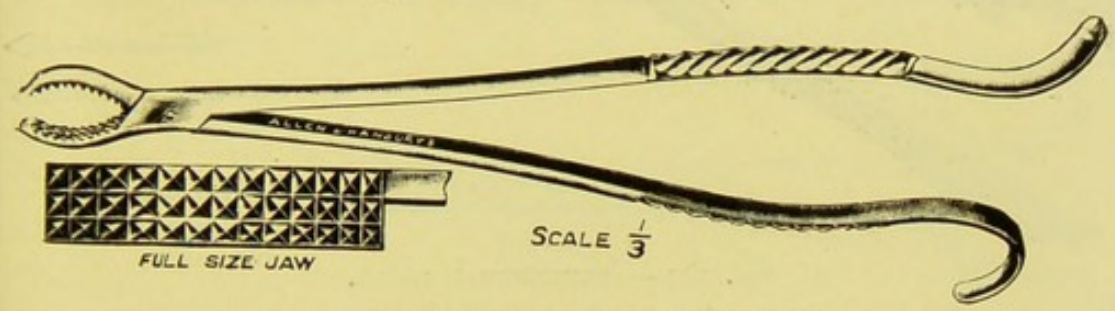


FIG. 346.—LANE'S BONE-HOLDING FORCEPS.

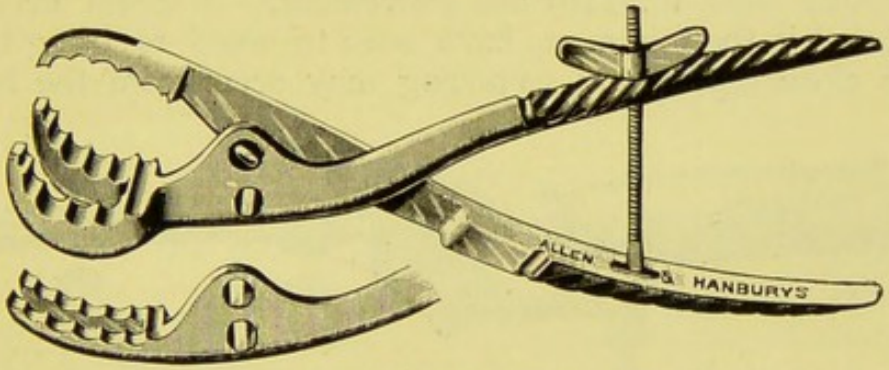


FIG. 347.—PETER'S BONE-HOLDING FORCEPS.

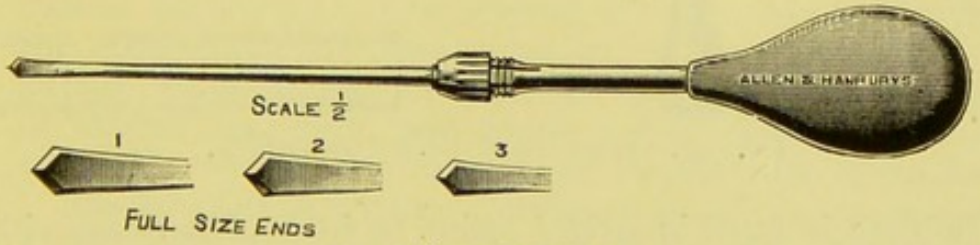


FIG. 348.—BONE DRILL.

sometimes used for holding the fragments in position. For piercing the bone, various forms of *bone-drills* are employed —the *awl* (Fig. 348), which may be provided with an eye to

carry the silver-wire, the *Archimedean drill* (Fig. 349), and the drill rotated by geared cog-wheels (Fig. 350) or by a brace handle. When screw-nails are used, a *screw-driver* with metal handle is required, and the nails are held in special

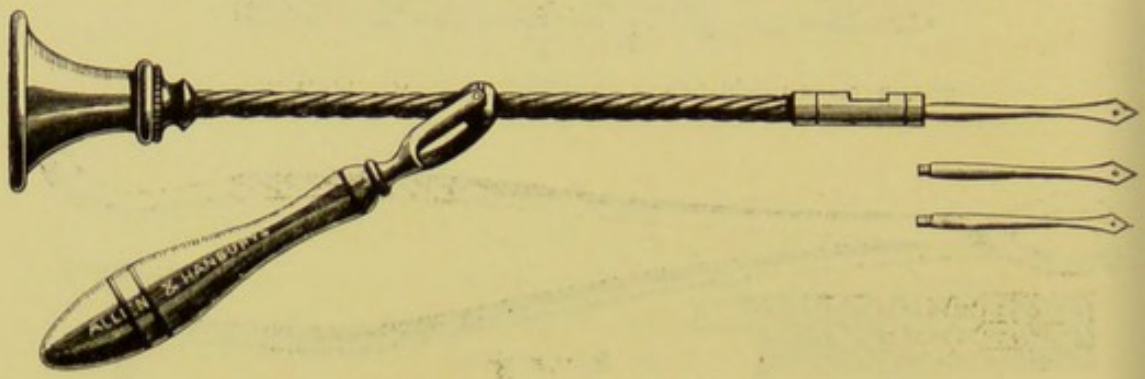


FIG. 349.—ARCHIMEDEAN DRILL.

forceps (Fig. 351). To close the wound in the soft tissues, *Michel's clips* (p. 140) are convenient. A drain may be inserted if the fragments have been trimmed to bring them into closer apposition, as oozing may occur from the bone.

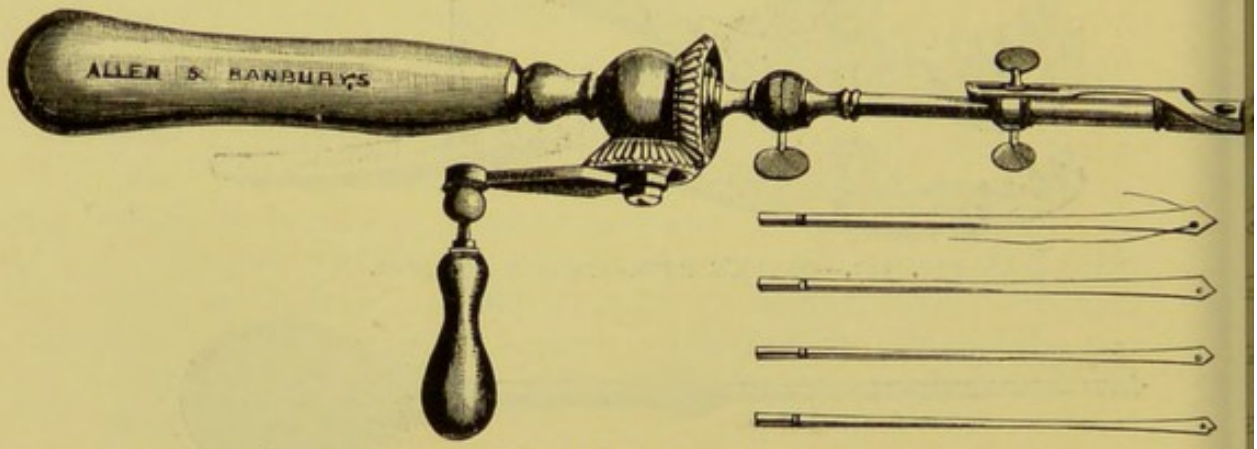


FIG. 350.—BONE DRILL WITH COG-WHEELS.

The limb is fixed in a rigid splint, or in a plaster-case with a window opposite the wound. If the soft parts are still swollen at the time of the operation, a splint is preferable.

After-Treatment.—The superficial sutures are removed on the eighth or tenth day. When a splint is used for fixation, massage and passive movements may be begun then, or

even earlier. In the case of the forearm or leg, the fingers or toes should be left free, and moved by the patient from the beginning.

Special Complications.—*Sepsis* is a serious complication, as it may delay healing for many weeks, or even entirely prevent union of the bone. A *superficial necrosis* of bone sometimes occurs from the irritation of the wire or screw, and produces a discharging sinus.

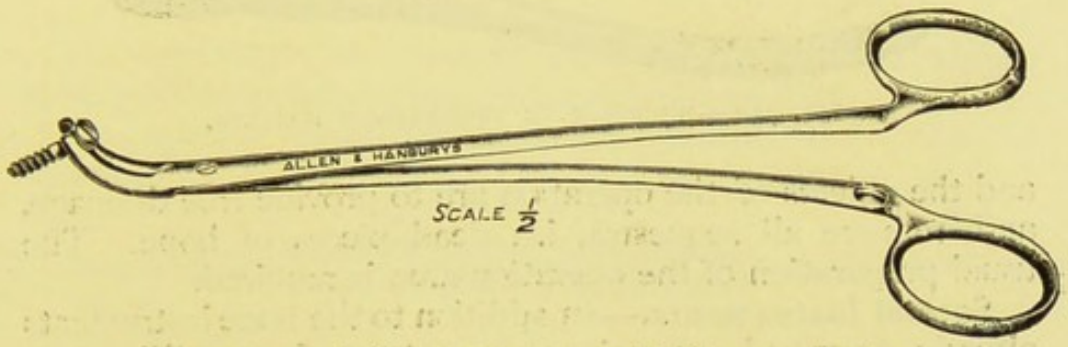


FIG. 351.—LANE'S FORCEPS FOR HOLDING SCREW-NAILS.

Operation for Fractured Patella.

Fracture of the patella is frequently treated by suturing the fragments. The **after-treatment** has an important influence on the result, as adhesions between the patella and the femur, and between the scar and the patella, must be prevented. Some surgeons begin movements of the knee-joint on the second or third day, while others wait for a week or ten days till the superficial wound has healed. The patella should always be moved laterally once a day from the second day after the operation. After a fortnight the patient moves about on crutches. Massage of the muscles of the calf and thigh, and gentle active movements of the toes and ankle are performed from the day after operation.

Special Complications.—*Serum* or *blood* may accumulate in the cavity of the joint and increase the risk of adhesions. It is treated by massage. *Sepsis* is serious if it involves the knee-joint. *Adhesion of the scar* to the patella is painful, and prevents free movement of the joint. Movement is also much restricted if the patella adheres to the femur.

Operations on Diseased Bones.

The diseases which affect bones are periostitis, osteomyelitis and tumours. For the last-named, amputation is frequently required. The other two conditions may be acute or chronic,

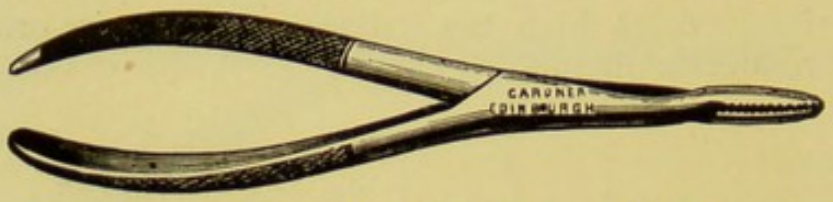


FIG. 352.—NECROSIS OR SEQUESTRUM FORCEPS.

and the objects of the operation are to provide free drainage, and remove all sequestra, i.e. dead pieces of bone. The usual preparation of the operation-area is required.

Special Instruments.—In addition to the bone instruments already described, *necrosis* or *sequestrum forceps* (Fig. 352)

FIG. 353.—CHISEL.

are required to extract a sequestrum. They have ridged blades, and must be of considerable strength. *Chisels* (Fig. 353) and *osteotomes* (Fig. 354), with metal handles and of various sizes, are used to chip away portions of bone. A

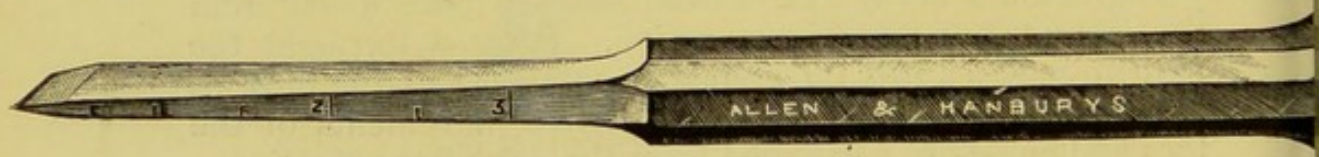


FIG. 354.—MACEWEN'S OSTEOTOME.

chisel is bevelled on one side, and an osteotome on both sides. It is driven through the bone by a *mallet*. *Gouges* (Fig. 355) of various sizes are used to remove pieces of bone, especially when it is softened by disease. They are

simply chisels with grooved blades. *Sharp spoons or scoops* (Fig. 356) are useful to scrape away granulations in the bone or in the wall of a sinus. They vary in the size of the scoop.

FIG. 355.—GOUGE.

For operations on diseased bone, the nurse must always have a suitable splint ready—shaped and padded.

No special after-treatment or complication requires mention.

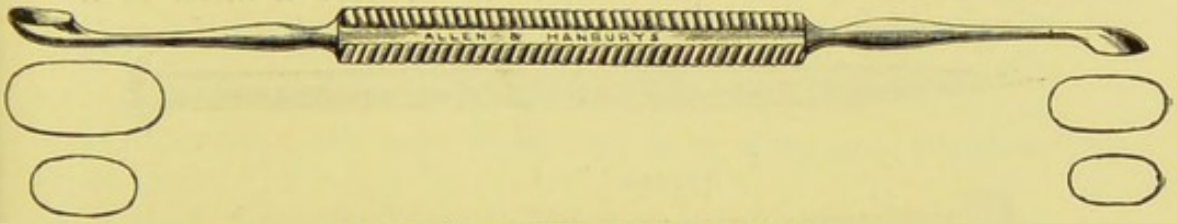


FIG. 356.—SHARP SPOON OR SCOOP.

EXCISION OF JOINTS.

In no class of operations are the effects of sepsis more serious than in those on joints. In addition, sepsis is especially apt to occur in them, and the most rigorous aseptic precautions must be taken by all who assist at the operation.

The operation of opening a joint, say for the removal of a loose body or the drainage of pus, needs no special description. It may, however, be emphasized that at the subsequent dressings great care must be taken to prevent sepsis or mixed infection until the wound in the capsule of the joint has healed.

Excision of a joint may be performed to get rid of disease, to overcome stiffness of the joint, or to remove deformity.

Preparation of the Patient.—Even although the joint is already infected, the same care must be taken as in an aseptic case, as it is of the utmost importance to prevent mixed infection.

Special Instruments.—All the instruments described for amputations (p. 371) and for operations on diseased bone must be sterilized, care being taken to select a suitable saw and knife for the particular operation. *Excision-pins*, which may be rounded or square (Fig. 357), may be required to nail the bones together in position. Some form of rigid splint must also be shaped and padded; or a plaster case (p. 386) may be preferred, a window being left through which the wound is dressed. If extension is to be applied to the limb after the operation, the necessaries for it must be ready, and the bed fitted with fracture boards and the extension pulley (p. 389). At the operation a tourniquet is often applied to prevent hæmorrhage.

After-Treatment.—The after-treatment varies according as the object of the operation is to procure a fixed or a

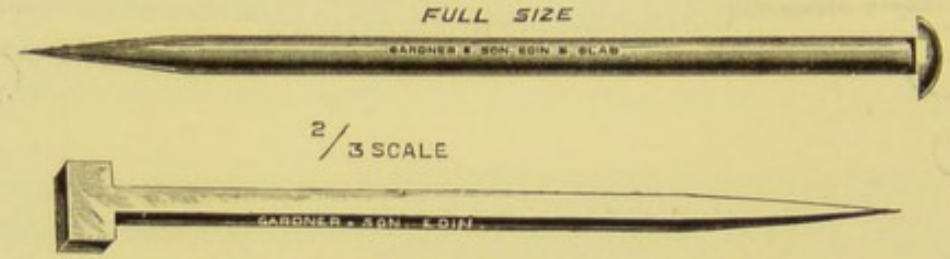


FIG. 357.—ROUND AND SQUARE EXCISION PINS.

movable joint. In general, a fixed or ankylosed joint is desired in the lower limb, and a movable joint in the upper limb.

When an *ankylosed joint* is aimed at, as in the case of the knee, great care must be taken at each dressing to avoid moving one bone on the other. If excision-pins are employed, their ends are left projecting through the skin. After three weeks, they are loose enough to be easily withdrawn. The patient is kept in bed, with a rigid splint or a plaster-case on the limb, for six weeks. When a splint is used, massage of the accessible parts of the limb may be carried out during the last fortnight. A plaster-case should be worn for some months, and then a well-fitted leather splint until a year has elapsed since the operation.

The **special complications** are: *Reactionary hæmorrhage*, which delays consolidation, and increases the risk of infec-

tion; *pain*, as after all operations on bone (p. 376); *sepsis*, which may result in failure of union between the bones; *yielding of the bone* so that the union is not at the desired angle.

When a *movable joint* is desired, the after-treatment is entirely different. Massage and movement must be systematically carried out from an early stage. In the case of the elbow-joint, the limb is placed on a pillow, or slung from a cross-bar. Massage of the fingers is begun on the second day, and their joints are gently flexed and extended—*passive movement*—the wrist-joint being fixed with one hand to prevent movement of the bones of the forearm. Next day the wrist is also massaged and moved, and the patient is directed to move the fingers gently for himself—*active movement*. At the end of a week the whole limb is massaged, and pronation and supination are carried out with care. As soon as the wound has healed, flexion and extension of the elbow-joint are begun. At the end of a fortnight, the splint is left off altogether, and the arm is carried in a sling and regularly exercised.

Special Complications.—*Reactionary hæmorrhage* may occur, and for this reason the wound is usually drained for twenty-four to forty-eight hours. *Adhesions* may form, and render impossible the movements desired in the joint. They are especially apt to occur if sepsis ensues. A *flail-like joint* results from excessive damage to the ligaments of the joint. The bones move on each other in all directions, and the joint is useless.

SECTION VI.

CHAPTER XXXII.

FRACTURES AND DISLOCATIONS.

A. FRACTURES AND DISLOCATIONS CONSIDERED GENERALLY.

VARIETIES OF FRACTURES.—Fractures are divided into two classes: *simple*, in which the skin is unbroken, and *compound*, in which a wound of the soft parts is present, and extends down to the broken bone.

Certain other terms are applied to fractures. A *greenstick* fracture is one in which the bone is bent and partly split, but not broken right across. It resembles the injury produced in a green twig by over-bending it. A *comminuted* fracture is one in which the bone is broken into several fragments. When one fragment of the broken bone is firmly wedged into the other, it is an *impacted* fracture. When the end of a bone of a growing patient is separated from the shaft, the condition is called a *diastasis* or *separated epiphysis*.

SYMPTOMS OF FRACTURES.—The symptoms of fracture are mobility at an unnatural place, i.e. between joints, deformity, crepitus (the name given to the grating between broken fragments of bone), loss of function, pain, swelling, discoloration, and alteration in the length of the limb. The temperature usually rises to 99·5° or 100° F. on the first or second day after a fracture.

TREATMENT OF SIMPLE FRACTURES.—*Reduction* of the fracture consists in bringing the fragments into the natural position, after which they are *retained* there by splints or

extension. The nurse's duties are to prepare all the necessaries for treatment.

Preparation of the Patient and Apparatus.—If the patient is suffering from shock, the reduction of the fracture is postponed till it passes off. Meanwhile he is kept quiet, and, as in post-operative shock, the foot of the bed may be raised and salines administered four-hourly by the rectum, till the signs of shock disappear. After a severe accident, this may not be for a day or more. In such a case, a purgative is administered, and the patient is otherwise prepared for a general anæsthetic.

If shock is absent, the reduction is effected at once, and, as an anæsthetic is often required, the necessaries must be placed at the bedside. In addition, the apparatus required for the retention of the fragments has to be prepared by the nurse, and on this account she must be familiar with the treatment of every fracture. Patients suffering from fracture in the lower limb are usually treated in bed. The mattress must be firm, and it may be made more rigid by placing under it two or three long wooden boards—*fracture-boards.* If the fracture is compound, or if the limb is much bruised and swollen, and the skin is in danger of sloughing, it should be cleansed and shaved as for an operation. This is also necessary if extension is to be applied. All the manipulations for cleansing must be carefully performed so as to avoid further damage to the limb. With rough handling, a sharp fragment of bone may pierce the skin, transforming a simple into a compound fracture.

Reduction of a Simple Fracture.—The patient may be anæsthetized to relax the muscles and so allow of the fragments being placed in their proper position. In addition, the surgeon may need to employ *extension*, that is steady traction on the distal fragment, as the ends frequently overlap. To make the extension more effective, he may request the nurse to apply *counter-extension* by pulling on the proximal portion of the limb. Then he moulds the broken ends into position —a process known as *coaptation.*

Retention of a Simple Fracture.—The fragments of the bone are kept in position by splints or extension or both. In some cases no such appliances are required, as the ends tend

naturally to lie in position. The tendency at the present day is to do without splints whenever possible, and simply place the limb in a comfortable position between sand-pillows. If, however, the patient is restless, or the fragments do not lie naturally in good position, some mechanical means of retention is necessary.

Splints.

Plain wooden boards, cut to the appropriate length and width, make excellent splints in emergencies and in private practice.

Gooch's splinting consists of strips of soft wood glued to a backing of wash-leather. When applied with the leather side next the limb, it encircles the part as a ferrule; if the wood is applied next the skin, the splinting does not bend. To cut and shape the splinting a strong knife is required.

Perforated sheets of tin or stiff *wire-netting* may also be used.

Poroplastic felt, which consists of strong felt saturated with resin, is used when it is desired to mould the splint accurately to the limb. The shape is obtained from a carefully fitted paper pattern. To cut poroplastic, a strong sharp knife is required, and it must be held at an angle so as to cut the material obliquely, and not at right angles to the surface. The shaped splint is placed in hot water until it is quite soft and pliable, laid flat on a towel and partly dried to remove the surface water, and accurately moulded to the part. As it cools, it becomes rigid. Leather and gutta-percha may be similarly moulded. Such plastic splints may be fitted in pairs, each encircling half the limb, and kept in position by a domette bandage or by elastic webbing.

Plaster of Paris Cases are applied in conditions in which movable splints are inconvenient. The case is formed by bandaging the part with plaster of Paris bandages, that is coarse muslin bandages into the meshes of which fine plaster of Paris has been rubbed. It must be dried beforehand for some hours in an oven. The "acetic plaster bandages," which are sold ready for use, have the advantage of setting most quickly and firmly.

When using plaster of Paris, the surgeon and his assistants should wear overalls to protect the clothes. A boracic lint bandage is first applied evenly to the limb, and bony prominences are specially padded with wool. One plaster bandage is placed end up in cold water till air-bubbles cease to escape, that is, till it is thoroughly saturated. Then the excess of water is squeezed out, and the bandage is applied in the usual way from below upward. When the first bandage has been almost all applied, the nurse places a second in the water as before, wrings it, and hands it to the surgeon. Several bandages are usually required, as the case should be two to four plies in thickness over the whole part. The plaster is "set," i.e. rigid, in half an hour, and any part that causes pressure in a different position of the patient should be previously cut with strong scissors; it is more difficult to cut after it has set. During the half-hour, the limb is left exposed to the air, but not near a fire, to allow water to escape. In children, a plaster-case may be rendered waterproof by painting over it a layer of melted paraffin.

To remove a plaster-case, immerse the limb for some minutes in tepid water, then cut along the most accessible part, and bend out the two edges. Or it may be sawn through without wetting it.

Sayre's Jacket is a plaster of Paris case applied to the trunk in disease of the spine (p. 367).

Padding for Splints.—Padding is essential under every form of splint. The part must be completely enclosed in a thick layer of cotton-wool or boracic lint. All hollows are to be filled up, and bony projections surrounded by a nest or ring of padding, to prevent pressure at these points. Opposing skin surfaces, as in the axilla and between the fingers, must also be separated by a layer of wool or lint. Then the splint is applied, and kept in position by a bandage.

Extension Apparatus.

Extension is applied in fractures and many other conditions in which it is necessary to keep the part at rest, to prevent overlapping of fragments, or to steady a joint.

Preparation of Materials.—*Extension plaster* is adhesive

plaster backed with calico. Two strips of it are applied, one on each side of the limb. Suppose the case is one of fracture of the shaft of the femur. The measurement from the seat of fracture, or a few inches above it, down to the malleolus or bony projection at the ankle-joint, gives the length of the required strip of plaster. The breadth is equal to half the circumference of the limb, which is greater above than below, and the plaster must be shaped accordingly. The upper end of the strip should be cut for 2½ to 3 inches so as to form three tails (*b*), and the edges should be snipped obliquely at intervals (*c*), in order that the plaster may fit more accurately on the limb. Two inches from the lower end, each edge should be cut and the plaster folded to the same thickness as the tape to which it is to be sewed (*a*). Strong twilled tape (*d*) is used, and it should be 1 inch wide and 1½ feet long (Fig. 358).

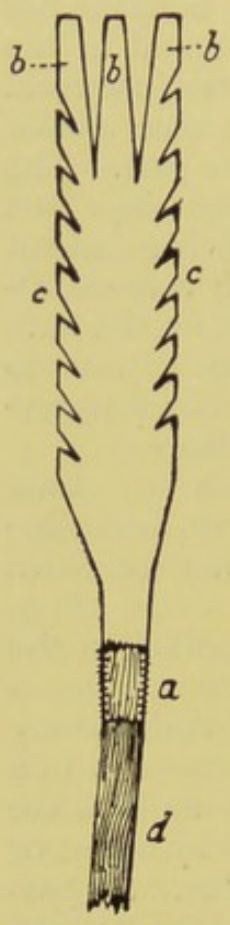


FIG. 358.—EXTENSION PLASTER FOR THIGH.

The extension-plasters may be applied next the skin, in which case the limb is to be shaved, or over a boracic lint bandage which is applied evenly to the limb from the toes up to the seat of fracture or higher. Even when the plaster is used next the skin, the malleoli must be protected from the pressure of the tapes by a boracic lint bandage. Then heat the plaster strips by holding the non-adhesive side near a fire or over a basin of hot water; in summer this is not usually necessary. Apply the strips, one at a time, to the sides of the limb without any wrinkling, down to a point three inches above the malleoli, making fresh snips if they are required for accurate fitting. Then apply a domette bandage from the toes upwards, leaving out the tapes at the lower end. When the three tails are reached, fold down the middle one so that it lies on the bandage, and cover it with the next turn. Do the same with the two remaining tails, and cover them with turns of the bandage. Fix the bandage with a safety-pin inserted in its long axis.

The plaster is left for a few hours to adhere firmly before the weights are applied. These weights may be either the ordinary weights used in commerce, or masses of lead or iron, each weighing ½ lb. or 1 lb. and perforated in the centre for attaching them to a strong cord. The cord is carried over a pulley placed at the top of a framework which is fixed to the foot of the bed and so constructed that the pulley may be raised or lowered.

Finally, the cord is connected by means of a board, about 6 inches square, with the two extension-tapes fixed on the limb. Attached to either side of the board is a leather strap and buckle to which the corresponding tape is fastened. Through a central hole in the board, the cord is pulled, and fixed with a knot.

By means of the weights, the muscles of the thigh are gradually fatigued. When they relax, the ends of the bones cannot overlap as they do when the muscles are contracted, and they fall into their natural position. The weight applied at first should be light, and gradually increased. For a child of six years suffering from fracture of the femur, begin with 2 lb. and increase to 3 or 4 lb.; for an adult begin with 4 or 5 lb. and go up to 8 or 10 lb. If the length of the injured limb is less than that of the sound limb, the weight should be increased; if greater, it should be diminished.

The objects of the board are to prevent the tapes pressing on the malleoli, and to equalize the pull on the two extension-tapes.

The foot of the bed must now be raised on wooden blocks; if it is level, the weight tends to pull the patient down bodily, but when it is raised at the foot, the weight of the patient's body acts as a *counter-extending* force. The bed-clothes are kept clear of the tapes and board by means of a wire-cage.

If the patient is restless, extension may be supplemented by a long splint (Fig. 362), applied on one or both sides.

The **list of materials** to be collected by the nurse before extension is applied is as follows:—

Strong moleskin adhesive plaster and strong broad tape, a tape measure, needle and thread (in many wards, a stock of plaster strips of various sizes is kept ready for use); scissors; several boracic lint bandages; two domette

bandages; safety-pins; a square piece of wood, sometimes called a stirrup, with a central hole, and a strap and buckle fixed to two opposite sides; framework with pulley; strong cord to attach weights to stirrup; weights; blocks to raise foot of bed; cage; means of heating plaster.

A simple method of applying extension, and one which admits of massage and movement being carried out, is the following. Shave the limb as before. Make the extension-strips of Mead's adhesive plaster, 3 inches broad for an adult. Measure the length as before: snip the edges 2 inches above the ankle- or the wrist-joint, and fold the plaster so as to bring a non-adherent surface next the skin. The end may be stitched to tape as before, or if left long, it may be directly fixed to the buckle. The strips are now applied to the skin, and encircled at intervals of about 6 inches by a layer of the plaster. The ends are attached as before by means of a stirrup to the weights. No bandage is required to cover the plaster, hence if any constriction occurs, its situation is at once discovered, and it may be rectified by loosening the tight encircling band.

After-Treatment of Simple Fractures.—Fracture cases are frequently hard to nurse. This is especially true if the patient is big and heavy and has a fracture of the thigh. In such a case, great care must be taken in changing the sheets, and lifting the patient on to the bed-pan, not to twist or move the injured limb.

Whenever possible, the fingers or toes should be left exposed and frequently inspected, whether splints, a plaster-case, or extension has been applied. If the digits are covered, any constriction of the limb may escape notice, and the consequences are serious. If the fingers or toes of the injured limb become blue and cold, some part of the apparatus is too tight, and the fault must be remedied at once.

Massage and movement (p. 65) are included in the after-treatment of every simple fracture. Massage is begun almost immediately to get rid of the blood and serum which collect in the neighbourhood of the fracture, and to stimulate the healing of the bone. In a few days passive movement of the joints of the limb which are farthest away from the fracture is begun, and later all the joints may be moved.

At the same time the patient is allowed to move the joints by contracting his muscles, the degree of active movement being gradually increased as the union of the bone progresses. Care must be taken throughout that the ends are not displaced by the movements. For this reason, the fragments should be fixed by the hands of an assistant. When the digits are left exposed, the patient is allowed to move them from the beginning.

The time required for the union of the fragments varies in the different bones, but it is shortened by the efficient and regular performance of massage and movement, a duty which often falls to the nurse. In addition, the stiffness which would follow if the limb was kept absolutely fixed for five or six weeks is to a great extent prevented.

Complications of Simple Fractures.—These fall into two groups according as they are due to the accident itself, or arise in the course of the treatment. In the first group are included *injuries to blood-vessels and nerves*, which may be pressed on or torn by a fragment of bone. Such a complication may necessitate operation for its relief. In the second group are included *delayed union*, *non-union* and *mal-union*.

Delayed union consists in the failure of the bone to unite as quickly as usual. It may be due to imperfect reduction or retention of the fragments, to the patient's general condition, or to the special situation of the fracture. An attempt should be made to hasten healing by fixing the fragments, and applying an elastic bandage above so as to induce passive hyperæmia (p. 66) for six to twelve hours a day. To confine the action to the site of the fracture, an ordinary bandage may be applied round the distal part of the limb.

Non-union.—Sometimes the fragments fail to unite at all. This may be due to a piece of muscle or other tissue being interposed between the two ends of the bone, or to the non-formation of *callus*, as the substance which unites the two ends, and is gradually transformed into hard bone, is called. Non-union also occurs if the ends of the bone are not kept at rest. It usually requires treatment by operation.

Mal-union, or *vicious union* is union of the two fragments in a bad position, for example at an angle to each

other instead of in a straight line. It may be due to improper reduction or imperfect retention. If seen early, while the callus is still soft, the bone may be re-broken and set in good position. At a later stage, an incision is usually required, and the bone is then broken with a chisel and mallet, and the fragments fixed in good position.

Excess of Callus.—When too much callus is thrown out, it may interfere with movements, or it may include or press on a nerve, and cause pain, or loss of power in certain muscles.

Absorption of callus sometimes occurs, for example when an acute infective disease such as scarlet fever comes on during the repair of a fracture. The ends of the bone again become loose, and the final union is delayed for some weeks.

Fat embolism sometimes occurs, but is seldom serious.

Retention of urine may follow on fractures in the lower limb in which the patients are forced to lie flat on their backs. It usually passes off with the first purgation.

Bronchitis and *hypostatic pneumonia* are prone to occur in old people in whom the injury necessitates continuous lying on the back. *Increasing debility* and the *tendency to bed-sores* also cause anxiety in these patients. Hence the treatment of the fracture is often held to be of secondary importance, and the prevention of these dangerous complications becomes the first consideration.

Delirium tremens frequently follows a fracture in alcoholic patients.

Treatment of Compound Fractures.—Compound fractures are more serious than simple fractures on account of the danger of septic infection of the broken bone. Hence the treatment of the wound is of great importance. When the patient is first seen, the injured limb is placed on a leg-tray, and thoroughly purified and shaved in the neighbourhood of the wound. Free syringing with sterile saline solution is the best method of cleansing, but care must be taken that the fluid flows out freely and does not burrow in the tissues. If particles of dirt are engrained in the edges of the wound, the latter should be clipped off, and if the superficial wound is small, it must be enlarged by the knife to permit of thorough flushing of the deeper parts.

Next the fracture is reduced and retained in position, like

a simple fracture. If extension is applied, a "window" must be left opposite the wound. This is effected by leaving a gap in the plaster; and when the domette bandages are being applied, one is stopped two or three inches below the wound, and the next one started the same distance above it. The intervening part is dressed with gauze, and covered by a many-tailed bandage.

To lessen the risks of infection, an elastic bandage may be applied above the fracture to induce passive hyperæmia (p. 66). When the wound is healed, massage and movement are carried out as in simple fracture. The time required for the repair of a compound fracture varies greatly, but it may be said that as a rule no callus is thrown out as long as sepsis is present. Sometimes the fragments are wired when the infection has been got rid of. In other cases, amputation of the limb is necessary.

Special Complications of Compound Fractures.—*Necrosis of bone* occurs chiefly when sepsis occurs. The dead fragment may be lying loose, or attached to the rest of the bone. In either case it should be removed.

Pyæmia or *Septicæmia* may result from the septic infection if free drainage is not established.

Dislocations.

The nurse is not directly concerned with the immediate treatment of recent dislocations. No special preparation of the patient is necessary, and no mechanical apparatus is required for the reduction of the dislocation or the retention of the limb. In the upper extremity, any fixation is managed with a bandage and sling, and in the lower extremity with sand-bags tied to the limb.

After-Treatment.—A few sentences will be sufficient to describe the modern method of after-treatment. Immediately after the reduction of the dislocation, the joint is gently stroked upwards for fifteen to twenty minutes to diminish the swelling. This is repeated each day, and the more vigorous manipulations of massage (p. 65) are gradually added to the stroking. From the first day passive movement is carried out in all directions except that which brings the end

of the bone near the tear in the capsule. Active movement also is allowed from the beginning, but the patient may be unable to carry it out for a day or two. By these means, the capsule heals more quickly, and the stiffness of the joint is less marked than with the old method of keeping the limb fixed for several weeks.

B. SPECIAL FRACTURES.

In this section, fractures of the bones of the limbs and pelvic girdle are alone considered. Fractures of the skull, spine, lower jaw and ribs are mentioned elsewhere.

Fractures of the Upper Limb.

Fracture of the clavicle may be associated with no displacement of the fragments, in which case it is sufficient to place the arm in a sling to support the elbow. If displacement is present, the arm may be bandaged in various ways to keep the fragments in position. Splints are not used.

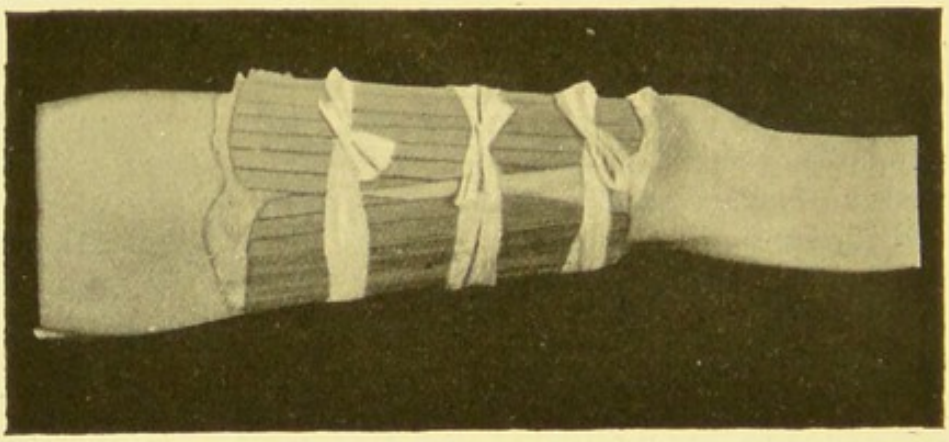


FIG. 359.—FERRULE OF GOOCH SPLINTING FOR THIGH.

Fracture of the Shaft of the Humerus.—If the fracture is oblique, and the fragments overlap, it is usually advisable to keep the patient in bed, and apply extension. The simple method already described (p. 390) will be found efficient. Or the

weights may be applied so as to hang from the elbow, thus producing extension while the patient is walking.

When no overlapping occurs, the fragments may be controlled, as in the thigh, by Gooch splinting applied as a ferrule to the bone (Fig. 359). Movement at the elbow-joint is prevented by a rectangular splint of wood or Gooch material (Fig. 360) applied to the outer side of the limb, or a rectangular gutter of poroplastic applied posteriorly, and at the shoulder-joint by a bandage surrounding the chest and the injured limb, or by a shoulder-cap of poroplastic. The arm should be supported in a sling.

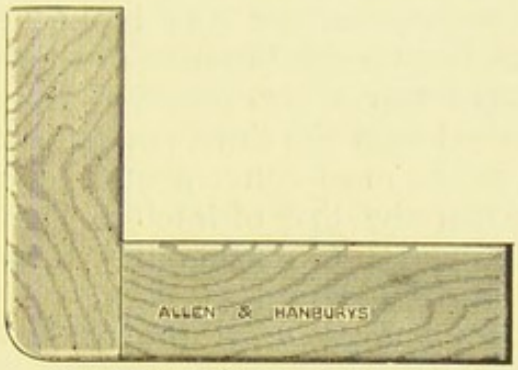


FIG. 360.—RECTANGULAR ELBOW SPLINT.

Fractures in the Region of the Elbow-joint.—These fractures, like all others in the neighbourhood of joints, are apt to

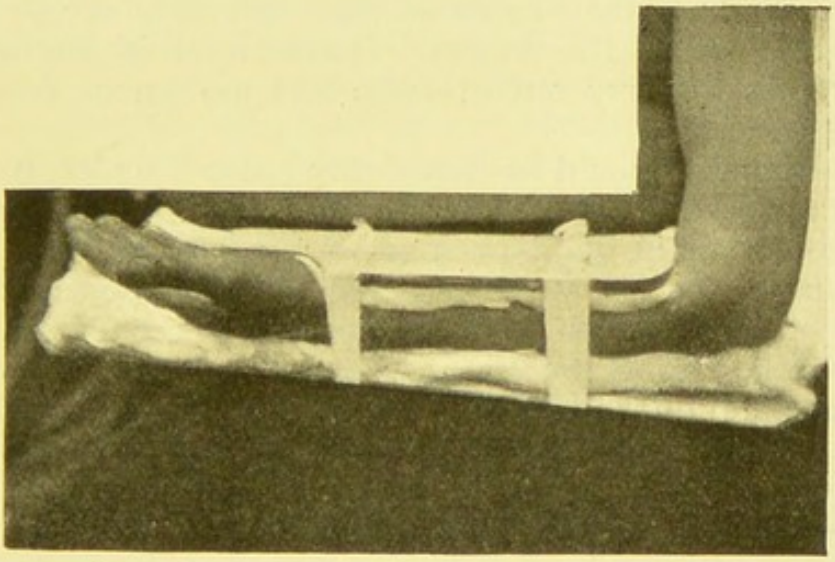


FIG. 361.—BOX-SPLINT OF GOOCH MATERIAL FOR FOREARM.

result in stiffness of the joint. To prevent this serious complication, massage and movement must be begun early and carried out systematically till the union is firm.

Fracture of the Bones of the Forearm.—In the forearm, as in the leg below the knee, there are two parallel bones. In these cases some form of *box splint* should be applied, as a ferrule splint, such as is used for the humerus, would cause pressure on the four broken ends, approximate them, and perhaps result in union of the two bones to each other. For the forearm, two pieces of Gooch splinting, applied with the wood next the limb, one anteriorly and the other posteriorly, are the most convenient (Fig. 361). In some cases, however, when the line of fracture is oblique and the fragments tend to overlap, extension may be applied till union in good position has begun.

Complication.—In fracture of the bones of the forearm, a serious complication occasionally ensues if the splints are applied too tightly, and the circulation is interfered with. It consists in a gradual wasting and shortening of the muscles, so that the fingers are bent into the palm, and the hand is useless. The condition is known as *ischæmic contracture.*

Colles' Fracture.—This is a very common fracture, usually resulting from a fall on the open hand. It is the radius that is broken at its lower end close to the wrist-joint. If adhesions occur here, they cause stiffness not only of the wrist-joint but also of the fingers. Hence it is of the utmost importance to carry out massage and movement from the earliest stages.

The fracture should be completely reduced under an anæsthetic. When this has been done properly, the fragments tend to remain in good position, and no splint is required. A splint of Gooch material may, however, be applied for two days. It is shaped to fit along the front of the forearm, and to leave the fingers free, it reaches not more than half-way up the palm of the hand. A piece is cut out so as to avoid pressure on the ball of the thumb. The arm is carried in a sling.

Immediately after the reduction of the fracture, the limb is gently massaged, and this is repeated in twenty-four hours, and several times a day afterwards. The patient should move his fingers and thumb from the beginning, and his wrist after the splint is taken off.

Bennett's Fracture.—This is a fracture at the base of the

metacarpal of the thumb. It is treated by abducting the thumb, and applying a poroplastic splint, shaped like a gutter, along the outside of the thumb and wrist.

Fracture of a Finger.—This is treated by a narrow Gooch splint, placed along the front of the finger and palm, and covering the fingers on either side of the damaged one. The three fingers are included in the narrow domette bandage, care being taken to separate the skin surfaces between each two fingers by cotton-wool.

Fracture of a Metacarpal.—If the fracture is transverse, the fragments do not tend to overlap, and the treatment simply consists in closing the fingers on a pad of wool, and applying the bandage for the closed fist (p. 90). As usual, wisps of wool must be inserted between the fingers. If the fracture is oblique and the fragments over-ride, extension is applied as follows. Apply a rectangular splint to the outer side of the upper arm and forearm, keeping the horizontal limb long enough to extend well beyond the finger-tips. Apply strips of adhesive plaster along the front and back of the injured finger, and attach them to a piece of rubber tubing. The latter is then put on the stretch, carried over the end of the splint, and fastened at the back.

Fracture of the Pelvis.—Fractures involving the pelvic girdle are frequently associated with serious injuries to the viscera, especially the bladder and urethra, and the treatment of these injuries takes precedence. The patient must be moved and handled with excessive care to avoid piercing of the viscera with a fragment of bone. The bed should be prepared with a firm mattress over fracture boards, and catheters should be sterilized, as the surgeon must satisfy himself that the bladder and urethra are intact. For the fracture itself, a many-tailed bandage is applied round the pelvis, and the knees are bandaged together with a pad of wool between them ; or the legs may be abducted, steadied by sand-bags, and extended by weights (p. 387). The patient is confined to bed for six to eight weeks, and during this time he requires much attention. As the skin of the back is specially apt to break in these cases, the sheets are sometimes stitched to the mattress to prevent any wrinkling. For the same reason the many-tailed bandage may be dis-

pensed with, and the pelvis fixed by sand-bags extending from the armpits to the heels. When the skin of the back is to be rubbed with spirit, he must be raised very slightly and "in one piece," two nurses lifting on each side. For the first four weeks, he should not be moved on to a bed-pan; pads of wool are used to catch the motions.

Fracture of the Femur.—The fracture may occur through the neck or shaft of the bone.

In *fracture of the neck of the femur*, in a child, the limb is fully abducted, and in this position is fixed in a plaster-case which surrounds the limb to the knee, and reaches up to encircle the pelvis. In adults, extension is applied to the limb in the abducted position, but in the old and feeble the risk of hypostatic congestion (p. 199) is considerable if they are kept lying on their backs, and it is the custom to prop them

FIG. 362.—LISTON'S LONG SPLINT WITH FOOT-PIECE.

up in a sitting position, and in great measure leave the fracture to take care of itself.

In restless patients, Liston's *long splint* (Fig. 362) should be applied over the extension-plaster to control the joints above and below. This consists of a board four inches in breadth, and long enough to reach from the axilla to one or two inches beyond the foot. In the original splint, about two inches from the upper end, were two holes about the size of a shilling, and at the foot two wedges were cut out so as to leave a double fork, but these are not now made use of. To fix the splint at right angles to the mattress, it is slipped into a groove in the foot-piece. If extension in the abducted position is required, the long splint must be constructed with a hinge opposite the hip-joint. In specially restless patients, a long splint should be applied to each limb, and the two fixed at the foot by a cross-bar. This is an efficient splint for young patients.

To apply the splint, lay it alongside the patient, with the upper end in the axilla but not high enough to cause pressure there. Mark on it with pencil the level of the great trochanter at the upper end of the femur, and of the external malleolus at the ankle. Fold a sheet exactly to the width between the two pencil marks and roll it round the splint, leaving as much of it unwound as will completely encircle the limb. To compensate for the greater circumference of

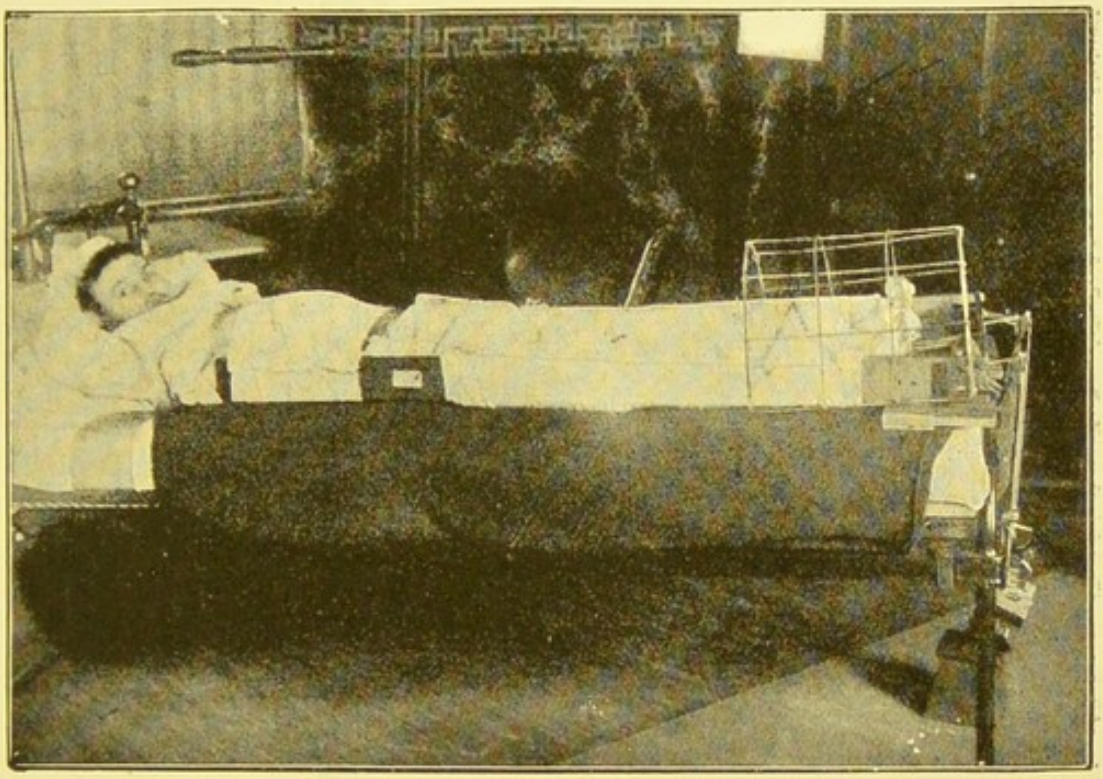


FIG. 363.—LISTON'S LONG SPLINT APPLIED.

the leg at its upper part, the sheet is wound obliquely round the splint. Apply a pad of absorbent cotton-wool to the front of the splint down to the sheet, and fix it in position with tapes. Now slip the loose part of the sheet under the fractured thigh, and bring it round the limb and fix it with several safety-pins to the folds on the outer side of the splint. Fix the upper part of the splint with a binder going round the chest and abdomen, and slip the foot-piece into position. Lay a sand-bag along each side of the limb, and pass tapes

round to fix them to the limb and the splint. Lastly, cover the patient's foot with a bed-cage (Fig. 363).

The two holes were formerly required to fix the ends of a perineal band, but this method of applying extension has

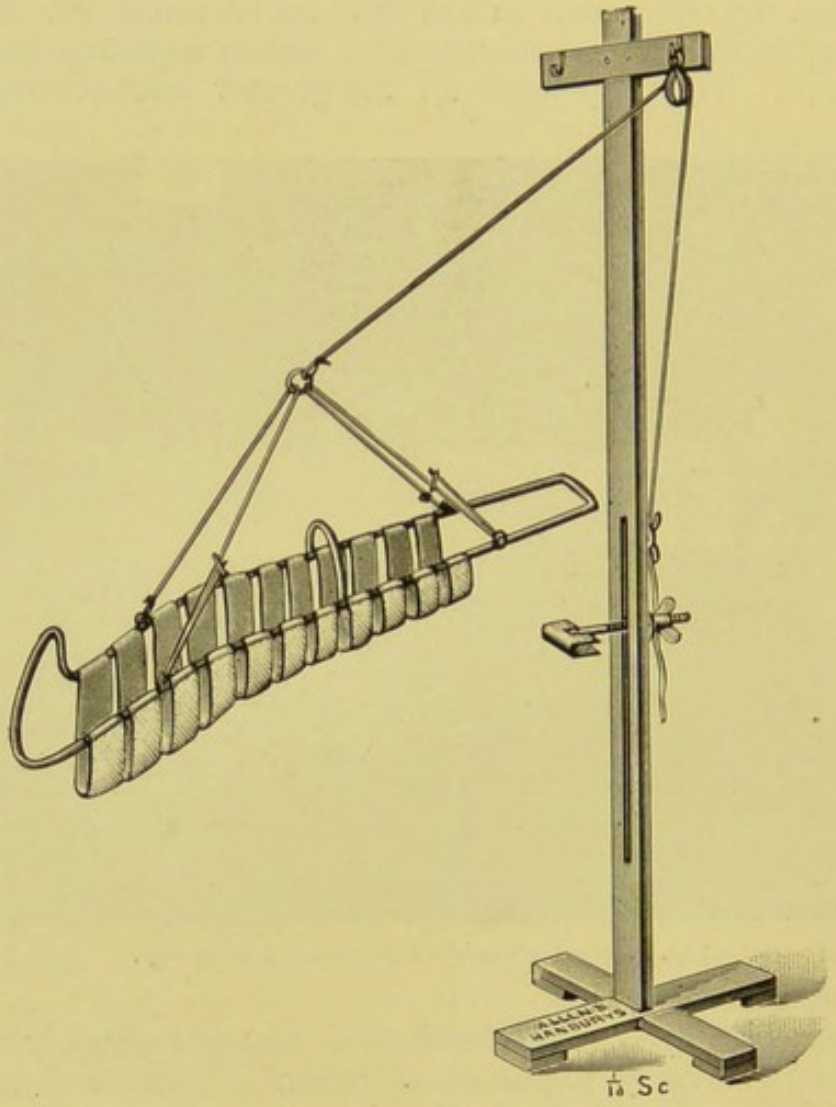


FIG. 364.—HODGEN'S SPLINT.

fallen into disuse. The fork at the lower end was made use of in applying a bandage to fix the patient's foot in good position; but it is now recognized that it is better to leave the foot free, and counteract eversion by keeping the splint fixed in the foot-piece, and by properly adjusted extension.

For *fracture of the shaft of the femur*, the typical treatment is extension by means of weights, with or without a long splint according as the patient is or is not restless. Long sand-bags

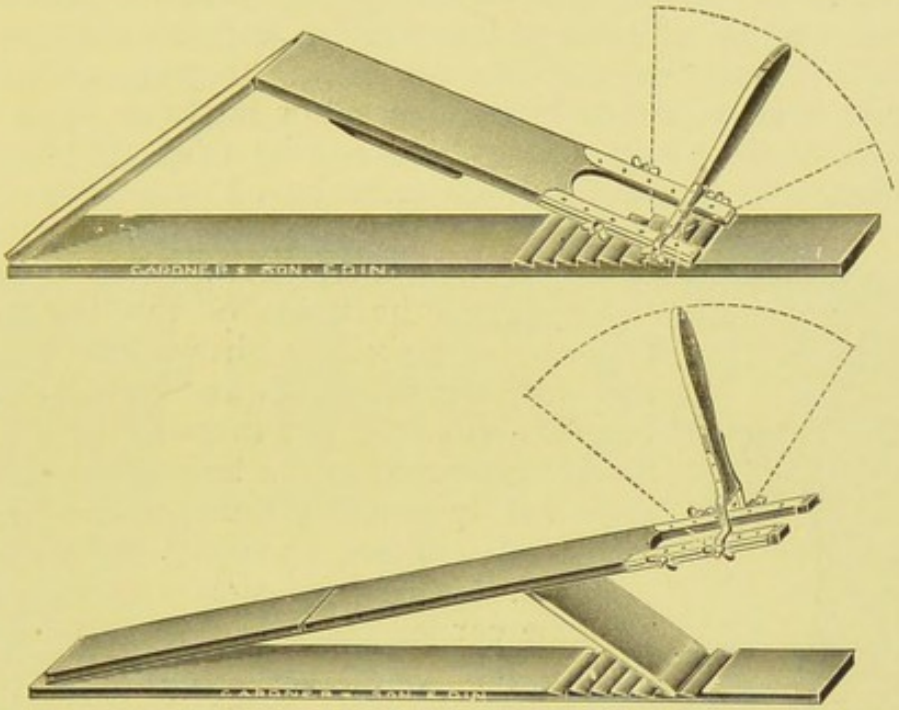


FIG. 365.—SPLINT ADAPTABLE FOR DOUBLE OR SINGLE INCLINED PLANE, WITH MOVABLE FOOT-PIECE.

should in every case be placed along either side of the limb. A comfortable method of treatment and one which allows of the patient sitting up, and facilitates massage and nursing, is

FIG. 366.—THOMAS'S KNEE SPLINT, WITH PATTEN FOR BOOT OF SOUND LIMB.

to place the limb in a *Hodgen's splint* (Fig. 364). This consists of a metal framework, from side to side of which run loose strips of flannel or a hammock-net to form a cradle for the limb. A bandage or extension plaster fixes the foot to

the splint, so that, when the apparatus is slung up, and is drawn towards the foot of the bed, the leg is also pulled on and extension is procured. Another splint sometimes employed is the *double inclined plane* (Fig. 365), and extension may be combined with it, the plasters stopping short at the knee. If local Gooch splints are applied, they should form a ferrule (Fig. 359) round the thigh. For fractures below the middle of the shaft, *Thomas's knee-splint* (Fig. 366) is convenient. In children, *vertical extension* of both limbs (Fig. 367) is the best method of treatment, the two extension tapes from each leg passing over a cross-bar.

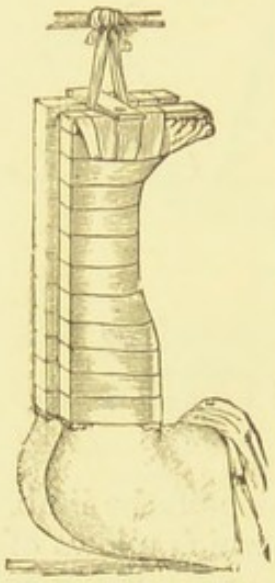


FIG. 367.—VERTICAL EXTENSION OF FEMUR.

In adults, the union of the fragments takes at least six to eight weeks. During this time the patient is at liberty to move the toes and foot, but massage is difficult to practise owing to the bandages, and the hip- and knee-joints usually show some degree of stiffness when the extension is removed. Then massage and movement must be carried out every day, and a day or two later the patient may be allowed up on crutches. If extension is obtained by means of adhesive plaster (p. 390), massage can be carried out during the whole course of treatment.

As is to be expected, bed-sores are apt to occur in patients suffering from fracture of the femur, and the skin of all areas which undergo pressure must be carefully tended.

Fracture of the Patella may be simply treated as follows. Place the limb on a pillow; raise the foot of the bed on blocks, and massage the whole leg to encourage the disappearance of the swelling. Or the limb may be raised by placing it on a single inclined plane (Fig. 365). Then draw down the upper fragment firmly and apply a strip of three-inch adhesive plaster round the thigh in such a way that its lower edge reaches the upper border of the patella. Continue the daily massage, and allow the patient up on crutches. Fractures of the patella are frequently treated by operation (p. 379).

Fracture of both Bones of the Leg.—This fracture is treated by means of the *box-splint* (Fig. 368). This is constructed as follows. Take two rectangular wooden splints, each four to six inches broad, and long enough to extend from above the knee to two or three inches beyond the sole. Fold a sheet so that its breadth corresponds to the length of each splint, and roll one splint somewhat obliquely in to either side, so that the distance between the two is slightly greater above, and corresponds to the breadth of the leg throughout. Three sides of

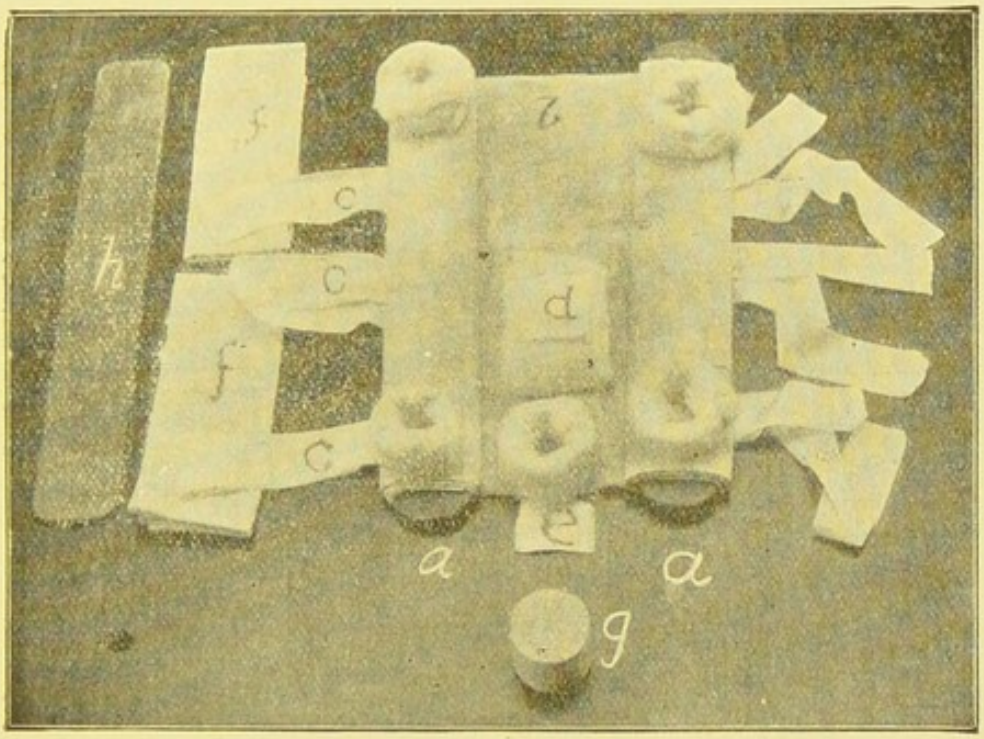


FIG. 368.—BOX SPLINT.

a box are thus formed, but to add to the rigidity of the posterior part and keep the foot in good position, a third splint of the same length as the others and provided with a vertical foot-piece may be inserted between the folds of the sheet which form the bottom of the box. The leg is placed in the box, and over it is laid a folded towel to form the lid. Three loops of bandaging cotton are placed under it and tied in slip-knots so as to fix the two sides in position alongside the limb.

Before this the box is padded with wool, and special rings

or "nests" are inserted to prevent pressure on the internal condyle, head of the fibula, malleoli and heel. Sand-bags are placed at either side of the box and tied to it to steady the limb, and if the foot tends to fall into bad position, it may be kept straight or slightly everted by a figure-of-eight bandage encircling the ankle and foot-piece (Fig. 369).

By untying the knots, removing the towel, and folding

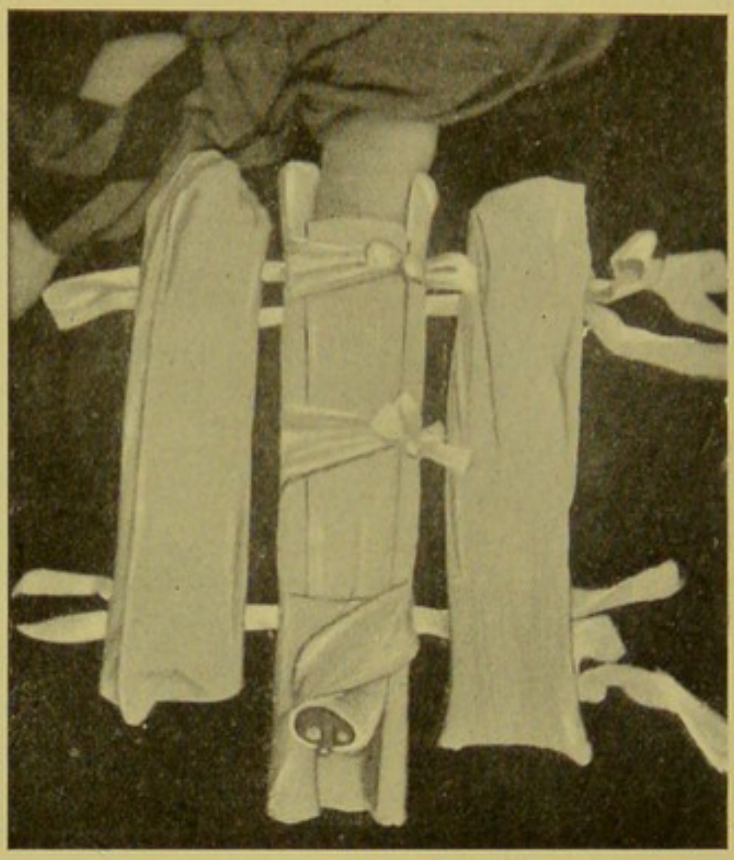


FIG. 369.—BOX SPLINT APPLIED.

down the sides of the box, the surgeon may readily examine the limb at any time, and massage is easily carried out.

Extension is required if the fragments are overlapping, and the length of the leg is diminished. The extension plasters are applied on either side of the limb up to two or three inches below the knee, i.e. above the seat of fracture. For fractures near the ankle, fan-shaped pieces of plaster may be applied to either side up to the seat of fracture, but this

method is often impracticable owing to the frequency with which the skin over the internal malleolus is damaged.

Fracture of the Tibia or Fibula alone may be treated in such a way that the patient may walk about. After two or three days when the swelling has subsided, the foot and leg are

FIG. 370.—AMBULANT SPLINT.

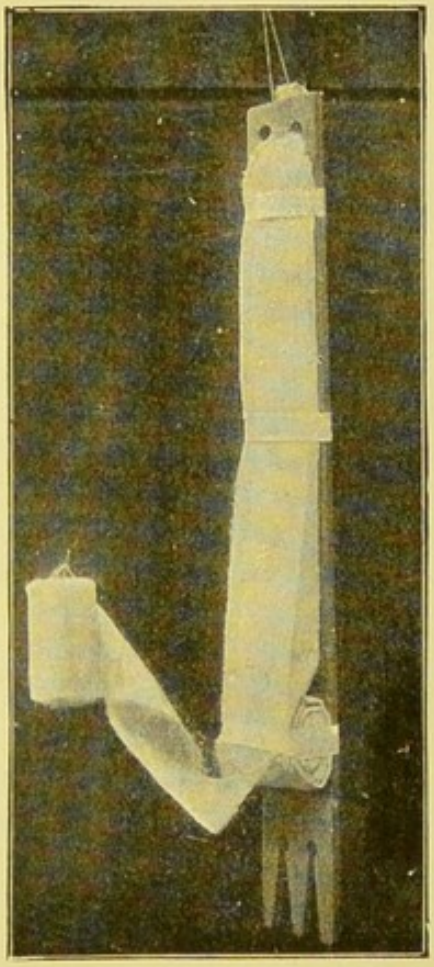


FIG. 371.—DUPUYTREN'S SPLINT READY FOR USE.

swathed in a boracic-lint bandage extending to the knee. Nests of wool are placed to take pressure off the tuberosities of the tibia and the malleoli. Then a pad of wool, three to four inches thick, is placed under the sole of the foot, and acetic plaster bandages are applied up to the knee. The toes are left exposed, so that excessive tightness of the plaster-

case may be at once observed. This splint is sometimes called the "elephant's foot" (Fig. 370). Its great advantage is that as soon as the plaster has set, the patient may walk about with a stick.

Pott's Fracture is usually fracture of the fibula plus tearing of the internal lateral ligament of the ankle-joint. The chief aim in the treatment is to prevent stiffness of the joint.

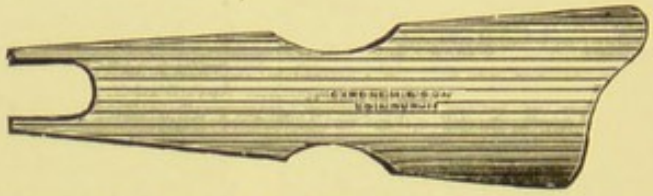


FIG. 372.—HERON WATSON'S POSTERIOR SPLINT.

Hence massage and movement are carried out from the first. If there is no displacement of the foot, the limb may simply be confined between sand-bags. If outward or backward displacement exists, the box-splint should be applied, and the displacement corrected by bandaging the foot in good position to the foot-piece for a few days. Some surgeons use *Dupuytren's internal splint* (Fig. 371) to correct eversion of

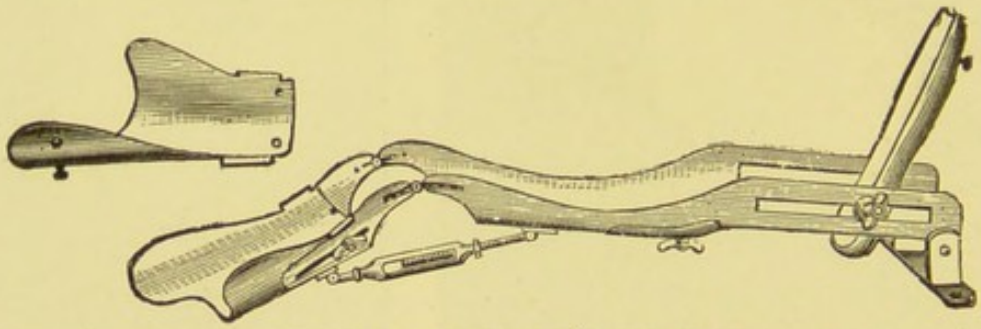


FIG. 373.—MACINTYRE'S SPLINT.

the foot, and *Syme's anterior horse-shoe* splint to correct falling back of the heel, but both prevent free access to the part for massage, and fix the foot so that no movement of it is possible.

Heron Watson's posterior splint of Gooch material (Fig. 372), and *Macintyre's splint* (Fig. 373) are useful in many cases in which it is desired to keep the leg at rest.

INDEX.

A HANDBOOK FOR NURSES.

By J. K. WATSON, M.D., M.B., C.M. New and Revised Edition. Profusely Illustrated. Cloth gilt.

5/- net
5/4
Post free.

NURSING: ITS THEORY AND PRACTICE.

By PERCY G. LEWIS, M.D., M.R.C.S., L.S.A. New Edition, Enlarged and Revised. Profusely Illustrated with over 100 New Cuts. Crown 8vo, cloth gilt.

3/6
Post free.

THE NURSE'S "ENQUIRE WITHIN".

A Pocket Encyclopædia of Diseases: their Symptoms, Nursing Treatment, and much other valuable information, alphabetically arranged. New Edition, with additional matter (suitable size for apron pocket), rounded corners. Illustrated.

2/- net
2/2
Post free.

NURSING HINTS TO PROBATIONERS ON PRACTICAL WORK.

By MARY ANNESLEY VOYSEY. New and Revised Edition. Crown 8vo. Illustrated. Cloth.

2/- net
2/3
Post free.

THE NURSE'S PRONOUNCING DICTIONARY OF MEDICAL TERMS AND NURSING TREATMENT.

Compiled for the use of Nurses. By HONNOR MORTEN. Sixth Edition, Edited and Revised, with Phonetic Pronunciations, by MARY I. BURDETT. Suitable for the apron pocket. Bound in cloth boards.

2/-
Post free.

In handsome leather, gilt.

2/6 net
2/8
Post free.

THE REARING OF CHILDREN.

A Practical Handbook for Mothers. By J. P. O'HEA, M.B. Lond., F.R.C.S. Eng.

"No home in which there is a child should be without a copy."—*Woman's Life.*

2/- net
2/4
Post free.

SURGICAL INSTRUMENTS AND APPLIANCES USED IN OPERATIONS.

An *Illustrated* and Classified List, with Explanatory Notes. By HAROLD BURROWS, M.B. Lond., B.S., F.R.C.S. Third Edition, Revised and Enlarged, with special New Chapter on Sterilisation of Instruments. Limp cloth.

1/6 net
1/8
Post free.

GYNÆCOLOGY FOR NURSES and GYNÆCOLOGICAL NURSING.

By COMYNS BERKELEY, B.A., M.B., B.C. Cantab., F.R.C.P. Lond., M.R.C.S. Eng.

A book containing the principal facts concerned with the more common diseases peculiar to women, and the chief points to be observed in gynæcological nursing, a knowledge of which is so essential to any properly trained nurse.

2/6 net
2/9
Post free.

THE MIDWIFE'S PRONOUNCING DICTIONARY OF OBSTETRICAL AND GYNÆCOLOGICAL TERMS.

Edited by H. ROBINSON, M.D. Bound in cloth boards.

1/- net
1/1
Post free.

MASSAGE MOVEMENTS.

Including the Nauheim Exercises. An Illustrated Guide for Masseuses and Nurses. With Phonetic Pronunciation of Technical and Medical Terms. New Edition, Revised by Miss M. ATKEY, I.S.T.M., Matron, Newport County Hospital, Mon. Demy 16mo, limp cloth.

1/- net
1/1
Post free.

ART OF MASSAGE.

By A. CREIGHTON HALE. Illustrated with over 70 Special and Original Cuts.

6/-
Post free.

MASSAGE IN PRACTICE.

For Graduate Workers. By Miss M. ATKEY, I.S.T.M. Crown 8vo, cloth.

2/6 net
2/9
Post free.

The above Books can be obtained of all Booksellers, or of the

NURSES' PUBLISHERS,

THE SCIENTIFIC PRESS, LTD.,

28 & 29 SOUTHAMPTON STREET, STRAND, LONDON, W.C.

Complete Catalogue on application.