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Fowler, Russell S. 1874-1959.
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Philadelphia : Saunders, 1913.

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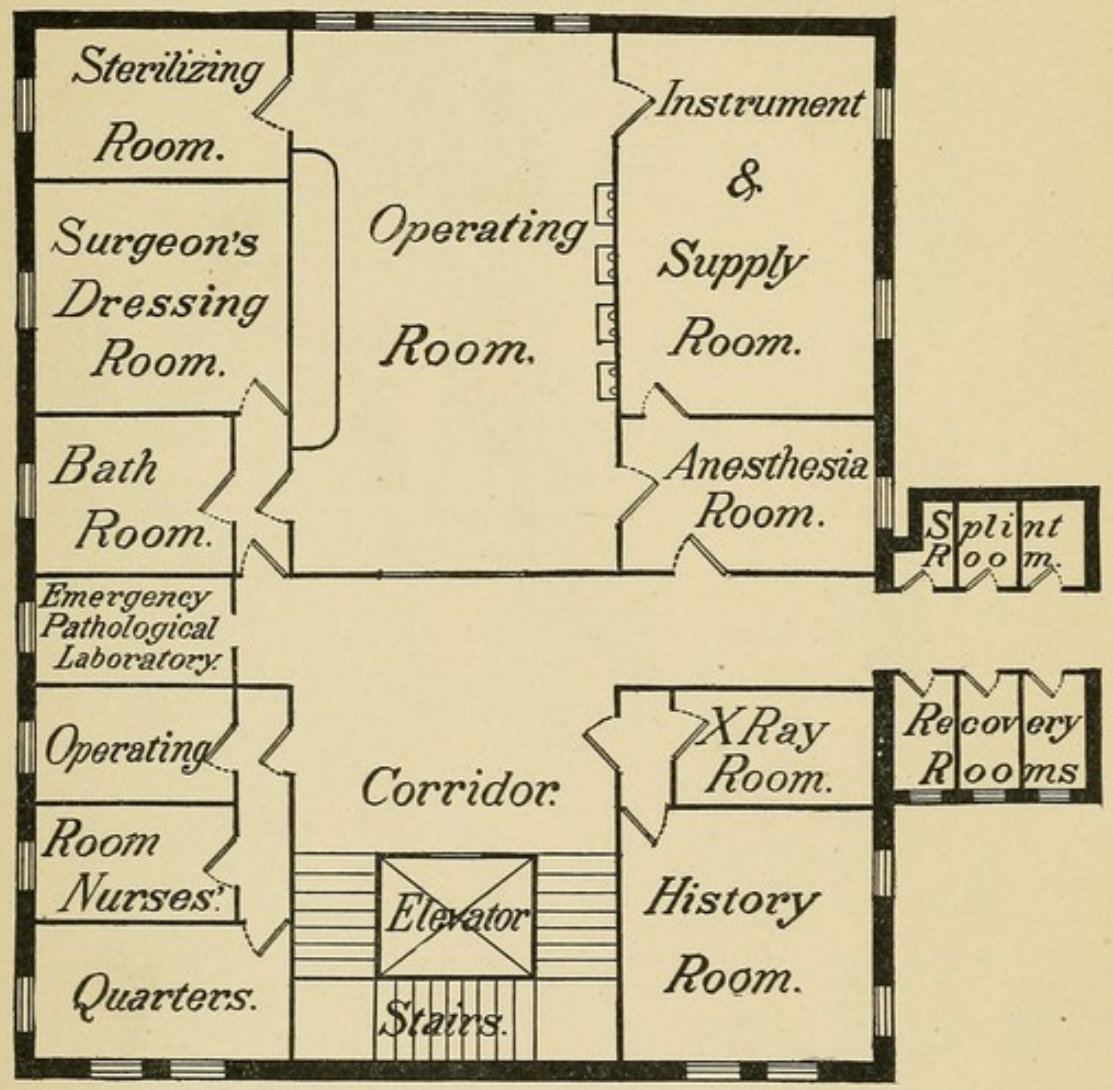
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Relation of Operating Room and Adjoining Rooms.

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THE OPERATING ROOM AND THE PATIENT

A MANUAL OF PRE- AND POST-OPERATIVE TREATMENT

BY

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THIRD EDITION
REWRITTEN AND ENLARGED

PHILADELPHIA AND LONDON
W. B. SAUNDERS COMPANY
1913

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PREFACE TO THE THIRD EDITION

Oct. 13, 1914 HFA

I WISH to acknowledge my indebtedness to Dr. James W. Ingalls for the paragraphs upon enucleation of the eyeball; to Dr. William W. Laing for his collaboration in the paragraphs on vaccine therapy; to Dr. Carl Fulda for translations from the German; to Dr. W. C. Woolsey for collaboration in the chapter on Anesthesia; to Dr. Robert L. Moorhead for collaboration in the paragraphs on Tracheotomy; to Dr. Paul O. Humpstone for contributing the paragraphs upon Obstetric Operations; to Mr. Francis A. Deck for his admirable illustrations, many of which are from "A Treatise on Surgery," by George Ryerson Fowler; to the W. B. Saunders Company for their coöperation, and to all those faithful friends who make life worth living and work a pleasure.

Whether a single operation is contemplated or a series, whether in a hospital or in a private house, the precautions to be observed are the same. It has been my purpose to simplify the technic as much as is compatible with careful work and to present the subject in a terse, yet I hope, readable manner. Simplification and standardization are the keynotes of the hour; hence many of the early methods have been discarded for others which experience has proven efficient and better because simpler.

Roughly, the underlying principles of successful surgical treatment may be summarized as follows: Careful anesthesia, exact hemostasis, asepsis, rest of the injured part, use of the rest of the body, feeding advanced to normal as fast as the anesthetic weakened stomach can care for it, and the following of the general rules of hygiene.

R. S. F.

BROOKLYN, N. Y., *March*, 1913.

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THE OPERATING ROOM
AND
THE PATIENT

CHAPTER I.

THE OPERATING ROOM.

General considerations. Operating room furniture. Disinfection of the operating room. Preparation of the operating table; sinks; scrub-up tray; hand basins, pitchers, pus basins and dressing pails; glassware. Arrangement during operation. Arrangement of the instrument and sponge table. Arrangement of the portable instrument stand. General operating room rules. Personnel of the operating room. Operating room costumes. Operating room nurse. Senior operating room nurse. First junior operating room nurse. Second junior operating room nurse. Supply room nurse. Anesthetic nurse. Operating room orderly. Operations in private houses. Operating furniture in private houses.

General Considerations.—The ideal hospital operating room (Fig. 1) should be on the top floor with ample floor space and moderately high ceiling with a large double air-tight central skylight. The east side of the room should have large windows. The floor, walls, and ceiling should be of waterproof construction with rounded corners. The floor should incline slightly to a central drain. Heating should be by hot water. Lighting should be by electricity on two circuits, the fixtures being a parallelogram with a central cluster. Gas should also be installed in case of accident to the electricity. An ideal relation of the operating room to the adjoining rooms is shown in the frontispiece.

The operating room furniture consists of two or more operating tables (Fig. 2) a long curved table for instruments, sponges,

ligatures and dressings, an adjustable instrument table, three stools, a portable irrigation stand, a stand for the large bichlorid hand bath, six basins and stands for solutions, two screens, a wheeled table for the scrubbing outfit, four sinks with hot and cold water taps, a waste sink, pails and receptacles for soiled gauze, gowns, etc., a portable parabolic light, a stand or inclosure for visitors.

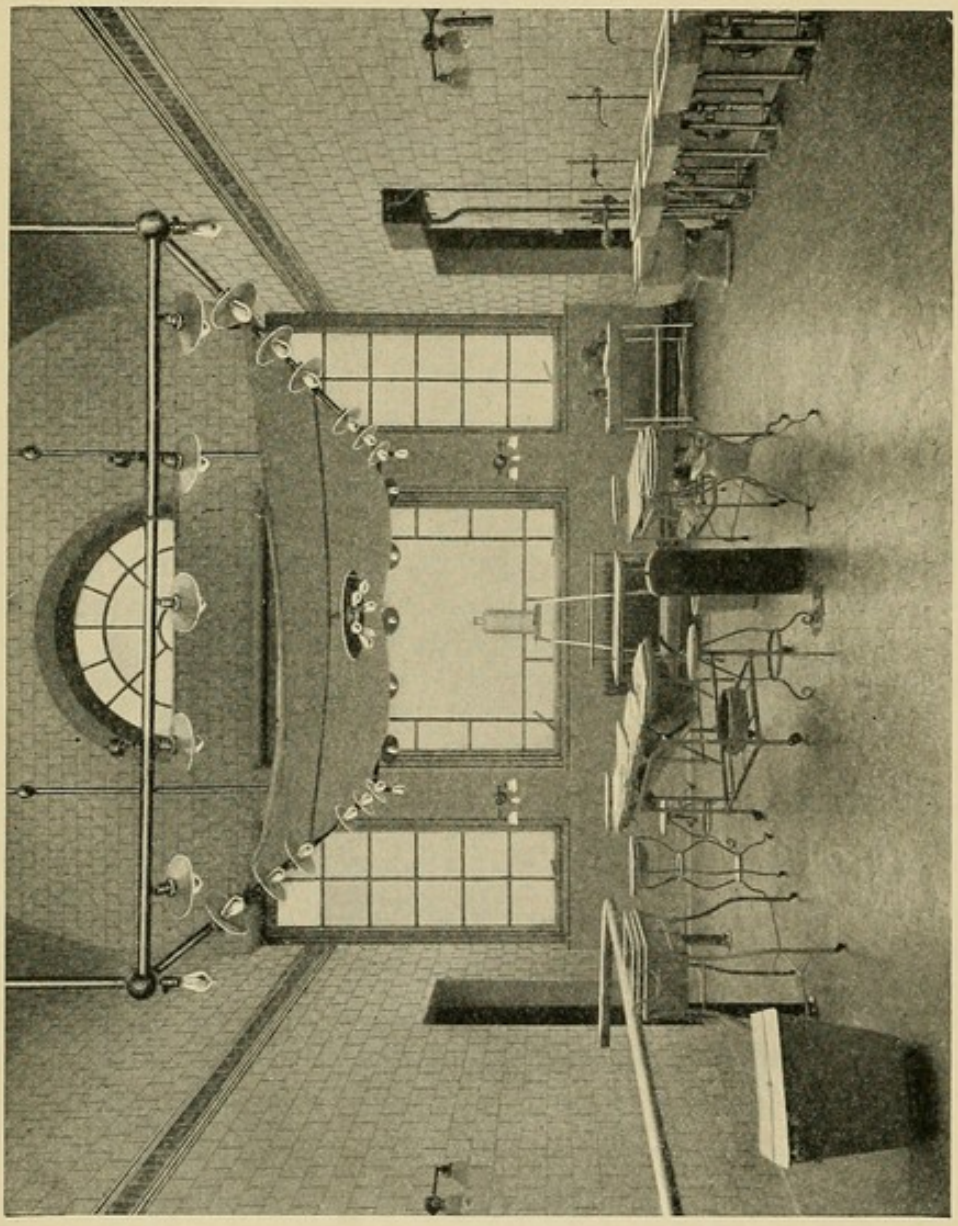


Fig. 1.—Operating room.

Disinfection of the Operating Room.—The walls and ceiling of the operating room should be washed down with a hose using hot water at least twice a month. Furniture is scrubbed with soap and water and wiped off with bichlorid (1:1000) or carbolic (1:20), and the floor flushed and mopped dry after every septic

operation and after every series of clean operations. The room is dusted daily and should always be ready for use. The air of the room should be moist. All windows are kept closed and drafts avoided. In summer those windows which are to be kept open in rooms adjoining the operating room should be provided with screens. The temperature of the room should be between 75° and 80° F. Ventilators are covered with non-

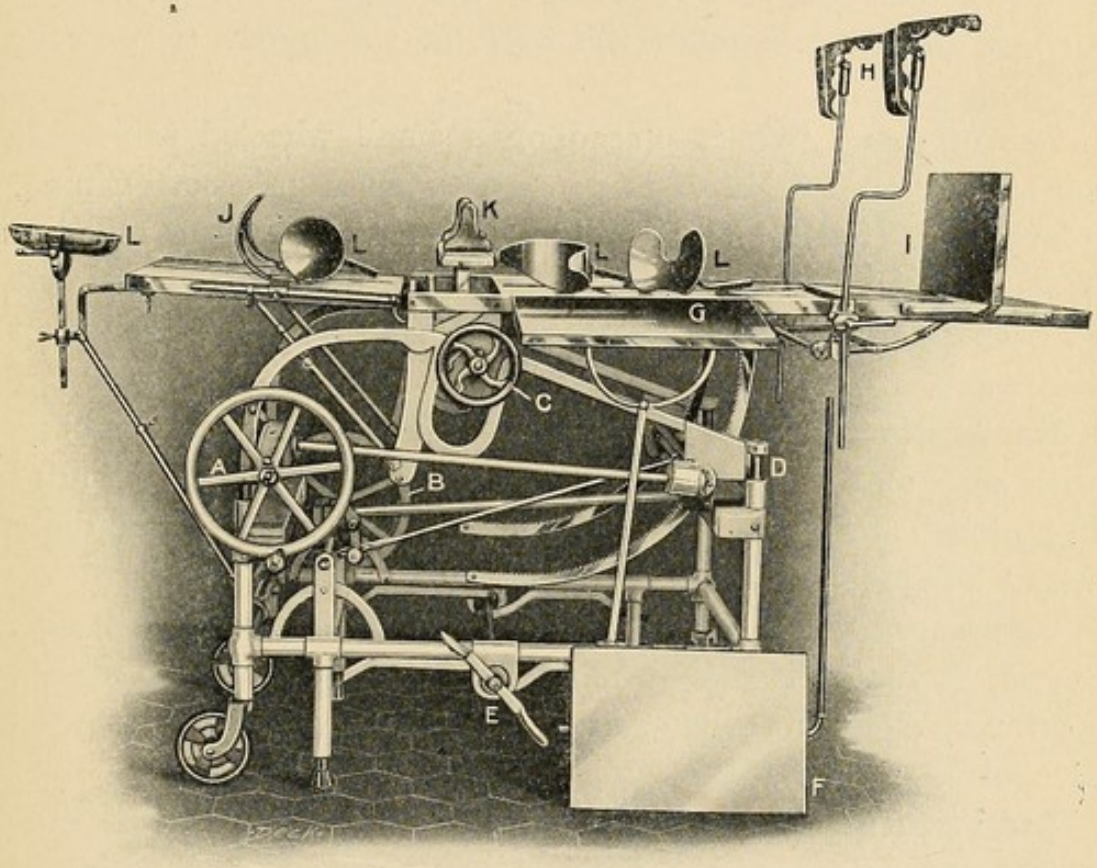


Fig. 2.—Author's operating table.

A, wheel to incline table; B, wheel to elevate table; C, wheel to control kidney elevator; D, showing entire table partially elevated; E, foot brake; F, instrument stand; G, hand-rest; H, Bierhoff stirrups; I, foot-rest; J, shoulder-rest; K, kidney support; L, various forms of head supports.

absorbent cotton filters. Once each month the operating room is disinfected by the formalin process. This method is also used after cases of streptococcic infections.

Preparation of Operating Table.—On the table are placed the Trendelenburg shoulder crutches, with small rubber pads attached to protect the patient from undue pressure, a long rubber cushion with linen slip cover, a small rubber pillow with linen

cover. The lithotomy posts and stirrups, the attachment for operations upon the hand and forearm and the various head attachments should be near at hand.

Preparation of the Sinks.—Nail scissors, nail files, wire nail brushes, a jar containing hand brushes, a jar of green soap, a bottle of alcohol, and a bottle of hand lotion are placed on a small table or shelf near the sinks. Bottles have bichlorid towels pinned around them or are covered with bottle bags with draw-strings to fasten around the neck of the bottle to prevent slipping.

The scrub-up tray is placed on a small wheeled table. It contains a large flask of sterile water with aseptic cotton plug, a large flask of acid-bichlorid, liquid green soap, tincture of iodin, Woelfler's solution, alcohol, ether, and a razor; it is convenient to keep safety-pins, bandages, adhesive plaster and scissors on this tray.

Hand basins, pitchers, pus basins and dressing pails are scrubbed with soap and water and sterilized by boiling for ten minutes in a utensil sterilizer. Nickel and brass work are cleansed daily with "bon ami" and polished with a dry chamois.

Glassware is cleansed by scrubbing with soap and water, rinsed, then sterilized by boiling for ten minutes in the utensil sterilizer, allowed to cool, and polished with gauze wet with alcohol.

Arrangement during Operation (Fig. 3).—The table (1) is so placed as to afford the best possible light on the field of operation; the anesthetist (A) seated at the head, the operator (B) to one side of the field of operation; his adjunct (C) opposite; the house surgeon (D) to the right of the operator; the senior assistant (E) to the left of the adjunct; the main instrument table (2) behind the adjunct; the operating room nurse (G) at the instrument table; the adjustable instrument table (3) convenient to the operator; the senior operating room nurse (F) near the adjustable table; near the operator a basin (4) for hand solution; also one at the adjunct's left; to either side of the table is a pail for soiled sponges (5); on one side of the room the sinks (6) with soap, brushes, etc., nearby the stand containing the bichlorid bath (7); the visitor's stand or inclosure (8) is so placed as to

be readily accessible from the operating room entrance; the large receptacles (9) for soiled dressings, gowns, etc., are at the farther side of the operating room.

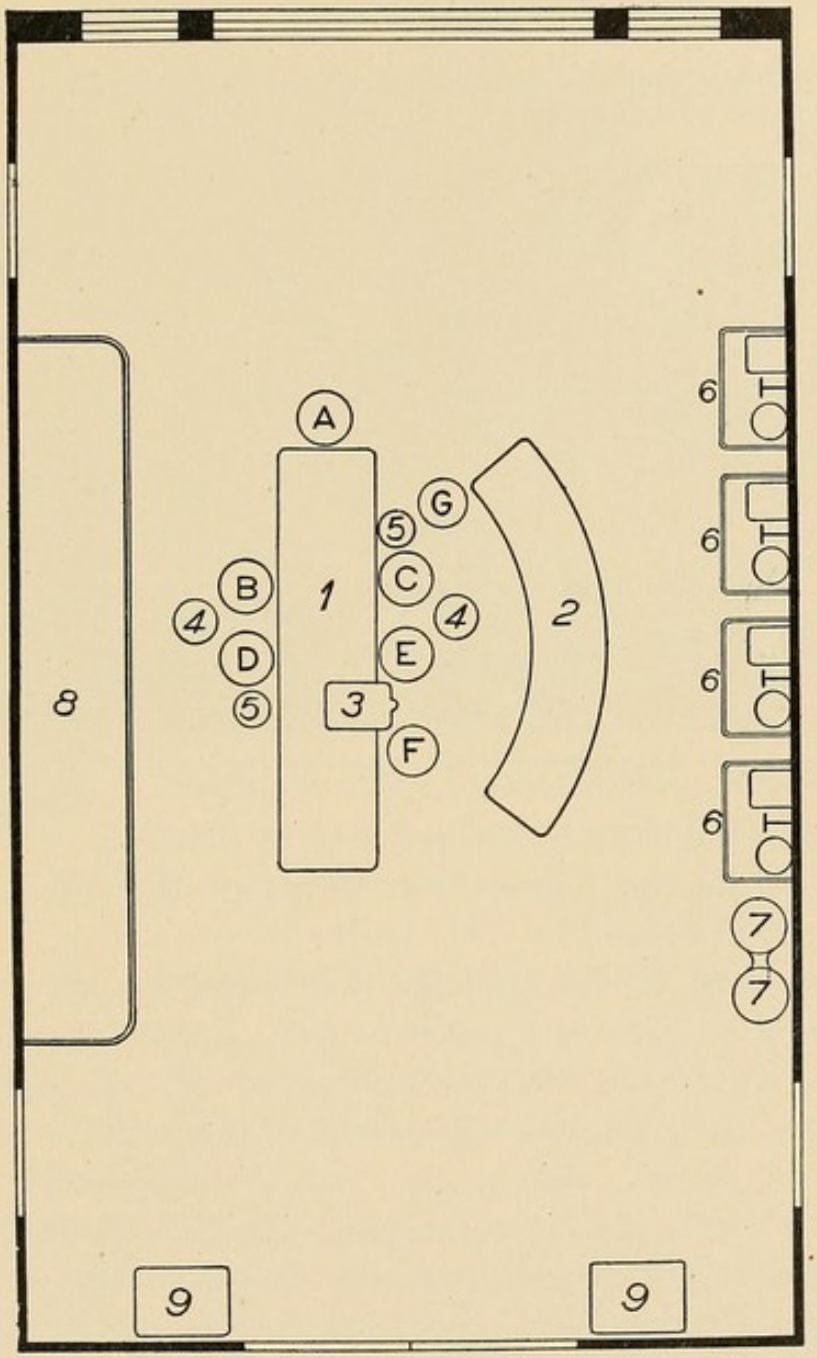


Fig. 3.—Arrangement of apparatus and personnel during operation.

Arrangement of the Instrument and Sponge Table (Fig. 4).—A certain method should be instituted and held to in the arrangement of instruments, dressings, suture material, gowns, etc. Gowns and protectors may be placed upon the lower shelf of the

table. Extra instruments and instruments not for use in the operation being performed are kept on the second shelf, while clamps, knives, anatomical forceps, scissors, needles, ligature material, sponges, compresses and those things which are apt to be called for frequently are kept in their appropriate places on the upper shelf. If the same place is always selected for the various articles time will be saved. Gloves and rubber goods

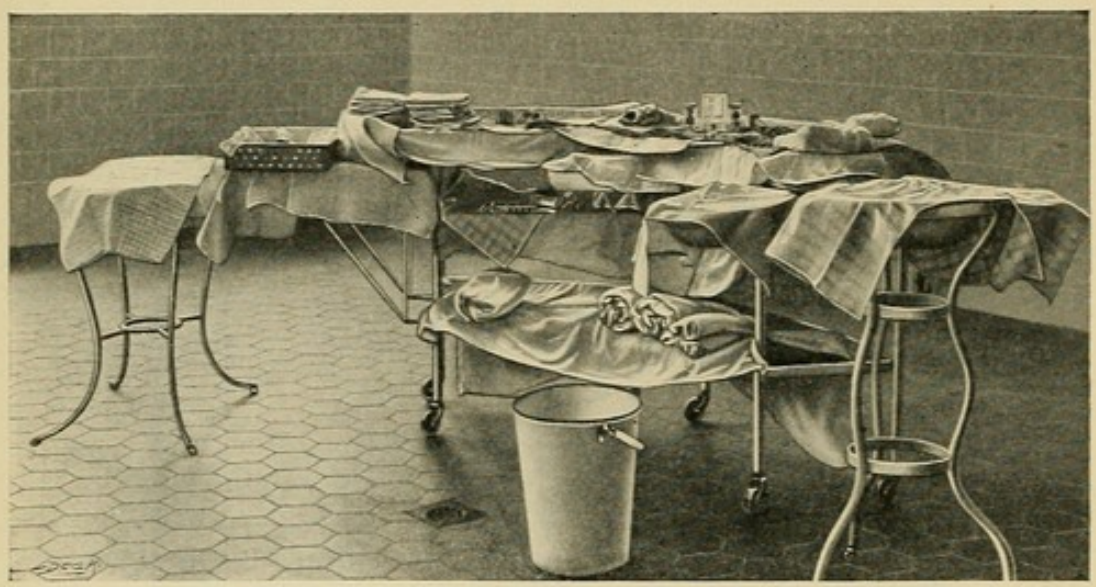


Fig. 4.—Arrangement of instrument and sponge table.

are kept in the hand basins attached to the table, while at the end of, on the rest provided for them, are the trays from the instrument sterilizer.

Arrangement of the Portable Instrument Stand (Fig. 5).—This is first covered with a loose sterile bag, the bag extending well down over the shaft of the stand. On the shelf sterile towels are then placed. The shelf of the stand is raised or lowered so that it is within easy reach of the operator. It may be placed over a part of the patient. In abdominal operations and in operations upon the neck the shelf is usually placed over the thighs of the patient. A regular arrangement of the instruments and sponges on this table tends to rapidity. Scissors, knives, anatomical forceps, retractors, hemostats, etc., should have their respective places and when not in use at the operation at hand should be returned to their places. The nurse assisting at the operation rinses blood stained instruments and replaces them.

General Operating Room Rules.—There must be no confusion. Each person should be thoroughly acquainted not only with his or her duties, but also with the duties of others employed in the operating room. There must be no unnecessary talking. Each movement should be executed quickly and noiselessly and without coming in contact with other persons. Persons having infection of the air passages necessitating coughing or sneezing are not allowed in the room.

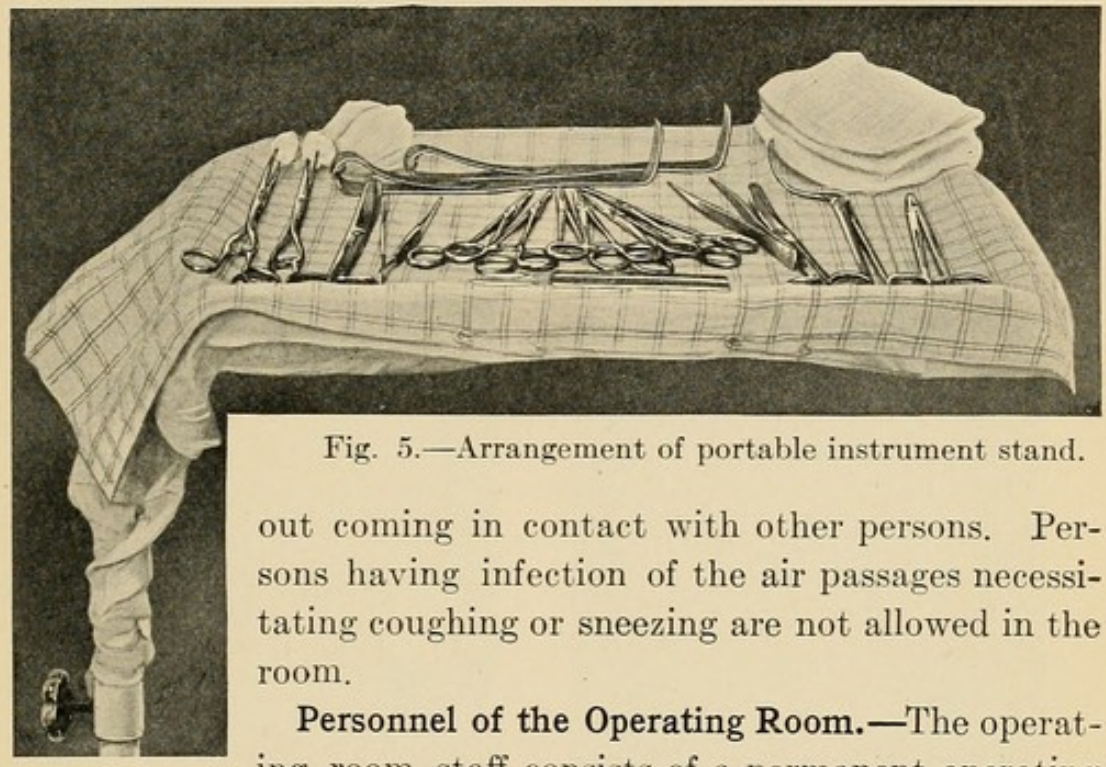


Fig. 5.—Arrangement of portable instrument stand.

Personnel of the Operating Room.—The operating room staff consists of a permanent operating room nurse, a senior operating room nurse, two junior operating room nurses, and an operating room orderly. The senior and junior nurses serve in each position for at least one month.

The operating staff consists of the operator, his adjunct, the house surgeon, the senior assistant, and the anesthetist. The resident pathologist attends operations in which cultures or frozen sections are desired.

Operating Room Costumes.—Nurses wear over their regular nurse's costume (sleeves and cuffs detached) a plain linen gown with long sleeves (Fig. 6). These gowns fasten in the back, are snug fitting, and of sufficient length to entirely cover the dress. A mask is worn which covers the nose and mouth. A cap is so arranged as to entirely cover and confine the hair. The operating room nurse and senior nurse wear rubber gloves. Rubber-heeled shoes are worn to prevent slipping.

The anesthetist is provided with a long-sleeved gown with

two breast pockets. He wears a mask and cap. The operating room orderly wears a long-sleeved gown and cap and mask. Operator's and assistant's gowns (Fig. 7) are long-sleeved.

Visitors are provided with freshly laundered, long-sleeved, loosely fitting linen gowns. Each gown is rolled up in a compact



Fig. 6.—Nurse's costume.

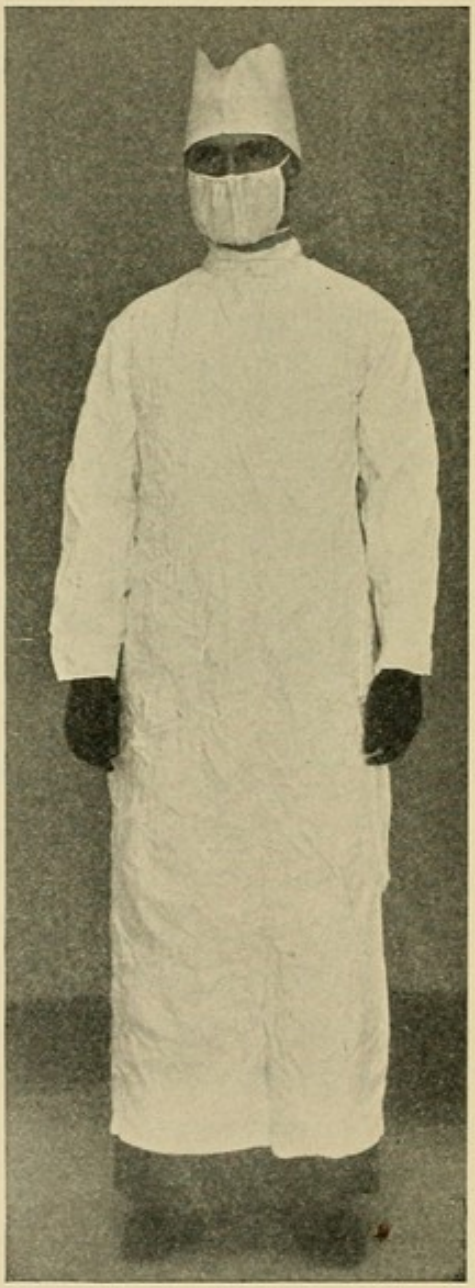


Fig. 7.—Assistant's costume.

package and is not unrolled until needed. They are put on before entering the operating room. The number of visitors is limited to the capacity of the visitor's stand.

Operating Room Nurse.—The operating room nurse is respon-

sible for the care of the operating room and the adjoining rooms. She prepares all instruments, dressings, ligatures, sutures and appliances for operations and those used in the hospital. She keeps a record of dressings and appliances issued to the different wards of the hospital, and prepares a monthly report. She stands at the main instrument table during operations and passes such instruments, etc., as the surgeon may require to the senior nurse. *She touches no instrument or article which has once left her hands until it has passed through the sterilizer.* She must always be sterile. She should endeavor to anticipate the surgeon's needs. She watches closely the nurses who assist her in the operating room and instructs them in the proper performance of their duties. She allows no instrument, apparatus, or dressing to leave the operating room without a written requisition. She sees that messages are delivered to the person for whom intended. She sends all specimens for examination to the pathological laboratory, properly labeled with the name of the patient, the date and the hospital number.

Senior Operating Room Nurse.—The senior operating room nurse has four weeks prior experience as first junior. Under direction of the operating room nurse she has charge of sterilization and preparation of material used in the operating room and also that sent to the wards. She lays out the towels, protectors, caps, masks, rubber aprons, gowns, etc., necessary for the operations.

During operations her post is at the adjustable instrument table. She passes all sponges, towels, and protectors, anticipating the needs of the operator, and is responsible for the correct counting of the sponges. She disinfects and changes her gloves after each operation.

After operations she cleans instruments and returns them to their places, washes out blood-stained gauze, gowns, etc. She sees that the surgeon's dressing room is provided with sterilized gowns for visitors and that the surgeon's operating clothes are properly prepared.

The first junior operating room nurse is responsible for the cleaning of the operating and adjoining rooms. The rooms are dusted each night before she goes off duty. She assists the senior

nurse in the preparation of material. Before going off duty, she sees that the operating room, instrument room and anesthetic room are in order, that the sinks and basins are clean, that the soap, brushes, etc., are in their respective places.

On operating days she arranges the operating room furniture, prepares the basins, solutions, and the anesthetic room. She assists in placing the patient in the required position. The blankets are smoothly arranged so as to completely expose the parts to be operated on, but no portion of the body is to be left unnecessarily uncovered. She assists in preparing the field of operation, bringing soap and water, ether, acid-bichlorid, or iodin as required.

She fastens the gowns, changes hand solutions when soiled, supplies anesthetic; picks up all sponges and towels which drop to the floor; picks up fallen instruments, cleanses them, and sterilizes them; collects the used hand brushes and sterilizes them; places freshly sterilized brushes in the brush jar for each case; keeps the instrument sterilizer three-quarters full of soda solution and boiling; prepares and gives hypodermic injections; operates the thermocautery; collects, counts, and places in a pail all soiled sponges used in a laparotomy, and reports the number to the senior nurse; keeps the saline solution at the proper temperature; takes all messages coming to the operating room and reports them to the operating room nurse.

Between operations she washes the frame of the anesthetic mask and changes the covers. She brings dry warm blankets for the patient and assists the ward nurse to prepare the patient to leave the operating room (dry shirt, stockings, etc.); flushes the operating room floor with bichlorid solution after each septic case; furnishes fresh hand basins; cleans and prepares the operating table for the next case; collects soiled gowns, towels, sponges, etc., and places them in their proper receptacles.

On the completion of an operation or series of operations she rinses out the stains in clothing and towels, and prepares them for the laundry. She cleanses the rubber aprons with soap and water and wipes them off with carbolic solution; cleans all the operating room furniture, anesthetic table, etc.; sees that the solutions are all in order, reporting any deficiency to the operating

room nurse; renews all solutions; and cleanses all glassware, basins, blood-stained gauze, etc.

She watches the operating room nurse, the senior nurse, and the anesthetist and anticipates their needs. She must not leave the room unless ordered to do so by the operating room nurse. She sees that each visitor is provided with a gown, cap and mask.

The *second junior nurse* helps the junior nurse. When two operations are proceeding simultaneously she helps at the second operation. At other times she is employed in preparing dressings and material.

A *supply room nurse* is employed preparing supplies.

The anesthetic nurse accompanies the patient from the ward to the anesthetic room and remains until the patient is taken to the operating room. She marks on the anesthetic slip her name, the name of the patient, the variety of anesthetic, the time begun, and the time established; also the patient's pulse when the anesthesia is established. She watches the pulse carefully, noting its quality and counting it frequently, and reporting its rate to the anesthetist. She assists in controlling any struggling of the patient. She gives hypodermic injections when ordered. She must be familiar with the use of the oxygen apparatus.

Operating Room Orderly.—The operating room orderly remains with the patient while in the anesthetic room, assists in placing the patient in position on the table, controls any struggling on the part of the patient, and wheels the patient into the operating room. Should the operation be one involving the male genitalia, the orderly assists in the preparation of the field of operation. He places screens around the operating table. In cases in which he is not needed in the operating room he remains in the anesthetic room and holds himself in readiness to receive orders from the operating room nurse. Such messages are delivered to him through the medium of the junior nurse. He cleans the floors and fixtures of the operating and adjoining rooms.

Operations in Private Houses.—Fewer operations are done at the present time in private houses than formerly, one reason being that the general public now recognizes the advantage to the patient accruing from operations in a well equipped hospital

where the surgeon is aided by assistants and nurses trained to his methods, and where every appliance is at hand to meet any emergency. There will, however, from time to time be cases which cannot be cared for in a hospital either through the very emergent nature of the case or because the distance is too great for transportation or because of reluctance on the part of the patient to follow the surgeon's wishes. This latter class of patients should have explained to them the desirability of the hospital from an operative standpoint, and either they or their friends should assume the additional risk of operating in the home.

A warm well-lighted room, preferably upon the same floor as that where the patient lies, is selected. All preparation should be conducted so far as possible without disturbing the patient, as the knowledge of the many precautions necessarily taken might increase his anxiety.

The preparation of the room differs in operations of convenience and those of necessity. In the former the room is prepared several days in advance. Everything is removed from it including carpet and hangings. The ceiling, walls, paint, woodwork and floor are thoroughly cleansed, proper furniture and apparatus installed, and the room brought as nearly as possible to those conditions which obtain in a hospital.

In emergency cases, however, harm will be done by attempts at thorough disinfection through raising dust and thus circulating bacteria. In such cases the carpet is covered with laundry clean sheets, sufficient furniture is removed to give room for the operating table and necessary adjuncts, the remaining furniture and mantel shelf being covered with laundry clean sheets. Hangings and pictures are covered; ornaments are removed. In removing articles from the room care must be taken not to raise any dust. If an overhead chandelier is in the room a laundry clean sheet is pinned about it. If the operation is at night the lighting portion of the chandelier is not covered.

Operating Furniture.—Surgeons who are called more or less frequently to operate in private houses will have complete kits comprising a portable operating table, nests of hand basins, a portable sterilizer, etc. If such is not the case, however, im-

provisations must take their place. An operating table is improvised by using a kitchen table and small stand; the Trendelenburg posture is improvised by inverting a straight-back chair upon the table. The table is covered with several blankets and over these a sheet of oil cloth covered by a laundry clean sheet. A moderate sized table is selected for an instrument, sponge and dressing table, and several smaller tables for hand solutions, catgut, etc.; if these small tables cannot be procured chairs may be utilized. The tables or chairs are protected by covering them with several layers of newspaper over which are pinned laundry clean sheets. Wooden or tin pails serve for waste receptacles; bread bowls and pitchers, sterilized by boiling in the clothes boiler, serve to hold sterile solutions. A plentiful supply of cold and hot sterile water should be at hand. Towels and sheets are steam sterilized by suspending them in a large wash boiler which is one-quarter filled with water, then dried by placing on a rack above the fire. Instruments are sterilized by placing them in the bottom of the wash boiler, or by boiling in a large fish kettle. Dressings, gowns, caps, etc., may be sterilized in the same manner as towels and sheets. Gowns may be improvised from sheets, caps from towels, and masks from pieces of gauze.

Rarely, however, will it be necessary to go to such lengths. A surgeon when called to a distance with a possible operation before him will go equipped for the emergency so far as gowns, caps, masks, sterile dressings, instruments, ligature material, sterile protectors and towels which are to be used in the immediate neighborhood of the wound are concerned.

Wherever possible a gas stove should be near the operating room so that in the event of the soiling of any instrument it may be quickly resterilized. Douche bags, sterilized by boiling, serve for irrigation purposes in an emergency.

The preparation of the patient is the same as in the hospital. Nor does the after-treatment differ. Elevation of the head of the bed can be secured if indicated by raising the head of the bed on a table or washstand. If this is impracticable the sitting posture may be improvised by using an inverted straight-back chair.

CHAPTER II.

PREPARATION OF INSTRUMENTS AND SUPPLIES.

General considerations. Instruments. Brushes. Soap. Nail cleaners. Chlorinated lime and sodium carbonate. Hand lotions. Caps. Masks. Rubber aprons. Gowns. Rubber gloves. Finger cots. Protectors. Perineal sheets. Anus protectors. Towels. Blankets. Screen covers. Rubber sheeting. Covers for rubber pads. Muslin bottle bags. Muslin hand, foot, arm and leg bags. Sheets, gowns, towels, blankets, etc. Sterilization. Powders. Solutions. Gauzes. Gauze drains. Wicking drains. Modified cigarette drain. Mikulicz drain. Rubber tissue drains. Umbrella tampon. Cotton. Lambs' wool. Sponges. Compresses. Graduated tampon. Laparotomy pads. Paper dressing. Cleansing of gauze. Waxed or paraffin paper. Rubber goods. Glass goods. Sterilization of catgut. Kangaroo tendon. Silk. Pagenstecher thread. Linen thread. Paraffin silk. Silkworm gut. Horsehair. Silver wire. Iron wire. Percentage table. Thermocautery. Sandbags. Splints. Adhesive plaster.

General Considerations.—The hospital instrument and supply room (Figs. 8 and 9) should communicate directly with the operating room. It is a large room fitted with numerous drawers and shelves containing all the supplies needed for use in the operating room. The furniture consists of three enamel chairs; one long, narrow enamel table for preparing supplies; bandage roller; an apparatus for preparing plaster-of-Paris bandages; and dust-proof instrument cases. Glass bowls, mortar and pestle, glass graduates, mixing rods and indelible ink for marking packages should be kept on a shelf above the supply table. A shelf should be reserved for books relating to aseptic technic, surgical bacteriology, operative surgery and instruments.

Instruments (for list of instruments for various operations see Chapter XXIII) are kept in their proper places in the instrument case when not in use. Knives are kept in racks to prevent dulling. Needles are kept in needle trays. So far as practicable, instruments should be kept in sets representing the operations for which they are commonly used. Instruments in part made of soft rubber are kept separate. No rubber goods are kept in the instrument cabinet. Sets of instruments, the prop-

erty of individual operators, are kept separate from hospital instruments. Duplicate sets of instruments are conveniently placed in linen holders.

Metal instruments (except edged instruments) are *sterilized by boiling* for ten minutes in a 1 per cent. solution of carbonate of

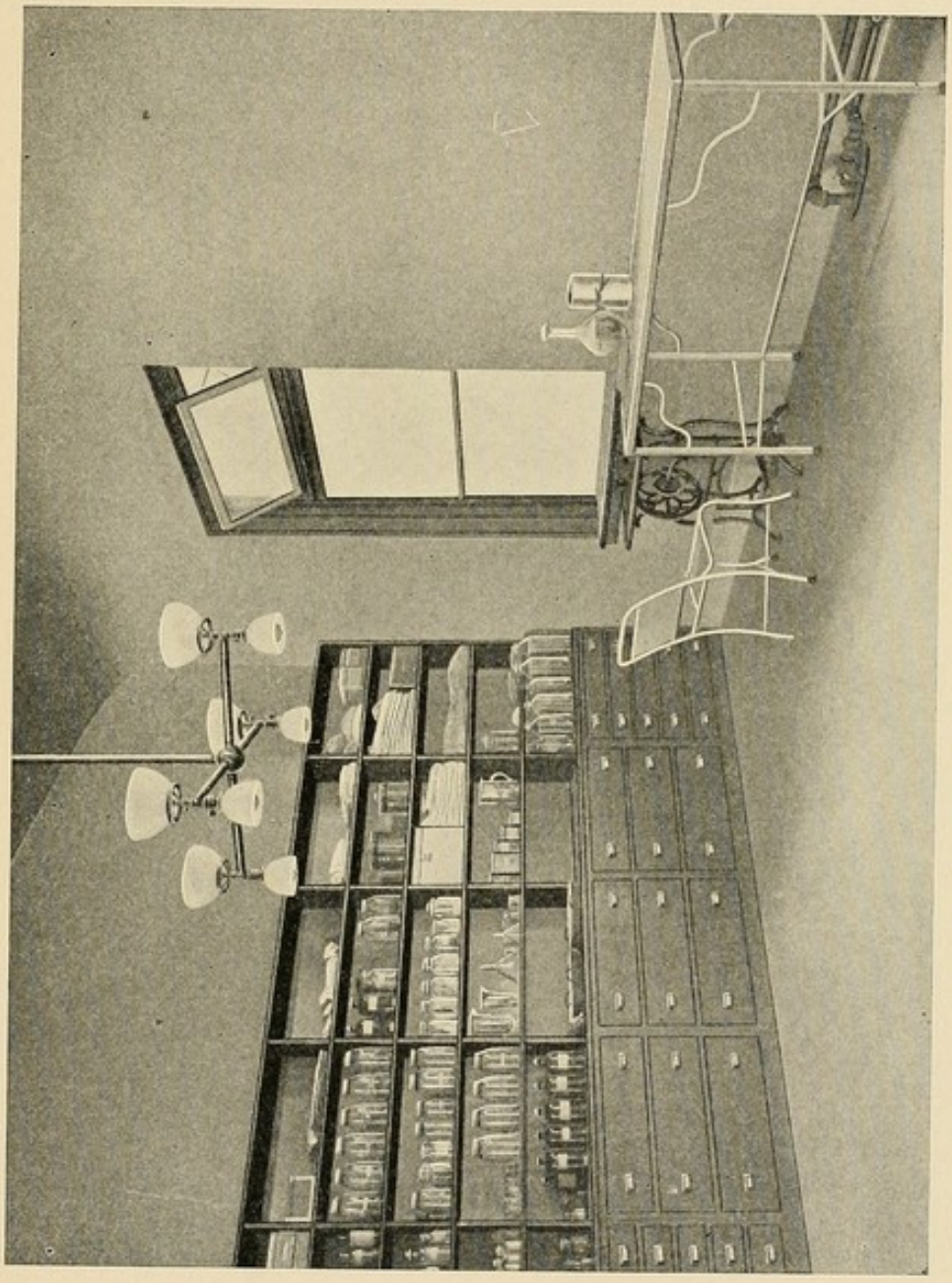


Fig. 8.—Instrument and supply room. First view.

soda just before using. They are taken from the sterilizer in a perforated tray, drained, placed on a sterile sheet, arranged, and covered with sterile towels. Instruments for different operations are boiled in separate trays, then placed, tray and all, upon the instrument table and covered with sterile towels until

required. Trays are removed from the sterilizer by long hooks. Edged instruments with locks, such as scissors and bone-cutting forceps, are boiled for five minutes. They are boiled separately from the other instruments and on a rack which keeps them from

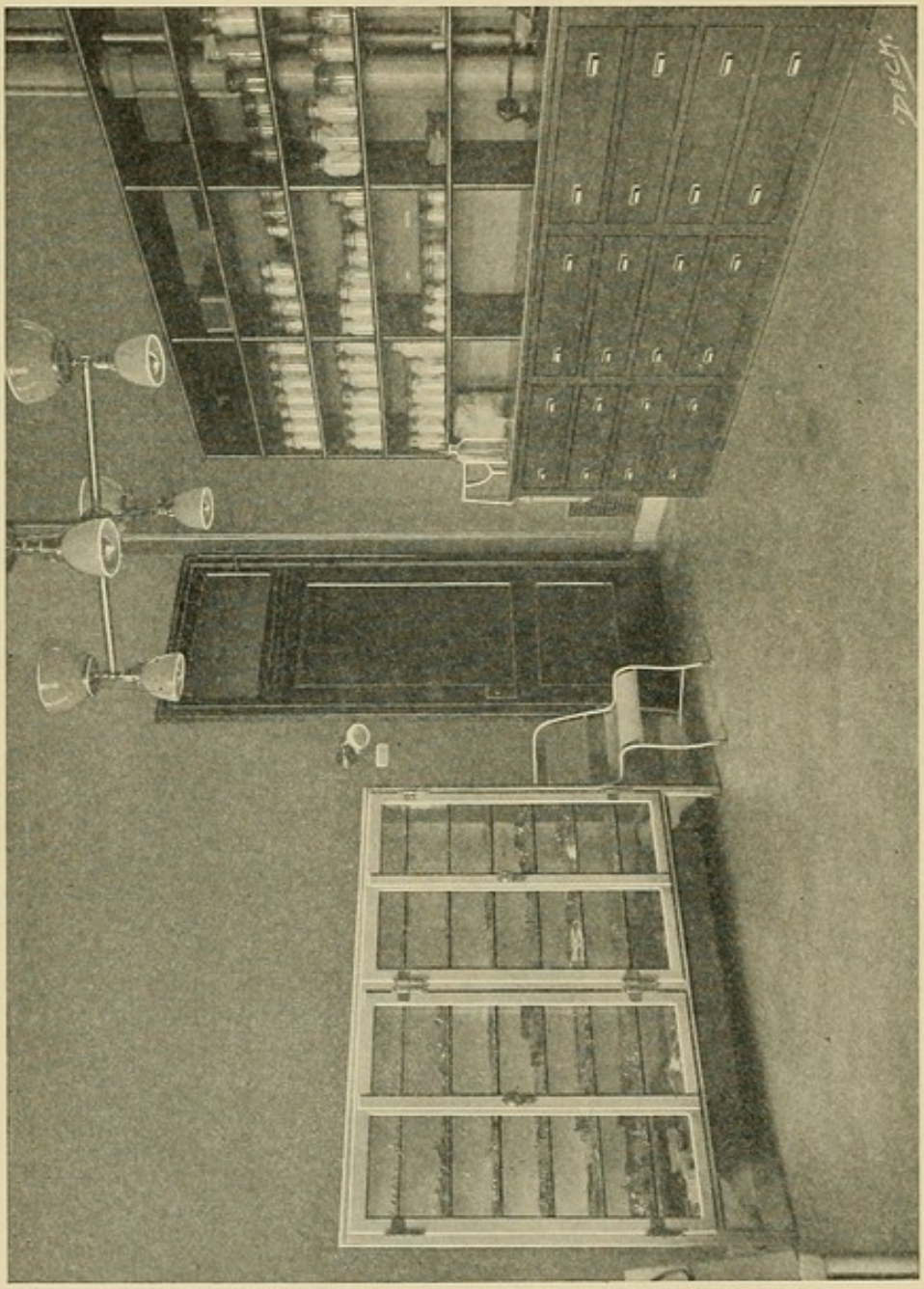


Fig. 9.—Instrument and supply room. Second view.

contact with the bottom of the sterilizer and so in part prevents vibration. Knives are boiled for two minutes in special racks so constructed as to keep their edges uppermost. Needles are boiled for three minutes in an open metal box. During sterilization the sterilizer should be covered. There should always be

sufficient soda solution in the sterilizer to cover the instruments. The instrument sterilizer should be of sufficient depth to accommodate several trays.

Directly after use, instruments are washed, piece by piece, in running cold water until all blood stains are removed. Particular attention is paid to locks and crevices. Instruments are then boiled for ten minutes in soda solution. Following this, they are scrubbed with warm water and "*bon ami*" until bright; rinsed in warm water, thoroughly dried with gauze, polished with a soft chamois, and put in their places in dust-proof cabinets. Each week the cutting-edge instruments that have been used during the week are sent to be set and sharpened. There should be a sufficient number of knives to allow one fresh knife to each operation during the week. The operating room nurse should learn to sharpen the knives. Instruments out of repair are sent at once to the maker.

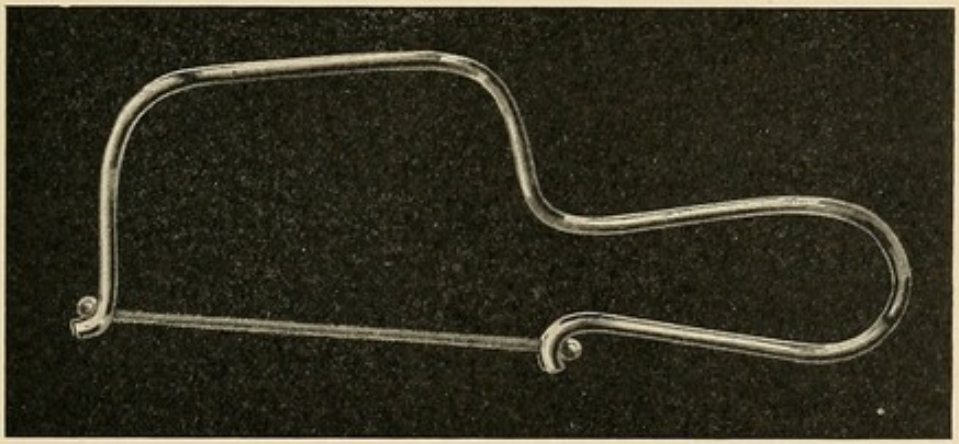


Fig. 10.—Nail cleaner. Metal frame and wire pipe cleaner.

Brushes.—Brushes are sterilized by boiling for ten minutes, after septic cases for one-half hour, in 10 per cent. bichromate of potash solution. They are transferred and kept in covered jars containing the same strength solution in 1:1000 bichlorid. The bichromate of potash-bichlorid solution is renewed at the end of each operating day. The use of this solution keeps the brushes in good condition and makes them last longer. Brushes should be of the common hand brush variety, of good quality, and not so stiff as to abrade the skin.

Soap.—The soap commonly used is the sapo viridis of the

pharmacopœia. Tincture of green soap is a convenient form. Ordinary green soap should be boiled before using in order to make it of more even consistency.

Nail cleaners, nail files, and nail scissors should be kept in a special tray near the sinks. The nail cleaner (Fig. 10) devised by George R. Fowler obviates injury to the matrix and insures thorough cleanliness.

Chlorinated lime and sodium carbonate are kept in separate air-tight stone jars. A ready means of disinfecting the hands after septic operations consists in rubbing a small quantity of each of these ingredients and water into the skin for a few minutes and then rinsing with warm water. The combination gives off chlorin gas. It is quite irritating if left on the skin for any length of time or if used as a routine procedure.

Hand lotions are at times useful in allaying irritation of the skin from too vigorous scrubbing or from chemicals. A simple lotion is made as follows:

℞. Acid, acetic dilut.,
Spiritus,
Glycerini,
Acid. boric. (sat. sol.).....āā ℥j
Aquæ rosæ..... ℥iv.

No hand lotion will make up for lack of care in the cleansing of the hands following operation.

Caps (Fig. 11) are made of bleached muslin in three styles: surgeons' caps, nurses' caps, and patients' caps. They should be made in several sizes and be large enough to come well over the occipital protuberance, covering all the hair. Patients' caps are made of unbleached muslin. They resemble the ordinary bath cap, except that in place of an elastic they have a drawtape which fastens at the back of the neck.

Masks are made of oblongs of muslin ten inches by six inches. Each long side is turned in and a drawtape run through.

Rubber aprons are preferably made of double-faced, red rubber sheeting. Such sheeting is more durable than the single-faced. A sheet one yard square makes the average apron. Elastic rubber tubing is preferable to tape for holding such aprons in place. Aprons are cleaned after each use by scrubbing with

soap and water, then wiped off with carbolic acid 1:40, and hung up to dry. A convenient light apron is made of stork sheeting hemmed with tape and with tape shoulder straps.

Gowns are of two varieties, operators' and nurses'. Gowns having closely fitting long sleeves are preferable to short-sleeved gowns, as the gowns are easily sterilized, while the skin is not.

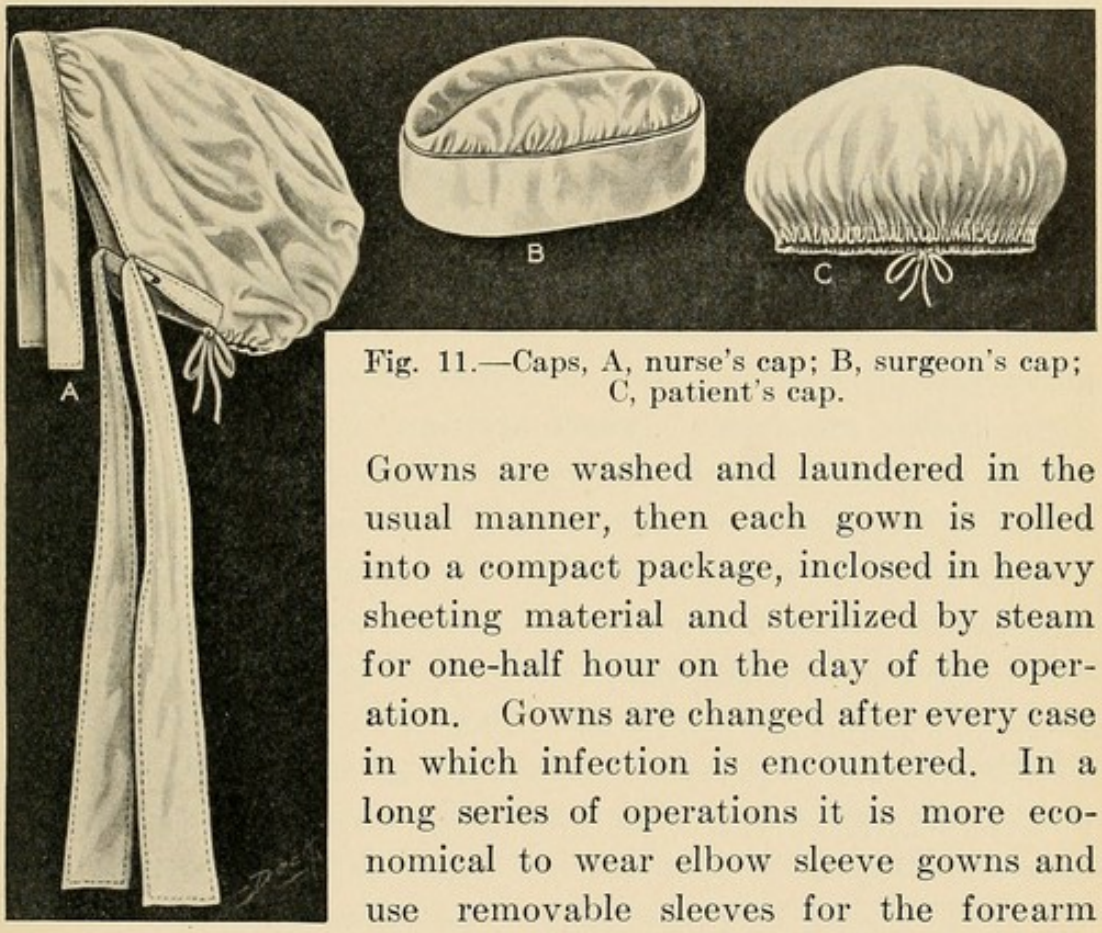


Fig. 11.—Caps, A, nurse's cap; B, surgeon's cap; C, patient's cap.

Gowns are washed and laundered in the usual manner, then each gown is rolled into a compact package, inclosed in heavy sheeting material and sterilized by steam for one-half hour on the day of the operation. Gowns are changed after every case in which infection is encountered. In a long series of operations it is more economical to wear elbow sleeve gowns and use removable sleeves for the forearm which are changed after each case. If the gown is blood stained, not infected, pinning a large sterile towel over the gown is permissible.

Rubber gloves are sterilized by boiling for five minutes in saline solution just before use. Before placing in the sterilizer each pair is loosely wrapped in gauze, the edges of which are secured by weights to the bottom of the sterilizer to prevent the gloves from ballooning and floating on the top of the solution. They are then immersed and filled with bichlorid, 1:3000, and put on. If the operator prefers dry gloves they may be sterilized by boiling, drained and then placed between several layers of sterile towels (enough thickness to ensure a dry surface between

the table and the gloves) by a gloved nurse and their outer surfaces patted dry. The gloves are then turned inside out and that surface patted dry. As each surface is dried it is liberally powdered with a drying powder composed of stearate of zinc and boric acid to keep the surfaces from adhering and cause the gloves to slip on easily. Finally the gloves are wrapped in pairs in sterile well-powdered towels and kept in a sterile receptacle. The drying powder used is sterilized by baking at a high temperature for one hour on three successive days. Gloves should have gauntlets which come well up on the forearm. They should be tested before use by filling them with bichlorid solution to detect any needle holes or tears. They are worn during all operations, but they should not be put on until after thorough mechanic disinfection of the hands. If injury to a glove occurs, the hands are disinfected and fresh gloves donned. Fresh gloves are donned before each operation. The use of a drying powder—*i.e.*, alum—as advocated by Dawbarn, prevents sweating to a certain extent. If the hands sweat excessively so that in the event of the gauntlet not fitting snugly on the forearm it is possible for the secretions to escape and wet the sleeve or even to soil the operating field a piece of gauze may be wound about the wrist and the glove drawn over it. The gauze absorbs the secretions and prevents their escape. Blood and secretions should not be allowed to dry upon the gloves. To avoid this frequent rinsing of the gloved hand is necessary. Before removing gloves they should be washed in running water to remove all blood and secretions. The wet method of sterilization is preferable to the dry as the surgeon can then himself easily determine by distending the glove with fluid whether the glove is perfect. Directly after using, gloves should be washed in soap and water, then boiled in saline solution for two minutes, rinsed in water, the outside dried, turned inside out, and hung up to dry. Allowing them to remain wet causes them to deteriorate. The surfaces may be kept from coming in contact and adhering by lightly packing the fingers with gauze. Needle punctures and slight tears are repaired by stretching the glove over a test-tube and cementing over the aperture a patch of thin rubber dam. If the cement is applied evenly and the

patch held slightly stretched until the cement takes hold the glove will stand sterilizing without loosening of the patch. Special cement comes for the purpose. A patched glove should be worn with the patches inside to avoid the possibility of the patch becoming displaced and being lost in the wound.

Finger cots of thin rubber are useful in examinations and to protect small abrasions on the fingers from infection. They may be put on the first and little fingers of each hand in cases in which many ligatures are to be tied and will aid in preventing the cut which the tying of many ligatures occasionally makes in the creases of these fingers. They are prepared and cared for in the same manner as rubber gloves, except they stand but one minute's boiling.

Protectors are made of heavy linen or of bleached muslin in two sizes, one and one-half yards by one and three-fourths yards, and one and one-half yards by three-fourths yard. They serve to cover the patient except the part to be operated upon. They are sterilized in sets of two, one large and one small, rolled into a compact package done up in heavy sheeting material.

Perineal sheets are used to cover the feet, legs, thighs, buttocks and lower abdomen of patients in the lithotomy position. They are two yards in length by one in breadth. Each short side has a pocket arrangement which covers the patient's foot. Through the center of that portion which covers the perineum is a twelve-inch slit. Each sheet is sterilized in an individual package.

Anus protectors for use in vaginal operations are two-tailed bandages of several thicknesses of gauze, the tails lying upon the abdomen, the body of the protector over the anus. The tails should be long enough to lie well up on the abdominal surface to preclude slipping. The body of the protector is held in place by the speculum. An anus protector should be sterilized in the package with the perineal sheet.

Towels are made of dish toweling of good quality. They are thirty inches in length by twenty inches in width, and hemmed. They are folded separately and sterilized in packages of six.

Blankets for use in the operating room are the ordinary single blankets cut in half. This size is most convenient for wrapping

around the legs of patients or placing over the chest. They are laundered and sterilized after each use.

Screen covers are changed weekly or as often as soiled. The light-weight canvas kind which are provided with eyelets and lace to the frame are best.

Rubber sheeting is kept in stock for making pads for the operating table and for rubber aprons. Several sheets one yard by thirty inches should be kept on hand to place under the patient to act as drainage pads when using irrigations.

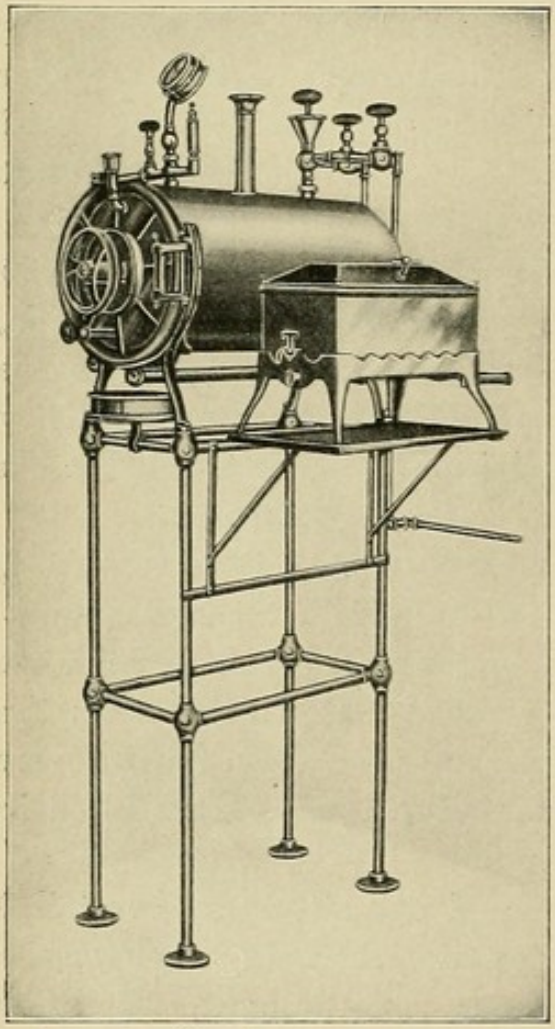


Fig. 12.—Small steam-pressure sterilizer and instrument boiler. (Fowler's Surgery.)

Covers for the rubber pads used on the operating table and carts are of stout muslin. These are fresh for each cause. *Muslin bottle bags* should be kept in stock in various sizes and fresh ones used for each series of operations. *Muslin hand, foot, arm* and *leg bags*, with drawstrings, are useful in operations in the neighborhood of these parts.

Sheets, gowns, towels, blankets, etc., are secured in convenient packages and sterilized by steam at least one hour before operations. If these sterilized bundles have not been opened for forty-eight hours they are resterilized before using.

The Sterilization of Gowns, Sheets, Towels, Gauze and Dressing Materials.—This is best accomplished by exposure to flowing steam, or steam under ten pounds pressure and upward, for one hour. A convenient apparatus for the former is the Arnold steam sterilizer (Fig. 14). In order to prevent the materials from becoming wet in the sterilizer by condensation of the steam

thereon, they should be first warmed. For sterilizing on a large scale for hospital purposes the steam-pressure apparatus (Fig. 15) is to be used. A convenient combination of steam-pressure sterilizer and instrument boiler for office use is shown in Fig. 12. For boiling instruments in soda solution and sterilizing gowns and dressing materials by steam at the same time the sterilizer of Schimmelbusch (Fig. 13) is convenient and efficient. Squares of gauze to be used in place of flat sponges in abdominal section, which require to be warm when brought in contact with the intestines may be boiled in a 0.6 per cent. solution of common salt (Tavel) and kept therein until ready for use, when they are wrung out (Fig. 16).

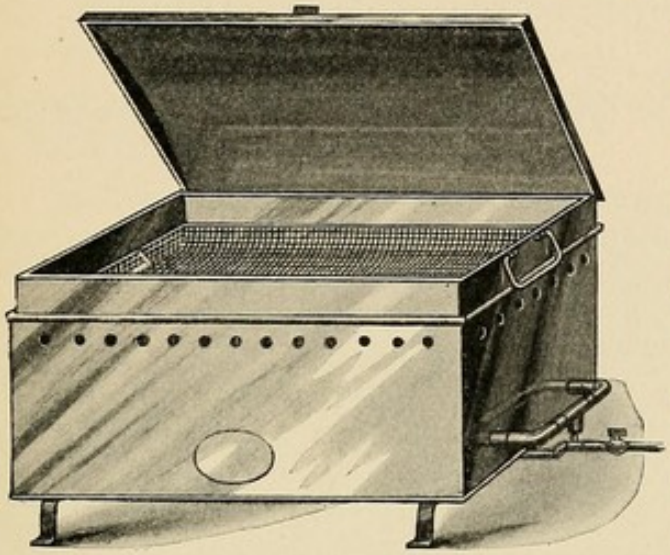


Fig. 13.—Schimmelbusch's sterilizer for boiling instruments in soda solution. (Fowler's Surgery.)

Powders for use in making up dressings and solutions are kept dry in wide-mouthed, screw-cap glass jars.

Iodoform.—This should be finely powdered by mortar and pestle before using. The container should be light proof.

Zinc oxid for making zinc oxid gauze and for use as a dusting powder.

Saline powders for making up solutions for intravenous infusion, made as follows:

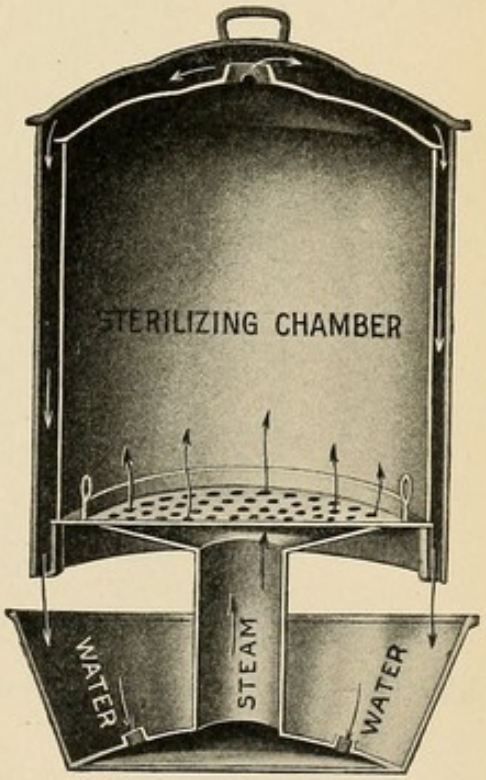


Fig. 14.—Arnold steam sterilizer. (Fowler's Surgery.)

℞. Sodii chlorid ..... ℥iv gr. vj
Sodii sulphat ..... gr. xj
Sodii phosphat ..... gr. iii¾
Sodii carbonat ..... gr. vss
Calcii phosphat ..... gr. ix⅛
Magnes. phosphat ..... gr. iv⅛.
M. Sig.—One powder to six quarts and nine ounces of sterile water.

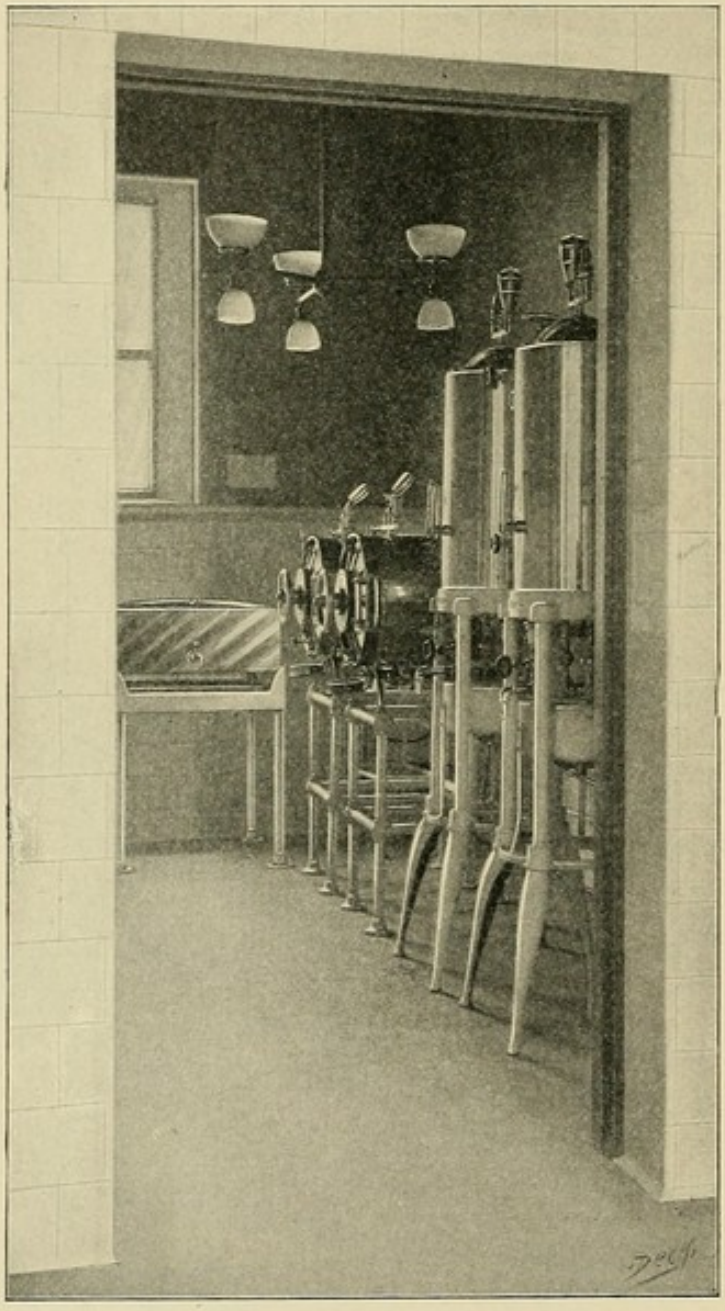


Fig. 15.—Hospital steam-pressure sterilizer, instrument boiler, and water sterilizer. (Fowler's Surgery.)

Potassium permanganate crystals in one ounce packages.
Oxalic acid crystals in one and one-half ounce packages.

Thiersch powders containing 15 grains of salicylic acid and 90 grains of boric acid.

Boric acid for making Thiersch powder, gauze, and solutions.

Bichlorid of mercury made up in tablets of 7 1/2 grains (one to one pint of fluid makes a 1:1000 solution) and for making stock solutions.

Carbonate of soda (℥iiss to the quart makes a 1 per cent. solution) for sterilizing instruments.

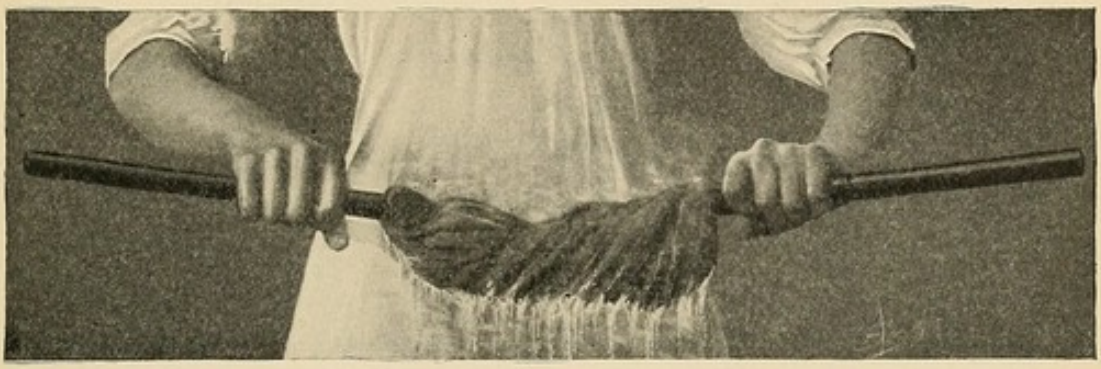


Fig. 16.—Wringer for hot towels, gauze, etc. (Fowler's Surgery.)

Bicarbonate of soda, saturated solution equals ℥ii ℥iiss to the quart.

Sodium chlorid made up in one dram packages and sterilized by dry heat.

Bichromate of potash (℥iss gr. xlviii for making the solution for hand brushes (one package to the pint makes 10 per cent. solution).

Cocain hydrochlorate in one-half grain tablets for making up spray and hypodermic solutions.

Novocain in one-third grain tablets.

Solutions.—All water used in making solutions is sterilized and all solutions are carefully labeled.

Bichlorid of Mercury.—The stock solution may be either 5 per cent. or 12 1/2 per cent. bichlorid in alcohol. It should be kept in a light proof bottle. Of the first, ℥j to the gallon makes a 1:3000; of the second, ℥iv to the gallon makes a 1:2000 solution; other strengths in proportion. A small quantity of anilin blue added to the stock solution is sufficient to color all the solutions and distinguishes them from other solutions.

Sufficient hydrochloric acid should be added to cause an acid reaction in all bichlorid solutions.

Acid bichlorid is made in the proportion of water, 30 parts; alcohol (94 per cent.), 60 parts; hydrochloric acid, 6 parts; bichlorid, to make a strength of 1:1250 (Harrington's formula).

Carbolic acid solution should be made hot. Stock solution, 95 per cent., ℥vj to 1 gallon makes a 1:20 solution; other strength in proportion. The addition of an equal part of glycerin causes the carbolic to mix better with the water. Also used pure in the disinfection of suppurating cavities. When used in this manner a quantity of absolute alcohol should be at hand.

Boric acid, ℥vj to the gallon, makes a saturated solution. Add the crystals while the water is hot; then filter.

Thiersch solution (boro-salicylic solution); salicylic acid, 15 grains; boric acid, 90 grains to the pint. Add the powder to cold water, then filter.

Normal Saline Solution.—Sterile sifted salt, ℥j to the pint. Dissolve in sterile water. Filter in sterile flasks, stopper with sterile nonabsorbent cotton, sterilize for one hour for three successive days at a temperature of 220° F., and cover the cotton stopper and neck of the flask with a rubber finger cot. When needed, place the flask in a deep basin filled with hot water until raised to the required temperature, 120° F. A special saline powder may be used, but is not essential. In an emergency a dram of sterile salt is added to a pint of hot sterile water, the solution is filtered and brought to the required temperature.

Bichlorid-permanganate Solution.—Potassium permanganate crystals, ℥j; bichlorid of mercury, gr. viiss; to 1 quart of hot sterile water. The solution should be made shortly before using.

Permanganate of Potassium Solution.—Crystals, ℥j; hot sterile water, 1 quart. Should be made shortly before using.

Oxalic Acid Solution.—Crystals, ℥iss; hot water, 1 quart. Should be made shortly before using.

Ammonia Solution.—Stronger ammonia, ℥j; cold water, 2 quarts. Should be made shortly before using. For neutralizing the effects of the oxalic acid.

Lime-water, for neutralizing oxalic acid.

Iodoform emulsion, 10 per cent.

℞. Iodoformi (finely powdered)..... ℥j
Glycerini..... ℥lx.

Put glycerin in wide-mouthed bottle, cork, and sterilize by steam for fifteen minutes; add iodoform gradually, shaking the mixture every few minutes.

Formalin Glycerin Mixture (formalin 10 per cent.) for injection into joint cavities.

Chlorid of zinc solution, 10 per cent., for use as an escharotic.

℞. Zinci chloridi..... gr. 384
Aquæ destillatæ..... ℥viij.

Bichromate of potash solution, 10 per cent.

℞. Potassii bichromatis..... ℥iss gr. xxx
Aquæ destillatæ..... 1 pint.

This solution is used for sterilizing and preserving hand brushes.

Woelfler's solution is compound tincture of benzoin to which 10 per cent. iodoform powder has been added. It should be shaken before using. For use as a peritoneal varnish; to fill the umbilicus after cleansing; to coat the nipple in breast operations.

Tincture of iodin, for skin disinfection. Bichlorid to make a 1:1000 solution may be added.

Benzin, for use in the thermocautery and for cleansing eczematous conditions of the skin. Great care must be exercised in handling benzin, as it is very inflammable. It is useful in removing adhesive plaster.

Alcohol, 50 per cent. for general use in cleansing and adding to hand solutions; 80 per cent. for the hands; absolute for sterilization of catgut.

Sterile water is kept in well-stoppered flasks. The hot and cold sterile water apparatus should give a generous supply.

Hydrogen peroxid kept in brown or blue glass bottles. An air space should be left above the solution.

Sodium bicarbonate ℥ii ℥iiss makes a saturated solution for diluting hydrogen peroxid just previous to use and to neutralize the effect of chlorid of zinc.

Commercial ether, for cleansing purposes.

Glycerin, for use as a lubricant; for tampons; for preparing catgut; for diluting carbolic acid.

Balsam of Peru, plain and mixed with an equal part of castor oil for gauze dressings.

Ichthyol, for adding to glycerin to make 10 per cent. tampons.

Vaselin in ounce glass jars for use as a lubricant. Should be sterilized after each use.

Olive oil, for use as a lubricant, and to prevent adhesions in laparotomy, should be sterilized after each use.

Whale oil and iodoform mixture (Mosetig-Moorhoff) for filling bone cavities. To be melted just before use.

Iodoform	60 parts
Spermacetti,	
Oil of Sesame	āā 40 parts.

Horseley bone wax, for controlling hemorrhage from bone.

Paraffin, of a melting-point of 120° F., for preparing silk sutures; for preparing paper coverings for dressings; for injection purposes.

Cocain Solutions.—Solutions of cocain should be freshly prepared. A 1/2 per cent. solution is 2 2/5 grains to the ounce; 1 per cent. solution, 4 4/5 grains to the ounce; other strengths in proportion.

Collodion in light-proof bottles for sealing wounds.

Gauzes.—All gauze previous to use or to impregnation with antiseptics is sterilized by steam for a half hour each day, at a temperature of 212° F., for three successive days (fractional sterilization). In the preparation of all gauzes, strict asepsis of the hands and all utensils is observed. Rubber gloves should be worn.

Iodoform Gauze No. 1. Formula:

Iodoform powder	gr. 116
Glycerin	℥j
Alcohol	℥ij.

Mix thoroughly. This quantity of iodoform makes a 10 per cent. gauze. For more strongly impregnated gauze use iodoform in proportion. This quantity is sufficient to impregnate one yard of gauze. The iodoform emulsion is evenly distributed through the gauze by repeatedly pressing the gauze into the liquid and wringing it out. The gauze is then folded or rolled in

convenient shape and placed in sterile, glass, air-tight, light-proof receptacles. Finally, the gauze is sterilized by steam heat for one hour at a temperature not exceeding 212° F.

Iodoform Gauze No. 2. Formula:

Iodoform powder	℥ss
Glycerin	℥j
Hydrarg. bichlorid (1:2000)	Oj.

Mix thoroughly. Cut the gauze by drawn thread into strips five yards long and four inches wide and fold or roll. Sterilize. Immerse in the above mixture, then sterilize for one hour by steam heat, 212° F.

Iodoform Gauze No. 3. Formula:

Iodoform powder	℥j
Glycerin	℥viij
Alcohol	Oj
Sterile water	℥viij.

Mix the iodoform and glycerin, then add the alcohol and sterile water. Proceed as above.

Iodoform Gauze No. 4. Formula:

Iodoform powder	℥iv
Glycerin	℥x
Alcohol	℥xxxv
Ether	Oj.

Mix the iodoform powder and glycerin. Let stand for twenty-four hours, then mix again and add alcohol and ether. Proceed as above. This formula is best for impregnating gauze.

Zinc Oxid Gauze. Formula:

Zinc Oxid Powder	℥ss
Glycerin	℥j
Sterilized water (warm)	Oj.

Mix thoroughly. Cut the gauze by drawn thread in strips five yards long and three and one-half inches wide; immerse in the solution, squeeze out, roll or fold, place in sterile glass jars, sterilize for one-half hour by steam heat on three successive days, and seal. Only small quantities of this gauze should be made up at one time as it deteriorates.

Boric Acid Gauze.—Cut gauze in strips as above, boil for one-

half hour in a saturated solution of boric acid, then sterilize as for zinc oxid gauze.

Bichlorid of Mercury Gauze. Formula:

Strength	1:1000	1:500	1:400
Absorbent gauze (dry)	13 av. oz.	13 av. oz.	13 av. oz.
Sol. bichlorid (1:1000)	12 1/2 oz.	25 oz.	31 oz.
Sterilized water	q.s. ad 32 oz.	32 oz.	32 oz.

After the gauze has been thoroughly saturated, dry in a dust-proof place and preserve in light-proof jars.

Thiersch Gauze.—Prepare Thiersch solution, 1:50 (proportion: boric acid, gr. viij; salicylic acid, gr. j; use 292 grains of the powder to 1 quart of water). Saturate sterile gauze in this solution for twenty-four hours, place in sterile jars, and seal.

Balsam of Peru Gauze. Formula:

Balsam of Peru	℥iv
Naphthalin	℥iiiss.

The balsam is sterilized for twenty minutes at a temperature of 212° F. Cut gauze in strips five yards long and three and one-half inches wide, sterilize, immerse in the above mixture, wring out as dry as possible, roll or fold, place in sterile jars, and seal. Prepare the gauze before the mixture cools.

Carbolized Gauze. Formula:

Resin	℥xiiiss
Carbolic crystals	℥iiiss
Alcohol	Oiv
Castor oil	℥ii2/3.

Mix thoroughly. This quantity is sufficient to impregnate thirty yards of gauze. Place impregnated gauze in sterile jars and seal.

Drains. *Gauze Drains.*—Strips of various dimensions, the edge turned in and hemmed to obviate fraying, are used for wound tamponade. Cut gauze strips by drawn thread. Gauze drains may be impregnated with antiseptics.

Wicking Drains.—Material is string lamp-wicking which comes in lengths of several yards rolled up in a ball. Cut in lengths of nine inches, place in bundles of four wicks each, fasten the ends with silk, boil for one-half hour in saline solution, place in jars,

sterilize, and seal. The wicking may be impregnated with antiseptics. Several strips of wicking or gauze may be inclosed in green silk protective or rubber tissue stitched in place (cigarette drains). The covering may be fenestrated if desired.

Modified Cigarette Drains (Fig. 17).—The protective only covers that part of the drain which lies in the external part of the wound, the longer portion of the gauze or wicking being used to pack the cavity. They are sterilized for twenty minutes at a temperature of 212° F.

The Mikulicz drain acts as a capillary drain and by compression arrests oozing. It is made of a square of one or two layers



Fig. 17.—Modified cigarette drain.

of gauze, plain or medicated, in which, after it is placed in the cavity to be filled, are packed, as in a bag, strips of gauze the ends of which, as well as the corners of the bag, emerge from the wound.

The three above-mentioned drains are useful in packing or draining cavities and yet allow of ready removal through a small opening.

Rubber Tissue Drains.—Rubber tissue is cut in strips two by three to six inches, boiled in water for five minutes, preserved in 50 per cent. alcohol in normal saline solution, or after boiling it may be rolled between layers of gauze, placed in jars, and sterilized for twenty minutes at a temperature not higher than 212° F. Heat will destroy very light rubber tissue if prepared in this way. It yields readily to the influence of overwarm or hot fluids and is often awkward to manage when in contact with either. Consequently it is of less practical use than the green silk. Moreover, it is too rapidly disintegrated by wound secretion to act efficiently as a drain for any length of time.

Umbrella Tampon.—This type of tampon (Fig. 18), formed by a rubber tube to which is sewed a curtain of gauze, is useful in controlling hemorrhage in rectal and perineal wounds. The interior of the curtain is packed firmly with gauze strips after

the tampon has been placed in the wound, the rubber tube allowing the escape of gas or urine, as the case may be.

Cotton, nonabsorbent, is prepared by cutting the original roll in half lengthwise, then unrolling each half and cutting crosswise into four sheets. Each sheet is rolled up, not very tightly, and covered with heavy sheeting material. Sterilize by steam at a temperature of 240° F. for one-half hour. This cotton is used for the outer protection of wounds and for padding splints.

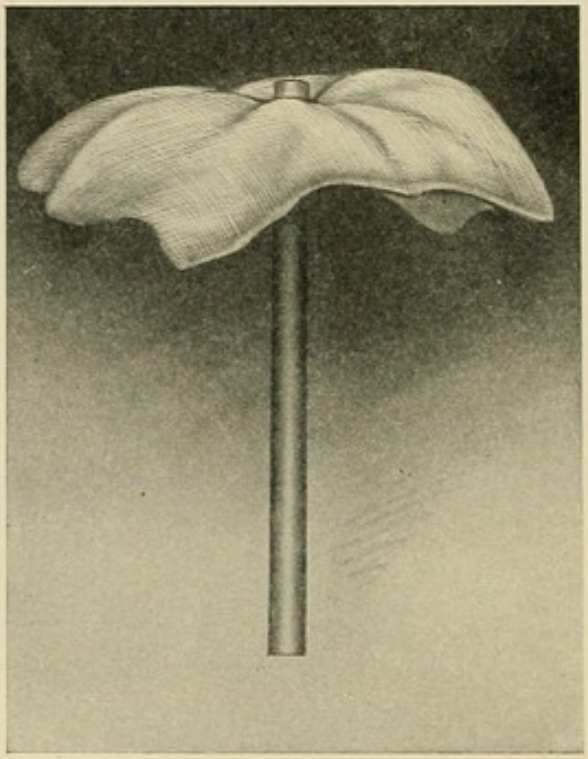


Fig. 18.—Umbrella tampon.

Cotton, Absorbent.—Small pieces are used on wooden applicators for cleansing wounds or applying caustics. A number of these are prepared and sterilized in their container. Absorbent cotton is rolled up in small packages and sterilized by steam for one-half hour.

Lambs' wool is cut into convenient sizes, two inches by four, for tampons. An eight-inch piece of cotton string is tied around the middle of the tampon to facilitate its withdrawal. The ends of the string should be knotted together. They are useful for vaginal tamponade.

Sponges.—*Hand sponges* are made of a single thickness of gauze eighteen inches square. Two opposite sides are folded

one over the other so as to lessen the width of the gauze two-thirds; the short sides of the resulting rectangle are folded toward each other and the end of one short side is inserted into the end of the other short side in the same manner that one tucks in the flap of an envelope. With a little practice sponges can be made more quickly in this manner than by sewing them. They are put up in packages of twenty-five.

Stick sponges are made from gauze one-sixteenth of a yard square in three ways; either like the hand sponges, or three corners of the small square may be folded to the center and then rolled into a ball which is held in shape by inclosing it with the fourth corner in the same manner that a pair of socks are held in shape when rolled up, or a small quantity of absorbent cotton may be inclosed in a three-inch square of gauze and secured by stitching. They are put up in packages of fifty.

Laparotomy sponges are made in three sizes, eight, ten, or twelve inches square, of six thicknesses of gauze, the edges turned in and hemmed so that there are no loose threads. To one corner of the sponge is sewn a tape twelve inches in length. Twelve laparotomy sponges of the same size, the tapes numbered from one to twelve are made into a package.

Crash wash-cloths are useful for this purpose. They should have the usual twelve-inch tape attached.

Particular care must be exercised in counting these sponges, both when they are made up into packages and when these packages are opened. Any inaccuracy in the count must be at once reported.

Compresses are made of a single thickness of gauze one yard square. Two opposite sides are folded so as to overlap each other, thus turning in the raw edges and decreasing the width of the gauze by two-thirds; the opposite sides are then folded over each other toward the center. Compresses are done up in packages of two, for ward dressings; three, for laparotomy dressings, and twelve for general operating room use.

Graduated tampon, a pyramid built up of different sized layers of gauze, held in place by a few stitches through the center, is useful in exerting even pressure or in checking hemorrhage.

Laparotomy pads are used to save gauze; they are made by

inclosing a twelve-inch square of nonabsorbent cotton in a gauze bag.

Paper Dressing.—Bags of gauze, twelve by eight inches, are loosely filled with shredded tissue paper. This form of dressing is very absorbent, and therefore useful in dressing cases in which a large discharge is expected. They serve admirably for vulvar pads.

Cleansing of Gauze.—All gauze (except the stick sponges) which has not been used in septic cases is soaked in several changes of cold water and stirred occasionally to remove the blood, then washed in running cold water until all stains are removed, rolled in packages, boiled for one-half hour in normal salt solution, wrung out, and placed in the steam sterilizer to dry. When dry, the gauze is made up into sponges and compresses and sterilized in the usual manner. Laparotomy sponges are cleansed in the same manner.

Waxed or paraffin paper is used to enclose packages of dressings, sponges, etc., after sterilization to keep them free from moisture. It is used as a substitute for oiled silk or gutta-percha tissue in making pneumonia jackets, protective covering for wet dressings, etc. It is much cheaper than either of these materials. Paraffin is cheaper than wax. To prepare, spread sheets of paper on a flat surface, melt the wax or paraffin, pour it on the paper; iron evenly with a hot flat-iron. The prepared paper should not be exposed to high temperatures.

Rubber Goods.—The stock supply of rubber tubing and other rubber goods, such as catheters, stomach tubes, perineal tubes, Esmarch constrictors, and Martin elastic bandages, should be kept in a drawer by themselves and liberally sprinkled with powdered sulphur. Treated in this way, rubber can be kept in good condition for years. Rubber tubing should not be kinked nor should rubber sheeting be creased. *Rubber drainage tubes* of various diameters cut in desired lengths from the stock supply, are scrubbed with soap and water, rinsed, boiled in 1 per cent. carbonate of soda solution for one-half to one hour, rinsed, and preserved in alcohol, 50 per cent., or carbolic acid, 1:40, in normal saline solution in sterile sealed jars. The solution is changed at least once each week. Fenestra are cut just before

using. When used for draining an infected area fenestra should be placed only in the infected portion of the wound, to do otherwise is to promptly invite infection throughout the entire area through which the tube passes. A form of self-retaining rubber tube useful in draining cavities, particularly pelvic abscesses per vaginam, has been designed by Harrison (Fig. 19). *Rubber dam* is sterilized by boiling for one-half hour in saline solution, rinsed and preserved in carbolic solution, 1:20. *Green silk*

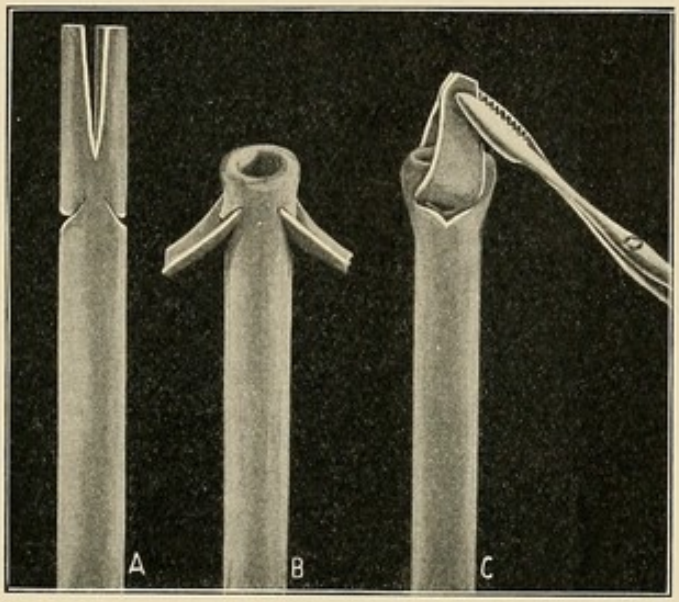


Fig. 19.—The self-retaining drainage-tube. A, Rubber tube shaped ready for forming the self-retaining wings; B, the split lateral portions of the tube reversed and passed through the openings on the side to form the wings; C, the tube grasped by the forceps ready to be placed in position. (Fowler's Surgery.)

protective is cut in strips fourteen inches long by two inches wide, washed with soap and water, placed in bichlorid solution 1:000 for one hour, rinsed in saline, laid between strips of sterile gauze of slightly larger dimensions, rolled loosely, and sterilized in jars at a temperature of 212° F. for twenty minutes. It is useful as a capillary drain. Two or more strips one-half inch wide and of sufficient length should be used. When applied in the form of narrow strips, imbricated or not, as in skin-grafting and blood clot organization (Schede), equitable temperature is maintained and free escape of discharges into superimposed absorbent dressings is promoted.

Filiform bougies should never be boiled. They are washed with soap and water and placed in carbolic solution 1:40 shortly

before using. Just before using they are rinsed in sterile water. After using, they are washed with soap and water, rinsed, and carefully dried. They should be kept in a box or metal cylinder by themselves.

Tourniquets and rubber bandages are washed with soap and water, rinsed in 1:100 carbolic, and rolled up just before using. After using, they are washed with soap and water and thoroughly dried. They may be prepared by boiling in plain water for two minutes.

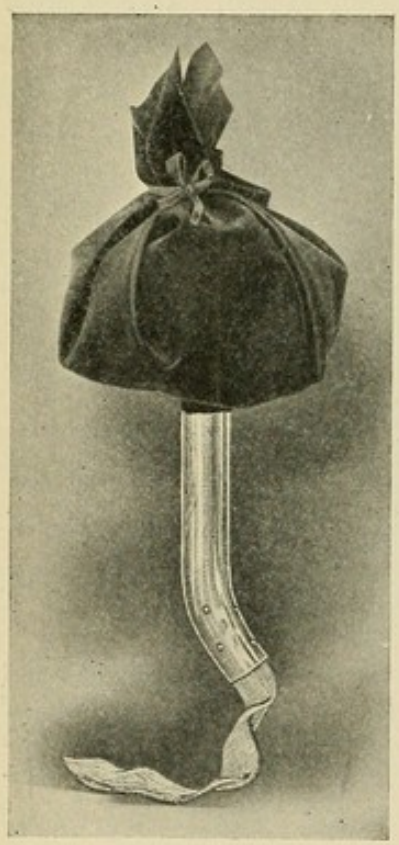


Fig. 20.—Glass drainage tube with rubber dam and gauze strip.

Rubber bolsters are used in tying cross-sutures in pairs. They are one inch in length, three inches for perineal bolsters, cut from thick-walled rubber aspirating tubing. The cut edges should be rounded with scissors. They are boiled for ten minutes just before using. They should be preserved after removal, cleansed and resterilized.

Glass goods comprise various sized drainage tubes, catheters, connections, irrigation nozzles, syringes, medicine droppers, and medicine glasses. They are sterilized by boiling in soda solution and kept in bichlorid, 1:1000, in covered glass receptacles. This process should be repeated at least once each week.

Flanged glass drainage tubes serve the purpose better than rubber tubes in the majority of cases as they are not as irritating and are more readily cleansed. The discharge through the tube may be kept from coming in contact with the wound by employing a bag of rubber tissue containing gauze, a strip of which leads down into the glass tube (Fig. 20). The bag is formed by making a minute hole in the center of a twelve-inch square of rubber dam. This is snapped over the end of the glass tube and the edges of the rubber sheet gathered together over the gauze and secured by a tape.

Sterilization of Catgut. *Alcohol Method* (Fig. 21).—Catgut is

wound evenly on glass spools, one yard of catgut on each spool, and each spool placed in a glycerin-jelly jar. Each jar is then filled with absolute alcohol, the cap lightly screwed on, and the jars placed, cap down, in a two-quart glass jar and covered with absolute alcohol. This jar is then placed in a water-bath on a gas stove (unlighted). A platform of wire netting, such as is

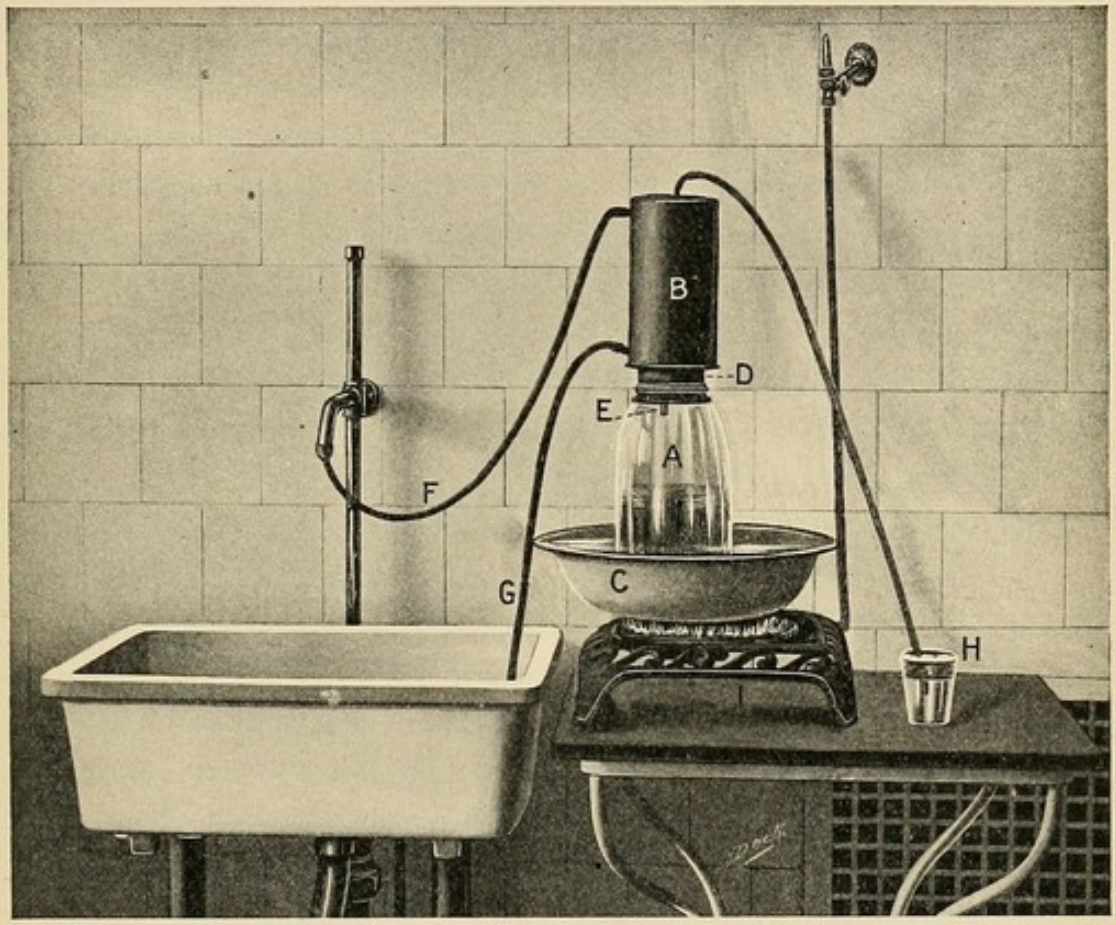


Fig. 21.—Apparatus for sterilizing catgut by boiling in alcohol. A, fruit jar containing jelly jars filled with catgut; B, Dowd's condenser; C, water-bath; D, rubber cork connecting the jar with the condenser; E, tube extending from body of condenser through which the condensed vapor of the alcohol flows back into the jar; F, tubing connected with cold-water faucet; G, outflow tube for water from the condenser; H, cotton-sealed receptacle for overflow of alcohol (should be placed further away from the flame); I, gas stove. (Fowler's Surgery.)

used in making wire splints, is placed at the bottom of the water-bath, and on this the large jar rests. The top of the jar is of rubber and should fit very snugly. Through the center of this top runs the lower tube of a Dowd condensing apparatus. The inlet water tube of the condenser is connected with a water tap and a small stream of water turned on. The outlet water tube is led into the sink. The end of the outlet alcohol tube is

placed in a glass jar, the top of which is covered with gauze wrung out of bichlorid. This jar should be set at a distance from the flame of the gas stove. Unless a large jar is used for this purpose, it may be necessary to empty it two or three times during the hour. Enough alcohol to cover the jelly jars should be left in the jar. When the gas stove is turned out and the sterilization jar begins to cool, this alcohol is sucked back by the vacuum in the sterilizing jar. Care must be taken that no fire is in the vicinity of the alcohol until the entire apparatus is set up and ready to start. The catgut is boiled in alcohol three successive times for one hour at intervals of twenty-four hours. It is not removed from the sterilizer jar until the entire apparatus is cool. Nor is fresh alcohol added to the alcohol bath, except under the above conditions. Finally the small jars are removed from the large jar and their caps screwed down tightly. They are then placed in a large sterile jar and kept covered with absolute alcohol.

Chromic Catgut No. 1.—Plain catgut is sterilized for one hour by the above method. It is then wound from the spool on glass plates, thoroughly dried for twenty-four to forty-eight hours (if not thoroughly dried the retained moisture weakens the gut), subsequently boiled in a solution of chromic acid, 1:5000, for one hour, and left immersed in this solution for twelve hours. Following this, it is allowed to dry thoroughly, wound again on spools, and prepared by the alcohol method.

Chromic Catgut No. 2.—Plain catgut is immersed for twenty-four hours in ether and sterilized by boiling in alcohol for one hour. It is dried for two days and then placed for thirty hours in a jar containing the following solution:

Bichromate of potassium	gr. iss
Carbolic acid	gr. x
Glycerin	ʒj
Water	Oj.

It is then thoroughly dried and prepared by the alcohol method.

Braided Catgut.—Cut three strands of catgut No. 0 or 1 in twenty-inch lengths; knot together at the end, then braid. Sterilize by the alcohol method, placing two braided sutures in each small jelly jar.

Bartlett Method.—Desired lengths of catgut in coils held together by silk for convenience in handling are placed on a sheet of asbestos in a hot-air chamber, the temperature being gradually raised in the first hour to 180° F., and the second hour to 220° F. It is then placed in an asbestos lined kettle containing liquid alboline and allowed to remain there until it is perfectly clear in the sense that the term is used in the preparation of histologic specimens. This process of clearing is usually completed in a few hours. It is not material how long the catgut is allowed to remain in the alboline after the clearing is established. Upon the completion of the clearing process or as soon thereafter as convenient, the kettle is placed upon a sand bath and the temperature gradually raised during one hour to 320° F. This temperature is maintained for one hour. The catgut is removed from the alboline with sterile forceps and placed in a mixture of iodin crystals, one part, and Columbian spirits, one hundred parts. The silk thread is removed. After twenty-four hours immersion the gut is ready for use. Raising the temperature too rapidly either in the hot air chamber or while the gut is being treated by alboline will result in rendering the catgut brittle.

Kangaroo tendon is sterilized by boiling for one-half hour in alboline, at a temperature of 245° F., then transferred to absolute alcohol in glass tubes and sealed.

Silk is boiled on small spools for five minutes in normal saline solution, and preserved in a solution of alcohol-bichlorid (1:5000); or boiled for five minutes in bichlorid, 1:500, and preserved in the same solution. This latter process weakens the silk. Silk will usually stand but three sterilizations, so but small quantities should be made up at one time.

Pagenstecher thread (linen thread treated with celluloid) comes in skeins of several yards. It is stronger than silk of the same size, is sterilized without deterioration by boiling, stands repeated sterilizations, does not tangle so readily as silk as it is stiffer. It is preferably prepared just before use by boiling with the instruments. It is not so smooth or pliable as paraffin silk. *Linen thread, Swedish linen thread* are prepared in the same manner.

Paraffin Silk.—Wind the silk loosely on a glass spool, and soak for one-half hour in soft, white paraffin at a temperature not higher than 240° F. Drain in a sterile towel. Sterilize by steam heat, fractional sterilization.

Silkworm-gut.—Boil for ten minutes in normal salt solution. Preserve in a solution of carbolic acid, 1:30; or boil a sufficient quantity for each series of operations with the instruments.

Horsehair.—Scrub with hot water and green soap, rinse thoroughly in plain water, then in alcohol 50 per cent. Boil for three minutes in saline solution. Preserve in alcohol-bichlorid, 1:1000.

Silver Wire.—All small pieces of silver wire should be saved, as the manufacturers allow for the silver returned. It is prepared by boiling for ten minutes in normal salt solution.

Iron wire, such as is used to suspend stove pipe, is preferable to silver or other wire, as it is of greater tensile strength and does not break on twisting. It is sterilized by boiling.

PERCENTAGE TABLE.

To make four fluid ounces of solution.
1/10 of 1 per cent. equals 1.92 grs.
1/8 of 1 per cent. equals 2.40 grs.
1/6 of 1 per cent. equals 3.20 grs.
1/4 of 1 per cent. equals 4.80 grs.
1/3 of 1 per cent. equals 6.40 grs.
1/2 of 1 per cent. equals 9.60 grs.
1 per cent. equals 19.20 grs.
2 per cent. equals 38.40 grs.
2 1/2 per cent. equals 48.00 grs.
3 per cent. equals 57.60 grs.
4 per cent. equals 76.80 grs.
5 per cent. equals 96.00 grs.
6 per cent. equals 115.20 grs.
7 per cent. equals 134.40 grs.
8 per cent. equals 153.60 grs.
10 per cent. equals 192.00 grs.
Other strengths in proportion.

Thermocautery (Fig. 22).—The thermocautery should be thoroughly tested each operating day. There should be an extra cautery in case of accident. Its principal use in the operating room will be for the destruction of mucous membrane in

appendicectomy, in operations upon the liver and bile passages, and in hemorrhoid operations. All three cautery tips—the point, the knife, and the button—should be in thorough order. The benzin chamber of the cautery should be replenished and the cap screwed on, and the rubber tube and bulb attached. The tip is held in a gas flame until it becomes a dull red. The benzin vapor is forced through the cautery by squeezing the rubber bulb. Care is taken not to fill the rubber air reservoir

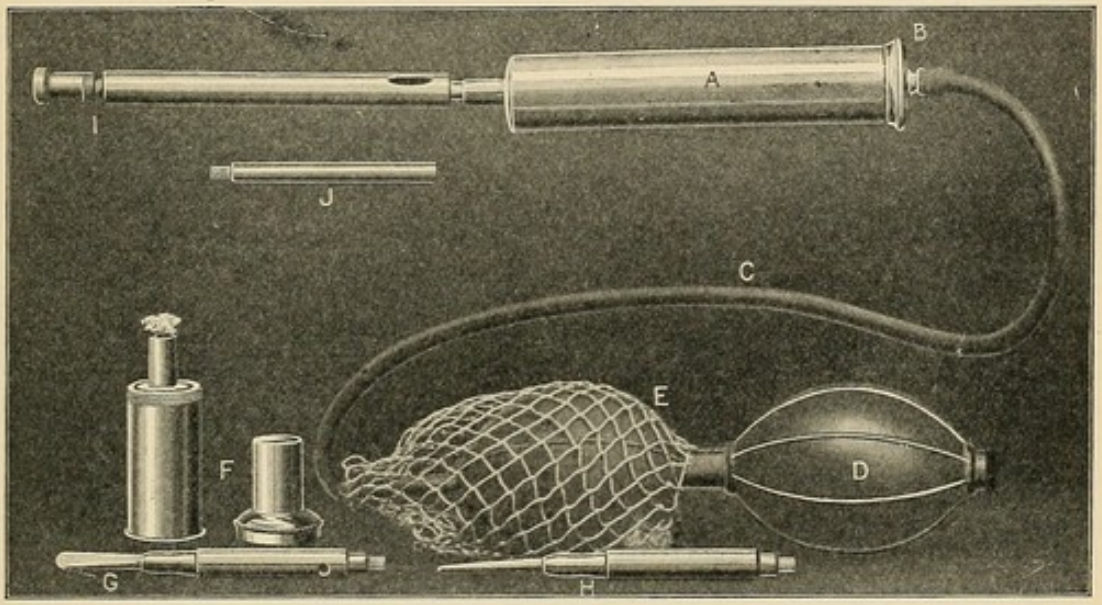


Fig. 22.—Thermocautery. A, Hollow handle containing absorbent cotton —saturated with benzin; B, removable cap; C, connecting tubing; D, rubber bulb; E, secondary bulb guarded by netting; F, alcohol lamp and cap; G, knife-shaped cautery point; H, pointed cautery point; I, dome-shaped cautery point; J, extension attachment to be used with the shorter cautery points. (Fowler's Surgery.)

too full or it may burst. The benzin vapor must not be forced through until the cautery tip becomes red. If this is done prematurely, the vapor cools the tip and the heating process has to be repeated. Some cauteries are provided with an apparatus by which the preliminary heating is accomplished through an extra tube connecting the benzin chamber, a stopcock controlling the flow of benzin. From three to five minutes should be allowed to get the cautery in running order. Once heated, the rubber bulb should only be pressed sufficiently often to keep the tip dull red, dull red showing the proper amount of heat for cauterizing. If the tip becomes too hot, this is remedied by momentarily pressing the rubber tube, thus shutting off the air. Just

before the cautery is handed to the operator, a dry sterile towel should be thrown around the body of the instrument in such a manner as to allow the operator to grasp the instrument without touching it directly. In handing the cautery to the operator and in receiving it from him, the nurse should exercise great care not to allow the tube to touch anything sterile. The heated thermocautery should be kept at a distance from the anesthetic. After use the tip should be thoroughly heated and allowed to cool slowly. When quite cool, the tip is gently cleansed with gauze. For appendicial operations the point tip is most frequently employed; for hemorrhoid operations, the button tip; for liver operations all three may prove useful.

Sandbags, useful for maintaining the patient in the required position and for supporting plaster-of-Paris casts while drying, are made in six convenient sizes; 25×8 inches; 18×10; 12×10; 10×9; 12×5; 20×15. They are covered with rubber sheeting.

Splints are kept in a small room adjoining the anesthetic room. All varieties of splints and splint material should be in stock. There should be a small bench and set of tools so that special splints can be made.

Adhesive Plaster.—Officinal resin plaster, rubber plaster, and moleskin plaster are the varieties commonly employed. Surgeon's adhesive plaster—rubber plaster—is now made in combination with zinc oxide, in order to render it less irritating to the skin.

Preparation.—The plaster may be used directly from the roll or it may be cut in long strips, one-half to three-fourths, two, three, or four inches in width, and these strips may be rolled on glass or metal rods six or eight inches long, for convenient handling. The small strips are useful for strapping the ankle and other joints, for the treatment of leg ulcers, and for retaining dressings; the wider strips for strapping the chest and abdomen.

Adhesive plaster may be used in the form of taped straps to retain an abdominal dressing in position (Fig. 23). For this purpose four or more strips are used, each strip having a length of ten or twelve inches and a breadth of three inches. One end of each strip is folded on itself, adhesive surfaces together, for a distance of one-half inch; the object of this is to facilitate removal.

The other end of each strip is folded on itself, adhesive surfaces together, for a space of one inch, and through this double thickness a triangular cut is made with scissors, and through the opening a half-inch tape is passed and knotted. Each tape should be long enough, eight to ten inches, to admit of being tied in a bow knot to its fellow of the opposite side over the abdominal dressing. Two of these prepared adhesive plaster straps are placed on the skin well back on each flank. The skin should first be dried to insure thorough adhesion. By applying straps

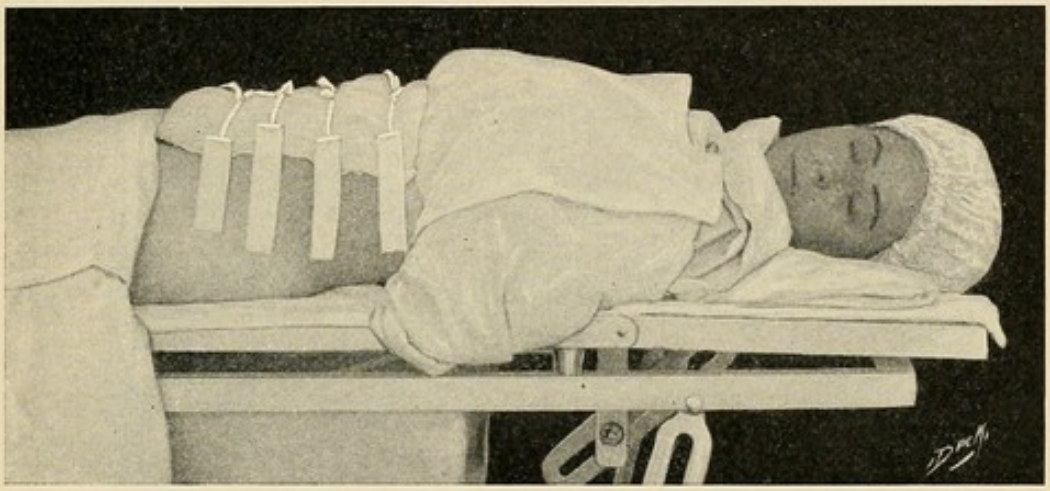


Fig. 23.—Adhesive plaster strips to retain abdominal dressing.

in this manner it is only necessary to untie the tapes when inspecting the dressing. This does away with the unpleasant necessity of frequent changes of adhesive plaster, and furnishes a more economical method of retaining dressings in most parts of the body. These strips are particularly useful in Syme's amputation and other foot amputations in which part of the tarsus is left. All adhesive plaster strips should be scrupulously freed from ravelings. It is particularly these threads which tend to irritate the skin.

Adhesive plaster may be employed for the purpose of approximating the edges of a wound. When so used the plaster should be sterilized by heat, unless it has been specifically prepared for this purpose by a reliable manufacturer. If it has not been so prepared it may be readily sterilized by passing it through a flame. In applying plaster to approximate wound edges, space should be left between the strips to provide for the escape of any

discharge that may form. If the ends be turned under for a distance of a quarter of an inch or so, and the surfaces stuck together, the strips can be the more readily raised and with less annoyance to the patient than if the ends be directly applied to the skin.

Resin plaster, when used for any purpose, must be heated in order to make it adhere. When this form of plaster is used, the degree of heat which it may have absorbed should be tested by applying the reverse side of the plaster to the back of the operator's hand before the plaster is placed on the patient's skin; otherwise blistering may result from the application of too great heat.

It is not necessary to heat rubber plaster to cause it to adhere, although it may be heated for purposes of sterilization. Strips

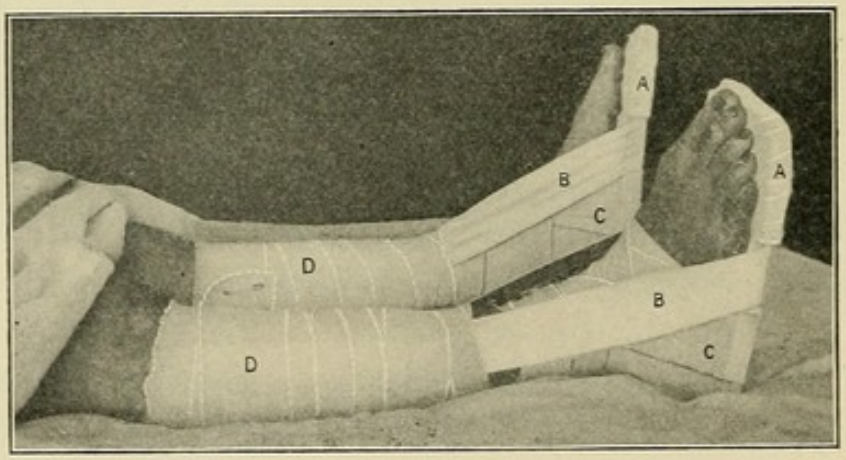


Fig. 24.—Stirrup of adhesive plaster to prevent the foot from assuming the equinus position. A, A, Padded foot-piece; B, B, adhesive plaster straps; C, C, bandages securing foot-pieces in position; D, D, bandages securing upper ends of adhesive plaster straps. (Fowler's Surgery.)

of plaster may be used for securing dressings in place while the bandage is being applied, as in applying dressings and bandages to a circular part such as the thigh.

Adhesive plaster may be incorporated in a bandage in such a manner as to retain the bandage in position, part of the adhesive plaster being adherent to the skin and part to the bandage. Adhesive plaster is also useful for exercising direct pressure upon a part as in strapping a joint or strapping the testicle; for exerting indirect pressure as in retaining a graduated compress in position; for securing immobilization in fractures; for pre-

venting the development of deformities, as in the prevention of the equinus position of the foot in patients long confined to bed, (Fig. 24); for relieving hyperemia as in the ambulatory treatment of ulcer of the leg (Fig. 153); for making extension, (Fig. 25); for preventing inversion of the lips of a deep wound, as in stout patients in whom there has been fat necrosis in the wound.

In applying plaster to any part of the body the parts should first be cleansed and, if necessary, shaved. If it becomes necessary to apply a second strapping to a part, the plaster should, if possible, be made to avoid any irritated areas that have resulted from the first strapping. Alcohol or benzin will faciliate the

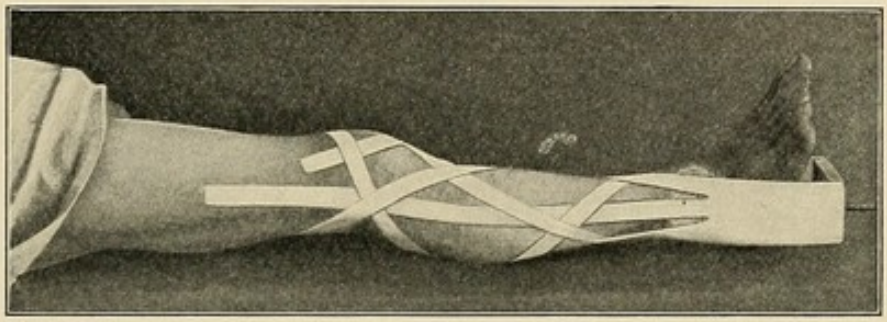


Fig. 25.—Extension with adhesive plaster. (Fowler's Surgery.)

removal of ordinary plaster. Benzin is an excellent solvent for plaster and may also be used for cleansing the skin after the removal of the plaster. With zinc-oxid plaster it is not usually necessary to use either alcohol or benzin. When the plaster is removed it is less painful to the patient if, after the plaster has been started, the skin is pulled away from it with one hand while steady traction is made on the plaster with the other hand. If the plaster is pulled away from the skin too rapidly and without the above precaution the edges of the plaster, where it has become most adherent to the skin, are apt to pull away some of the superficial layers of the skin, and in some instances an injury resembling a "scratch" results.

Adhesive Plaster Abdominal Scultetus (Fig. 26).—This form of dressing was advocated by Boldt as a means of supporting the abdominal wall after laparotomy and thus allows of the earlier moving about of the patient. Zinc-oxid plaster is used to reduce skin irritation to a minimum. The quality of the plaster should be such as to preclude stretching. The full

width of the plaster (twelve inches) is used and, according to the size of the patient, the strip should measure from twenty-eight to forty inches or more in length. From the center of the lower edge of the strip a semicircular piece is cut, in order to avoid soiling during defecation. The patient is placed upon the bandage so that the lower border comes on a level with the pubes. The fabric covering the plaster is now removed. This is facilitated by rolling the patient first to one side and then to the other, while an assistant steadies the plaster and removes the fabric. Each end of the plaster is next split into four tails. These tails are snugly adjusted, the lower one on one side being applied first, then the lower one on the other side, and so on.

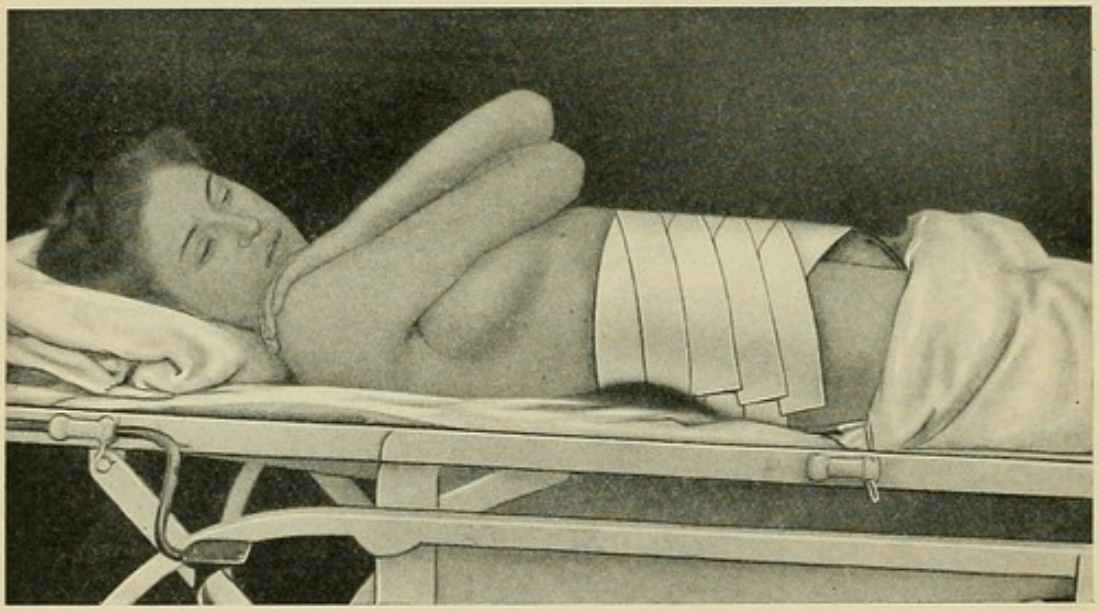


Fig. 26.—Adhesive plaster scultetus.

These overlap, thus making a double support in front and at the sides. This process is continued until the four tails on each side have been snugly adjusted. If the upper part of the bandage should reach to the epigastrium, the upper tails are not drawn so tight to avoid pressure on the ribs and consequent interference with respiration. The anterior-superior spines of the ilia are protected by lightly padding with gauze. At the time for the removal of the sutures the adhesive plaster is cut in the middle line anteriorly from the pubes up and each lateral portion is folded back. After the completion of the dressing the cut edges of the adhesive plaster are reinforced with other pieces

of plaster; perforations are then made one-half inch from the cut edge and at one-inch intervals. Beginning at the pubes the dressing is snugly laced up with a piece of tape or corset lacing and the outer binder applied.

CHAPTER III.

BANDAGING.

Materials.—According to the purpose which they are to serve, bandages are made of various materials, those commonly employed being bleached and unbleached muslin, linen, crinoline, gauze, flannel and rubber.

Uses.—Bandages are used for retaining dressings, as in the case of wounds; for retaining splints, as in fractures; for making pressure, as in the palliative treatment of varicose veins and as in Bier's hyperemia treatment of tuberculous joints and other infections, and for the arrest of hemorrhage; for purposes of immobilization, as in fractures, in which event a hardening agent such as plaster of Paris, paraffin, water-glass, or starch is worked into the bandage.

Classification.—Bandages are classified according to the materials of which they are made, according to the form in which the material is made up, and according to the purpose for which the bandage is to be used. Bandages may be classified as follows:

1. The simple or roller bandage, which may be a single or double roller. A double roller is made by sewing together the initial extremities of two roller bandages (Fig. 47). It is much less used than formerly.

2. Compound bandages, or many-tailed bandages and slings.

3. Immobilizing bandages, such as those made of crinoline or other large-meshed material in which plaster of Paris or starch or some other hardening agent has been incorporated. These are most frequently of the roller-bandage type.

4. Pressure bandages, usually made of rubber, such as Martin's rubber bandage.

Manufacture.—Of whatever material the bandage is composed, the most frequently used is the roller bandage. These

are made by cutting the selected material into strips that vary in width and length, according to the locality to be bandaged. If gauze is the material of which the bandage is to be made, a simple way of cutting the bandage straight, without frayed

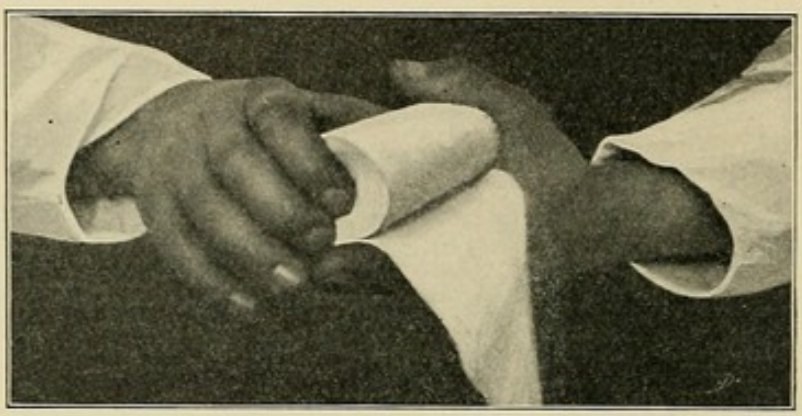


Fig. 27.—Rolling bandage by hand. (Fowler's Surgery.)

edges, is to draw a thread the desired length of the bandage, thus allowing of the clean cutting of the material along the line so indicated. The strips are rolled into a cylinder either by hand or by means of a bandage machine. If they are rolled by hand, one end of the strip is first folded on itself a number of times until a smooth cylinder is formed. This cylinder is grasped by

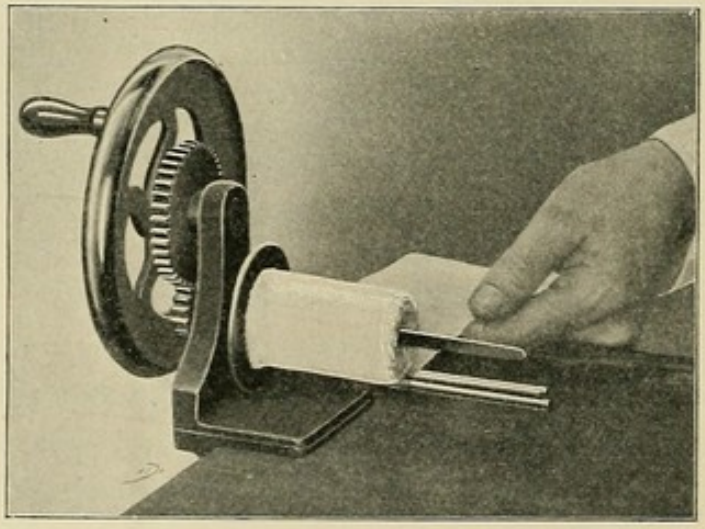


Fig. 28.—Hand roller-bandage machine. (Fowler's Surgery.)

the right hand, the forefinger pressing upon one end, the thumb on the other, and while so held it is revolved by the fingers of the other hand in such a manner as to roll around it the rest of the strip which is guided by the left hand (Fig. 27), or, the bandage

having been started in the above manner, the process may be continued by rolling it on a hard surface with the palm of the hand, or by placing the bandage on the anterior surface of the thigh and rolling it toward the knee with the palm of the hand. In either case tension should be made on the strip at the same time and care taken that with each revolution the strip accurately overlies the preceding one. Bandages may be rolled by a machine worked by hand (Fig. 28) or by foot (Fig. 29). One end of the bandage is fastened under tension to the revolving

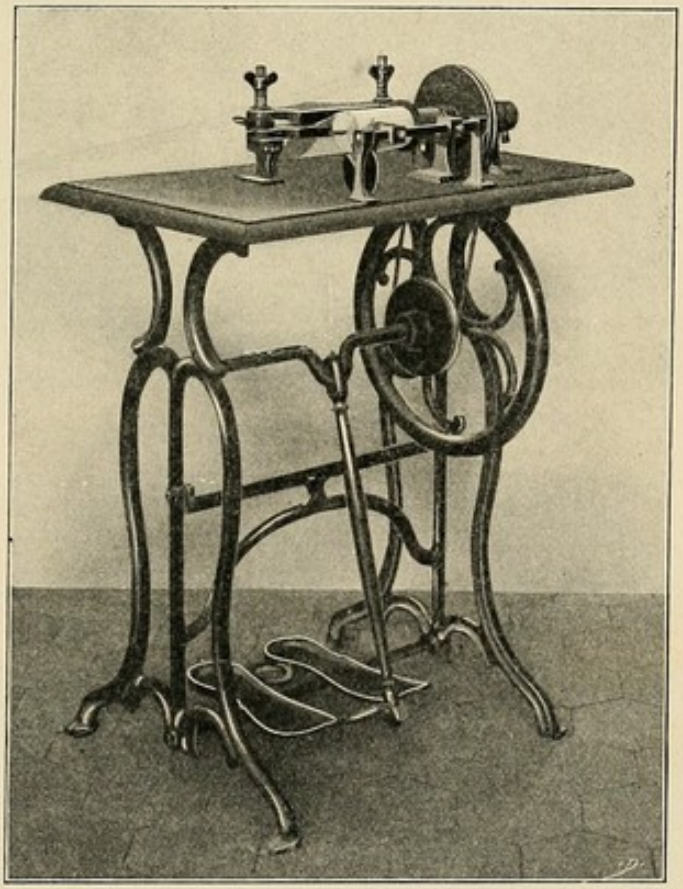


Fig. 29.—Foot roller-bandage machine. (Fowler's Surgery.)

spindle of the machine, and this being turned by a crank, rapidly rolls up the strip. Bandages may be made rapidly in quantities in the following manner: A wide box, one foot deep, three feet wide, and long enough to accommodate the bolt of material, is required. This box (Fig. 30) is fitted with one-half dozen wooden rollers for guiding the material, and a metal roller with a crank attached, on which to wind the material. The required number of yards is wound on the metal roller, and the material is

cut across. The roll is removed by withdrawing the metal roller. This long roll is then cut into the required widths by means of a bandage knife. A Christy bread knife answered this purpose

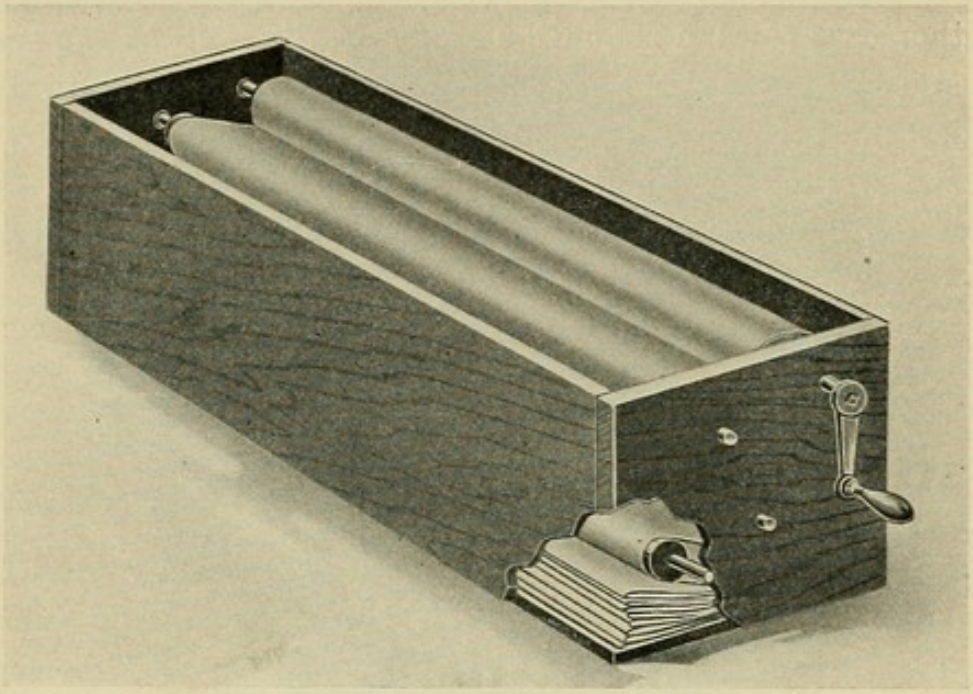


Fig. 30.—Roller-bandage box.

admirably. For steadying the roll while it is being cut a carpenter's small mitre box is useful (Fig. 31).

Dimensions.—The following are the most commonly used

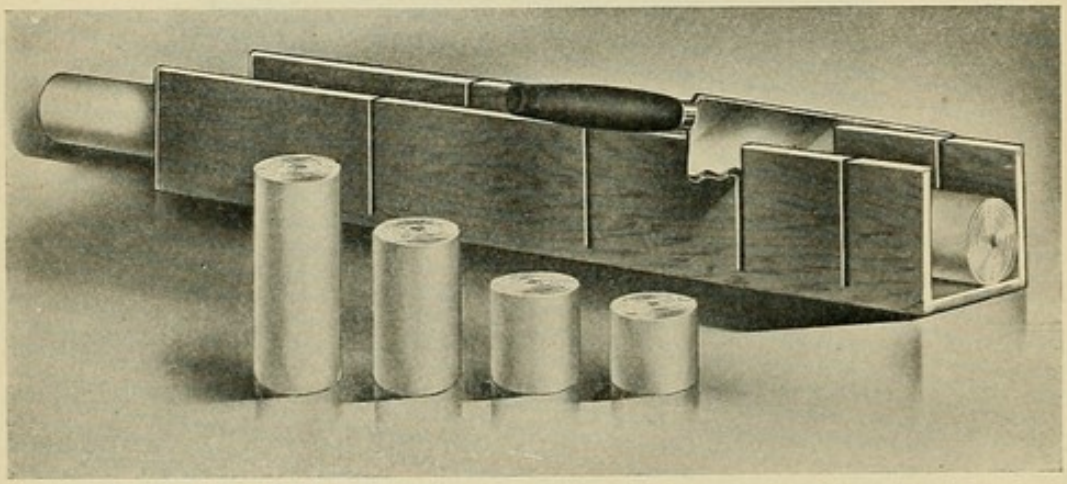


Fig. 31.—Mitre box and Christy knife for cutting bandages.

bandages, though other materials and other dimensions are used according to the part to which the bandage is to be applied, and also according to the purpose for which it is to be used.

Muslin, 7 yards long by 1 3/4, 2 1/2, 3, and 4 inches wide; gauze, 8 yards long, by 3 and 3 1/2 inches wide; flannel, 6 yards long by 1 1/2, 2, 2 1/2, 3, and 4 inches wide; crinoline, 6 yards long by 2, 2 1/2, 3 1/2 and 4 inches wide; finger bandages, 4 yards long by 1/2 and 3/4 inch wide; double roller head bandage, 10 yards long by 1 1/2 and 2 inches wide; chest or abdominal roller bandage, 10 yards long by 4, 6 and 8 inches wide; plaster bandages, 7 yards long by 2 1/2 and 3 1/2 inches wide; starch bandages, 1, 2, and 3 inches wide.

Certain terms are applied to different parts of the roller bandage in order to facilitate the description of its application. The free end is known as the initial extremity, the enclosed end as the terminal extremity, and all the portion between is termed the body of the bandage. The surfaces are known as the internal and external.

General Rules.—In the application of the roller bandage the roller should be grasped tightly between the thumb and finger, the body of the bandage resting in the hollow of the hand, the loose end on the palm, so that it will unroll easily while resting in the palm. The internal surface becomes the external when it is applied to the part, and the external surface becomes the internal. When a bandage is applied to an extremity, it should (when applied anteriorly) roll away from the median line of the body. The turns are always to be applied smoothly and with even pressure; otherwise, swelling or even gangrene may result. If it is too tightly applied, though with even pressure, ischemic muscular paralysis may result. In the case of an extremity the bandage should be begun at the toes or fingers and applied in an upward direction. Before the application of the bandage the part to be bandaged should be placed in the position in which it is to remain after the bandage is applied. If this is not done the bandage will not lie smoothly and may subsequently cause uneven pressure. When bleached-muslin bandages are employed, the material may be wrung out of warm water, as this will be found to facilitate the application, particularly in the case of small muslin bandages, such as finger bandages. The terminal extremity should be fastened, either by sewing with needle and thread or by the use of safety-pins,

or the end may be torn longitudinally, knotted to prevent further tearing, and the two tails passed around the part in opposite directions and tied. When pelvic or chest bandages are applied, the body may be supported by the Volkmann block (Fig. 32). An inverted hand basin serves the purpose in an emergency.

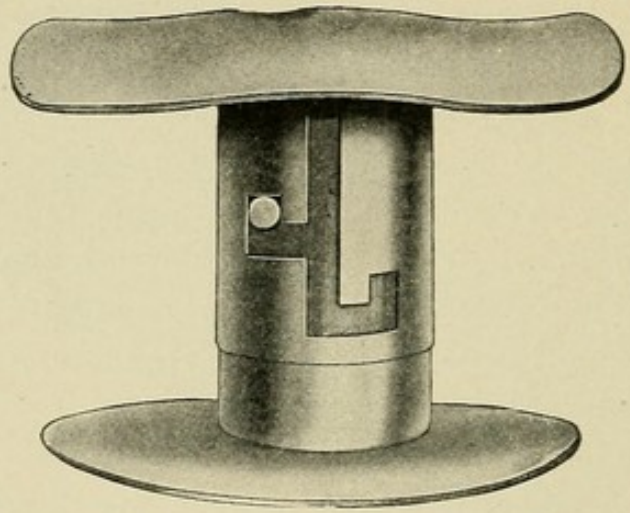


Fig. 32.—Volkmann's block. (Fowler's Surgery.)

Bandages are removed either by cutting or by unwinding them. If they are removed by cutting, special scissors having a blunt point on one blade should be used in order to prevent possible injury to the skin (Fig. 33). If a bandage is removed by unwinding it, the unrolled portion should be loosely grasped in a mass as the unwinding proceeds, the unwound portion being passed from one hand to the other, thus allowing of rapid and neat removal. In hospital practice bandages should be

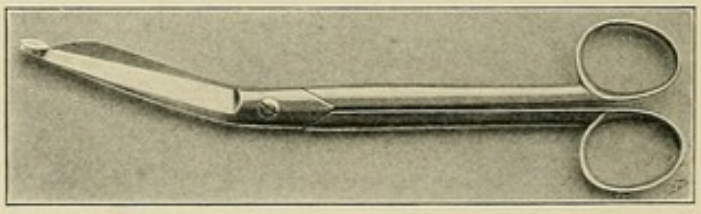


Fig. 33.—Bandage scissors. (Fowler's Surgery.)

removed by unrolling rather than by cutting, unless they are too soiled to allow of ready cleansing, or unless their removal by unrolling would cause pain to the patient by undue moving of the affected part.

Varieties of Roller Bandages.—In bandaging, a number of

turns are used with which it is necessary to become familiar before applying any special bandage. Circular, spiral, and spica turns are used either alone or in combination, or with some modifications, and the bandage, the predominating feature

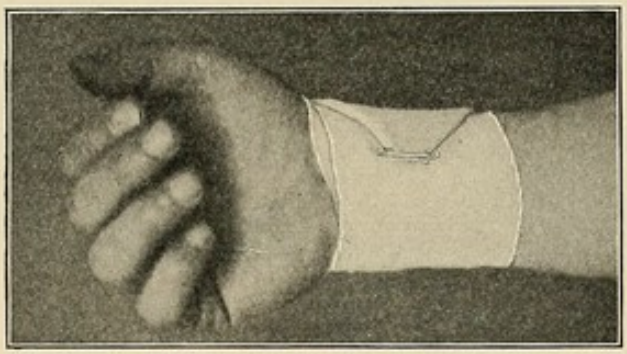


Fig. 34.—Circular bandage. (Fowler's Surgery.)

of which is formed by these turns is known as a circular, spica, or spiral bandage.

Circular Bandage.—A circular bandage (Fig. 34) is made up of a number of circular turns, each turn overlying the turn preceding it. It is useful in retaining dressings upon circular portions of the body, and for purposes of coaptation.

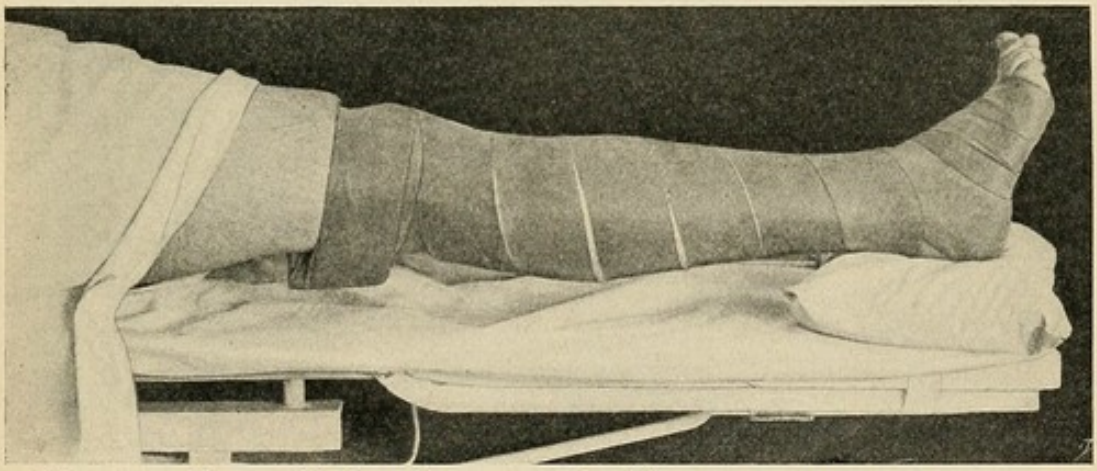


Fig. 35.—Esmarch's bandage applied. Showing method of application without overlapping. The last three turns serve as a tourniquet. (Fowler's Surgery.)

Oblique Bandage.—An oblique bandage is one in which the turns run obliquely around the part without overlapping (Fig. 35). Such a bandage is useful in applying temporary dressings. The Esmarch bandage is applied in this manner, to allow of ready removal in the reverse order of that which was employed when it was originally applied.

Spiral Bandage.—In a spiral bandage (Fig. 36), the turns surround the part in a spiral manner, each turn covering one-half or more of the preceding turn. This form of bandage is

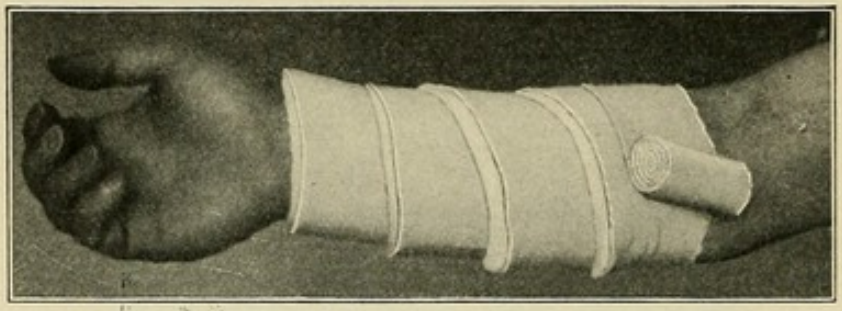


Fig. 36.—Spiral bandage. (Fowler's Surgery.)

useful in parts of the body which do not increase rapidly in circumference, as the finger, chest, or abdomen.

Reversed Spiral Bandage.—When the part of the body to be bandaged increases rapidly in circumference, as in the case

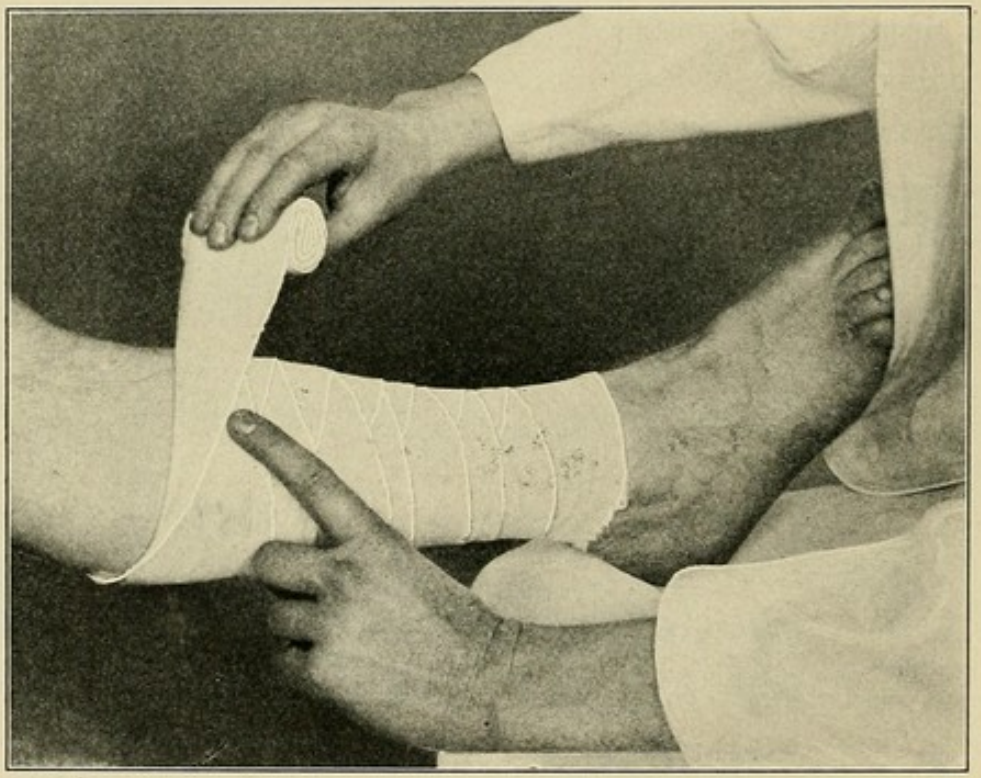


Fig. 37.—The spiral reversed bandage. (Fowler's Surgery.)

of the forearm or leg of a well-nourished person, it is found impracticable to use spiral turns, as they do not lie smoothly and, what is more important, do not exert even pressure. To overcome this, when a part of the limb is reached where the spiral

turn if continued would not lie smoothly, a "reverse" is made so as to cause the turn to conform to the shape of the part (Fig. 37). In making these reverses it is well not to unroll much of the bandage, but only six or eight inches of it. While the forefinger of the left hand presses on the previously applied turn and holds it in place, the head of the roller is turned toward the operator in such a manner that the slack is turned or folded obliquely on itself. As many of these reverse turns

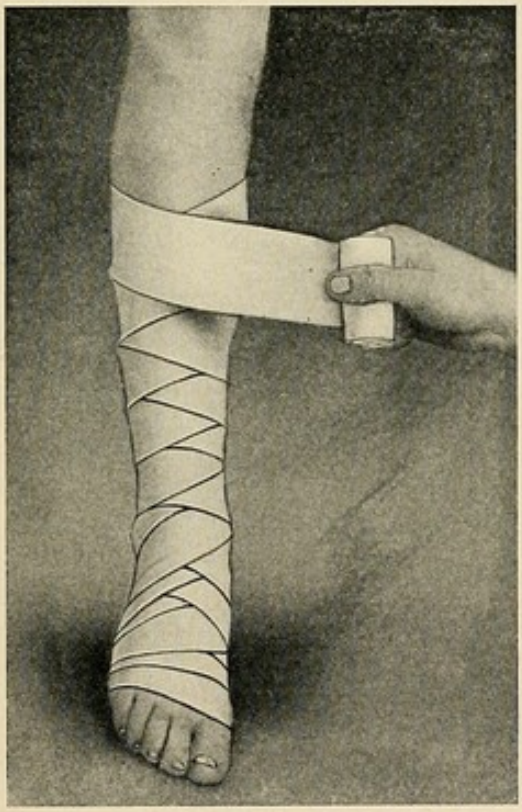


Fig. 38.—Short figure-of-8 (spica) bandage of the leg.

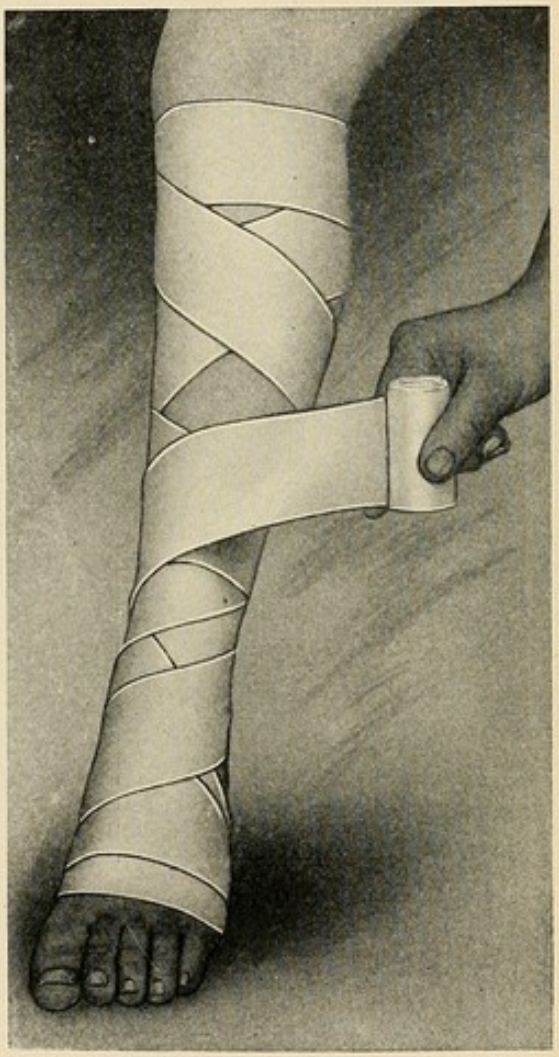


Fig. 39.—Long figure-of-8 bandage of the leg.

are applied as are required. Care must be taken that the points of the reverses are in alignment, that they are smoothly applied, and that they do not lie over bony prominences, such as the crest of the tibia, for here they may give rise to pressure effects.

Spica Bandage.—Spica turns are those which cross each other in the form of the capital Greek letter Lambda, and a bandage made up for the most part of these turns is known as a spica

bandage (Fig. 38). Such a bandage is useful in retaining dressings to the shoulder and groin, and also in exerting firm pressure.

Figure-of-8 Bandage.—Those bandages are made of figure-of-8 turns, and are most frequently employed in the neighborhood of joints, a turn being first taken above the joint and then one below it, thus forming a figure-of-8. In the same manner a figure-of-8 may be applied to the leg, either short turns being used, when the bandage is known as a short figure-of-8 or spica (Fig. 38), or longer ones with some spiral turns, when it is known as a long figure-of-8 (Fig. 39).

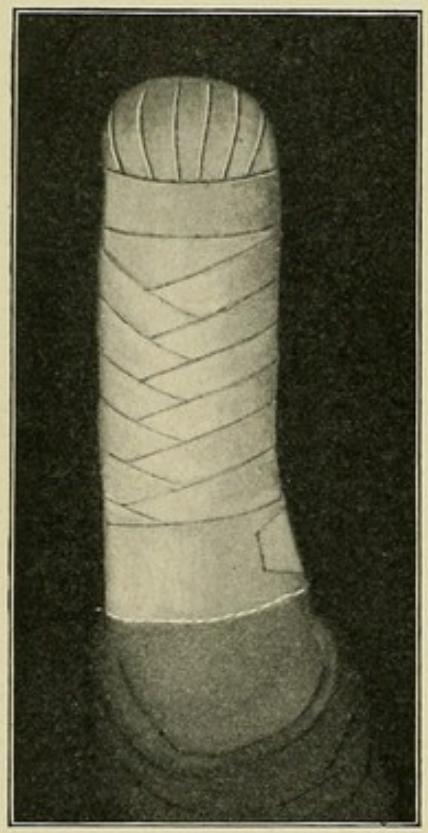


Fig. 40.—Recurrent bandage of stump. (Fowler's Surgery.)

Recurrent Bandage.—Recurrent bandages (Fig. 40) are made up of turns which extend back and forth over the part until it is covered in, all these turns being secured by spiral or circular turns. This bandage is used for covering in the ends of fingers, for retaining stump dressings, and for retaining dressings upon the scalp.

Head Bandages: Fronto-occipital Bandage.—The initial extremity of the bandage (Fig. 41) is fixed beneath the inion by means of the index-finger of the left hand; the roller is then carried across the parietal bone of the left side to the forehead, over the forehead, and over the right parietal region back to the starting-point; these turns are repeated, care being taken that each turn shall accurately cover the preceding turn. The terminal extremity of the bandage is fastened beneath the inion.

Oblique Bandage of the Head.—The initial extremity of this bandage (Fig. 42) is fixed by means of one or two fronto-occipital turns. From the occiput the roller is passed obliquely over the left parietal eminence to the forehead and then continued as in making a fronto-occipital turn that ends at the forehead. From the forehead the roller passes obliquely over the right

parietal eminence to the occiput. At the occiput these turns are continued in the order named, each oblique turn covering in the lower two-thirds of the preceding oblique turn. The bandage is completed by one or more fronto-occipital turns, the terminal extremity being fastened beneath the inion. These oblique turns make a very pretty finish to a recurrent head bandage, and at the same time render it more secure.

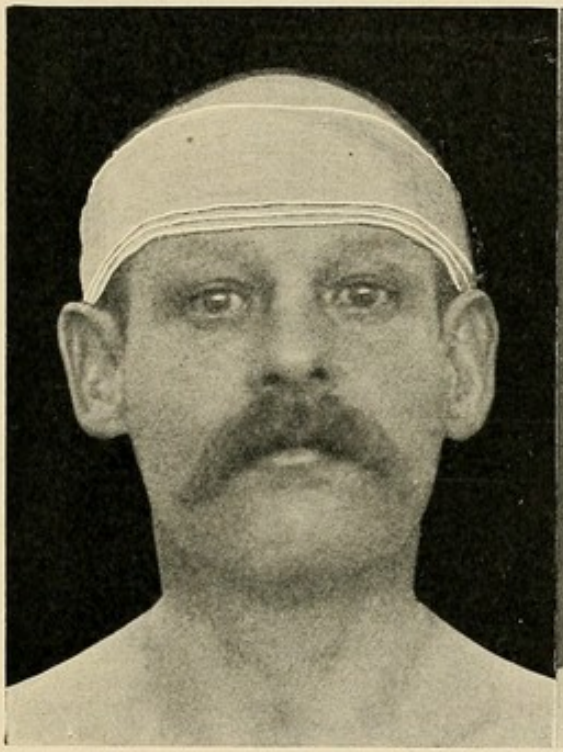


Fig. 41.—Fronto-occipital bandage. (Fowler's Surgery.)

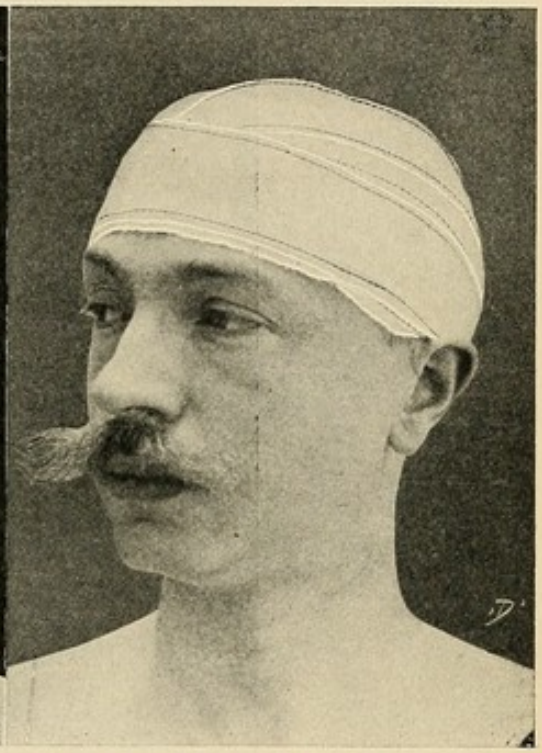


Fig. 42.—Oblique bandage of the head. (Fowler's Surgery.)

Recurrent Bandage of the Head.—The initial extremity of the bandage (Fig. 43) is secured by means of one or two fronto-occipital turns. Beginning at the central point of the forehead a reverse is made and the roller carried directly back to the median line over the vertex to just below the inion; here the roller is folded on itself and carried forward to the forehead, to the left of the first recurrent turn, so that it overlaps it by two-thirds. These recurrent turns are repeated between the occiput and the forehead until the whole of the left half of the vertex is covered. The recurrent turns are then secured by a fronto-occipital turn. In the same manner the right half of the vertex is covered in. The bandage is completed by one or more fronto-occipital turns.

Barton's Bandage.—The initial extremity of the bandage (Fig. 44) is fixed to the vertex of the head in the middle line, the index-finger of the left hand being used for the purpose. The roller is then passed over the left parietal bone to a point below the inion, and then over the right parietal bone to the starting-point; this forms turn number 1. To form turn number 2, the roller is continued from the starting-point over the temporal bone, down the side of the left cheek, in front of the left

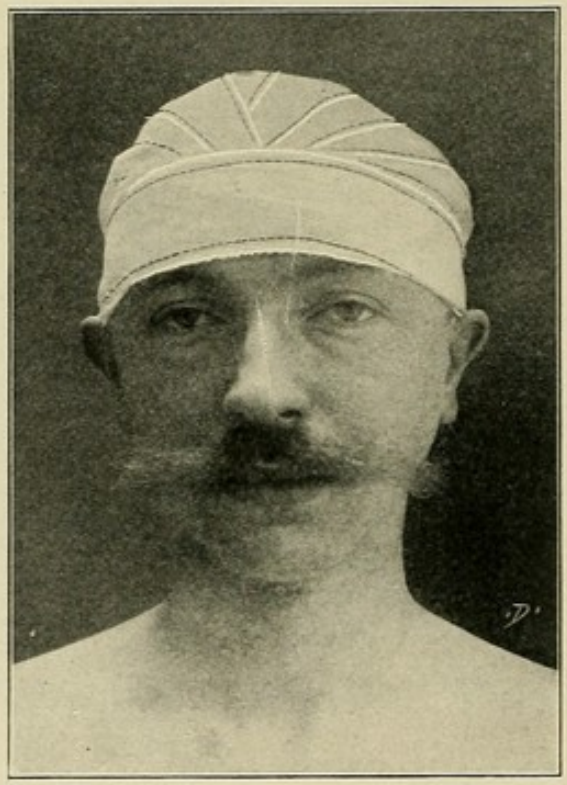


Fig. 43.—Recurrent bandage of the head. (Fowler's Surgery.)

ear, under the chin, up the side of the right cheek, in front of the right ear, and finally over the right temporal bone to the starting-point. To form turn number 3, continue from the starting-point over the left parietal bone to a point below the inion, below the right ear, around the right side of the inferior maxilla, to the front of the chin, passing over the anterior aspect of the chin to the left aspect of the inferior maxilla, and then over this and below the left ear to a point just below the inion. These three turns are repeated a number of times in the order described.

The bandage has been *modified* by adding (Fig. 45) a fourth turn—a fronto-occipital turn following the third turn. Except

for this the modified Barton's is the same as the Barton's usually described. The points of intersection of the various turns are secured by safety-pins. In applying this bandage, as in applying all bandages which fix the lower jaw, care should be taken, when the application is made under an anesthetic, that provision is allowed for the escape of vomited matter.



Fig. 44.—Barton's bandage. (Fowler's Surgery.)

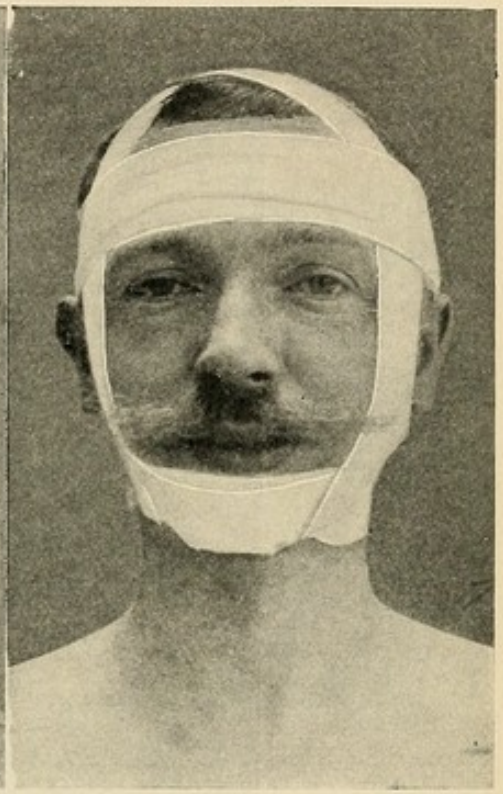


Fig. 45.—Modified Barton's bandage. (Fowler's Surgery.)

Gibson's Bandage.—The initial extremity of the bandage (Fig. 46) is fixed with the forefinger of the left hand over the temporal region just anterior to the left ear; thence the roller is carried down the cheek, under the chin, up in front of the right ear, and over the vertex to its starting-point. Three such complete turns are made. A reverse is made at the end of the third turn and the roller is carried to the inion, and three complete fronto-occipital turns ending at the inion are made. The roller is then carried around under the right ear, along the jaw to the chin, over the front of the chin, along the left side of the jaw, and under the left ear to the inion. Three such complete turns ending at the inion are made. Here the roller is reversed

and carried in the median line from the vertex to the forehead, where it is fastened. All intersections of turns are secured by means of safety-pins.

A similar way of applying the turns, and one which is perhaps more secure, is to fix the initial extremity of the bandage at the vertex, and then to pass down the right side of the jaw in front of the ear to the chin, under the chin, up the left side of the jaw,



Fig. 46.—Gibson's bandage. Safety-pins should be placed on all the intersections to prevent the bandage from slipping. (Fowler's Surgery.)

in front of the ear, and so back to the vertex, where the initial extremity of the bandage is crossed by the roller, and the roller continued over the right parietal bone to the inion, under the inion, and up over the left parietal bone to the starting-point, thus making a figure-of-8 turn. This figure-of-8 turn is repeated three or four times, and then when the inion is again reached, on the third or fourth turn, the third turn of the Gibson bandage as before described is made.

Crossed Bandage of the Head.—A double-headed roller is used. A fronto-occipital turn is made, the bandage "crossing" just above the temporo-maxillary articulation (Fig. 47). The

roller is carried down over the side of the jaw, under the chin, and up the opposite side of the jaw to the temporo-maxillary articulation of that side. Here it is "crossed" by the other roller, which is passed over the vertex (Fig. 48). The points of "crossing" alternate.

Occipito-facial Bandage.—This bandage is applied in the same manner as the first and second turns of the Gibson bandage, by either of the methods just described The turns along the side of the jaw, however, cover in more of the surface and do not accurately overlie each other.

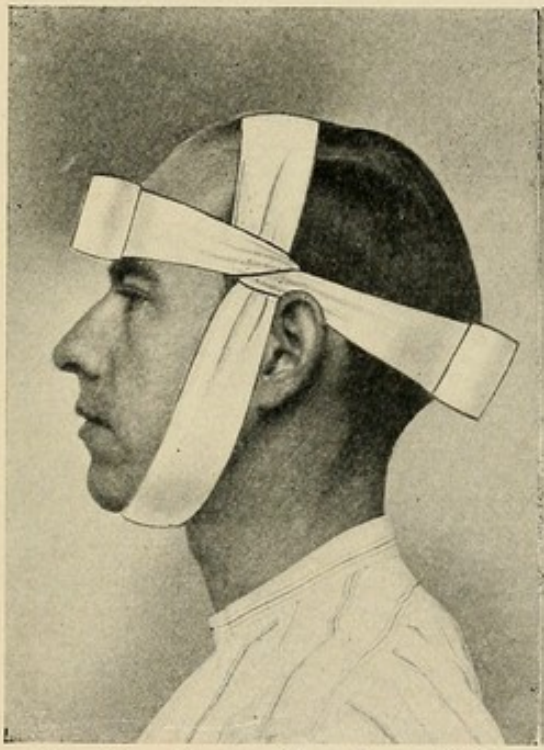


Fig. 47.—Crossed bandage of the head. First turn.

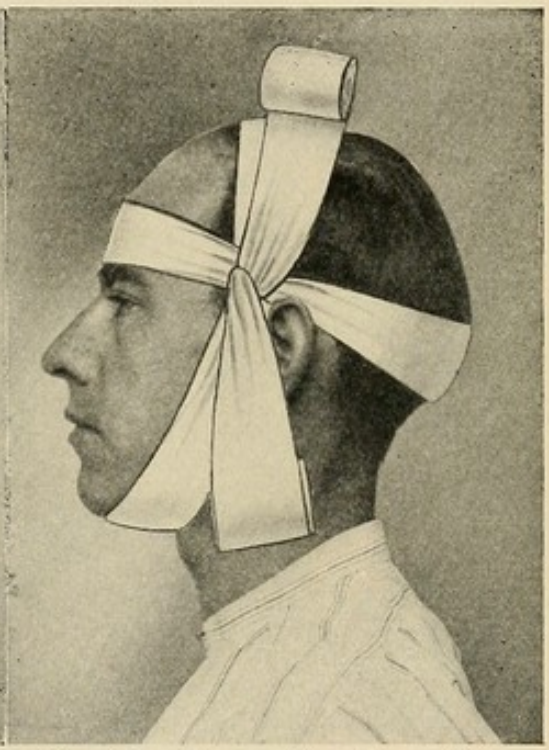


Fig. 48.—Crossed bandage of the head. Second turn.

Forehead and Chin Bandage (Fig. 49).—The initial extremity of the bandage is fixed by one or two fronto-occipital turns. From below the inion the roller is passed around the side of the jaw, below the ear to the chin, across the anterior surface of the chin and along the left side of the jaw, below the left ear, to a point below the inion. A fronto-occipital turn is then made. These turns are alternated.

The Forehead and Upper Lip Bandage.—This bandage (Fig. 50) is applied in the same manner, except that the second turn passes

from the inion to a point above the ear, thence to the upper lip, and so around above the opposite ear to the inion.

In the forehead and neck bandage the second turn passes from the inion, around the neck, and back to the inion.

Oblique Bandage of the Jaw.—The initial extremity of this bandage (Fig. 51) is fixed by means of one or more fronto-occipital turns. If it is intended to cover in the left side of the jaw the roller is passed from right to left; if the right side, from left to right. From the occiput the roller is passed below the ear,



Fig. 49.—Forehead and chin bandage. (Fowler's Surgery.)



Fig. 50.—Forehead and upper lip bandage. (Fowler's Surgery.)

under the chin, and up over the opposite angle of the jaw. It is then carried to the vertex from the side of the face just posterior to the external angular process of the frontal bone, and in front of the ear of the same side. The roller is carried across the vertex, behind the ear of the opposite side, to the point at which it first passed under the chin; thence it is continued around under the chin as before, this time, however, the turn being so placed as to overlap the posterior two-thirds of the previous turn. These turns are continued, each overlapping the posterior two-thirds of

the previous turn until the space between the external angular process and the ear is completely covered. The oblique turns may include the ear if the indication for this is present. When a sufficient number of these turns have been applied, a reverse is made above the opposite ear, two or three fronto-occipital turns are made, and the bandage is secured.

Single Eye Bandage.—The initial extremity of the bandage (Fig. 52) is fixed by one or two fronto-occipital turns. If it is desired to cover in the left eye the turns should pass from right to

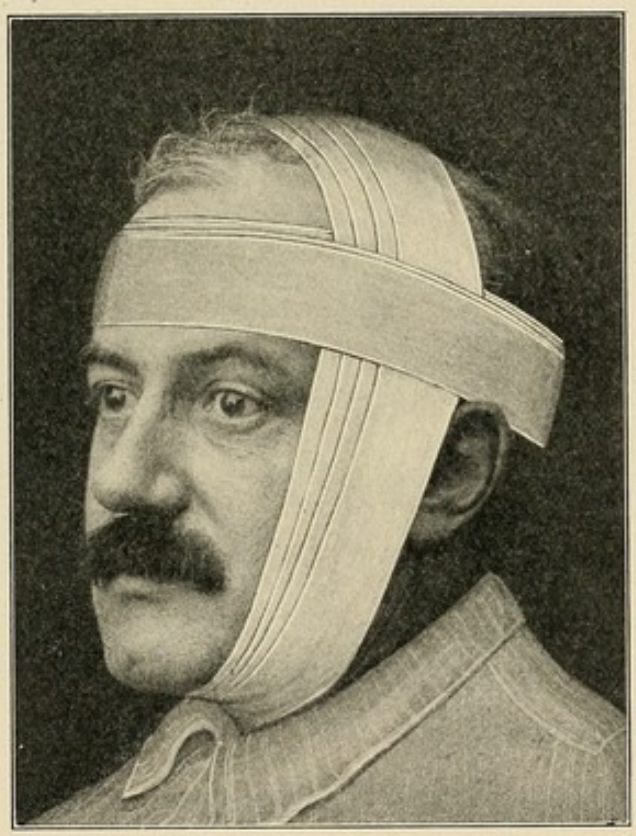


Fig. 51.—Oblique bandage of the jaw. (Fowler's Surgery.)

left; if the right eye, *vice versa*. From the occiput the roller is passed below the lobe of the ear to the cheek, upward over the cheek to the glabella, thence obliquely over the frontal and parietal regions of the opposite side to the occiput, forming turn number one; a fronto-occipital turn is then made. Turn number two is the same as turn number one, save that it ascends above it by one-third its width. It will be found more comfortable for the patient if the second and subsequent turns cover in the ear instead of passing below it, as in the case of the first

turn. These turns are repeated, alternating with the fronto-occipital turns, until the eye is entirely covered in. A few fronto-occipital turns complete the bandage.

Bandage for Both Eyes.—The initial extremity of the bandage (Fig. 53) is fixed by one or more fronto-occipital turns. From the occiput the roller is passed under the lobe of one ear to the cheek, upward upon the cheek to the glabella, covering in the first eye, and thence obliquely across the opposite frontal and

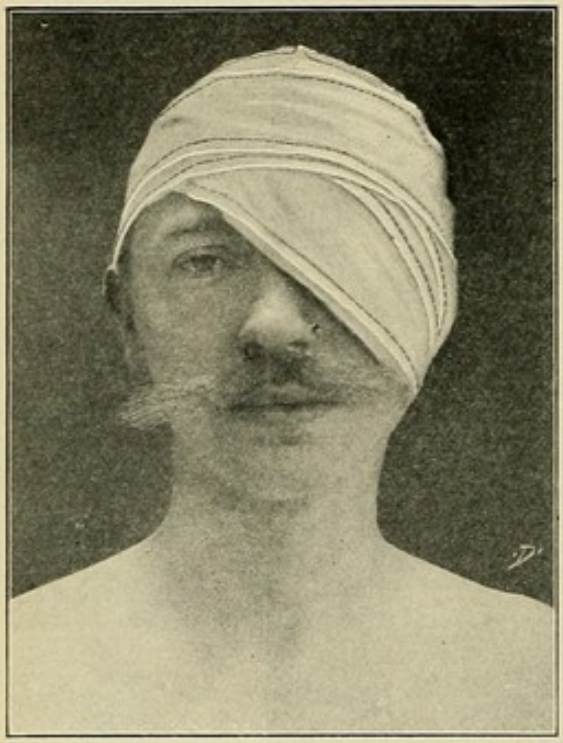


Fig. 52.—Single eye bandage. (Fowler's Surgery.)

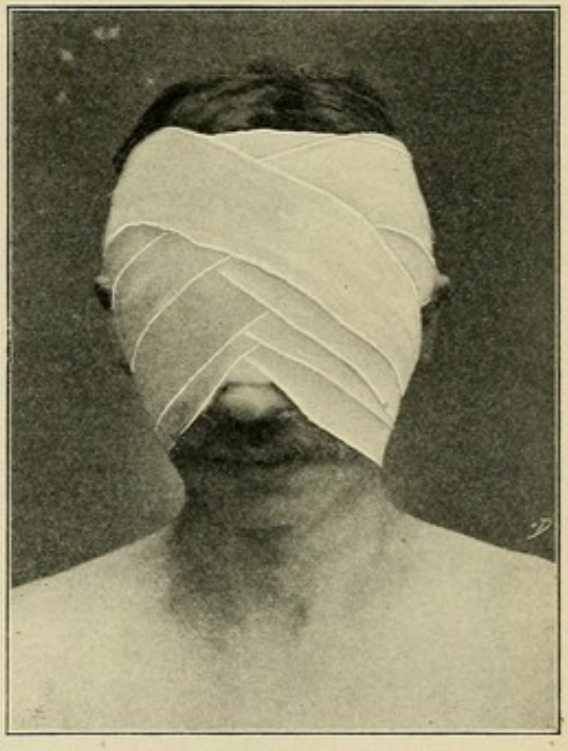


Fig. 53.—Bandage for both eyes. (Fowler's Surgery.)

parietal regions to the occiput. A fronto-occipital turn is then made. From the occiput the roller is passed up over the parietal and frontal regions to the glabella, thence, over the second eye, obliquely down the cheek, beneath the lobe of the ear, to the occiput. Again a fronto-occipital turn is made. These turns are repeated first over one eye and then over the other eye, each succeeding turn covering in two-thirds of the preceding turn, and being alternated by a fronto-occipital turn. These turns are continued until the eyes are completely covered. The fronto-occipital turn may be omitted.

Figure-of-8 Bandage of the Neck and Axilla.—The initial extremity of the bandage (Fig. 54) is fixed by one or more circular

turns around the neck; these should not be too tightly applied. According to the axilla to be included, the roller is passed obliquely across the corresponding shoulder, under the axilla, and back again obliquely over the same shoulder, crossing the first oblique turn. A circular turn is then made around the neck. The circular neck turns are alternated with the turns passing

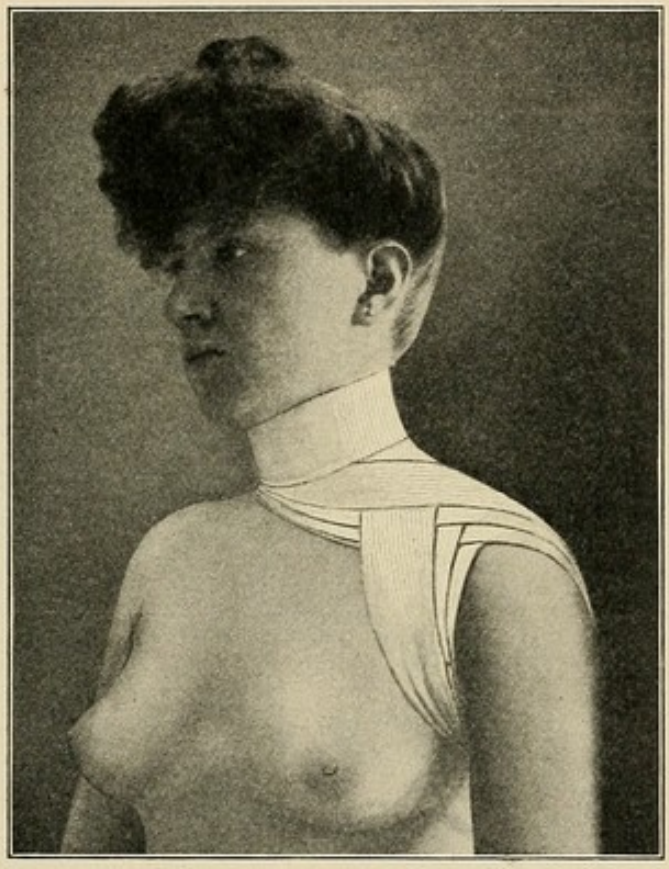


Fig. 54.—Figure-of-8 bandage of the neck and axilla. (Fowler's Surgery.)

under the axilla and crossing over the shoulder. Each succeeding turn overlaps the preceding one by two-thirds of its width. A circular turn around the neck completes the bandage.

Combined Neck Bandage.—A combination of head, neck, and chest turns is useful in securely retaining the dressing after an extensive dissection in the cervical region (Fig. 55).

Ascending Spica Bandage of the Shoulder.—The initial extremity of the roller (Fig. 56) is fixed by means of one or two circular turns around the arm of the affected side at the level of the axillary fold, or a short distance below it. The roller is carried directly across the anterior aspect of the chest to the axilla of the opposite side, under the axilla to the posterior aspect of the

chest, and finally across this to the starting-point. A circular turn is next made around the arm at the starting-point, and then a second turn, similar to the first, but ascending and covering in two-thirds of the previous turn, except at the opposite axilla where the turns exactly overlap, is made around the chest. The chest turns alternate with the circular turns around the arm, each ascending by one-third of its width above the preceding turn. In this manner the shoulder is ascended by spica turns until it is

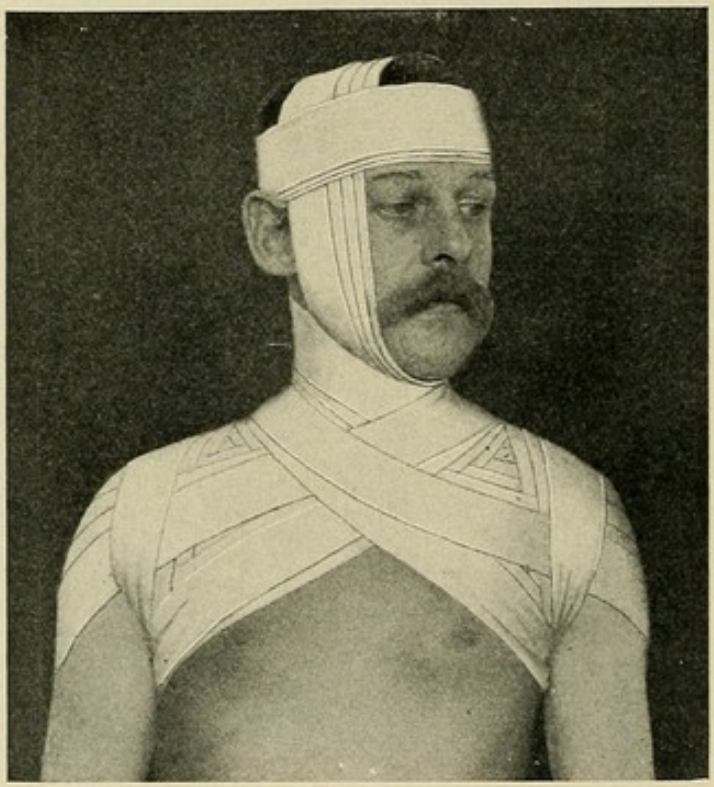


Fig. 55.—Combined head, neck, and figure-of-8 of the axilla. (Fowler's Surgery.)

completely covered. The bandage is completed by a circular turn around the arm and there fastened. To prevent chafing of the opposite axilla, a pad of cotton should be held in place there by the first turn of the bandage around the chest.

Descending Spica Bandage of the Shoulder.—The initial extremity of the bandage (Fig. 57) is secured by means of one or two circular turns around the arm at the level of the axillary fold or at a short distance below it. The roller is carried over the shoulder to the anterior aspect of the chest as high up as it can be made to stay, then under the axilla of the opposite side, around the posterior aspect of the chest, to the starting-point, where a

circular turn is taken. These turns alternate one with another, each chest turn descending by one-third the width of the preceding turn until the shoulder is completely covered in. The bandage is finally completed by a circular turn around the arm. The same precautions are taken, as regards the opposite axilla, as in the case of the ascending spica of the shoulder.

Velpeau Bandage.—Two or more roller bandages are required. The arm of the affected side is drawn across the chest, the palmar

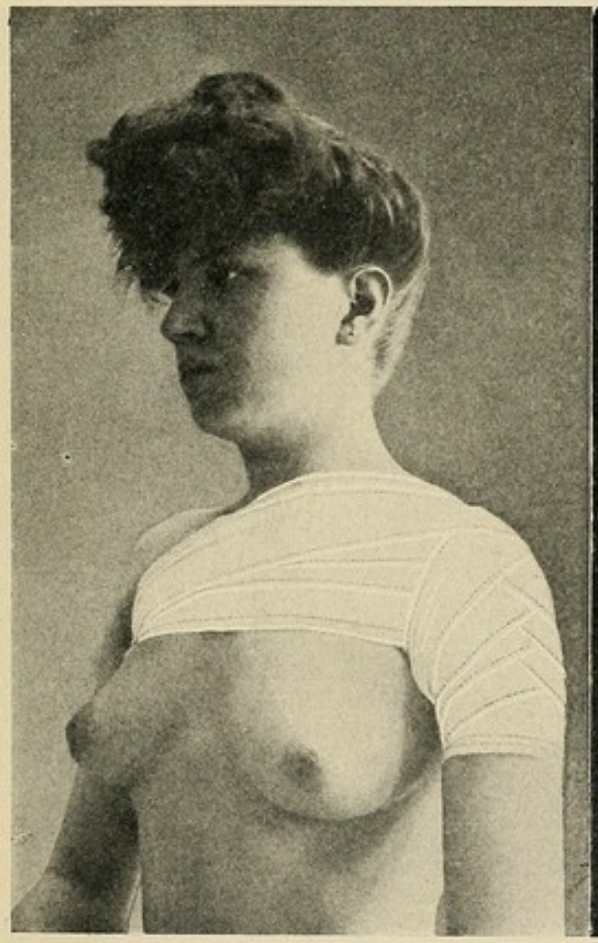


Fig. 56.—Ascending spica of the shoulder. (Fowler's Surgery.)



Fig. 57.—Descending spica of the shoulder.

surface of the fingers resting upon the sound shoulder near the base of the neck. The initial extremity of the roller is placed over the scapular region of the unaffected side, and the roller is carried over the point of the affected shoulder; thence it is carried down across first the outer and then the posterior surface of the arm of the same side, and under the elbow to the anterior chest wall, from which point it should pass diagonally across the

anterior chest wall upward to the axilla of the unaffected side, and under the axilla to the starting-point, thus completing the first turn (Fig. 58). This turn is repeated in order firmly to fix the initial extremity of the roller. From the scapular region the roller is carried directly around the body, passing over the elbow of the affected side near its point, thence to the axilla

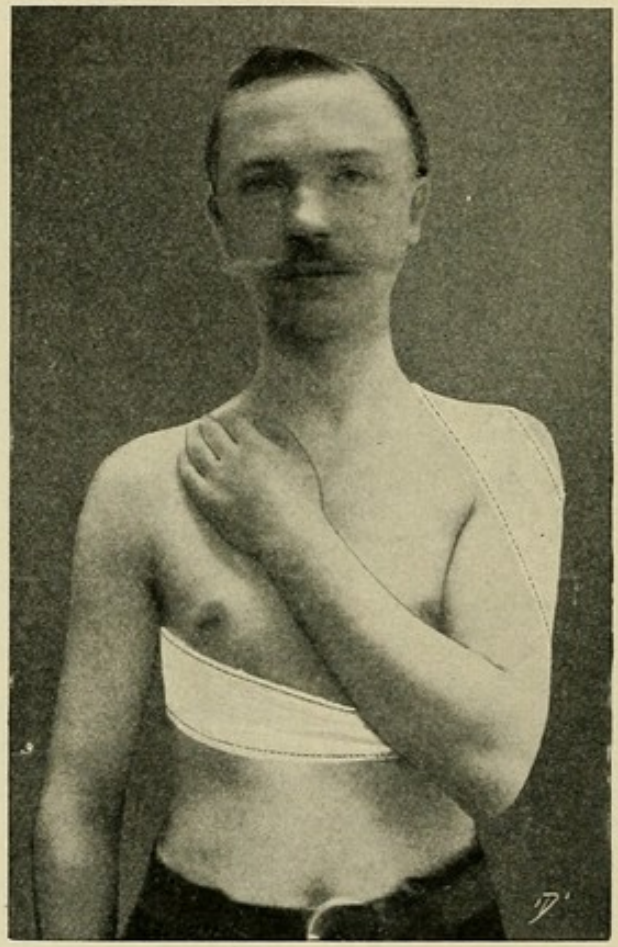


Fig. 58.—Velpeau's Bandage. First turn. (Fowler's Surgery.)

of the sound side, and thence to the starting-point, over the scapular region of the sound side (Fig. 59). These turns alternate one with the other, each succeeding turn overlapping the preceding one by two-thirds its width, and the shoulder turns gradually approaching the base of the neck; the turns cross the elbow and gradually ascend the arm until the last turn passes across the wrist and is secured in the axillary line of the sound side (Fig. 60). In applying this bandage, as in other cases in which skin surfaces are pressed together, a layer of cotton should

be placed between such surfaces and plenty of drying powder be used to prevent maceration and excoriation.

The Desault bandage consists of three roller bandages. A wedge-shaped pad is placed in the axilla of the injured side. This is held in place by the first roller of the bandage. The initial extremity of the bandage is held in place by pressure of the fingers of the left hand over the lower ribs of the injured

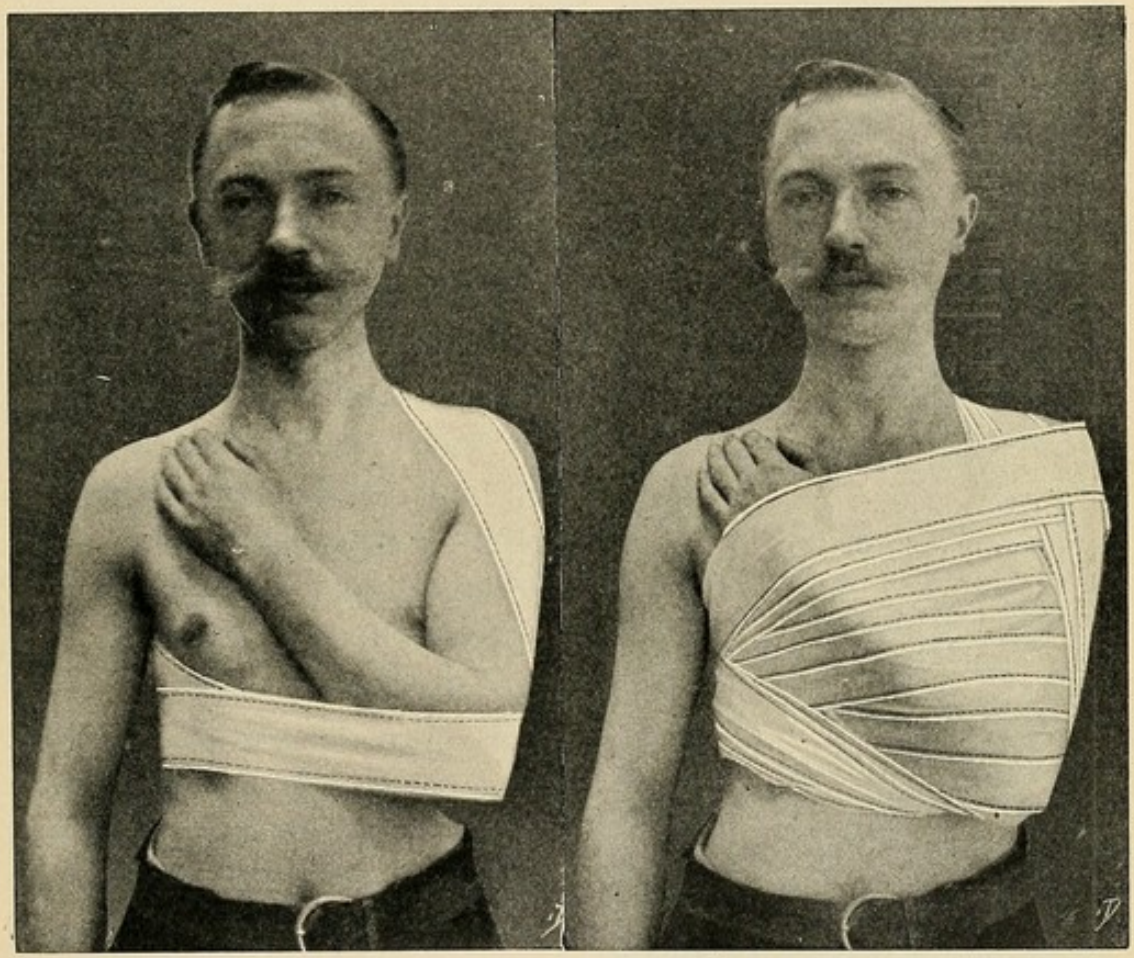


Fig. 59.—Velpeau's bandage. Second turn. (Fowler's Surgery.)

Fig. 60.—Velpeau's bandage completed. (Fowler's Surgery.)

side; the bandage itself is then carried obliquely across the anterior aspect of the chest, over the shoulder of the sound side, and thence through the axilla to the apex of the shoulder, when it crosses the first turn. Then it passes diagonally across the back to the injured side, fixing the initial extremity by passing over it low down on the ribs. The chest is then ascended by spiral turns which thus securely fasten the wedge-shaped pad in

position. These spiral turns ascend to the level of the axilla. The arm is now brought to the side, the pad acting as a fulcrum. The second roller of the Desault is a series of ascending spiral turns including the arm and chest. These turns begin just above the elbow of the injured side, and end just below the level of the shoulder.

The initial extremity of the third roller is fixed in the axilla of the sound side by the fingers of the left hand, and the roller is carried obliquely across the chest to and over the shoulder of the injured side, directly downward to the elbow of the injured side, over this and diagonally up across the chest to the starting-point; thence the roller is carried obliquely over the posterior aspect of the chest to and over the shoulder of the affected side directly down to and over the elbow of the affected side. Thence it passes diagonally across the posterior aspect of the chest to the starting-point. These turns are repeated until the roller is finished. The hand is supported by a bandage sling.

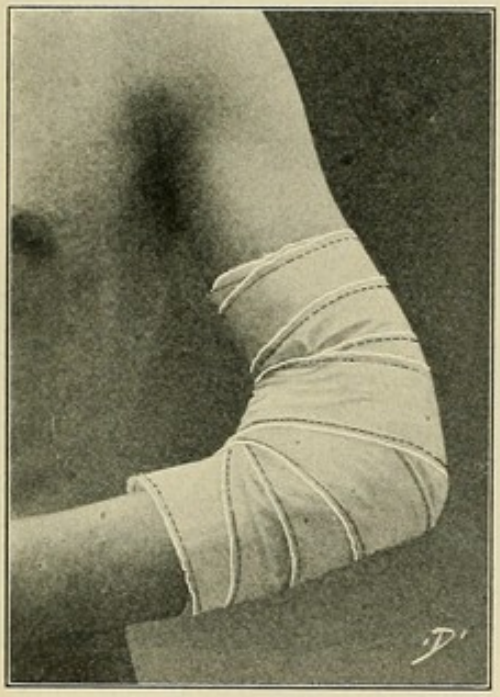


Fig. 61.—Figure-of-8 bandage of the elbow. (Fowler's Surgery.)

The Desault bandage is used in fractures of the clavicle, the pad being the fulcrum over which the second roller forces the arm to the side in such a manner as to correct the inward displacement. The third roller, by elevating the shoulder, corrects the downward and forward displacement.

Figure-of-8 Bandage of the Elbow.—The bandage (Fig. 61) should be applied with the elbow flexed. The initial extremity of the bandage is fixed by one or more circular turns made a few inches below the elbow-joint. The roller is then carried across the flexure of the joint and a circular turn is made a few inches above the joint. The roller is then carried obliquely to the starting-point and a circular turn is made there. Circular turns below the joint

alternate with those above the joint, the bandage each time obliquely crossing the flexure of the elbow. The circular turns gradually approach the tip of the olecranon from both directions. The bandage is finally completed by a circular turn around the flexure, thus covering in the olecranon. A neater effect may be produced by first passing a circular turn around the flexure of the joint and over the tip of the olecranon then a circular turn below, and then one above, and so on until the joint is completely covered, each turn covering in two-thirds of the preceding one.

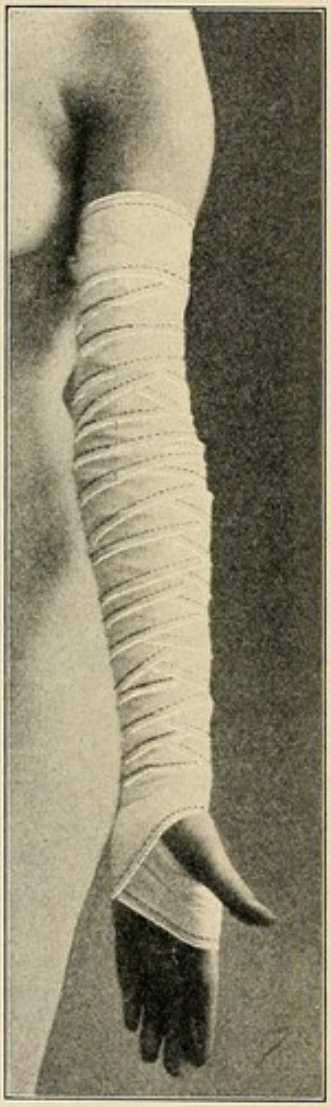


Fig. 62.—Reversed spiral bandage of the upper extremity. (Fowler's Surgery.)

Reversed Spiral Bandage of the Upper Extremity.—The initial extremity of the bandage (Fig. 62) is fixed by means of one or two circular turns around the wrist. The roller is then carried obliquely across the back of the hand to the level of the last phalangeal joint. Here a circular turn is made. By means of spiral or reverse turns the roller ascends the hand to the metacarpo-phalangeal joint of the thumb, passes obliquely to the wrist, where a circular turn is taken around the wrist, thence back obliquely to take a circular turn around the body of the hand. Three or more of these figure-of-8 turns are made, thus carrying the bandage as far as the wrist. The forearm is ascended by means of spiral or spiral reverse turns, according to the conformation of the forearm, until the elbow is reached. If it is desired to keep the arm flexed the elbow is covered by a series of figure-of-8 turns while the part is in a state of flexion. If, however, the arm is to be kept extended, spiral and spiral reverse turns are continued over the elbow and up the arm. The bandage is completed by one or two circular turns at the level of the axillary fold. Care should be taken in applying this bandage that the reverses do

not press over bony prominences, as the ridge of the ulna, also that the reverses are in accurate alignment.

Figure-of-8 Bandage of the Hand and Wrist (Dorsal).—The initial extremity of the bandage (Fig. 63) is fixed by one or two circular turns around the wrist. Thence the roller is carried obliquely across the dorsum of the hand to the base of the index-finger, where a circular turn and a half is made around the hand at the metacarpo-phalangeal articulation. The roller then returns obliquely to the wrist. After a circular turn at the

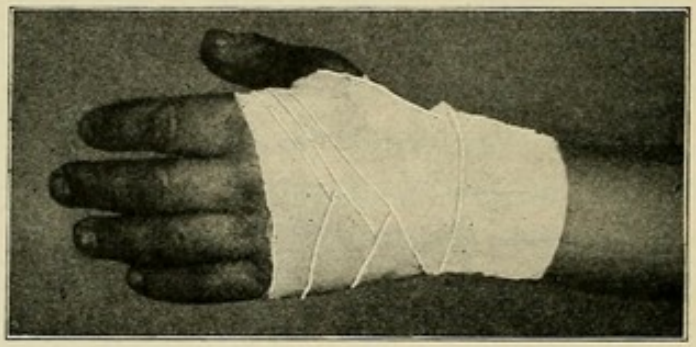


Fig. 63.—Figure-of-8 bandage of the hand and wrist (dorsal). (Fowler's Surgery.)

wrist has been completed the roller is again carried obliquely to the base of the index-finger, and a second circular turn is made around the hand. These turns are continued, each overlapping the preceding turn by two-thirds of its width, until the dorsum of the hand is completely covered. A circular turn at the wrist completes the bandage.

Figure-of-8 Bandage of the Hand and Wrist (Palmar).—This is applied in the same manner as the dorsal figure-of-8 of the hand and wrist, except that the oblique turns cross the palm instead of the dorsum of the hand.

Demi-gauntlet Dorsal Bandage.—The initial extremity of the bandage (Fig. 64) is fixed at the wrist by one or two circular turns. The roller is carried obliquely across the back of the hand to the base of the thumb, which is surrounded by a circular turn, and the roller is returned to the wrist. Here a circular turn is made, and the roller is carried obliquely across the back of the hand to the base of the index-finger, there making a circular turn and again returning to the wrist. This is continued until the base of each finger has in due order been surrounded by a

circular turn. The bandage is completed by a few figure-of-8 turns of the hand and wrist.

Demi-gauntlet Palmar Bandage.—This bandage is applied in the same manner as the dorsal demi-gauntlet bandage, except that the oblique turns from the wrist to the bases of the fingers pass over the palmar instead of the dorsal surface.



Fig. 64.—The demi-gauntlet (dorsal) bandage. (Fowler's Surgery.)

Gauntlet Bandage.—The initial extremity of the bandage (Fig. 65) is fixed by means of one or two circular turns at the wrist. The roller is then carried by an oblique turn to the tip of the thumb, and the thumb covered by spiral or spiral reverse turns. Upon the completion of these turns the roller is carried back to the wrist, a circular turn made there, thence to the index-finger, which is bandaged in the same manner as the thumb. In like manner the remaining fingers are covered. The bandage is completed by a few circular turns at the wrist, or additional

figure-of-8 turns may be passed around the hand and wrist for further security.

Spica Bandage of the Thumb.—The initial extremity of the bandage (Fig. 66) is fixed by one or two circular turns around the wrist. The roller is then carried over the dorsal aspect of the tip of the thumb and there a circular turn is made. The roller returns to the wrist and a circular turn is made around the wrist.

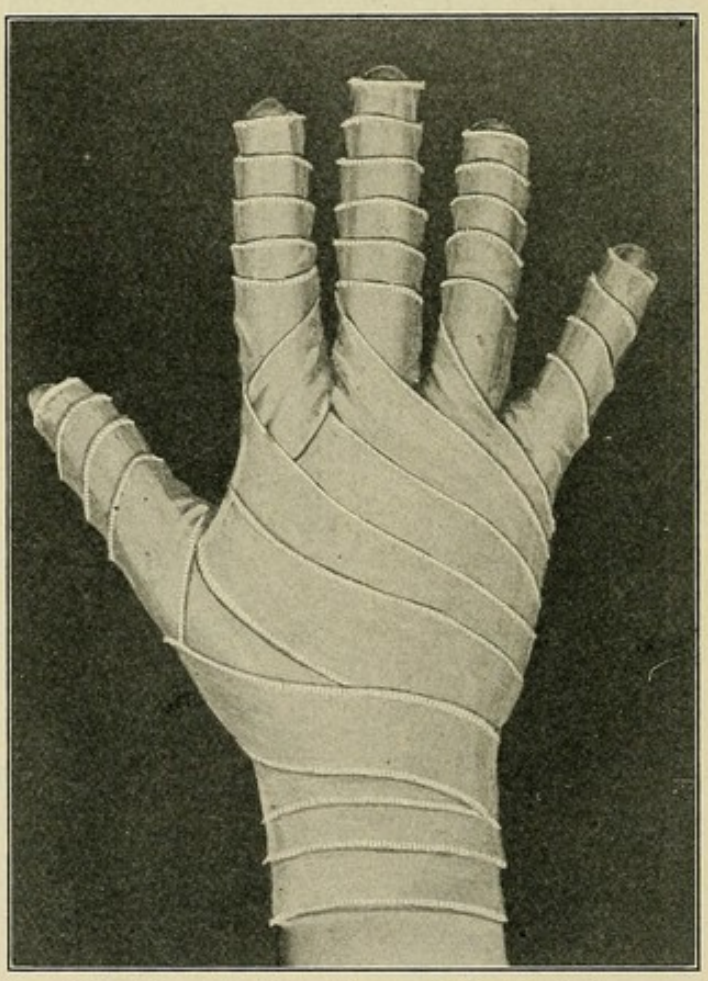


Fig. 65.—Gauntlet bandage. (Fowler's Surgery.)

Thence the roller is again carried obliquely across the dorsal aspect of the thumb. A second circular turn is made around the thumb, this last overlapping the first turn by two-thirds of its width. This procedure is continued until the thumb is covered, a turn around the wrist completing the bandage. A few recurrent turns may be first placed over the tip of the thumb if it is desired to include this in the bandage.

Spiral Bandage of the Finger.—The initial extremity of the bandage (Fig. 67) is fixed by two or three turns around the

middle phalangeal joint. The bandage is then carried in a spiral manner to the base of the finger, each turn covering in one-half

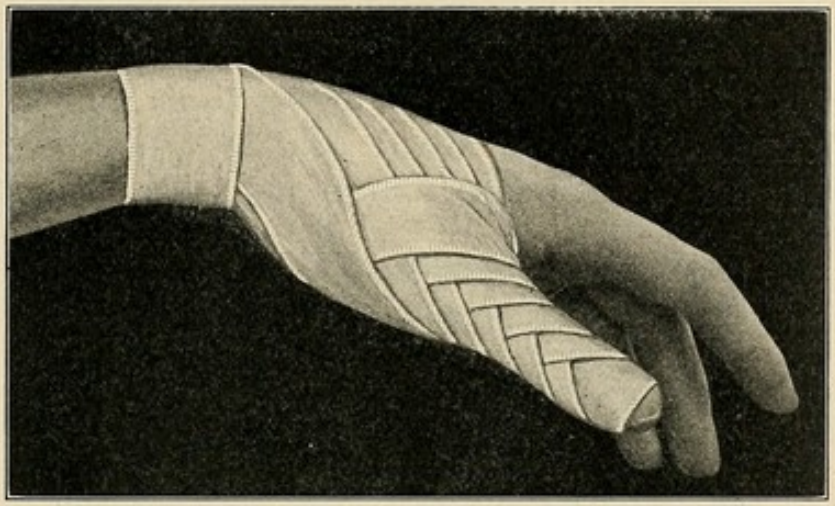


Fig. 66.—Spica bandage of the thumb (Fowler's Surgery.)

of the preceding turn. A circular turn is made at the base of the finger and the bandage is carried by means of spiral turns to its starting-pont at the middle phalangeal joint. From the



Fig. 67.—Spiral bandage of the finger. (Fowler's Surgery.)

posterior surface of this joint a recurrent turn is now passed directly over the tip of the finger to the anterior surface of the

joint, the fingers of the operator's left hand holding this turn taut while a second recurrent turn is passed back over the inner half of the finger tip to the starting-point of the first recurrent turn. This is also held in place and a third and final recurrent turn is passed over the outer half of the finger tip. A circular turn secures the ends of these three recurrent turns. The bandage is then carried to the distal end of the finger by means

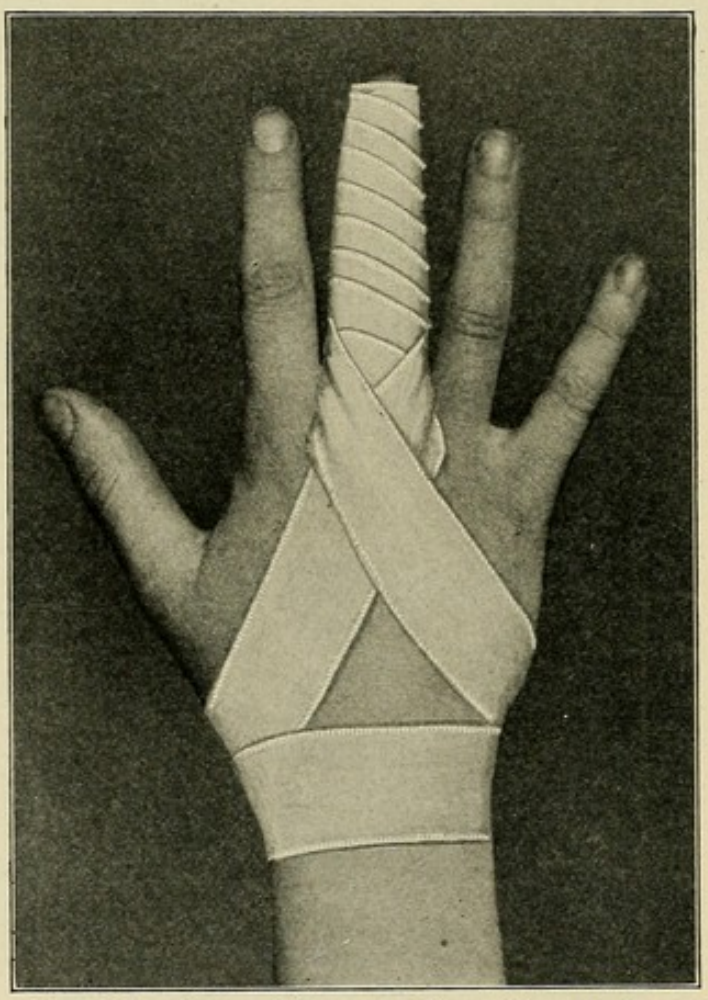


Fig. 68.—Spiral bandage of finger. Second method. (Fowler's Surgery.)

of spiral turns. At the extremity a circular turn is taken that secures the recurrent turns which extend on either side of the finger tip. Finally, by means of spiral turns the base of the finger is reached and the bandage is fastened there by splitting it longitudinally for a distance of six or eight inches, then knotting it just beyond the split to prevent further splitting, and tying the ends directly around the base of the finger; or the bandage may be split for a distance of ten or twelve inches, the long ends being

knotted and carried around the wrist once or twice and then tied securely. The last method effectually prevents the loosening or falling off of the bandage.

A second method of applying the spiral bandage to the finger is to fix the initial extremity of the bandage by taking two or three turns around the base of the finger (Fig. 68). From the posterior aspect of the base of the finger the bandage is passed directly over the finger tip to the anterior aspect of the base of the finger. The second and third recurrent turns are passed in like manner over the inner and outer half of the finger tip. A circular turn at the distal extremity holds these in place, following which a series of spiral turns descend to the base of the finger where the bandage is completed by a circular turn.

A simpler method may be used where it is not desired to cover in the finger tip. The initial extremity of the roller is secured by two or three circular turns around the base of the finger, the finger is then ascended to its tip by spiral turns, a circular turn is made at the tip, and by means of spiral turns the base of the finger is again reached, where a circular turn completes the bandage.

Reversed Spiral Bandage of the Finger.—This bandage is applied in the same manner as any of the spiral bandages just described, with the exception that reverse spiral turns are used in place of spiral turns.

Anterior Figure-of-8 Bandage of the Chest.—The initial extremity of the roller (Fig. 69) is fixed by means of the index-finger of the left hand over the middle third of the sternum. The roller is then carried over one shoulder to its posterior aspect, under the axilla of the same side to the anterior aspect of the shoulder, diagonally across the chest to the posterior aspect of the other shoulder, under the axilla to the anterior aspect of the chest, and diagonally across to the starting-point, thus forming a cross over the sternum. These turns are repeated a number of times. The bandage may be *modified* by first making a few circular turns around the chest at the level of the axillary fold or by alternating these circular turns with the figure-of-8 turns (Fig. 70). The turns may be placed in such a manner that each shall exactly cover in the preceding one, or each turn may

overlap the preceding one by two-thirds of its width. The bandage is fastened by pinning through the intersections over the sternum.

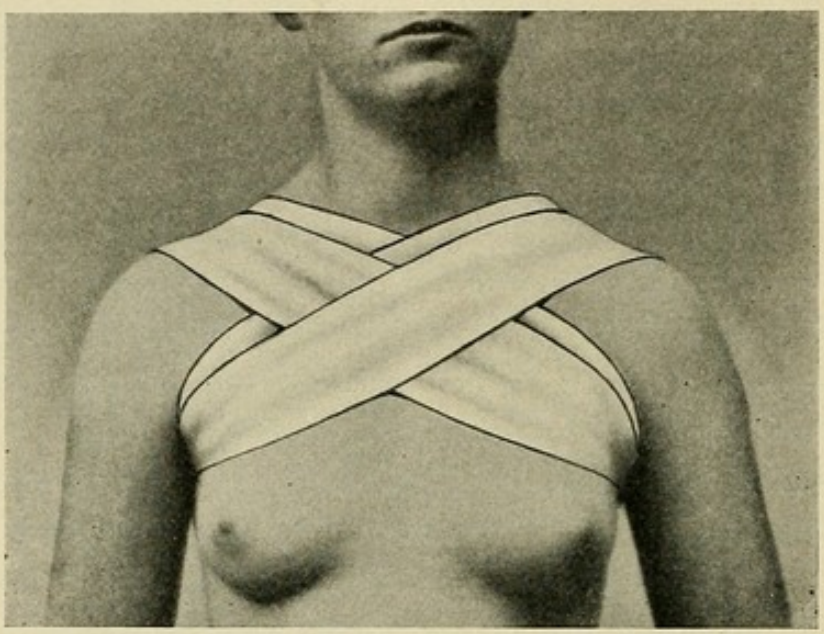


Fig. 69.—Anterior figure-of-8 bandage of the chest.

Posterior Figure-of-8 Bandage of the Chest.—The initial extremity of the roller (Fig. 71) is fixed between the scapulæ at the level of the axilla and the roller is carried over one shoulder

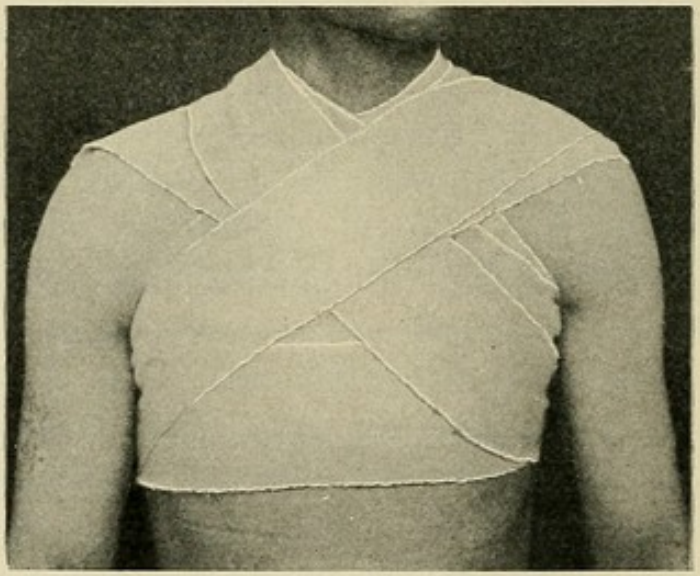


Fig. 70.—Anterior figure-of-8 bandage of the chest modified. (Fowler's Surgery.)

to its anterior aspect, under the axilla on that side to the posterior aspect of the shoulder, and thence back to the starting-point.

In a similar manner the roller is carried around the other shoulder. These turns alternate first around one shoulder, then around the other, until the bandage is finished. The point of intersection between the scapulæ is pinned.

Spiral Bandage of the Chest.—The initial extremity of the roller (Fig. 72) is fixed by means of one or two circular turns around the chest at the level of the xiphoid cartilage. The roller then gradu-

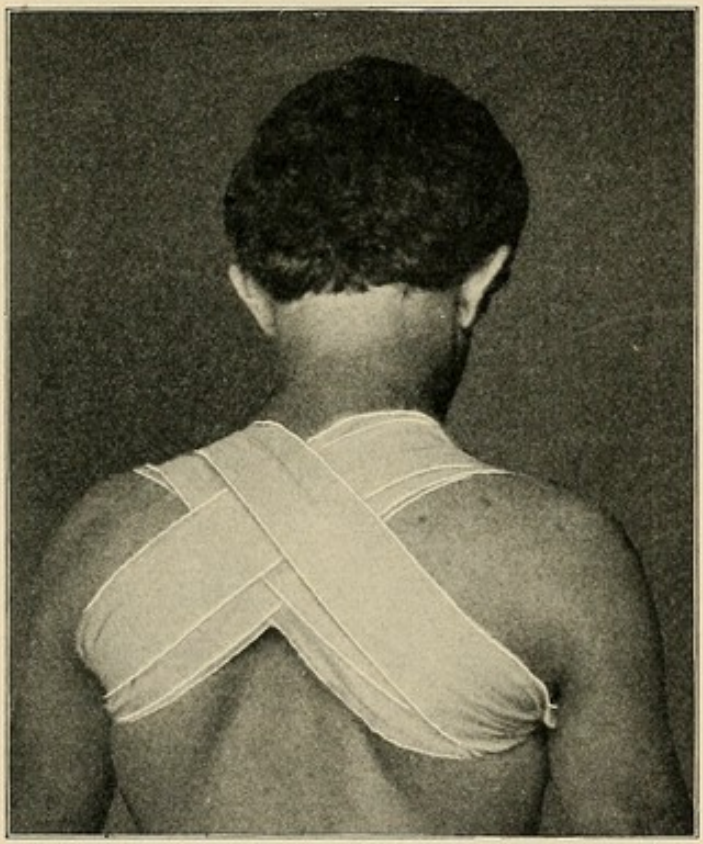


Fig. 71.—Posterior figure-of-8 bandage of the chest. (Fowler's Surgery.)

ally ascends the chest by means of spiral turns, each turn covering in two-thirds of the preceding turn until the level of the axillary fold is reached. Here one or two circular turns complete the bandage. The spiral turns may be supported by shoulder straps pinned in front and behind (Fig. 73).

A second method of completing the bandage (Fig. 74) is to make one circular turn at the level of the axillary fold, pass under the axilla to the posterior aspect of the chest, thence obliquely to the opposite shoulder, over this to the anterior aspect of the chest, and diagonally down over the turns of the bandage to

the xiphoid cartilage where the bandage ends and is pinned. Pins are inserted to fasten this last oblique strip to each spiral turn of the bandage.

Single Breast Bandage.—The roller (Fig. 75) is started from the scapula of the affected side, is carried over the shoulder of the opposite side to the anterior chest wall, and thence under

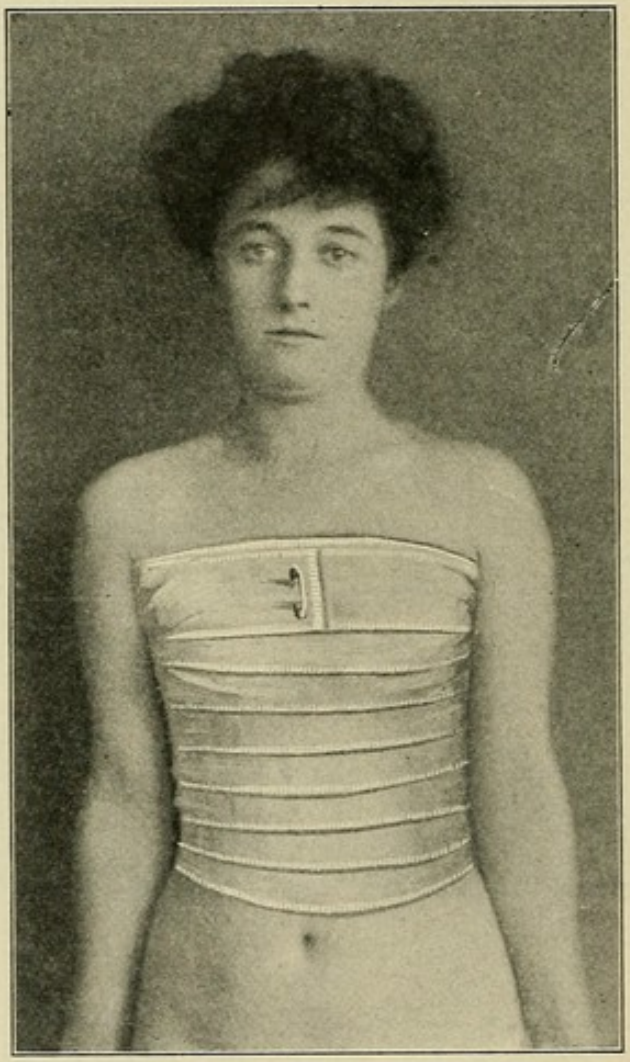


Fig. 72.—Spiral bandage of the chest. (Fowler's Surgery.)

the affected breast and obliquely along the lateral and posterior chest wall to its starting-point. This turn is repeated in order to secure the initial extremity. Again, starting from the point of the initial extremity over the scapula of the affected side, the roller is carried completely around the chest just under the affected breast. These turns are alternated, each turn covering in its corresponding preceding turn by two-thirds of its width, and thus gradually ascending and covering in the breast completely.

Care should be taken that the affected breast is compressed equally and that the other breast is not unduly pressed upon.

Double Breast Bandage.—The first turn of this bandage (Fig. 76) is the same as that of the single breast bandage. The second turn is a circular one around the chest just below the breasts. The third turn begins at the point of the initial extremity, and the roller is carried around the chest wall to the under

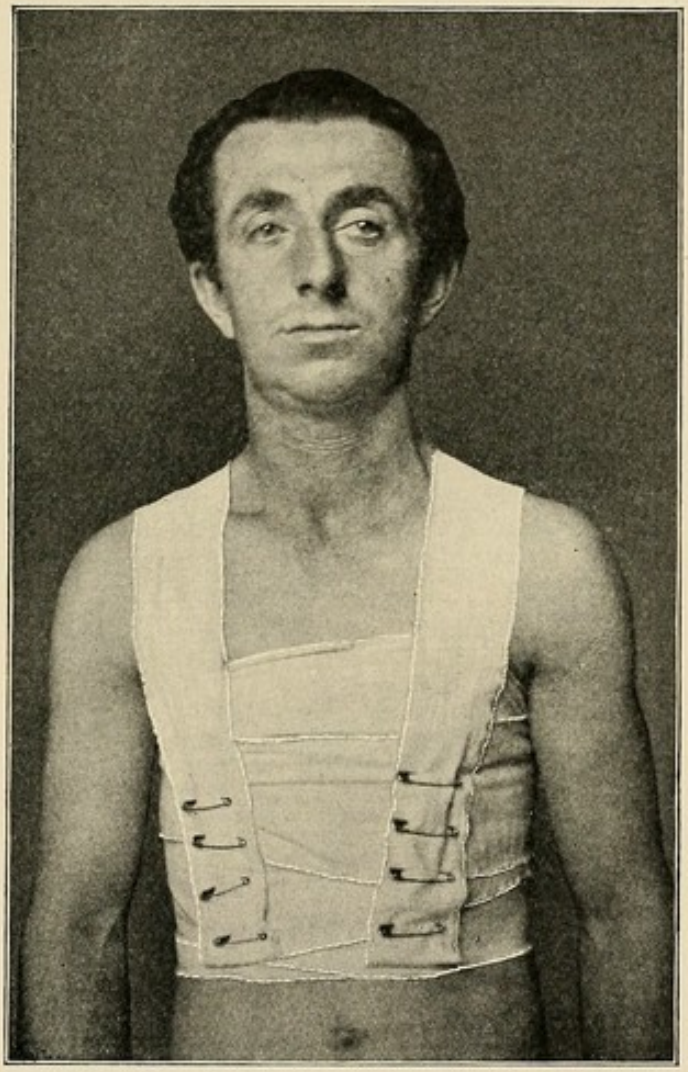


Fig. 73.—Spiral bandage of the chest. Method of securing. (Fowler's Surgery.)

surface of the second breast; then it passes obliquely up over the anterior chest wall and over the shoulder opposite the breast thus supported, thence over the posterior chest wall to the starting-point. Turn number two is now repeated, then turn number one, then turn number three. These turns are repeated in this order, each breast turn covering in by two-thirds of its

width the corresponding preceding turn, and in this manner both breasts are securely and neatly covered.

Ascending Single Spica Bandage of the Groin.—The initial extremity of the roller (Fig. 77) is fixed by means of one or two circular turns around the body just above the level of the iliac crest. If the right groin is the one to be bandaged the roller

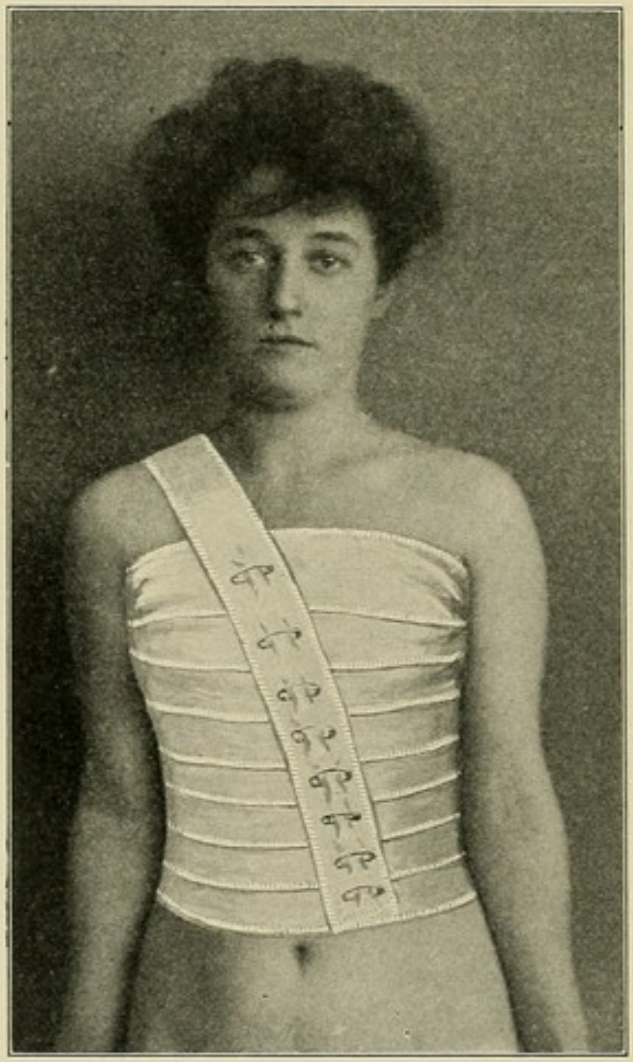


Fig. 74.—Spiral bandage of the chest. Second method of securing. (Fowler's Surgery.)

should run anteriorly from left to right, and *vice versa*. The roller is carried from the summit of the iliac crest opposite the groin to be bandaged, obliquely across the anterior surface of the abdomen to the outer side of the thigh of the affected side at the junction of its middle and upper third. A circular turn and a half is made around the thigh at this point, the roller emerging on the inner side of the thigh and crossing the first oblique part as



Fig. 75.—Single breast bandage (Fowler's Surgery.)

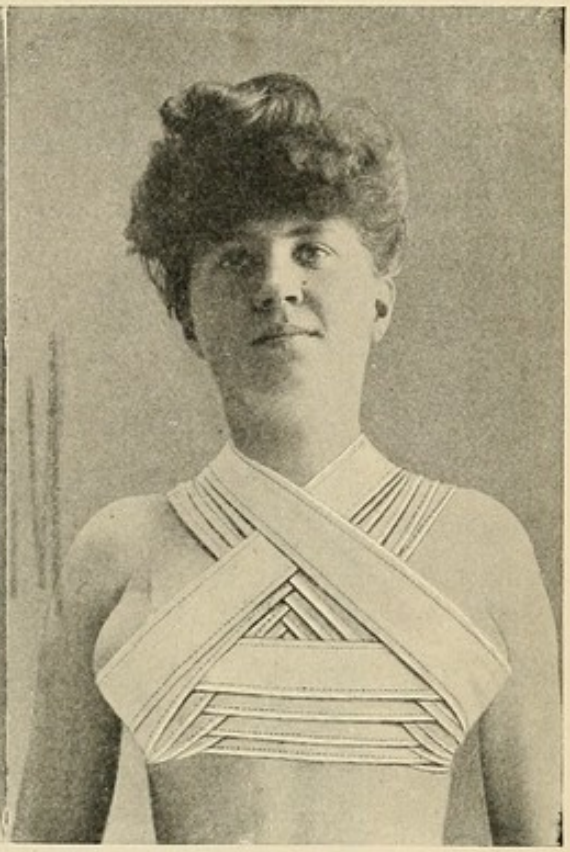


Fig. 76.—Double breast bandage. (Fowler's Surgery.)

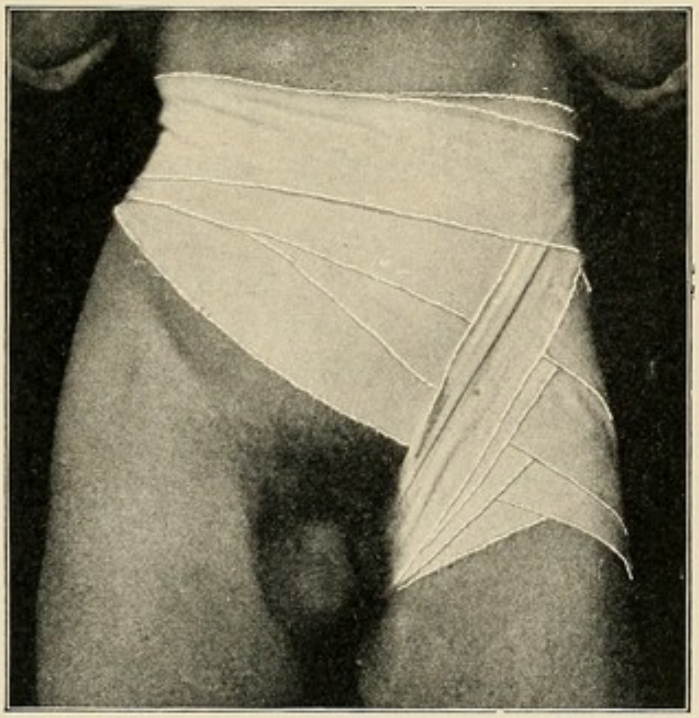


Fig. 77.—Ascending single spica bandage of the groin. (Fowler's Surgery.)

low down as possible in the middle line of the thigh; thence it passes over the groin to the lateral aspect of the iliac bone on the same side, and over this in a slightly oblique direction to a point above the iliac crest. A circular turn is now made around the body just above the iliac crest, as in the first turn which secured the initial extremity. The spica turns and the circular turns around the thigh are alternated with the circular turns around the body, the two former ascending by one-third of the width of the bandage. In this manner the upper third of the thigh and all

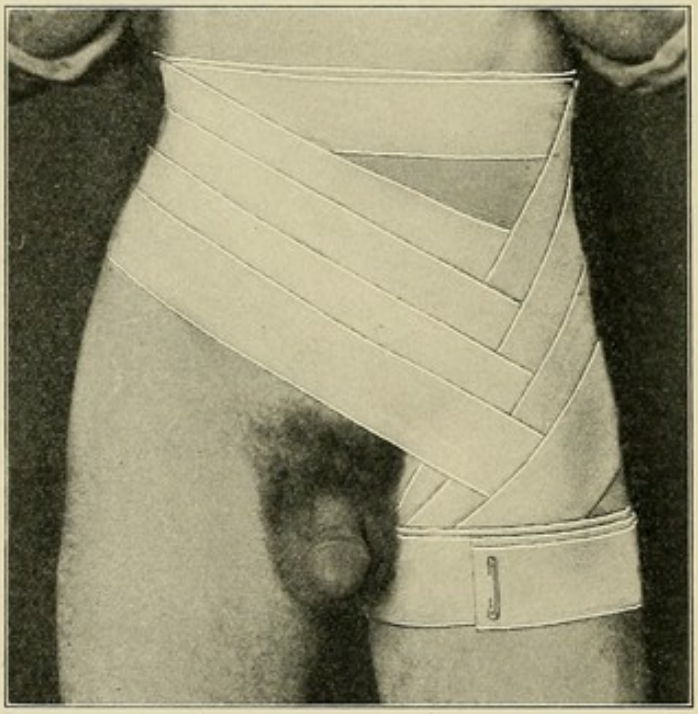


Fig. 78.—Descending single spica bandage of the groin. (Fowler's Surgery.)

of the groin are completely covered in. Either the circular turn around the body or that around the thigh, or both, may be omitted. The spica turns should cross each other exactly in the middle line of the thigh and groin. If, in bandaging the right thigh, the bandage is started around the body from right to left, instead of from left to right, the roller will then of course be carried obliquely across the groin from the lateral surface of the iliac crest of the affected side to the internal aspect of the thigh at the junction of its middle and upper third, where a circular turn and a half is made. The roller emerging on the outer side of the thigh is carried obliquely across the anterior surface of the thigh, crossing the first oblique part of the spica turn in the middle

line of the thigh as low down as possible, and is carried obliquely across the anterior surface of the abdomen to above the iliac crest of the opposite side and thence circularly around the body to its starting-point. If, in bandaging the left groin, the roller is started from the left to the right, the above description also holds good for that side.

Descending Single Spica Bandage of the Groin.—The descending spica of the groin (Fig. 78) is applied in the same manner as the ascending, and consequently the same description holds good for both, with the exception that, whereas in the case of the ascending spica the first turn is placed at the junction of the middle with the upper third of the thigh, and the subsequent spica turns ascend from that point by one-third of their width, in the case of the descending spica the first turn is placed as high up as possible and the subsequent turns descend by one-third of their width until the junction of the middle with the upper third of the thigh is reached.

Ascending Spica Bandage of Both Groins.—The initial extremity of the bandage (Fig. 79) is fixed by means of one or two circular turns around the body just above the level of the iliac crests. The roller runs from left to right, or from right to left, according to the thigh which is to receive the first spica turn. Starting from the iliac crest of one side the roller is carried obliquely across the anterior surface of the abdomen and groin to the external surface of the opposite thigh at the junction of its middle and upper thirds. Here a circular turn and a half is made, the roller emerging from the inner side of the thigh and passing obliquely across the first part of the spica in the middle line of the thigh as low down as possible, then obliquely ascending to the lateral surface of the iliac bone of the same side, thence obliquely around the body posteriorly to the opposite iliac crest. A circular turn is made around the body and the bandage is carried only to the iliac crest opposite the groin yet to be bandaged. The roller is then carried obliquely across the back to the lateral aspect of the iliac bone of the opposite side, and thence obliquely over the anterior surface of the groin of that side to the anterior surface of the thigh at the junction of its middle and upper third, where a circular turn and a half is made. The roller then emerges

on the external surface of the thigh and ascends obliquely over the anterior surface of the groin, crossing the first oblique part of the spica turn in the middle line of the thigh. Thence the roller is carried obliquely over the anterior surface of the abdomen to the opposite iliac crest, where a circular turn is made around the body. These turns are repeated in the following order: first, a circular turn around the body; then a spica turn around one groin, the bandage emerging from the inner side of

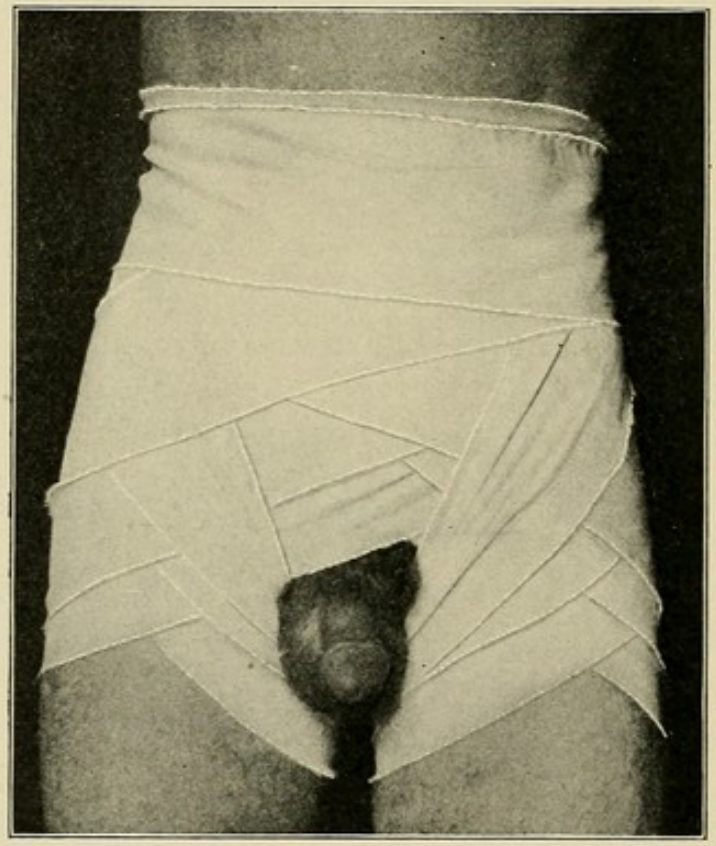


Fig. 79.—Ascending spica bandage of both groins. (Fowler's Surgery.)

the thigh after surrounding it; then a circular turn around the body, and a spica turn around the other thigh, the bandage emerging from the outer side of the thigh after surrounding it by a circular turn; then, finally, a circular turn around the body, until both groins and the upper third of both thighs are completely covered in. The circular turns about the body accurately overlie each other and the circular turns about the thighs ascend by one-third of their width. Either the circular turns around the body or the circular turns around the thighs or both may be omitted.

Descending Spica Bandage of Both Groins.—The descending spica of both groins (Fig. 80) is applied in the same manner as the ascending spica, with the exception that the oblique turns in the descending spica begin to cross high up and descend to the junction of the middle with the upper third of the thigh.

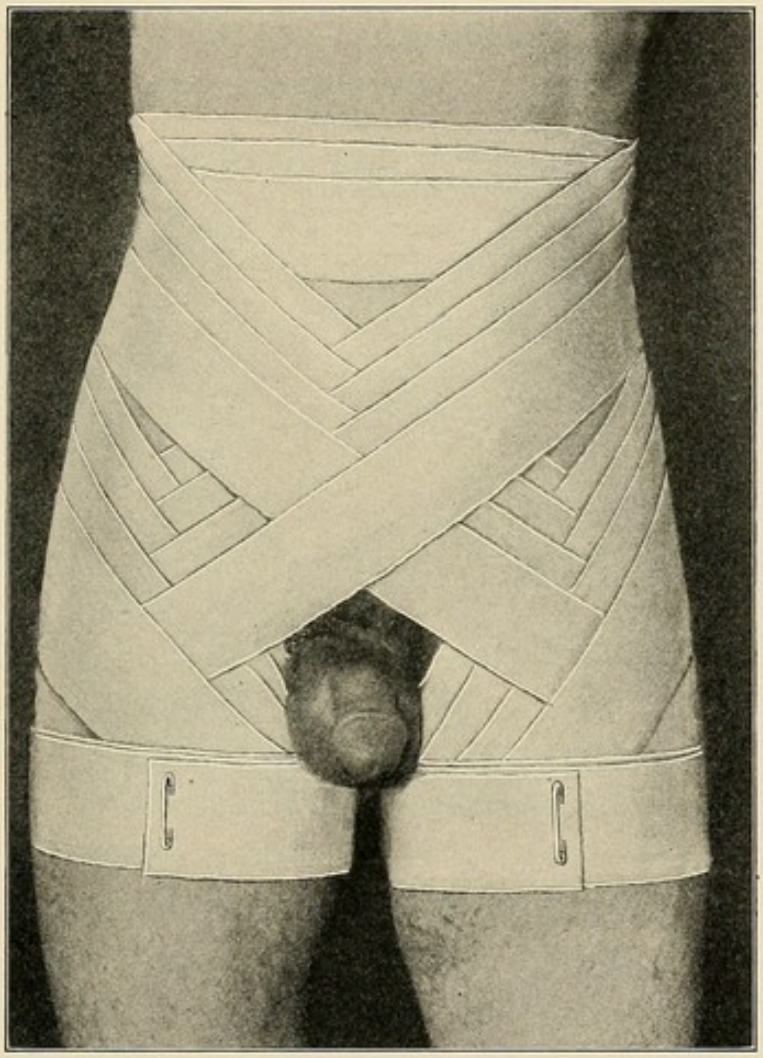


Fig. 80.—Descending spica bandage of both groins. (Fowler's Surgery.)

Figure-of-8 Bandage of the Knee.—The initial extremity of the bandage (Fig. 81) is fixed by means of one or more circular turns around the thigh a short distance above the knee-joint. The roller is carried obliquely across the popliteal space to the inner surface of the leg and surrounds the leg by a circular turn about three inches below the joint. The roller is then passed obliquely upward across the popliteal space, crossing the first oblique turn in the middle line to the inner surface of the thigh where a circular turn is made which overlaps the preceding circu-

lar turn at this point by two-thirds of the width of the bandage and approaches the knee-joint by one-third of its width. The popliteal space is again crossed to the circular turn below, and here is made another circular turn which ascends toward the knee-joint by one-third of the width of the bandage. These turns are continued first above and then below the knee, the upper ones gradually descending and the lower ones gradually ascending until the knee is entirely and securely covered.

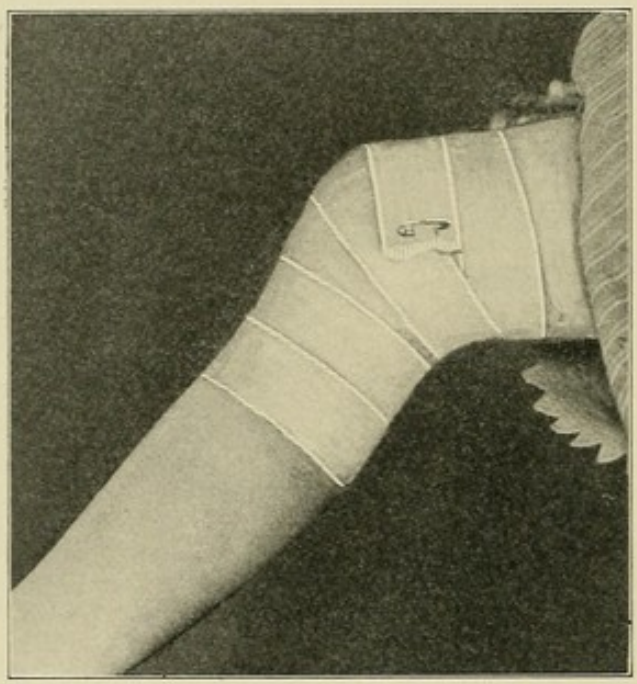


Fig. 81.—Figure-of-8 bandage of the knee. (Fowler's Surgery.)

Figure-of-8 Bandage of Both Knees.—The patient's knees are placed closely together, being separated only by a layer of non-absorbent cotton or some soft material to protect the opposing bony prominences from pressure. The initial extremity of the bandage is fixed by means of one or two circular turns which include both thighs at a short distance from the knee-joints. The roller is carried obliquely across both popliteal spaces to a point about three inches below the knees, where a circular turn is made around both legs. The popliteal space is again obliquely crossed by the roller and a circular turn is made around both the thighs, this turn overlapping the previous turn by two-thirds and descending toward the knees by one-third of the width of the bandage. Again, the popliteal spaces are crossed to the turn below the knees and a second circular turn is made there, this

turn overlapping the previous one by two-thirds and ascending toward the knees by one-third of its width. These circular turns are repeated, first one above and then one below the knees until the parts are completely covered. Finally, to complete the bandage, the roller is passed from the posterior surface between the thighs to the anterior surface of the bandage, over this to between the legs, and so posteriorly to emerge between the thighs, and is fastened on the anterior surface.

Reversed Spiral Bandage of the Lower Extremity.—One of the foot bandages is first applied. Instead of ending the foot bandage at the ankle, the roller (Fig. 82) is carried up the leg by

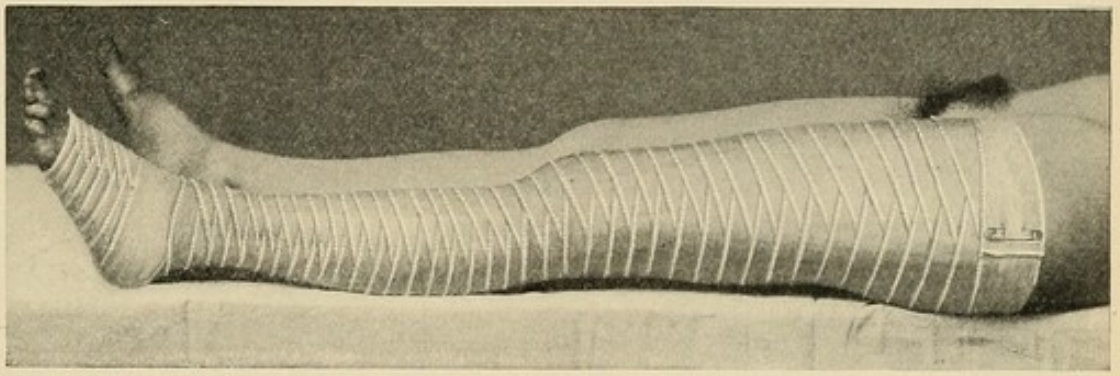


Fig. 82.—Reversed spiral bandage of the lower extremity. (Fowler's Surgery.)

means of spiral or spiral reversed turns, according to the conformation of the part, until the knee is reached; here the bandage may be ended with a few circular turns, or, with the leg in the extended position, it may be continued on up the thigh to the groin, and either end there or a spica of the groin be added for additional security. If it is desired to allow the patient's knee to remain in a flexed position, the figure-of-8 bandage of the knee takes the place of the spiral or spiral reversed turns in that region.

Short Figure-of-8 Bandage of the Leg.—If the leg is fairly well nourished this is the best bandage to use (Fig. 38) First apply one of the foot bandages, then ascend the leg by means of spiral turns until these can no longer be made to lie smoothly; here the figure-of-8 turns begin. The bandage is carried obliquely upward and around to the median line posteriorly, whence it is carried obliquely downward and around to the front of the leg, crossing the starting-point as near the median line as is per-

missible without bringing too much pressure over the long ridge of the tibia. These figure-of-8 turns are repeated, gradually ascending the leg until the calf is covered. The bandage is completed by one or more circular turns around the leg just below the knee.

Long Figure-of-8 Bandage of the Leg.—The initial extremity of the bandage (Fig. 39) is fixed by one or two circular turns around the ankle, and some form of foot bandage is then applied. When it again reaches the ankle the roller is carried so as to conform evenly to the parts by an oblique turn, but, when the knee is reached, a circular turn is made and an oblique turn is carried in a downward direction until the first circular turn at the ankle is reached. An ascending spiral turn is made to the knee and an oblique turn in the downward direction is repeated These turns are repeated, each evenly applied according to the conformation of the limb, until the entire leg is securely bandaged. This bandage is one of the easiest of the leg bandages to apply and affords even pressure.

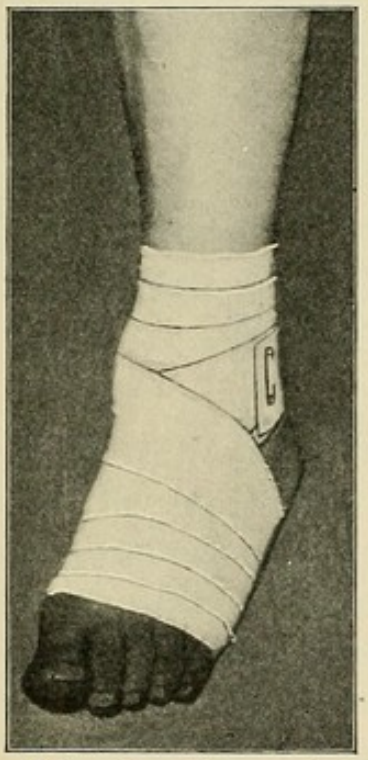


Fig. 83.—Figure-of-8 bandage of the foot and ankle. (Fowler's Surgery.)

Figure-of-8 Bandage of the Foot and Ankle.—The initial extremity of the bandage (Fig. 83) is fixed by a circular turn or two just above the malleoli. The roller is carried obliquely across the instep to the base of the toes, where a circular turn is made and the roller is returned to a point above the outer malleolus. A circular turn overlying the first circular turn is then made. These turns are continued, one above and one below the ankle, those above gradually descending and those below gradually ascending until the instep and ankle are covered. The bandage is completed by a circular turn around the ankle.

Spiral Bandage of the Foot.—The initial extremity is fixed by the finger tips placed above the inner malleolus. The roller

is carried around the ankle anteriorly; it crosses the initial extremity and thus fixes it. The roller now crosses the instep to the base of the toes, where a circular turn is made. Spiral turns, ascending the foot and instep, are next made as far as the conformation of the parts permits. The roller is then carried to the ankle, a few circular turns are made, and the terminal extremity is fastened.

Spiral Reversed Bandage of the Foot.—The mode of application is the same as that of the spiral bandage, except that spiral reversed turns are employed in place of spiral turns.

Spica Bandage of the Foot (Fig. 84).—The initial extremity is fixed by a circular turn or two above the malleoli, and the roller is carried obliquely across the instep to the base of the toes, where a circular turn is made. The roller is carried obliquely across the instep to the lateral aspect of the foot, along the lateral aspect to the posterior surface of the heel well down, thence along the lateral aspect of the foot obliquely across the instep; it crosses the instep and turns obliquely in the median line to the other side of the foot. This completes the first spica turn. These spica turns are repeated, each one ascending the foot by one-third of the width of the bandage until the foot and ankle are covered in. The bandage is completed by a few circular turns above the malleoli. It may be desirable to apply a few spiral or spiral reversed turns around the instep before beginning the spica turns, in order to make the bandage look neater. The intersection of the spica turns should always be in the median line.



Fig. 84.—Spica bandage of the foot and ankle. (Fowler's Surgery.)

Serpentine Bandage of the Foot.—The initial extremity of the bandage (Fig. 85) is fixed by means of a circular turn or two above the malleoli. The roller is carried obliquely across the

instep to the base of the toes, where a circular turn and a half is made, bringing the roller to the middle line anteriorly. The roller is carried obliquely to the outer edge of the sole, then under the hollow arch of the foot to the internal lateral aspect of the heel, well down, thence obliquely up over the posterior aspect of the heel to the external malleolus, and obliquely to a

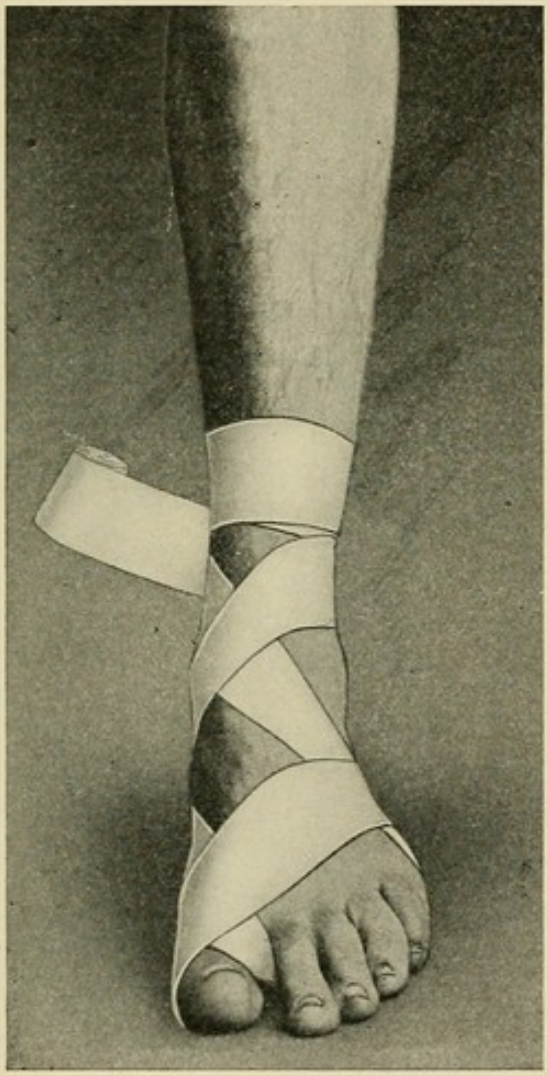


Fig. 85.—Serpentine bandage of the foot, first turn. The bandage has been made to include the great toe.

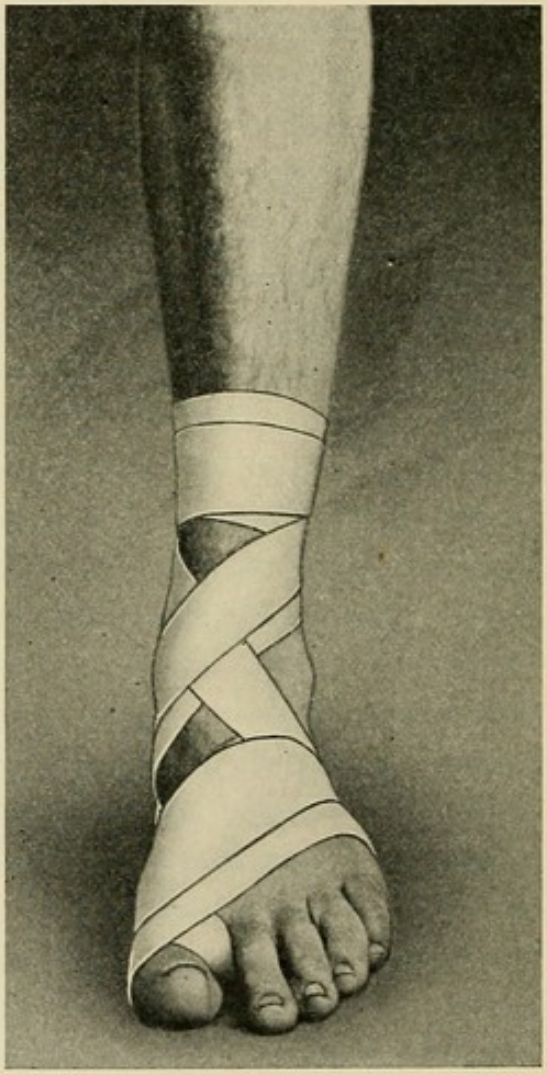


Fig. 86.—Serpentine bandage of the foot, second turn. The bandage has been made to include the great toe.

point above the malleoli, where a circular turn is made. This forms turn number one. The roller is now carried obliquely across the instep to the base of the toes, the roller naturally going to the internal aspect of the base of the toes, whereas in turn number one it came to the external aspect. A circular turn and a half is made around the base of the toes. Thence

the roller is carried obliquely over the instep to the internal edge of the sole of the foot, then onward beneath the hollow arch of the foot obliquely to the external lateral aspect of the heel, well down, thence obliquely up over the posterior aspect of the heel to the internal malleolus, and obliquely to a point above the malleoli, where a circular turn is made. This forms turn number two (Fig. 86). Turn number three is a circular

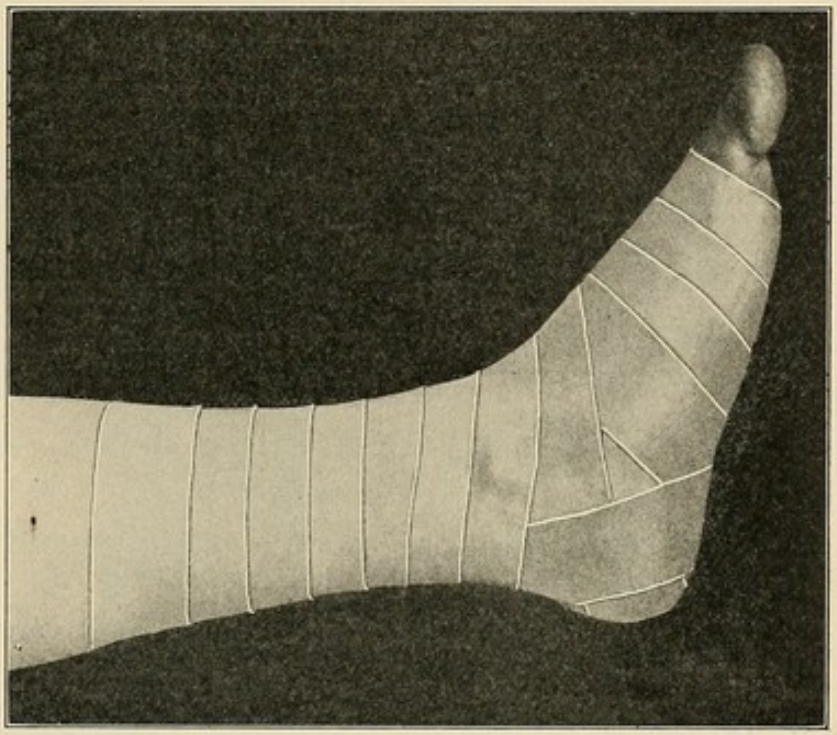


Fig. 87.—Serpentine bandage of the foot completed. (Fowler's Surgery.)

turn around the instep and point of the heel, the edges of which are held and covered in by a repetition of turns number one and two, thus completely covering in the heel. Turns number one, two, and three are repeated until the parts are sufficiently covered (Fig. 87). If it is not desired to cover in the heel, the circular turn number three may be omitted. This forms the most efficient foot bandage.

Recurrent Bandage of the Foot.—Any of the usual foot bandages may have included recurrent turns for the purpose of covering the toes. *Combinations* of spiral, spiral reversed, spica, figure-of-8, recurrent, and serpentine bandages of the foot may be used as indications arise in individual cases. It may sometimes be necessary to carry spiral or spiral reversed turns above the ankle.

Spica Bandage of the Great Toe (Fig. 88).—This is applied in a manner similar to that employed in applying a spica of the thumb. The initial extremity is fastened by one or two circular turns above the malleoli. The bandage then crosses the instep obliquely from above the internal malleolus to the outer side of the great toe. A circular turn is made around the great toe, as near the tip as possible, and the roller is carried from the inner side of the toe obliquely across the instep; it crosses the first oblique part of the spica as near the tip of the toe as possible and passes thence above to the external malleolus. Here a circular turn is made. If desired, the tip of the toe may be covered in by a few recurrent turns. The spica turns are repeated; they ascend toward the base of the toe each time by one-third of the width of the bandage, until the toe is completely covered. The circular turns may be omitted.

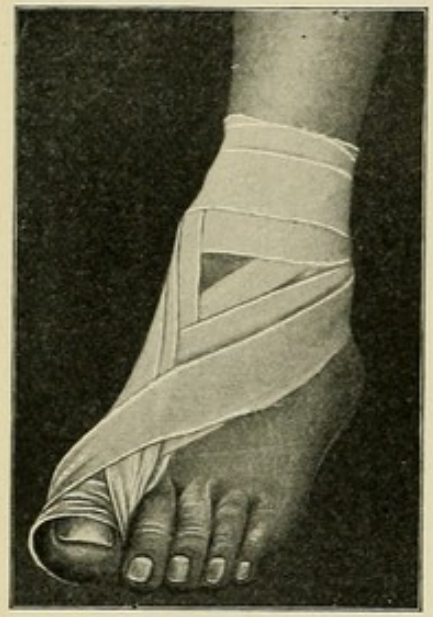


Fig. 88.—Spica bandage of great toe. (Fowler's Surgery.)

Serpentine Bandage of the Great Toe.—The initial extremity of the bandage is fastened by means of one or two circular turns above the malleoli. The roller is then carried obliquely across the instep to the outer edge of the sole, obliquely under the sole to a point just posterior to the thenar eminence, then to the inner edge of the foot, and finally across the anterior surface of the base of the toe to its tip. Here a circular turn is made and a few recurrent turns may be added. From the tip of the toe the roller crosses the anterior surface of the base of the toe, and passes thence, obliquely across the base of the other toes, to the outer surface of the foot to a point opposite the hypothenar eminence. The roller passes under the sole obliquely, just behind the thenar eminence under the arch, to emerge at the inner edge of the foot, and from this point it passes obliquely across the instep to a point above the external malleolus. Here a circular turn is made. These serpentine turns are repeated,

each overlapping the preceding one to a slight extent until the toe is completely covered.

COMPOUND BANDAGES.

Compound bandages are used for the most part to take the place of roller bandages, for use in unskilled hands. They are usually made of unbleached muslin cut to conform to the shape of the part of the body to which they are applied. They are used in first-aid dressing on the battlefield; but few of the bandages are useful in civil practice, as they afford neither the comfort nor the security of the well-applied roller bandage. Of those used in civil practice the sling is the one most frequently employed. For supporting the forearm, a yard square of unbleached muslin is cut diagonally, two triangular slings thus being provided; or the yard square may be folded diagonally on itself, thus forming

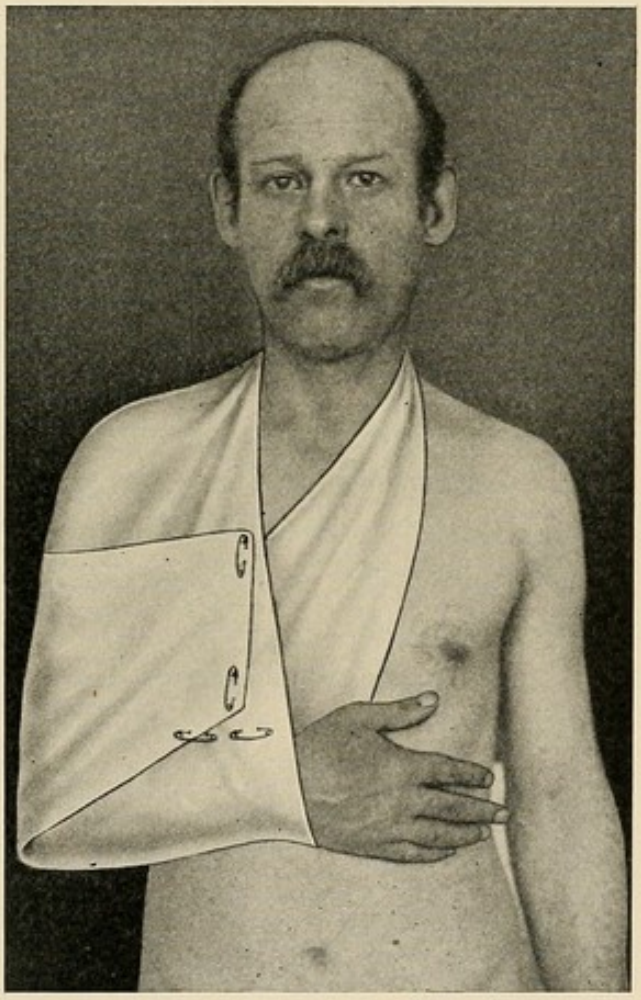


Fig. 89.—Arm-sling.

a triangle. The apex of the triangle is applied beneath the elbow, the portion of the sling next the body is carried over the opposite shoulder, the other portion over the shoulder of the affected side, and the ends are fastened by knotting them at the back of the neck. Enough traction is used to insure that the body of the triangle affords equal support to the entire length of the forearm. The apex of the triangle is secured to the front of the sling. To afford additional security the two sides of the sling may be sewed or pinned together just above and parallel with the forearm (Fig. 89).

Another variety of sling for the upper extremity is made by using a strip of muslin three feet in length and of sufficient breadth to support the forearm. A bandage or binder of the chest is first applied, one end of the sling being pinned in front to the median line of the binder or bandage. The other end is passed between the body and the forearm, beneath the latter, and around it to the starting-point, where it is pinned with enough traction to afford comfortable support.

Sling for the Lower Extremity.—A long external, well-padded board splint, ten inches broad and extending from the axilla to a point below the heel, is secured to the chest and pelvis by a bandage of adhesive plaster. A strip of muslin broad enough to surround the lower extremity is used. One edge of the long side is tacked to the uppermost edges of that portion of the splint which corresponds to the leg and thigh. The strip is then passed under the leg and thigh back to the first edge and there fastened, sufficient tension being used to support the limb comfortably.

T-bandages are mostly used for holding perineal or vulvar dressings in place. They may be modified to secure dressings in other parts of the body, such as the head and face.

The single T-bandage (Fig. 90) is made by sewing a strip of unbleached muslin, three inches wide by eighteen inches long, to the middle of another strip four inches wide by forty inches long. The edges should be hemmed.

The double T-bandage (Fig. 91) is made by sewing a split strip to the middle of the long strip. The long strip or body of the bandage may be made wider according to the part of the

body to which it is intended to apply it. Two strips may be fastened a short distance to each side of the middle of the body of the bandage.

Triangular bandages are modified T-bandages. The vertical strip of the single T-bandage is made broad at the base and triangular in shape, the base being attached to the body of the bandage. This form of bandage is useful in securing dressings

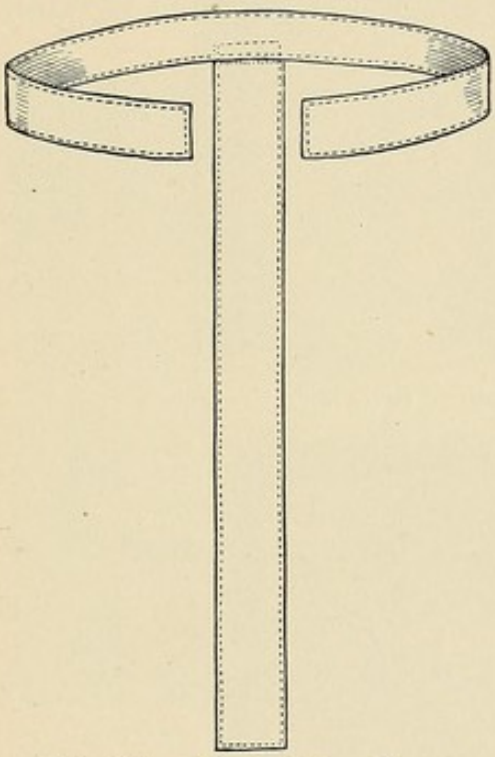


Fig. 90.—Single T-bandage. (Fowler's Surgery.)

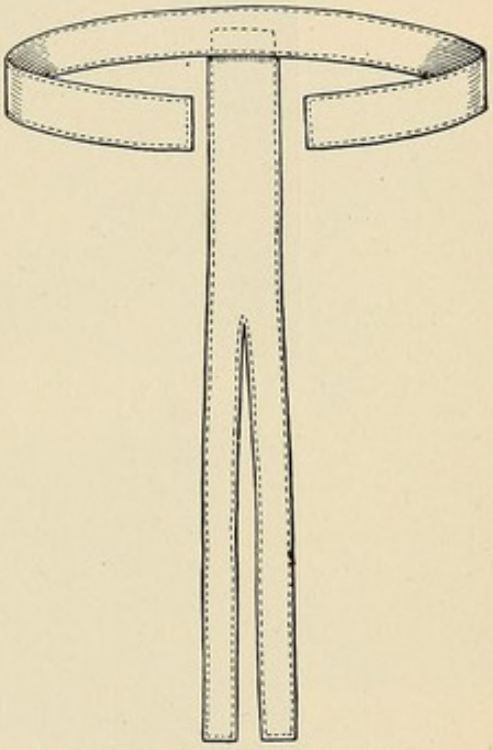


Fig. 91.—Double T-bandage. (Fowler's Surgery.)

in the region of the groin (Fig. 92), in the gluteal region and in the anal region. In applying a T-bandage to retain dressings against the perineum, or against some part in that neighborhood, the body of the bandage is first made to surround the pelvis and then is fastened in the median line in front. The vertical strip or strips are then drawn taut from behind forward over the dressing and are secured to the body of the bandage over the lower part of the abdomen.

When the **T-bandage of the chest** (Fig. 93) is applied, the body of the bandage, ten or twelve inches broad, is made to surround the chest, being fastened by pins in the median line in front or at one side. The vertical strips are then brought from behind

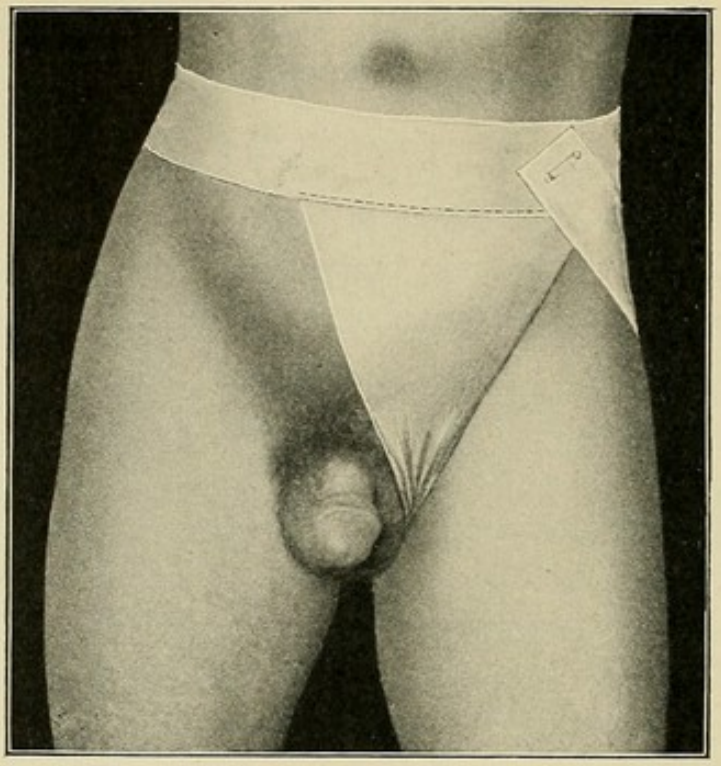


Fig. 92.—The triangle of the groin. (Fowler's Surgery.)



Fig. 93.—T-bandage of the chest. (Fowler's Surgery.)

forward snugly over the shoulder and fastened to the body of the bandage in front.

The abdominal T-bandage or abdominal binder (Fig. 94) is made of two thicknesses of unbleached muslin, or of one thickness of canton flannel, in several sizes, from ten to eighteen inches wide, by 3/4, 7/8, 1, 1 1/8, 1 1/4, and 1 1/2 yards long. The body of the bandage surrounds the abdomen and pelvis, the lower edge of the body of the bandage reaching well down on the thighs.

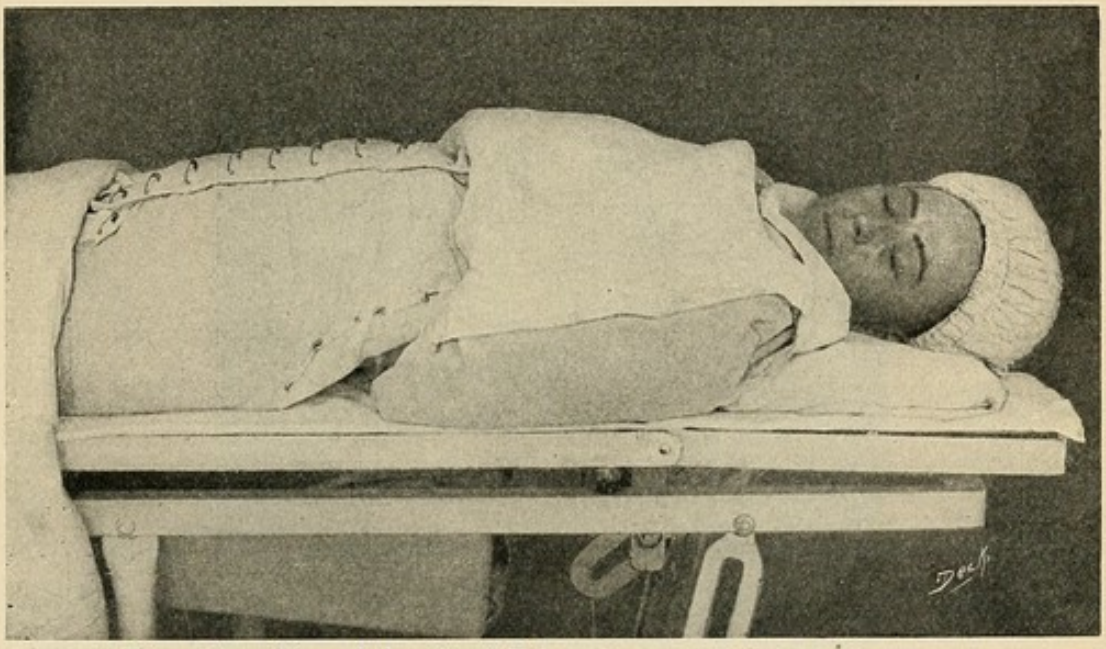


Fig. 94.—The abdominal T-bandage. (Fowler's Surgery.)

It is secured in front with safety pins and the vertical strips are passed from behind forward between the thighs and fastened anteriorly to the body of the bandage, thus securing it and preventing it from slipping up upon the abdomen. These strips are called perineal straps, and, instead of being originally part of the bandage, they may be pinned in place after the body of the bandage has been applied so as to permit of their easy removal should they become soiled. The abdominal binder is made to conform more snugly to the parts by pleating with safety pins on each side.

Hernia Bandage (Fig. 95).—This is made by lengthening the body of an ordinary triangular bandage sufficiently to allow the body of the bandage to encircle the body twice. A three-inch roller is attached to the apex of the triangle, and this is used as a spica of the groin after the triangle is applied.

The breast binder (Fig. 96) is made of two thicknesses of unbleached muslin or of one thickness of canton flannel. It

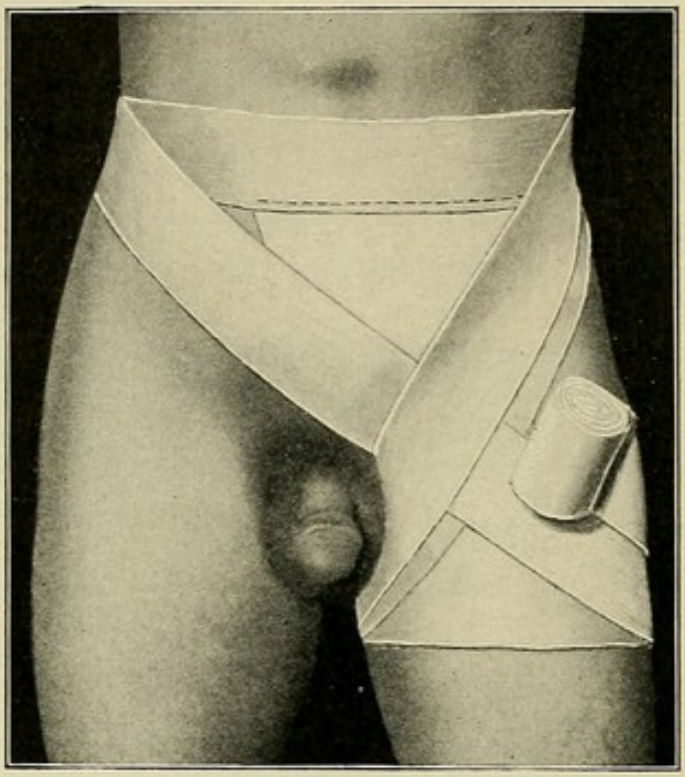


Fig. 95.—Hernia bandage. (Fowler's Surgery.)

resembles an armless jacket. The dimensions are: length, one yard and one-fourth; width, at the back, sixteen inches, in front

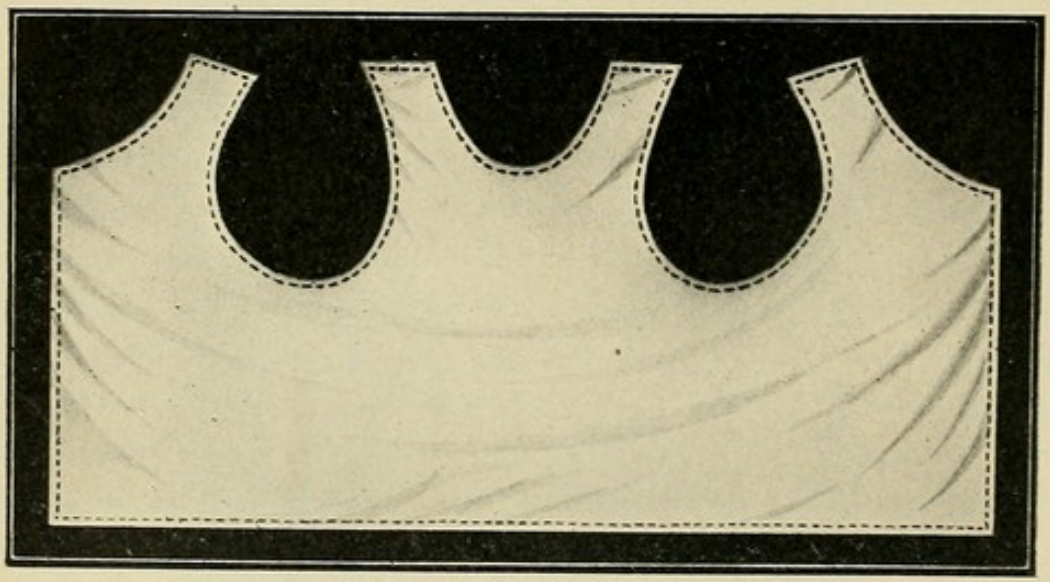


Fig. 96.—Breast binder.

eleven inches, under the arms nine inches. The body of the bandage surrounds the chest and is secured by pinning in the

median line in front. The portions corresponding to the strips of the T-bandage of the chest are fastened over each shoulder with safety-pins (Fig. 97). The bandage is made to fit snugly by taking pleats in the sides with safety-pins. This bandage is most frequently used, after a radical operation for carcinoma of the breast, to retain dressings and to afford support to the opposite breast.



Fig. 97.—The breast binder applied. (Fowler's Surgery.)

Four-tailed Bandage.—This is a modification of the T-bandage. It is made by splitting in two and tearing longitudinally a strip of bandage four inches broad by three feet long. Each end is split longitudinally up to a point within four inches of the middle of the strip. The unsplit portion is the body of the bandage. Such a bandage is useful in retaining certain fractures of the jaw in position, and for dressings in the region of the chin (Fig. 98).

The body of the bandage is applied to the symphysis of the lower jaw. The upper two of the four tails are carried directly backward to beneath the inion and are there drawn taut and knotted. The lower two of the four tails are carried directly upward until the vertex of the skull is reached, where they are drawn taut and knotted. The four ends are then tied tightly together and the superfluous part of the bandage is cut away.

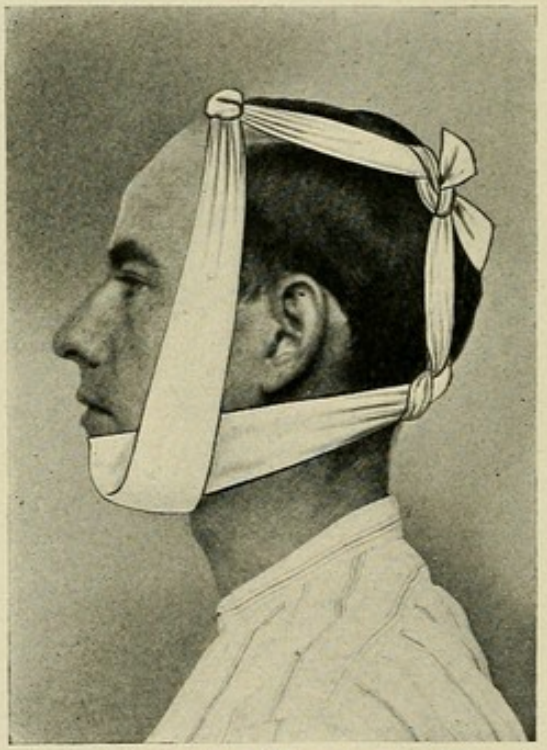


Fig. 98.—Four-tailed bandage of the jaw.

Retractor Bandages.—Modifications of the T-bandages are used for the purpose of retracting the soft parts in amputations, in order to prevent injury to the soft parts while section of the bone is made. They are two-tailed for amputations of the humerus or femur, and three-tailed for amputations of the forearm or leg. They are made of several thicknesses of unbleached muslin, each tail measuring twenty inches long by eight inches wide (Figs. 99 and 100).

The scultetus (Fig. 101) is another form of many-tailed bandage. That most frequently used is similar to an abdominal binder, the binder being split into many tails from each extremity to a point within four inches of either side of the middle line of the bandage. Such a bandage is useful in retaining dressings upon an abdominal

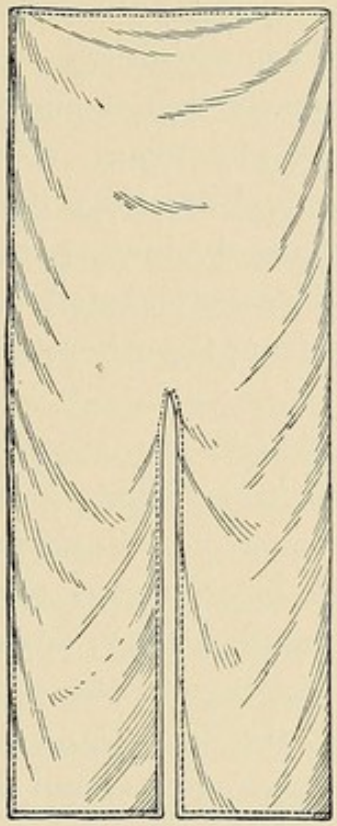


Fig. 99.—Two-tailed retractor. (Fowler's Surgery.)

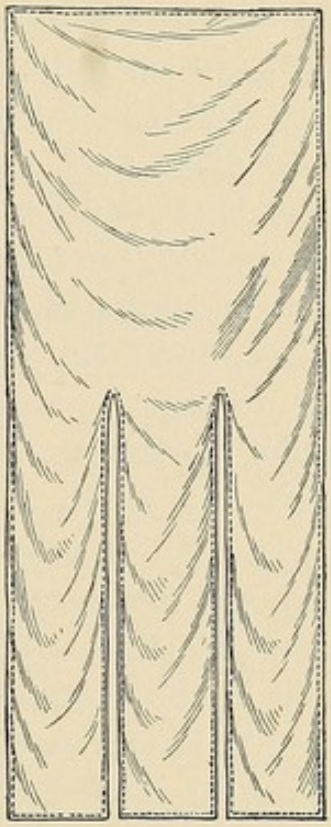


Fig. 100.—Three-tailed retractor used in amputation of the leg. (Fowler's Surgery.)

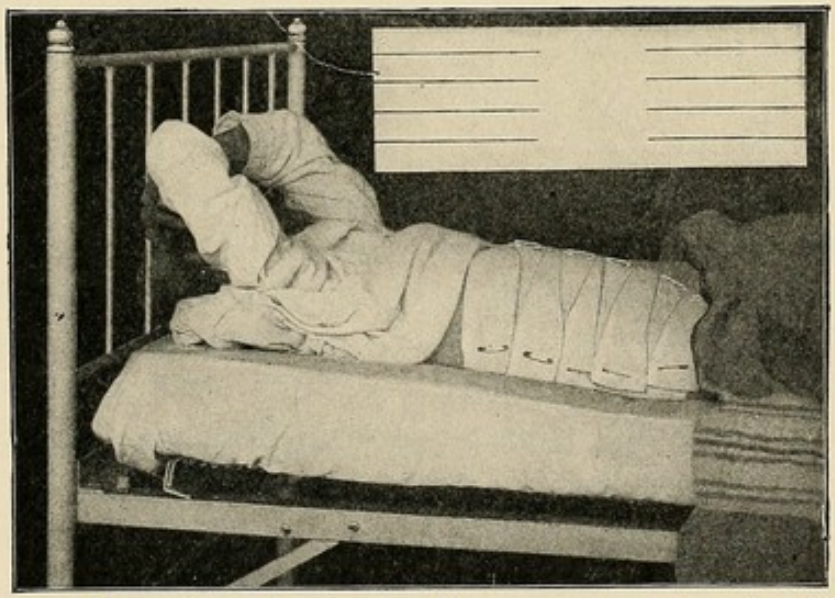


Fig. 101.—The scultetus bandage. The appearance of the bandage before application is shown in the upper right-hand corner of the illustration. (Fowler's Surgery.)

wound and in exerting even pressure during paracentesis abdominis. In the latter case, as the fluid is withdrawn from the abdomen the tails of the bandage are drawn tighter and tighter so as to exert even pressure upon the abdomen. When the scultetus is applied for retaining abdominal dressings the lower tails of the bandage are first brought across the lower part of the abdomen and fastened, then the other tails are alternately brought into place, first from one side and then from the other side, from below upward.

Fixation Bandages.—Bandages in which are incorporated materials that finally harden have been in use since the middle ages. The old Arabic physicians Albugerig, Athuriscus, and Rhazes used bandages in which were incorporated albumen, gypsum, and chalk. The use of such bandages was apparently common in the Orient for centuries. Larrey, in the course of Napoleon's Egyptian campaign, found the Egyptians using a hardening mixture of white of egg, camphor spirits, and subacetate of lead in cases of fractures from gunshot injury. He mentions that the Greeks for a long time had used a retentive bandage made of a mixture of mussel shells, chalk, albumen, oil, and hemp. These bandages were removed by employing the solvent action of a steam bath. In 1798 the English Consul Eaton, stationed at Bassora, reported that the native surgeons had been successful in healing a complicated fracture of the leg in a soldier by means of plaster of Paris. This was a case in which the English naval surgeons were about to amputate the limb Froiep gave further publicity to these facts in 1817, and two Berlin surgeons, Kluge and Dieffenbach, 1828, made experiments with the plaster-of-Paris bandage. Their methods were so crude that the treatment was abandoned. The extremity was oiled and placed in a long wooden chest which was filled with a pulp of plaster of Paris After the hardening had taken place the lateral boards of the box were removed. A Belgian surgeon, Seutin, wrote on the subject in 1844. Two Dutch surgeons, Mathysen and van der Loo, in 1848 developed the plaster-of-Paris bandage as it is used to-day.

Pirogoff and Szymanowski recommended the use of plaster-of-Paris compresses in place of the bandage—*i.e.*, linen strips

dipped in a paste of plaster of Paris. This form has the advantage of being cheaper, especially if the skin is only oiled and not bandaged previous to the application of the plaster compresses. It has the disadvantage, however, of making a dressing that is very clumsy and that can be removed only with difficulty. Narrow plaster-of-Paris strips, made moist, practically do all that a plaster-of-Paris bandage does. These folded several times may be used to strengthen weak parts of the applied plaster-of-Paris bandage, especially at the joints. Pasteboard splints dipped into warm water may be adjusted at the weak places, or a rigid splint of iron or iron wire (Esmarch) may be incorporated. The incorporation of such additional splints is useful where it is desired to make a cast as light as possible. Beeley recommends that plaster-of-Paris splints be made by dipping strands of hemp into plaster-of-Paris paste.

The Bavarian splint exemplifies one of the older methods of applying plaster-of-Paris. Two pieces of flannel, canton flannel, or other similar material are cut to conform to the part to be enclosed and are sewn together by a double line of stitching lengthwise in the middle line. The inner of these two pieces is applied to the part and thickly coated with plaster-of-Paris paste. The outer piece is then drawn over this, and the whole moulded to the part. When the plaster has set, the dressing is cut down in the middle line anteriorly. This allows of ready removal and inspection, as the place where the two pieces of material were sewn together acts as a hinge. A much neater method of application, though more tedious, consists in applying one lateral half at a time, waiting for it to harden, and then turning the edge of the external outer half of the material over the internal half. This disposes of the necessity for cutting the cast. The whole is held in place, after hardening, by a roller bandage.

The stocking bivalve plaster splint (Fig. 102) is made of two pieces of muslin cut in the shape shown in the figure and in size to fit the limb, and stitched together in the middle. Between the two layers of each lateral half are laid twelve or fifteen layers of gauze, cut slightly smaller than the corresponding half of the splint and soaked in plaster cream. The whole is

then bound in place. If the limb swells or inspection is necessary, the bandages are loosened and the two sides of the splint turned down, the line of stitching behind acting as a hinge (Stimson). A permanent plaster-of-Paris cast is applied following the subsidence of the swelling and the assurance that the reduction is as complete as possible.

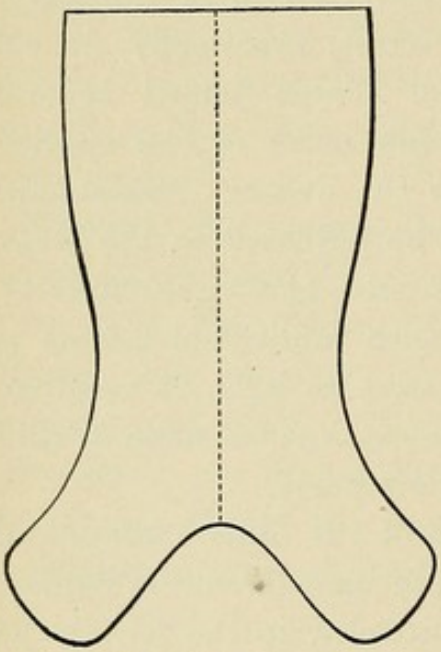


Fig. 102.—Stocking bivalve plaster splint. (Fowler's Surgery.)

Manufacture of Plaster-of-Paris Bandages.—A perforated piece of tin one inch wide and a length equal to the width of the bandage is shaped longitudinally into a triangular cage. This serves the double purpose of acting as a core upon which to wind the bandage and of allowing of a rapid and thorough wetting of the bandage when immersed in the solution just prior to use. Plaster-of-Paris bandages are rarely rolled by hand at the present time. A machine (Fig. 103) is used which allows of an even distribution of the plaster. Wide-meshed crinoline, two, three, or four inches wide and of the usual roller-bandage lengths, forms the best material for the bandages, as the wide meshes allow the plaster to lie in them and not on the surface of the bandage where it is liable to cake during application. The metal core is placed on the spindle of the bandage-rolling machine, and the bandage is placed on this and wound in the usual manner, except that it is loosely rolled and that it passes through the box containing the plaster of Paris and becomes impregnated with it as it is being rolled. After rolling, the bandage is pinned to prevent unrolling, and the core is filled with plaster of Paris. Each bandage is placed in a separate metal receptacle containing plaster of Paris, or several bandages may be placed in the same receptacle. Such a box should preferably be of metal and may be made air-tight by sealing with adhesive-plaster strips. Plaster of Paris should be stored in a dry place. As an additional safeguard against dampness each bandage may be

wrapped in oil paper and an elastic snapped about this to retain it.

Measures of Precaution which are Necessary while the Plaster-of-Paris Bandage is being Applied.—Before the application the quality of the plaster-of-Paris should be inquired into. That commonly sold often contains, besides anhydric calcium sulphate, so

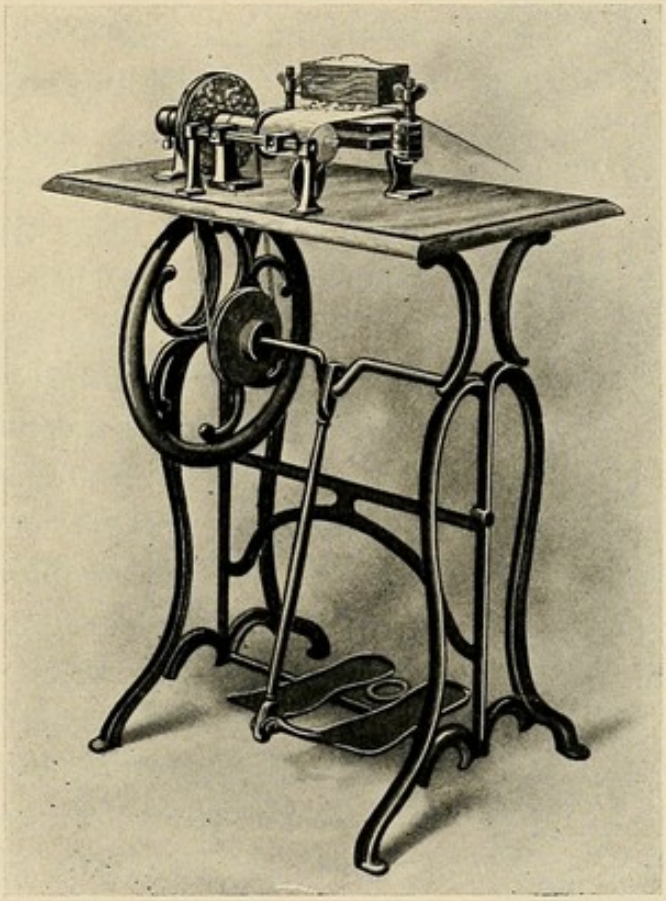


Fig. 103.—Plaster-of-Paris attachment to foot machine.

much calcium carbonate that it does not harden to a solid mass after being mixed with water in which calcium carbonate is somewhat soluble, but crumbles. Plaster of Paris which has been overheated is useless, because it only sparingly takes up water. The plaster-of-Paris may be too moist and consequently is likely to have lost its anhydric qualities. The best grade of dental plaster should be used. When it has become moist it may be dried in a pan over the fire before using. Less pure plaster may be made to harden better if alum is added to the water.

The precautions which have been noted as necessary in the application of bandages, in order to prevent venous stasis,

gangrene and ischemic muscular contracture, must be even more closely observed in the case of the plaster-of-Paris bandage, for this does not yield at all to swelling. As venous stasis increases rapidly, care must be taken that each turn of the bandage shall cover the extremity without in any way constricting it. In addition the patient is to be very carefully watched during the first two or three days, and, in case of swelling of the peripheral portion of the limb, the bandage is to be split longitudinally. If this does not suffice, the bandage must be removed completely. This rule must be particularly observed in recent fractures treated by the primary use of the plaster-of-Paris bandage. Here the swelling consequent upon the injury may induce constriction even when the bandage has been correctly applied. The specialist, as well as the beginner, must give strict attention to these cases, at least during the first forty-eight hours. The patient should be further instructed to report any pain or swelling at once. The bony prominences, such as the malleoli, the crest of the tibia, the tubercle of the tibia, the patella, the trochanter major, the spine of the ilium, the head of the ulna, the olecranon, the acromion process, and the heel, must be particularly protected against pressure effects. When gauze or cotton is applied over these prominences as extensive amount must not be used, otherwise the adjustment of the plaster-of-Paris bandage will be interfered with and it would lose somewhat of its fixing effect. In case pain is complained of at one of these prominences a fenestra should be cut in the bandage, but openings should not be cut over these prominences as a precaution, for the edges of such openings press upon the soft parts and allow of swelling where the supporting effect of the bandage is lost. In case the bandage covers a wound from which discharge is expected, a fenestra should be cut over the wound; otherwise the bandage would rapidly become moistened and ruined. This is done after the hardening process is complete. The edges of such fenestræ are packed carefully with gauze and coated with collodium to prevent the discharge injuring the plaster of Paris. In applying a cast in such a case, provision may be made for dressing the wound by not covering that part of the limb. It is, however, easier and neater to cut the fenestra later.

Application.—The parts are placed in the exact position in which it is desired that they remain, and this position is retained during the application of the bandage and thereafter maintained by sandbags laid alongside of the limb until the plaster has thoroughly hardened. The hardening process may be accelerated by allowing a draft of air from an electric fan to blow upon the bandage. In the absence of the electric fan an ordinary fan may be used.

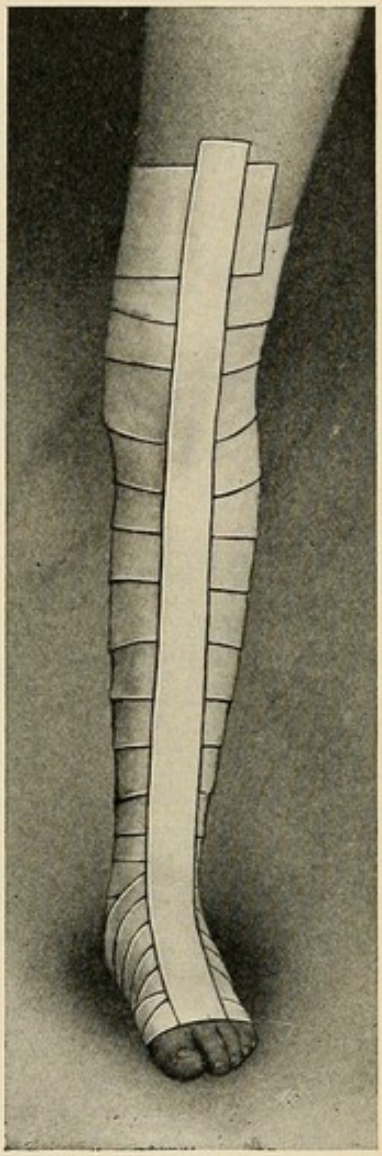


Fig. 104.—Flannel roller and adhesive plaster strip in place on leg. Ready for the application of plaster-of-Paris.

Everything which is to be employed in the application of the cast should be at hand and within convenient reach, so that the cast may be rapidly applied. The bed should be protected by a piece of rubber sheeting, and the operator's clothes by an apron. The skin of the part is protected by coating it with vaseline and covering it with a layer of stockinet material, a cotton stocking, or a flannel roller bandage may be applied. As before noted, particular attention is paid to the protection of the bony prominences. Here pads of cotton are placed. These may be held in place by strips of adhesive plaster or by turns of the flannel bandage. Bandages made of thin French cotton batting are preferable to flannel as a protecting bandage. On the line at which it is desired finally to cut down the cast, is placed a strip of adhesive plaster (Fig 104).

A sufficient number of plaster-of-Paris bandages to form the cast are placed near a basin of hot water. The water in the basin should be of sufficient depth to allow of complete immersion of the bandages. Two bandages are laid on their side in the water. If the atmosphere is damp or if the quality of plaster is

inferior, a small quantity of salt or alum may be added to the water to hasten the hardening The bandage is left immersed until it is thoroughly saturated and is then lightly squeezed out, under water, to force out air from the interstices and allow of further saturation. The bandage is then tightly squeezed to expel the excess of water. As soon as one bandage is removed from the water, another is substituted for it until the required number is reached. The bandage is applied evenly and smoothly, in the same manner as an ordinary roller bandage. More numerous turns are made near the joints, as there the strain is greatest. The number of bandages used will depend on the purpose for which the cast is applied. If this be to retain a simple dressing in place, as in cases of scalp wounds with delirium tremens, one or two bandages will suffice. To secure immobilization of joints, from six to eight thicknesses may be necessary

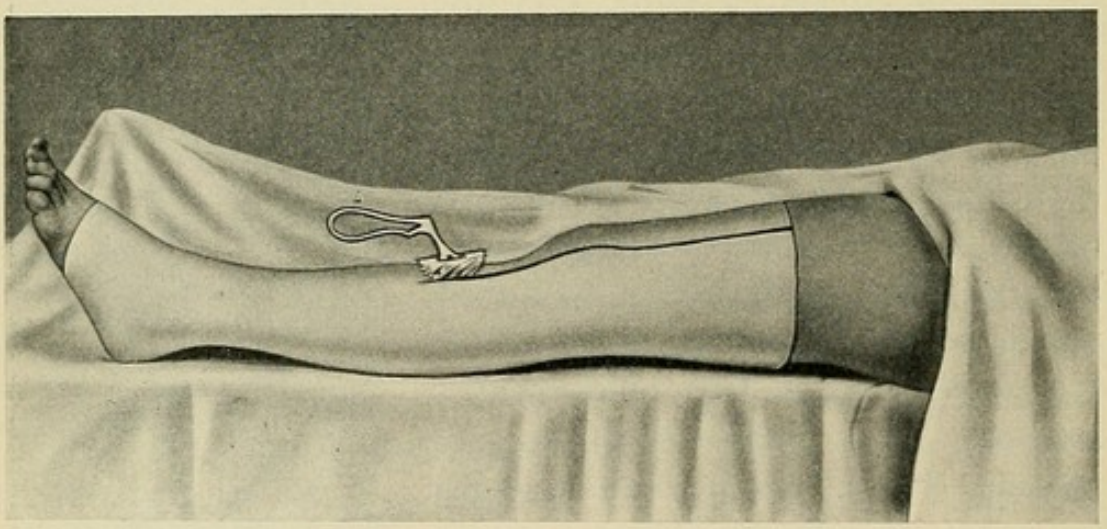


Fig. 105.—Removal of plaster cast.

Fractures of the leg, when the patient is allowed to walk about, require heavier casts than those in which no such strain is put upon the damaged bone. In the former instance an additional safeguard may be furnished by the introduction of a thick roll of lamb's wool on the sole of the foot held in place by additional plaster bandages. When fenestræ are required, the plaster should first be allowed thoroughly to harden. If large fenestræ are needed, the cast should be strengthened by incorporating in it one or more strips of soft iron, bent like a basket handle, at the site of the proposed fenestræ. The cast may be finished

in one of two ways, either one of which enhances its appearance. The final bandage may have its selvage left on and is then to be applied as a short figure-of-8, or plaster-of-Paris paste may be

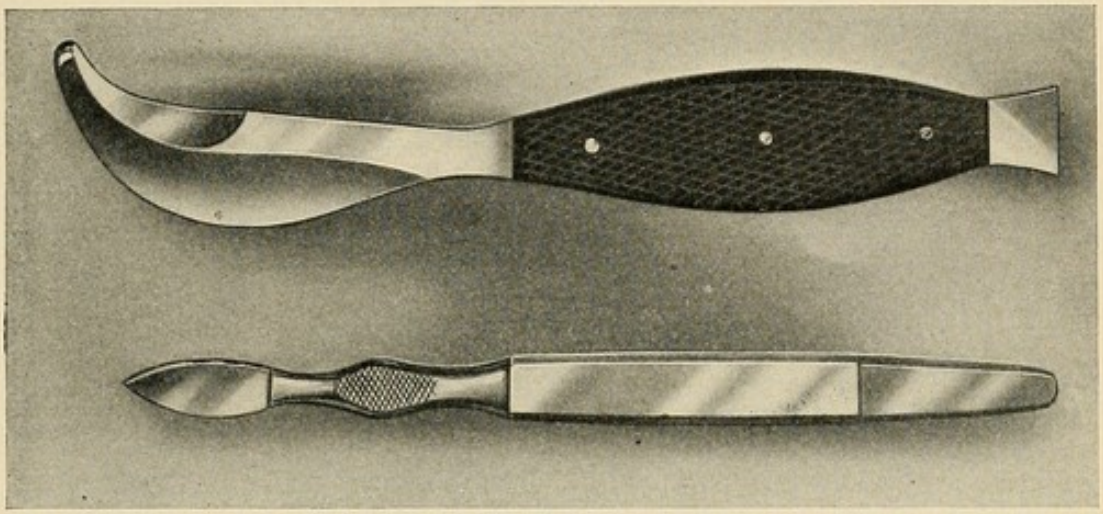


Fig. 106.—Knives for removal of plaster-of-Paris casts.

rubbed in, so as to produce a smooth finish. Dry plaster may also be dusted on while the cast is still moist.

Removal.—After the cast has hardened it may be cut down at the line at which the adhesive plaster was placed (Fig. 105)

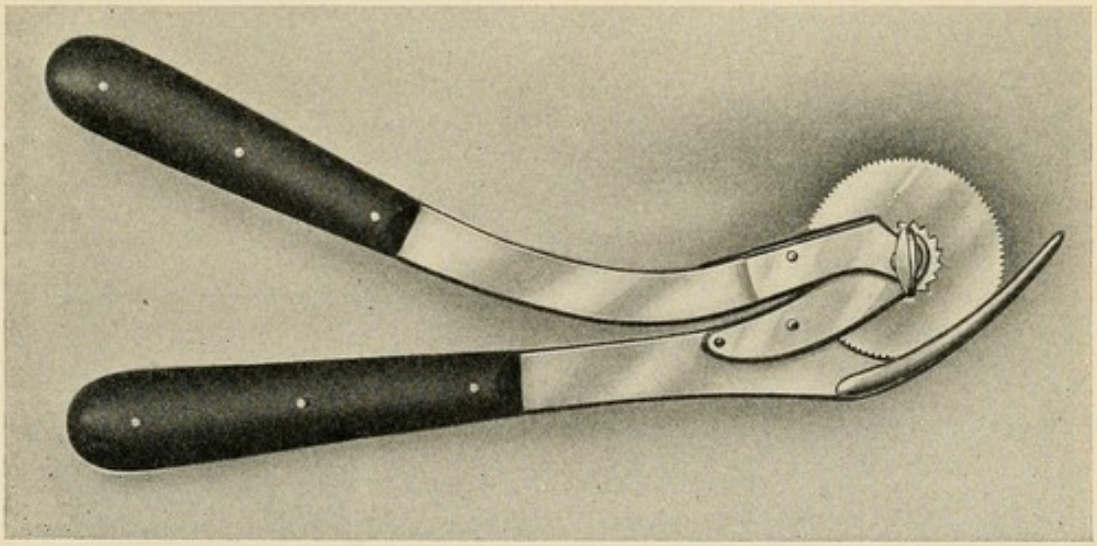


Fig. 107.—French saw for the removal of plaster-of-Paris casts.

This is desirable when the plaster is applied soon after the receipt of a fracture, as it allows somewhat for swelling and also allows of the cast being sprung apart by the hands in case swelling becomes more pronounced. The cast thus cut down

is held in place by a gauze bandage. If it be cut down when its period of usefulness is past, the projecting ends of the adhesive

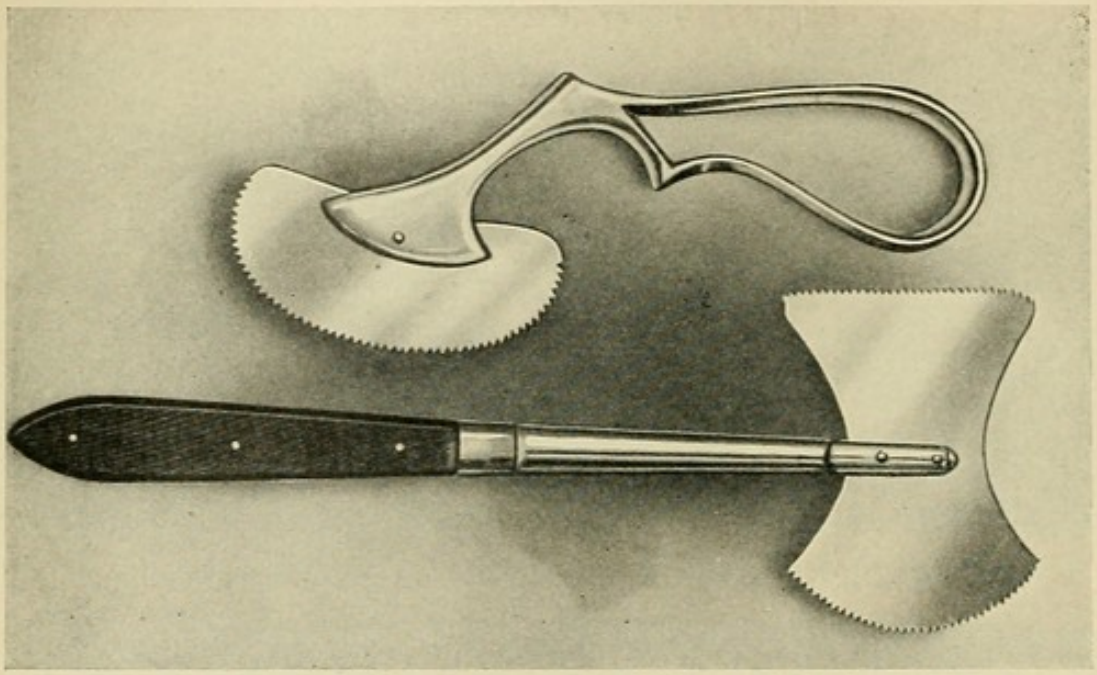


Fig. 108.—Saws for the removal of plaster-of-Paris casts.

plaster strip serve as a guide to the line along which to cut, and guard the skin against injury from the instrument employed.

Many instruments have been devised (Figs. 106, 107, 108, 109)

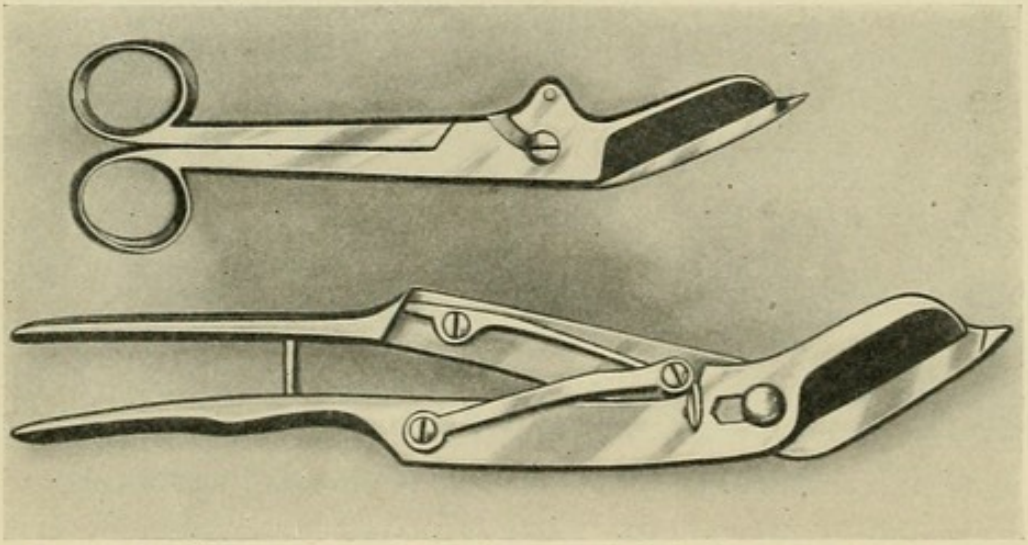


Fig. 109.—Scissors to assist in the removal of plaster-of-Paris casts.

for removing casts. Those commonly employed are the strong resection knife, with an elevator handle, and the small hand saw. If the cast is cut down with a knife it will be found easier if the

cut is made somewhat obliquely to the surface. Painting the proposed line of incision with vinegar facilitates removal, but this should not be done if it is intended to replace the cast, as the vinegar softens the plaster throughout quite a distance. The sensation conveyed by the knife or saw will tell the operator when the plaster has been entirely cut through, as the instrument will catch in the soft protecting material beneath.

When the cast has been completely cut through, the edges are pried apart sufficiently to allow them to be grasped with the fingers and then separated widely. The protecting dressing is then cut through, and the entire dressing, cast and all, is held widely separated while an assistant lifts the part out of the cast. This mode of procedure is desirable in order to disturb the parts as little as possible. If it is decided to replace the same cast the edges may be bound with adhesive plaster and, after being reapplied, it may be held in place with a muslin bandage.

Either vinegar or sugar water will be found useful in removing plaster from the operator's hands. Vaselin rubbed into the subungual spaces and about the nails helps to keep the plaster from adhering.

Plaster Splints.—These may be made in two ways. A cast may be applied as described and, after it has hardened, it may be removed in two sections. These are well padded and the edges bound with adhesive plaster; the entire splint is then held in place by adhesive plaster and a muslin bandage. A second method is to fold the bandage on itself on a smooth surface, thus forming a flexible splint of the desired width, length and thickness. One or more of the splints are moulded to the parts in such a manner as to permit of ready removal. While hardening they are held in position by a few turns of a gauze bandage. After they have become hardened they are lined with cotton, applied to the part and held in position by adhesive plaster and muslin bandages.

Starch Bandages.—Seutin, a Belgian surgeon, in 1884, advised the use of starch bandages as a removable immobilizing dressing. Originally, gauze bandages were soaked in fresh starch, and the starch was spread between the bandage turns as they were applied. Now, however, crinoline bandages are used, these

containing, as a rule, enough starch to act as a hardening dressing. If the amount of starch is deficient, powdered starch may be incorporated in the meshes of the bandage. Before application the bandage is immersed in hot water and applied wet.

Application.—The limb is first bandaged with an ordinary flannel bandage, or, in the case of the lower extremity, a stocking may be put on. A strip of adhesive plaster is placed longitudinally along the anterior aspect of the limb in the median line, and a second strip along the posterior aspect in the median line. These strips extend for the full length of the proposed bandage, and serve to protect the limb when the starch cast is cut in two portions. Several layers of the starch bandage are applied in the same manner as is done in the case of a plaster-of-Paris bandage. Such a dressing has the advantage of lightness, but it possesses the disadvantage of becoming firm only after from twenty-four to forty-eight hours, during which time it must be protected. For the purpose of maintaining the parts in position during hardening of the starch, wooden splints may be employed; or an outer layer of plaster of Paris, which is removed after forty-eight hours (Rosen), may be used. The starch cast has the additional advantage of being readily cut with stout scissors.

Soluble-glass Bandage.—This form of fixed dressing is cheaper and lighter than plaster of Paris, but, as it takes twenty-four hours to become firm, neither it nor the starch bandage can replace plaster-of-Paris in the treatment of recent fractures or for use in the correction of deformities. Both these forms of bandage, however, can be very profitably employed as a later supporting dressing in fracture cases and in cases of resection of a joint. As in the case of the starch bandage, the soluble-glass bandage must be supported for from twenty-four to forty-eight hours either by wooden splints or by a few turns of a plaster-of-Paris bandage. The application of the soluble-glass bandage is quite simple. The liquid is poured into a basin, and a number of gauze bandages are placed in the solution until they become saturated. It is necessary to protect the skin against the action of the liquid either by means of a flannel bandage or by the use of a stocking, as the liquid contains, in

addition to the hardening potassium silicate, a greater or less amount of free potassium—an agent which affects the skin. During the application of the bandage additional liquid is poured between the layers so as to fill the meshes of the gauze. Longitudinal strips of pasteboard may be interposed to strengthen the bandage. After it has hardened, the bandage may be removed in two sections with strong scissors. There will thus be formed two splints, the edges of which may be bound with adhesive plaster and so protected against splintering. The splints are then held in apposition to the parts by means of an ordinary roller bandage. Less commonly, *magnesite* is similarly employed.

Starch bandages and soluble-glass bandages have the advantage over plaster-of-Paris in that they are not affected by moisture, but this disadvantage of the plaster-of-Paris bandage may be overcome by rubbing the bandage with a solution of dammar resin (Mitscherlich), or soluble glass may be poured over the final layer of the plaster-of-Paris bandage. Mixtures of soluble glass and plaster of Paris harden very readily and are insoluble in water.

Caoutchouc Bandages.—These are of advantage in young children. Strips of caoutchouc are immersed in hot water until soft, and then are rolled up with a linen roller bandage and dipped in cold water to cause them to harden as quickly as possible. The resulting bandage is light and rather firm, and is not affected by water. They have the disadvantage of being expensive. Just previous to application the bandage is immersed in hot water.

Pressure Bandages.—Pressure bandages may be used to produce pressure, as in the treatment of varicose veins of the lower extremities; to produce hyperemia, as in the treatment of infections and tuberculous processes occurring on the extremities; to control effusions in joints and in the soft parts, and to promote absorption of such effusions; to control hemorrhage. For such purposes an ordinary muslin roller is impracticable as it does not possess elasticity enough to produce the required even pressure, and, if tightly enough applied to exert pressure, it may produce injury to the soft parts. For producing such pressure effects a bandage possessing a certain degree of elasticity

is necessary When but a slight degree of elasticity is required, bandages of stockinet, flannel, or Japanese crêpe may be employed. Such bandages exert uniform pressure and do not irritate the skin. When a more pronounced pressure effect is indicated, an India-rubber or a cotton-elastic bandage should be used.

The dimensions of the bandage vary with the purpose for which it is to be used. *A Martin's India-rubber bandage* is the one commonly employed in cases of varicose veins. When it is desired to render the extremity bloodless a thick rubber bandage—Esmarch bandage—is employed. For the immediate control of hemorrhage occurring in the course of an extremity, and for the control of hemorrhage occurring after the extremity has been rendered bloodless by the Esmarch, an *India-rubber tourniquet* is employed. This is a long, narrow, thick India-rubber band having a chain attached to one end and a hook to the other, by means of which it is secured in place after having been wrapped tightly about the limb at the point where the main artery is superficial—in the case of the upper extremity, well up to the axillary fold; in the case of the lower extremity, well up to the groin. Over the course of the artery is first placed an ordinary roller bandage, and this is secured in position by circular turns of the tourniquet, which is finally fastened by the hook and chain. Care should be taken that too much pressure be not employed, otherwise the skin and underlying soft parts may be injured. Some protection may be afforded by placing a folded towel around the parts before applying the tourniquet. If too extreme pressure is employed, or if the tourniquet is kept applied for too long a period, there results a vaso-motor paresis which predisposes to secondary hemorrhage. The common mistake made in applying a tourniquet is to apply it, in operations upon the forearm and hand, just above the elbow, in which event pressure upon the musculo-spiral nerve may result in paralysis; or, in operations upon the leg and foot, in applying it just below the knee, at which point pressure upon the peroneal nerve is likely to result in paralysis of the muscles supplied by that nerve.

Application of the Esmarch Bandage—The bandage is started

at the distal end of the extremity and ascends by oblique turns, the edges of which just touch each other. When the entire extremity has been ascended by these oblique turns a few circular turns may be made, these circular turns being lifted up over the course of the main artery by the fingers of the left hand, and the remaining part of the body of the bandage being placed vertically under them, so that the circular turns hold the body of the bandage against the main artery and effectually shut off the blood supply (Fig. 35). Beginning at the distal extremity the oblique turns are now unwound up to the level of the circular turns, the loose part of the bandage being bunched and held out of the way by a few loosely applied turns (Fig. 110). In opera-

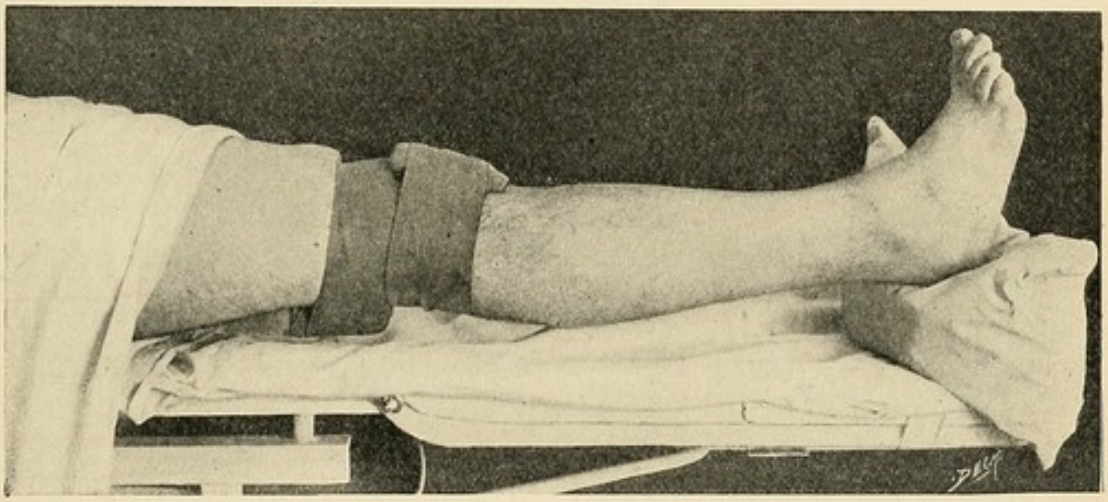


Fig. 110.—Esmarch's bandage, showing hard roller in position over the vessel and secured by the last few turns of the bandage. The roll in front is the loose bandage unwound from the limb, gathered in a roll, and placed for convenience of disposition beneath a few loosely applied turns. (Fowler's Surgery.)

tions for malignant growths or for septic conditions the bandage should not be applied from the distal extremity of the limb and continued up the limb, as the adoption of this course might force tumor products or septic materials into the circulation, or at least into parts of the limb not originally invaded by the disease. In such cases the limb should be elevated for five minutes and then the Esmarch bandage should be started above the level of the disease. Instead of finishing the Esmarch by inserting the body of the bandage beneath the last few circular turns over the main artery of the limb, an India-rubber

tourniquet may be employed at that point and the Esmarch then entirely removed.

Application of Martin's India-rubber Bandage.—This bandage is three inches wide and four yards long. To its terminal extremity is fastened a double tape for the purpose of securing the bandage after it has been applied. This is chiefly used in varicose conditions of the lower extremity. A turn is first made about the ankle. The bandage is carried to the base of the toes, and a circular turn is made there. The limb is ascended by spiral turns, the bandage ending just below the knee. Reverse turns are not necessary, as the elasticity of the bandage allows it to conform to the shape of the extremity. In the case of very muscular subjects, however, it may be necessary to use long figure-of-8 turns in order to make the bandage lie smoothly. Even pressure should be exerted from the base of the toes to the knee. The bandage is secured by tying around the limb the two tapes which are attached to its distal end. Such a bandage is removed at night, rinsed with warm water, dried with a towel, and hung up loosely to air. The skin of the limb is kept in good condition by light massaging night and morning with alcohol. If, in spite of this, a tendency to an

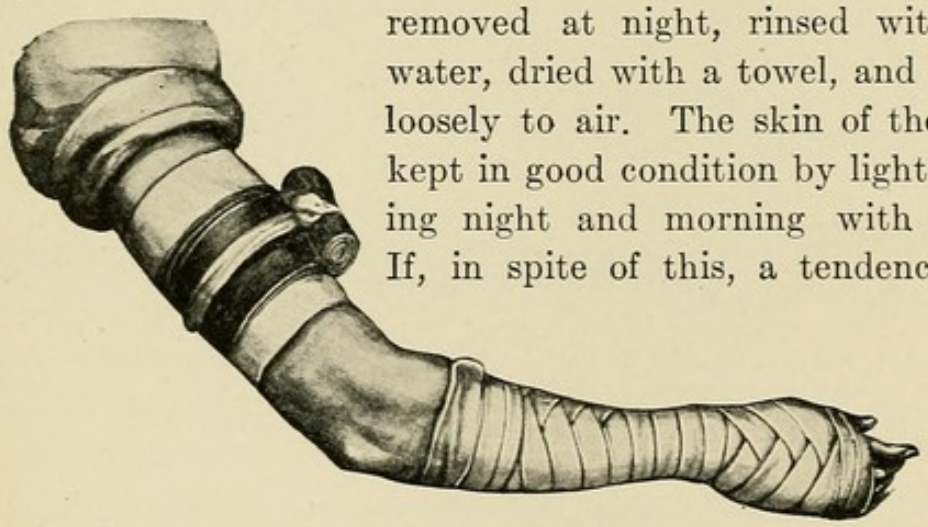


Fig. 111.—Bier's method of securing temporary passive congestion in the treatment of tuberculosis of a part. (Fowler's Surgery.)

eczematous condition exists, due to daily contact of the rubber with the skin, a thin flannel bandage may be applied next to the skin or the rubber bandage may be applied over a white stocking. For use in the Bier hyperemia treatment of tuberculous joints, or of infections that have developed in the course of an extremity, a much shorter rubber bandage may be employed, only half a dozen circular turns being used to produce the required hyperemia. The skin may be protected

from irritation by the application of a few turns of a flannel bandage. The parts distal to the area in which it is desired to produce hyperemia may be supported by a rubber or by a flannel bandage (Fig. 111).

CHAPTER IV.

ANESTHESIA.

Furniture. Preparation of patient. Prevention of post-anesthetic vomiting. Special preparation. Preliminary medication. The anesthetist. Selection of the anesthetic. Ether anesthesia, drop method. Complications. Ether vapor anesthesia. Chloroform anesthesia. Nitrous oxid. Nitrous oxid and ether. Junker's apparatus. Trendelenburg cannula. Tracheal insufflation anesthesia. Spinal analgesia. Local anesthesia. Artificial respiration, Sylvester, Laborde. Intralaryngeal insufflation, Meltzer. The relation of acapnia to surgical shock.

The furniture of the anesthetic room (Fig. 112) consists of the anesthetic table, oxygen apparatus on a wheeled stand, gas apparatus, and a stool for the anesthetist. On the anesthetic table is placed the anesthetic tray.

The oxygen apparatus should have the tube boiled after each use, and fresh sterile water placed in the bottle.

On the anesthetic tray are placed ether, ether drop-bottle, and ether mask; chloroform, chloroform drop-bottle, and chloroform mask; tongue forceps, aseptic tongue sutures, mouth-gag, sponge forceps, stick sponges, vaselin or oxid of zinc ointment, hypodermic syringe, aseptic hypodermic needles, atomizer, muslin bandages, bandage scissors, safety-pins, pus basin, towels; two small sterilized glasses, one bottle of sterile water, a minim dropper, a glass graduate, and the restoratives. These consist of a 4-ounce bottle of half-strength whiskey; tablets of strychnin sulphate, gr. 1/30; digilin solution; caffein benzoate, gr. j; Magendie's solution of morphin, ampules of camphor, saturated solution in olive oil, and ergotol. The ergotol solution is made by adding 1 dram of the solid extract of ergot to 1 ounce of a 1:3000 solution of formalin. The hypodermic dose is 30 minims.

Chloroform and ether should be poured into blue glass grad-

uated bottles and a reserve supply should be kept in their original packages.

The simplest form of ether mask obtainable, suited to the drop method of administration is the mask to use under all but special circumstances mentioned hereafter: Examples of such masks are sold under the name of Mayo's, Ochsner's or

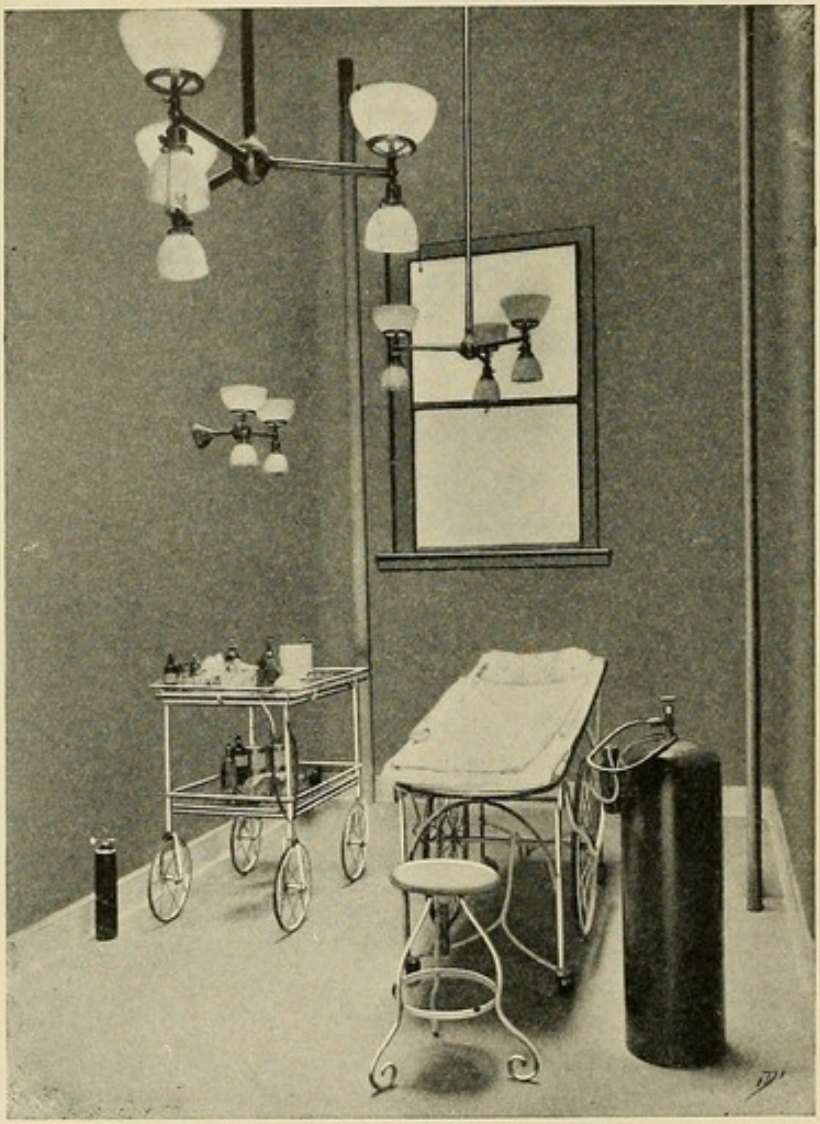


Fig. 112.—The anesthetic room.

Schimmelbush's. These are washed, dried and fresh covers of gauze or flannel put on for every case.

On a reserve anesthetic tray is kept some form of vapor generating anesthetic outfit for special cases, Junker's, Gwathmey's, or as described below.

Preparation of the Patient.—Rest in bed and tonic medication may be necessary to restore a lessened factor of the resistance;

mental training toward the acquirement of absolute confidence in the procedure and operator is an element of importance. In general, severe purging is to be avoided, mild laxative measures being sufficient. Total abstinence from food for at least five hours prior to operation is necessary; water may be allowed in any reasonable quantity. Remove all clothing and put on a loose garment of some kind, seeing that the body surface is at all times warmly covered and as dry as possible. After operation substitute dry for the sweat soaked garments. Artificial heat on the operating table can never be out of place and many times it is necessary.

Prevention of Post-anesthetic Vomiting.—The patient's nose, mouth, and pharynx should be thoroughly cleansed by spraying with an astringent, mildly antiseptic solution an hour before anesthetization. Should a catarrhal condition be present, it should receive special attention. In such cases the spray should be used every three or four hours for as long a time as the preparation of the case will admit. Spraying the throat and nose with a 2 per cent. solution of cocain directly before anesthetization will be found valuable in lessening the irritability of the mucous membrane to the anesthetic, and thus lessening the amount of secretion. The patient's head is turned to one side and slightly lowered during and after anesthesia to favor the flow of secretion from the lower angle of the mouth and nose. The stomach should be empty, but the patient should not have been too long deprived of food. In catarrhal conditions of the stomach, lavage should be employed. A sufficient amount of the anesthetic is to be administered to overcome any efforts at vomiting during the course of the anesthesia. The struggles of an under-anesthetized patient cause subsequent muscular discomfort and lassitude. This should be particularly avoided in patients with a weak heart. The secretions of the mouth and nose should be removed as fast as they collect. Stick sponges are provided for this purpose. The admixture of oxygen with the anesthetic tends to lessen the frequency and violence of the vomiting. Oxygen may be administered for from fifteen to thirty minutes following the withdrawal of the anesthetic, with excellent results.

Special Preparation.—In subjects for thyroidectomy special preparation is necessary with the idea in view of eliminating the deleterious psychic assault of fear, etc. The patient is made familiar with the procedure of narcosis by administering on each of several days prior to the operation a few whiffs of alcohol on the mask and if possible not told the time of the actual operation.

The fact is well known that an anesthesia in an apprehensive nervous subject is from the very initiation uneven, difficult, and many times fraught with serious physical collapse. Fear, resistance and general nerve dissociation produces distinct cell disintegration, increases adrenalin and the output of glycogen, inhibits the activity of the entire digestive mechanism and may even cause albumin and casts to be seen in the urine.

In that class of cases where cerebral excitation might be expected in the early stages of the narcosis, as is the case in the alcoholic, plethoric, etc., prevention may be facilitated by the shutting off from the general circulation, that blood which can be sequestered in the limbs by the application of a tourniquet to their bases just before beginning the anesthetic. Such procedure has for its object, diminution of the amount of anesthetic needed; ease of control of hemorrhage during operation because of lessened venous tension; shortened operation as the result of dryer field; lessened intracranial pressure, therefore lessened danger of death from disturbance of the respiratory mechanism; more space between the brain and skull for brain surgery; an unetherized portion of blood ready to be set free as a means of resuscitation in collapse.

The special preparation of a subject about to be operated for prostatic disease reduces to an appreciable minimum the dangers of an anesthesia which otherwise has a mortality of the highest. The subject's margin of safety must be raised by the mitigation of the sepsis, nephritis, and intestinal stasis with portal plethora.

Having prepared a patient for the narcosis, the next step is to see that he is properly placed (Fig. 113) on the table for the operation. Place an ordinary surcingle snugly around the table and patient's legs just above the knees, have the shoulder sup-

ports well padded and in place ready for the Trendelenburg or prostatectomy position, the arms at the side, palms down, well under the buttocks or folded across the chest and fastened with a broad soft roller of gauze around the forearms from wrist to elbow. In cases for gastric, gall-bladder or kidney work the kidney bridge of the operating table should be properly situated under the part to be elevated so that no later change of position will be necessary. In all cases where nitrous oxid is to be the anesthetic the patient should be placed in position before the anesthetic is begun; especially is this true of the lithotomy posi-

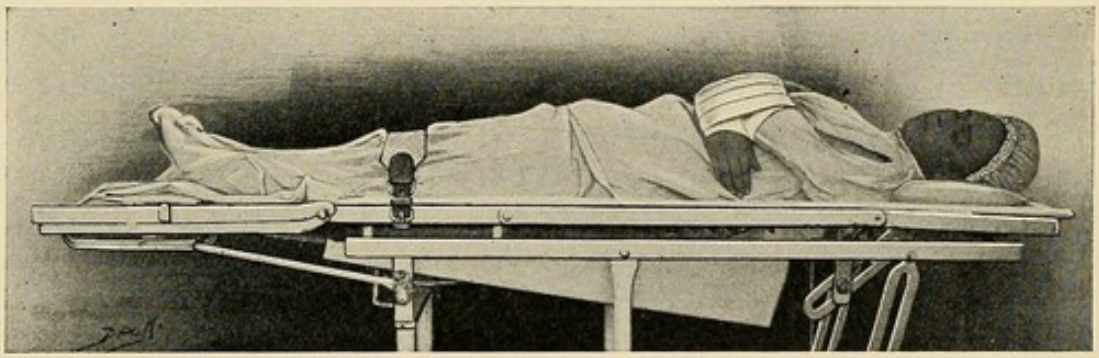


Fig. 113.—Patient in position for anesthesia.

tion, for spasm of the limbs is common even with deep narcosis. In cases for thyroidectomy the trunk is best elevated to an angle of thirty-five degrees with the legs and the head dropped back as far as possible without interfering with breathing. In brain surgery the Cushing or other head rest is placed in position before the final preparation for operation.

The use of **preliminary medication** in the form of morphin, scopolamin, pantopon, chlorotone, etc., has an important bearing on the initiation of the anesthesia as well as the general surgical aspect of the case immediately post-operative. Except in the aged, the very young, and these patients in whom septicemia, anemia or other diseased conditions have already done what morphin and scopolamin do, namely, depressed the associational power of the brain, the preliminary use of sedative medication is distinctly indicated.

At least one hour prior to operation, give hypodermically one-eighth grain of morphin, or one-sixth grain of pantopon, or, by mouth, fifteen grains of chlorotone and if the desired sedative

effect of the medication is not noted by the time for anesthesia, give another one-eighth of morphin or sixth of pantopon. Scopolamin is distinctly less safe than other sedatives. With preliminary sedative medication, much less anesthetic can be tolerated by the subject.

The **anesthetist** should don his gown and cap, but need not put on his mask until he enters the operating room. He should be familiar with the patient's history and with the condition of the heart, lungs, and kidneys. He takes charge of the case from the time it is brought to the anesthetic room until it is placed in charge of the nurse who watches it until consciousness is regained. He should endeavor to inspire the patient with confidence. He should see that all foreign bodies are removed from the mouth and that respiration is not impeded through constriction of the neck or chest by clothing or dressings. In catarrhal conditions of the nose and throat a preliminary spray of 2 per cent. cocain solution is useful. The nose, lips and skin in the neighborhood should be anointed with vaselin to avoid irritation from the anesthetic. The eyes are protected by covering them with a dumbell-shaped piece of gutta percha tissue over which is placed a layer of wet cotton. If, in spite of this precaution the eyes are irritated, they are irrigated with boric acid solution and a compress wet with boric acid solution applied. The patient's head is turned somewhat to one side to facilitate the escape of secretions from the angle of the mouth and the nose. The position should not be forced, and should not interfere with respiration. A flat pillow is placed under the patient's head to protect the head from the table. The head is raised or lowered to secure the best posture for breathing. Proper elevation of the head tends to prevent falling back of the tongue and jaw.

The anesthetist should call the operator's attention to any deviation from the normal course of anesthesia and see that stimulation is promptly administered. He is not to leave the patient for any reason unless some one is at hand to relieve him. He will be notified by the operator when to discontinue the anesthetic. The anesthetic is discontinued during dilatation of the sphincter preliminary to operations upon the rectum. Otherwise the deep inspirations which this procedure occasions

would cause the patient to become too profoundly anesthetized. This is particularly dangerous in chloroform anesthesia.

The selection of the anesthetic depends upon the condition of the patient and the character of the operation. The anesthetic which will be borne with least danger and yet will permit of all necessary manipulations in the operation is the one to be selected. Ether is first and foremost the general narcotic agent combining greatest efficiency with greatest safety and ease of application. It is the agent of choice for the majority of operations and patients, and should be so chosen unless some special feature of the case indicates the use of nitrous oxid, oxygen or chloroform.

Chloroform has practically one indication and that is in those stout, athletic, plethoric, resistant individuals or those habituated to the use of alcohol or tobacco: in these, all of the toxic effects of ether are produced by the efforts to subdue them long before any muscular relaxation or quiet can be attained so that the ether in such excessive dosage becomes distinctly more harmful than the chloroform. There may exist advantages in chloroform in the presence of the anasarca of kidney or cardiac disease on account of the liability of ether producing pulmonary edema and again in the case of intestinal obstruction where vomiting is so often the factor determining sudden death at the outset of anesthesia.

Local anesthesia is indicated in operations occupying short periods of time and those in which the nerves supplying the parts can be readily anesthetized; also in operations of longer duration in which ether or chloroform is absolutely contraindicated, the operation being upon a part of the body which is not controlled by spinal analgesia. Nitrous oxid may be indicated in some of these latter cases. If ether or chloroform is contraindicated either by the character of the operation or by the weak condition of the patient, or by advanced lesions of the heart, lungs, or kidneys, we must employ local anesthesia or spinal analgesia.

Ether Anesthesia (Drop Method).—Precaution is used in case of ether as to the thermo-cautery, flame, etc. The patient's confidence is secured. The mask is applied to the face covering

the mouth and nose and the patient instructed to breathe regularly. The neck and face are covered by several wet towels except for a space the size of a silver dollar through which the ether is slowly dropped. While the mask is being arranged, the arms and lower limbs are secured in position and the final preparation of the field of operation begun. This distracts the patient's attention from the anesthetic. Conversation calculated to allay apprehension and divert the patient's attention is very useful. The nurse should keep a finger constantly upon the pulse. Ether is added drop by drop, slowly at first and then more rapidly. If added too rapidly at first the patient will gag and struggle. The size of the drop is regulated by cutting a broader or narrower point on the gauze emerging alongside the cork of the ether bottle. By this graduated drop method the patient passes into a state of primary unconsciousness. This state may be transitory and a state of unconscious struggling may ensue or the patient may pass directly into a state of profound anesthesia. This primary state of unconsciousness varies. In alcoholics and drug habitués, it is of brief duration, while in patients profoundly septic, or in shock, this stage passes directly into profound anesthesia. Following the state of primary unconsciousness, there is usually some unconscious struggling. This is more marked in men than in women and is most severe in alcoholics and drug habitués. During this stage the ether should be dropped faster, the cone pressed firmly over the mouth and nose, the jaw held forward, and the patient's struggles restrained. In restraining the struggling no greater force should be used than is absolutely necessary. Misguided efforts in this direction only tend to increase the struggling. The unconscious movements of the patient should be guided, rather than forcibly restrained.

The stage of excitement gradually subsides. The convulsive movements become less and less marked. The later part of this stage is marked by muscular rigidity. Muscular relaxation gradually follows. The respirations, which during the stage of excitement have been irregular, spasmodic, and interrupted by attempts at speech, become deep, regular, and finally stertorous. The conjunctival reflex disappears. The pupil is midway

between contraction and dilatation and responds to light. Deep anesthesia is now established. Should the anesthetic be continued the pupil will dilate, will not respond to light, and the respirations will become shallow, marking the danger stage of anesthesia. Should the anesthetic be discontinued, the pupil will also dilate, but will respond to light, the respiration will become normal, and the patient will regain the stage of excitement. Both these conditions should be avoided. The anesthetic having been thoroughly established, the condition should be maintained by dropping ether on the mask from time to time. It must be remembered that anesthesia is used to cause unconsciousness and consequent freedom from pain. With the patient strapped in position very deep narcosis is unnecessary.

If there is a tendency for the jaw to drop back thus interfering with respiration this may be overcome to a great extent by raising or lowering the head to a level at which respiration is least impaired. If this is not sufficient the jaw must be held gently forward. The forcible pressing forward of the jaw may result in unilateral dislocation or subsequent pain, or even temporary paralysis from pressure on the facial nerve. The anesthetist watches the respiration and pulse, and in bad cases, the pupil. The respiration will be the best guide to the depths of the narcosis. The anesthetic is continued until muscular relaxation is complete; oxygen may be combined with the ether. If rigidity persists, a few drops of chloroform may be added. Difficult cases are watched very carefully. In many cases the administration of oxygen with the ether will cause the case to pursue a normal course of anesthesia. From this, it would seem that the cause of the condition lies in an imperfect oxidation of the ether through insufficient air-supply. There are other cases, patients suffering from profound sepsis, deep shock, or severe hemorrhage, whose pupils remain dilated throughout, whose respirations are shallow, and whose relaxation is complete, but whose pulse gains force under the stimulating effects of the ether. Such cases require very little anesthetic.

Complications.—*Cyanosis* may occur during any stage of anesthesia and results from insufficient air-supply. Occurring in the early stage it is due to spasm of the glottis or to accumu-

lation of mucus in the pharynx. The former results from too rapid administration of ether. The mask is immediately removed, a mouth-gag inserted, and the tongue pulled gently forward. This is done with tongue forceps which should be so constructed as not to crush or bruise the tongue. As soon as the patient has taken two or three deep inspirations the mask is replaced. In case of accumulation of mucus or vomited matter in the pharynx, the cone is removed, a mouth-gag inserted, the pharynx sponged out, and the anesthetic then continued. Later on, after anesthesia has been established, cyanosis may be caused by the administration of too much ether, which results in falling back of the tongue, accumulation of mucus in the pharynx, or *paralysis of the central nervous respiratory mechanism.* In the latter event attempts at respiration will cease. The anesthetic is immediately discontinued, the mouth-gag inserted, a suture passed through the tongue transversely to the septum one or two inches from the tip, and gentle rhythmic traction made upon the tongue, and the pharynx sponged out. If the patient does not begin to breathe immediately, gentle rhythmic traction on the tongue is continued, the head of the table is lowered, oxygen is administered through a tube placed as well down to the glottis as possible and by tightly closing the mouth and nose forcing the oxygen into the lungs; atropin sulphate, gr. 1/50, administered hypodermically; the sphincter ani widely dilated, and artificial respiration begun and continued until breathing is reestablished or until thirty minutes after cardiac pulsations have ceased. The anesthetist should attend to the mouth-gag, tongue, jaw, and pharynx; a nurse should hold the oxygen tube in place; two assistants, one at each side, should keep up the artificial respirations, a third assistant should dilate the sphincter; a second nurse should administer the hypodermic stimulation; a third nurse should bring the faradic battery, connect the electrodes, moisten them, and place one on the lateral region of the neck, and the other on the epigastrium, the second electrode should be moved over the chest. It is only by quick, combined, and protracted efforts that these cases of respiratory paralysis can be saved. The premonitory signs are not marked. The patient is not often seemingly deeply

anesthetized. The respirations stop suddenly, the patient gives a gasp or two and then is quiet, the heart action continues, and cyanosis becomes marked.

There may be a moderate degree of persistent cyanosis due to imperfect oxidation of the ether. This is remedied by combining oxygen with the ether. Such cases require careful watching.

The condition of the blood in the field of operation is a guide to the administration of the anesthetic. Should the blood become dark, the operator will call the anesthetist's attention to the fact. Should the patient be manifestly under the influence of the anesthetic, the ether should be withdrawn and oxygen administered until the blood regains its normal color. Should the patient be manifestly not under the anesthetic, more air or oxygen should be given with the anesthetic. An experienced operator will know intuitively, aside from the information given him by the anesthetist, when the patient is in danger.

Primary circulatory failure rarely occurs with ether. When it does occur, there is usually a premonitory acceleration and weakening of the pulse. This condition should be combated by the administration of as small an amount of ether as possible, combined with oxygen; strychnin sulphate, gr. 1/20, repeated if necessary; half-strength whiskey, one syringeful after another until the pulse responds; ergotol ɱxxx, given when the pulse first begins to flag; all these alone or combined may be useful. Rarely, *acute cardiac dilatation* occurs. Treatment other than immediate exposure and manipulation of the heart is of no avail.

Ether-vapor Anesthesia.—Ether is most scientifically administered by means of some form of ether-vapor generating device; such technic eliminates the element of refrigeration present in all open methods, allows most certainly for minimization of dosage, removes the anesthetist well out of the operative field, allows at any moment the adoption of nasal or tracheal administration for special operations about the head and neck, easily and efficiently permits the exhibition of oxygen during the narcosis and for emergency, and, by percolation of the ether through water removes deleterious constituents of the ether that causes vomiting, bronchial irritation, acetonemia, etc.

The most convenient form of vapor apparatus is that that

bears the name of Dr. J. T. Gwathmey, but one can be easily constructed like that in the accompanying illustration (Fig. 114). The ether bottle is graduated, the water bottle contains hot water scented with oil of terpineol or essence of orange, and the mask is of the Yankhauer pattern with a perforated vapor

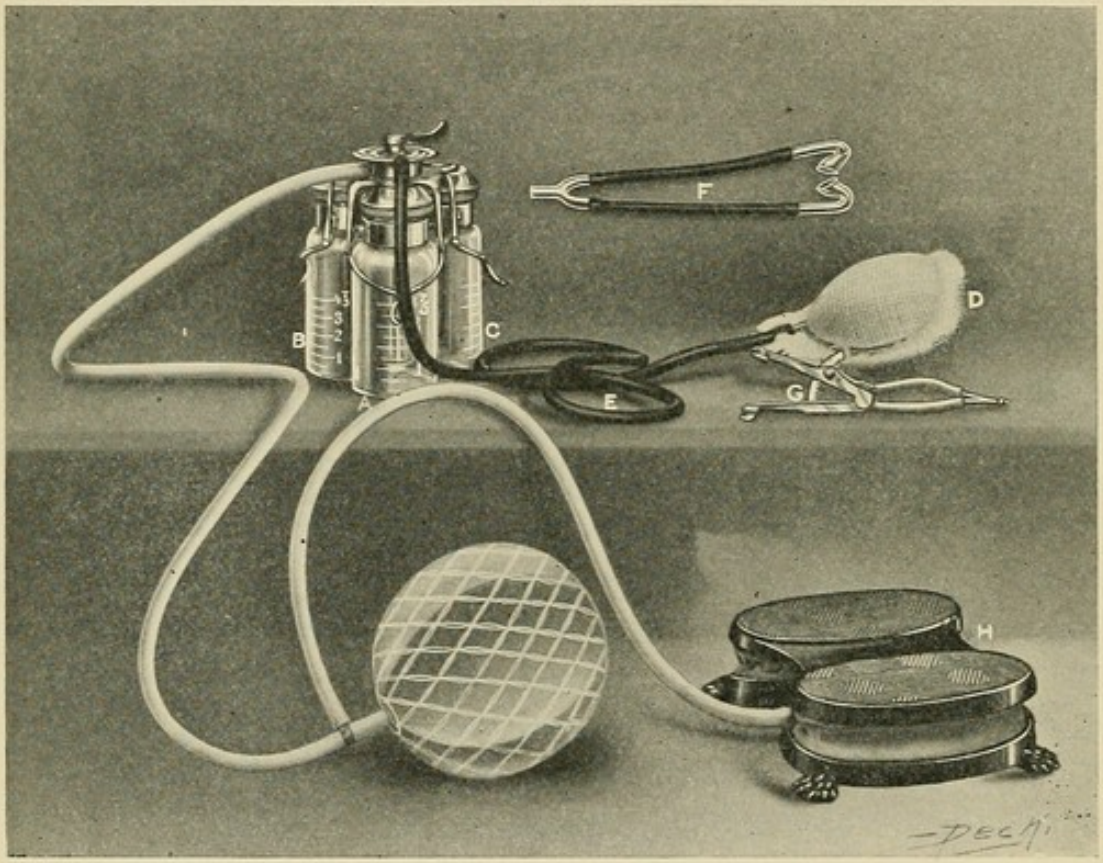


Fig. 114.—Vapor apparatus for anesthesia. A, bottle containing hot water and essence of orange; B, ether bottle; C, chloroform bottle for ether or chloroform at descretion of anesthetist; D, mask for ordinary anesthesia, connected to bottles by delivery tube E; F, Lombard nasal tubes for nasal insufflation anesthesia; G, vapor delivering mouth gag for work about the mouth and throat; H, foot pump.

delivery tube fastened in its dome. The vapor is generated by means of a foot pump which forces the air through the ether bottle, over to and through the water bottle to the mask. The mask is covered with a towel to conserve the ether vapor and fastened to the patient's face by a strip of adhesive plaster. An oxygen tank can be attached to the vapor delivery tube at any point from the bottle to the mask by means of a glass Y tube and oxygen given with the ether vapor or alone in case of need.

In refractory subjects of the chloroform type a few drops of chloroform may be needed on the mask at the initiation of the

narcosis to hasten the induction but if so used must be carefully watched.

Chloroform Anesthesia.—Chloroform vapor is more irritating than ether vapor, so a liberal amount of vaselin must be used on the lips, nose, and neighboring skin. It will be found advantageous as a routine measure to spray the nose and pharynx with 10 per cent. cocain solution. This seems to counteract in part the dangerous effects of chloroform narcosis. The Esmarch mask is held a few inches from the patient's face and chloroform dropped slowly upon it. The mask is gradually brought nearer the face, but not in contact with it, still slowly dropping the chloroform. An abundance of air should be allowed at all times. If the process is slow the patient often goes under without a struggle. If hurried there will be struggling, but the effect of chloroform in concentrated form is so powerful that when it is "pushed" the anesthetization becomes profound almost immediately. Such a procedure is dangerous. The skin becomes somewhat pale, the reflexes abolished, there is a slight accumulation of mucus in the pharynx, the pupil is midway between dilatation and contraction, the respirations moderate in depth and frequency. Altogether, the patient presents a much more pleasing picture than when ether is employed.

The stage of excitement is shorter with chloroform than with ether and is rarely marked. The pupillary reflex, general relaxation, respiration, and pulse must be carefully watched. Respiratory failure is not common as a primary complication. Alcoholics, however, may take chloroform quite as badly as they do ether and the same cyanotic conditions develop. They are to be treated in the same way. No matter how troublesome the patient, chloroform anesthesia must not be "pushed." When cardiac failure complicates chloroform anesthesia, respiratory failure quickly follows or is synchronous with it. The skin becomes blanched, the heart stops, perhaps gives a throb or two and then stops again. There is no warning. Respiration may continue for a few minutes and then ceases. In the rare cases in which respiratory failure precedes circulatory failure some hope is held out for restoring the patients, but in true circulatory failure the hope for a successful issue is a very faint one. Nevertheless

the same procedure should be gone through with as has been described under ether anesthesia. Should the patient revive and it be deemed expedient to proceed with the operation, ether should be substituted for chloroform. It will be found advantageous in all cases to combine oxygen with chloroform. To facilitate this, the oxygen tube is pinned to the inside of the chloroform mask or a special tubed mask may be used.

The accident of chloroform poisoning in narcosis is due to two main errors of administrative technic; first, actual overdosage, the result of the administration of stronger than a 2 per cent. vapor, and relative overdosage, which occurs early in the narcosis when the anesthetist fails to note the period of apnea that immediately succeeds the patient's voluntary excessive breathing when starting the anesthetic. During this period of apnea the anesthetist continues to pour chloroform on the mask with the result that a large quantity of strong vapor lies in wait, so to speak, for the long, deep respirations that invariably follow the period of apnea. Acute toxemia is the result and consequent collapse frequent, therefore the bad reputation of chloroform in the early stages of anesthesia and for short simple operations.

Nitrous oxid is the safest of general anesthetics, but is satisfactory for prolonged use only in the hands of an expert anesthetist, and, considering all sides of the question, is to be selected as the anesthetic of choice for short operations, painful dressings and as an initiative to ether narcosis or in such special cases as severe sepsis, where the cytolitic effect of other anesthetics contraindicates their use; in severe anemia, acute or chronic; in marked shock, as from acute traumatism or perforative peritonitis; in diabetes if an anesthetic is mandatory and in such conditions as strangulated hernia, as an aid to local anesthesia. Its use is contraindicated in empyema, angina Ludovici, sublingual or post-pharyngeal abscess, or other conditions where asphyxia is present or may be induced by the procedures of the operation.

For all short administrations of nitrous oxid the ordinary dental outfit is satisfactory, but for the initiation of ether narcosis or prolonged administration, special apparatus is necessary and must provide for the admixture of oxygen with the nitrous.

The method adopted as the best in this country is that of Bennett, Gwathmey or Gatch, the latter being specially used in the prolonged exhibition of nitrous and oxygen, and the former for gas initiation of ether narcosis or gas alone.

While putting a patient under nitrous oxid there is usually a marked increase in the rate and depth of breathing; if the proportion of nitrous and air or oxygen is left unchanged the patient becomes cyanotic, the respirations labored, the pulse slowed and in very faulty administration there are clonic muscular contractions. These are phenomena of anoxemia of the brain. This deficiency of oxygen nature tries to overcome by increasing the activity of the respiratory mechanism, but instead of this increased activity furnishing more oxygen, more nitrous oxid is inhaled which of course increases still further the oxygen deficiency and increases the oxygen hunger, hence a vicious cycle between the gas bag and the respiratory mechanism is established. Now in the course of a nitrous anesthesia if, at the moment there is an increased respiratory action, a specific warning, the nitrous oxid is at once turned off and air or oxygen given, the respiratory activity will be immediately smoothed out. The constant admixture of sufficient oxygen will prevent this vicious cycle of anoxemia. For all surgical purposes the administration of nitrous oxid and oxygen to the exclusion of air as adopted in the Gatch technic is the method to be preferred. Familiarity with the instrument is necessary to its proper use.

Nitrous oxid and ether is a very satisfactory method of anesthesia. The gas-bag is filled and the ether compartment is saturated. The patient first breathes air for two or three deep breaths, then gas is turned on and inhaled and expired through the valves. When about one-half of the gas in the bag has been used in this way the valves are turned so that the patient breathes in and out of the bag. Nitrous oxid anesthesia should now be complete. The ether is now turned on so that the patient breathes gas mixed with ether. No air should be given until ether anesthesia is complete. This takes about three minutes. Anesthesia may be continued by the addition of small quantities of ether as required and the admission of oxygen.

Junker's Apparatus (Fig. 115).—The two catheters are inserted, one in each nostril, until the level of the pharynx is reached. A safety pin is then passed through each catheter to mark off the proper distance to which they are to be reinserted in case of removal. A narrow piece of adhesive plaster wound once around the tubes and fastened to each cheek serves to keep the tubes in place. In coupling up the apparatus it is essential that the leading-to tube, the tube by which air is forced through the chloroform, be properly attached; otherwise chloroform liquid instead of chloroform vapor will be forced

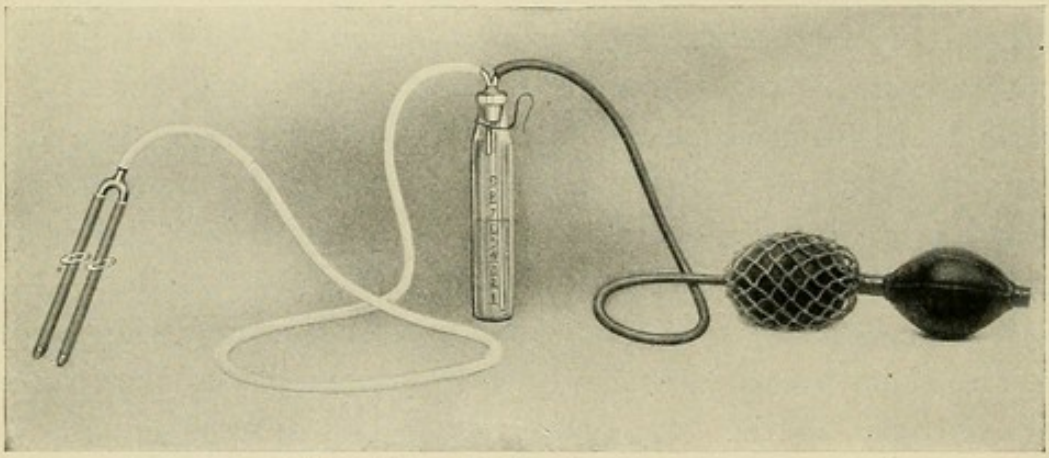


Fig. 115.—Junker's apparatus.

through the catheter and suffocate the patient. After testing the apparatus to insure its proper assembling it is well to pack the chloroform receptacle with lambs' wool to still further guard against spray instead of vapor being forced through the catheter. The apparatus is useful in operations in which anesthesia by the ordinary methods would bring the anesthetist in the way of the operator.

The Trendelenburg cannula (Fig. 116) is useful in operations about the larynx and pharynx. The tube is introduced through a tracheotomy opening, and the little air-bag around the tube gently inflated. This prevents blood descending alongside the tube. Chloroform is given drop by drop on the gauze covered cannula in the usual way, or better attached to some form of vaporizing bottle.

Tracheal Insufflation Anesthesia.—Tracheal insufflation anesthesia is a special anesthetic technic suggested by Meltzer and

Auer of the Rockefeller Institute for use in intrathoracic surgery and in such cases as have heretofore demanded some such procedure as Crile's tubation of the pharynx, Kuhn's intubation, or the Trendelenburg cannula.

In intrathoracic surgery beside maintaining the narcosis, it prevents the occurrence of acute pneumothorax when the pleural cavity is opened, by distending the lung with an internal pressure of fifteen to twenty millimeters of mercury, it carries on respiration by means of a current of air constantly passing

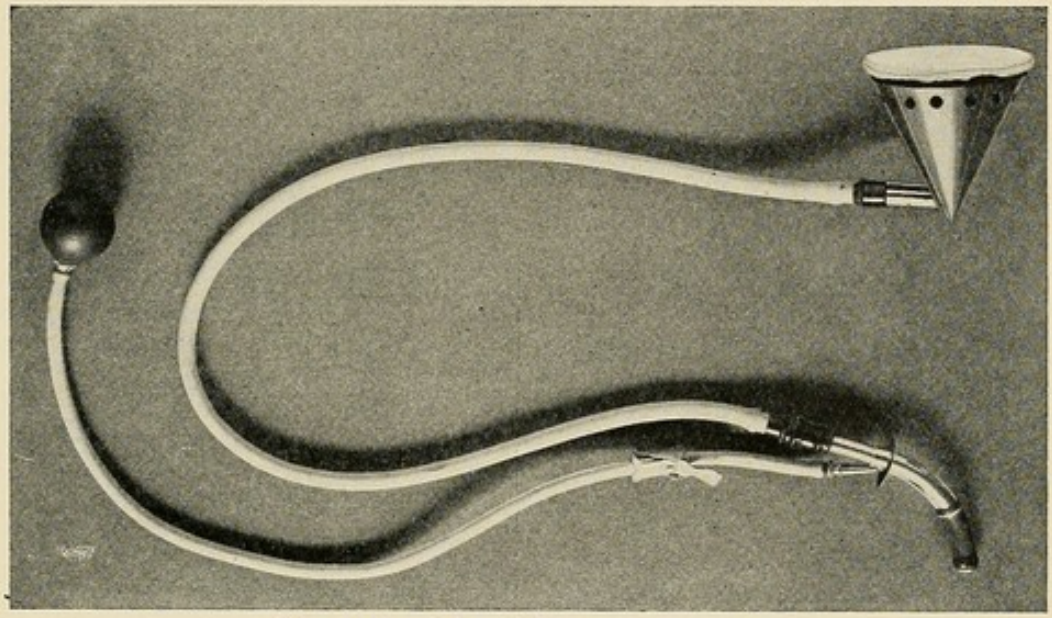


Fig. 116.—Trendelenburg cannula.

through the tracheal tube and prevents aspiration of throat and mouth contents by the force of the return air current alongside the tracheal tube.

In operations about the head for disease of the mouth, nose, sinuses, and maxillary bones it prevents blood and débris entering the trachea with respiration, takes the anesthetist well out of the operative field and provides complete oxygenation of the blood despite the presence of obstruction of the airways.

Physiological laboratories and increasing experience in man have given much evidence that the tracheal tube in the trachea and larynx, the direct application of ether vapor to the bronchi, and the intrapulmonary pressure are not contraindicating factors in the procedure.

Technic.—Tracheal insufflation anesthesia is carried out by

means of special apparatus constructed for the purpose. The apparatuses in common use are those bearing the name of Elsberg and Janeway, but simpler and less costly constructions (Fig. 117) can be used with satisfaction if they adopt the essential

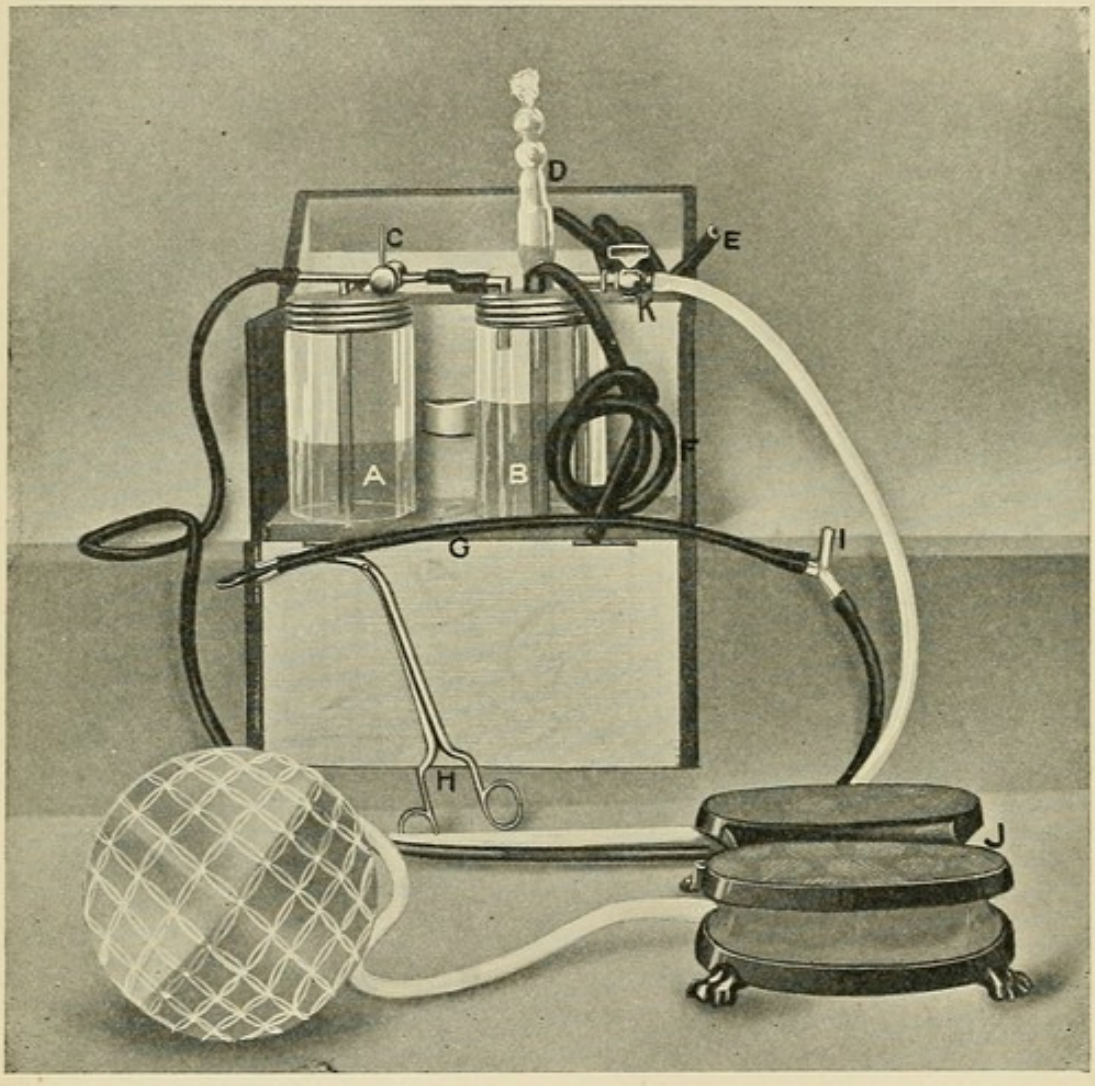


Fig. 117.—Apparatus for tracheal insufflation anesthesia. Arranged to administer ether vapor or nitrous oxide and oxygen. A, ether bottle; B, water bottle; C, valve for switching in ether as desired; D, mercury manometer and safety valve; E, rubber tubing for attachment to nitrous oxide tank; F, tube to oxygen tank; G, silk woven tracheal catheter size F; H, introducing forceps for catheter; I, by pass for interrupting air current to lungs; J, foot pump, which may be replaced by electric motor pump; K, stop cock to shut off pump when nitrous oxide and oxygen are being used.

principles, namely, a source of air pressure such as is furnished by a foot pump or electric motor, a water bottle for filtering and moistening the air, an ether bottle equipped with a valve that will regulate the varying quantities of ether required, and a safety valve and manometer to measure the internal pressure

of the apparatus as well as prevent sudden rise of pressure in the lung causing harmful distention.

The tube that is introduced into the trachea is a twenty-two or twenty-four French urethral catheter silk woven or soft rubber. This catheter should have a mark at a point twenty-six centimeters from its end to indicate the distance from the teeth to the bifurcation of the bronchi. The tube is introduced through a direct vision Chevalier Jackson laryngoscope or by means of a special introducer designed by Cotton and Boothby.

Anesthesia is maintained by the constant pumping of the ether ladened air stream through the tracheal tube to the bronchi and no factors except the technic of exhibition differ from other forms of ether administration.

Spinal Analgesia.—By this method immunity from pain may be relied upon in all operations up to the level of Poupart's ligament. In the vast majority of cases there will also be immunity from pain in operations up to the level of the umbilicus anteriorly and somewhat higher posteriorly. Beyond this, analgesia cannot be relied upon. In rare cases, it may extend as high as the second rib. In cases in which this higher area of analgesia is obtained the Trendelenburg position may be, in part, responsible. Nor is analgesia at all satisfactory in intraabdominal operations. This is particularly true in inflamed conditions of the peritoneum.

During and following the period of analgesia numerous unpleasant symptoms may occur. That these are not due to the cocain alone seems to be proven by the fact that the same symptoms are equally marked whether a large or small dose of cocain be employed as well as in cases in which antipyrin, tropococain, or chloretone was used, and in one case, vertigo, pallor, cold sweat, sighing respiration; rapid, weak pulse; dry cough, nausea, and vomiting occurred before any cocain had been introduced and after but a few drops of cerebrospinal fluid had been withdrawn. In addition to these unpleasant symptoms there may occur: headache, chills, and involuntary defecation and urination. On the other hand, the course of analgesia may be quite free from all unpleasant symptoms, or at most a rise of temperature and headache may develop a few hours afterward.

In order to avoid respiratory or circulatory depression it is customary to give strychnin sulphate, gr. 1/20, hypodermically fifteen minutes before the spinal injection.

Vertigo is seldom noticed. Nausea occurs in about one-half of the cases five to ten minutes following the injection. Actual vomiting takes place in about one-third of the cases. It rarely lasts longer than two minutes. Dry retching will exceptionally occur, but is not persistent. Some cases seem to be relieved of their nausea and vomiting is prevented by swallowing a cup of hot coffee when the first symptoms appear. Headache occurs in two-thirds of the cases; it is usually frontal in character and may be mild or severe, coming on three or four hours after the injection. The severe form may become general and last for from twenty-four to forty-eight hours. Treatment is of slight avail. Nitroglycerin seems to be the most efficient drug in this connection. Rise of temperature is a fairly constant symptom. It occurs from three to eight hours following the injection Usually the temperature does not rise higher than 101° to 102° F. and rapidly returns to normal. Involuntary micturition and defecation occur in few cases. Sometimes the patients are aware of these occurrences and sometimes not. Pronounced chills are seldom observed. Pallor, cold sweat, and sighing respiration have only been noted in cases in which there was also present nausea, vomiting, and rapid, weak pulse. All of these unpleasant symptoms are lessened by the preliminary hypodermic use of strychnin sulphate, gr. 1/20.

Rules for Making the Injection.[1]—1. The instrument employed may be a fine aspirating needle and an ordinary solid-piston hypodermic syringe. A special needle inclosed by a cannula is a convenience under some circumstances, and a glass barrel and asbestos-piston syringe add a nicety to the procedure. These should be sterilized by boiling.

2. Give the patient a hypodermic injection of 1/20 grain of sulphate of strychnin, a quarter of an hour before the injection, and have a cup of hot coffee ready should nausea occur.

3. The cocain is sterilized by crushing the required amount, usually 1/2 grain, in a sterilized spoon and pouring on a few drops

[1] George R. Fowler, *Medical Review of Reviews*, April, 1901.

of chloroform to form a paste (Bainbridge). When the chloroform has evaporated, add from 15 to 30 minims of boiled water.

4. A soap and water and alcohol cleansing of the skin of the back, with proper isolation by means of clean towels and surgically clean hands answer the requirements of asepsis.

5. The position of the patient may be either the sitting position upon the edge of the operating table, leaning well forward, or the left lateral decubitus, with both thighs flexed upon the abdomen, and a cushion placed between the left loin and the table to prevent lateral deviation of the spine in the lumbar region.

6. The highest point of the crest of the ilium is to be identified, and upon a line straight across the back from this point will be found the fourth lumbar vertebra. The depression immediately above this or the one below, if this is more easily identified, is utilized for the injection.

7. Select a point about half an inch to the right of the middle of the space chosen and here introduce the needle. A preliminary injection of a few drops of cocain solution, first in the skin itself and then into the depths, renders the patient less liable to start when the needle is introduced, and a slight incision with the scalpel is an additional precaution against infection.

8. Enter the needle at the point where the hypodermic puncture has been made and direct its course in such a manner that its point reaches the spinal column in the median line. A very little practice will enable the operator to estimate the angle necessary to hold the needle to effect this. Pass the needle slowly, and if the angle has been correctly estimated and the middle of the space between the spinal processes properly identified, the resistance to its passage will be but slight, until it reaches the interspinous ligament, when a decided and appreciable increase in resistance will be felt. Should it strike bone, withdraw partially or entirely and change its course. It will be more likely to strike the upper than the lower lamina. Once it has entered the spinal canal, unless its lumen has become blocked, the cerebrospinal fluid appears, flowing from the needle in clear or slightly blood-tinged drops. An amount approximately equal to the volume of solution to be injected is allowed to escape.

9. Screw upon the needle the hypodermic syringe previously charged with cocain solution and inject slowly. Leave the needle *in situ* with the syringe attached for half a minute, so as to prevent leakage from the puncture, and then withdraw. Pencil a little collodion over the point of puncture and cover with a small piece of adhesive plaster.

10. Test for analgesia once a minute, commencing in the soles of the feet, with a needle. Simple touch sensation is not abolished; the patient must complain of actual pain, otherwise analgesia is established. In the average case, numbness and formication in the feet occur in from one to three minutes, and analgesia in the lower extremities in from four to six minutes. In from seven to fifteen minutes the analgesia has reached to varying points between the umbilicus and the level of the fourth rib in the line of the nipple. The level is higher posteriorly than anteriorly. The analgesia lasts from thirty minutes to an hour and a half, according to the quantity of cocain employed, and recedes from above downward.

Local Anesthesia.—*Hydrochlorate of cocain* is employed in 1/2, 2, 4 and 6 per cent. aqueous solution. The two latter percentages and higher up to 10 per cent. are used as topical applications to mucous membranes. Schleich's solution may be made from tablets or may be prepared according to the following formulas:

No. 1 (Strong).

Cocain hydrochlorate	gr. j
Morphin	gr. 1/8
Sodium chlorid	gr. j
Sterile water	℥j.

No. 2 (Medium).

Cocain hydrochlorate	gr. 1/2
Morphin	gr. 1/8
Sodium chlorid	gr. j
Sterile water	℥j.

No. 3 (Weak).

Cocain hydrochlorate	gr. 1/20
Morphin	gr. 1/16
Sodium chlorid	gr. j
Sterile water	℥j.

Cocain solutions should preferably be freshly prepared. This is easily done by Bainbridge's method. A known quantity of the crystals or a tablet is ground into a fine powder in a sterile spoon. To this is added a few drops of chloroform, and a paste made by thoroughly mixing the two. The chloroform soon evaporates. A sufficient quantity of sterile water is then added to make the strength of the solution required.

Novocain is largely replacing cocain. It is much less toxic and can be sterilized by boiling.

When possible the blood supply of the part should be arrested in order to maintain the local anesthetic effect. This is accomplished in the case of the extremities by means of an Esmarch constrictor; in case of the fingers or toes by constricting the base of the member with a small rubber elastic catheter.

Following the usual aseptic preparations a hypodermic syringe is filled with the required solution and the needle attached. The strength of solution required for skin incisions is usually 1 per cent.; for deeper dissections 1/2 per cent. For anesthetizing nerve trunks a few drops of a 2 or 4 per cent. solution is used. In eye operations the lids are everted and a few drops of 4 per cent. solution allowed to flow over the conjunctiva.

In anesthetizing the skin by the infiltration method, the needle is introduced into the substance of the skin and a few drops of the solution injected—enough to raise a white wheal. The needle is then pushed farther along the proposed line of incision, still in the substance of the skin, and a second wheal raised which overlaps the first. This process is repeated until the entire line of the proposed incision has been anesthetized, it being necessary to withdraw and reinsert the needle several times. The skin is tested for anesthesia with the point of the knife, and, as soon as this is established, usually in less than two minutes, the skin incision is made. In deeper dissection injections of 1/2 per cent. solution may be made into the surrounding tissue, or, as in hernia operations, the main nerve trunk supplying the parts may be anesthetized. In extensive dissections the injection of 1/6 to 1/4 grain morphin sulphate is made a half hour before the operation. As the period of anesthesia is variable, it is well to proceed with the operation as speedily as possible. The amount of cocain

employed should be noted and not more than 1 grain be injected into tissues in which the blood supply is not under control. Rarely is it necessary to use this amount. In operations in which constriction is employed, the constriction should be intermittently removed at the close of the operation in order to avoid throwing a large amount of cocain rapidly into the general circulation.

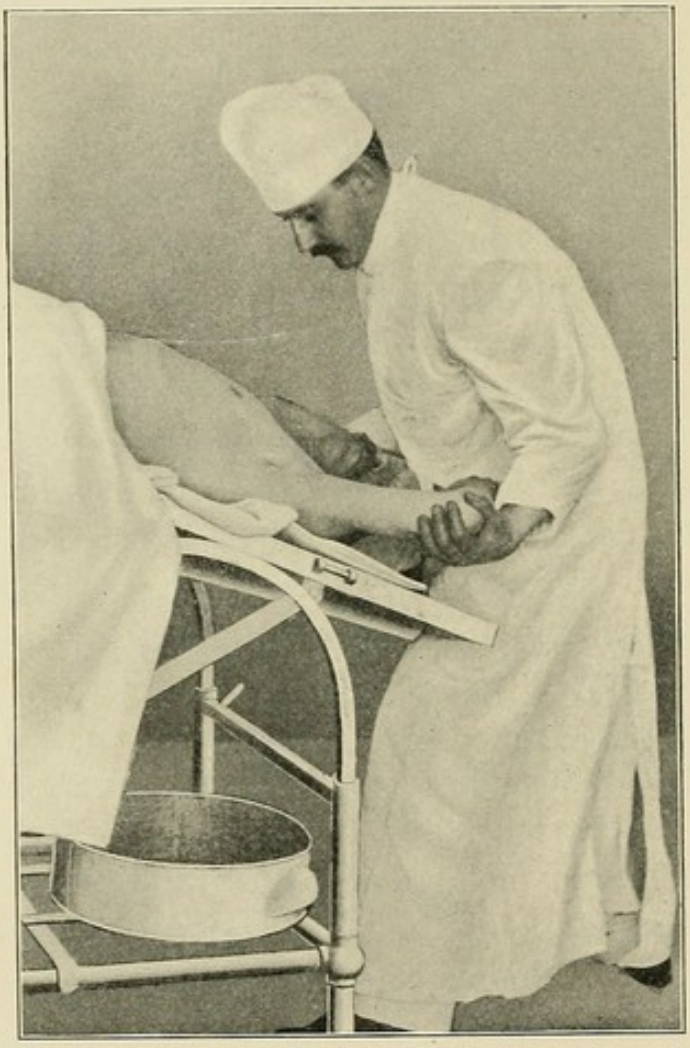


Fig. 118.—Sylvester's method of artificial respiration (inspiration). (Fowler's Surgery.)

General effects from the cocain will be noted. The patient talks quite freely. Should the heart action be quickened and the pupils dilate, caffein and strychnin will be found useful. A cup of strong, hot coffee often makes these patients quite comfortable.

Artificial Respiration.—This is employed more frequently for the restoration of patients suffering from dangerous surgical narcosis than in any other connection. It should be commenced as soon as respiration actually ceases, as shown by the absence

of all thoracic and abdominal movements, the absence of evidences of air passing from the mouth or nose, and the signs of deepening cyanosis.

Sylvester's Method.—The head and neck should be fully extended, the former hanging over the end of the table; the tongue is well drawn forward to prevent possible obstruction to



Fig. 119.—Sylvester's method of artificial respiration (expiration). (Fowler's Surgery.)

the entrance of air. The arms are grasped at the elbows and pressed firmly for about two seconds against the sides of the chest (Fig. 119). If this does not cause an expiration, the pressure should be made below the costal margins in the direction of the diaphragm. The arms are now brought upward to each side of the head, inspiration being effected by thus increasing the capacity of the chest through the action of the pectoral muscles on the upper ribs (Fig. 118). These movements are kept

up at the rate of about fifteen times a minute. With the occurrence of spontaneous efforts at breathing, care must be taken to supplement rather than substitute the normal respiration. The artificial movements are occasionally suspended in order to judge of the efficiency of the normal efforts.

Laborde's method of rhythmic traction of the tongue is sometimes successful in restoring the respiratory reflex. The tongue is grasped by forceps and alternate traction and relaxation made about twenty times a minute. This is kept up for at least half an hour, unless respiration is established in the meanwhile. This method may be employed alone or in conjunction with other methods.

Intralaryngeal insufflation consists in forcing air from a bellows into the lungs through an intubation attachment (Fell-O'Dwyer method). Provision is made for the escape of the expired air through a branch tube. A modification of this apparatus consists of the substitution of a graduated pump for the bellows, and the addition of a mercurial manometer and automatic cut-off for preventing the backward leakage of air. This improved apparatus is also arranged for administering oxygen or an anesthetic while artificial respiration is being carried on (Matas).

Meltzer's Method.[1]—A stomach tube is introduced. A 22 French catheter is inserted into the pharynx 5 1/2 inches from the teeth. The tongue is pulled forward by tongue forceps. A pad one inch long and one inch thick made of gauze or cotton is placed under the chin on the suprahyoid region and pressure made on it by a handkerchief tied at first only moderately firmly over the head. Pressure on this pad presses the middle part of the tongue against the posterior part of the hard palate. The bandage should be tied over the posterior part of the parietal bones. A weight of twelve to thirteen pounds is placed on the abdomen. Pressure on the abdomen offers the further advantage that it drives the blood from the abdomen to the heart and brain and the medulla. A moderate size bellows is connected with the catheter and air pumped into the lungs. Care should be taken that at the beginning the compression should not be made too

[1] S. J. Meltzer, *Journal American Medical Association*, vol. lviii, No. 19, p. 1413.

forcibly and rapidly, not oftener than ten to twelve times per minute. If each compression causes only a slight heaving of the chest, the bandage over the head should be tightened and if the heaving appears too strong the bandage should be loosened accordingly. Here, as in the method of intratracheal insufflation, too much pressure and careless handling may do harm. The compression should never be made so tight as to make the escape of air through the mouth impossible or very difficult.

The introduction of a tube into the stomach permits the handling of the insufflation with greater force, more efficiency and greater safety. In some cases the use of the stomach tube might be even indispensable, when for one reason or another, no weight can be placed upon the abdomen. The stomach tube should not be too small in diameter, should have two lateral openings near its end and should be introduced at least sixteen inches from the teeth. It should be introduced before the pharyngeal tube. There is no objection to having both devices together, the stomach tube and the weight on the stomach.

The insufflation is just as efficient no matter what position the patient is in. Instead of the bellows an oxygen tank can be utilized, by inserting a T tube in the connection between the oxygen tank and the catheter. An attendant closes and opens the vertical, open branch of the T tube about twelve times per minute; the closing will cause inspiration and the opening expiration. The closure should last about two and the opening about three seconds. In order to prevent too much pressure it is advisable to introduce another T tube which should be connected with a safety valve. The latter is prepared in the easiest and simplest manner by having mercury in a double-necked bottle or a bottle closed with a stopper having two perforations. Through one of these openings a graded tube is introduced and submerged about 15 to 20 mm. under the surface of the mercury. This prevents the oxygen entering the pharynx with a pressure higher than 15 or 20 mm. of mercury.

The Relation of Acapnia to Surgical Shock.—Recent studies of the English physiologists[1] have demonstrated the intimate

[1] Haldane and Smith: W. H. Howell, Text-book of Physiology, 2nd ed., p. 614. Prof. Yandell Henderson, *Johns Hopkins Bulletin*, vol. xxi, No. 233, Aug., 1910. *Amer. Journ Phys*, vol. xxiv, April 1, 1909, No. 1.

causative relation between the lowering of the carbon dioxid content of the blood and the condition known as surgical shock. This lowered carbon dioxid content has been termed "acapnia," smokelessness.

Carbon dioxide, not oxygen, is the element in the blood upon which direct stimulation of the respiratory mechanism depends; the oxygen may vary within wide limits, other things being equal, and yet have no material influence on the respiratory mechanism so far as its efficiency and rapidity of functionation is concerned.

In similar degree is the general venous tone regulated by the carbon dioxid content of the blood and tissues, and overventilation of the lungs by hyperpnea, or rapid respiratory frequency, through its production of the acapnic state, causes not only respiratory collapse but also that circulatory phenomenon noted by all observers on shock, autogenous hemorrhage or venous stasis.

In surgery the factors which have to do with the production of the acapnic state and its resultant contributory part in surgical shock, are, first the anesthesia and second the exposure of large surfaces of the abdominal viscera.

The excitant stage occurring early in many improperly exhibited ether anesthesias, is accompanied by varying degrees of hyperpnea or accelerated respiratory frequency. This accelerated respiration soon overventilates the lungs and coincidently lowers the carbon dioxid content of the blood and tissues. At the same moment—that is, the moment of excitation and hyperpnea, the dosage of the anesthetic agent is pushed to a maximum by the anesthetist anxious to subdue the struggling subject; the result is, that simultaneously, the sensitiveness of the respiratory mechanism is diminished by the excessive dosage of narcotic and the amount of natural stimulant to that mechanism, namely, carbon dioxid, is lowered. These two conditions existing at the same moment result in a failure of respiration because the lowered stimulant cannot reach the desensitized respiratory mechanism. The threshold of the respiratory function is elevated, the subject is coincidently acapnic and primary respiratory collapse occurs.

As to which factor plays the more important part in such

anesthetic respiratory failure, the carbon dioxid starvation or the anesthetic toxemia, there remains much yet to be investigated and proven. Two things, however, are of practical value, first, that many patients die early in the narcosis from primary respiratory collapse, which may be prevented if the acapnic state is kept in mind and warded off, and second, that in actual practice, the conservation of carbon dioxid early in a narcosis, plus the careful control of all the principles of what Crile includes in his heading "Anoci-association" has materially lessened the accident of early anesthesia and the degree of anesthetic shock.

The second factor in surgery bearing upon the occurrence of acapnia, is the exposure of viscera. Professor Henderson after extensive experimentation has concluded,[1] that from the serous surface of viscera exposed during laparotomies there is given off carbon dioxid in such quantity as to be an important contributory factor in the production of acapnia

The anesthetic plays a very constant and serious part in surgical shock through its toxemia, the induction of circulatory disturbances such as acapnia and loss of venous tone, respiratory collapse, and many serious sequelæ. The rebreathing of modern anesthetic technic and the preliminary use of sedative hypodermic medication are among the practical applications of the acapnic theory of shock.

CHAPTER V.

PRE-OPERATIVE PREPARATION AND THE PRIMARY DRESSING.

General considerations. Examination of the blood; heart; lungs; kidneys. Blood pressure. Skin. Bowels. Diet. Local preparation; general directions; head; neck; thorax; abdomen; pelvis; extremities. Mouth and associated cavities. Preparation for cleft palate operations. Esophagus and stomach. Esophageal diverticula. The small and large intestine. Rectum and anus. Urinary system. Preparatory to operations upon the thyroid gland. Exophthalmic cases. Preparation just prior to anesthetization. Position of the patient. Dependent head position; extended neck

[1] *Amer. Journ. Phys.*, vol. xxiv, No. 1.

position; position for operation on the thyroid; for amputation of the breast; for thoracotomy; for operations upon the upper abdomen; dorsal position; Trendelenburg position; reversed Trendelenburg position. Lithotomy position. Exaggerated lithotomy position; Sims' position; kidney position; ventral position; knee-chest position. Final preparation of the field of operation. Hand disinfection. Application of dressings.

The **general preparation** of the patient begins from the time that the surgical condition is recognized. Patients should be treated in such a manner as to maintain, and indeed increase, their confidence in a successful solution of their trouble. Anything tending toward discouragement should be obviated. As a rule, the nearer the individual's normal manner of living is imitated, the more satisfactory the result. If the patient is not ill enough to be confined to bed it is well for him to walk about, read, go to the toilet, take his own bath, and at the time set for the operation walk to the operating room. By so doing not only is the patient's mind kept active but especially in hospital work a not inconsiderable amount of nurse's time is saved. Nervous patients should be insured a good rest the night prior to the operation by the administration of a sedative, preferably a combination of the bromids. Any concomitant disease should receive appropriate treatment. **An examination of the blood** should be made in all cases of chronic septic conditions as well as in acute infections, hemorrhage cases, and cases presenting signs of anemia. The examination should consist of a red-cell count, a white-cell count, a differential white-cell count, and an estimation of the percentage of hemoglobin. Should the latter be below 50 per cent. it should be increased, if feasible, before the operation. In suspected hemophiliacs and in jaundiced patients, the coagulation time should also be noted.

An examination of the heart and lungs is made, any deviation from the normal noted and proper treatment inaugurated.

Kidneys.—Immediately following the bath the patient is asked to urinate. Catheterization in females should only be resorted to in case the examination of the first specimen is made difficult by the admixture of vaginal discharge. When time allows, the total quantity passed in twenty-four hours is saved and a sample of the mixed urine analyzed. In the event of the discovery of any pathologic condition, suitable treatment is

inaugurated and subsequent urinalyses made sufficiently often to note the progress of the condition.

Blood Pressure.—The blood pressure should be taken as a routine measure in all patients presenting evidence of arteriosclerosis, and where high blood pressure is found the operation should be postponed if practical. In operations of great magnitude involving necessarily a great amount of shock, such as operations upon the central nervous system, the blood pressure is noted before the operation and at frequent, two minute, intervals during the operation. In such cases operations should be so planned as to allow of discontinuance when the blood pressure falls.

The arterial blood pressure should be determined by a special apparatus devised for this purpose. Of these the Janeway is one of the most practical for surgical purposes. In emergency cases with low blood pressure rapidly diffusible cardiac stimulants by hypodermic and intravenous or direct transfusion are indicated. In emergency cases with high blood pressure nitroglycerin hypodermically is of value. In cases which allow of several days preparation, suitable treatment by administration of nitrites is indicated in cases with abnormally high blood pressure. In case of low blood pressure, whenever feasible, the case should be brought to as nearly a normal state as possible before operating.

Janeway gives the normal systolic pressure for children up to two years as 75 to 90 mm. of mercury; for children over two years 90 to 110 mm.; for adults 100 to 130 mm. The pressure in females is about 10 mm. less than in males. As age advances, the pressure as a rule becomes higher, as high as 145 mm. not being considered abnormal. The diastolic pressure registers from 25 to 40 mm. less than the systolic. For ordinary surgical purposes the determination of the systolic pressure is all that is necessary.

Whatever instrument be used, it is essential that the armlet be broad, as the narrow armlets record a higher blood pressure. The personal equation of the observer plays an important rôle.

Technic.—Janeway's Portable Sphygmomanometer[1] (Fig. 120).

[1] The Clinical Study of Blood Pressure, Janeway, 1904.

The apparatus consists of a U-shaped manometer connected with a cistern. The upper joint of the manometer tube is removable, making the instrument portable. The illustration shows rings on the right-hand portion of the sliding board in which this removable portion of the manometer tube is stored. The open end of the U is closed by a small cork (F); the other end is automatically closed when the case is shut by a block

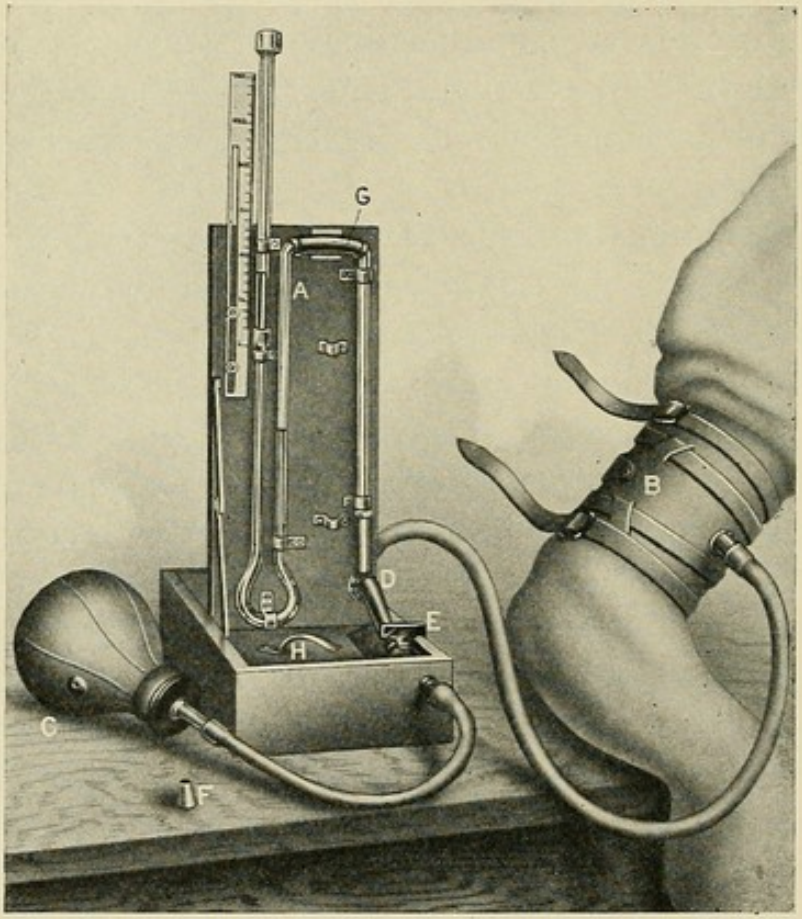


Fig. 120.—Blood-pressure apparatus. (Janeway.)

which compresses the rubber joint (G). The scale is slid down, the Politzer bag (C) removed from the stop-cock (E) which contains a needle valve for slow release of pressure. This stop-cock is allowed to slip under a spring (H) as the case closes. The lid, to the under side of which the manometer is fastened, is then closed by dropping the catches which fasten behind and folding down the hinge at the left, the lower end of the lid sliding back in a groove. The box when closed measures 10 1/4× 4 5/8×1 7/8 inches and with the armlet and Politzer bag weighs 2 1/2 pounds. The manometer tube has a caliber of 3 mm. and

all connections are of heavy pressure tubing. The armlet (B) is a hollow rubber bag 12 cm. wide and 18 cm. long with an outer leather cuff 15×33 cm. This is fastened by two straps with friction buckles. The needle valve is easily manipulated and allows for gradual or sudden lowering of the pressure as desired. The scale is graduated empirically.

Application.—The armlet is buckled on. The cuff should be adjusted snugly; too loose an adjustment results in too small amplitude of pulsation. The outlet tube should be directed anteriorly. The scale is set with the zero point at the level of the two mercury columns. The removable portion of the manometer tube is secured in place. The radial artery is palpated, inflation of the arm bag is made by the Politzer bag raising the pressure until the pulse is obliterated, then releasing it very slowly and steadily until the pulse returns. The reading on the scale gives the systolic pressure. In cases presenting extremely low tension the Politzer may not be large enough to force sufficient air into the arm bag to the extent of obliteration of the pulse. If this is so, the stop-cock (E) is closed while the Politzer bag refills, then while squeezing the Politzer bag the stop-cock is slowly opened. In this manner the pressure can be carried as high as desired when the stop-cock is closed. With the finger on the pulse, open the stop-cock slowly until the air begins to escape through the needle valve. In this manner the pressure of the armlet is very gradually lowered until the return of the pulse. Then carry the pressure a little higher and repeat. After the pulse is again detected allow the pressure to fall 5 or 10 mm. at a time until the lowest point of maximum oscillation of the manometer column is determined. Allow any air remaining in the apparatus to escape by removing the Politzer bag. The precaution must be observed to allow time after each fall in pressure for the mercury to recover from the procedure before comparing its oscillations with those at the previous level. If the drop has been sudden there will be a rebound of the mercury which will make the first pulsations abnormally large. At least ten to twenty oscillations should be observed at each level to obtain an average. Janeway thinks that a rough approximation should be made by allowing the

blood pressure to fall 10 mm. at a time; then, after releasing all the pressure to return to just above the point thus determined and make a careful estimation at 5 mm. intervals. When the greatest fluctuation of the column does not exceed 5 mm. it is not possible to form any judgment and the same holds good when the pulse is very rapid.

The Skin.—A hot bath is taken the evening before the operation. The entire surface of the body is vigorously scrubbed with soapsuds and a soft brush. Particular attention is paid to the head, axillæ, genitals, anal region, hands and feet; the finger nails and toe nails are cut short, and the subungual spaces well scrubbed. Patients too ill to take or be given a tub bath have a sponge bath.

Bowels.—Thorough catharsis is not only unnecessary but harmful as it dehydrates the patient. After the use of calomel occult blood is always found in the stools. Magnesium sulphate is a cardiac depressant, extracts too much water and tends to produce later post-operative distention. Of all cathartics, castor oil is the least harmful. Cases, other than acute infections of the abdomen, receive two ounces of castor oil in an equal amount of dark beer the afternoon before the operation. If the bowels do not move freely an enema is given early on the morning of the operation. Castor oil dehydrates the patient much less than the older method of giving magnesium sulphate. In this connection it must be remembered that in more than 6 per cent. solution magnesium sulphate may act as a poison and that certain obscure deaths are traceable to its use. In emergency cases the oil is omitted, and a large soapsuds enema given immediately following the bath.

Diet.—The diet should be highly nutritious, rapidly assimilable, and such as to leave the minimum residue in the intestines. The patient should be encouraged to indulge in liberal quantities of water up to within six hours of the time set for the operation. In emergency cases which have recently partaken of a meal the stomach should be washed out. Debilitated patients should receive rectal alimentation every six hours in addition to being fed by the stomach.

Local Preparation. *General Directions.*—The afternoon pre-

ceding the time set for operating the skin of the field of operation is shaved. In emergency cases this is done just preceding the anesthetic.

Head.—Preceding operation upon the brain the hair of the entire head is shaved. Preparatory to intracranial operations requiring localization Krönlein's cerebro-topographic lines

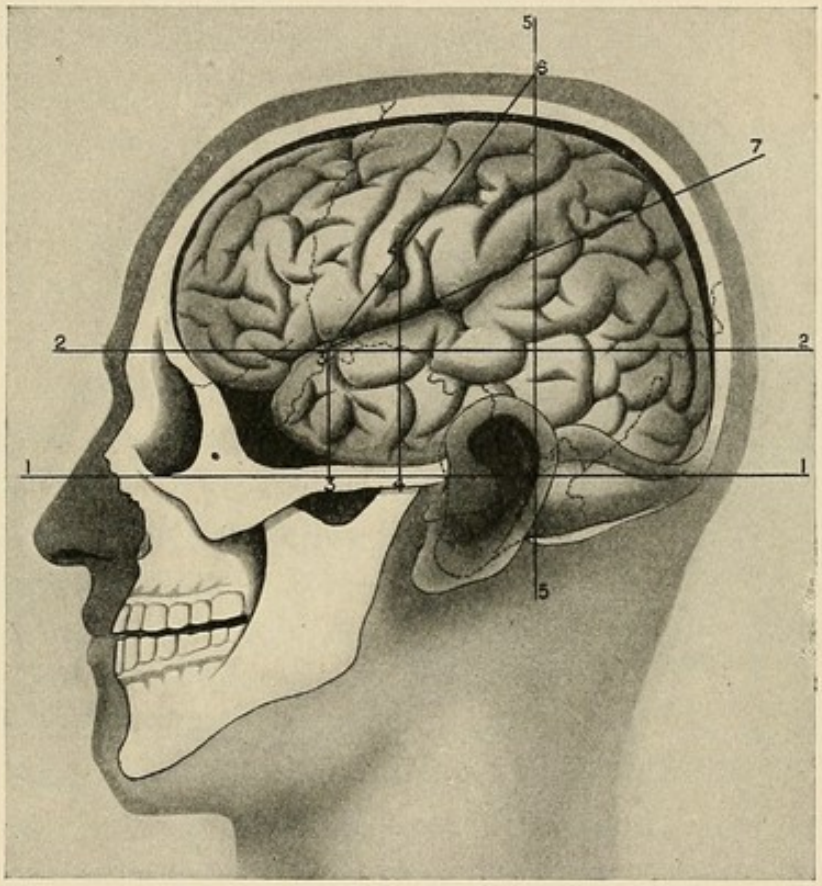


Fig. 121.—Krönlein's craniocerebral topographic lines. 1, 1, Base line, passing through the infraorbital ridge and the superior border of the auditory meatus; 2, 2, superior horizontal line, passing through the supraorbital ridge parallel to the base line; 3, 3, anterior vertical line, passing from the middle of the zygomatic arch perpendicular to the base line; 4, 4, middle vertical line, passing from the head of the inferior maxilla (immediately in front of the tragus) perpendicular to the base line; 5, 5, posterior vertical line, passing from the posterior palpable margin of the mastoid process perpendicular to the base line; 3, 6, line of fissure of Rolando; 3, 7, line of fissure of Sylvius. (Fowler's Surgery.)

should be drawn with an anilin pencil on the shaved scalp in accordance with the rules shown in the illustration (Fig. 121). A ready method of locating the fissure of Rolando is as follows (Fig. 122): (1) Draw a line from the glabella to the inion with an anilin pencil, and mark a point half an inch behind the midway point of this line; this represents the commencement of the

fissure; (2) select a piece of stiff paper or light cardboard four inches square, fold it diagonally on the line AC, bringing the edge AD to correspond with the line AC; (3) place the card with the point A at the commencement of the fissure, and the edge AB on the middle line, when the folded edge AE will mark the site of the fissure sufficiently near for all practical purposes.

Preparatory to intracranial operations the blood pressure should be noted and the blood-pressure apparatus left attached so that the pressure can be noted at frequent intervals during the operation. Fall in blood pressure calls for a discontinuance of the operative procedure.

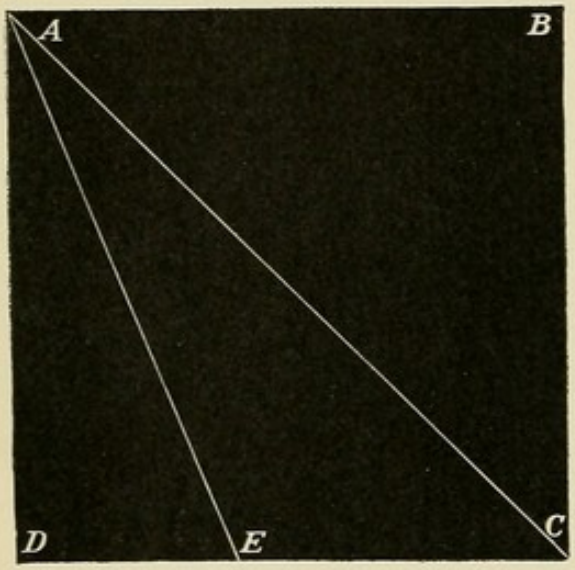


Fig. 122.—Chiene's device for locating the fissure of Rolando (reduced size). (Fowler's Surgery.)

In the case of small tumors or wounds of the scalp it is sufficient to remove the hair wide of the site of operation. The hair remaining is cleansed by shampooing with soap and hot water, thoroughly rinsed in cold water, then rubbed with alcohol and bichlorid, 1:5000, thoroughly dried, and in the case of females protected from further injury. The eyebrows should not be shaved, but should be completely disinfected. In operations near or involving the mouth or nose, the beard and mustache should be removed. The ears should be cleansed and lightly packed with sterile cotton. In inflammations of the meninges and serous cavities in general hexamethylenamin has been proved to have an inhibitory action on the growth of bacteria (Crane). It is administered in five to seven and a half grain doses, preferably combined with benzoate of soda, 10 grains, three times daily.

To prevent hemorrhage from the soft parts in operations upon the skull in those localities which allow of its application a three-quarter inch flat rubber tubing of sufficient length to encircle the head is used as a tourniquet. This is tightly applied and

secured by a clamp or tape. Its posterior part lies below the inion, its anterior at the glabella; laterally it rests just above the ears. A tape fastened antero-posteriorly in the middle line keeps the tubing from descending too far and pressing on the eyes (Cushing), or this may be prevented by temporarily suturing the tubing in place (Bristow).

Neck.—In operations in this region the hair on the side to be operated upon is shaved to above the level of the ear. The hair is shampooed as for operations upon the head. The ears are cleansed and packed with sterile cotton. The axillæ should be carefully disinfected, as it is here that the bacillus pyocyaneus has its habitat. It is not, however, necessary to shave the axillæ. The shoulder and chest should be included in the preparation.

Thorax.—Both axillæ should be disinfected; the one upon the side to be operated upon should be shaved. The arm upon this side should be included in the preparation, as well as the shoulder and upper part of the abdomen.

Abdomen.—The cleansing should extend from the nipples to the middle third of the thighs and as far back as the post-axillary line.

Pelvis.—The preparation should include the lower abdomen and upper third of the thighs, as well as the external genitalia, perineum and buttocks. In males the prepuce should be carefully cleaned and in females the clitoris. In operations involving the *vagina,* as well as in laparotomy cases, the vaginal mucous membrane is cleaned by douching twice or thrice daily with hot boric acid solution. In septic conditions this is preceded by a 1:2000 bichlorid douche.

Extremities.—In operations upon the arm the axilla and shoulder should be included in the preparation; in the case of the thigh the genitalia and hip should be included. In operations upon joints the entire extremity should be prepared. The preparation of the hands and feet is part of the general preparation of the patient. Areas such as the *elbow, knee,* and *sole* of the foot should receive more careful attention than areas where the skin is not so thick. Over these areas borosalicylic compresses should be applied and renewed every four hours, the loosened epithelium being removed by sponging with alcohol.

Mouth and Associated Cavities.—Preceding all operations upon the mouth and associated cavities the condition of the teeth should be investigated and made as perfect as possible. The teeth should be cleansed with a brush after each meal, and in addition an astringent and antiseptic mouth-wash and nasal douche should be employed every three hours. Minute doses of morphin and atropin are valuable in controlling excessive secretion. Ulcerative conditions such as are present in carcinoma of the tongue should be treated by lightly touching them with 5 per cent. zinc chlorid solution or 10 per cent. chronic acid solution.

Preparation for Cleft Palate Operation.—In infants the nutrition should be improved by giving liquid food every two hours for a week or ten days before the operation. The quantity should be gauged to prevent stomach regurgitation. The feeding bottle should be provided with a shield which will cover the defect in the palate and prevent for the most part regurgitation through the nose. The mouth and pharynx should be examined and any septic condition as aphtha or any catarrhal condition as chronic pharyngitis due to the manner of breathing be treated. Ulcerative conditions must be cured before operation. Inflammation of the pharynx and nose should be treated and the mucous membrane brought to as near normal condition as possible. Adenoid growths in the naso-pharynx and enlarged tonsils should be removed preliminary to the operation; otherwise, not only would the operation be more difficult but its success will be doubtful as the secretions of the naso-pharynx would not have a ready exit and would very readily infect the plastic flaps formed at the operation; also breathing would be difficult. No food should be given for six hours previous to the operation.

The Esophagus and Stomach. *Esophageal Diverticula.*—Preparatory to anesthesia the sac should be emptied, otherwise in manipulating the sac during the operation its contents are expressed into the pharynx and aspiration pneumonia may ensue (Mayo). If the patient is much emaciated operation is postponed and feeding by tube instituted until a more favorable condition of the patient results. This is readily accomplished by the method devised by Plummer as a means of diagnosis in

these cases. The patient swallows three yards of buttonhole silk twist and ten or twelve hours later three yards more of the continuous thread. If there is an opening out of the diverticulum the thread will finally find its way into the stomach and sufficiently far into the intestine to resist removal by traction. Upon this as a guide the stomach tube is passed. *Stomach.*—If there is interference with the motor function the stomach should be washed out shortly before the operation. The washing should continue until the fluid returns clear, when the remainder should be siphoned out, leaving the stomach empty.

The Small and the Large Intestine.—The most we can hope to accomplish is a diminution in the number of bacteria which here normally find their habitat. This is best accomplished by the ingestion of sterile food leaving the smallest residue and frequent cleansing irrigation of the mouth and nose. In the case of the large intestine, Strassberger has shown the bacterial content to be 60 per cent. normally. This is decreased in constipation, increased in diarrhea. Thorough purgation is therefore contraindicated. Sterilized feeding and repeated colon irrigations for several days preceding the operation is sufficient.

Rectum and Anus.—The preparation includes the perineum, buttocks, genitalia and upper third of the thigh. Colonic irrigations should be given the evening before and early in the morning, at least six hours before the time set for the operation.

The Urinary System.—The functional activity of the kidneys is increased by forcing fluids. This flushes out the urinary tract. In operations involving the bladder and in those in which a septic condition of the urine exists the bladder is washed out with boric acid solution. An ounce or two of the latter may be left in the bladder. Urotropin several times daily with sodium benzoate is useful in septic conditions. In operations involving the urethra, should septic conditions be present, thorough irrigation through a small catheter with boric acid solution should be done. Cases for prostatectomy with much residual urine should be regularly catheterized every six hours for a week or ten days before the operation in order to avoid renal congestion from too rapid relief of pressure at the operation.

Preparatory to Operations upon the Thyroid Gland.—Goiters not presenting symptoms of hyperthyroidism are prepared as for any operation. Morphin, gr. 1/4, combined with atropin, gr. 1/120, is administered hypodermically one-half hour before the operation is to begin. In cases in which anesthesia is employed the preparation of the field of operation should be done previous to beginning the anesthesia. In cases with *scabbard trachea* the head and neck should be maintained in the position in which the patient breathes easiest.

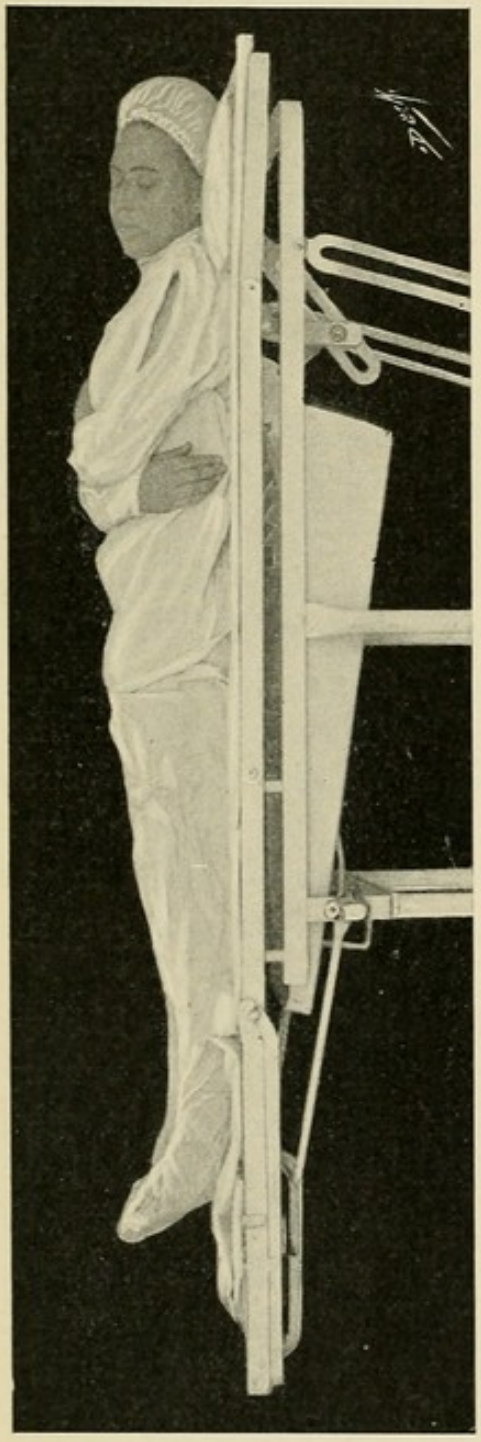


Fig. 123.—Dorsal position; operation suit.

Exophthalmic cases and those goiters of other types which present or have presented symptoms of over-activity of the gland are specially prepared by conserving the water in the tissues. For this reason cathartics are contraindicated and for several days before the operation a large amount of water should be ingested. On the evening before and on the morning of operation a colon irrigation is given. Patients who have had the slightest dilatation of the heart should not be prepared for general but for local anesthesia for the reason that even in the hands of the most skillful anesthetist the slight accumulation of mucus in the bronchi may prove too much strain on the already dilated heart. Iodine should not be used on the skin as its absorbtion may cause increase of hyperthyroidism. For the same reason antiseptics should not be used at

the operation. Operation should not be undertaken during an exacerbation of the disease.

Preparation Just Prior to Anesthetization.—A freshly laundered, light flannel night shirt, open in the back, is put on the patient; also a cap or bandage to confine and protect the hair, and long stockings (Fig. 123). If the patient is unable to urinate catheterization is employed should the operation involve the pelvis, otherwise catheterization may be omitted. Those cases not urinating voluntarily or not catheterized should be watched for distention of the bladder. Routine pre-anesthetic stimulation is unnecessary. In all patients save children, the very old, the septic or the anemic one-eighth of a grain of morphin sulphate with one two hundred and fiftieth of atropin sulphate is given hypodermically one hour before the time set for the operation. If the full effect is not noticeable in forty-five minutes the dose is repeated.

The position of the patient on the operating table varies according to the nature of the operation. It should be such as will render the parts involved prominent and easy of access and yet such as not to interfere with respiration or circulation. There must be no pressure on important nerves. The position should be as natural as possible. The pad under the patient should be sufficiently thick and soft to adapt itself to the patient's body. If the lumbo-sacral curve is more pronounced than normal a rubber pillow is placed under the body at this point. If these directions are disregarded backache will follow. The musculo-spiral nerve is the one most frequently injured through allowing the arm to rest against the edge of the table. It has been caused by an assistant leaning against the arm. As the anesthetic is started the patient is secured in the required position and the local cleansing begun. For most positions the limbs may be secured to the table by fastening a broad strap just above the knees. The arms are fastened by passing each into either end of a long sleeve in which the patient interlaces his fingers and are surrounded by a thick broad soft bandage the ends of which are secured to the table (Fig. 113).

The dependent head position (Fig. 124) is used in operations upon the mouth and nose. Its object is to prevent the entrance

of blood into the larynx. The patient lies in the dorsal position, arms by the side, with the head hanging over the end of the table. The back of the neck is protected by placing under it a small flat pad. The vertex of the head may be supported by

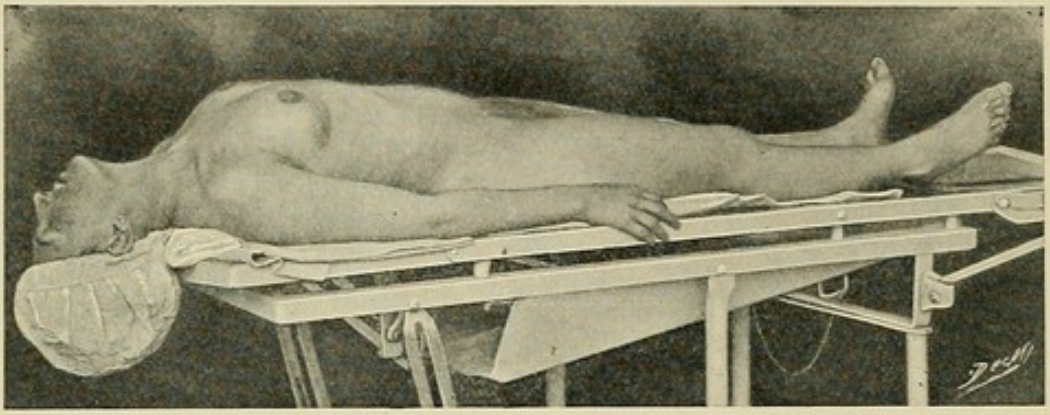


Fig. 124.—Dependent head position.

the hand of an assistant. The position may be combined with the Trendelenburg posture, the head of the patient resting in the operator's lap.

The extended neck position (Fig. 125) is produced by placing

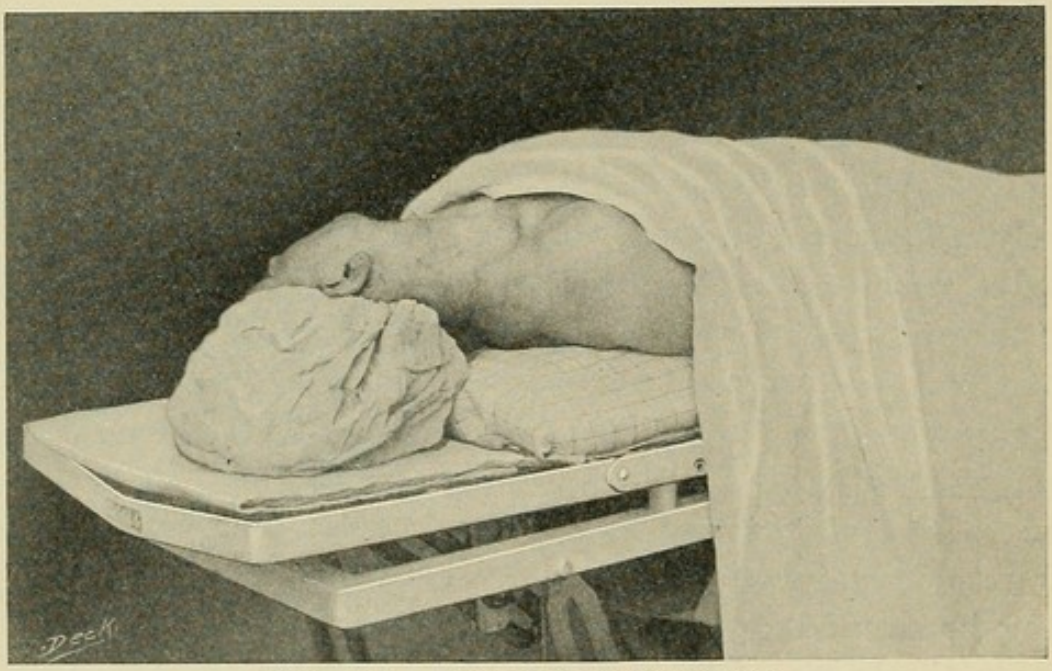


Fig. 125.—Extended neck position.

the patient in the dorsal position, hands fastened across the epigastrium, with a flat sand-bag beneath the shoulders. The sand-bag should be of such thickness as will allow the head to rest on the table without excessive extension of the neck. This

position is used in operations upon the anterior and lateral regions of the neck.

Position for Operations on the Thyroid Gland.—The patient

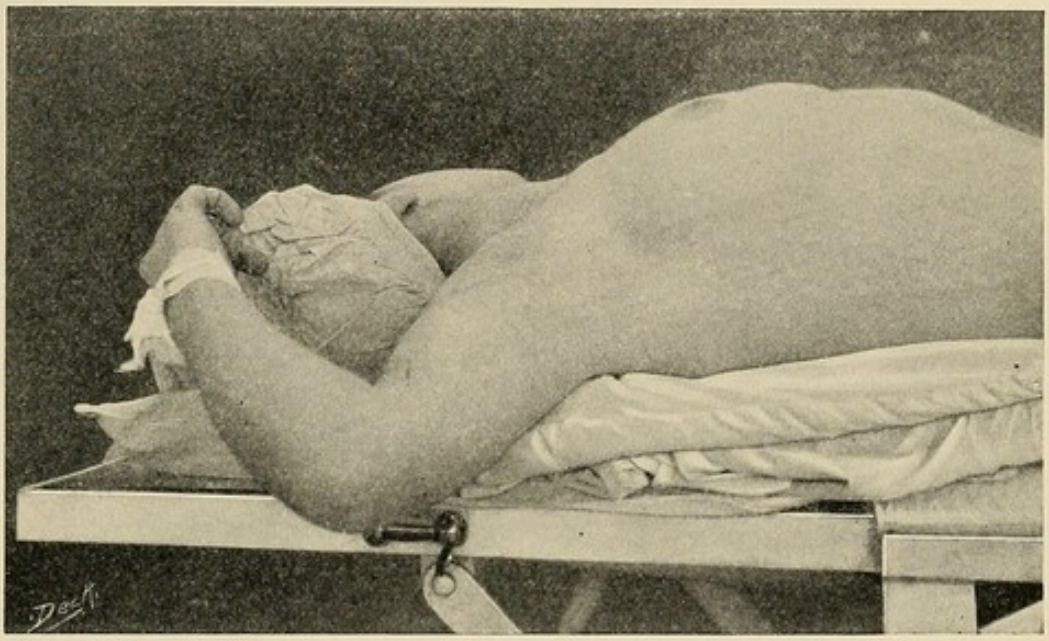


Fig. 126.—Position for amputation of breast. A pad should be placed underneath the elbow to protect against pressure.

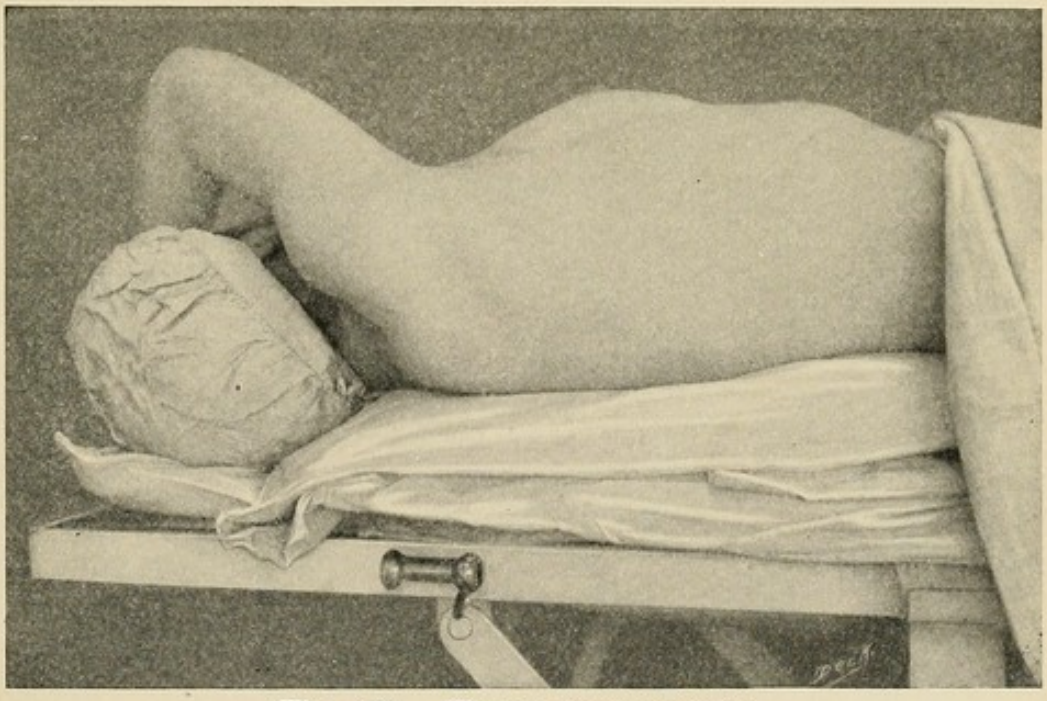


Fig. 127.—Thoracotomy position.

is placed in the extended neck position, employing the Hartley head rest before anesthesia is commenced. The position must be such as to allow free respiration. The hands are

bandaged together while clasped over the epigastrium and the ends of the bandage fastened to the restraining strap secur-

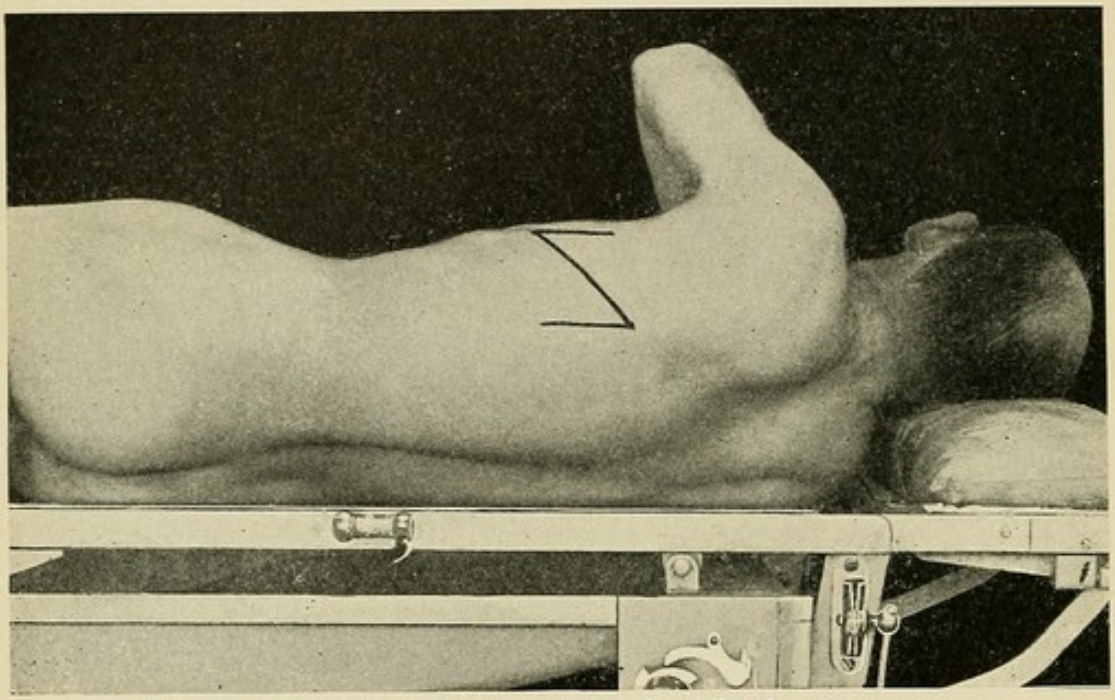


Fig. 128.—Position for resecting the ribs in pleurectomy. (Fowler's Surgery.)

ing the lower limbs. As soon as anesthesia is established the head of the table is raised in order to lessen hemorrhage. Fre-

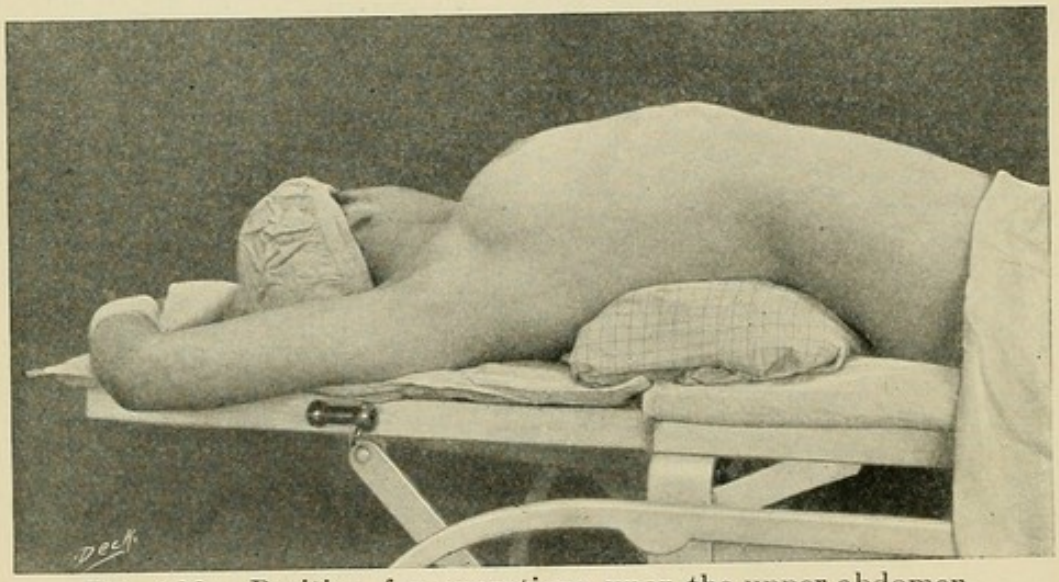


Fig. 129.—Position for operations upon the upper abdomen.

quently it happens that very little additional anesthesia is required when this elevation is used. It is an advantage to have

the anesthetist out of the way and for this reason vapor anesthesia is especially desirable.

The position for **amputation of the breast** (Fig. 126) is the dorsal position with a flat sand-bag under the thorax on the affected side. The patient lies near the edge of the table on that side. The arm of the affected side is flexed at the elbow, abducted to a right angle at the shoulder, and held in that position by bandaging the wrist loosely to the table or is held by a nurse. The other hand lies close to the patient's side. The patient's face is turned away from the affected side so that the administration of the anesthetic will not interfere with the operator. Before the introduction of the sutures the arm is brought to the side in order to secure proper approximation of the skin flaps.

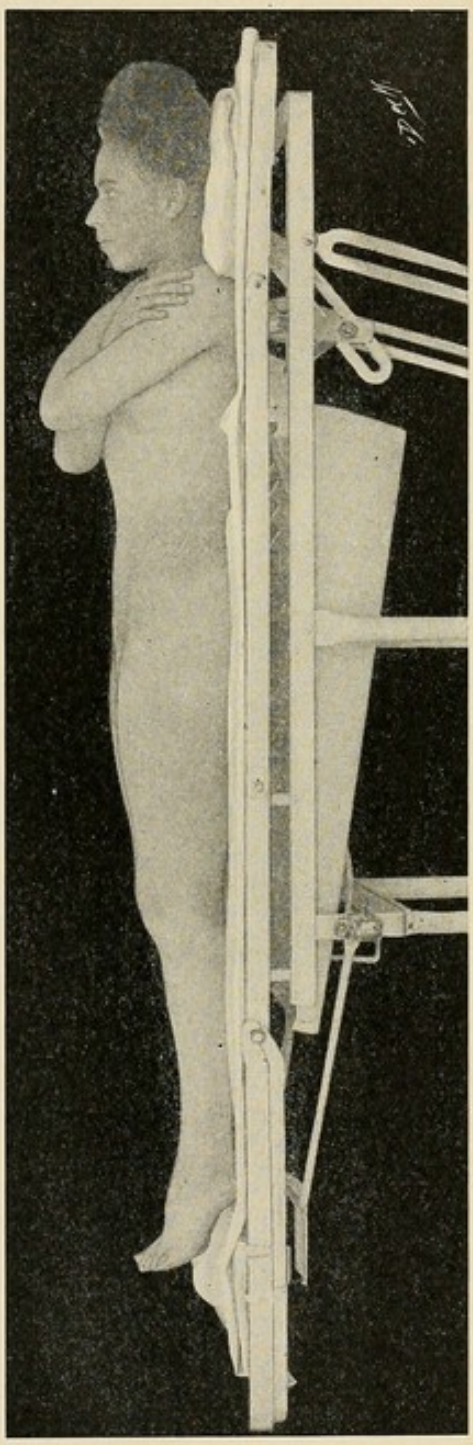


Fig. 130.—Dorsal position.

The position for **thoracotomy** (Fig. 127) is similar to the above except that a larger sand bag is used and the lateral chest wall more exposed by allowing the arm of the affected side to lie across the chest. For more extensive operations the patient is placed more nearly on the side (Fig. 128).

The position for **operations upon the upper abdomen** is the dorsal position or the dorsal position with a moderately large sand-bag under the dorsal spine, or the position is secured by using the apparatus on most operating tables to make the upper

abdomen prominent. The arms may be placed above the head (Fig. 129) or secured high up across the chest. Before introducing the sutures the elevator is lowered to obviate tension on the wound.

The dorsal position (Fig. 130) is with the patient flat on the back. The arms may be either secured high up on the chest fastened naturally above the head, or allowed to rest at the side.'

The Trendelenburg position (Fig. 131) is secured by placing the patient in the dorsal position, with the shoulders resting

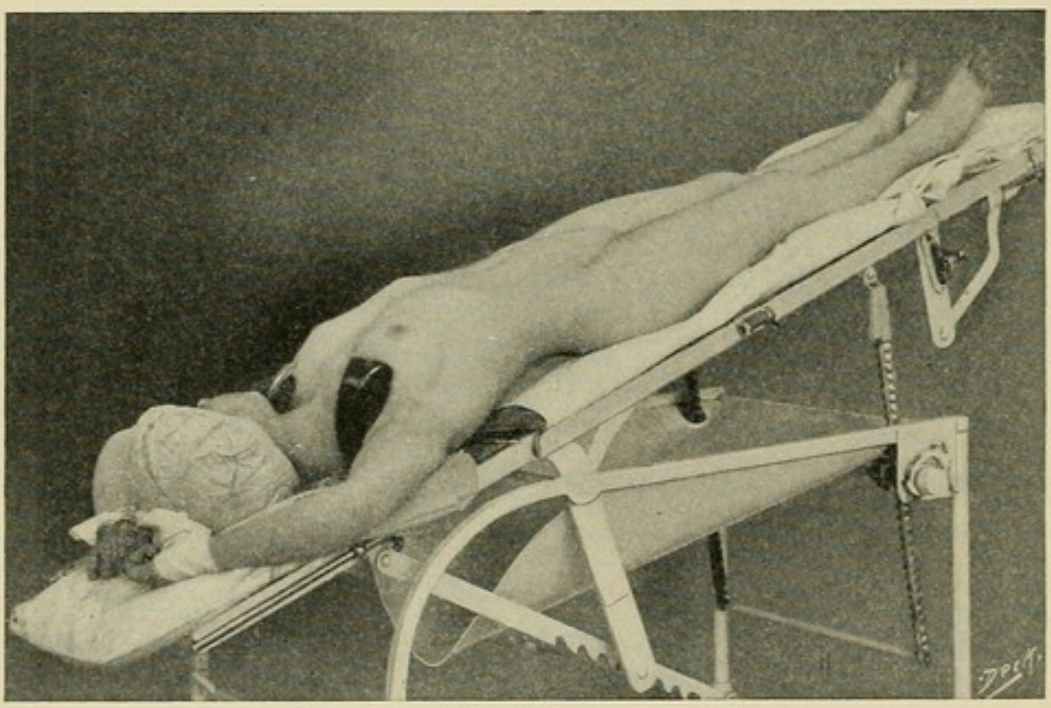


Fig. 131.—Trendelenburg position.

against the shoulder supports of the table. The head of the table is then depressed as much as required. In intrapelvic operations the Trendelenburg position is useful. The weight of the body rests on the shoulders. To prevent pressure effects, rubber pads are placed between the shoulders and the supports.

The reversed Trendelenburg position (Fig. 132) is useful in operations for varicocele, varicosities of the lower extremity, in limiting infection to the lower abdomen in diffuse septic peritonitis and in operations on the head and neck. The patient is secured to the table by bandages arranged to distribute the strain, the feet resting against a padded foot piece.

The lithotomy position (Fig. 133) is obtained by placing the

patient in the dorsal position with the thighs flexed on the abdomen and the legs on the thighs. The patient should then be drawn down on the table until the buttocks project well over the edge. The position may be maintained by a sling sheet (Fig. 134). To accomplish this, a large sheet is folded diagonally and placed with the apex hanging over the foot of the table. The patient is then placed on the table in the lithotomy position, with the shoulders resting upon the upper folded portion of the sheet. Each lateral corner of the sheet is then passed around

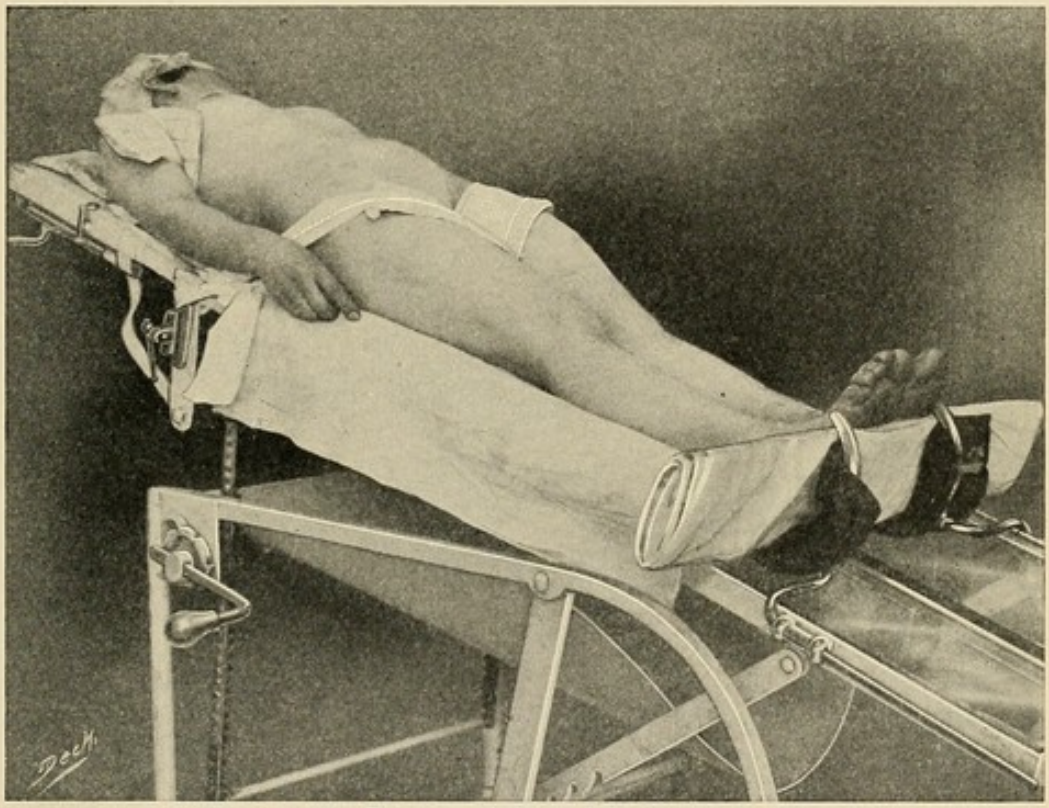


Fig. 132.—Reversed Trendelenburg position.

the thigh from the outside and drawn taut. One end is then passed back of the neck and secured by knotting to the other end. A more secure position is obtained by using the foot-holders and lithotomy posts. Care should be taken not to over-flex the thighs nor to allow the inside of the legs to be pressed tightly against the posts.

The exaggerated lithotomy position (Fig. 135) is similar to the above except that the pelvis is elevated either by placing a large flat sand-bag beneath the buttocks or by combining with the Trendelenburg position. In the latter event, the shoulder

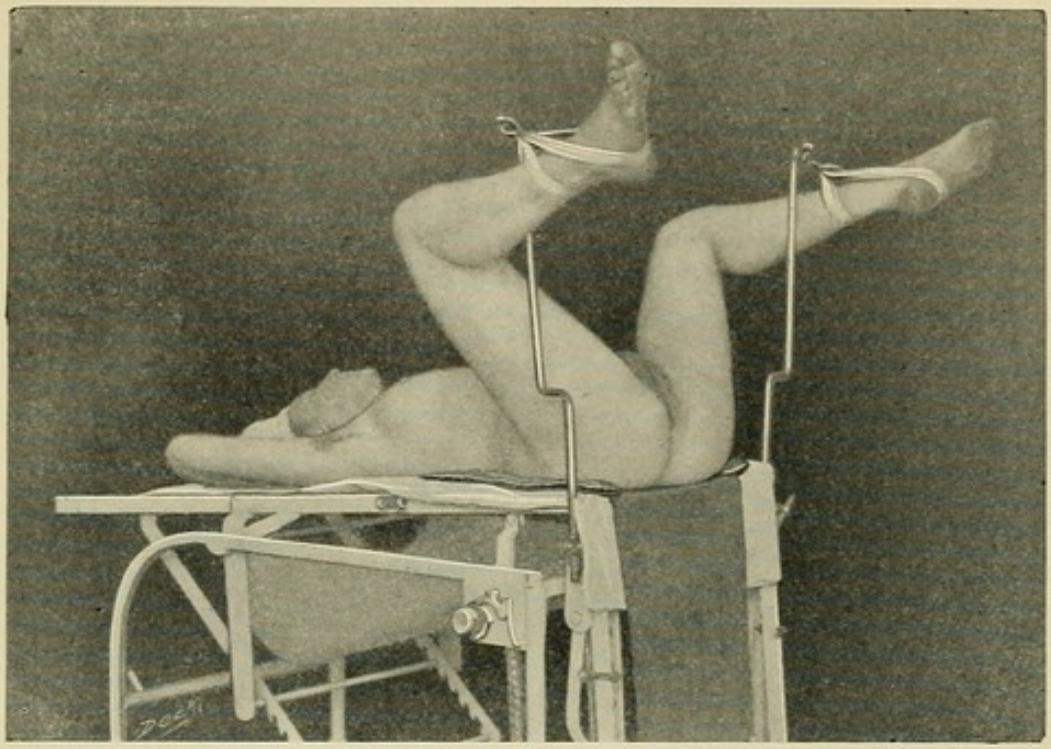


Fig. 133.—Lithotomy position.



Fig. 134.—Lithotomy position, with sling sheet.

supports should be so placed as to prevent the patient from slipping away from the edge of the table. This position is useful in clean vaginal sections to aid in keeping the intestines out of the pelvis, in rectal operations and in examination of the female bladder.

The Sims' position (Fig. 136) is obtained by placing the patient upon the left side, the left side of the face, left shoulder and

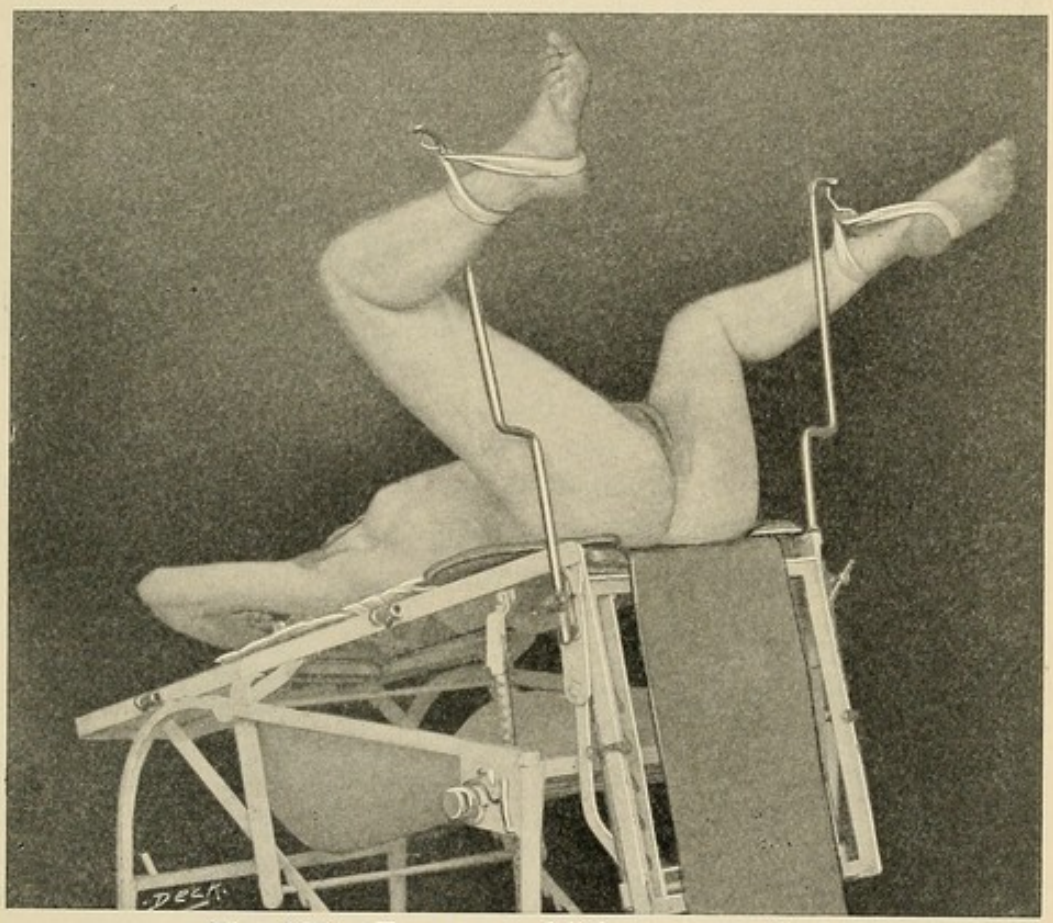


Fig. 135.—Exaggerated lithotomy position.

breast resting upon a very flat pillow. The left arm lies straight on the table behind the patient. The right arm, bent at the elbow, lies naturally across the chest. The buttocks lie near the edge of the table; the knees are flexed and drawn up toward the abdomen, the right knee nearer the abdomen than the left. A small pad is placed between the knees.

The kidney position (Fig. 137) is secured by placing the patient in Sims' position, either upon the right or left side, as required; then introducing an oblong sand pillow between the table and the flank so as to cause the kidney region on the

affected side to become prominent. The sandbag should be sufficiently large to cause a flattening of the affected side by widening the space between the ribs and the iliac crest. The

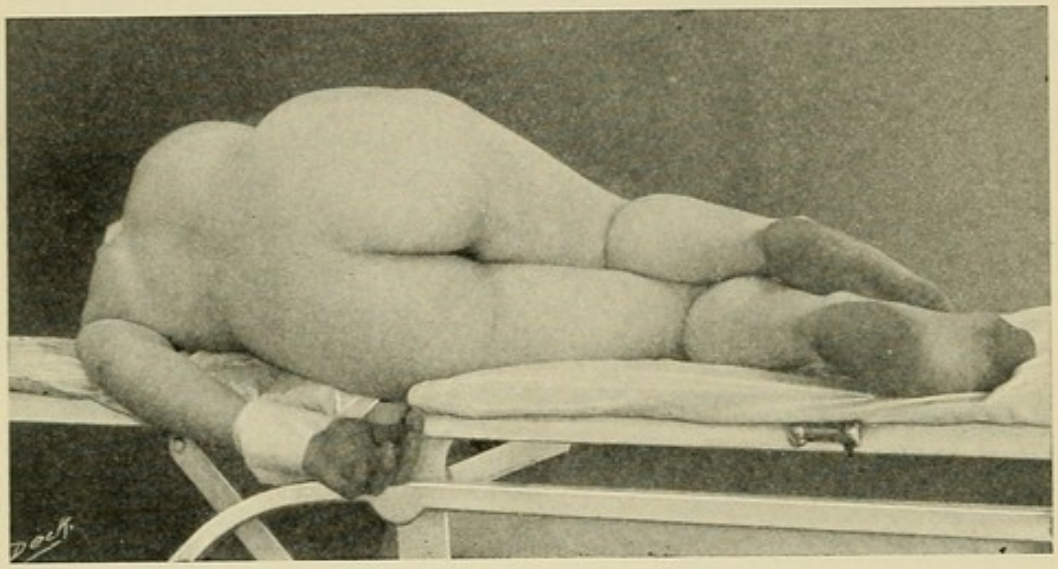


Fig. 136.—Sims' position.

kidney attachment to the operating table may be used in place of the sandbag. The patient should lie more upon the side than in the Sims' position. This is maintained by a second large sandbag placed parallel to the abdomen or by securing

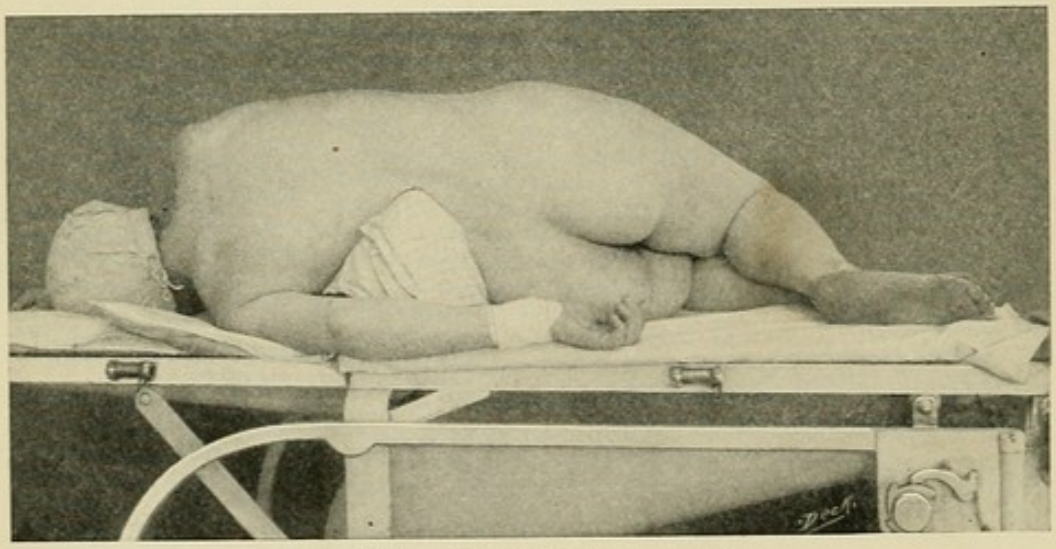


Fig. 137.—Single kidney position.

the patient to the table by a broad, adhesive plaster strap crossing the body above the level of the ensiform.

The ventral position (Fig. 138) is flat on the belly with the head turned to one side. In operating upon both kidneys, as

in removal of the capsule or double suspension operations, this position is exaggerated by placing a large sandbag under the

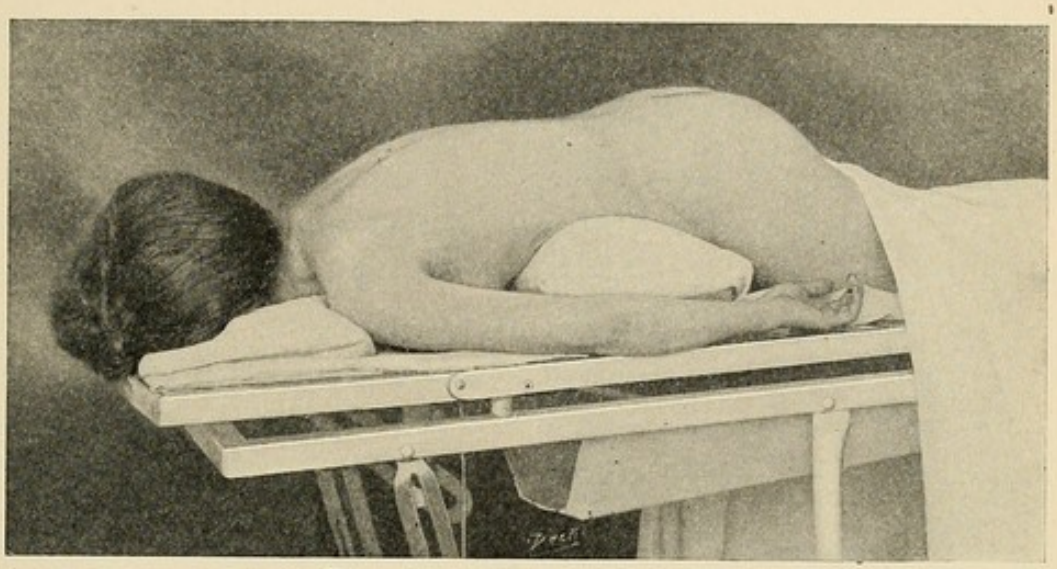


Fig. 138.—Ventral position.

abdomen. The kidney elevator may be used in place of the sandbag. The arms lie at the side.

The knee-chest position (Fig. 139) is useful in direct examina-

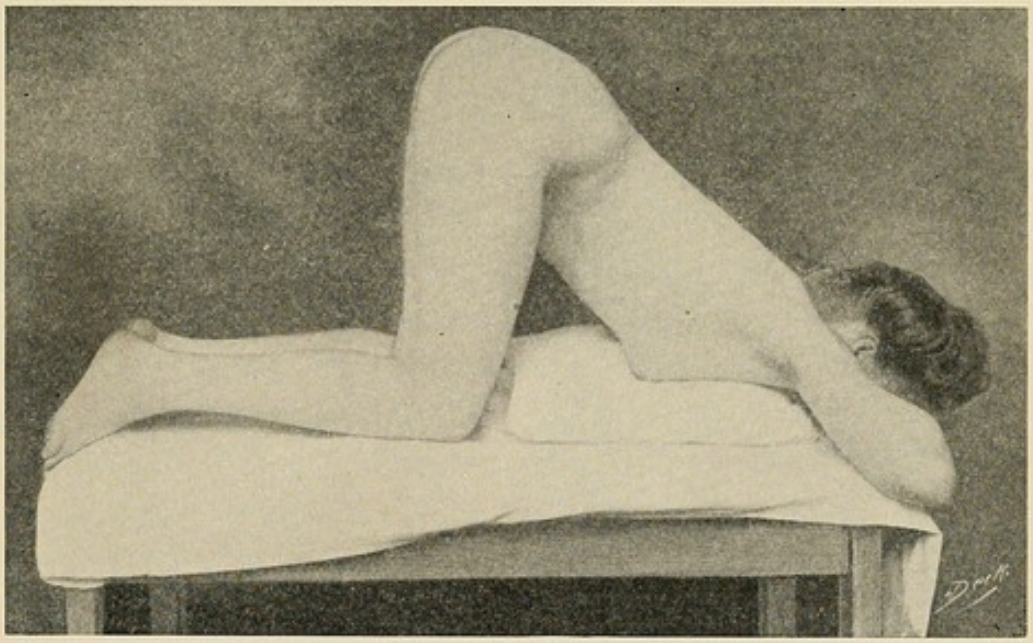


Fig. 139.—Knee-chest position.

tions of the rectum and the bladder. The patient kneels upon the table and with the thighs at right angles to the legs inclines the body until the chest rests upon a rather large pillow, the

head being turned to one side; the arms, flexed at the elbow, help to support the body.

Final Preparation of the Field of Operation.—An assistant should have disinfected his hands before anesthesia is started. He dons two pairs of gloves, a heavy loose pair over the usual ones. The former are for use while preparing the field for operation and are then discarded. He should have on cap, mask, and rubber apron, but should not don his gown until he has finished preparing the patient. As the anesthesia is started the patient is placed in the required position. Half blankets are arranged smoothly so as to widely expose the field of operation and the area to be disinfected surrounded with sterile towels (Fig. 140). The parts are then carefully scrubbed for three

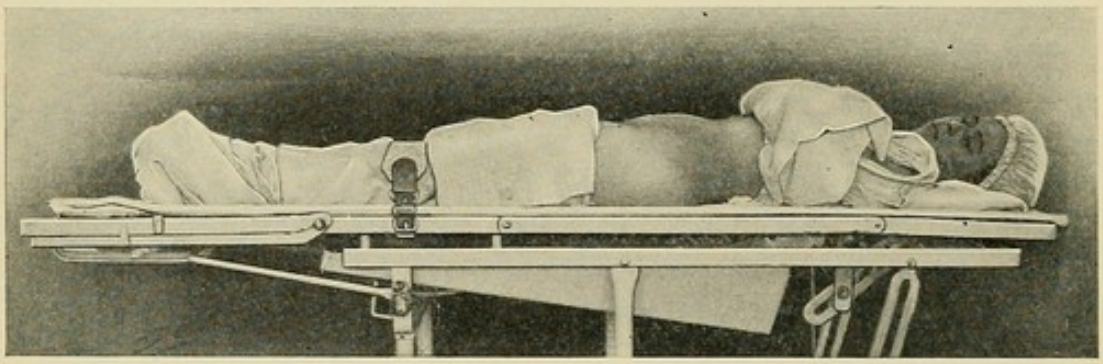


Fig. 140.—Dorsal position; ready for final preparation.

minutes with soap, hot water and sterile gauze. The soapsuds are sponged away with sterile water. The skin is sponged carefully with acid bichlorid (Harrington's solution) and then dried with ether, fresh gauze being used for each solution. The area beginning at the line of incision is painted with tincture of iodin on a stick sponge. The skin must be quite dry before the iodin is applied. If the preliminary preparation has been thorough it is only necessary to paint the site of operation and the neighborhood with iodin. Sinuses are disinfected by curetting and packed with sterile gauze. In abdominal operations in the female no more than the ward preparation of the vagina is necessary, unless a preliminary curettage is to be done. In septic endometritis cases a bichlorid douche is added to the repetition of the usual disinfection. In operations upon the bladder, if septic conditions be present, the bladder should be

irrigated with boric acid solution. In operations upon the rectum and anus the sphincter should be massaged and gradually dilated, a speculum inserted, and the rectum washed out with saline. During dilatation of the sphincter the anesthetic should be discontinued, otherwise a dangerous depth of narcosis might result. Every part of the patient except the immediate field of operation should be covered with sterile protectors and towels held in place by safety-pins or special clamps (Fig. 141). The patient should be kept dry throughout the preparation. Solution must not be allowed to wet the patient except over the area to be prepared.

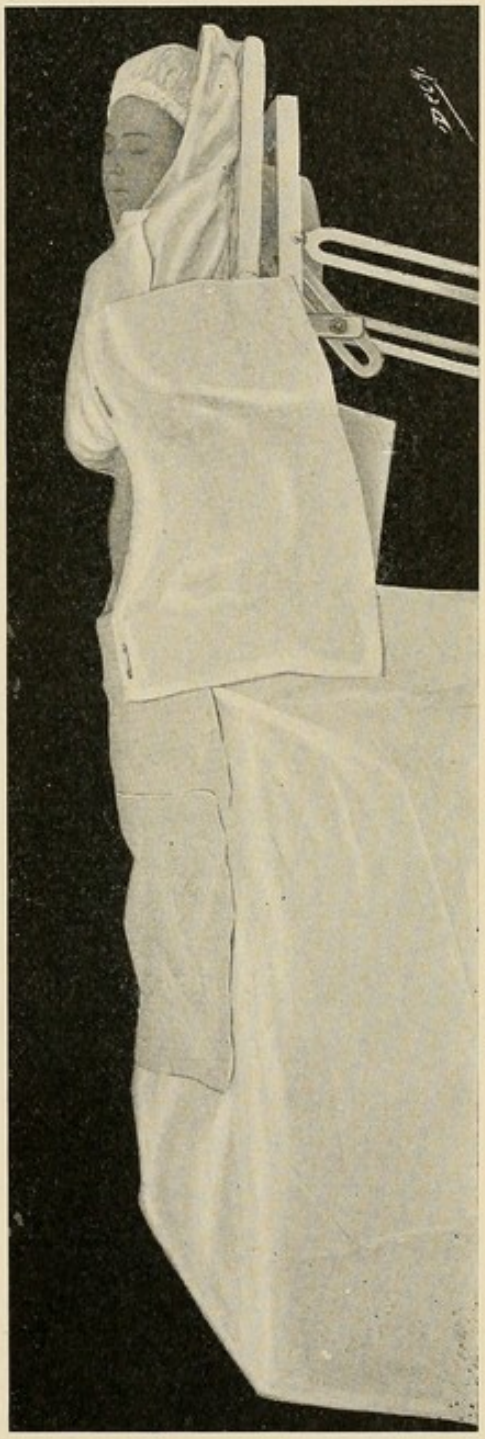


Fig. 141.—Dorsal position; ready for operation.

Hand Disinfection.—It is of extreme importance that all persons coming in contact directly or indirectly with the operative field keep their hands always in a healthy and cleanly condition. Those exposed to septic organisms, as dressers, must wear rubber gloves while doing such dressings. Skin disinfection has for its object the mechanic removal of germs from the surface of the skin, the chemic inhibition of germs which are brought from the depths of the skin to the surface by the sweat and sebaceous glands, and the mechanic lessening of the conditions which produce sweating. There is at present no method by which these aims can be certainly attained. A hand which is scrubbed clean mechanically and which gives

no culture will, upon being moved about for a few minutes, give a culture. With the object of overcoming the conditions present so far as possible, the following procedure is advocated:

The hands and forearms are first vigorously scrubbed for five minutes with soap and a soft brush or gauze in hot running water. The hot water brings to the surface at least some of the bacteria residing in the depth of the skin. Vigorous scrubbing facilitates this and removes the bacteria from the surface. The nails, softened by the hot water, are then trimmed down to the quick, not close enough to be painful, but close enough to obliterate the subungual spaces. For those who object to trimming their nails so short, a wire nail cleaner is recommended. The hands and forearms are again scrubbed for five minutes. The brush must not be so stiff or used so vigorously as to abrade the skin; so doing would open up avenues of infection quite needlessly. The lather is rinsed off frequently. The hands are finally rinsed in 1: 3000 bichorid of mercury. If gloves are to be worn they are put on wet in the bichlorid solution; if gloves are not desired the hands are deeply stained in a hot bichlorid-permanganate solution. This serves three purposes; the permanganate penetrates the skin deeply, and so carries the bichlorid into the depths of the skin; owing to its astringency, it contracts the tissues and so tends to prevent sweating; in addition, it forms a film on the surface of the skin and so tends to prevent the entrance as well as the egress of bacteria from the depth of the skin. Finally, during the operation at intervals of five minutes the hands should be rinsed in cold bichlorid solution 1 : 3000 or 1 : 4000 in 50 per cent. alcohol. This serves to rinse off such bacteria as work out from the depths of the skin while the low temperature of the solution and the alcohol present tend to minimize sweating. In cases of skin-grafting and plastic operations saline solution is used for the hands in place of bichlorid solution.

The after-care of the hands is important. The hands are gently scrubbed in hot water to open up the pores, all soap rinsed off, and if permanganate has been used, immersed in a hot saturated solution of oxalic acid to remove the permanganate. The hands are rinsed in warm water and then in cold

ammonia solution, one ounce of ammonia to two quarts of water to neutralize the oxalic acid. If a little green soap is added the hands are kept white and soft. If the hands feel dry, lanolin may be rubbed into the skin.

Before disinfecting the hands and forearms a cap, mask and rubber apron should be donned. After disinfection is complete a sterile gown is put on.

Application of Dressings.—The skin in the neighborhood of the wound is cleaned with hydrogen peroxid, then saline solution and dried. Dry sterile gauze compresses are placed next the wound. Adhesive plaster is useful to retain the wound dressing. If drainage tubes have been used the gauze is built up around them to prevent undue pressure. In drainage cases the compresses are moistened to promote drainage. The neighboring parts are then dried and a layer of absorbent cotton covered by a layer of nonabsorbent is placed over the wound dressing. In other cases a single layer of nonabsorbent cotton is used. In securing bandages with pins care should be taken not to wound the skin. In moving the patient strain upon the

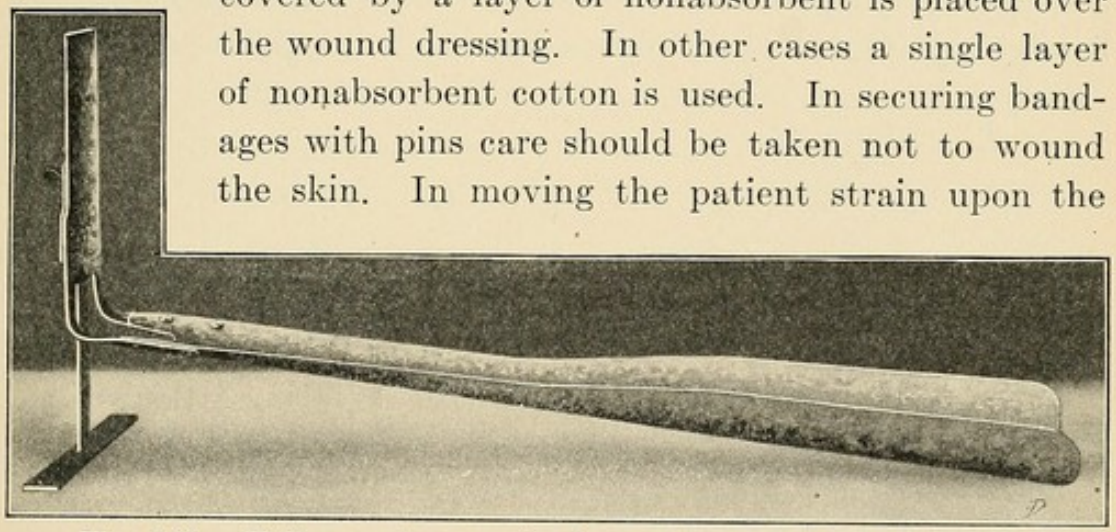


Fig. 142.—Volkmann's posterior leg splint. (Fowler's Surgery.)

sutures must be avoided. The purpose of the dressing is to relieve strain and insure rest of the parts as well as to protect the wound against infection. Dead spaces should be obliterated by pressure of the dressing. The Volkmann block or an inverted basin facilitates the application of dressings to the trunk. Dressings should fit smoothly and be comfortable. Dressings on the cervical region should include the head, shoulder, and thorax. Thorax dressings should include the shoulder and upper abdomen. Abdominal dressings should go well over the flanks, thighs, and lower part of the thorax.

Respiration, however, must not be interfered with. In applying the abdominal binder the binder should be rolled up halfway lengthwise; the patient should be rolled partly on the side and the rolled portion of the binder placed beneath; by rolling the patient partially in the other direction the rolled-up portion of the binder can be grasped and unrolled. The binder is pulled taut. It should extend well down on the thighs and well up on the lower part of the thorax, and should fit snugly. The ends are folded on themselves and pinned, the one over the other in the middle line. A vertical line of safety-pins over each flank causes the binder to fit more closely to the body. Two perineal straps which follow the gluteal fold keep the binder in position. Vulvar and perineal dressings are retained in position by T-bandages. In applying splints, such as the Volkmann (Fig. 142), to the lower extremity the foot should be first attached in the desired position to the splint before bandaging the rest of the extremity.

CHAPTER VI.

GENERAL CONSIDERATIONS IN THE AFTER-TREATMENT.

General considerations; purpose. The bed. Position of the patient. The elevated head and trunk position. Recovery from anesthesia. Post-anesthetic vomiting. General appearance of the patient. Parotitis. Pain. Backache. Thirst. Feeding. Gavage. Nasal feeding. Rectal feeding. Sterile feeding. Subcutaneous feeding. Gastrostomy feeding. Jejunal feeding. The digestion. Distention. Intestinal toxemia. Fecal impaction. Enemata and colon irrigations. Proctoclysis. Singultus. Dilatation of the stomach and duodenum. The general rules of hygiene. Urine. Albuminuria. Cystitis. Anuria. Retention of urine. Catheterization in the female. Catheterization in the male. Post-operative pneumonia. Cupping. Hydremia. Temperature. The pulse. Respiration. Delirium tremens. Toxemia following operations. Acidosis.

General Considerations.—A successful issue in many cases depends upon the care which is exercised in the after-treatment. The operator's responsibility does not end with the laying down of the scalpel, but continues until healing is complete. Many operative procedures would be absolutely negatived by failure

to carry out the proper after-treatment. Attention to detail insures a successful outcome while its neglect has lost many a patient and marred many a reputation.

The *purpose* of the after-treatment is to recognize complications early and so to treat them as to give the patient not only the best chance for recovery, but also the best final functional result. Not only must the wound or injury itself be treated, but the entire organism must be brought to as nearly a normal condition as possible. Each case must be studied as regards habit of life and complicating diseases particularly as to anemia, syphilis, tuberculosis and diabetes. The working of every organ must be known in order to treat the case intelligently.

Utensil Sterilization.—It is important that not only should utensils that come in direct or indirect contact with the wound be sterilized but also that such utensils as bed pans, douche pans, urinals, etc., be sterilized after each use. An unsuspected specific urethritis or vaginitis may otherwise be communicated. As an additional precaution, patients with communicable diseases should have individual utensils.

The bed should be easily separable for purposes of cleanliness. Enameled iron bedsteads with wire springs serve admirably. They have the advantage of being cheap, and are practically indestructible. Felt mattresses are preferable.

Preparation of the bed for the reception of the patient: The bed clothes consist of a thin rubber sheet to protect the mattress, two sheets, an upper and an under one, and a draw-sheet, two light blankets, a counterpane, and a small pillow. Several towels and a basin for vomitus are so placed as to avoid soiling of the clothing. Hot-water bottles are placed between the blankets half an hour before the return of the patient is expected. Unless the patient is in shock these are removed when the patient is placed in bed; if not, care must be taken that they do not burn the patient.

The *position* of the patient will depend upon the character of the operation and upon the presence of shock (Fig. 143). During the first few hours shock may necessitate the Trendelenburg posture except in diffuse septic peritonitis cases. In uncomplicated cases the position should be as comfortable as compatible with

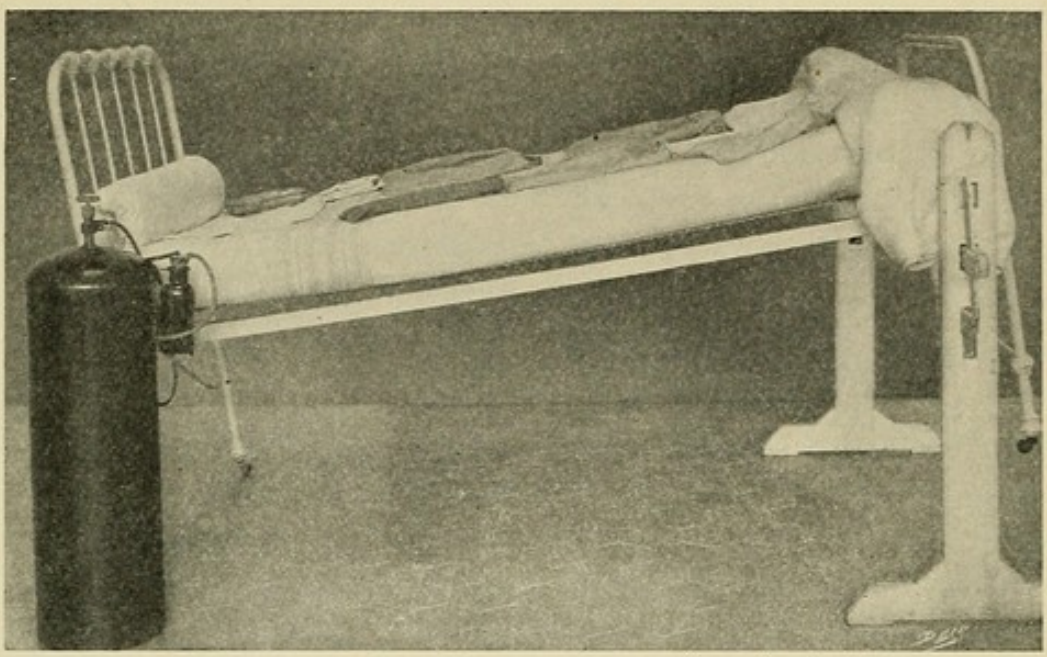


Fig. 143.—Bed ready to receive patient in shock.

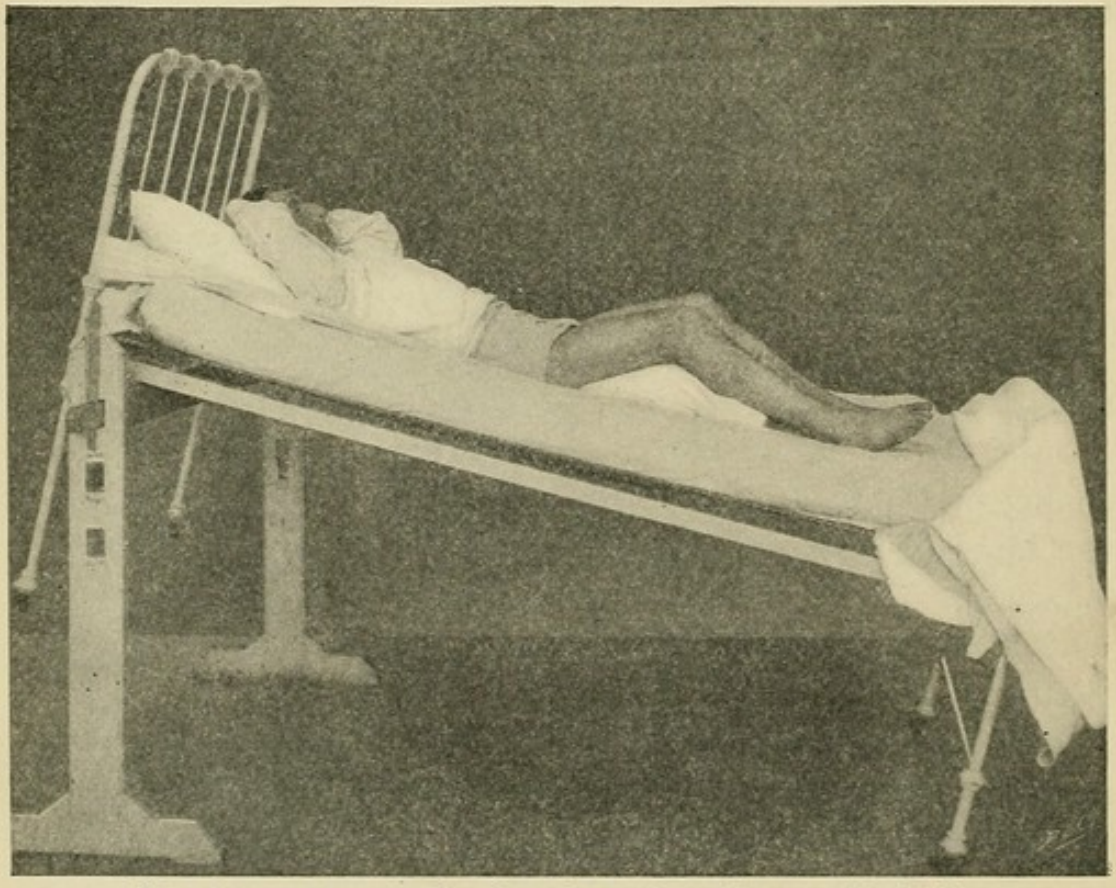


Fig. 144.—Elevated head and trunk position. (Fowler's Surgery.)

proper rest of the operated part. The patient may be placed on one side, as in empyema or renal operations; or the elevated head and trunk position (Fig. 144) is employed in cases of diffuse peritonitis, excessive vomiting, or following operations upon the upper abdomen. Except in scabbard trachea met in certain goiter cases the head may be in such position as the patient wishes. Following herniotomy or abdominal section a pillow under the knees makes the patient more comfortable by relieving the tension on the abdominal wall. Sandbags are useful to maintain quiet of an injured member. Should extension of a limb be necessary, boards are placed beneath the mattress to give stability. Pressure from bedclothes is avoided by frames which keep the weight of the bedclothes from the body. Bed-rests, rubber rings and pillows are useful in maintaining the patient in a comfortable position. The water bed is necessary in spinal cases or in much debilitated cases. In cases in which hemorrhage or oozing is feared, the parts affected should be elevated to lessen the flow of blood to them. Old or debilitated patients should have the shoulders propped up and their position changed frequently in order to avoid hypostatic pneumonia.

Elevated Head and Trunk Position.—There is normally a force in the peritoneal cavity which carries fluids and foreign particles toward the diaphragm regardless of posture, though *gravity may greatly favor or retard the current.* To further the force of gravity and to counteract the force exerted by the diaphragm in attracting infectious material to its own neighborhood, the plan of placing the patient in the elevated head and trunk position, in order to facilitate the passage of fluids from the abdominal areas to the pelvis, is believed to be of value. The head of the bed is raised so that its plane is from twelve to sixteen inches from the horizontal. The patient is prevented from slipping down in the bed by a large folded pillow placed beneath the flexed knees and resting against the thighs and buttocks. The pillow is prevented from slipping by a strong bandage passed through the folded portion and secured to the frame of the bed at its sides (Fig. 144). The elevated head and trunk position offers the additional advantages of assisting

materially in relieving the nausea and vomiting, and of favoring peristalsis and the relief of distention by the passage of flatus.

The stay in bed should be as short as is compatible with wound rest. If wound rest can be maintained with the patient in a chair or walking about this is preferable. As soon as possible the patient should get into the open air and sunshine.

Flat-foot occasionally develops upon again walking after long-continued nonuse. The essential point in the treatment is to compel the patient to walk on the outer side of the foot, supination being thus encouraged. To effect this he should wear a high laced shoe, with a high and broad heel which extends well forward to the site of the articulation between the os calcis and the cuboid. The inner side of this heel, and the sole as well, should be increased at least a half inch in thickness. At the same time a thin steel flap or inside sole, curved to fit the normal arch (Whitman) and covered with gutta-percha, is to be worn inside the shoe to support the arch (Fig. 145). In the cases in

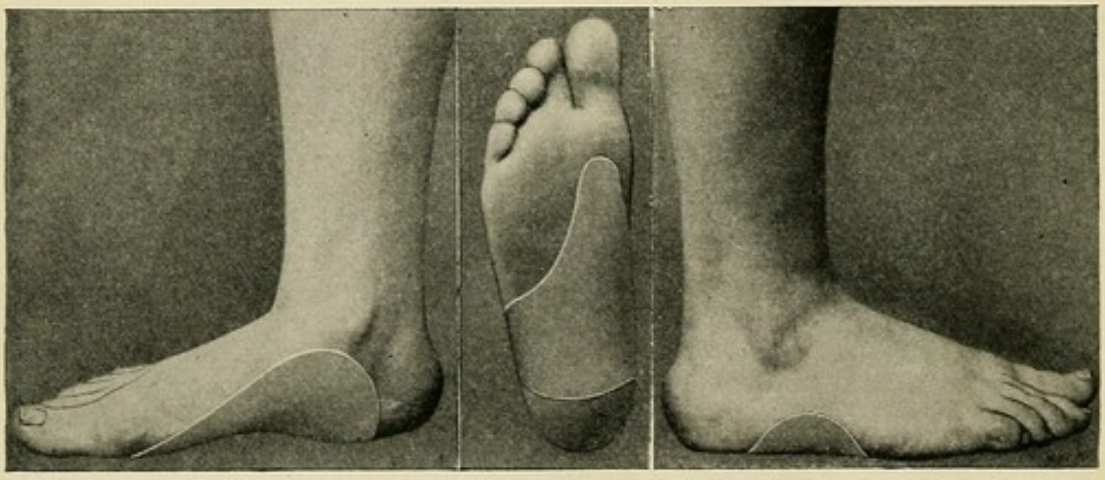


Fig. 145.—Whitman's plate to support the arch of the foot in flat-foot. (Fowler's Surgery.)

which these measures fail to compel the patient to walk on the outer side of the foot, the application of an internal splint, jointed at the ankle and extending to an encircling band at the knee, will assist in supinating the foot. Massage of the foot and of the muscles of the leg should not be neglected. During an acute exacerbation in inflammatory flat-foot the patient should assume the recumbent position, when supination sometimes occurs from the weight of the foot. After a rest in bed of from

seven to fourteen days he may be permitted to walk with a Whitman's curved steel plate in the shoe to support the arch.

Recovery from Anesthesia.—The patient is watched until conscious. Movements tending to bring strain on the operated parts should be restrained. Too vigorous restraint is avoided as it causes the patient to struggle harder. In case of violent patients a sheet is passed over the thighs and another over the shoulders and fastened to the sides of the bed. As a rule, the less the minor movements of the extremities are interfered with, the more tractable the patient will be.

Post-anesthetic Vomiting.—The vomited matter is watery and usually colorless. It consists of anesthetic-soaked mucus and stomach secretions. At times, it may present a brilliant green appearance, due to admixture with bile. It rarely lasts longer than a few hours and need cause no anxiety, though the patient feels wretchedly. The chief danger is that some of the vomitus may be aspirated into the bronchi and set up a foreign-body pneumonia. Vomiting is prevented to a great extent if proper *precautionary measures* have been employed. The elevated head and trunk position tends to prevent vomiting, and promotes the passage of stomach contents into the intestine. To allay persistent anesthetic vomiting lavage is practised. This, if done early, removes the anesthetic-soaked secretions from the stomach which is the chief cause of post-anesthetic vomiting. Spraying the nose and throat with a 4 per cent. solution of cocain will prove useful in some cases. Frequently rinsing the mouth with cold water is useful. It sometimes happens that vomiting persists for several days or in neurotic patients even longer. This, when not traceable to other causes (vicious cycle, obstruction, dilatation of the stomach) must be attributed to a disturbed motility of the stomach itself, due to nerve disturbance. The character of the vomitus does not differ from that of anesthetic vomiting. Thin, mucous secretions, partially bile-stained, are vomited frequently. Systematic lavage of the stomach must be practised. This is repeated at intervals of four hours if vomiting persists. Following a thorough cleansing of the stomach, one-fourth grain of morphin with gr. 1/120 of atropin sulphate, is administered hypoder-

mically. In this connection it is well to remember that some persons have an idiosyncrasy to morphin, and that the drug may cause persistent nausea and vomiting. In neurotic individuals the use of counter-irritation over the epigastrium by means of a mustard plaster, or even the application of the thermocautery, is useful. Nutrition in cases of persistent vomiting is maintained by nutrient enemata. Medication by the mouth is withheld while the attacks of vomiting continue. When feeding by the mouth is renewed, half ounce doses of hot fluids are given at hour intervals, and, if these are retained, the amount is gradually increased and the intervals lengthened.

General Appearance of the Patient.—To an experienced eye the picture which the patient presents is of great value. In an *uncomplicated case* the facial expression will be contented and the patient will welcome the surgeon with a smile. There may be some minor complaints, but, on the whole, the picture will be a happy one. Such a case need occasion no anxiety. In *abdominal distention* the countenance is somewhat troubled. In *hemorrhage* the face is colorless, lips waxy, pupils dilated, respiration rapid and shallow, the skin clammy, and the patient thirsty, anxious, and restless. In extensive *peritonitis* the face is drawn and anxious, the eyes somewhat sunken, pupils dilated, skin covered with sweat, and the patient depressed; later restlessness, both mental and physical, develop, while in some cases a peculiar dusky suffusion of the face is noted. In *anuria*, in the early stages, there is a peculiar glittering of the eye and a suffusion of the face which clinical experience readily recognizes. Later, the picture is classic. In *pneumonia* the face is dusky and the respiration rapid and labored *Parotitis* is self-evident. It will repay the surgeon to make a careful study of patients' faces. Often the first clue to a serious complication may be thus furnished. On the other hand, a calm face and air of general contentment will furnish grounds for a good prognosis even when serious complications are threatening.

Parotitis.—This is an infrequent complication. I have seen it eight times following laparotomy, never after other operations. In four cases typical symptoms of the disease presented during the second week following operations upon the adnexa. Neither

case suppurated, though painful swelling persisted for several days. In one case the disease was bilateral, in the others unilateral. In a fifth case the disease was unilateral, developing five days following an operation for extrauterine pregnancy. In the sixth case the disease developed eighteen days following an operation for appendicitis with abscess. Two other cases followed operations for appendicitis in which there was no outlying infection. Another case occurred as a complication of appendicitis which was not operated upon. In this case the infection attacked the external ear and rupture of the lining of the external auditory canal occurred. Another case occurred in a patient suffering from septicemia. All the cases were in females and all recovered.

In reported cases which have resulted fatally and which have been submitted to microscopic examination the cause was a catarrh of Stenson's duct following infection from the mouth. In such cases the prognosis should be good. The lesion, however, may be one of many resulting from a profound septic condition. This complication occurs more frequently after abdominal operations than after operations elsewhere. It is not contagious. The regular course is from seven to ten days. The parotid of the other side may become inflamed as the one first affected is subsiding, or both may be affected simultaneously.

Treatment.—The overlying skin should be kept scrupulously clean. Pain is relieved by morphin. An ice-bag is used to allay the inflammation. The mouth should be frequently cleansed. Should suppuration ensue incision and free drainage are indicated. The incisions are placed parallel to the branches of the facial nerve to minimize danger of injury to this nerve.

Pain is, as a rule, not much complained of. Neurotic patients may suffer excruciating agony following removal of a cystic ovary. Other patients will suffer but slightly after much more extensive operations. Morphin, on account of its effect in locking up secretions, should not be given if its use can be avoided. One dose for primary wound pain is permissible. In neurotic individuals after the period of primary wound pain has passed, hypodermic injections of sterile water serve admirably. Morphin or cocain habitués usually require small doses of the drug

to which they have been accustomed. Primary wound pain usually subsides in twenty-four hours. If the patient is restless pain may result from pulling upon the stitches. Recurrence of pain in the wound after several days' quiescence is to be regarded as one of the symptoms of infection. Pain from distention is treated by repeated enemata. In diffuse abdominal pain the ice coil proves beneficial. Pain persisting after the patient is up and about must be closely inquired into. Not infrequently a complete change of scene, tonics, and an out-of-door life will cause these vague, indefinite pains to disappear.

Backache following operations may be due to a hard flat operating table. This is obviated by having a sufficiently thick soft pad on the table. It is treated by massage, change of posture and heat.

Thirst.—Thirst is present after every anesthetization, and, in spite of the vomiting which the imbibing of fluids causes, patients will beg for water to quench their thirst. The patient must not be allowed to indulge in excessive fluids shortly after anesthesia, otherwise dilatation of the stomach may occur. Since employing repeated saline enemata complaints of thirst have been infrequent. If much blood has been lost, thirst will be a prominent symptom.

Treatment.—After every operation necessitating anesthesia the patient should receive an enema of from one pint to one quart of saline solution at a temperature of 110° F. Aside from its other advantages, this will result in a great diminution in the thirst. This enema is given very slowly, one-half hour being allowed for its introduction and following prolonged operations or operations producing shock, is repeated at intervals of four hours, four times being usually sufficient. Small quantities of cool or hot fluids may be given as soon as anesthetic vomiting has ceased unless the operation has been one involving the stomach. The frequent rubbing of the mouth, gums, and lips with cool water will prove grateful. A camel's hair brush is useful for moistening the lips and a medicine dropper for instilling cool water along the gums. Ice should be prohibited, as it tends to increase thirst.

Feeding.—For the first few hours feeding by mouth is pro-

hibited on account of the irritability of the stomach from the anesthetic. As soon as anesthetic nausea has ceased, liquid food may be given. Water, milk, if agreeable to the patient, or light broths are best for the first twenty-four hours, the doses being small and so graded as to gradually accustom the stomach to retain larger amounts at more extended intervals. At the end of twenty-four or at the latest forty-eight hours full fluid diet is reached. Following this, stronger soups and farinaceous foods are given for a few days, and finally meat and vegetables. Patients lying in bed do not require as large a quantity of food as those walking about. Overloading the stomach is to be avoided. The character of the food should be such as to be readily assimilable. Flatus-producing foods are avoided. Emaciated patients receive additional nourishment by rectum. Care must be exercised in the selection of a diet and individual taste and idiosyncrasy consulted as much as possible. The appetite does not return, as a rule, for one or two days. It is not necessary to force the feeding. The patient's inclinations are the best guide as to the amount of nourishment that is needed in the first few days. The diet should be a varied one as soon as the patient is able to digest properly. In much debilitated patients brandy and water in the proportion of one part brandy to seven of water may be dropped on the tongue with a medicine dropper, or the lips and tongue may be gently brushed with a camel's hair brush saturated with this solution. While water is not absorbed by the stomach weak alcoholic solutions (5 to 15 per cent.) are readily absorbed, such a solution being retained and absorbed when everything else is rejected.

Continued loss of appetite may be caused by an unfavorable condition of the wound. When by reason of the nature of the operation swallowing is impossible, or apt to interfere with wound healing, or if an obstreperous patient refuses nourishment, gavage is indicated.

The stomach tube is employed for purposes of artificial feeding (gavage). The instrument is best made of thick-walled rubber tubing, with a smooth-edged extremity, or a lateral velvet-edged opening near the end.

Before introducing the stomach tube the distance from the lips to the hypochondrium should be measured, in order to avoid introducing the tube too far. In the normal esophagus the tube is arrested at a point directly behind the cricoid cartilage, at which point the latter approaches the vertebral column. In order to overcome this resistance the larynx is drawn forward by placing the tip of the index-finger of the left hand in the depression between the epiglottis and the tongue, and drawing the parts forward through the medium of the glosso-epiglottic ligament. Simply bending the finger sharply against the base of the tongue usually suffices, the point of the tube being at the same time directed toward the posterior pharyngeal wall and passed downward. The patient is then directed to make efforts at swallowing. The tube passes without further resistance into the esophagus. For purposes of artificial feeding, the tube is connected to a glass funnel. The fluid must be introduced slowly, otherwise efforts at vomiting will be provoked. In cases of injury of the pharynx and esophagus, and after certain operations about the neck (extirpation of the larynx, etc.), the frequent introduction of the stomach tube may do harm. Retention of the tube *in situ* by means of a safety-pin passed through its wall, to which a tape is secured and passed around the neck and tied over the dressings, is here indicated.

The stomach tube is also used for washing out the stomach (*lavage*), the fluid which has been introduced being withdrawn by simply lowering the glass funnel to which it is connected just before it is empty. The tubing which connects the funnel to the stomach tube being longer than the portion which occupies the esophagus, a siphon effect is produced and the stomach is promptly emptied. It may be refilled and emptied in this manner as often as required. Finally, the stomach should be siphoned dry.

Nasal Feeding.—When the patient resists, as the insane, a proper-sized tube may be passed through the nasal cavity and thence to the stomach. This form of feeding finds its chief indication in children and in operations about the mouth in which mastication and swallowing would interfere with wound healing.

Rectal Feeding.—Rectal feeding is indicated in debilitated patients to more rapidly increase nutrition; in irritative conditions of the stomach such as persistent vomiting; in obstructed lesions of the pharynx and esophagus; in lesions of the stomach in which stomach rest is desirable; in general conditions of the patient such as shock, coma and delirium; in cases such as diffuse septic peritonitis in which peristalsis is to be avoided; as an adjunct to gavage in the after-treatment of operations on the mouth and its neighborhood. The enema is administered in the same manner as an ordinary enema but more slowly, allowing fifteen to twenty-five minutes for the administration. The quantity administered will depend upon the patient's ability to retain it, from four to ten ounces every four to six hours. After the enema has been administered, pressure with a folded towel should be made firmly against the anus to cause the retention of the enema. This pressure should be maintained as long as the desire to expel the enema persists. If the fluid is administered slowly through a small catheter at a temperature of blood heat, in a proper quantity for the individual and firm pressure is made following its introduction it will usually be retained. The rectum should be cleansed once daily by saline irrigation. Great care and gentleness are essential, as otherwise an irritative condition of the rectum will be set up which will result in the rejection of the enema. Where rectal feeding alone is relied upon it will be necessary to give saline for retention twice daily in addition to the nutrient enema in order to maintain the body fluids. In cases in which the Murphy method of proctoclysis is used the nutrient material may be placed in the receptacle for the proctoclysis. The formula recommended by Ewald of two tablespoonfuls of wheat flour stirred up with 150 c.c. of warm milk or water to which is slowly added while still stirring one or two eggs and a pinch of salt, and the whole beaten up with 50 c.c. of a 15 per cent. solution of grape sugar, is highly satisfactory. The addition of a half ounce to an ounce of claret promotes absorption and favors retention. Other formulas are those of Leube, milk three ounces, peptone two ounces; Boas, milk eight ounces, yolk of two eggs, a pinch of salt and red wine one-half ounce, starch or flour one table poonful. These three

formulas represent the foundation of most nutrient enemas. In prolonged rectal feeding they should be alternated.

Sterile Feeding.—In cases in which it is desirable to reduce the number of bacteria in the gastrointestinal tract to a minimum, sterile feeding is indicated. It has been demonstrated[1] that it is possible to render the stomach and intestines sterile as a preparatory measure before operations. The teeth are brushed and the mouth rinsed with an antiseptic solution before and after every feeding as well as several times daily. If a test meal shows the presence of microörganisms in the stomach, the stomach is washed out twice daily. A diet consisting of boiled water, sterilized milk, beef tea, albumen water, and similar fluids is administered in small amounts at frequent intervals from sterile vessels. For six to ten hours previous to operation nothing is given by mouth, rectal feeding being substituted.

Subcutaneous Feeding.—This is rarely indicated. In all probability most of the cases in which it has been used have been more benefited by the fluid introduced in this manner than by the actual food value of the material. Five and 10 per cent. solutions of grape sugar, olive oil, and dilute milk and peptone solutions have been used. Grape-sugar solutions are apt to set up an irritation at the site of injection. An injection of olive oil is not without the theoretic danger of fat embolism. The fluid injected should be sterilized and all aseptic precautions should be used. A quantity of not more than 30 c.c. should be injected in any one place.

Gastrostomy Feeding (p. 456).

Jejunal Feeding (p. 460).

The digestion of the food should be ascertained. Constipation and flatulence are watched for and remedied as far as possible by diet. Apple sauce, prunes, grapes, orange and lemon juice, and Vichy water will be found of value in this regard. Lack of accustomed exercise will account for constipation in most cases. Enemata, either of soapsuds and warm water or containing spirit of turpentine, ox-gall, lac asafetida, or alum, according to the severity of the case, are indicated if a natural movement does not result in forty-eight hours.

[1] Harvey Cushing, *John Hopkins Hospital Reports*, vol. ix.

Distention is relieved by enemata, by the passage of the rectal tube, and by the elevated head and trunk position. In elderly persons suffering from atony of the intestinal wall, treatment of flatulence must be vigorous and initiated early. Tincture of belladonna is useful in this condition. Calomel and salines may be necessary to produce thorough evacuation. A single dose of castor oil will often prove beneficial. During convalescence, massage, both general and local, is of value. A natural cathartic water, or one teaspoonful of the fluid extract of cascara (aromatic) combined with the fluid extract of licorice is given at bedtime. The bowels should move once daily while the patient is in bed, with the exception of the first day. If regular movements do not occur, *intestinal toxemia* is apt to develop. This is shown by a furred condition of the tongue, foul breath, distention, abdominal discomfort, and a rise of temperature. Following a free bowel movement the unpleasant symptoms subside. In the care of the bowels in operations involving the integrity of the intestinal wall reliance is placed upon enemata. No cathartic is given until the tenth day. *Fecal impaction* may result if proper attention is not paid to the movements. It occurs particularly in old people. Occurring in the rectum, the patients will complain of rectal distress. There will be small fluid evacuation without relief. Rectal examination reveals a large mass of hardened feces. This will necessitate spooning the hardened fecal masses from the rectum and the administration of a course of calomel and castor oil and olive oil enemata.

Enemata and Colonic Irrigations.—In surgery, these take the place of cathartics for the most part and are sufficient. A short rectal tube is as useful as a long one. If the enema or irrigation is given slowly retroperistalsis takes the fluid up into the colon and normal peristalsis then returns it when the colon is distended.

Enemata.—Technic of enemata for the purpose of evacuation. *High enemata.* The temperature of the solution should be 100° F., the tube is coated with vaselin and a small amount of fluid allowed to run through the tube in order that no air will be injected. With the patient in the recumbent position on a bed-pan, and the knees drawn up, the buttocks are separated

with the left hand and while the patient strains slightly to relax the sphincter the tip of the tube is pressed against the anus and inserted in an upward and slightly forward direction. As soon as the tube has passed the sphincter the direction is changed somewhat backward. If resistance is met with the tube is slightly withdrawn and again advanced; while this is being done the further passage of the tube is facilitated by allowing the fluid to slowly flow. In the majority of cases it is not possible to introduce the tube more than six or seven inches without its coiling on itself. When the tube has been introduced as far as is practicable with gentleness the flow is continued until the desired amount is introduced. For purposes of evacuation a sufficient amount must be introduced to distend the intestine, from one pint to one quart or more. During the course of the flow the patient may complain of fullness in the rectum and inability to hold the fluid; if the flow is temporarily stopped, the rectum will become used to the pressure and more fluid may then be injected. When no more can be introduced with comfort the flow is stopped and the tube withdrawn. The patient should be instructed to retain the enema for ten minutes if possible.

Low Enemata.—In administering a low enema an ordinary small hard rubber rectal pipe is gently inserted until its tip is well within the external sphincter; the solution is then allowed to run in slowly. Low enemata are desirable in fecal fistulas of the large intestine in which a high enema may result in washing the fecal matter through the wound instead of causing propulsion in the normal direction.

Enemas are given in preference to cathartics following any operation upon the bowel, and, generally speaking, after abdominal operations, enemas are far preferable to catharsis. If the operation on the bowel has been low down, enemas are contraindicated. For the purpose of producing evacuation, enemas vary in composition. The ordinary "SS" enema consists of two quarts of strong solution of soapsuds; castile soap is preferable. If this is not effectual a more stimulating enema must be used. Such an enema is composed of glycerin, 1 1/2 oz., magnesium sulphate, 1 oz., water, 2 1/2 oz.; or, turpentine, 1/2 oz., hot water and soap, 1/2 pt., castor oil, 1 oz.; or, ox-gall, 2 drams, glycerin, 4 oz.,

warm water, 1 pt. Various combinations of glycerin, olive oil, ox-gall, magnesium sulphate and turpentine with warm water are used. A very efficient enema consists of one quart of hot water in which is dissolved one ounce of alum. Another almost equally efficient enema consists of one pint of milk and molasses. An alternation of these latter enemas is useful at times. Milk of asafetida, 3 oz., either alone or in solution is useful. If much irritation is produced from stimulating enemas an enema of one ounce of starch with sufficient cold water to make a paste and the addition of boiling water to dilute this mixture to the consistency of mucilage, or the injection of a few ounces of olive oil occasionally into the rectum will prove soothing.

Colonic Irrigation.—Colon irrigations are indicated for the purpose of completely emptying the colon before operations upon the rectum and colon, for the treatment of diseases of the colon and for the purpose of causing rapid absorption of a large quantity of saline. The latter indication is now fulfilled surgically by proctoclysis by the Murphy method. A Kemp's (Fig. 146) or Tuttle's tube may be employed, or in an emergency

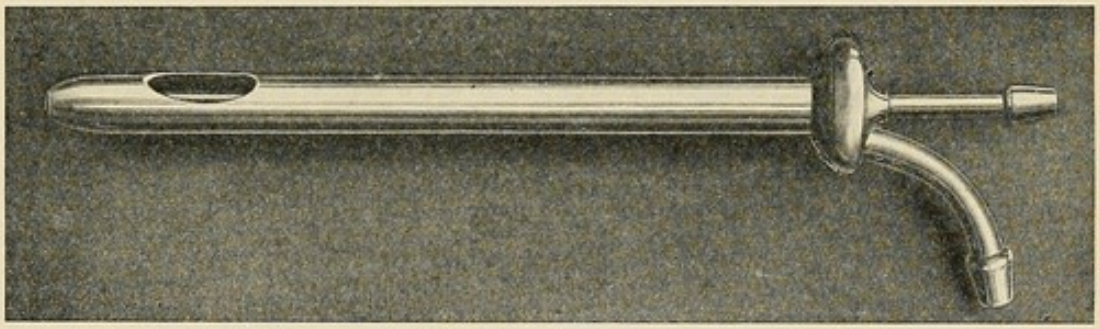


Fig. 146.—Kemp's tube for colonic irrigation.

an ordinary rectal tube with a T-attachment may take their place. The simplest apparatus consists of a receptacle (a douche bag or can) for holding the saline or whatever medicated solution is indicated, a length of rubber tubing, a T-shaped connection, a rectal tube and a length of rubber tubing with a clip for the outflow. Rubber sheeting prevents soiling; a large pail is used to collect the irrigating fluid. Several pitchers of irrigating fluid at the proper temperature should be at hand. The patient is placed preferably in the Sim's position with the hips elevated. Changing the position of the patient occasionally

allows the solution to reach all parts of the colon. The fluid at a temperature of 100° F. to 105° F. is allowed to flow *slowly* to avoid exciting peristalsis. Elevation of the receptacle from two to four feet gives the proper flow. If the simplest apparatus is used the fluid is introduced with the clip on the outlet tube closed until the colon is well distended, the average individual being able to hold one to two quarts without much discomfort. The inflow tube is then pinched, the clip on the outlet tube opened, allowing the fluid to return through the rectal tube and outflow tube into the pail. In pre-operative preparations the irrigation is continued until the fluid returns clear. It is usually necessary to use several gallons. A much more efficient irrigation is obtained by using either a Kemp's or Tuttle's tube.

Proctoclysis.—The employment of proctoclysis in the treatment of peritonitis and general toxic conditions is of the utmost value. By its use the tissues are flushed by the absorption of large quantities of saline solution, all elimination is made more active and toxins are rapidly eliminated. In 1899 and for some years previous to that time, it was our practice to give saline by rectum for the purpose of absorption after every laparotomy both for the relief of the thirst and to prevent deleterious effects of the anesthetic upon the kidneys. A pint to a quart of saline at a temperature of 110° F. is given through a small catheter, allowing twenty to thirty minutes for its administration. This is repeated at four-hour intervals so long as toxic or shock symptoms prevail.

Murphy Method.[1]—The apparatus for Murphy proctoclysis consists of a fountain syringe or douche can with a large rubber tube attached, connected with a vaginal hard rubber or glass tip, flexed at an obtuse angle two inches from its tip and having numerous openings at its bulbed end (Fig. 147). The tip is inserted into the rectum so that the angle fits closely to the sphincter and the tube is then secured to the thigh by adhesive-plaster strips to prevent expulsion. The receptacle for saline is suspended so that its base is from six to eight inches above the level of the buttocks. The connecting tube should be as short as possible and yet allow of not being dragged upon by slight movements of the patient. Once having secured the

[1] *Journal American Medical Association*, April 17, 1909.

proper level for the receptacle it need not, except to increase or decrease the speed of the influx, be disturbed until the proctoclysis is no longer indicated. Saline solution at a temperature of 100° F. is placed in the receptacle. This temperature is maintained by placing hot water bags around the receptacle and covering the whole with flannel. Various means for keeping

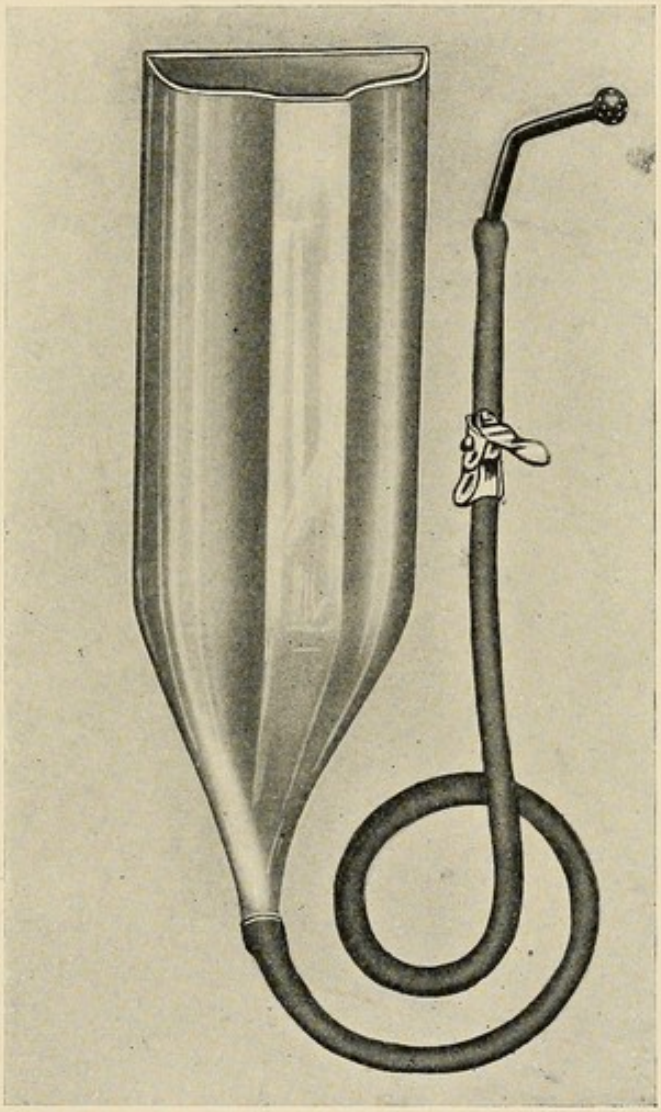


Fig. 147.—Apparatus for Murphy proctoclysis.

the solution at the proper temperature have been devised, but the above is the simplest for general use. Murphy gives an average of eighteen pints in twenty-four hours and believes that less than eight pints is of little value. The retention of the fluid depends upon the slowness of its flow. If too rapid a flow is allowed the large intestine becomes overdistended causing a spasm and consequent expulsion of the fluid. The flow may be

continued for days with little disturbance. If too much fluid is being absorbed it will be shown by slight edema of the ankles, hands and sometimes of the face, thereupon the proctoclysis should be discontinued until the circulatory equilibrium is restored; usually proctoclysis employed for three days is sufficient, more rarely as long as five or six. Every two hours one and a half pints of solution are placed in the receptacle. At the normal rate of flow the receptacle will become empty in 40 to 60 minutes, thus allowing the rectum a period of rest of about an hour.

In cases in which the heart muscle is weak care should be taken not to overburden the tissues with fluid. This is particularly true in the later stages of pneumonia. The control of the flow should never be interfered with by lessening the lumen of the inflow tube or by having few openings in the tip. If a Y-shaped connecting tube is used with a second tube leading back to the can this restriction is not essential, as the return tube ensures accurate regulation of the quantity of fluid administered, regularity of flow, and prevents overdistention of the bowel. By using a Y-shaped tube the result is practically a slow Kemp's irrigation of the large intestine with the absorption of all of the fluid. In case a Y-shaped tube is not used it is essential that a large inflow tube be used and that the rectal tip have numerous openings to provide for the sudden return of the flow into the can when the patient strains, wishes to expel fluid or void gas. Any attempt to constrict the tube and thus control the flow will result in the expulsion of the fluid alongside the tube and the consequent soiling of the bed. The lowest level and the shortest inflow tube give the best results. A saline drop regulator of which several have been devised and of which that devised by E. C. Ryall[1] (Fig. 148) is a type, is useful though not essential.

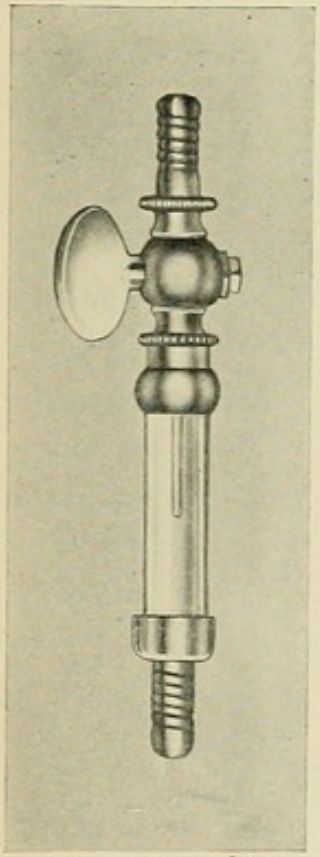


Fig. 148.—Drop regulator for use in proctoclysis.

[1] *Lancet*, Nov. 18, 1911.

The barrel is made of toughened annealed glass and nickel-plated metal mounts at either end for attaching the tube securely cemented with metallic solder so that the appartus can be sterilized. The stopcock allows of the regulation of the number of drops; three drops per second, is the rate advised by Murphy. Instruments of this kind also allow of a short length of tubing between the saline receptacle and the rectum as the rate of flow can be controlled by the apparatus and the receptacle need not be raised or lowered. It is necessary that the nurse note the rate of flow frequently. When such an apparatus is used, however, it is best to use it in conjunction with the Y-shaped return tube already mentioned.

Singultus is a spasmodic contraction of the diaphragm causing inspiration, followed by a sudden closure of the glottis. In ordinary circumstances this is a comparatively harmless affair to which any one is subject; occurring post-operatively, however, in patients weakened by disease and operation it may prove disastrous. It is caused by the irritation of the terminal filaments of the pneumogastric nerve or by irritation of the phrenic nerve. Inflammations and tumors in the course of these nerves or irritative substances so located as to irritate the terminal filaments, are apt to be complicated by hiccough. One of the most frequent causes is irritative substances in the stomach itself or lower down in the digestive tract. Occasionally the trouble seems to be purely neurotic, being discontinued during sleep. In other cases it is almost continuous. Once started, the arhythmia is apt to continue. The hiccough will occur at short or long intervals. Post-operatively it occurs in renal complications, in peritoneal inflammations, in intestinal obstruction, in tumors and inflammations in relation wih the diaphragm, and more rarely in inflammations so located as to irritate the pneumogastric filaments of the upper air passages.

Treatment.—In cases without ascertainable cause, diverting the attention as by the common method of holding the breath and making pressure upon the upper lip will cause its disappearance. Mild cases respond to this method or to the administration of carminatives, such as aromatic spirits of ammonia, compound spirits of ether, compound tincture of cardamon, etc.

Immediately upon the occurrence of hiccough a thorough examination of the patient should be made, the cause ascertained if possible and treatment for the cause instituted. Treatment for the hiccough itself consists in lavage of the stomach and siphoning dry; in the removal by enemata, or mild purgation if the operation allows, of possible irritations in the intestinal canal; in the elevation of the head of the bed to obviate pressure upon the diaphragm, in intraabdominal conditions; in counter-irritation applied to the epigastrium in the form of mustard, turpentine, ice or the actual cautery, in cases in which the incision permits; the administration of atropin and morphin by hypodermic, either alone or in combination. Atropin in large doses seems to be the most effectual single remedy. The administration of hot and cold liquids, the rapid sipping of fluids or a quantity of thick farinaceous material; lumps of ice, ice cream, rhythmic traction of the tongue, forcible traction of the tongue, cocainization of the pharynx, pressure on the pneumogastric nerve in the neck, pressure on the supraorbital nerve, pressure on the lower costal arches, with the idea of relaxing the diaphragm; tight bandaging of the lower portion of the chest with the same idea in view; sudden mental shock; chloral, amyl nitrite, faridization of the phrenic nerve; all these may be tried.

In cases where all efforts to stop the hiccough have failed and the patient is becoming exhausted from lack of sleep, anesthesia by ether or chloroform is indicated.

Supportive treatment must not be neglected. Food, stimulation, and fluids must be administered, if not by stomach, then by rectum and endermically.

Dilatation of the Stomach and Duodenum.—This post-operative complication is rare, though of late quite a few cases have been reported. Many of the cases reported have been attributed to nervous causes. Such has not been our experience.

The lesion is at first a mechanic one, later the stomach and duodenum undergo a paresis due to their continued and great distention. P. Miller[1] describes a condition which he designates as mesenteric incarceration of the duodenum. A case of this character came under our observation and died in spite of early

[1] *Deutsche Zeitschrift für Chirurgie*, vol. lvi, p. 486.

diagnosis, repeated washing out of the stomach, and change of position. The autopsy verified the diagnosis. On opening the abdomen an enormously dilated stomach reaching from the free border of the ribs to the symphysis was seen. The dilated stomach, stretched almost beyond recognition, filled the entire abdominal cavity. On raising the stomach up there was disclosed collapsed small intestine filling the pelvis. The duodenum was enormously dilated and from the duodeno-jejunal juncture collapsed jejunum descended into the pelvis. At the duodeno-jejunal juncture the mesentery of the small intestine was so drawn upon as to constrict the gut at this point.

This condition seems to be brought about by the tension of the mesentery of the small intestine, this tension being produced by the sinking of the small intestine into the pelvis thus causing the duodenum to press against the superior mesenteric artery and vein, and so completing the obstruction. *The condition is favored by too rapid ingestion of fluids in a stomach weakened by anesthesia.* This is an avoidable cause.

In most of the reported cases the condition has followed laparotomy, but it may occur after operations upon other portions of the body. The symptoms are characteristic. There is first distention of the stomach and duodenum. This may begin directly after anesthetization, or may be delayed for three or four days or even later. The stomach and duodenum gradually fill up. This distention is marked by a tumor above the umbilicus, the remainder of the abdomen not being distended. Vomiting is persistent and profuse, though the stomach is rarely completely emptied. The vomited matter consists, first, of whatever fluid has been introduced into the stomach; second, of stomach secretion mixed with bile; and third, of duodenal contents. It never becomes fecal. There is no pain, but a great deal of distress. The distention of the stomach gradually increases until the stomach may occupy the entire abdomen. At first there is little gas or fecal matter passed. There is no rise in temperature. The pulse becomes rapid, prostration is marked. The patient's countenance expresses anxiety, there is extreme thirst. Intestinal obstruction from other causes is ruled out by the absence of fecal vomiting, the enormous quan-

tity of the vomited material and its character. Occurring after abdominal section, this complication should be readily diagnosed, as the after-treatment of all cases of abdominal section should include frequent palpation of the abdomen to determine the presence of distention. In cases of dilatation of the stomach and duodenum the distention of the upper part of the abdomen will thus be early recognized and prompt measures may be instituted for its relief. I have seen three additional cases in which there was marked dilatation of the stomach occurring two and three days following operations for appendicitis. The distention was only marked above the umbilicus; below there was no distention. Under repeated lavage and change of position these patients recovered. It may be noted that in none of the cases personally observed had the elevated head and trunk position been employed.

Treatment.—Treatment to be effectual, must be instituted early, before extreme dilatation and consequent paresis has occurred. It may be that the gradual filling up of the stomach and duodenum, with a slight kinking at the duodeno-jejunal juncture, is a sufficient producing cause for the condition; the absolute obstruction being kept up by the pressure of the dilated duodenum. This would seem to be true for the reason that cases with characteristic clinical symptoms recover without operation. The treatment consists in repeated lavage and complete emptying of the stomach and duodenum, in abstinence from mouth feeding, in the frequent change in the position of the patient, rectal alimentation and hypodermoclysis and such supportive measures as the general condition of the patient requires. The foot of the bed should be raised with the view of causing the collapsed small intestine to gravitate from the pelvis toward the diaphragm and so relieve the tension upon the duodenum. This will be further facilitated by turning the patient on the stomach and then raising the foot of the bed. The abdominal binder should be snugly applied. If in spite of change of posture and repeated lavage with siphoning dry of the stomach the symptoms still persist it will be necessary to open the abdomen. If at such an operation the stomach and duodenum present the appearance of paresis a gastrojejunostomy with lateral duodeno-

jejunostomy must be done. If gastrojejunostomy alone is done, in all probability the symptoms will still continue on account of the reversed peristalsis of the paretic duodenum.

The general rules of hygiene must be carried out. The room and surroundings are made as pleasant as possible. There must be plenty of fresh air. The bedclothes must be clean and changed frequently. The patient's skin must be kept clean by sponge baths. Care is taken that the patient is not chilled. Vaginal douches are given as required. The teeth, hair, and nails should receive attention. Not only is the patient thus kept comfortable, but wounds will heal more quickly, if hygienic conditions are good. General massage should be given to increase the action of the skin and keep up muscle tone.

The urine must be watched carefully. In all cases the total quantity passed in the first twenty-four hours is recorded. A sample of the urine with the name, date, and the amount passed, is sent to the pathologist for examination. The same procedure is carried out on the tenth day. In cases presenting kidney complications the urine is examined more frequently.

Albuminuria may develop as a result of the anesthetic. This will, as a rule, disappear by the tenth day, and is not significant of a kidney lesion. Should diabetes or renal disease develop, the urinalysis will give the first clue and treatment may be begun promptly.

Cystitis may follow the use of the catheter, particularly in females. With careful avoidance of traumatism and cleanliness in technic, catheter cystitis should rarely occur. Early catheterization is of value as showing whether the kidneys are properly functionating or not.

Anuria may occur after any anesthetization, but is more likely to occur after operations involving the urinary apparatus; next in frequency after laparotomies. It may be caused by the absorption of strong antiseptics, such as carbolic acid and bichlorid of mercury. Treatment consists in cupping the kidney areas, and administration of saline by colon or endermically.

Retention of Urine.—The bladder must not be allowed to become distended. If the patient has not urinated voluntarily

in ten to twelve hours the catheter is used. It is not necessary to catheterize until this time, provided the bladder has been emptied prior to the operation, as the amount of urine secreted in the first twelve hours is not sufficient to unduly distend the bladder. A suprapubic examination of the bladder will show whether the use of the catheter is imperative. Subsequent catheterization may be done every six or eight hours as indicated. It should be discontinued as soon as possible.

Applying hot compresses, turning the patient on the side, or, if feasible, allowing the patient to get out of bed may cause the urine to be passed voluntarily.

Catheterization in the Female.—Many a patient's life has been rendered almost unbearable because of a cystitis acquired through carelessness in catheterization. The hands are scrubbed and thoroughly disinfected. The parts surrounding the urethral orifice are cleansed with sterile water, followed by swabbing with a mild antiseptic solution. The patient lies on her back with the thighs well separated and the limbs flexed at the knees. The parts should be exposed to a good light. It is preferable to use a glass catheter on the score of cleanliness. If such a one is not at hand, a silver instrument may be used. It is rendered aseptic by boiling and is lubricated with olive oil. The instrument is gently inserted within the urethral orifice and pushed without force along the urethra. As soon as the bladder is entered the urine will flow through the catheter into the vessel held to receive it. Following catheterization there may persist a slight degree of vesical irritability. To avoid this the bladder is irrigated after each catheterization with a 2 per cent. boric acid solution and two drams of 5 per cent. argyrol are left in the bladder. The *danger of infection* of the bladder, ureters, or kidneys must be borne in mind at every catheterization. The resulting cystitis is quite as apt to be due to actual injury to the delicate bladder mucosa as to infection introduced from without. For this reason the utmost care is necessary in performing the catheterization as gently as possible, using a very small instrument. When pain is complained of it is usually because too large an instrument has been used.

Catheterization in the Male.—The entire procedure is conducted

with aseptic precautions. The hands of the operator, the patient's parts are cleansed and the solution and instruments rendered sterile. A dram or two or olive oil is injected by means of a glass syringe into the anterior urethra. If a metal catheter is used the procedure is as follows: The patient lies in the recumbent position with his head resting on a pillow, the legs slightly flexed and the thighs separated. The surgeon stands at the patient's left side. The penis, with the foreskin drawn

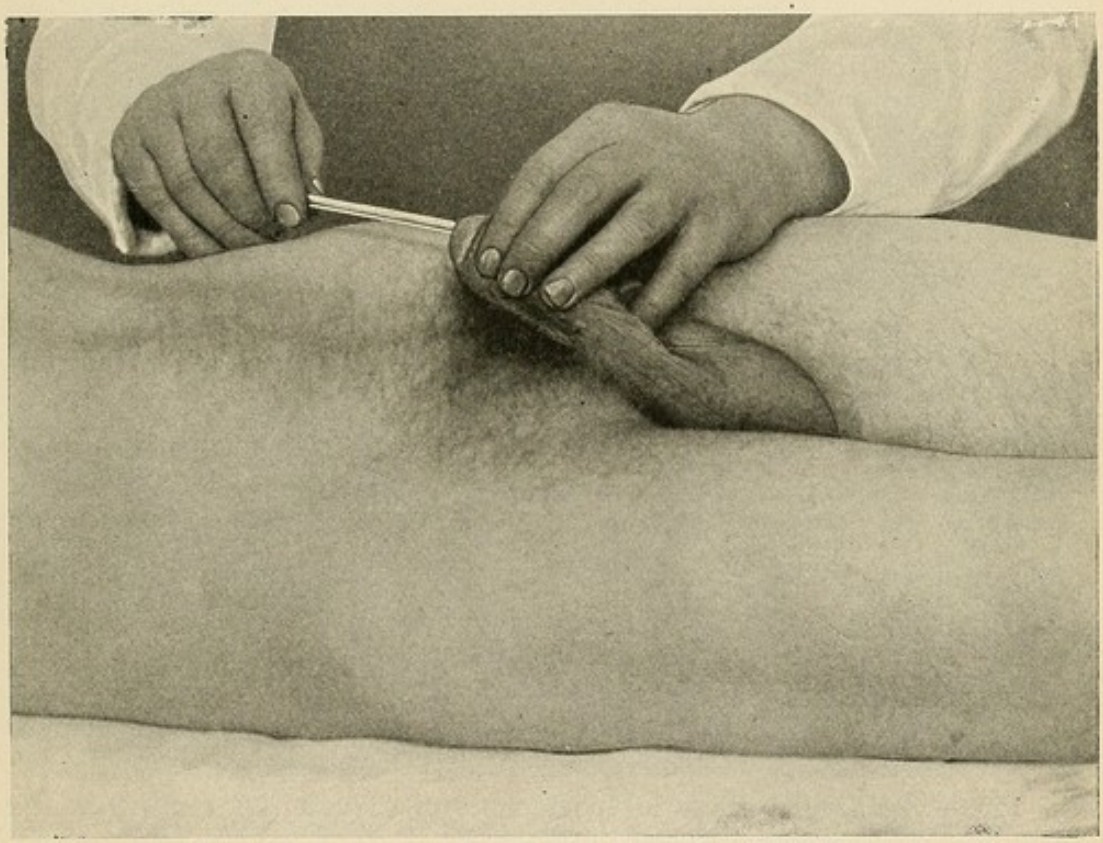


Fig. 149.—The first stage in the technic or catheterization. (Fowler's Surgery.)

back, is grasped with the left hand. The catheter is held in the right hand, the palm of the latter directed toward the patient's feet. The beak of the instrument is introduced with its shaft held over the groin and almost touching the skin, until it passes the penile urethra or until all of the curve and an inch or more of the shaft has disappeared. Only the gentlest pressure is employed. The penis is drawn over the catheter, the beak following the roof of the canal. As the extremity of the catheter reaches the cul-de-sac of the bulb, as determined by the little

finger of the hand that holds the penis, the instrument enters the membranous portion of the urethra, thus completing the *first stage* of the operation (Fig. 149).

In the *second stage* the handle of the instrument is carried to the median line. The shaft is kept well back toward the surface of the abdomen, almost touching the latter. As the beak adapts itself to the subpubic curve the penis is released and the scrotum grasped in the hollow of the left hand, while

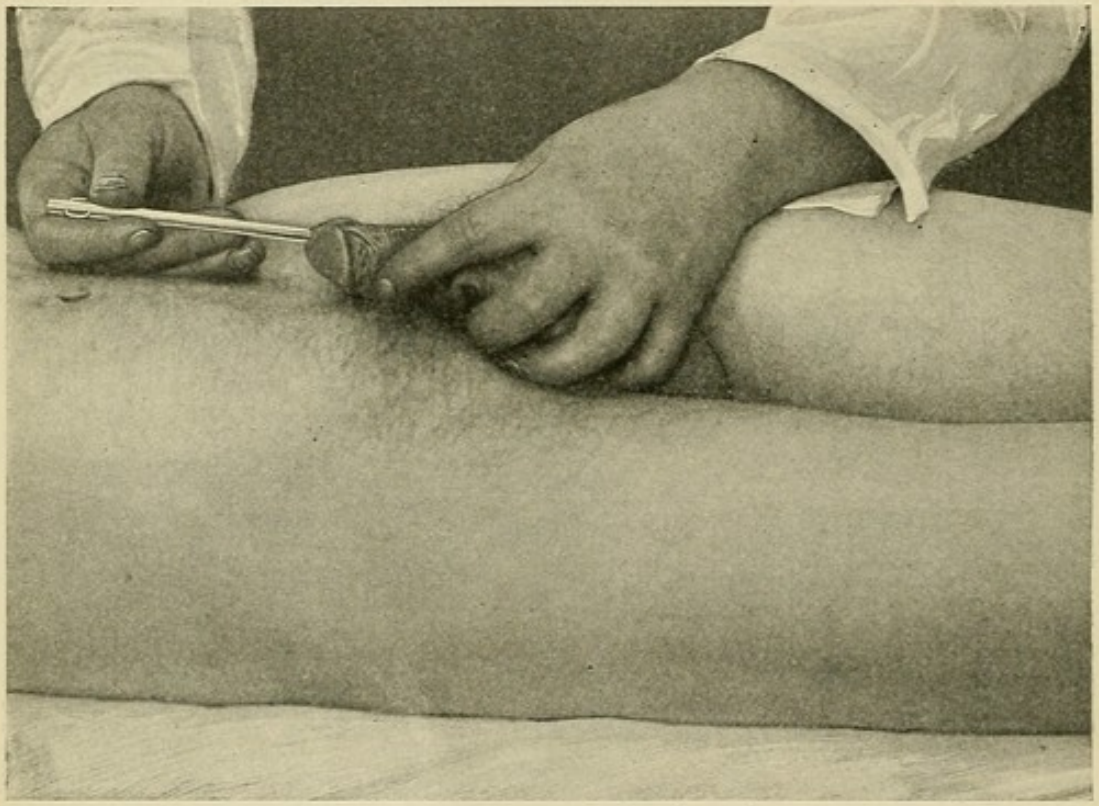


Fig. 150.—The second stage in the technic of catheterization. (Fowler's Surgery.)

at the same time the parts are pressed against the pubis and upward traction made (Fig. 150). The instrument is now gently advanced until its point lies well against the pubis, when the scrotum, testicles, and penis are released and the instrument transferred to the left hand.

In the *third stage* the instrument is steadied in the median line by the left hand and its shaft carried away from the surface of the abdomen (Fig. 151), the handle describing the arc of a circle during this part of the manipulation. This movement is to be continued until the handle of the instrument almost

reaches the meatus. The right hand now makes pressure in a downward direction on the root of the penis to stretch the suspensory ligament and diminish the curve of the membranous portion of the urethra (Fig. 152). At the same time the instrument is depressed between the thighs and slips into the bladder. The entrance of the instrument into the bladder is announced by a flow of urine. The same technic applies to the *passage of*

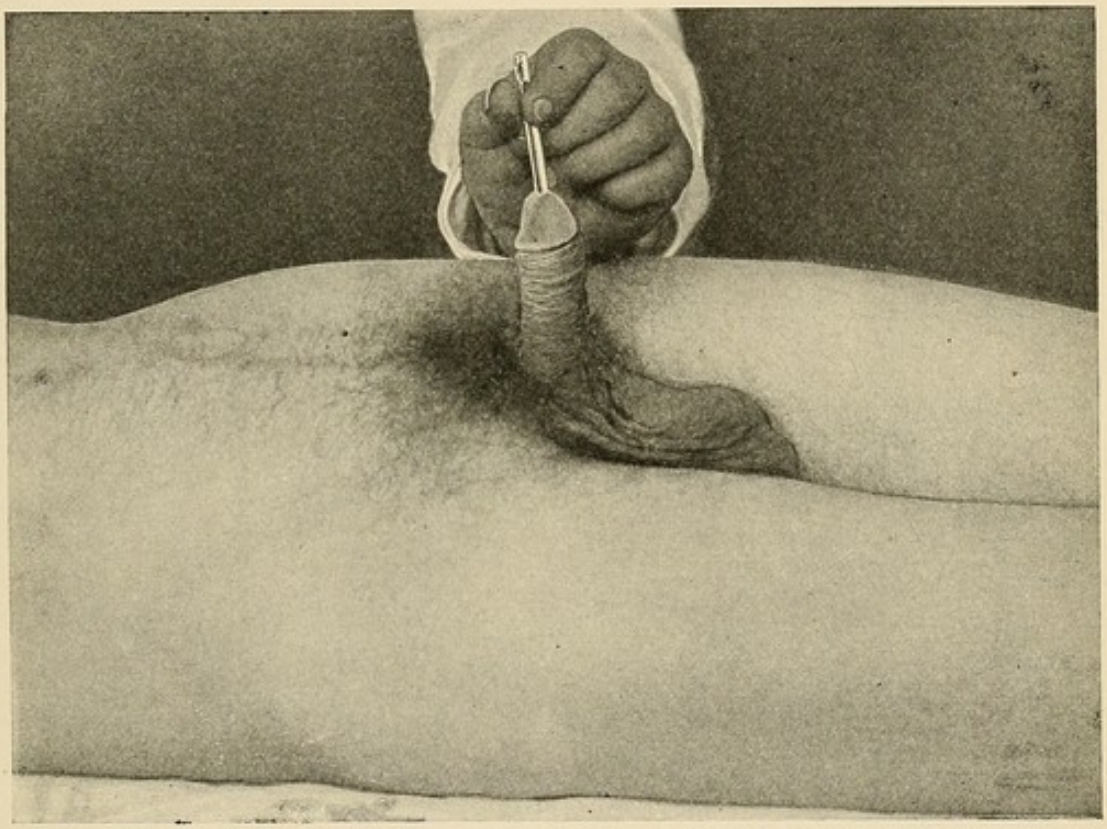


Fig. 151.—The third stage in the technic of catheterization. The instrument has been carried in an arc of a circle from the surface of the abdomen, while at the same time it has been advanced still further into the urethra. (Fowler's Surgery.)

sounds. The entrance of the latter into the bladder is indicated by the ability to rotate it on its own axis in all directions.

The passage of a metal instrument through the curved portion of the canal marks the most difficult stage of the operation. The beak may, at the moment of change in its direction, press the bulb too far down by prematurely lowering the handle, so that the wall is crowded before the instrument. Further progress is blocked and the instrument must be partially withdrawn for another trial.

The method of using a *gum-elastic catheter* armed with a stylet does not differ from the foregoing. A *flexible catheter* of vulcanized rubber is easily passed, under normal conditions, by simply "feeding" it in, a half-inch at a time.

Following catheterization the *bladder is irrigated* with a pint of warm 4 per cent. boric acid solution and a dram or two of 5 per cent. argyrol solution left in the bladder. If a two-current catheter has been used the flow of irrigating fluid may be con-

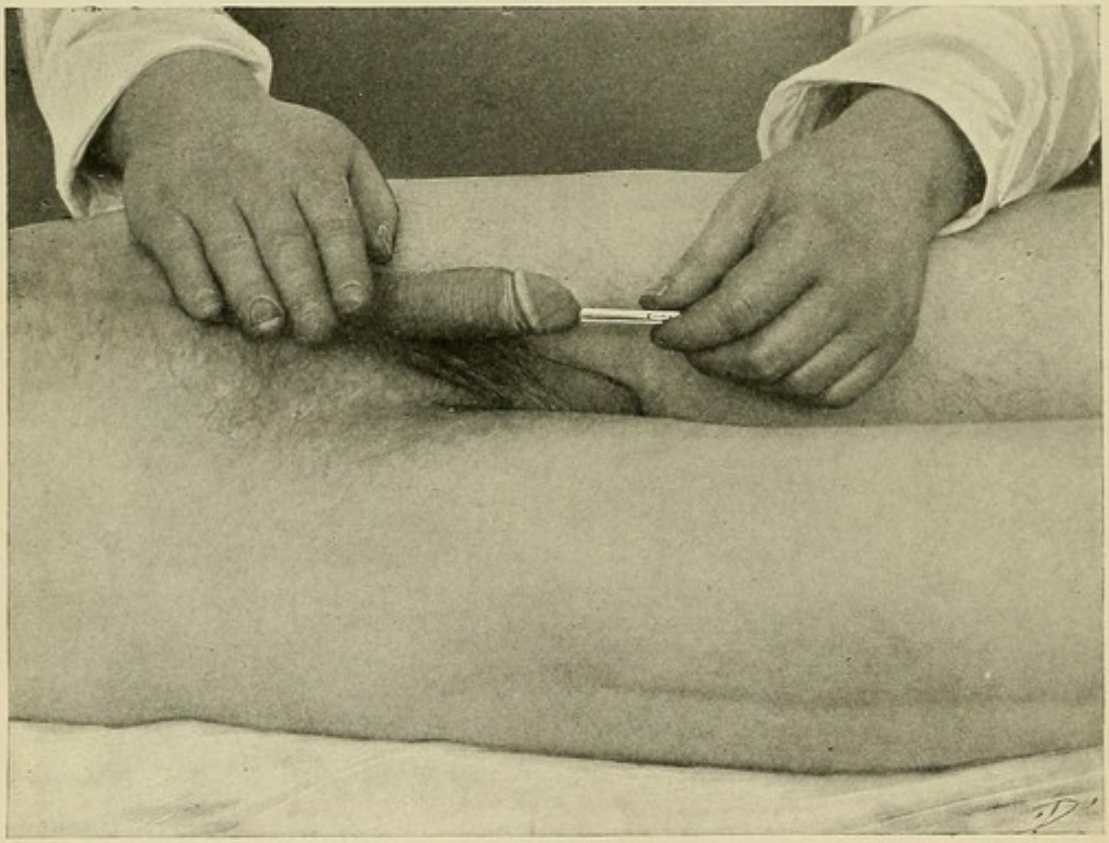


Fig. 152.—The fourth stage in the technic of catheterization. The instrument is depressed between the thighs, and at the same time pressure is made at the root of the penis to stretch the suspensory ligament and diminish the curve of the membranous portion of the urethra. (Fowler's Surgery.)

tinuous; if a single current catheter from four to six ounces of the solution is allowed to run in and this is drawn off before introducing more.

Post-operative Pneumonia.—May result from exposure of the patient while under the anesthetic; from inspiration of secretions from the mouth or of material vomited during anesthesia (foreign body pneumonia); from keeping debilitated patients too long confined in the dorsal position (hypostatic

pneumonia); from infection carried to the lung through the blood (septic pneumonia). Aside from the ordinary contributing causes of pneumonia, such as age, alcoholism, cachexia; cardiac weakness, and weather conditions, the disease occurs more frequently after operations on the respiratory apparatus; next in frequency after abdominal operations, particularly those in the neighborhood of the diaphragm. Loss of blood predisposes to pneumonia.

Treatment.—Preventive treatment consists in cleansing the mouth, throat, and nose precedent to anesthetization; in keeping the air-passages free during anesthetization; in the proper selection and preparation of patients for operation (except in imperative cases operations should be deferred in the presence of any respiratory disease, however mild its character); in taking care not to expose the patient unnecessarily, either during the anesthesia or while the patient is recovering from the anesthetic (the patient's body should be kept dry and drafts avoided); in frequent change of position of the patient during the after-treatment to avoid hypostatic pneumonia; in proper care of the wound.

The treatment of the disease itself consists in repeated dry cupping early in the disease, the application of a pneumonia jacket, frequent change of position and plenty of fresh, cold air. Oxygen should be administered in cases where a considerable area of lung is involved. Drugs, with the possible exception of massive doses of camphor in oil by hypodermic (Seibert), do not seem to exert any influence upon the disease itself. Ten-grain doses of carbonate of ammonia or of guiacol every two or three hours serve to somewhat stimulate the heart and to aid the larger air-passages in getting rid of their secretions.

Cupping.—Wet or dry cupping may be used. Wet cupping, formerly much employed, is rarely used at the present time. Dry cupping consists in causing a local congestion by applying, over the area where it is wished to produce congestion, a receiver from which the air has been exhausted. Ordinary glass tumblers serve as well as special cupping glasses. The interior of the tumbler is moistened with a little alcohol or proof whiskey. To do this, twist some cotton around the end of a lead pencil,

moisten it with alcohol and rapidly smear the interior of the tumbler with the alcohol. Light the alcohol in the tumbler with a match, and apply the tumbler quickly to the area indicated. The stick armed with cotton that has been saturated with alcohol, and the supply of alcohol, that was used for saturating the cotton mop, should be kept at a distance from the patient. Care should be taken not to smear the interior of the tumbler too profusely with alcohol, otherwise some may run down over the edge of the tumbler and burn the patient. Several of these tumblers may be used. As the expanded air in the tumbler cools, the underlying soft parts will be forced by the outside atmospheric pressure up into the tumbler, and so congestion of these parts will be produced. The amount of congestion will vary somewhat with the length of time (usually a few minutes) the tumbler is left in place. To remove the tumbler, press the skin down with the thumb at the edge of the glass and so allow the air to enter; the tumbler may then be readily removed. Glasses with sharp edges should not be employed, as they may cut the tissues if left long in position. If wet cupping is employed, the above procedure should be first carried out, and then the congested area may be scarified, preferably with a scalpel. (In former times a spring scarificator was employed, but it was found practically impossible to keep the blades aseptic). The cups are then applied a second time, and the suction from the cups causes the blood to flow from the scarified area. When sufficient blood has been drawn, the cups are removed and an aseptic dressing is applied.

Hydremia.—It is possible by the administration of too much fluid by rectum, by hypodermoclysis or intravenously to cause so marked a relative increase in the fluid contents of the blood that the tissues become "water logged." The symptoms are similar to those of shock and hemorrhage. The logical treatment would seem to be cardiac stimulation and direct transfusion of blood to lower the relative increase of plasma.

The temperature is taken every four hours for the first three days; later night and morning in ordinary cases. In septicemia and complicated cases the temperature is taken every four hours until all danger is past. In cases of beginning septic abdominal complications, in which the diagnosis is uncertain, whether opera-

tive or under observation, the temperature is taken every hour. Directly after the operation the temperature may be *subnormal*. This may occur at times during the after-treatment. Of itself it need not occasion alarm. If the wound pursues an aseptic course the temperature will not vary to any marked degree. It may be normal or as high as 100° F., but will pursue an *even course*. A slight rise to 100° F., or 101° F. occurring in the first few days prior to the occurrence of a bowel movement is not a source of anxiety. The cause is found in intestinal fermentation. This causes an autointoxication. Autointoxication may not be due to partial reabsorption of excrementitious matter in the intestinal canal alone, but may also be due to lessened activity of the skin, lungs, kidneys, and liver. Should the tongue be furred, breath bad, a bad taste in the mouth, headache, anorexia, or malaise be present, and the bowels be closed, together with a slight rise of temperature, moving the bowels promptly causes a return to the normal course. During the first twenty-four hours the temperature may rise to 100°, 101°, or even 102° F. in aseptic cases. This reactive fever is commonly known as *aseptic fever*. This rise in temperature is gradual; reaches its maximum in a few hours, in any event by the end of the first twenty-four hours; and is rarely accompanied by a chill. There is a corresponding increase in pulse-rate. The patient's face is flushed, the eyes are bright, and there is more than the usual amount of thirst. These symptoms subside in a few hours, or in any case by the end of the second twenty-four hours. They need occasion no alarm. There is decidedly less reaction, the more exact the hemostasis. Saline by rectum also lessens the reaction. Any sharp deviation from the normal course of wound temperature is to be regarded with suspicion. Normal wound *temperature* may not be normal temperature in the usual sense, but may be 99° to 100°F. Actual normal temperature, 98.4° F., may not be reached until the tenth day. A slight rise of temperature indicating a slight local disturbance is not incompatible with primary union. Every rise of temperature has a cause, and this cause must be sought out and removed. A rise in temperature in the first twenty-four hours, while probably due to the absorption of nucleins and albumoses (aseptic fever), may be due to *pneumonia*, *bronchitis*, or *nephritis*. In the

latter, however, there will be other symptoms which will lead to a correct diagnosis. Tension of the pulse, headache, wandering delirium, and muscular twitching will establish the diagnosis of a renal lesion. Physical examination of the chest and careful urinalysis will aid in establishing the cause of the fever. Fever occurring after a lapse of two or three days indicates superficial *wound infection*, if the bowels have moved. If not, *intestinal fermentation* may be ruled out by moving the bowels. Fever occurring in the second week usually indicates *infection of the deeper tissues*, such as *stitch abscess*. Fever due to causes other than those mentioned may occur. Operative cases have no more immunity from the usual causes of fever—typhoid, malaria, diphtheria, etc.—than other patients. As a rule, a temperature which continues high, associated with rapid pulse from the time of operation, indicates severe general infection.

The pulse should be just as carefully watched as the temperature. Any var'ation from the normal frequency, rhythm, and tension is noted. It is studied in connection with the temperature. After severe operations or prolonged anesthetizations a rapid pulse is the rule. This may persist for forty-eight hours, but so long as it does not increase in rapidity and so long as the general condition of the patient is good there will be no cause for anxiety. In cases pursuing a normal wound course the same relation will be maintained throughout between the pulse and the temperature.

The respiration is also carefully watched and recorded. It is studied in its relation to the temperature and pulse. Its type, costal or abdominal; depth, deep or shallow; rhythm, regular or irregular; rate, rapid or slow; equality of expansion of each side of the chest, whether painful or not; and its other characters are noted. If any variation from the normal occurs, a prompt search for the cause is instituted. Physical examination to be thorough must include not only the anterior and lateral chest wall, but also the posterior region. It is here that pneumonic processes (hypostatic pneumonia) begin. After abdominal operations the respiratory rate may be increased to twenty-four and remain so for several days.

Delirium tremens occurs as a complication following injury or

operation in chronic alcoholics. It more often occurs in whiskey drinkers than in beer or wine drinkers. It may follow even trivial operations. It is favored by digestive disturbances and the fever which accompanies wound infection.

Symptoms.—There is first characteristic restlessness, followed by hallucinations. Examination of the urine shows an albuminuria. There is marked tremor of the extremities. It may occur a short time after the operation, or not until two or three days have elapsed. Insomnia may be the first symptom. The patient is nervous and talkative. The speech is confused. Mental disturbances are mild at first, later they become more pronounced. The pulse-rate is increased and arterial tension is raised. The hallucinations become more marked and it becomes necessary to restrain the patient. The character of the hallucinations differs; some patients imagine they see various kinds of animals, others imagine that some danger is impending, others that they are at their regular business. The hands and feet are in continuous motion. These patients are insensitive to pain. The disease lasts from one to three days. In favorable cases this excited condition is followed by exhaustion, and the patient finally drops into a deep sleep, from which he awakens much weakened without any recollection of his trouble. In many cases the patient dies from exhaustion or acute cardiac dilatation.

Treatment.—The treatment is largely preventive. In operating upon alcoholics it is advisable to administer a fourth of a grain of morphin sulphate hypodermically, thirty minutes before the anesthetic. This not only causes the patient to take the anesthetic better, but tides over the pain of the operation and the period of excitement which accompanies it. Patients who are known to be alcoholics should be given large doses of bromids, and large quantities of water both by mouth and rectum. Upon the appearance of restlessness, increased tension of the pulse, and tremor of the hands an intravenous saline infusion of from thirty to forty ounces should be given. This acts by increasing the elimination of the skin and kidneys and diluting the toxemia. It will usually suffice to abort the attack (Warbasse). Whiskey may, in moderate doses, be given by mouth. Sudden abstinence in chronic alcoholics seems to favor

the occurrence of delirium tremens. In such cases it is well to give some whiskey during the entire course of the after-treatment. Capsicum and digitalis are useful. Chloral hydrate is given for insomia. Should the case go on to delirium, opium is employed and the patient restrained; otherwise, as these patients have no sense of pain, they may do themselves injury. The operated part should be protected by plaster of Paris in the case of operations upon the extremities, or by adhesive-plaster strapping in operations upon the trunk. Chronic alcoholics should be gotten out of bed as soon as possible. They should be watched for the first symptoms of delirium tremens. In such cases it is particularly important to see that each organ of the body carries on its function properly, the bowels should be thoroughly moved daily, the skin cleansed daily, easily digested food and a maximum amount of fluids should be given, the latter by hypodermoclysis if sufficient fluid cannot otherwise be taken.

Toxemia following Operations.—The cause for faulty metabolism, evidenced by a fairly constant train of symptoms following operations, is unknown. We see cases presenting the symptoms of headache, malaise, nausea and sometimes vomiting. Urinary examination of these cases shows a decided increase in the daily amount of uric acid, as shown by the lowered urea and uric acid ratio and the presence of acetone, diacetic acid, and sometimes beta-oxybutyric acid. In other cases there is a decided increase in the daily excretion of indoxyl-sulphate and skatoxyl-sulphate, as shown by the presence of indican and skatol in the urine and a lowered ratio of mineral and ethereal sulphates. The urine may present a combination of both these characteristics.

Acidosis follows operation in a certain proportion of cases. It is favored by vigorous catharsis and deprivation of fluids before operation. The same conditions favor its occurrence following operation. Lord and Osgood in 1907 showed that acetonuria occurred in 88.5 per cent. in 173 ether anesthesias by the cone method while it only occurred in 26 per cent. of a series of 222 ether anesthesias by the drop method. Conti in 1895 first called attention to acetonuria after anesthesia. The complication is prevented by the free administration of fluids

before and after anesthesia. If free fluids by mouth are contra-indicated then saline should be given by rectum by the Murphy method. Upon the occurrence of acidosis, alkalines in large doses are indicated. A teaspoonful of bicarbonate of soda in 8 oz. of water is given every two to three hours by mouth. Enough bicarbonate of soda is added to the Murphy proctoclysis to make a 2 per cent. solution. In very emergent cases repeated hypodermoclyses of 2 per cent. solution of bicarbonate of soda are indicated.

CHAPTER VII.

CARE OF THE WOUND.

General rules. Aseptic wounds. Revision of dressings. Normal course of wounds healing per primam. Primary dressing. Redressing. Technic of removal of skin sutures. The second dressing. Drainage. Aseptic wounds healing per secundam. Secondary suturing. Infection of the wound. Aseptic fever. Intestinal fermentation. Immediate infection. Early infection. Late infection. Stitch abscess. Retention of secretion. Retention of secretions with tension. Subcutaneous phlegmon. Tendinous phlegmon. Diffuse cellular infiltration. Infection in loose cellular tissue. Aseptic wounds in infected tissues. Retention of secretion from blockage of the drain. Removal of gauze drains. Irrigation of cavities. Disturbance of granulation. Sluggish granulation. Exuberant granulation. Pyogenic membrane. Indolent wounds. Direct sunlight. Treatment of varicose ulcer. Sinus. Thermocautery wounds. Care of the skin in the neighborhood of the wound. Vaccine therapy of infection. Antitoxins. Bier's hyperemia. Bismuth paste.

General Rules.—Local rest of the part must be maintained until healing is complete. General rest is only necessary when body movements would interfere with the local rest of the wound.

Aseptic Wounds. Revision of Dressings.—The dressing should be inspected frequently and at once revised if displaced. Revision should not include inspection of the wound unless the wound has become exposed. Too early inspection favors infection.

Normal Course of Wounds Healing per Primam.—A wound aseptically made usually heals without complications, though cultures taken from wounds will, in 50 per cent. of cases grow,

i.e., one-half of such wounds contain infective agents. In the course of five to seven days skin union has occurred. In portions of the body subject to strain, union is not firm before the tenth to the fourteenth day. Age is a factor in the healing of skin wounds as in wounds of other tissues; in elderly persons, skin wounds heal slowly; in young children, very rapidly. The blood and lymphatic supply of the part plays an important rôle; wounds of the face heal in five days, as here the blood and lymphatic supply is very rich; wounds of other parts are slower in healing. The healing process in the deeper structures, *i.e.*, the muscular and fascial layers, is slower than in the skin; from ten to fourteen days being necessary before moderately firm union is accomplished. The extent of the wound is a factor in healing. Small wounds heal more readily than large wounds. Practically we can say that a wound in any part of the body involving the soft parts is healed on the fourteenth day. Such a wound, however, must not be subjected to strain, as the union is still fresh. Complicating diseases, particularly anemia, syphilis, diabetes and tuberculosis delay wound healing.

The primary dressing may be an occlusive or an absorptive one. The common form of occlusive dressing is collodion, either alone or in combination with cotton or gauze extending beyond the wound for a space of two inches in all directions. It does not provide for the absorption of any considerable wound secretion and should only be used in wounds in which hemostasis has been exact and in which discharge is not expected. The contiguous integument should be thoroughly cleansed, the wound carefully dried, and the edges approximated. The collodion is applied with a camel's hair pencil, minute pieces of fluffed out cotton being added from time to time. Several layers of absorbent cotton or gauze may be mingled with the collodion, and the area thus covered may be quite extended. Iodoform and other medicaments are sometimes mixed with collodion, but little if any advantage can be claimed for these combinations. The presence of fluid beneath this dressing is suggestive of present or impending infection and should prompt its quick removal, absorptive dressing being employed instead.

When discharge is expected an absorptive dressing is indicated,

such as dry sterile plain gauze shaken out and applied loosely over the wound covering the surrounding surface for at least six inches so that the wound is thoroughly protected by a soft and comfortable dressing, retained in place by strips of zinc oxid plaster and a suitable bandage or binder.

Redressing is done on the fifth day in wounds of the head and neck; on the seventh day in wounds of other parts, at which time the superficial sutures are removed. Without indication a wound expected to heal per primam should not be dressed earlier. The principle of rest to the wound and infrequent dressings should be remembered. Only too often it happens that meddlesome interference with the dressing on the third or fourth day results in infection. At this, as at all dressings, the wound and the skin in its neighborhood should not be touched by the hand. All manipulations are done with sterile instruments and sponges. No irrigation is used. Just as much care in the preparation of the hands, in the isolation of the wound by sterile towels, and in the sterilization of instruments and gauze, is employed as at the orginal operation. It is unnecessary, however, that the hands be disinfected preparatory to each dressing if rubber gloves are properly donned. These are easiest put on in a dry state with the gauntlet turned back for two inches. The left glove is grasped by the fingers of the right hand, taking a firm grip on the anterior surface of the cuffed gauntlet. The left hand is then inserted into the glove and if the hand is dry and well powdered the glove will at once be drawn smoothly on the hand. The right glove is then picked up and donned in a similar manner by the left hand, taking care to keep the fingers beneath the cuffed portion of the glove. The wish to give the wound rest and not to interfere with the healing process must not, however, delay the dressing when indicated.

The bandage and outer layers of the dressing are removed without touching that next the wound. The final layer of dressing is removed with forceps in the direction of the long axis of the wound so as to occasion least pain and not to weaken the union. The wound appears as a thin line marked by the dark, thin blood clot lying between its lips.

Technic of Removal of Skin Sutures.—If a subcuticular suture

has been used, one end is caught by thumb forceps and slight traction is made until it is removed from its bed for one quarter of an inch where it is cut. The other end of the suture is caught with forceps and removed by traction in the long axis of the wound. At the point of emergence of the suture there will usually exude a single drop of blood; this is sponged away without allowing the fingers to come in contact with that part of the sponge which touches the wound. If the suture does not come away readily and there is danger of breaking the thread by more pronounced traction, it may be left for twenty-four or forty-eight hours longer. A dressing similar to the original dressing is applied. If individual sutures or a chain stitch has been used, each stitch, or in the case of the chain stitch, each section of suture, is to be raised, cut and removed. If inspection shows that wound healing is not firm the sutures may be left for a day or two longer, or the wound may be supported by sterile strips of adhesive plaster.

The *second dressing* is done on the tenth to the fourteenth day. In small wounds in parts other than the abdomen the tenth day is the usual time for the removal of through-and-through sutures, using the same technic as in the removal of individual skin sutures. In small abdominal wounds the sutures may be removed on the tenth day. In more extensive wounds they are removed on the fourteenth day, or, as in cases of extensive ventral herniæ, even later where tension is great. A loose suture means that it is no longer serving its purpose in securing apposition of the wound edges and so should be removed. If buried sutures have been employed the wound is inspected on the tenth to the fourteenth day, and the young scar supported by adhesive plaster if in a part subjected to strain.

Drainage is indicated in aseptic wounds in which a dead space has been left which cannot be closed by suitable pressure of the dressings or in which large areas have been exposed from which serous discharge may be expected. Drainage is provided for by strips of green silk protective, gauze or tubes. Such wounds heal practically per primam and their treatment differs only in the treatment of the drain. The wound is inspected at the end of twenty-four hours and the amount of

serous discharge noted. Should the discharge be continuing and the drain not clogged up, it is only necessary at this dressing to renew the copious gauze dressing which has covered such a wound. A dressing of this kind should be done daily until the serous discharge is reduced to a minimum. Usually the discharge has ceased at the end of twenty-four or at most forty-eight hours and the drain may be removed and the wound not dressed again until the seventh day. Should it be found that the serous discharge has become somewhat thickened without entirely ceasing and that the albumin has coagulated on the drain and so reduced its draining power, the drain must be renewed and again inspected at the end of twenty-four hours.

Aseptic Wounds Healing per Secundam.—Wounds in which cavities exist which could not be obliterated by pressure and of such an extent as to require granulation tissue to fill them are usually packed. The primary tamponade should cause gentle even pressure upon all parts of the cavity. There is considerable escape of serum necessitating a change of the outer dressing at the end of twenty-four or forty-eight hours. The tamponade if unclogged, is not changed for three or four days. The packing is then removed and unless there is damming back of secretion a new packing is immediately introduced. Discharges lying upon the surface of the wound are carefully sprayed away with a mild antiseptic solution in an atomizer, and the wound surface dried. Redressings should be done every twenty-four or forty-eight hours according to the amount of wound discharge. When the shape and situation of the wound permit, tamponade should be discontinued and strapping or secondary suture done.

Secondary Suturing.—Secondary suturing is indicated in wounds which are healing by granulation and in which the wound is clean, particularly when such wounds occur in the neighborhood of joints or in places where large areas of cicatricial tissue are undesirable. Even if it is not possible to obtain accurate apposition of the wound surfaces, still healing occurs more rapidly and a stronger cicatrix is obtained. It should be performed as soon as the wound is clean and before profuse granulation has occurred. The surfaces of the wound should be

as accurately coapted as possible. It is especially necessary that the deeper parts of the wound should be coapted accurately. This is accomplished by passing the sutures deeply, taking in the depths of the wound. It may be necessary to freshen the edges of the wound and to curette away profuse granulations. If there is much tension of the skin, lateral incisions under the skin with loosening up of the skin flaps is permissible, always providing that there is no infection present. After freshening the wound surfaces pressure should be exerted until oozing has stopped. Wounds secondarily sutured should be dressed every two, three, or four days, according to the amount of discharge. Such wounds are more prone to disturbance of granulation, particularly to exuberant granulations, than primarily clean wounds. The treatment of the disturbances of healing is the same as in other wounds.

Infection of the Wound.—Mild infection may occur without fever, and with only slight evidence of local disturbance. The patient may complain of slight pain in the wound. In all wounds there is some pain for the first few hours following an operation. This pain subsides at the end of twenty-four hours only to recur if the parts are moved. Pain occurring after the subsidence of primary wound pain is to be regarded as an evidence of infection. This pain is caused by a swelling of the wound which causes the sutures to press upon the parts. In more marked infection, fever, pain, general depression, loss of appetite and headache may develop. Of these symptoms, fever and pain are the most common. Even if the fever is absent, however, infection cannot be excluded for the pus focus may be well walled off. This is the case in infection having its origin in a ligature acting as a foreign body. In such cases fever is delayed until the focus has enlarged considerably, while the recognition of such a condition may not be possible until it has approached the surface. The presence of both the symptoms of pain and fever makes the diagnosis of infection certain. The occurrence of one makes the diagnosis probable. A sudden rise of temperature marks the development or the extension of infection. So-called aspetic fever must not be mistaken for wound infection. *Aseptic fever* occurs during the first twenty-four hours following the operation;

the rise of temperature is gradual, rarely going above 102° F. It reaches its maximum twenty-four hours after the operation and quickly subsides, rarely persisting beyond forty-eight hours. It need occasion no anxiety. The character of the operation will enter somewhat into the amount of aseptic or reactive fever. In cases requiring extensive dissection, or in which the tissues have been exposed for a considerable length of time, aseptic fever is more apt to occur. Another cause for fever is *intestinal fermentation.* In every case of fever following operation the condition of the bowels should be inquired into, and if they have not moved freely, a laxative should be given except in operations upon the gastrointestinal tract in which case an enema is indicated. If the fever is due to constipation or fermentation, a thorough evacuation of the bowels will cause the temperature to subside. Continued fever, with acceleration of the pulse, and interference with the general condition of the patient always calls for an inspection of the wound. The symptoms will vary with the virulence of the infection and the resistance of the tissue. If there is free drainage and an abundant absorptive dressing as is the case in wounds healing per secundam, there will be but slight absorption, and in spite of the occurrence of infection the general symptoms will not be marked. In wounds completely sutured even the occurrence of slight infection may cause general symptoms. Upon the institution of free drainage the symptoms usually subside though it must be remembered that the simplest infection may result fatally.

Clinically, infection is designated as immediate, early and late. In *immediate infections* high temperature, rapid pulse and the rapid invasion of sepsis begin at once following the operation. Fortunately, such a state of affairs is rare and can be traced to a preventable cause, errors in aseptic technic. *Early infection* occurs from the third to the seventh day following the operation and is usually superficial. Upon changing the dressing a slight redness of the edges of the incision or in the neighborhood of the stitch holes is seen. As a rule, this readily subsides following the removal of the superficial sutures, or if this is not desirable a compress wet with mild alcohol-bichlorid solution may be applied to the wound. This is changed daily, kept moist and its evap-

orating qualities not interfered with. In other infections, also of a mild nature, but slightly more marked than the preceding, upon the removal of the dressing there is found in addition to the redness of the wound edges a drop or two of pus exuding either from the incision or from the suture holes, though for the most part the wound is healed. Both these mild forms of infection are due to bacteria in the depths of the skin itself, notably the staphylococcus epidermis albus. These bacteria are lodged so deeply in the skin that it is practically impossible to eliminate them. Fortunately, not only are they of little infective strength, but the skin itself is possessed of a high degree of resisting power. Removal of the skin suture at the site of infection, thus providing free drainage, and the application of alcohol-bichlorid solution will usually suffice to allay the inflammation. Should there be any tendency of the infection to spread, the entire skin wound should be opened. Even when all the suture holes and the entire skin wound are infected, the deeper portions may remain free from infection and healing in that part of the wound proceed uneventfully. In such cases the superficial parts are red and swollen and pus exudes. The sutures are seen imbedded in the swollen soft parts, the skin edges are glued together by a sticky exudate, a feeling of tension in the wound will be complained of, and there will be slight evening rise of temperature. Healing may occur with only very slight separation of the wound if the sutures are removed as soon as infection is discovered. The wound should be gently sprayed, gently dried and lightly packed. Too vigorous cleansing is undesirable. Small adhesive-plaster strips may be used to reinforce the wound edges, the support of which is weakened by removal of the sutures. If pain and fever are at all marked the entire skin wound must be opened up and free drainage provided for. In other cases it is only necessary to separate the wound edges at the points where pus exudes, spray away the pus and by small pledgets of gauze insure drainage. Rapid healing may be secured in such cases by careful and frequent dressings.

Still another variety of mild infection is shown in cases in which there is oozing of blood under the skin. This predisposes to infection. The prevention is thorough hemostasis. In the

early stages blood may escape from between the wound edges; later skin healing becomes complete and the swelling develops as a hematoma under the skin. Such effusion of blood becomes in part absorbed and in part organized. Should infection occur the clot breaks down and the usual symptoms of infection follow. In infections of this character the wound should be opened sufficiently to thoroughly express and wash out all of the infected clot. The resulting cavity is then lightly packed. As a rule, rapid healing results.

In aseptic wounds in which drainage has been used infection is shown by an increase in the amount of discharge and a change in its character from serum to sero-pus and finally to pus.

Late Infection.—Late infection manifests itself during the second week. It is usually a deep infection. Starting in the neighborhood of the aponeurotic structures of the wound, the clinical course of the wound thus infected is as follows: Healing proceeds apparently uneventfully until some time between the seventh and fourteenth day, when a sudden rise of temperature shows that infection has taken place. It may be that at the removal of the skin sutures on the seventh day absolutely no evidence of infection was apparent. Some days later, when the temperature rises and the wound is again inspected to see if the cause for the increased temperature resides there, careful inspection will show a swelling of the wound which originates in the deeper parts of the wound. Except for this swelling the superficial parts will appear normal. Such an infection may occur at a much later date, even four to six weeks after wound healing has apparently become complete. For this reason it is advisable to instruct patients to report immediately upon the occurrence of any strange sensations or appearance of swelling. This very late deep infection is caused either by an infected piece of suture or ligature material or by a piece of suture or ligature material which fails to become absorbed and which produces a foreign body suppuration. Such infections may also be due to deep hematomas, the result of inefficient hemostasis.

Treatment consists in passing a narrow bladed pair of anatomical forceps, closed, to the center of the swelling and withdrawing

them while separating the blades. This allows of the escape of the infection through the tract made by the forceps. The opening should be enlarged sufficiently to permit of free drainage, a small rubber tube is introduced for the first few days. When the discharge diminishes this is replaced by gauze drainage or strips of green silk protective. If the superficial parts are firmly healed the infection must be opened with a scalpel.

The treatment of such an infection should be initiated upon its discovery. It is futile to wait, in the vain hope that the swelling will subside. If not opened early the infection spreads and results in a subcutaneous, muscular or tendinous phlegmon according to the structure involved.

Stitch Abscess.—Stitch abscesses are either superficial or deep. The superficial are caused by the staphylococcus epidermis albus; the deep may be caused by this germ being carried to the deeper portions of the wound by the passage of the needle, but are quite apt to be deep infections endeavoring to find an exit along the suture. One suture only may be involved or all the sutures may be involved. Should the wound itself partake in the suppurative process, this must be opened up, offending sutures removed, and each stitch abscess opened up into the wound, the bridge of skin between the stitch abscess and the wound proper being incised, thus connecting the two. Necrotic and infected tissues should be curetted away, and the wound cleansed with the peroxid of hydrogen spray, and lightly packed with gauze wrung out of an antiseptic evaporating solution. Should the wound itself not be infected, each stitch abscess is to be treated as an independent infection, the stitch removed, the abscess opened, curetted and cleansed. The evaporating dressing should be kept moist. Here as in all infections the general rule must be followed as closely as the conservation of important structures will allow—the surface opening must be at least of the same size as the depth of the wound.

Retention of Secretions.—If only a portion of the secretion flows away, the remainder will stagnate in the wound and fever will result. The surface signs of inflammation will be slight, and if the stagnation is in the deeper portion of the wound these symptoms may be absent. There will be but slight pain on

account of the absence of tension. If the secretions infiltrate the tissues, or if there is no exit for them, the pain will be marked and the general disturbance will be greater. The pain varies from the pain of mild tension to a constant, agonizing throbbing pain which is increased by pressure or by movement. Fever may occur in an open superficial wound, even if there is no marked infection, in case the secretions are not absorbed by the dressing. In such cases frequent dressings are indicated. Upon changing the dressing the thick secretions will be found bathing the wound surface. It may be necessary to change the dressings in such a case two or even three times a day. Moist evaporating absorbent antiseptic dressings will decrease the infection. The free evaporation of the secretions must not be interfered with.

Retention of Secretions with Tension.—Here we have all the symptoms of abscess or phlegmon. The suture which overlies the point of greatest tension must be removed and an outlet provided for the escape of the retained secretions. If the removal of several sutures does not provide adequate drainage, and the general symptoms continue, more sutures are to be removed at a subsequent dressing. Free escape of secretions is essential. This is aided, as in the case of stagnation of secretions, by employing an evaporating antiseptic solution to moisten the gauze, thus increasing the rapidity of the evaporation of the discharge. There is the same necessity for frequent change of dressing. Such dressings, however, should not be employed until adequate drainage has been provided. As soon as the discharge lessens dry gauze dressings are employed. Should the local condition not subside under this treatment, the entire wound must be opened up and loosely packed with gauze. It may be necessary to make counter openings. In wounds involving cavities, even the opening of the entire wound may not provide adequate drainage, as in the case of tuberculous bone disease or empyema thoracis, in which event a second operation may be necessary.

Phlegmon. *Spreading Infection.*—Whenever infection occurs there is always a possibility of its spreading. If the wound secretions have free exit the tendency to spread is slight. Even in such a case, however, by reason of the virulence of the infection it may spread to adjacent tissues. This also occurs even with

germs of low infective power if drainage is interfered with. Phlegmons differ clinically according to the location of the infection.

The infection spreads in the direction of least resistance, as, for instance, in moderately loose connective tissue, or along connective tissue and intermuscular planes, or along tendon-sheaths. Where the anatomic peculiarities of the part present a barrier to the progress of the infection along the lines by which it has started the infection follows the line of least resistance until another plane of tissue is found. Obstructing bands of tissue have their blood supply interfered with by pressure of the inflammatory products and finally undergo necrosis. This is particularly true of fascia and tendon-sheaths. In *subcutaneous phlegmon* the skin is finally attacked, becomes reddened, stretched out, and perforation occurs. Where the phlegmon is restricted to the subcutaneous tissue the elasticity of the skin prevents any great degree of tension until nature has set a firm barrier of inflammatory tissue around the original focus of infection, thus preventing its spread. Usually the phlegmon becomes circumscribed early and readily subsides following incision.

Intermuscular Phlegmon.—This may follow rupture of the urethra, infected compound fractures, or infected wounds of the neck. The infection follows the course of the deeper fascial planes and being beneath them is not readily diagnosed. This is of much more serious import than the subcutaneous phlegmon, for the reason that the infection readily travels along the fascial planes and is only limited by the boundaries of these planes. The general symptoms are much more severe. The fever is higher. Repeated chills, slight in character, may precede the fever. The rapid pulse and apathetic appearance of the patient show the occurrence of general infection. The character of the pain in the affected area is dull, tense and not exactly located by the patient. The swelling is diffuse, most prominent over the center of the infection. An entire extremity may be involved. In the case of the neck, the infection may spread to the opposite side. The overlying skin becomes a livid bluish-red. This is due to pressure upon the deep vessels. As the inflammation approaches

the skin more pronounced redness develops. The overlying tissues are doughy to the feel, the deeper tissues give a sense of brawny infiltration. Fluctuation is first felt in the center of the infection. The center of the infiltrated mass becomes softened, and upon palpation it feels as if a hole had formed in the center of the infiltrated tissue. The function of the surrounding muscles is lost early. The part is kept in the least painful position and as a result contractures occur. Only rarely does the phlegmon approach the surface and rupture spontaneously. If early incisions are not made general infection occurs. Incisions must be made early to prevent widespread functional impairment of the part.

Tendinous Phlegmon.—This occurs most frequently in the forearm and hand. It may follow the inadequate incision of a felon. The phlegmon is initiated by fever and throbbing pain. Pain is sufficiently intense to cause sleeplessness. The swelling is exquisitely tender. On account of the density of the palmar fascia swelling may not be so prominent in the palm, but through the pressure of the secretions under tension will cause swelling on the back of the hand. Unless relieved by incision the tendency is to spread beneath the carpal ligaments to the tendon-sheaths of the forearm. When the tendon-sheaths of the forearm are attacked the whole forearm becomes swollen. Redness appears over the infected tendon-sheaths. These rupture and an intermuscular phlegmon is added. Such cases should be incised at the earliest possible moment, otherwise the tendon itself will surely be destroyed. Incisions must be free. In all three varieties of phlegmon early and free incision is the only rational treatment. Small incisions are of no avail. The treatment by parenchymatous injections of carbolic acid, the application of ice, and the inunction of ointments, is only mentioned to be condemned.

In the treatment of *diffuse cellular infiltration*, as, for instance, the cellular infiltration remaining after free evacuation of the primary focus of infection in the case of a palmar abscess, Bier's treatment by hyperemia is indicated. This may be accomplished by the application of a broad band of elastic in the course of the forearm and the Bier suction apparatus should be

used in addition. This treatment is of decided benefit in such diffuse infiltrations. It is only to be used, however, after adequate drainage has been provided.

Infection in Loose Cellular Tissues.—In loose cellular tissues infection spreads rapidly, as is the case in infection following operations involving the scrotum. The infection is usually of a mild character and rapidly subsides upon the provision of efficient drainage. The lower limit of the infection should be incised and a tube introduced to drain the infected cellular tissue. The position of the infected part should always be such as to favor drainage by gravity; and counter openings should be planned accordingly. Infection in cellular tissue underlying mucous membrane is treated by multiple punctures and scarifications with the application of evaporating lotions.

Aseptic Wounds in Infected Tissues.—A wound made in infected tissues is necessarily infected, and this infection must be disposed of before healing can occur.

The principles upon which the treatment of such a wound rests are adequate drainage and the hastening of the separation of the sloughing tissues. Such wounds are exemplified by furuncle, paronchyia and carbuncle. The wound is lightly packed with moist gauze and kept open. Incisions must be adequate. Moisture hastens the separation of sloughs. For this purpose alcohol-bichlorid is useful. The evaporating qualities of the gauze should not be interfered with. The dressings should be changed sufficiently often to prevent any stagnation of secretion. The margins of the wound should never be squeezed in the endeavor to evacuate pus as this results in forcing infection into adjacent tissues. Sloughs should not be forcibly removed. Those necrotic masses which come away easily may be removed. Irrigating with saline solution will wash away loosened necrotic masses. Peroxid of hydrogen sprayed on the wound through an atomizer will help in cleansing the wound. These wounds should be dressed at least once daily until the slough has separated. The parts should be kept absolutely at rest, and in such a position as to provide for the best circulation. Sprinkling naphthalin crystals over the wound will aid in separating the slough. After the wound has become clean dressings may be done every second

day. Such wounds are liable to be complicated by lymphangitis and lymphadenitis.

Retention of Secretion in the Wound through Blockage of the Drain.—There is slight fever and general and local discomfort. These symptoms may directly follow the operation, or supervene after several days of an aseptic course. Upon removal of the outer dressing only a slight amount of discharge is found upon it. The margins of the wound are slightly reddened and there is some pain. The removal of the drainage tube or gauze drain is followed by a gush of pus. The wound should be thoroughly cleansed with saline irrigation, and a drainage strip introduced. Following this the discomfort and symptoms of general infection disappear and the parts become normal in appearance. In any case in which drainage has been used the occurrence of fever should be looked upon as an indication for the removal of the drain to ascertain whether it has become blocked. In the case of tube drainage this is accomplished by inserting a smaller tube in the one to be removed and holding it there while removing the larger one. The *symptoms may continue after the drain has been removed*, the wound cleansed and a new drain introduced. This indicates a focus of infection which is not reached by the drainage. The drainage tract must be explored and the focus of infection found and efficiently drained. If this cannot be done through the original drainage opening, a counter-opening must be provided.

Removal of Gauze Drains.—These are moistened just before removal to render their removal less painful and to cause less traumatism. Half-strength hydrogen peroxid is useful for this purpose.

Irrigation of Cavities.—In irrigating cavities great care should be taken particularly if the cavity is in relation with the peritoneum, that fluid is not forcibly injected into the wound cavity with consequent forcing of infection into neighboring tissues. A free exit must always be provided. Especial care must be taken when using hydrogen peroxid.

Disturbances of Granulation.—The granulating process may proceed too slowly (sluggish granulation), too rapidly (exuberant granulation), or the surface of the wound may be covered with a tough gray elastic membrane (pyogenic membrane). In the

wound in which *the granulating process is sluggish,* the individual granulations will be small and rounded, with spaces between them. The granulations do not grow freely enough; they lose their red color and become grayish and shrunken. These sluggish granulations are quite apt to develop in old people or in patients with lowered vitality. The wound surfaces will either be quite dry or dotted here and there with tenacious secretion. The treatment consists in exciting granulation by sprinkling the surface with naphthalin crystals or with balsam of Peru. In a very sluggish wound the naphthalin crystals are first used with balsam of Peru; later, when granulations become more profuse, the balsam alone may be used, and finally, when an even surface results, oiled gauze. Curetting the wound stimulates granulation. Criss-cross incisions may be made through the floor of the wound and including the edges one-eighth of an inch apart and deep enough to reach healthy tissue. Through these incisions healthy granulations spring.

The wound, *the site of exuberant granulations,* presents a soft, mushy appearance and bleeds easily. The granulations fill the wound. There is profuse thin discharge. The cause may be a foreign body, such as a small piece of bone or ligature, or may be due to irritation from the shifting of the dressing or inefficient asepsis.

The treatment is to remove the granulations with scissors, to scrape the wound with a curette, and to paint the wound with either 50 per cent. nitrate of silver or equal parts of carbolic acid and iodin. If the *wound is covered by a tough membrane,* this should be dissected away and the wound painted with a 10 per cent. solution of chlorid of zinc. Following this, the wound is stimulated daily with naphthalin crystals and balsam of Peru. It may be necessary to use criss-cross incisions and to apply moist dressings to favor healthy granulation. This condition occurs most frequently in neglected wounds, such as old ulcers. Supporting the tissues in the neighborhood of the wound by adhesive-plaster strapping improves the blood supply. *Scarlet red* in 5 per cent. ointment increases the rapidity of epithelization over such surfaces.

Indolent wounds of all varieties are best treated by scrupulous

cleanliness and exposure to *direct sunlight* for a few hours daily. Two layers of thin gauze serve to protect the wound from dust while exposed to the sunlight.

Treatment of Varicose Ulcers consists (1) in correcting as far as possible the disturbed conditions of the circulation on which the ulcer depends; (2) in affording even and firm support to the vessels of the part, in order to minimize as much as possible the tendency to stasis. Elevation of the limb, with the patient in the horizontal position, whenever this is possible, is of material service in fulfiling the first indication, and systematic strapping and bandaging fulfil the second. In carrying out the latter, all antiseptic conditions should be complied with. Thorough shaving and scrubbing of the neighborhood, and irrigating with sublimate solution, should precede the application of the strapping. In case a hard elevated ridge circumscribes the ulcer, or a dense fibrous floor exists, it will be necessary first to incise these thoroughly in order that the vessels beyond and beneath the area of the ulcer may be permitted to find their way into the latter and convey suitable nourishing material for the purpose of repair (L. A. Sayre). These incisions should be made about a quarter of an inch apart, in the direction of the long axis of the limb, and should penetrate well through the hard fibrous floor above mentioned. An anesthetic is not necessary, under ordinary circumstances, as the incisions can be rapidly made, and the parts, as a rule, are not very sensitive. Bleeding having ceased, whatever blood remains on the surrounding skin should be carefully wiped away by means of a bit of dry sterilized gauze, while any clots which cling to the edges of the incision or remain on the ulcerated surface should be left undisturbed. These blood-clots will form an arbor or trellis-work, through the medium of which the surrounding and underlying vessels, which now have access from the cut edges of the incisions, will penetrate and form new granulation material. The circulation in the foot should be supported by either a snug flannel bandage or circular strips of adhesive plaster, systematically applied. These may reach to within about two inches of the edge of the ulcer. The ulcer itself is to be strapped in so-called "basket strapping." This consists of strips of diachylon or

resin plaster, cut in lengths about one inch less than will be sufficient to encompass the limb and not more than one inch wide. When practicable, it is better to cut the strips crosswise to the piece as it is furnished by the manufacturer. This facilitates their smooth application. Each strip, at the moment of application, is heated over the alcohol lamp. This sterilizes the surface which is to be applied to the ulcer, and at the same time increases its adhesiveness. The first strip is applied horizontally, and just overlaps the upper boundary of the flannel

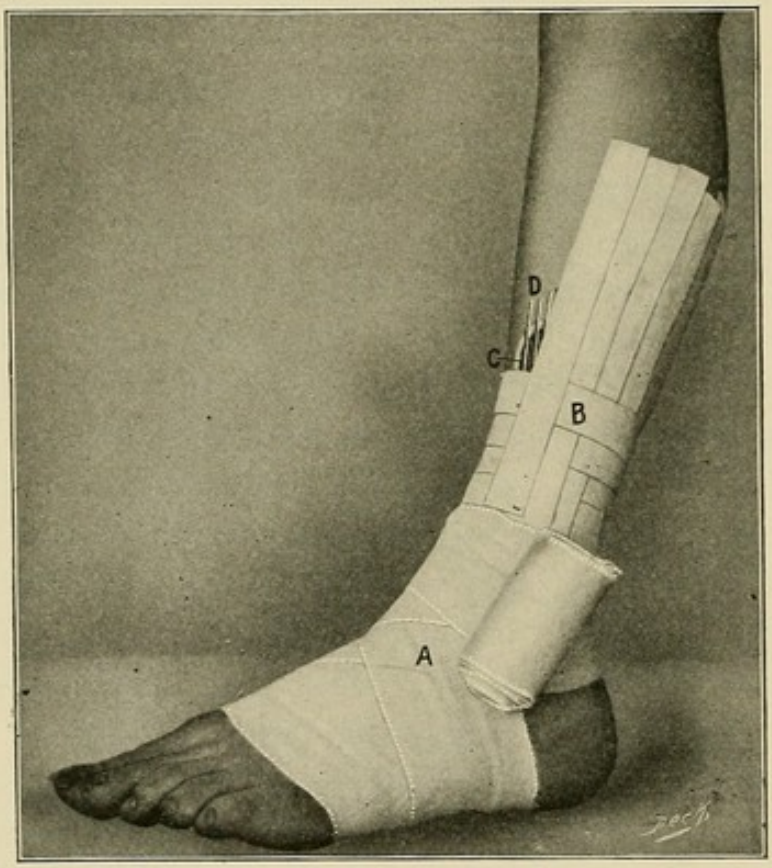


Fig. 153.—Basket strapping for ulcer of the leg. A, Bandage applied to foot and ankle; B, basket strapping; C, portion of ulcer remaining uncovered; D, incisions through base and edges of ulcer. (Fowler's Surgery.)

bandage; it encircles the limb. The next strip is placed vertically, or at right angles to the above, and is likewise placed at least two inches from the nearest border of the ulcer. The next strip is placed horizontally, and half overlaps the first. The next or fourth strip is placed vertically and half overlaps the second, or the vertical strip which has preceded it. The process is now continued in the same manner, alternate horizontal and vertical strips being applied until the entire surface of the ulcer

is gradually covered (Fig. 153). The strapping is carried well above and beyond the margins of the ulcer. An antiseptic compress, made of crumpled gauze and large enough to cover and overlap the plaster strapping, is now placed over the latter, and over all, including the flannel bandage of the foot, a roller bandage is firmly applied. Should no discharge or other evidences of disturbance occur, the dressings should be allowed to remain for from ten to fourteen days; the patient, as a rule, is permitted to walk about. At the end of this time the bandage and plaster are to be slit up with a pair of bandage scissors, care being taken in doing this to select a point sufficiently far from the site of the ulcer in order to avoid injuring this with the scissors. The bandages and plaster are now removed, the latter peeling off like the bark of a tree. Some tenacious secretion from the ulcerated surface will be found on the plaster, as well as on the neighboring skin. From the latter situation it may be removed with a piece of sterilized gauze; on no account should the gauze be permitted to come in contact with the ulcer itself. In lieu thereof a gentle stream of a mild antiseptic solution (boric acid 1:1000) should be allowed to flow over the surface of the ulcer until it is thoroughly cleansed. A striking change will be found to have taken place in the ulcer. In place of the hard and elevated edge, which will be found to have disappeared, there is a soft flattened margin, from which a white or pale blue line of new epidermis is already forming. The hard and smooth floor will have given place to a bed of soft and healthy granulations. The incisions, where they cross the margins, gape widely and are filled with healthy granulations. The antiseptic solution is not to be dried from the surface of the granulations; only the surrounding skin is to be dried. Precisely the same course is now followed as at first.

It may happen that the first dressings will need replacing before the time specified above, owing to the occurrence of discharge through the bandage; it is rare, however, that a bandage cannot remain on at least a week. Two or three dressings, except in exceptionally large ulcers, usually suffice, when the epidermal layer is found to have completely covered the granulating surface, and the cure is complete. The patient should

thereafter, in order to escape relapse, wear a silk elastic stocking to support the circulation in the part, care being taken in the beginning to place a piece of soft linen or lint over the newly-formed cicatrix in order that this may not become irritated and renewed ulceration occur. In case of the latter the skin-grafting method of Reverdin or that of Thiersch should be employed. Although chronic ulcers of the extremity are far more amenable to treatment now than formerly, there are still cases which are intractable, suggesting malignant disease. Still others extend deeply and involve the periosteum, necrosis resulting. In these cases, as well as in some instances which involve the entire circumference of the leg (circular ulcer), other measures failing, the resort to amputation is justifiable.



Fig. 154. Delatour's sinus curette. (Fowler's Surgery.)

Sinus.—It sometimes happens that following an infection the wound heals until only a small sinus is left. This may prove persistent. In treating a sinus a thorough exploration of it must first be made with a slender probe. The depth and direction of the sinus is noted, and also its width. It may be found to communicate with a cavity deep in the wound, or it may be found to widen out in its depths. In either of these events the external opening must be enlarged to correspond in extent to the depths of the sinus. The entire sinus surface is then curetted (Fig. 154) and packed with gauze saturated with balsam of Peru. This dressing should be renewed daily. In case of a simple sinus with no enlargement toward the bottom of the sinus repeated curetting will usually effect a cure. In very small sinuses a curettement followed by the injection of a few minims of 95 per cent. carbolic acid, or of a few minims of equal parts of carbolic acid and iodin, will usually serve to effect a cure. This is best done by means of a sinus syringe (Fig. 155). After allowing the carbolic acid to remain in the sinus for two minutes, the sinus is syringed out with pure alcohol. Sinuses treated in this way do not require drainage except possibly to keep the

external skin opening patent, in which event a short rubber tube is placed in the skin opening and kept from entering the depths of the sinus by means of a safety-pin.

In sinuses which have been in existence for a considerable time and in which the walls are hard and tough, the sinus is curetted and chlorid of zinc applied by means of an applicator. If a few treatments of this kind do not suffice for a cure, it will be necessary to dissect the sinus out in its entirety.



Fig. 155. Sinus syringe. (Fowler's Surgery.)

Occasionally the cause of a persistent sinus will be found to be an unabsorbed ligature or piece of suture material. The curette is usually not sufficient to engage the small piece of catgut or silkworm gut lying at the bottom of the sinus; to remove this, several loops of silkworm gut are fastened by silk to the flat end of a slender probe. This little apparatus is carefully introduced to the bottom of the sinus when the probe is twirled between the fingers so that the offending material is immeshed in the loops of silkworm gut and so removed. Persistent sinuses may be the result of tuberculous infection.

Thermocautery Wounds.—If the operation was done with a thermocautery, as in the treatment of lupus, gangrene, anthrax, and some forms of nevi, the resulting wound should be dressed for the first few times with boracic acid ointment. The eschar resulting from the use of the cautery separates in from eight to ten days, leaving an underlying healthy granulating surface which may be skin grafted, or the ointment dressings may be continued if the area is small. Scarring following the use of the thermocautery is remarkably slight where the entire thickness of the skin has been destroyed.

Care of the Skin in the Neighborhood of the Wound.—Wounds healing per primam are left alone. In wounds healing by granulation in which the process is not rapid great benefit is derived by gently *massaging* the skin near the wound. The

hyperemia produced results in the more rapid formation of new blood vessels. In all open wounds the skin in the neighborhood should be gently cleansed at each dressing both for the reason just given and to prevent *dermatitis* from irritation from the discharge.

Vaccine Therapy of Infection.—Immediately upon the appearance of infection a culture should be taken from the wound and a vaccine prepared for possible use. If alarming symptoms become manifest pending the manufacture of the autogenous vaccine a stock polyvalent vaccine should be given. Rarely under proper surgical care will it be necessary to use either stock or autogenous vaccine but should the emergency arise it is very comforting to the surgeon to have the autogenous vaccine ready. It must be remembered that vaccines are adjuncts to surgical treatment and not to be alone relied upon. They must be combined with the established methods of wound treatment. Although preliminary work had previously been done by others, the credit of establishing vaccine therapy on its present basis must be awarded almost entirely to Dr. A. E. Wright. Metschnikoff's work on phagocytosis is too well known to require more than mention. Wright went one step further by demonstrating that before phagocytosis could take place a substance must be present which acts on the bacteria and prepares them for ingestion by the phagocytes. These substances, apparently specific for each species of bacteria, he calls "opsonins." The amount of these opsonins in any given case he measures by ascertaining by appropriate means the phagocytic capacity of the individual to be tested toward a specific organism and comparing it with the phagocytic capacity of a "pool" of blood taken from several normal persons and mixed. This comparison gives what he calls the "opsonic index."

Wright further showed that the opsonin content of the blood could be increased by the subcutaneous injection of bacteria killed by heat.

On this basis, "Vaccine Therapy" consists in the attempt to produce an active immunity by the injection into the tissues of dead bacteria, thus increasing the opsonins; or in more general terms, stimulating the production of specific antibodies.

In the beginning this method of treatment was used only in connection with the opsonic index. The index was taken before and after the injection, and repeated at intervals. A second dose was administered only when the opsonic index was believed to have reached its highest point or begun to decline. It was found that the first effect of the treatment was to cause a lowering of the opsonins, to cope with the bacteria and toxins injected, and this has been called the "negative phase" and corresponds to a period of lessened resistance. This lasts about twenty-four hours and is followed by a gradual rise to and above normal, the so-called "positive phase," after which the opsonins begin to decline again. This period with moderate doses lasts eight or ten days. It is the aim of treatment to repeat the dose at the top of each successively increasing wave of the positive phase, thus producing a steadily increasing immunity.

Later experience has demonstrated that to a large extent this mode of treatment may be carried out depending on the clinical symptoms as a guide to dosage and intervals, thus doing away with the tedious, difficult, time consuming and necessarily expensive "opsonic index" and thus greatly extending the possibility of the treatment.

It is perhaps too early to speak dogmatically as to the value of this mode of treatment, but increasing experience seems to demonstrate more and more its safety and efficiency. Given a proper dose, at suitable intervals, in proper cases, bacterial vaccines may be said to be perfectly safe. Wrongly given they are capable of doing much damage, but the same is true of any powerful therapeutic agent.

To produce such vaccines, the specific organisms are cultivated in the incubator for twenty-four hours on the surface of a solid medium such as bouillon agar or other medium, depending on the requirements of the specific organism. A little sterile saline solution is then poured over the growth, which is gently scraped off with a sterile platinum needle.

The resulting emulsion is then well shaken in a tube with a few glass beads to break up the clumps, and the resulting vaccine is standardized as follows: In a capillary pipette, one volume of vaccine emulsion, one of blood, of normal standard (5,000,000

red cells per cm.) and three volumes of 2 per cent. sodium citrate solution to prevent clotting, are thoroughly mixed and one drop spread on a slide and stained, as for blood counting. With a crossline eye piece micrometer the number of red cells and also of bacteria in a number of fields are counted, and the number of bacteria in 1 cm. of the emulsion calculated. This is then diluted to a suitable strength with sterile normal saline solution. The next stage consists in killing the bacteria by heating to a suitable temperature for one hour on three successive days. In the case of the pyogenic cocci, 60° C. is found to work well. After sterilizing, the product is tested by culture to prove that it is sterile, and is then ready for use. An autogenous vaccine requires four or five days or more to make, so a stock vaccine may be used in the interval. In some cases, *e.g.*, gonorrheal infections, outside of the urinary tract, stock vaccines are said to act as well as autogenous. Pyogenic infections, and those with colon bacilli do better if treated with autogenous vaccines. If stock vaccines are used those are best if "polyvalent"—*i.e.*, made from several different strains of the same organism from diverse sources. Combined vaccines are made of a mixture of several different organisms—*e.g.*, colon bacilli, streptococcus, staphylococcus—and may be used in mixed infections or in emergency when the infecting organism is unknown.

Dosage.—No specific rules can as yet be laid down. Each case must be judged individually in accordance with the symptoms and the degree of reaction. The dose is measured by the number of organisms injected, *not by the bulk of the fluid.* Ordinary doses for adults vary from 5,000,000 to 1,000,000,000. Acute cases call for small doses at short intervals—one to four days. As the symptoms improve, larger doses and longer intervals become the rule. If the reaction is very marked, as shown by increase of fever and other symptoms or locally by marked swelling, pain, tenderness and redness, this is an indication for lessening the dose and increasing the intervals. Large doses, of several hundred millions should not be repeated oftener than eight or ten days apart, as it takes that long for the opsonins to reach their height. The more virulent bacteria are naturally given in smaller doses—*e.g.*, streptococci, two to fifty millions.

Staphylococcus pyogenes and colon bacillus vaccines are given in doses of fifty to five hundred millions or sometimes more.

In the acute cases, small doses avoid the production of a negative phase, and the positive phase, though produced promptly is relatively slight and transient.

Staphylococcus infections (albus, aureus, citreus) including boils, felons, carbuncles, septic wounds, post-operative sinuses, do well almost invariably when treated with the appropriate vaccine. Failure here usually indicates either the selection of the wrong vaccine at the start, or a subsequent infection with some other organism. A conservative initial dose would be 50 to 100 millions, and if no marked reaction occurs, this may be repeated in a day or two. As the patient improves the dose may be increased to 750 to 1000 millions every eight or ten days.

Streptococcus infections do well under vaccine treatment, more particularly the local forms. The dose of streptococcus vaccines is always small as compared to most others, two to fifteen millions are all that should ordinarily be given. Erysipelas yields well and certainly to appropriate treatment. The following rules for dosage, according the Ross are quoted from Synnott: "Five million streptococci are given to a severe case in the first inoculation and ten if the case is less severe. On the second day the severe case is given five million more if there be signs of improvement. The most important of these latter, according to Ross, is a clearing of the intellect and less tenderness and pain in the local condition. There may be a moderate fall in the temperature on the morning following the injection. A drop of two or three degrees would be a valuable indication for a second inoculation. If the severe case shows no improvement the second inoculation should consist of only two and a half million. In less severe cases improvement is almost always manifested after twenty-four hours and the patient receives half the first dose or five millions. Thereafter two and a half, five or ten million are given every second day until a week after the temperature has reached normal, and the erythema has subsided. The severity of the infection must be our guide to dosage. The more severe the case and the less satisfactory the clinical response, the smaller the dose."

Colon bacillus infections of the genito-urinary tract and elsewhere may be treated with vaccines with benefit. Autogenous vaccines are necessary in these cases, as the various strains of colon bacilli vary so that stock vaccines have proved very disappointing. At best, treatment with colon bacillus vaccines is somewhat uncertain. Many cases are cured promptly some are improved, and in some cases no amelioration is produced. The initial dose is five to twenty million and this may be continuously increased to as much as five hundred million every ten days.

Gonococcus vaccines up to the present time have been disappointing in acute urethritis, but constitute a valuable therapeutic measure in gonorrheal rheumatism and some cases of chronic gonorrheal urethritis. Stock polyvalent vaccines give as good results as autogenous vaccines. Dose, one to fifty million.

The pneumococcus is sometimes responsible for surgical lesions, such as empyema and otitis media. The appropriate vaccine is indicated, initial dose, fifteen to twenty million.

Antitoxins.—In the case of three diseases only has the use of an antitoxin (serum) been followed by dependable results: viz., diphtheria, tetanus, and epidemic cerebrospinal meningitis. Diphtheria will not be here considered as not being ordinarily a surgical disease.

In tetanus the results are not so uniformly gratifying as in diphtheria, but the method is of great value. Large doses of the serum are indicated in the presence of the disease up to as much as fifty thousand units several times a day until amelioration sets in. The value of tetanus antitoxin as a prophylactic in suspected wounds is certain. Fifteen hundred units as early as possible after the injury repeated in ten days is the usual dose.

Antimeningitis serum, introduced by Flexner has shown brilliant results in the treatment of meningitis due to the meningococcus. The spinal canal is punctured under aseptic precautions in the usual manner and a quantity of the subdural fluid at least equal in quantity to the volume of serum to be injected, is first drawn off, the syringe then attached and the serum injected directly into the subdural space. Subcutaneous injection is

useless, as the serum must come in direct contact with the cocci localized in the spinal canal.

Bier's Hyperemia.—The aim of Bier's hyperemic treatment is to increase the usual inflammatory hyperemia brought about by nature in its fight against the disease present, and where it is lacking to stimulate it. Whatever method be used to produce or increase hyperemia the blood must continue to circulate and there must never be a stasis of the blood.

Advantages.—The advantages claimed for the treatment are the suppression of infection, the avoidance of suppuration in many cases, the possibility of using a small instead of a large incision in cases where suppuration has already set in, the hastening of the course of the pathologic processes, the favoring of absorption, the diminution of pain and the wide field of its application.

Passive or venous hyperemia may be induced by means of an elastic bandage or band, or by means of cupping glasses of various size and shape. Active or arterial hyperemia may be induced by means of hot air.

Bier's Hyperemia by Means of an Elastic Bandage.—The hyperemia of parts other than those diseased is not deleterious. An elastic band or bandage according to the configuration of the parts is applied at the most convenient healthy place between the area of inflammation and the heart, firmly enough to *slightly* constrict the veins but not so firmly as to compress the arteries. This latter is determined by palpating the pulse below the bandage. The tendency is to apply the bandage too tightly, therefore it must be emphasized that Bier's hyperemia is not a stasis hyperemia.

Feelings of the Patient.—If any complaint of pain or a sense of constriction or paresthesias are noted, the bandage has been too tightly applied. Too tight application of the bandage results in too rapid turgescence of the subcutaneous veins. The extremity assumes a bluish-red appearance, and later red blotches and small cutaneous hemorrhages occur, while later still cyanosis becomes extreme and the pulse disappears if the constricting band is not loosened. There should be absolutely no increase in pain. Less frequently the bandage is applied too

loosely resulting in a slight obstruction to the return of the lymph but producing no venous congestion whatever.

The band or bandage employed varies with the part to which it is to be applied. If applied along the course of an extremity a soft rubber bandage two and one-half inches wide and of a length sufficient to surround the limb six or eight times is used. In applying the bandage one layer overlaps the other by about one-half inch so that pressure is distributed over a comparatively wide area. The bandage may be secured by a strip of adhesive plaster, by pinning or by tying it with tapes sewn to the bandage. If there is a tendency for the bandage to slip more turns may be used or the bandage may be additionally secured with adhesive plaster strips. Where the bandage is to remain for long periods or in persons with tender skin, a flannel bandage is applied beneath the rubber bandage. It is not necessary to always reapply the bandage in exactly the same place. A slight change in position at each reapplication will obviate skin disturbances. In affections of the upper and lower extremities the bandage is placed around the arm or thigh as here the entire venous return is under control of the bandage. For producing hyperemia by band in the neighborhood of the shoulder-joint a rubber tube is fastened with a tape or clamp snugly about the shoulder. This is held in place and its tension increased by a broad bandage passed through it and around the neck. A piece of bandage is fastened to the tubing in front and behind, the ends being tied in the axilla of the opposite side. Hyperemia by constricting band is not possible in the neighborhood of the hip-joint. Arterial hyperemia can be produced but not venous.

In producing hyperemia of the head a strip of elastic webbing three or four inches wide with a hook at one end and a number of eyes on the other is used. The band is applied about the neck below the larynx; on either side a piece of soft material such as felt or lambs' wool is tucked beneath the bandage over the jugular vein.

For producing hyperemia in the treatment of diseases of the testicles, a piece of rubber tubing of convenient length and size surrounds the root of the scrotum, the necessary tension being secured by a small clamp or tape. Skin irritation is prevented

by placing a layer of soft material beneath the tubing. The degree of hyperemia is judged by the appearance of the superficial veins.

Care of the Wound during the Hyperemia.—All dressings are removed except a few layers of gauze loosely held in place. The parts are maintained in a comfortable position. In acute infections the rapid absorption of the inflammatory edema accompanying hyperemia is often accompanied by a temporary rise in temperature. Hyperemia causes more profuse wound discharge, hence more frequent change of dressings is indicated. It must be borne in mind that hyperemia is not the cure of infection but is only an adjunct to ordinary surgical treatment. It helps nature abort infections in the early stages, causes more rapid localization of infection in the later stages and by causing freer osmosis through the wound hastens the separation of sloughs and the healing process generally.

Edema accompanying Hyperemia.—A certain amount of lymphatic edema necessarily accompanies hyperemia that is continued for several hours. This edema becomes absorbed during the period of rest between the applications of the hyperemia, unless it has been necessary to continue the hyperemia for long periods of time, twenty to twenty-two hours out of the twenty-four, in which case the absorption of the edema is favored by elevation of the affected parts during the rest period.

Duration of Application of Hyperemia.—Acute inflammatory processes require prolonged application, twenty to twenty-two hours a day. Chronic affections, particularly tuberculous cases, require two to four hours a day.

Hyperemia by Means of Cupping Glasses.—These cups are of various shape and size to fit different parts of the body. To the glass is attached a rubber bulb or provision is made for attaching a rubber tube with a three-way stopcock to which a suction pump may be attached. Large forms are made in which the hand and part of the forearm may be placed or the foot and part of the leg; also apparatus for the elbow-joint and for the knee-joint.

Technic.—In using the smaller cups the edge of the cup is first smeared with vaselin. With the rubber bulb collapsed, the

cup is applied to the parts; releasing the rubber bulb causes a vacuum within the cup. The underlying tissues are sucked up into the cup and this causes hyperemia of the area which extends into the deeper tissues. Care must be taken not to produce too much suction. The skin should be bluish red, never white. With the larger cups the vacuum is produced by means of a vacuum pump.

Care of the Wound during Hyperemia by Suction.—The suction apparatus serves two purposes; it not only produces hyperemia in the parts but also serves to cleanse the wound. Wound discharges are aspirated slowly. Suction may be sufficient to drain away the necrotic tissues. In most instances packing or tube drainage of the wound treated in this manner is not necessary. Following the removal of the cup the surroundings of the wound are cleansed and an external dressing applied. At the first application of the cup some bleeding may occur; this as a rule does not continue and need occasion no alarm.

Duration of Application.—Bier's advice is to apply the cup daily six times for five minutes with intervals of three minutes between the applications. The duration of the application, however, will vary somewhat with individual cases. The rest periods are for the purpose of allowing the subsidence of the accompanying edema. Care in the application will prevent soiling of the rubber parts. The cup and glass parts are boiled and kept sterile.

Larger Apparatus.—In the use of the larger apparatus for the hand, foot, knee, elbow, etc., the rule that the application shall be absolutely painless and shall not interrupt circulation must be borne in mind. Such apparatus is not only useful in the treatment of infection but has given excellent results in mobilizing stiff joints.

Bismuth Paste (Beck). *Technic of the Injection.*—Two formulas are employed. The first consisting of one part bismuth subnitrate, arsenic free, and two parts vaselin either yellow or white, is employed for diagnostic purposes and for the first treatment injection. Should a longer retention of the paste be desired the following formula which makes a firmer paste may be employed:

Bismuth subnitrate	30 per cent.
Vaselin	60 per cent.
Paraffin (120° melting-point)	5 per cent.
White wax	5 per cent.

In preparing formula No. 1 the vaselin is first boiled in an enameled jar and the bismuth powder stirred in while cooling. Care should be taken to exclude any water from the mixture as this will destroy its homogeneous consistency and prevent it from becoming firm. The resulting paste is smooth and yellow and upon being heated over a water bath becomes sufficiently liquid to allow its being drawn into a glass syringe. Formula No. 2 is prepared in the same manner, the paraffin and white wax being stirred in while the vaselin is still boiling. Various types of glass and metal syringes are used for the injection according to the character of the sinus cavity to be filled.

On injecting a sinus the external opening and its surroundings are cleansed with alcohol; there is no preliminary irrigation or curettage. With the tip of the syringe placed so as to fully occlude the opening of the sinus the liquefied paste is injected slowly and with gentle force until the patient complains of pressure or there is such resistance as to cause a return of the paste. The syringe is then removed and pressure made against the external opening of the sinus to prevent the return of the paste until cooling and consequent hardening occurs. All the ramifications of the sinus will be penetrated by the liquefied paste which, in the case of formula No. 1 will remain long enough to allow of radiography of the injected region. Such a radiogram shows a clear picture of the sinus and its ramifications and in many instances traces the sinus to the original focus of disease. Hardening occurs quickly after the use of formula No. 2. The quantity to be injected varies with the character of the sinus. Except in sinuses with large drainage openings it is not advisable, however, to inject more than 100 grams.

Contra-indications.—Injections of bismuth paste are contra-indicated in acute inflammatory conditions. The Becks have occasionally noted aggravation of symptoms after its use in acute cases. The paste should never be administered through a hypodermic needle as in such a procedure there is danger that

some of the paste may be forced into a vein and so act as emboli. Great care should be exercised in injecting the paste in sinuses which may have their origin in the cranium as here there is a possibility that the injected material may find its way into the subdural space. An injection should never be made into fistulas communicating with the gall-bladder or pancreas.

Causes of Failure.—Sequestra are the most frequent causes of failure. These can be recognized by radiography using formula No. 1. Their removal is indicated before making an injection with formula No. 2 unless the operation is one of magnitude, in which event formula No. 2 may be injected, though without a certainty of cure. The Becks report two instances in which sequestra have healed in under the bismuth treatment.

The second cause of failure is found in not using the paste soft enough to permit its being gently forced into the remotest parts of the sinus and filling it completely. If some small branch is missed the suppuration will continue and in time the entire tract will become reinfected.

The Course of Cases Injected.—If after the first injection the purulent discharge changes into a serous one a good result is to be anticipated and closure usually follows. Should the discharge remain purulent, however, the case is apt to prove more tedious. After a week a second injection is made and subsequently an injection is made every three or four days for about a month. Daily dressings with frequent microscopical examinations of the wound discharge are made during this time. When the discharge no longer shows microörganisms a 10 per cent. paste is substituted for the greater strength, or sterilized vaselin alone may be employed.

If no improvement is noted the cause of failure must be searched for.

Dangers. Toxic Effects following the Injection.—There have been reported numerous serious cases and some fatal ones resulting from this treatment. Careful observation of each case and the use of the paste only according to indications, in chronic suppurations in which the thick walls of the tracts do not permit of ready absorption, and the avoidance of its use in acute suppurations will prevent fatalities. The first symptom of slow

absorption is a pale, livid tint of the skin; following this small bluish ulcers appear on the gums. Later nausea, headache, vomiting and albuminuria supervene. As the absorption continues the ulceration of the gums increases, the patient becomes emaciated and gradually succumbs. Close observation in all cases will detect the early manifestations of poisoning. The injection of the cavity with warm sterile olive oil which is allowed to remian from twelve to twenty-four hours until it has formed an emulsion with the paste and the removal of this emulsion by aspiration will prevent the further appearance of untoward symptoms. To ensure that the paste is removed the cavity can again be injected with olive oil and washed out several times with it.

CHAPTER VIII.

HEMORRHAGE.

Post-operative hemorrhage. Hemophiliacs. Primary oozing. Secondary hemorrhage. Hemorrhage from vessels of large caliber. Hemorrhage due to loosening of the ligature. Hemorrhage due to infection or erosion. Hemorrhage due to vascular paresis. Hemorrhage due to blood clot. Diagnosis. Treatment. Treatment of late secondary hemorrhage. Intravenous saline infusion. Intravenous infusion without dissection. Hypodermoclysis. Autoinfusion. Direct transfusion. Crile's method. Brewer's method. Elsberg's method.

Post-operative Hemorrhage. Hemophiliacs.—Occasionally such subjects require operation. Whenever possible hemophiliacs should be treated before operation by administering twenty-grain doses of calcium lactate four or five times daily. If the necessity for the operation does not permit of delay the administration of calcium lactate should be begun immediately following the operation. Saline infusion is contraindicated, but copious hot saline enemata should be employed. The inhalation of carbon dioxid gas has some effect in controlling the oozing. Thyroid extract is useful in some cases. The subcutaneous daily injection of several ounces of human or horse serum has proven of value. The oozing is best controlled by direct continuous pressure applied to the source of hemorrhage. Adrena-

lin solution 1 : 1000 may be applied to the wound as a temporary expedient. Rectal enemas of 5 per cent. gelatin solution are sometimes useful but may result in embolism. Ergot is administered by mouth. When the bleeding has been finally arrested the patient is given Blaud's mass, ten grains, three times a day, and the diet made as nutritious as possible.

Primary Oozing.—In wounds in which hemostasis has not been exact, or in which large areas have been opened up, the primary oozing will be profuse. At the time of the operation, owing to the depression of the heart from the anesthetic, there may have been no signs of oozing. Upon recovery from the anesthetic, however, and upon the rising blood pressure from the patient thrashing about in coming out of the anesthetic, the increased vis a tergo may be sufficient to displace the small blood clots in the mouths of the capillaries, and more or less oozing follows. Usually this is not sufficient to be serious. The most that happens is the saturation of the wound dressings with bright blood. The dressings should be changed immediately and the wound repacked. If the dressings are not changed the blood will form a soft clot on the surface of the wound after having saturated the dressings, and this still further favors bleeding. In case there is only slight primary oozing, not sufficient to soak the dressings, it is only necessary to apply fresh gauze to the outside of the wound dressing and to bandage snugly. Primary oozing favors the occurrence of infection by furnishing a culture medium.

Secondary hemorrhage may occur early or late in the course of wound healing. In case drainage has been employed the blood will usually escape externally to some extent; in other cases the blood will escape into the adjoining tissues or into a cavity of the body. Bleeding may take place gradually or very quickly. In the former event *oozing* may continue from the time of the operation. As the depressing effects of the operation and anesthetic wear off and the heart action recovers somewhat, the blood escapes more quickly from the open capillaries, and the oozing, which was but slight at the time of operation, and seemingly well controlled by simple pressure, may assume alarming proportions. In such an event if the escape of blood is noticed externally, as in the case of operation upon the surface, it is not probable that

sufficient blood will be lost to be dangerous before remedial measures are instituted. If, however, as in operations upon the pelvic viscera where many adhesions have been encountered, the oozing occurs under the packing, lifting it up and forming soft clots which favor further oozing, the tell-tale packing and drainage strip may not be efficient in absorbing more than a very small percentage of the effused blood, the remainder escaping into the general peritoneal cavity (concealed hemorrhage). Usually in cases which ooze somewhat at the time of closing the wound and in which packing is employed, the oozing stops, and before the depressed heart action has become normal coagula of sufficient strength have formed in the open ends of the capillaries to withstand the increased blood pressure. Such a happy occurrence does not always take place, therefore cases in which large raw surfaces are present must be carefully watched. The oozing in these cases is very insidious and the symptoms may be mistaken for prolonged postoperative shock. This belief may be maintained and measures employed to combat the supposed shock, with the result of raising the blood pressure and producing further bleeding.

Hemorrhage from vessels of larger caliber may occur while the patient is recovering from the anesthetic. Such vessels may have passed unnoticed at the time of the operation as the blood pressure was not sufficient to cause more than a trifling oozing. During the involuntary struggling of the patient while recovering from anesthesia the blood pressure is raised and a sharp hemorrhage ensues. This is more readily diagnosed than the insidious oozing of the first variety of secondary hemorrhage, which has been noted above.

Hemorrhage Due to Loosening of the Ligature.—If the ligature has been carelessly tied—*i.e.*, a "granny" in place of a square knot—bleeding may occur at any time within twenty-four hours. In large vessels a simple square knot may be tied in place of a Ballance and Edmunds stay knot, with the result that the continued impulses from the heart either cause the knot to loosen or to be pushed off the cut end of the vessel. For this reason also the ligature should not be placed too near the cut end of a large vessel. Yet another cause of secondary hemorrhage is to be

found in too early softening of the ligature. This cause is rare except in the case of large vessels, for in small vessels twenty-four or at the most forty-eight hours' ligation is sufficient time for the vessel to become firmly occluded.

Hemorrhage Due to Infection or Erosion.—With the aseptic precautions of the present day, hemorrhage from this cause is rare. The ligature itself may be the cause of the infection, or infection may arise in the surrounding tissues and attack the vessel wall. In either event the usual time for such hemorrhage to occur is ten days after the ligature is applied. Exceptionally the vessels themselves are involved in a septic process, when erosion of the vessel wall and consequent hemorrhage may occur at any time, after two or three weeks even, during the activity of the septic process.

Hemorrhage Due to Vascular Paresis.—A too tightly applied Esmarch bandage or tourniquet, or one which has been left in place for a long time, four to ten hours, as is sometimes necessary in cases of traumatic amputation when the condition of the patient does not permit of immediate interference, causes a paresis of the vessels of the limb. Several hours after the tourniquet has been removed and when the blood-pressure has been raised somewhat, oozing begins and may continue until a dangerous amount of blood has been lost unless means are taken to control it.

Hemorrhage Due to Blood Clot.—The formation of soft blood-clots produced by an insignificant amount of oozing may result in a more pronounced hemorrhage, as bleeding is favored by the formation of such clots.

Diagnosis.—The diagnosis of secondary hemorrhage with escape of the blood externally is a simple matter. Such also is the case when a sudden, sharp hemorrhage occurs, even when there is no escape of blood externally. In the latter the blanched lips, cold skin, restlessness, rapid and panting respiration (air hunger), the excessive thirst, and subnormal or normal temperature with rapidly weakening and increasing pulse-rate are diagnostic. In the former the symptoms may not become so severe, for the escape of blood externally will serve as a warning. In cases of slow oozing with escape of blood externally the diagnosis should also

be easily made before severe symptoms develop. In those cases of oozing, however, in which there is but slight or no escape of blood externally the diagnosis is extremely difficult. One does not know at first whether one is dealing with a case of prolonged shock or of concealed secondary hemorrhage. To establish a diagnosis one must be thoroughly conversant with the operative procedure employed. If the operation has been one involving the separation of numerous and dense adhesions, there has probably been left a small drain as a tell-tale. Should there be no blood or but slight staining upon this, remove it, and, if necessary, enlarge the opening through which it emerged so as to allow of the escape of fluid blood.

Treatment.—To be efficacious treatment must not only be prompt but must be intelligently directed. Not one unnecessary drop of blood should be allowed to be lost. Particularly is this true in the case of young children and old people who bear poorly the loss of even small amounts of blood. First, by a review of the condition present at the operation, the probable source of the hemorrhage should be ascertained. Second, appropriate means for its control should be immediately instituted. *Above all, do not stimulate the circulation until this bleeding has been effectually stopped.* The means for accomplishing this are the same as those used at the operation. Whether or not an anesthetic may be employed will depend upon the condition of the patient. If the patient is not much depressed by the loss of blood, and the source of hemorrhage is deeply situated, an anesthetic may be given. If the patient is much weakened, or if the bleeding vessel or oozing area can be readily reached, it is best not to use an anesthetic. If the restlessness of the patient is uncontrollable an anesthetic must be used. Every bleeding point is to be secured, either by direct ligation or circumligature. It may be necessary in some cases to ligate a vessel at a distance from the wound. When there is a general oozing with no visible vessel the thermocautery may be used, but styptics are never to be employed, as they predispose to later bleeding. Tamponade in cases of secondary hemorrhage may be used to supplement the means outlined above. In hemorrhage due to vascular paresis, consider whether the main vessels have been effectually

ligated. If this is decided in the affirmative, do not remove the inner dressings. Remove the outer dressings and apply fresh gauze, then apply a snugly fitting rubber bandage from the most distal portion of the extremity to the former site of the constrictor, elevate the part, and keep it quiet. In this class of cases the elastic compression controls the oozing and the course of the wound is not interfered with. The tension of the bandage is lessened every twelve hours.

In secondary hemorrhage occurring under large flaps—as, for example, after extensive plastic operations—before removing the sutures and thereby endangering the success of the operation, remove the dressings, press out all fluid blood and particularly all clots, for hemorrhage continues more readily under soft blood-clots, and apply firm, even pressure to the part. Though the wound dressing may be soaked with blood, this does not necessarily mean a large loss of blood, as gauze is very hydroscopic. It will usually be found that firm pressure is sufficient, and no anxiety need be felt, particularly if one is certain of the accurate ligation of the larger vessels. In wounds of the surface which have been packed to control oozing, and in which clots form in and beneath the gauze and hemorrhage occurs, the packing should be removed, the wound cleansed of clots, and a fresh packing introduced.

When the site of the hemorrhage permits the Esmarch bandage or digital compression should be employed until more radical means can be used.

Whenever it has been necessary to remove the sutures and open the wound, the normal wound apposition should be restored as quickly as possible. If this is impracticable at the time, secondary closure may be resorted to at a later period. Rigid asepsis is essential.

In the *treatment of late secondary hemorrhage* occurring as the result of erosion of a vessel from sepsis, control is at times difficult. A slight bleeding may precede a more marked hemorrhage. The wound should be firmly packed and the part elevated. In the case of an extremity the joint proximal to the wound should be flexed to compress somewhat the main artery. If bleeding continues the vessels must be isolated and ligated.

If it is not possible to do this in the wound itself by reason of the septic condition present, the vessel may be exposed through healthy tissue at a distance from the wound and there ligated. In desperate cases it may be even necessary to perform an amputation in the case of an extremity.

Following or coincident with the control of the hemorrhage various procedures are instituted to overcome the effects of the bleeding.

Intravenous Saline Infusion. *Indications.*—In cases suffering from shock; in cases in which a large amount of blood has been lost; in cases where the function of the kidneys has been suspended; in cases in which there are toxins in the blood the rapid elimination of which is desired. In this latter class are septicemia and delirium tremens.

Physiologic Action.—In the amount of from forty to sixty ounces and at a temperature of 115° F., intravenous saline infusion raises the blood pressure by increasing the amount of fluid on which the heart can work, while by its heat it stimulates all the body functions. The disturbed circulatory rhythm is reestablished.

In shock, by increasing the amount of fluid upon which the heart has to work, the great volume of blood which has been stored up in the abdominal veins is forced into the general circulation. The high temperature of the solution is of inestimable benefit.

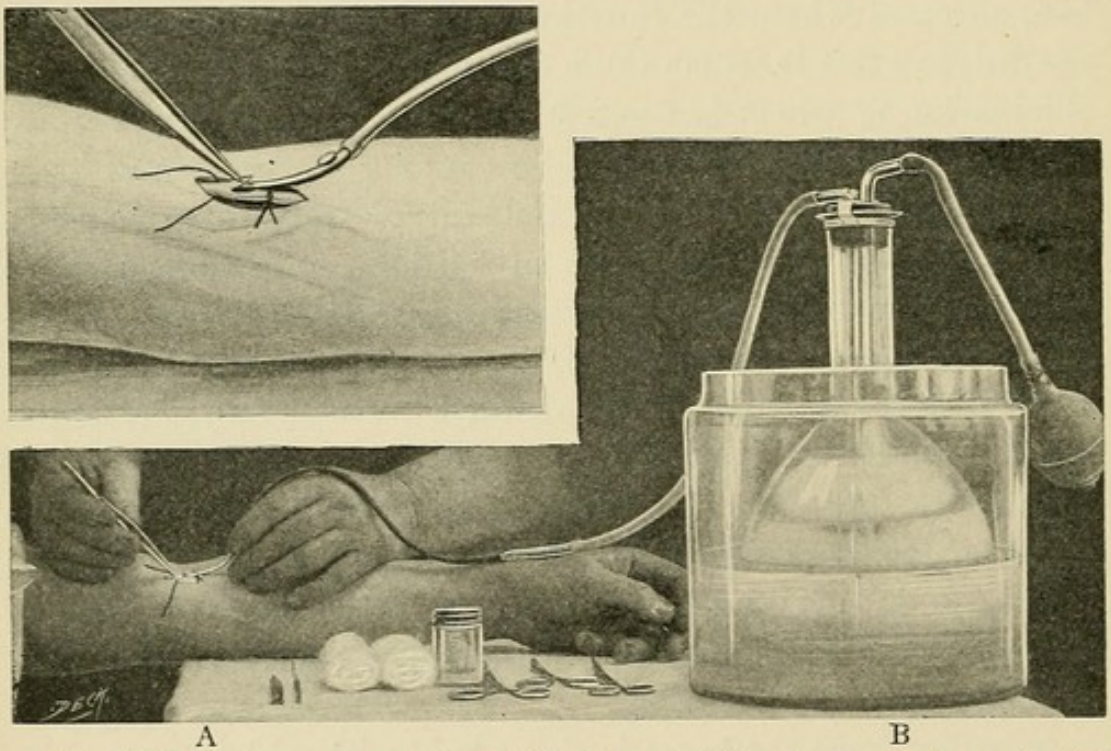
In hemorrhage the heart is given fluid with which to carry on its work, and the patient stimulated sufficiently to tide him over the shock from the loss of blood. In such cases the infusion should never be started until the bleeding point is secured. In anuria the raising of the blood pressure forces the kidneys to perform their proper function. Whether in renal insufficiency or due to entrance through the blood by absorption from the intestinal canal, as in delirium tremens, or the lungs, as in gas poisoning, or to toxins from an infected wound, the virulence of these toxins is reduced by dilution and their elimination hastened by raising the blood pressure.

Technic.—The solution used should be 6/10 per cent. sodium

chlorid at a temperature in the jar of 120° F. A special saline powder may be used.

In cases in which secondary hemorrhage is feared care should be taken not to raise the blood pressure too high by introducing a large amount of saline. The solution should be allowed to flow in very slowly.

An ordinary irrigating jar with sterile tubing, glass connection and infusion cannula is used. If desired an apparatus such as shown in the illustration may be employed. (Fig. 156).



A B

Fig. 156.—Intravenous saline infusion. A, The lower ligature is tied and the upper ligature is in place ready for tying. The valve-shaped opening in the vein is shown ready to receive the cannula. B, Flask containing the saline solution. This flask is an ordinary wash-bottle, the long glass tube of which is connected to the infusion cannula and the short glass tube to a rubber bulb with valves. By pumping air into the flask above the solution the latter is forced into the vein. (Fowler's Surgery.)

The median basilic or the median cephalic vein at the bend of the elbow is usually selected. A constricting bandage (the fillet) is placed around the upper part of the arm so as to obstruct the return flow through the superficial veins but not tight enough to interfere with the arterial flow. With aseptic precautions the vein is bared and cleared for about one inch. Two ligatures are passed loosely around it, one above the point of intended opening

and one below. An opening small and valve-shaped is made in the vein with pointed scissors, the tube of the cannula is introduced therein, first allowing some of the infusion fluid to flow through it in order to guard against the entrance of air. The upper ligature is now tightened around the cannula, holding it in place and also preventing leakage. The lower ligature is tied, closing the vein below. The fillet is now removed. The infusion jar should be lifted about three feet above the vein. The rapidity of the flow of the solution can be regulated by raising or lowering the jar containing the saline.

In shock it may be desirable to combine small doses of adrenalin chlorid in 1 : 1000 solution with the saline infusion. This may be done by introducing the hypodermic needle into the rubber tubing and slowly injecting the adrenalin into the saline. This may be repeated at intervals of every few minutes (Crile) until the blood pressure is manifestly raised. In cases of shock in which strychnin has been administered before the saline infusion is started there is always a risk that the saline infusion will cause the strychnin to be absorbed too rapidly. In such cases symptoms of strychnin poisoning may develop.

Intravenous Infusion without Dissection.—A needle having an obtuse-angle point (Fig. 157) is substituted for the intravenous

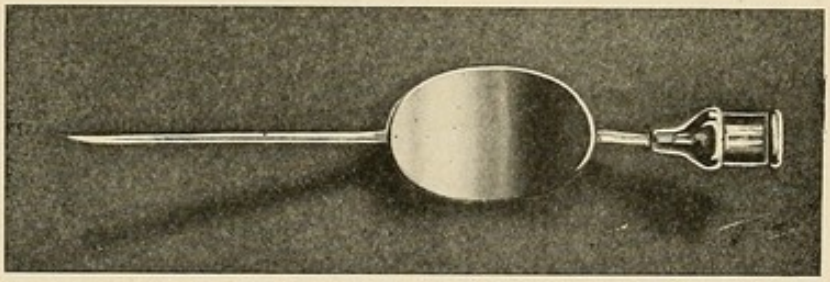


Fig. 157.—Needle for intravenous infusion without dissection.

cannula. Without previous dissection the needle is thrust into the distended vein at an oblique angle while the saline is flowing. Otherwise the procedure is the same as ordinary intravenous infusion. With a little practice the introduction of the needle into the vein is quite simple.

Hypodermoclysis.—In cases which are not so urgent hypodermoclysis may be substituted for intravenous saline infusion. The apparatus consists of two hollow needles, a Y-connection,

rubber tubing, and an ordinary bulb syringe or an irrigator. The needles are introduced into the cellular tissues beneath each breast and from one to two pints of the solution slowly introduced, usually a pint beneath each breast. Gentle massage of the parts helps to diffuse the fluid. This is rapidly absorbed. Should a second hypodermoclysis be indicated, it may be given in the interscapular region or the inner surface of the thigh.

Autotransfusion.—Autotransfusion, like intravenous saline infusion, should only be employed after the source of hemorrhage is under control. In cases of shock it is used to favor the cardiac and respiratory centers in the medulla. In such cases the foot of the bed is raised to an angle of forty-five degrees. This tends to force the blood to the medulla. In cases of hemorrhage after the bleeding point has been secured, one or all of the extremities may be bandaged, beginning at the most distal point and bandaging toward the trunk, thus forcing the blood of the extremities into the body circulation. This is of great value as a temporary resource. It does not take the place of intravenous saline infusion, but may be used to gain time and tide the patient over while the saline infusion is being prepared. The extremities should not be kept bandaged in this manner for longer than two hours.

Direct Transfusion.—The two main indications for direct transfusion are hemorrhage and shock. It is also indicated in hemophilia and cholemia. In shock, according to Crile, direct transfusion causes a greater and more prolonged effect upon the blood pressure than does the intravenous injection of saline. In toxic conditions of the blood, such as delirium tremens, complicating operations, direct transfusion is indicated. These latter conditions may be likened to gas poisoning, in which venesection followed by transfusion is the treatment par excellence.

Dangers. Hemolysis.—The present tests for hemolysis are not practical in emergency work as they require twenty-four hours for their performance. Whenever feasible such tests should be made between the donor's corpuscles and the recipient's serum and the recipient's corpuscles and the donor's serum. Hemolysis in the former case is not necessarily harmful but in

the latter another donor must be chosen. In emergency cases to prevent the danger of hemolysis as much as possible the donor should be chosen from among the relatives of the patient, using as close a blood relation as possible. In any event the donor must be free from constitutional or other disease.

Crile's Method.[1]—The radial artery of the donor and any superficial vein of the recipient (usually a vein in the forearm) is utilized. Twenty minutes before the transfusion both donor and recipient are given a hypodermic injection of morphin. The usual aseptic preparation of the parts is made. The eyes of both are covered. The table on which the donor is placed should have the Trendelenburg attachment so that in case of

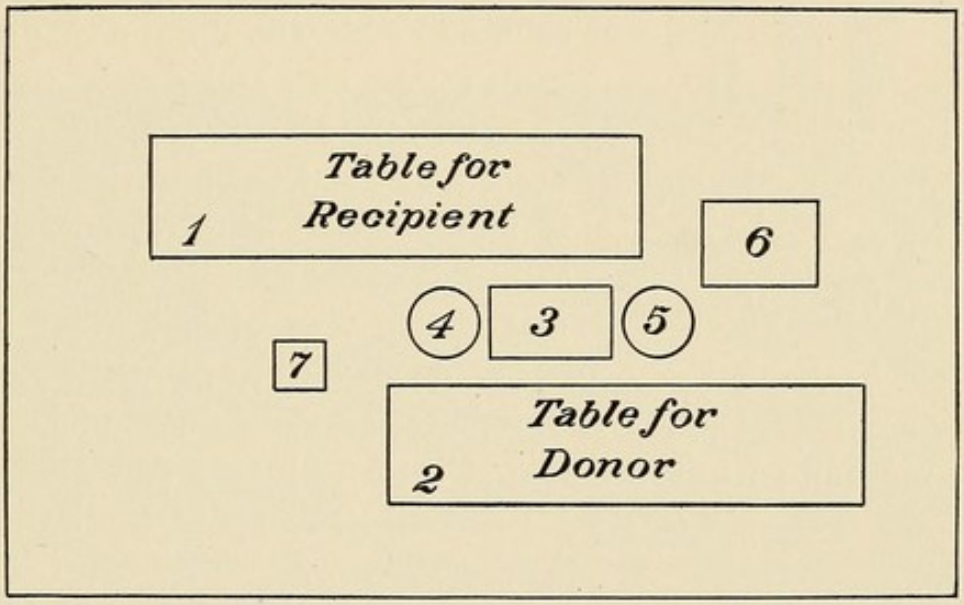


Fig. 158.—Arrangement of patient for direct transfusion. 1, Table for recipient; 2, table for donor; 3, table for arms of recipient and donor; 4 and 5, stools for operator and assistant; 6, instrument and dressing table; 7, saline irrigator.

syncope the head can be rapidly lowered. The recipient is placed on a table with the head in the opposite direction from the donor. The relative position of the recipient, donor, operator and assistant is shown in the accompanying diagrammatic sketch (Fig. 158). Under local anesthesia about 3 c.c. of the donor's radial artery at the wrist is exposed and the smaller branches tied with very fine silk. A Crile clamp (Fig. 159) is applied to the proximal end of the artery and the distal end ligated. The

[1] *Philadelphia Lancet*, Aug,, 1907, vol. xl, pp. 1057–1068.

artery is then divided, the adventitia pulled over the free end as far as possible and snipped off close. The field is now covered with a wet saline sponge. Three or 4 cm. of the superficial vein of the recipient is exposed, the distal part ligated and the proximal end closed with a Crile clamp. The distal part is then divided with scissors, the adventitia being drawn out as far as possible and snipped off close. A cannula (Fig. 160) is selected the bore of which is larger than the natural tissue thickness of either vein or artery. The vein is then pushed through the cannula with the free end drawn back at the cuff and snugly tied in the second groove. To facilitate the procedure the handle of the cannula is manipulated with forceps. The artery is then drawn over the vein and snugly tied with a small linen ligature in the first groove. Should the artery be atheromatous or for any reason contracted, its lumen may be dilated by means of a mosquito hemostat pushed into its lumen and gradually opened. The vein clamp is removed, then gradually the artery

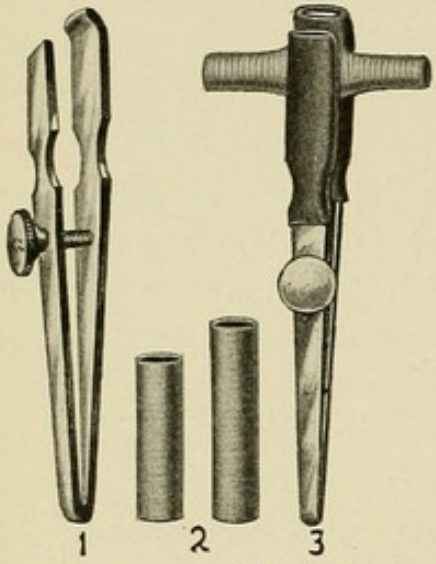


Fig. 159.—1, Crile's clamp; 2, rubber tubing for slipping over the ends of the clamps; 3, clamp applied to artery. (Fowler's Surgery.)

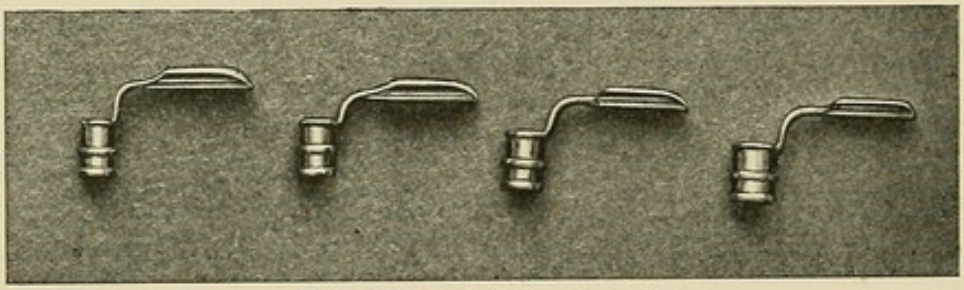


Fig. 160.—Crile's cannulæ.

clamp. At this point the blood will be seen to pass from the artery across to the vein dilating the latter. Exposure and manipulation of the vessels will cause them to contract, particularly so in the case of the artery which may contract sufficiently to obliterate its lumen. A constant gentle stream of warm saline

solution by keeping the vessels from the air will materially aid in bringing about relaxation. The pulse wave may be palpated in the vein. It is best to introduce the blood very slowly. If allowed to pass too rapidly in cases in which the recipient's cardiac muscle is weak symptoms of acute cardiac dilatation may occur.

Distressing symptoms which occasionally occur and which call for temporary cessation of the transfusion with the Crile clamp are cardiac distress, uneasiness, coughing, rapid pulse and cyanosis. These symptoms pass off after a time. The transition in the recipient is striking. In shock and hemorrhage there is a gradual alteration of the pale haggard facies and a substitution of pink coloration. In the donor after from twenty to forty-five minutes of continuous flow from the radial artery a gradual pallor of the face and ears may be noted, and serious

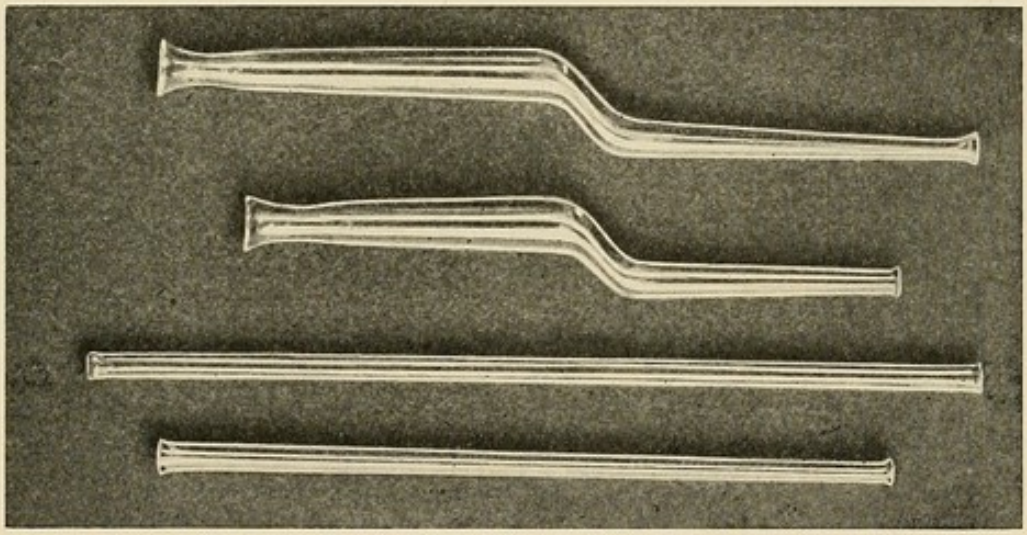


Fig. 161.—Brewer's tubes.

effects will be observed if the transfusion is allowed to go on. The transfusion should be terminated as soon as the donor shows irregular respiration, or sighs, or becomes uneasy, or presents any of the evidences of the loss of blood. The earliest and most constant change noted in the recipient is the almost instant and continuous rise in blood pressure continued up to a certain point the total rise depending upon the physical state and the quantity of blood transfused. There is also a rise in the hemoglobin and the red blood count. The most constant phenomenon on the part of the donor is increased leucocytosis.

Brewer's Method.—Brewer employs glass tubes two and one-

half inches long of various shapes (Fig. 161) somewhat bulbous at the ends, smaller at the artery end and larger at the vein end. There is a depression near each end in which the ligature securing the vessel rests. The tubes are sterilized, dipped in melted paraffin, shaken briskly and allowed to cool. The vessels selected for the procedure are exposed and prepared and two Crile clamps applied in the usual manner. The artery is then drawn over one end of the tube and secured by a ligature. The Crile clamp on the artery is loosened sufficiently to permit the blood to fill the tube, the distal end of which is then inserted into the vein and secured by a ligature. The clamps are then removed and the transfusion allowed to proceed.

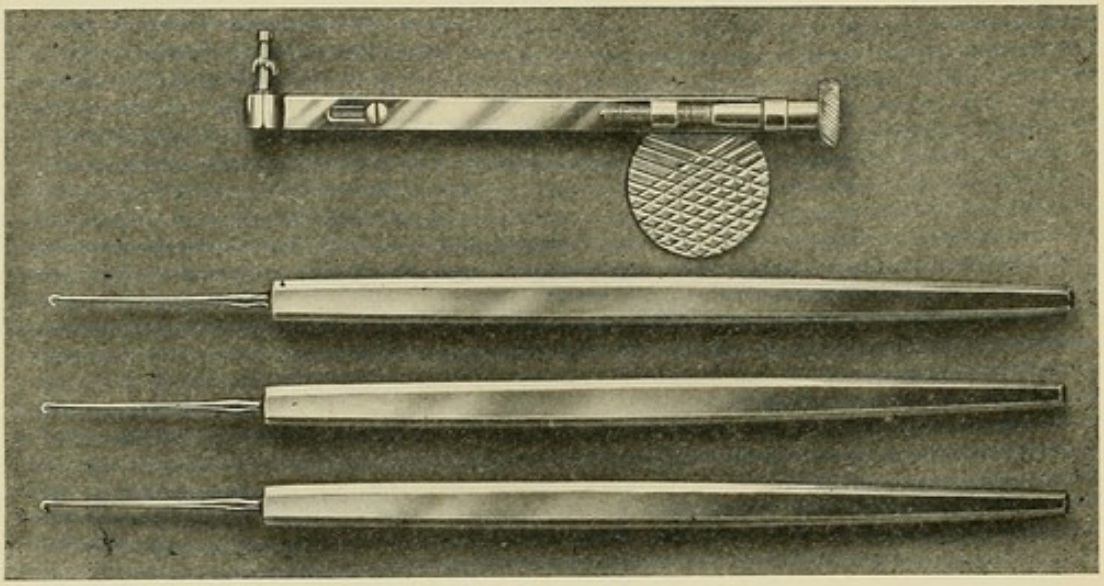


Fig. 162.—Elsberg's cannula.

Elsberg's Method.—The cannula (Fig. 162) is built on the principle of a monkey-wrench, and can be enlarged or narrowed to any size desired by means of a screw at its end. The smallest lumen obtainable is about equal to that of the smallest Crile cannula, and the largest greater than the lumen of any radial artery. The instrument is cone-shaped at its tip, a short distance from which is a ridge with four small pin-points which are directed backward. The lumen of the cannula at its base is larger than at the tip.

The radial artery of the donor is exposed and isolated in the usual manner. The cannula, screwed wide open, is then slipped under and around the vessel. It is then screwed shut until the

two halves of the instrument slightly compress the vessel. The artery is then tied off about one centimeter from the tip of the cannula. Before the vessel is divided three small eye tenacula are passed through the wall of the artery at three points of its circumference, a few millimeters from the ligature. Small mosquito forceps may also be used. These are given to an assistant, who makes traction on them while the operator cuts the vessel near the ligature. The moment the artery is cut the stump is pulled back over the cannula by means of the tenacula or forceps, and is held in place without ligation by the small pin-points. There is no bleeding from the artery, even though no hemostatic clamp has been applied, because the cannula itself acts as a hemostatic clamp. The vein of the recipient is then exposed, but not freed, two ligatures are passed around it; one is tied peripherally in the usual manner. A small transverse slit is made in the vein, the cannula with the cuffed artery inserted into the vein, a ligature tied around the vein and cannula, the cannula screwed open, and the blood allowed to flow. The rapidity of the flow can be varied as desired by the size to which the instrument is screwed or unscrewed, and the lumen of the artery is never diminished.

Following the control of the hemorrhage and the treatment of its immediate effects by the above measures further fluid is furnished the tissues by the introduction of saline by rectum. This is accomplished by giving a pint to a quart of saline every three or four hours, allowing thirty minutes for its administration, or by proctoclysis by the Murphy method.

CHAPTER IX.

COMPLICATIONS OF WOUND INFECTIONS.

Lymphangitis. Cellulitis. Lymphostasis. Lymphatic edema. Rectubular lymph phlegmon. Tubular phlegmon. Lymphadenitis. Septicemia. Pyemia. Erysipelas. Erysipelas bullosum. Hospital gangrene. Malignant edema. Infectious emphysema. Bacillus pyocyaneus infection. Tetanus. Trismus associated with paralysis of the facial nerve.

Lymphangitis.—Lymphangitis is the result of infection of the lymphatic channels in the neighborhood of an infected wound. Clinically we find two forms of lymphangitis. In the first there

is a circumscribed patch of reddened and edematous skin in the neighborhood of the infected wound. This may persist even after the infection in the wound has subsided. The anatomical reason for such an isolated patch of lymphatic infection resides in the fact that in such cases only a small area of minute lymph vessels is involved. The infection in such an area may extend to the larger lymph trunks and be carried to distant glands even after the wound infection has subsided. When the larger lymph trunks are involved thrombi may be felt as hard cords. The overlying skin is reddened in streaks. These streaks run parallel to one another and extend from the reddened area in the neighborhood of the wound to a considerable distance along the course of the lymphatics. The infection extending through the walls of the lymphatics involves the cellular tissues, and so *cellulitis* with an increase in the redness of the overlying parts and swelling develops. Should a considerable number of lymph channels be involved, *lymphostasis* occurs and *lymphatic edema* complicates the already existing inflammatory swelling. Usually upon disinfection of the wound and suitable drainage these symptoms subside, though suppuration may ensue. In such an event abscesses develop along the course of the infected lymphatic trunks. These abscesses, unless opened early, finally coalesce and form one elongated suppurative focus.

Treatment.—The wound itself should be vigorously disinfected. The reddened areas in its neighborhood (*rectubular lymph phlegmon*) or reddened strips (*tubular lymphangitis*) should be covered by large compresses wrung out of alcohol-bichlorid solution, to which tincture of opium in the proportion of one ounce to a pint of the solution is added to alleviate the pain. Upon the subsidence of the acute inflammation mercurial ointment may be gently rubbed along the thickened lymphatic trunks. In isolated lymphatic infection ichthyol in lanolin may be gently rubbed over the area. Should suppuration ensue the infected foci should be thoroughly opened and dressed and treated as infected wounds.

Lymphadenitis.—Lymphadenitis may occur with or without preceding lymphangitis. It is more apt to occur with only a slight degree of lymphangitis, for the reason that in severe cases

of lymphangitis the lymph channels become blocked and so the infection cannot be carried to the nearest lymphatic glands. The lymph glands through which the lymphatic channels in relation with the wound drain may become swollen; with the subsidence of the infection in the wound these swollen glands usually become normal. If the infection is severe or prolonged the lymph glands undergo suppurative changes and abscesses result. It quite often happens that only a portion of the inflamed lymphatic gland undergoes suppurative changes, the pus escapes through the gland capsule, infiltrates the surrounding tissues, finds an exit for itself externally, or an opening is made by the surgeon and a sinus forms. This sinus connects with the inflamed gland and is persistent.

Treatment.—The original wound must be disinfected and thorough drainage instituted. This will usually result in the subsidence of the lymphadenitis, but it may happen that the lymphadenitis persists after the original focus of infection has healed. In such a case the lymphadenitis may remain as a chronic hyperplasia of the glands, or if the infection has been severe suppuration may occur. In the first instance if inunctions of mercurial or ichthyol ointment do not cause the hyperplasia to subside, the glands should be removed if considerably enlarged. Small glands need not be interfered with unless they are a source of annoyance to the patient. Glands palpably the seat of infection and in which there is certainty of suppurative changes should be opened and all gland tissue removed. Suppurating glands which have opened spontaneously with the formation of a sinus should be excised.

Septicemia.—Before the advent of antisepsis and asepsis septicemia, together with pyemia and hospital gangrene, were the chief causes of death following operations and injuries. At the present time these diseases are rarely seen, and then only when there has been a failure to apply or to maintain aseptic and antiseptic measures.

The advent of septicemia is marked by a rise of temperature varying from 101° to 105° F. This occurs within the first few days after the operation. Chills are rarely observed, and even when they occur in the outset of the disease they are not repeated.

In this respect the disease differs from pyemia. The pulse rises to 120 or higher. The tongue is dry and leather-like. When the patient is asked to show his tongue it protrudes in a hesitating and trembling way. The lips are parched. The skin is hot and dry and of a dirty brownish color; in severe cases it may be pale yellowish and there may be petechiæ. With more pronounced disintegration of the blood in the later stages of the disease hematogenous icterus may occur. Characteristic changes occur in the blood. The granulations in the wound are flabby and covered with a thin, gray, offensive discharge; there is a foul odor to the wound. There is anorexia. As a rule, the bowels are constipated, but in severe cases there may be profuse and at times, bloody diarrhea. The respirations are rapid and superficial. The mental attitude is one of indifference. The disease usually proves fatal in from five to fourteen days. In those cases which recover there is remission of the fever, preceded by sweating, the mental condition becomes more acute, the respirations deeper and less rapid, the wound becomes healthier and shows a tendency to heal. In the fatal cases coma develops, the temperature becomes subnormal, and the pulse extremely rapid and feeble.

Treatment.—As soon as a foul odor to the wound is noted, and this is one of the earliest symptoms of septicemia the wound should be opened up in its entirety and thoroughly cleansed, decomposing and sloughing tissues should be curetted away, the wound thoroughly irrigated, absolutely free and efficient drainage provided, and a 10 per cent. solution of chlorid of zinc should be applied to the wound surfaces. Should the medullary tissue of a bone be involved, in case the disease has attacked a joint, resection or amputation should be done at once. The general treatment of the patient should be supportive. Of the drugs which prove valuable in these cases quinin and alcohol seem the most efficient. Alcohol may be given in the form of beer, one bottle three times daily. Oxygen should be given to increase the function of the red blood cells. A solution of yeast may be used to irrigate the wound, and yeast may be given internally.

A stock polyvalent vaccine should be immediately given pending a blood culture and a culture from the wound. A

vaccine is prepared from the blood culture but if this is sterile as not infrequently happens, a vaccine can always be prepared from the wound. Both cultures are made simultaneously to avoid delay. This autogenous vaccine is immediately administered.

Pyemia.—This disease, like septicemia, is now rarely seen. When it does occur it is almost always the result of neglect upon the part of the patient or his attendant. It may not become manifest for from five days to several weeks after the wound has become infected. At first there is an infected wound with the usual daily rise and fall of temperature. After a few days there develops a chill, followed by a higher rise of temperature, and local symptoms at a point distant from the wound, showing the presence of metastatic infection. The temperature may go as high as 105° F. The local symptoms of the metastasis will depend upon its situation. The most frequent location is in the lungs, usually near the periphery of the lung. In such a case there would be cough with the physical signs of infiltration and softening. When near the pleura, pleuritis follows, either serous, or seropurulent, or even suppurative. A portion of the lung may become gangrenous. Occasionally we see cases of diffuse lobar pneumonia surrounding a single metastatic abscess.

Next in frequency the liver, kidneys, and spleen are invaded. In the case of the liver and spleen there will be tenderness over these organs with localized pain. In the case of the kidneys pus will be found in the urine.

The tendinous attachments of muscles are apt to be involved, also the joints and serous membranes. The knee-joint, hip-joint, and elbow-joint are the joints most frequently involved. With each metastasis there occurs a chill and an exacerbation of the fever. As the metastatic deposits increase in number chills become less frequent, and there is less exacerbation of the fever. Finally the patient dies of asthenia. The general symptoms are those of prolonged fever.

Treatment.—The recovery of the patient depends upon the thorough disinfection of the primary focus and the opening up and draining of the metastic deposits as they occur. As these deposits may occur in any part of the body, and as each deposit

forms a focus from which other deposits may arise, it is easily seen how hopeless is the prognosis. If the case is seen and the disease is recognized before the occurrence of many metastases there is some hope that by the disinfection of the original focus and by vaccine therapy the course of the disease may be stayed. If the original focus is on one of the extremities, and symptoms of metastasis in important internal organs have not developed, an immediate amputation should be made. In case of an infected thrombus in one of the large veins either of the neck or of the extremities double ligation with excision of the infected portion of the vein should be done. In other respects treatment is the same as for septicemia.

Erysipelas.—The onset of the disease is rapid. There is a continuous rise of temperature. Usually an initial chill occurs. Sweating is rare. Nausea and vomiting generally follow the chill. There is anorexia. The temperature is irregular and progressively rises as fresh areas are involved. The duration of the disease is about a week; the subsidence of the attack is characterized by remission of the morning temperature.

Wound Appearance.—Except in erysipelas of the scalp (p. 352) the skin in the neighborhood of the wound is intensely red. It is differentiated from lymphangitis by the absence of red streaks. The disease usually advances in the direction of the lymphatic current. The patch of redness is irregular, there is increased heat and but slight edema. In *erysipelas bullosum* there is profuse exudation of reddish serum with the formation of vesicles. These follow the stage of redness and resemble the blisters following a burn. Suppuration may occur in them. A phlegmonous inflammation of the subcutaneous tissues may complicate the erysipelas. The inflammation may be severe enough to culminate in gangrene. In such a case there is first the formation of blisters and brownish-red spots, which afterward change to black. This gangrenous process shows the same tendency to spread as does ordinary erysipelas. Erysipelatous inflammation may be carried to distant portions of the body.

Complications.—Transient albuminuria may occur. Bronchitis is a frequent complication. According to the location of the erysipelas, the various serous membranes may be affected;

for instance, in erysipelas of the scalp the meninges may be involved; in erysipelas of the chest wall, the pleura; in the case of the abdomen, the peritoneum; in the case of joints, the synovial membrane.

Predisposition.—The scalp seems to be specially predisposed to erysipelas. It may follow operations for the removal of long-standing tumors in which the skin over the tumor has become thin and atrophic. It occurs more frequently in weak individuals with tender skins. The loss of a large amount of blood seems to favor the occurrence of the disease.

Treatment.—Immediately upon the discovery of the disease the case should be isolated and all articles which come in contact with the patient in any way should be boiled before being again used. The attendant who dresses the wounds of a patient suffering from erysipelas should not come near any other wound. After each visit to his patient he should use every possible means of disinfection to avoid carrying the disease. All dressings should be burned. General supportive treatment of the patient is indicated. An injection of streptococcic vaccine is given immediately (p. 349). An autogenous vaccine should be prepared.

Local Treatment.—The erysipelatous area should be covered by large moist dressings of either carbolic acid, bichlorid of mercury or alcohol. As the streptococci proliferate most rapidly in the margins of the inflammation it is here that the skin should be injected with carbolic acid or alcohol-bichlorid 1 : 5000, or with salicylic acid solution. Tincture of opium may be added to the antiseptic dressing in the proportion of two ounces to the pint to allay pain. Scarification of the skin at the margin of the area is of value.

Hospital Gangrene.—Hospital gangrene is rarely seen at the present time. The appearance of the wound is that of a septic inflammation of a granulating surface with coagulation necrosis of the outer layer of the granulations.

This necrosis of the granulations with coagulation of fibrin on them resembles a diphtheria patch in its dirty grayish-brown color. The granulations fuse together, minute abscesses form, and ulceration follows. There is usually profuse exudation. The granulations become swollen and grayish white; following this, gang-

rene of the wound occurs. In one part of the wound there may be a diphtheritic patch; in another part, necrosis of the granulations with minute abscesses; in another part, a pulpy condition of the granulations with profuse exudation; in another part a gangrenous condition. As long as the granulations are not broken down, no general symptoms occur. With the destruction of the granulations, however, the infection becomes general. The rise of temperature is not high; it may even remain normal, or become subnormal. There is profound depression. Pyemia may develop.

Treatment.—The treatment is largely preventive. With proper aseptic and antiseptic precautions and the proper care of the granulations the disease should not occur. When it does occur, however, the wound should be promptly curetted and should be redressed every six hours. Wet dressings of either carbolic acid or alcohol-bichlorid should be employed. At each change of dressing the granulations, which will be found to grow almost by magic, should be curetted away. The wound is swabbed with a 10 per cent. solution of zinc chlorid. When gangrene occurs, in addition to curetting the wound the thermocautery should be used for the purpose of completely destroying the infection and sealing the lymph channels. An efficient dressing consists in gauze kept wet with hydrogen peroxid. Vaccine therapy is indicated.

Malignant Edema.—This may complicate severe injuries of bone and extensive injuries of the soft parts. It is sometimes met with complicating the bites of insects. Its onset is rapid, with gangrenous edema of the subcutaneous connective tissue and intermuscular planes. The overlying skin becomes brownish red, there is venostasis, the tissues are edematous, and on palpation a distinct crackling sensation is felt. This crackling sensation is due to the gas manufactured by the infecting bacillus (Bacillus œdematis maligni). The discharge from the wound is thin and blood-streaked. This same discharge infiltrates the tissues and can be pressed from them. Lymphatic involvement is rapid and general infection soon follows. The temperature rapidly rises and remains high. The mental condition is blunted, the tongue is dry, the pulse rapid and feeble, the pupils dilated. Coma

supervenes, and death may occur in from two to four days. The local spread of the disease is very rapid.

Treatment.—In the very beginning extensive multiple incisions of the infected tissues, curettage of the wound and the application of copious absorbent evaporating antiseptic dressings may be of avail. A vaccine should be prepared but probably will not be completed in time. The wound should be inspected every two hours, and an accurate measure kept of the extent of the disease. If in spite of these early measures the disease spreads ever so slightly an amputation, in the case of an extremity, should be immediately performed as far above the disease as possible.

Infectious Emphysema.—This complication of wound infection is exceedingly rare. It is due to the entrance into the tissues of the bacillus aërogenes capsulatus. Infections by this germ spread rapidly and are accompanied by the formation of gas. This gives a crackling sensation on palpation of the tissues. As a rule, there is but slight constitutional disturbance.

Treatment.—Very mild cases are met with which give only the symptom of crepitation in the neighborhood of the wound. Should this show no disposition to spread, and be but slight in extent, no treatment will be necessary. The wound should be carefully watched, however, and if the infection does show a tendency to spread, the sutures should be removed, the wound curetted, and if this does not suffice, multiple incisions made into the infected areas and copious moist dressings applied.

Bacillus Pyocyaneus Infection.—Infections by this germ are characterized by the peculiar bluish-green color given to the wound discharge. As a rule, infections by this organism are mild and easily controlled. Occasionally, however, it has been the cause of rapidly progressive gangrene.[1]

This germ has its normal habitat in the skin of the axilla and the groin. Therefore wounds in these neighborhoods are more apt to be infected by this germ than wounds elsewhere.

The germ is readily destroyed by alcohol-bichlorid solution in the proportion of 1 : 1000 bichlorid in 50 per cent. alcohol. It is readily transmissible in spite of the ease with which it can be

[1] Two cases of rapidly progressive gangrene in which pure cultures of the bacillus pyocyaneus were found. George R, Fowler, *N. Y. Medical Journal*, February 10, 1894.

destroyed and through carelessness may be carried to other wounds.

Tetanus.—Fortunately this dread disease rarely attacks operation wounds. Occasionally, however, cases are seen. In these instances the infection can in almost all cases be traced to catgut. Kangaroo tendon does not seem to harbor the germ. In one case which we have observed the germ seemed to have found its entrance into the blood through the use of a potato-bobbin used in a gastroenterostomy. In another case the catgut was at fault. While in still another case in which kangaroo tendon only was used, the germ probably was already in the skin. The germ is found in thick strands of catgut, the interior of which it is practically impossible to sterilize. Its occurrence from this source can be obviated by using the smaller sizes of gut. The time necessary for the development of the disease depends upon the amount of infection, its entrance, the location of the infection, the character of the tissues infected, and the virulence of the culture. The usual time of incubation is seven to ten days. In a compound fracture coming under our care, the disease developed forty days following the receipt of the injury, during all of which time the patient was under our own observation in the hospital. Tetanus may supervene upon an ordinary infection of the wound, or the symptoms may not begin until wound healing is apparently complete.

The first symptom is restlessness, an anxious condition of the patient. This is followed by difficulty in speaking, next by difficulty in swallowing, finally by rigidity of the neck and spine (opisthotonos). Occasionally emprosthotonos, the reverse of opisthotonos, occurs, or pleurosthotonos may occur. The slightest external irritation, even a draft of air, may bring on an aggravation of the spasms. These cause excruciating pain. The temperature rises to 104° or 106° F. There is profuse sweating, the mental condition remains unaffected, the pulse rapid and feeble. The patient is in a continual state of excitation. The cases in which infection has occurred early in the course of the wound are almost always fatal. Of infections occurring later, some recover. If the patient survives the disease beyond the fourteenth day recovery is the rule.

Trismus Associated with Paralysis of the Facial Nerve.—This is sometimes called hydrophobic tetanus from the fact that attempts to swallow bring on the spasm. E. Rose, 1870, first described this disease. It follows injuries of the head, and particularly of the facial region. It is not so likely to be fatal as the other forms of tetanus. There may follow a chronic form of the disease which ends in death.

Treatment.—In wounds from toy pistols, and in incised wounds with laceration of the deeper structures in which the skin itself rapidly heals—*i.e.*, wounds from which the air is excluded (the tetanus bacillus does not grow in the presence of oxygen)—an immunizing dose of tetanus antitoxin should be administered proximad to the wound. In cases in which the disease is already existing, many forms of treatment have been advised. Chloral should be employed to diminish the reflex excitability. Chloroform may be administered by inhalation to relieve the pain and to relax the contracted muscles. Hypodermic injections of morphin should be given to relieve the pain and decrease the irritability. These measures should be supplemented by the use of tetanus antitoxin, the dose of which will vary according to the nature of the case, the injections being repeated at four-hour intervals, until an effect on the spasm is produced. The antitoxin may be given under the skin in cases which are not extremely urgent, directly into a vein in urgent cases. Intracerebral injection in the frontal lobes has been advised. The antitoxin may also be injected into the spinal canal. This would seem the most logical site.

Bacelli advises the injection of a 1 per cent. solution of carbolic acid, ten to thirty drops every three or four hours.

The patient should be nourished by nutrient enemas. When possible this should be supplemented by feeding through a small tube passed through the nose. The room should be darkened, absolute quiet should be enforced, and every possible source of excitement or noise avoided. Intraspinal injection of sulphate of magnesia is efficient in controlling spasm (Blake-Meltzer). One cubic centimeter for each twenty-five pounds of body weight, of a 25 per cent. solution is introduced through lumbar puncture. This may be repeated. Magnesia sulphate may be introduced

into the cellular tissue using a sufficient quantity of a 6 per cent. solution to ensure flacidity of the muscles. It is hard to gauge the dosage and its use by either method is not without danger. Respiratory paralysis may follow.

Differential Diagnosis.—The clinical picture of tetanus is very similar to that of strychnin poisoning. The surgeon, however, will rarely be called upon to make this differential diagnosis. Occasionally it will happen that in cases of profound shock in which hypodermic injections of sulphate of strychnin have been repeatedly employed, and in which, following this, intravenous saline infusion has been used, there will result from the increased absorption caused by the intravenous infusion a rapid absorption of the strychnin previously injected. This rapid absorption may give rise to symptoms of strychnin poisoning. Three such cases have come under our observation. In such cases there might be a momentary hesitation as to the cause of the spasms, but a review of the history and treatment of the case will speedily reveal the true condition.

CHAPTER X.

COMPLICATIONS THE RESULT OF ANTISEPTICS; COMPLICATIONS THE RESULT OF PRESSURE; CIRCULATORY COMPLICATIONS.

Wound Disturbance the Result of Antiseptics.—Local effect on wound surfaces. Toxicity of the antiseptic. Individual idiosyncrasy. Carbolic acid. Bichlorid of mercury. Iodoform poisoning. Systemic poisoning.

Rashes Occurring in Surgical Patients.—General diagnosis. Surgical scarlet fever. Herpes. Types of rash; causation; treatment. Rashes due to drugs; enemata; ether; sepsis.

Complications the Result of Pressure.—Post-operative paralysis. Paralysis due to operative traumatism. Paralysis of an entire extremity. Hysterical paralysis. Constriction paralysis. Postural paralysis. Ischemic muscular paralysis and contracture. Decubitus.

Circulatory Complications.—Prevention of venous return. Thrombosis of the femoral vein. Phlebitis of the internal saphenous vein. Air embolism. Fat embolism. Shock. Cause of sudden death following operation.

WOUND DISTURBANCES THE RESULT OF ANTISEPTICS.

However ideal a given antiseptic may be from a bacteriologic standpoint, it is upon the practical results following its clinical

employment that our judgment of it must be based. The value of an antiseptic depends, first, upon its power of destroying or inhibiting the growth of germs; second, upon its local effect on the wound, whether neutral, irritating, or caustic; and, third, upon the ease with which it may be absorbed and the toxicity of such absorption.

Sternberg demonstrated that bacterial death was produced by bichlorid of mercury in 1:20,000 solution; iodin in 1:500; potassium permanganate in 1:338; carbolic acid in 1:100. These strengths were sufficient to destroy pus cocci in two hours, and were also efficient in the case of other microörganisms. Their inhibiting power was found to be: Bichlorid of mercury, 1:30,000; iodin, 1:4000; carbolic acid, 1:500; boracic acid, 1:200; alcohol, 1:10. Further bacterial researches have shown that still smaller proportions of the first three mentioned are sufficient to inhibit bacterial growth. In wounds the germs are not all on the surface alone, where they come into intimate relationship with the antiseptic used, but reside deeper in the tissues, so that the power of penetration of the antiseptic into the tissues must enter into the calculation. It is also to be borne in mind that even strong antiseptics do not necessarily kill germs, but may only inhibit their growth, so that if they are freed from the antiseptic they may continue to multiply. The inhibiting power of the antiseptic used may be neutralized by the albuminous secretion of the wound and germ growth proceed. The above shows the desirability of the prevention of infection by all possible means, since the actual, positive destruction of the germ is impossible with the use of antiseptics in strengths which will not of themselves cause actual destruction of tissue.

Certain antiseptics in a dry form are of value: Iodoform, naphthalin, zinc oxid, and the various preparations of bismuth. Newer antiseptics possess no great advantages over the older preparations. Zinc oxid is the best of the above, as it produces marked chemotaxis, as does also naphthalin. These powders have the property of absorbing or combining with wound secretions.

Local Effect on Wound Surfaces.—Strong antiseptics cannot be used in wound treatment except in those cases in which

actual destruction of the superficial layer of the wound is desired. In wounds infected by the common pus organisms this is not desirable, as the dead tissue forms a nidus for the further growth of germs. In infections the result of anthrax, actinomycosis, or chancroidal infection, stronger antiseptics or, better, the actual cautery are to be used to destroy the germs, and in order to thoroughly destroy them it will be necessary to destroy a portion of the adjacent tissue as well. These agents are stronger on account of their great caustic action. Nitric acid, chlorid of zinc, and potassa fusa are the most prominent. They act by an actual destruction of tissue. Their use has become more and more restricted, the thermocautery taking their place as a more reliable method of destruction and as being more completely under the control of the operator. Zinc chlorid finds a field of usefulness in the treatment of inoperable carcinoma of the uterus with involvement of the cervix, and in treating gangrenous areas.

Flushing with weak solutions of antiseptics tends to stimulate leucocytosis, as well as mechanically wash away or inhibit the growth of germs, and hence is advantageous even in the first stages of wound infection. On the other hand, though strong solutions produce leucocytosis, this is accompanied by actual destruction of tissue and an escharing of the tissues which not only serves as a nidus for germ growth, but mechanically prevents the escape of germs from the tissue, and hence is not to be practised in the treatment of ordinary infected wounds. One of the chief points to be remembered in the treatment of infected wounds is that a free exit must be provided for all wound secretion. Nature will, as a rule, take care of those germs already in the tissues if the wound is kept free from accumulated infection. More active measures may be harmful in that at the very least they retard the healing process.

Toxicity of the Antiseptic.—In general, it may be stated that large quantities of antiseptic are harmful and may produce general toxic effects. Weak solutions are more apt to be absorbed than strong solutions, as the stronger the solution the more active the local leucocytosis produced. Particularly is this true of carbolic acid. The area of the absorbing surface,

whether flat, a cavity, or a sinus, as well as the length of time the solution is applied, must also be considered.

Individual Idiosyncrasy.—In certain individuals a form of eczema is quickly set up by the application of even a weak solution of bichlorid of mercury, carbolic acid, or iodin. Iodoform is particularly prone to produce undesirable local effects. It is impossible to prognosticate those cases which will be so unfortunate as to become either locally or generally poisoned. The skin of children and old persons is more delicate than that of more robust persons, and they are consequently more readily susceptible.

Carbolic Acid.—This agent was first introduced by Lemaire in 1863, but it was not until Lister in 1866 formulated an elaborate system of disinfection and dressing that its usefulness was generally recognized. It is today one of the best known antiseptics, but its disadvantages are so marked that its field of usefulness has been greatly narrowed. Its advantage consists in the reliability with which it destroys (1:20 to 1:40), renders inert (1:100 to 1:500), septic microörganisms, and the readiness with which it mixes with wound secretions. Weak solutions produce no coagulation and penetrate to all parts of the wound. On the other hand, its disadvantages outweigh in most cases its advantages. Its volatility necessitates frequent change of dressing. If this is guarded against by placing rubber protective, oiled silk, or a similar air-tight material over the dressing, local heat is retained and the dressing becomes a poultice, favoring wound secretion. The parts become sodden, the superficial layers of the skin exfoliate, and a condition is produced which greatly favors germ growth—*i.e.*, heat, moisture, and a culture-medium. The skin is rapidly reduced to a condition of moist eczema, and if the treatment be persevered in, gangrene may develop. Following its prolonged use the part becomes first moist, then anesthetic. Local anemia is marked. The skin becomes dirty gray in color, and dry gangrene ensues, which may involve all the tissues of the part, even the bone. In mild cases the gangrene does not extend beneath the skin. In severe cases amputation will be necessary. These results are more frequent in the fingers and toes. The simplest cases will have

intense burning at first and the skin will present a blistered appearance. If the drug is discontinued at this stage, no danger is to be apprehended. Severe as are its local toxic effects, the results of absorption are to be borne well in mind. The persons who seem to be particularly susceptible to poisoning are young children and old people, and patients suffering from renal disease. Large fresh wounds absorb the acid rapidly. Its rapid absorption in large quantities is marked by profound collapse, and death shortly ensues through failure of respiration. Slower absorption is marked by severe gastric symptoms, nausea, and protracted vomiting. Giddiness, stupor, and aural vertigo develop. The pulse is small and rapid. The quantity of urine is decreased and is colored green. The discoloration is apparent after the urine has been exposed for some time to light. The sulphates are absent from the urine. The *treatment* consists in abandoning the use of the antiseptic, washing the wound thoroughly with alcohol to neutralize the carbolic acid and prevent further absorption, and the ingestion of large quantities of alcohol in the form of brandy. The bladder should be catheterized frequently to prevent absorption through its wall of the acid in the urine. Intravenous infusion will raise the blood-pressure, and by thus increasing the functional activity of the kidneys, effect more rapid elimination of the poison. Atropin should be given for its effect upon the respiration. Oxygen will assist materially. Sodium sulphate has been advised.

Unfortunately individual idiosyncrasy plays an important rôle. The injection of a small quantity of a weak solution into a narrow sinus may cause alarming symptoms. It is absolutely impossible to forecast the result of the poison in individual cases. The escharing effect of the pure acid renders its use safer than dilute solutions, its poisonous effect being expended upon the tissue with which it comes in contact. The cases which are more likely to result in local gangrene are those in which moderately strong solutions are applied to a part and the acid prevented from volatilizing by an air-tight covering.

At the present time the use of this antiseptic is limited to the primary disinfections of long existing or well isolated abscess cavities, in those around which nature has thrown a protective

zone, and only in those cases in which the action of the acid can be observed. Acid of 95 per cent. strength is poured into the wound cavity, the surrounding parts being protected with gauze wrung out of absolute alcohol. The acid is allowed to remain in contact with the wound one minute, during which time it penetrates to all parts of the wound. It is then washed away with absolute alcohol. In the treatment of obstinate sinuses of moderate extent, equal parts of iodin and carbolic acid may be injected, but the sinus must be subsequently washed out with alcohol. Furuncles in the primary stage may be injected with one or two minims of the pure acid, and after two minutes have elapsed an equal quantity of absolute alcohol may be injected. The use of carbolic acid as a wound dressing has become almost entirely superseded in our work by an acid alcohol-bichlorid solution. Certain other coal-tar products have been brought forward to replace carbolic acid, such as creolin and lysol. They are more expensive and their advantages are not sufficient to warrant their use over that of an acid alcohol-bichlorid solution.

Bichlorid of Mercury.—When first recommended as a trustworthy antiseptic in the treatment of wounds by Koch in 1881, this drug was extensively used. Gradually its field of usefulness had become narrowed, both on account of the local necrosing effect common to antiseptics and on account of its toxic effects, both local and general. At the present time its use is limited to disinfection of the skin in strengths of from 1:1000 to 1:4000 and to disinfection of wounds in which the infection has been recent or is presumed to have occurred, but in which the local evidences of inflammation are slight. Combined with 50 per cent. alcohol, however, it is of considerable use as a wet dressing in cases of long-continued suppuration and in recently opened infections, such as felons and abscesses. It is employed in cases in which carbolic acid was formerly used. It rarely produces constitutional effects. With this, as with other antiseptics, local irritation may be set up if strong solutions are employed or if free evaporation is prevented. In cases in which its use is long continued, or when a large wound surface has rapidly absorbed a quantity of the bichlorid solution, typical symptoms

of poisoning, with salivation, loss of appetite, vomiting, abdominal cramps, albuminuria, and bloody diarrhea will develop and death may ensue. The treatment is to discontinue the drug, stimulate the patient, give warm baths, and treat the gastro-enteritis. A 1 per cent. solution applied to a large surface has been known to produce fatal poisoning.

Iodoform Poisoning.—The local effects are irritation and redness and a wet, eczematous condition of the surrounding skin. The redness spreads beyond the dressing and the skin becomes swollen. Blebs form, which somewhat resemble erysipelas bullosum. These blebs vary in size from a pin head to a small marble. The absence of fever differentiates it from erysipelas. A general erythema may appear. The treatment is to stop the drug and apply 1 or 2 per cent. silver nitrate to the inflamed surfaces.

Systemic poisoning following the use of iodoform, either as a wound dressing or as an injection in tuberculous cavities or sinuses, is fortunately not common. Such poisoning is more dangerous than that following the use of other antiseptics because more insidious. Idiosyncrasy must be taken into account. Children seem more susceptible than adults. Fatal intoxication may result from a very small amount. Great care should be exercised in using this drug in the neighborhood of the kidney. The general symptoms are caused by the decomposition of the iodoform. There occurs slight rise of temperature, the pulse-rate rapidly increases in frequency. In the early stages there is headache, a feeling of lassitude and depression, vomiting, loss of appetite, and anuria. Then occurs restlessness, hallucinations, and delirium. The symptoms may persist with more or less severity for an almost indefinite period. In the acute form death rapidly ensues. The autopsy will show fatty degeneration of the heart muscle and of the kidneys and liver.

There are certain conditions which predispose to iodoform poisoning. Fats dissolve iodoform, so absorption occurs more readily in large wounds of the fatty subcutaneous tissue, to a lesser extent in other tissues. Iodoform in powder form is more readily absorbed than when incorporated in gauze. The perito-

neum absorbs the drug readily, as it does all soluble foreign matter brought in contact with it.

It should be used with care in children and old persons with weakened heart muscle. In cases suffering from kidney lesions it should not be used at all. In cases of severe anemia it is dangerous.

Treatment consists in thoroughly cleansing the wound surfaces of the drug. Curetting should be done when the powder has been used. Large quantities of water should be given; also vegetable alkalies, stimulation, saline infusion, and saline enemas should be employed. Bicarbonate of potash in solution is recommended as an antidote, both internally and as a wash for the wound.

Picric Acid Poisoning.—This may follow the use of picric acid in the treatment of burns. Its occurrence is rare and death has not been traced to its use. The symptoms are nausea, vomiting, headache and an intense yellow color of the skin and mucous membranes. The acid is excreted by the kidneys and the urine will be yellow, brown or black. Jaundice is excluded by the presence of bile in the stools.

Treatment.—Change to dressing of another character causes disappearance of the symptoms. The yellow discoloration of the skin due to deposit of the pigment fades away gradually.

RASHES OCCURRING IN SURGICAL PATIENTS.

General Diagnosis of Rashes.—When a rash appears in a post-operative case the time of its occurrence, the medication used in the case, the form of enemata, the character of the operation and all other points in connection with the same must be carefully considered. Rashes are not very common but when they do occur are apt to cause a great deal of anxiety to the patient and if a diagnosis cannot be speedily reached as to the cause, considerable anxiety to the surgeon. Operative patients are no less liable to general infectious diseases than are other persons. In fact to some diseases they are more liable owing to their lowered vital resistance. The particular disease which it is essential to exclude is scarlet fever and this may be excluded from rashes caused by other diseases by the appearance of the throat and

tongue. If any doubt exists as to the character of the rash the patient should be isolated until a decision is arrived at. Particularly in the children's department of a hospital is care to be used in differentiating.

Surgical Scarlet Fever.—According to McCollom[1] the existence of surgical scarlet fever in distinction from medical scarlet fever is a disputed point. Patients on whom a surgical operation has been performed if exposed to scarlet fever are, no doubt, more likely to contract the disease by reason of their lessened resisting power. Many rashes occurring in surgical patients caused by drugs are mistaken for scarlet fever rashes and in former days before the era of aseptic surgery septic rashes were commonly confused with scarlet fever.

Patients suffering from burns are apt to contract scarlet fever more readily than would be the case if the skin were intact. Scarlet fever in surgical patients is to be regarded for the most part as coincident.

Herpes.—An attack of herpes may follow an operation upon the genito-urinary organs. Its occurrence is probably coincident.

Types of Rash.—Martin[2] cites four types of surgical rashes: (1) typical urticaria, raised wheals with white crests and red bases; (2) small red raised papules the size of mustard seeds with a pale pink field between; (3) irregular dusky red blotches not unlike measles; (4) a uniform vivid scarlet blush resembling that of scarlatina. The favorite sites for the rash are the extensor surfaces of the elbows, forearms, hands, and knees, the face and front of the chest. The rash may suddenly leave one area and invade a distant one. The duration is from one to four days; as it is fading the skin affected may present a yellow tinge. Occasionally there are constitutional symptoms resembling mild scarlatina. If the rash has been very marked desquamation follows.

Causation.—Rashes occur in post-operative patients just as they occur in other individuals. The rash may be produced by certain articles of diet, certain drugs, or the cause may not be asertainable. Some patients acquire rashes after the administra-

[1] Osler's Modern Medicine, 1907, vol. ii, p. 359.
[2] The after-treatment of Abdominal Section, London, 1894.

tion of a turpentine enema. With aseptic conditions of the wound a rash may develop. Martin cites four cases occupying consecutively the same bed in all of whom an eruption occurred post-operatively. As a rule they occur in patients who otherwise present no other untoward symptoms.

Treatment.—The cause should be ascertained and removed. Other than the removal and the treatment of the cause, the only treatment indicated is saline purgation.

Rashes due to Drugs.—Many of the drugs commonly used in post-operative treatment are capable of setting up a punctate erythema which has frequently been difficult to differentiate from that of scarlet fever. The points in differential diagnosis are the absence of the characteristic appearance of the mucous membrane in the throat, the appearance of the papillæ on the tongue and the variety of constitutional disturbance. *Bichlorid of mercury* will in some cases produce a punctate erythema twenty-four hours after its application in the preparation for an operation. *Iodoform* in individuals susceptible to it will cause an eruption similar to that of scarlet fever. *Copaiba* may cause a rash similar to that of scarlet fever, though the rash more frequently resembles measles. *Strychnine* sometimes, though rarely, produces a rash resembling scarlet fever. An eruption caused by *atropin* has been mistaken for scarlet fever. *Quinin* in persons having an idiosyncrasy, will cause a general punctate eruption very closely resembling scarlet fever. It may then be followed by desquamation. *Salicylic acid* locally may produce small clear vesicles, the bases of which may be inflamed. It is not accompanied by itching and rapidly disappears if the character of the dressing is changed. The rash appears on those parts of the skin with which the salicylic acid has come in contact.

Other drugs which may cause rashes are bromids, chloral, belladonna, the coal-tar products, the iodids, opium and its derivatives, sodium benzoate and chlorid of potash.

Rashes following Enemata.—Such rashes have been noted after soap enemata, especially if hard soap has been used, or turpentine enemata. It is probably due to absorption of a portion of the enema. It is not very common after enemata in which soft soap has been used, or after small as after large

enemata. It appears within twenty-four hours following the enema. The usual type resembles scarlet fever, measles or urticaria, or a combination of these forms may be observed. Itching may accompany any of the forms. Severe itching accompanies the urticarial variety. As the rash is rarely severe desquamation is not common. Fever is absent as a rule but a slight elevation of temperature may occur. Occasionally nausea and vomiting accompany the onset of the rash. The duration of the rash is two to four days. It fades away slowly.

Treatment.—Irritating substances should be excluded from future enemata in susceptible cases as a reappearance of the rash is possible. Severe itching is relieved by bathing with sodium bicarbonate solution. General treatment is unnecessary.

Ether Rash.—At the height of ether anesthesia, usually in females, bright red blotches may appear suddenly on the face and neck. These are without clinical significance. The blotches appear in the areas supplied by the superficial cervical plexus, are large, irregular, sharply defined, and irregularly situated. They are analagous to the nervous blotches appearing during periods of excitement from any cause.

Septic Rash.—Various forms of rash accompany septic conditions and form part of the picture in general sepsis. The onset of the rash is usually accompanied by some rise in temperature, symptoms of general malaise and rapid pulse. The rash may be as bright as the scarlet erythema of scarlet fever; there may be a uniform injection of the skin; it may be punctate or blotchy; more rarely papular. The eruption may fade on pressure. It is varied, the most common type a uniform scarlet rash appearing simultaneously all over the body. In other cases it may be confined to the buttock and flexor aspects of the thighs and skin over the extremities, or on the ankles, hands or wrists. The rash may last a few days and then fade away. Occasionally it persists for a week or even longer. Desquamation follows in the more severe forms. Temporary albuminuria is present in the more severe cases. The general appearance of the patient is that of a varying degree of sepsis. A few days after the clearing up of the septic condition the rash clears up.

The occurrence of the rash depends upon the susceptibility of

the patient to infection; it is more frequently seen in children than in adults and in some cases is the only evidence of sepsis present.

The wound may present very slight evidence of sepsis but the rash itself is an evidence of general infection. The treatment is the treatment of septicemia.

COMPLICATIONS THE RESULT OF PRESSURE.

Post-operative Paralysis.—The occurrence of post-operative paralysis may be discovered while the patient is recovering consciousness from the anesthetic, at which time it is noted that the patient fails to move the part affected. More commonly, however, the discovery is made at a later time, when the patient complains of inability to move the affected part. In case the paralysis affects a part of the body covered by a dressing the discovery may only be made when the dressing is changed.

Paralysis Due to Operative Traumatism.—The cause may be in the operative procedure itself, particularly if the operation has been in the neighborhood of or has involved one or more large nerve trunks. The suspicion would naturally arise, in such a case, that the nerve or nerves had been cut, ligated, contused through retraction, perhaps pressed upon by a drainage strip, or even injured by the antiseptic employed. The prognosis will depend greatly upon the rapidity with which symptoms of improvement appear. Should symptoms of return of function appear after a few days or weeks, a rapid recovery may be looked for; if after several months, recovery will be slow; if a longer period elapses without definite symptoms of return of function, recovery may be despaired of. In this particular class of cases it is almost always a single nerve that is affected; for example, the recurrent laryngeal nerve in goiter operations, and the ulnar nerve in elbow-joint resections.

It is rarely that the exigencies of an operation will demand destruction of an important nerve structure. If such is necessitated by the operation, the nerve should be united whenever such a course is practical. The inclusion of a nerve in a ligature is inexcusable. Sufficient retraction must be employed to clearly expose the operative field, but never to the extent of injuring the underlying tissues.

Paralysis of an Entire Extremity.—It sometimes happens that an entire extremity is affected; for example, after resection of the elbow there may be found total paralysis of the forearm extending up to but not beyond the level of the operation. It hardly seems probable that the musculo-spiral, median, and ulnar could all have received operative injury. It may be that such cases are hysterical. If so, there should be other signs of hysteria present. In addition, *hysterical* paralysis may occur in any part of the body other than that operated upon. True hysterical paralysis occurs in patients having a hereditary predisposition to mental disturbances. Some have post-operative amnesia, others delirium or mental confusion. They may resemble hysterotraumatic palsies. That such cases are hysterical in origin is further shown by the fact that such disturbances do not occur in children, and also that they are not observed among soldiers. This latter is probably due to the care exercised in the selection of soldiers.

Constriction Paralysis.—The tourniquet is responsible for some paralyses, though fortunately this cause is rare and can always be avoided. The most common example is paralysis of the musculo-spiral nerve. As a result of carelessness or ignorance, the tourniquet, instead of being applied at a higher level, may be placed around the arm at the point where this nerve curves around the humerus. Constriction paralyses are more apt to occur in lean individuals.

Postural Paralysis.—This is caused by faulty position of the patient on the table. The nerves affected may be at a distance from the field of operation. For example, a laparotomy case may develop paralysis involving part or all of the brachial plexus, or a paralysis of the ulnar or musculo-spinal nerve. In paralysis involving the brachial plexus the cause resides in a faulty position of the arms above the head. The arms are stretched forcibly above the head, instead of being placed in a natural position. Not only are the nerves put on the stretch, but the position of the arm causes the head of the humerus to press on the brachial plexus, which may be further pressed upon by the clavicle.

When the ulnar nerve is affected it will be the result of a faulty fixation of the arm across the chest. If the arms are too

tightly fastened respiration is interfered with; if insecurely fastened the arms will fall down beside the chest and are apt to rest against the edge of the table in the neighborhood of the ulnar nerve. In the case of the musculo-spiral nerve the pressure of an assistant leaning against the patient, the arm being fastened across the chest, has been known to cause paralysis.

Other examples of paralysis of the upper extremity are seen in improper Sims' position by not guarding the underlying arm against pressure; pressure on the shoulder by not having the shoulder crutch used in the Trendelenburg position well padded.

In the case of the lower extremity, paralysis may result from pressure or stretching in an improper Trendelenburg position the patient's legs being flexed at the knees and supporting the entire weight of the body. Stretching of the sciatic nerve may result from a too exaggerated lithotomy position or the lithotomy posts may press too forcibly against the limbs, or an assistant may lean against the leg of a patient in the lithotomy position.

In these paralyses sensation is disturbed, but slightly and quickly returns.

Paralysis the result of nerve stretching or nerve pressure from improper position of the patient, need only be borne in mind to be avoided. Parts of the body where paralysis is readily produced should be protected from pressure. Positions demanding extraordinary strain should be avoided. The assistant should never rest against the patient. Even slight continued pressure on a patient's chest will produce difficulty of respiration.

It is fortunately true that, while serious paralyses do occur, they are rare. More often there is present a weakness or paresis of the affected part. This is transitory and easily overlooked. The patient mistakes the feeling of weakness for a natural outcome of the operation, and at first does not call attention to it. This will be particularly the case if the affected part is covered with a dressing.

These paralyses or pareses may be caused by pressure from dressings upon a nerve. As a rule, this is because the splint has been improperly applied, though it may follow secondary

swelling under the dressing. For example, the external popliteal nerve at the point where it goes around the fibula may be pressed upon by dressings for fracture of the leg.

The necessity for using every care and precaution to guard against such accidents is apparent, but even more necessary is their early recognition when they do occur. The longer the conditions causing them are allowed to persist, the more lasting will be the paralyses. If for no other reason, dressings should be inspected and the condition of the parts noted at sufficiently frequent intervals to guard against such calamities. This is particularly true in cases in which such disturbances are likely to occur. The earlier the condition is noticed, the more rapidly, safely, and easily can a normal condition be brought about by an immediate removal of the cause and the administration of galvanism, faradism and massage to the affected member.

Ischemic Muscular Paralysis and Contracture.—When paralysis occurs as a result of direct pressure upon a nerve trunk the condition is bad enough, but an even more hopeless condition may follow if the blood supply of the part is seriously interfered with. Such a condition may follow the ligation of the main artery of a limb, but is more commonly due to an improperly or too tightly applied dressing, particularly inelastic dressings. It may well be that the dressing does not cause an artificial anemia at first, but only after some swelling has occurred. For this reason cases in which plaster dressings or other nonelastic dressings have been used should be inspected shortly after the application of such dressing in order to insure that good circulation is present in the part. The local anemia means insufficient nutrition of the muscles, and the result is a rapidly progressive atrophy which, in turn, results in paralysis. Electric irritability diminishes, faradic reaction is lost first, later galvanic. Contractures appear early, almost simultaneously with the paralysis. The prognosis is very unfavorable. This is perhaps because, as a rule, the condition is not noted until a change of dressing is necessary, by which time the atrophy may be well established. Only in the milder cases is recovery possible. Usually not only is restoration to the normal impossible, but not the slighest improvement can be noticed. The contractures increase steadily.

Treatment, electricity, massage and douches should be continued for months in any event.

These ischemic paralyses are noted more frequently in the treatment of fractures, particularly simple fractures. In compound fracture the voluminous aseptic dressing necessitated by the wound allows of more swelling to occur inside the plaster cast without pressure effects. Moreover, the case is seen oftener, as the wound requires change of dressing. Since these paralyses occur so readily, great care should be taken in the application of the dressing, which should be inspected frequently during the first few days. The patient and his attendants should be instructed to be on the watch for swelling. This will be indicated by change in the distal portion of the extremity, which should be left uncovered for this very purpose.

Decubitis (local pressure gangrene) is caused by a continued pressure over a part of the body not protected by a fatty layer or not well supplied by blood. It is a local anemia and may result from pressure of a bandage or apparatus, as, for example, an insufficiently protected splint. It may occur without marked pain, so that even a trivial complaint upon the part of a patient should be inquired into. It is better to redress a wound or a part, and find out the real cause of discomfort, than to neglect it, only to find out later that a local gangrene is well under way. The pain of which the patient will complain will usually be described as a burning. Such a complaint should always be investigated, for the more experience one has, the more one realizes that patients do not unnecessarily complain of pain. When the dressing is changed at first nothing may be observed to be wrong, but upon making a careful search it will be found that perhaps a safety-pin holding a drainage tube is pressing against the skin, or it may be that an adhesive-plaster strip has been too tightly applied, or that the edge of the plaster is turned against the skin, or a bony prominence may not have been sufficiently well protected.

Bedsores usually occur in the neighborhood of the sacrum, coccyx, and tuber ischii. They are very apt to occur in paralysis of cerebral or spinal origin. In such cases it is not necessary for the pressure to be very considerable or prolonged to produce

local gangrene. Other points overlying bony prominences may be involved according to the position of the patient. The appearance presented when a bedsore is about to occur is characteristic. There is a reddish discoloration of the skin at the point of pressure. This is followed by a bluish tint which subsequently changes to a brown or black. The gangrenous process involves the entire process of the skin and may even extend to the underlying osseous structures. Such a sore may show neither a tendency to heal nor a tendency to extend. If infection occurs the suppuration may result in an extension of the original sore.

Treatment.—The occurrence of pressure sores has caused many a surgeon to regret that he did not pay more attention to the details of his work. In patients who are long confined to bed, massage and change of position with cleanliness will usually suffice to prevent the formation of bedsores. In paralytic cases, a water or air bed should be employed. In cases under treatment for a very considerable length of time only the utmost vigilance will ward off this complication. Elastic cushions and rings may be used to change the position of the patient and to relieve the bony parts from pressure. Daily massage of the parts with alcohol and the employment of drying powders following this are of use. If in spite of all care ulceration occurs it should be treated antiseptically. Further pressure upon the part must be absolutely prevented. The ulcerated surface should be powdered with naphthalin and iodoform in equal proportions and dressed with antiseptic gauze. The separation of sloughs may be hastened by the vigorous use of the curette and by wet dressings. An ointment of the red oxid of mercury is useful, also an ointment composed of one part of nitrate of silver, five parts of Peruvian balsam, and twenty parts of lanolin. In intractable cases the entire ulcer may be dissected out, including the floor and margins, and the resulting fresh wound skin grafted.

CIRCULATORY COMPLICATIONS.

Prevention of the Venous Return.—Such interference is shown by cyanosis, formication, paresthesia and edema. These are trifling and easily remedied if due to improper bandaging, but

if the main venous trunk has been tied the case is more serious. In such cases more care is necessary that the bandage does not still further interfere with the return flow. Collateral circulation and the passage of a minimum amount of blood to the part should be favored by high elevation of the part.

Thrombosis of the Femoral Vein.—In patients with weak heart, in old people, and in debilitated patients long rest in bed is sufficient to cause thrombosis of the femoral vein. The internal saphenous vein is usually also involved. The location of the operation does not seem to bear any relation to the thrombosis. The thrombus usually begins at the junction of the internal saphenous with the femoral vein. There is an uncomfortable sensation of weakness and weight in the limb, pain over the site of the thrombus and along the course of the vein, and a numb sensation in the limb. Such subjective symptoms are accompanied by edema varying in extent according to the development of the collateral circulation. There is coldness, pallor except at the periphery, where cyanosis develops, and dilatation of the superficial veins. The thrombosed veins feel cord-like. Movements of the limb are painful.

A well-developed case shows involvement of the internal saphenous vein and the femoral vein for a distance of several inches below Poupart's ligament. The thrombus may extend into and block the external iliac, the iliac, and even the inferior vena cava, extending thence into the iliac vein of the opposite side, with the occurrence of the same symptoms on that side. The extension of the thrombus upward will be shown by the dilatation of the veins on the abdominal surface. Both sides may be affected by thrombi almost simultaneously. In the majority of cases the thrombus does not extend. The clot becomes organized and in time a passage for the blood may be made through it.

This unpleasant complication keeps the patient in bed much longer than he would be kept by the healing of the wound. Even if all the symptoms disappear while in bed, yet as soon as the patient gets out of bed the symptoms reappear, at least in part, and several months must elapse before a normal condition is attained. Indeed, in weak patients or patients with weak heart

action the condition may become permanent. During the first few weeks, while the thrombus is still soft, there is danger of some of the clot becoming detached and forming emboli in the lungs.

Treatment.—In cases which are to be kept quiet in bed for some time, in cases with weak heart, in debilitated patients, and in old people, the limbs should be massaged daily and the heart action stimulated. If in spite of prophylaxis thrombosis does occur, the treatment consists in moderate elevation of the limb to keep as little blood as possible passing through the limb, absolute rest, the avoidance of any but the most necessary cardiac stimulation. There must be no active treatment until the clot is organized, which will be in about three weeks. Following this, massage and bandaging may be used to dispel the edema.

Occasionally such a thrombus becomes infected. If so, the onset of the infection is shown by a rise in temperature and a chill, with increased tenderness over the thrombus. Septic emboli may be carried to the lungs and death ensue either from pulmonary embolism, septic pneumonia or general sepsis. In such a case the only treatment which will be of avail will be the excision of that portion of the vein containing the infected thrombus before pulmonary embolism occurs. The least that can be done is proximal ligature of the infected vein.

Phlebitis of the Internal Saphenous Vein.—Without thrombosis there may occur an inflammatory condition of the internal saphenous vein with the following symptoms: pain, most marked at the saphenous opening; tenderness along the course of the internal saphenous vein; rigidity of the muscles along the inner side of the thigh. Such a phlebitis may occur in all classes of patients and as a complication of all operations, irrespective of the previous condition of the patient or of the duration of the stay in bed. It seems to be more frequent after abdominal operations than after operations on other parts of the body. That there is no thrombus present would seem to be proved by the short duration of the symptoms and by the fact that the symptoms are not severe. The treatment consists in rest, enveloping the limb in cotton, moderate elevation of the limb, supporting bandages, and counter-irritation over the course of

the vein. The duration is usually a few days, though the symptoms may persist for a few weeks. The same condition may present in the course of the external saphenous.

Air Embolism.—The entrance of air into the veins, though a rare circumstance, is one that must be guarded against both during operations in the neighborhood of large veins, particularly those of the neck, and in the after-care of operations in the neighborhood of large veins in which packing has been used to arrest hemorrhage or in which septic processes are active. The accident has happened in connection with operations upon the internal and external jugular, the subclavian vein, the cerebral sinuses, the facial, axillary, subscapular, thoracic and femoral veins, and enlarged veins in the neighborhood of malignant tumors. The entrance of air into a vein is characterized by a hissing sound. If only a small amount enters no appreciable effect may be noted. In case of larger quantities labored breathing and rapid heart action will result. If sufficient air has entered to fill the right side of the heart, death may occur at once, the air preventing the contraction of the right ventricle.

Treatment.—Pressure should be made upon the proximal portion of the injured vein and the wound flooded with saline solution until the vessel is secured. Artificial respiration, inhalations of oxygen, electricity applied over the cardiac area, and intravenous saline infusion should be employed, together with the usual treatment for shock.

In repacking a wound in the neighborhood of a large vein a mass of gauze should be at hand to rapidly plug the wound in case of erosion of the vein.

Fat embolism is a rare complication. Fat globules are found in the urine of practically all cases of fracture. Since symptoms from the presence of the fat in the blood are rarely seen it must follow that a very appreciable amount of fat must be forced into the circulation to result disastrously. Fat may find its way into the blood in fractures, in acute inflammatory diseases of bones, in injuries to the liver and in injuries involving fatty tissues generally. It has not been observed in fractures in childhood probably because the medulla is comparatively free from fat in early life.

Autopsies show that when an appreciable quantity of fat has found its way into the circulation the pulmonary capillaries become plugged. Small quantities may be forced through and disseminate without giving rise to symptoms. Larger quantities cause pulmonary thrombosis and edema. If the patient survive the pulmonary thrombosis the capillaries in other organs, kidney, brain, etc., become plugged and symptoms accordingly will be observed.

The earliest symptoms, appearing from a few hours to a few days following injury, are those of pulmonary thrombosis; at first increased respiration, dyspnea and pallor followed by cyanosis and weakened circulation, and later pulmonary edema. Cerebral symptoms, delirium, somnolence, coma and occasionally paralyses or convulsions follow, if the patient survive sufficiently long.

Occurring immediately after an injury the lesion may be mistaken for *shock*. The later occurrence of fat embolism serves in most cases to differentiate it. In shock the patient is pallid, the temperature subnormal, the respirations shallow; in fat emboli, the patient is cyanotic, the temperature more approximately normal, the respiration stertorous. The pulmonary signs and weak pulse of fat embolism will differentiate it from apoplexy, intracranial hemorrhage or ordinary embolism. The diagnosis may be confirmed by the appearance of small hemorrhages into the skin and mucous membrane. Urinary examination will in the majority of cases show fat. Ophthalmoscopic examination may show fat droplets in the retinal vessels. Acute suppression of urine after injury or operation should cause the suspicion of fat embolism.

Shock.—Shock is most frequently observed in young children, the aged, and weak individuals. Children rapidly recover from its effects. The most prominent symptom is extreme weakness of the heart's action. The preventive treatment consists in encouraging the patient as to the outcome of the operation, in preliminary rest in bed, in the prevention of cooling of large surfaces of the body during anesthetization, in careful anesthetization and in the avoidance of loss of blood. In amputations cocain should be injected into the main nerve trunk of

the limb (Crile). In patients already the victims of shock only the most imperative operations should be performed, and these should be done with as much expedition as possible.

Treatment.—The treatment is the same as for hemorrhage, except the local treatment of the wound. Nitroglycerin and amyl nitrite are contraindicated on account of the vasomotor dilatation which they produce.

Cause of Sudden Death following Operation.—Acute cardiac dilatation may occur at any time following an operation. Sometimes death occurs at so remote a period as to leave one in doubt whether there was any connection between the operation and the sudden death. In seven cases occurring in our experience[1] death occurred from ten to twenty-one days following the operation, and always in cases which were proceeding uneventfully and which held out every hope of recovery. In the last of these cases, a case of hemorrhoids, death occurred just as the patient was about to leave the hospital, as the patient was walking from the toilet to his room. Autopsy demonstrated acute cardiac dilatation with no other lesion. There is no way of prognosticating the occurrence of this complication.

CHAPTER XI.

OPERATIONS UPON SPECIAL TISSUES.

The Skin and Subcutaneous Structures.—Cicatrization. Skin-grafting. Open treatment of skin-grafted surfaces. Plastic operations. Complications occurring in scar tissue. Keloid. Latent infections in scar tissue. Operations for moles. Syndactylism. Operations upon the nails.

Tendon and Muscle.—Tendon suture. Tenorrhaphy. Tendon and muscle transplantation. Continuity. Complication by suppuration. Treatment. Muscular suture. Tenotomy and myotomy. Tuberculous tenosynovitis. Dupuytren's contracture. Contracture of the finger-joints.

The Vascular System.—Secondary hemorrhage. Disturbance of circulation. Ligature of the external iliac, femoral, axillary, subclavian, common carotid. Varicosities of the saphenous vein. Impending gangrene following high ligation of the femoral vein. Thrombosis and embolism. Aneurysm. Complications. Infections. Secondary hemorrhage.

The Lymphatic System.—Lymphatic edema. Lymphangeioplasty. Lymphorrhea. Lymphangiectasis. Persistent fistula. Adenectomy.

[1] Six cases cited in Fowler's Surgery.

The Nervous System.—Peripheral nerves. Nerve resection. Nerve suture. Nerve anastomosis. Course following nerve anastomosis for facial paralysis. Spinal accessory nerve. Hypoglossal nerve. Suture of the brachial plexus. Nerve-stretching. Needling. Neurotomy and neurectomy for painful conditions. Trophic disturbances. Dryness of skin. Disturbances of circulation. Operations upon the spinal cord and posterior nerve roots. Underlying principles.

OPERATIONS UPON THE SKIN AND SUBCUTANEOUS TISSUES.

Such wounds usually heal in from five to ten days. Superficial skin wounds may heal in a shorter period. The further process of **cicatrization** requires a much longer time and depends upon the amount of tension to which the young scar is subjected, either through its position or by the early use of the part. The amount of tension varies. It will be much greater if the incision is at right angles to the lines of normal skin cleavage than if it were parallel to these lines. The operator should bear this fact in mind and should conform the incision, as nearly as the exigencies of the case will permit, to the lines of normal skin cleavage. Even with the most careful attention in this regard and with beveled incisions, there will result but a small percentage of "invisible" cicatrices. For cosmetic reasons such scars are particularly to be desired, but are extremely difficult to obtain.

The young cicatrix, however narrow it may be, differs in color from the surrounding skin. Until cicatrization is begun there is apparent to the eye a thin, dark red line formed by coagulated blood, which marks the site of the incision. The skin for the space of one-eighth to one-quarter of an inch on either side of the incision is slightly reddened. From the seventh day the character of the line of the incision gradually changes and by the tenth day there is a distinct rosy appearance of the young cicatrix. This is due to the formation of new blood-vessels. The surrounding skin has now resumed its normal appearance. The rosy color of the scar becomes more marked for a period of several weeks or months. During exertion the minute blood-vessels become congested and give an angry appearance to the scar. Gradually, however, the color fades until a pearly white band is all that marks the site of the incision. The scar never assumes the complete appearance

of normal skin, owing to the absence of pigment. This color contrast is more marked if the scar is broad.

Except under the best conditions in the most perfect primary union the scar becomes broader as time goes on. Secondary union results in a still broader and more disfiguring scar. Even after years have passed scars of this latter class will assume an angry red color during severe exertion or strong emotion. The broadening of the scar is due to the elastic tension of the skin, a constantly acting force in those incisions which are at right angles to the line of normal cleavage. As long as the sutures are in place this force is successfully combatted, but upon their removal the young cicatrix is gradually but surely stretched until after months a scarcely perceptible linear scar may become a broad, pearly white, disfiguring band. In wounds of this character the treatment is mostly preventive. The incision should be made in the line of normal skin cleavage. Sutures should be allowed to remain at least seven days, and if there are no symptoms of irritation ten days, or even fourteen to twenty-one days in cases in which the tension is very great. The young cicatrix should be supported by painting it and the surrounding skin with collodion. Adhesive-plaster straps should be employed at a distance from the scar to draw the neighboring skin in the direction of the scar and thus further support it. The collodion painting should be employed for several weeks until the scar has become firmer and more resistant. But even with every precaution, if the wound is at right angles to the line of normal cleavage the constantly acting elastic traction of the adjacent skin will serve to broaden the cicatrix somewhat. The great amount of stretching of which the scar is capable is exemplified in post-operative hernia and in the broad scars on the chest following extensive removal of carcinoma mammæ.

The mature cicatrix offers great and often successful resistance to the forces seeking to stretch it. This tendency to contraction is inherent in all scar tissue. The greater the amount of scar tissue, the greater the final contraction to be expected. The neighboring skin is drawn upon and contractures and much disability may result. When favorably placed this contraction may cause an unsightly scar to become an insignificant spot.

The cicatrices following Thiersch skin-grafting are not as disfiguring or liable to contraction as the cicatrix of secondary union. The technic of the procedure must be perfect to attain the best results. Though the cosmetic effect is not nearly so good as that of a linear scar, yet the color more nearly approaches that of normal skin. If the grafts are not of uniform thickness or if they are not very closely applied, considerable cosmetic deformity will result.

Skin-grafting.—This is indicated in all wounds of any magnitude of the superficial parts which do not allow of secondary suturing. The grafts are preferably placed on the wound surface before granulation is well under way. If, however, the wound is

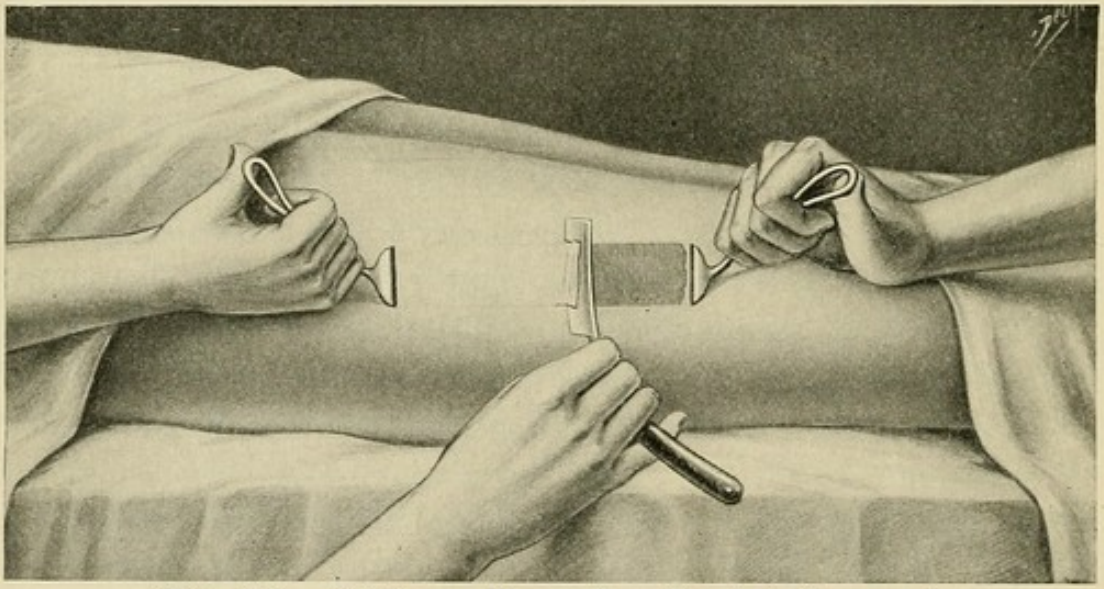


Fig. 163.—Cutting a skin-graft. (Fowler's Surgery.)

granulating, the granulations should be leveled and bleeding arrested by pressure before the grafts are placed. Only with practice can adeptness be gained. The grafts are best taken from the anterior surface of the thigh. If this is unavailable for any reason the outer surface of the arm may be utilized. No antiseptics are used in the preparation or course of the procedure. Following a soap and water cleansing the parts are flushed with saline solution. A skin-grafting razor or an ordinary razor is used in cutting the grafts; the main requisite being that the instrument be very sharp. The skin is put upon the stretch and made prominent by encircling the part with the hand slightly

in advance of the razor. If any apprehension is felt that the razor may slip the hand may be guarded by a piece of gauze. With the skin on the stretch long narrow strips of a thickness of only a portion of the thickness of the skin are shaved off by a sawing motion of the razor. The razor is held parallel with the skin surface. It is desirable to make these strips the same length as the surface to be grafted. With practice strips an inch wide or an inch and a half wide and as long as desired can be secured. When the razor approaches the hand, the hand is moved further away. McBurney's skin-stretching hooks may be used (Figs. 163 and 164). The strips should be of uniform thickness and breadth. A gentle stream of saline at a temperature of 100° F. is directed over the field during the procedure. The strips are

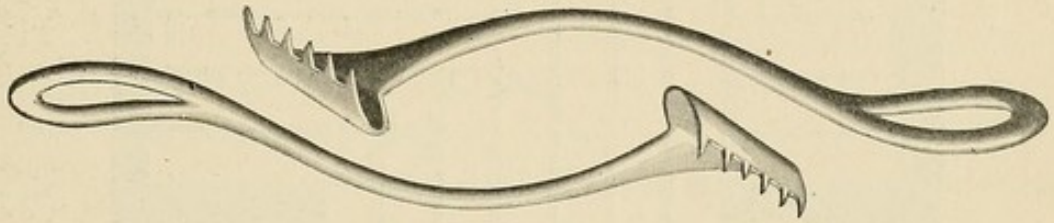


Fig. 164.—McBurney's skin-stretching hooks. (Fowler's Surgery.)

applied directly to the surface to be grafted. They are spread flat and evenly and the tendency of their edges to curl under is corrected by gentle manipulation with a slender flat-ended probe. The entire surface is covered with grafts which should lie edge to edge but should not overlap. The area from which the skin was taken is dressed with boric acid ointment. The grafted wound is dressed with narrow strips of green silk protective arranged as a basket strapping, with spaces left for the escape of wound discharge (Fig. 165). This is covered with a copious aseptic gauze dressing moistened with saline solution. Over this is placed a layer of nonabsorbent cotton and the whole is held in place by a roller bandage. This dressing is moistened from time to time with saline without disturbing the wound. The first dressing is done in three days. Before removing the gauze and silk straps the dressing is thoroughly moistened, but no stream of solution should be allowed to play upon the wound for fear of loosening and washing away some of the grafts. The

dressing is renewed and changed every second day until healing is complete. At each dressing grafts or portions of grafts which have not taken are removed with sharp-pointed scissors to preserve an aseptic condition of the wound.

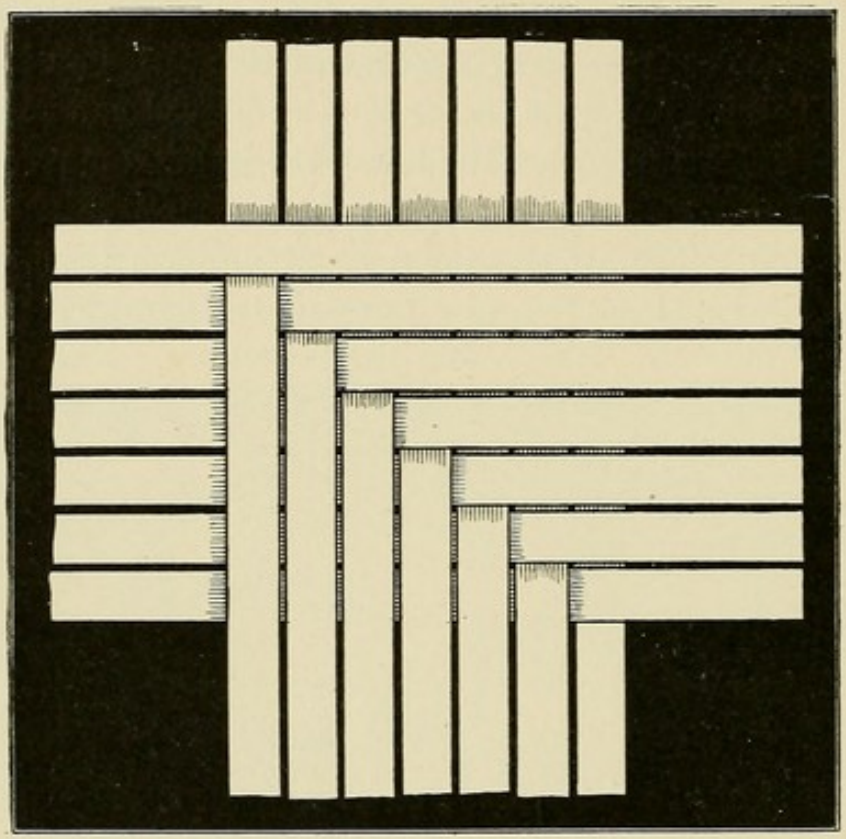


Fig. 165.—Basket strapping dressing for skin-grafting. (Fowler's Surgery.)

Open Treatment of Skin-grafted Surfaces.—A well of gauze is built up around the grafted area and on top is placed a sheet of wire gauze. The whole is held in place by adhesive-plaster strips placed so as not to interfere with the ventilation of the wound. The healing process is watched through the wire mesh and is usually complete enough in ten or twelve days to allow of the application of a simple gauze dressing.

Plastic Operations.—In order to secure a good final result it is essential that the amount of shrinkage of the flap and the amount of cicatricial contraction be correctly judged, and due allowance made at the time of operation. If too small a flap is employed, and allowance for shrinkage not made, the immediate result may appear perfect, but the final result will be bad. On

the other hand, if too large a flap be employed, the final result will not be so imperiled, though the immediate result be bad. In flaps which are covered on both sides by skin and mucous membrane, if exact union is obtained there will be but slight secondary contracture. If the flap is loosened from the underlying connective tissue shrinkage cannot be avoided and its amount cannot always be gauged. There is an immediate shrinkage due to the normal elasticity of the skin, and a secondary shrinkage due to cicatricial contraction. This is not so marked if primary union occurs, but if the healing process has been left in part to granulation the retraction will be considerable. The edge of the flap rolls up on itself along the border of the granulating wound. A small amount of blood under the flap will be sufficient to cause its elevation. The object of the after-treatment is to keep the surfaces in exact apposition and thus prevent the elevation of the flap and promote rapid healing. A thin lead or silver plate may be placed over the flap with this object in view. Sheets of silver foil or strips of oil-silk protective may be employed. Gentle pressure is continued until healing is effected, and thereafter at intervals of at least a few hours every day until cicatrization is complete. The patient is instructed to bind the metal plate, which conforms to the shape of the part, over the flap for several weeks. In case edema of the flap occurs the same pressure treatment is to be employed. The edema usually subsides rapidly.

At the point where the pedicle of the flap was twisted, in order to bring the flap accurately into the defect, there is apt to remain a slight deformity. This is readily remedied by a secondary operation, but this is better undertaken when cicatrization is complete, and surely not before the integrity of the blood supply of the flap is assured. Deforming cicatrices should not be removed until the process of contraction has been completed. The adhesion of the cicatrix to bone may cause considerable deformity. This is particularly true in wounds of the face, where the adhesion of the cicatrix, by limiting the mobility of the muscle, may simulate a partial paralysis. These cases are not to be hastily operated upon, as massage carried out systematically for weeks and which may be done by the patient, accom-

plishes much. An excision of the scar is likely to be followed by a recurrence of the deformity.

In plastic operations in which a defect is corrrected by a flap situated at a distance from the defect with its base or bases left attached, extraordinary care is essential to success. Absolute immobility must be maintained until the flap has become firmly attached. This necessitates great discomfort to the patient. Plaster of Paris combined with adhesive plaster forms the most stable dressing. The dressing must not only fix the parts absolutely, but must make the patient as comfortable as possible. The pressure must be equally distributed. The fixation dressing should be so applied as to allow of ready inspection of the wound without disturbing the relation of the parts. A copious wound dressing is applied. Drainage is, as a rule, unnecessary. All places where there are folds in the skin or where skin surfaces come into contact should be protected against excoriation, especially in neighborhoods where sweat and sebaceous follicles abound. Otherwise an annoying eczema will develop, following which infection of the wound may follow. Unless infection occurs there is no need of redressing the wound until the tenth or fourteenth day. The fixation dressing is not disturbed. If healing is firmly established, the base or bases of the flap may be separated with sharp scissors or a scalpel and the fixation dressing removed. If healing has not progressed satisfactorily, a fresh wound dressing is applied, but the fixation dressing is not disturbed. After the lapse of five to seven days the wound is again inspected and the base of the flap severed and the fixation dressing removed. This is followed by a marked anemia of the flap. This need not cause anxiety, as unless gangrene has already taken place at the margin of the flap, the new vessels coming in from the edge and through the under surface of the flap will be sufficient to nourish it. Even pressure is all that is subsequently required. There is anesthesia of the flap at first, but finally sensation is as complete as in the surrounding skin. In some cases it may be best to sever the base gradually, taking several days for the process.

Complications Occurring in Scar Tissue.—Scar tissue is little resistant to infection and injury. An abscess may occur. A

foreign body, such as a ligature, owing to the limited vital resistance of the scar readily causes suppuration. In a recent scar ulceration may be caused by pressure or chaffing of the clothing. In recent scar tissue ulceration readily heals, but later on, when the blood supply is not so rich, ulcerated areas are slow in healing. A painful condition of the scar may result from the inclusion of nerve filaments. As the scar contracts this may be due to direct pressure upon a nerve or to adhesion to a nerve-sheath.

Keloid.—Negroes seem to be particularly susceptible to keloid. The cause of keloid is obscure. It is due to some degenerative change in the scar tissue, characterized by increased density and increased vascularity of the scar. The scar becomes broader, thicker, and involves irregularly the neighboring skin, the surface becomes irregular, raised knobs are formed. A scar the seat of keloid is very unsightly. Burning or itching will be complained of. The color becomes deep pink, in negroes black. Microscopically the disease seems to be a simple hypertrophy of the scar. Usually the entire cicatrix is involved, occasionally only a part. Every stitch-hole may be marked by a hypertrophy the size of a pea. Infection seems to play no part. It occurs quite as frequently after primary as after secondary union. It may occur soon after union is affected or not appear for weeks. The growth is slow until a certain size is attained, when the keloid remains stationary. Atrophy does not occur. Excision is followed almost without exception by recurrence, which is apt to be more extensive than the original keloid.

Treatment.—Excision should not be attempted. Electrolysis (Hardaway), elastic pressure (Verneuil), and multiple scarifications followed by inunctions of mercurical ointment are recommended but are rarely successful. Repeated exposure to Röntgen rays will cause the flattening and partial disappearance of recent and small keloids. In larger keloids and those of long standing the effect is not marked. Repeated exposure to the X-ray is successful in some cases in causing a disappearance of the keloid.

Pseudo-keloid occurs after the healing of tuberculous sinuses. The knobby scar tissue resembles normal skin more closely than in true keloid. Excision is not followed by recurrence.

Malignant degeneration in scar tissue is occasionally noted in old cicatrices following operation for injury or nonmalignant disease. The disease is of the carcinomatous type, but save in cases of great malignancy does not extend beyond the skin. It may follow prolonged ulceration of the scar, or occur as a primary disease. The former is the more common, as exemplified by primary malignant disease occurring in old leg ulcers and following lacerations of the cervix uteri. In epithelioma occurring in old ulcers there is some reason to suppose that nitrate of silver or other cauterizing agents may have contributed through irritation to the formation of the malignant disease.

Latent Infections in Scar Tissue.—In cases such as deep abscesses of the forearm which have been opened, thoroughly drained, and allowed to heal by the slow process of granulation in place of being secondarily sutured, there will naturally result an excessive formation of scar tissue. The skin scar will be broad and will be slow in approaching the characteristics of normal skin. The process may not be completed until six or eight months have elapsed. Such cases are susceptible to infection in the scar tissue, which may take place a week or ten months or a year following wound healing. In these cases the remote infection seems to occur in the depths of the scar tissue, not in the skin scar, nor is the skin scar involved except through a direct extension of the infective process. For this reason it is reasonable to suppose that germs either have lain dormant in the depths of the wound from the time of the original infection, or have been brought to the depths by the blood-vessels and, lodging there, found a point of less resistance. The treatment consists in evacuating the pus and getting the wound clean by frequent dressing and disinfection. When this has been accomplished the old scar tissue should be dissected out and secondary suturing done.

Operations for Moles.—Incomplete operations, such as cauterization and excisions not wide of the growth, are apt to be followed by melano-sarcoma either in the neighborhood of the original growth or at a distance.

Syndactylism.—Didot's Operation. Scars along the dorsum do not interfere with the future usefulness of the hand but scars

along the palmar surface are apt to result in palmar contraction and interference with extension. To prevent this a dorsal splint should be worn to keep the finger in which the dorsal flap has been used extended. To be effective such a splint must extend beyond the end of the finger and above the wrist (Fig. 166). This splint should be worn for two months being removed for a few minutes daily to permit of passive motion. At the end of

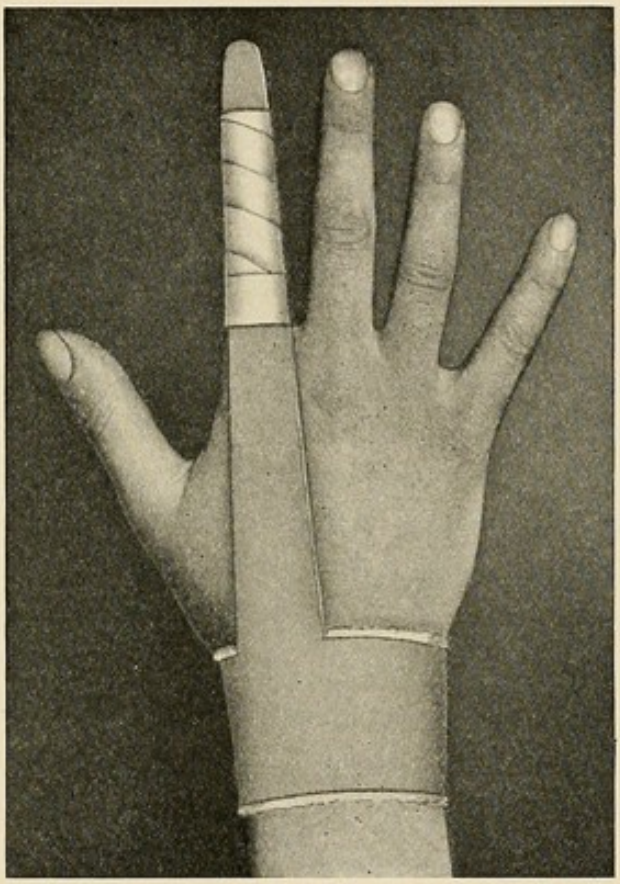


Fig. 166.—Dorsal splint for after-treatment of syndactylism.

two months it may be left off during the day but is replaced at night for a long period, generally six months to a year. This palmar contraction is lessened by securing linear union at the original operation. If this is not possible without undue tension skin-grafting should be done.

Operations on the Nails.—Following complete or partial excision of the nail for paronychia a copious evaporating mildly antiseptic dressing (alcohol-bichlorid) is applied. This is kept moist, frequently changed and made smaller as the inflammation subsides. Following subsidence of the inflammation boric acid

ointment is applied until the new epithelium at the base of the nail ceases to be tender. A new nail is formed in four to six months.

Following excision of *ingrown toe nail* the same procedure is followed if there is much outlying inflammation; otherwise an ointment dressing may be immediately applied. The length of time the parts are kept quiet depends upon the amount of pain. Proper shoes should be advised.

OPERATIONS UPON TENDON AND MUSCLE.

Tendon Suture, Tenorrhaphy, Tendon or Muscle Transplantation.—While in operations upon the skin the primary object is to obtain a good cosmetic result, in operations upon tendons and muscles the functional result is of the first importance. This result depends on the after-treatment as much as on the operation itself. An operation alone does not cure. The final result may vary considerably even when the same operative procedure has been employed; *i.e.*, in case of suture of the flexor tendons of the fingers, in one case motion may be complete, while in another case there will be entire inability to flex the fingers. The fingers remain extended, and while capable of passive flexion, regain their extended position as soon as the flexing force is removed. In the first instance union of the divided tendons has been complete and suitable after-treatment has freed the tendon from adhesions; in the second instance union has failed to take place. In another class of cases motion is impossible or limited owing to the adhesions between the divided tendon, its sheath, and the surrounding tissues.

As the function of the tendon consists in transferring the muscular movements to its attachment, it is necessary that the mobility of the tendon in its sheath be absolutely free. When a tendon has been divided the contractility of the muscle causes a wide separation of the divided ends, which is further increased by the unopposed action of the oppositely acting muscles. Suturing unites the divided ends temporarily and favors union, but only too frequently is this disturbed. The poor blood supply causes slow union. On account of the longitudinal direction of the tendon fibers the sutures readily tear out;

especially as the contractility of the muscle causes considerable traction. This muscular contractility must be limited as much as possible by means of snugly applied bandages. The muscle must be relaxed by approximating as closely as possible its point of origin and insertion. In lesions of flexor tendons this is accomplished by superflexion, in case of the extensors by superextension. Neighboring joints must be fixed by splint. Absolute immobility during the early days of healing is essential to success. Splints are applied to the side of the member opposite the wound.

If infection has not taken place it is not necessary to change the dressing until union has occurred, not firm union perhaps, but of sufficient strength to allow of change of dressing. Union is usually firm enough in ten to fourteen days to permit this.

Continuity, the first essential to success, has then been established. If drainage has been employed this is removed on the second to the fourth day without disturbing the splint. The relation of the parts must not be disturbed and the same care be exercised in rebandaging the parts. After the twenty-first day the dressing may be gradually loosened. The plastic exudate and later the new connective tissue which has united the sutured ends and in part surrounds them has also produced adhesions to the surrounding tissues. The newly cicatrized point of suture has grown fast to the tendon-sheath, or in the absence of a sheath to the surrounding parts. This union not infrequently extends to the skin cicatrix, so that on attempting active and passive motion the movements are found to be restricted, the surrounding parts moving with the tendon. It is the new cicatricial tissue which causes this fixation of the tendon. This must be stretched. Passive and active movements accompanied by massage and baths, systematically carried out over a period of weeks and months, will cause the scar tissue to stretch and render the tendon freely movable in its sheath. If these movements are not carried out there will result loss of function of the injured part. The cicatricial tissue becomes old, firm, and nonelastic, and this can only be remedied by further operation with excision of the scar tissue. The final result of such secondary operations is always doubtful. Therefore it is essential first to absolutely

fix the parts in their proper position and later to employ active and passive motion to restore the function.

Complication by Suppuration.—If the wound becomes infected or was infected from the first as in *traumatic cases* the result will be doubtful. The tendon ends slough and direct union fails. The large amount of cicatricial tissue thrown out to fill the gap connects the ends only to a limited degree. The extensive adhesions to the surrounding tissues prevent a good functional result. Cicatricial contraction ensues and results in a contracture of the parts which it is difficult to remedy. Tenosynovitis due to infection may take place and extensive sloughing of the tendon ensue.

Treatment.—The wound is left entirely open and a mildly antiseptic, freely evaporating absorbent dressing applied and changed several times daily. Sloughing portions of tendon are removed. When the wound becomes clean tenorrhaphy and plastic operations for the cure of the disability are undertaken.

Muscular suture is similar to tendon. The same rules apply in relaxation of the muscle. Bandaging and position aid in controlling spasmodic movements. Union is more rapid on account of the better blood supply. There is more effusion of blood and usually a hematoma forms. If several muscles are involved the hematoma may be quite extensive, and drainage be made necessary. Passive and active movements are essential, for atrophy is marked and rapid, partly on account of inaction but more on account of the section of many small nerves. In from eight to ten days light massage and electricity should be used. In three weeks slight voluntary movements should be encouraged and gradually increased.

Tenotomy and Myotomy.—In the treatment of contractures the endeavor is just the opposite from tendon and muscle suturing, for here it is desired to produce a decided gap to be filled in with cicatricial tissue connecting the partially or completely severed ends. This is favored by the growth of connective tissue from the tendon sheath and surrounding tissue into the organizing blood clot between the tendon ends. If one allows tenotomy or myotomy to be followed by the correction of the mal-position and the fixation of the member in the corrected position, there is

danger that the too widely separated ends will not undergo any union at all, and that each end will only unite with its tendon sheath or the surrounding tissue, and the muscle become functionless, the same as after the unintentionally cut tendon which has not been united by suture. This is not desired. The function of the divided muscle should be preserved. The purpose of the operation is to artificially increase its length. To obviate the danger of nonunion, the muscle or tendon may be only partially divided through a minute incision and the remainder of the muscle or tendon torn or stretched, or it may be advisable to correct the position five to eight days following the tenotomy or myotomy. In the interval the insignificant skin wound has healed under an aseptic dressing and new connective tissue has formed between the divided ends which guarantees the definite bridging over of the space. By the judicious use of appropriate orthopedic apparatus this new tissue is stretched to the proper length. Four weeks rest in the corrected position is usually sufficient. Function is then restored by electricity, massage, passive and active motion and the use of suitable orthopedic apparatus.

Tuberculous Tenosynovitis.—At the operation the tendon sheath has been opened widely and perhaps considerable of it removed. In such cases, if asepsis is successful and all diseased tissue has been removed, there will result adhesions between the tendon and the surrounding tissues, especially the skin, which will interfere with the function for a long time. These adhesions are especially firm at the point where the drain emerged. The overlying skin follows the movements of the tendon. The great mobility of the skin allows of some functional result, with which we may be satisfied if a recurrence of the disease does not take place. The use of the parts frees the adhesions gradually. Too early movements predispose to a recurrence of the disease. Electricity and massage should be employed to prevent atrophy.

Dupuytren's Contracture.—Following *complete* excision of the contracted fascia, the hand and wrist is splinted with the affected finger in extension. The parts are kept quiet for seven days when the sutures are removed and the finger gently flexed. The splint may be left off in the daytime and applied at night for a week longer when it may be entirely discarded. The success of

the operation depends on complete excision of the contracted fascia, strict asepsis and early, persistent and methodic massage. If the scar is exposed to injury through the patient's occupation a leather palm protector should be worn.

Circulatory disturbance and severe pain may necessitate the early removal of the splint to allow of *slight* flexion of the finger. If this has been done the extended position should be again resumed in twenty-four hours.

Contracture of the Finger-joints.—The most important consideration in these contractures relates to the condition of the tendons. With adhesions in the sheaths of the tendons the condition of the joints is of more importance, since, even if the motion of these were restored, the fingers would be comparatively useless.

In cases of threatened stiffness of the fingers it is important to provide for a useful position of the finger by avoiding the use of straight splints and employing such means of support during the healing process as shall prevent stiffening in the straight position but rather favor partial flexion. The adjoining uninjured finger may serve as a splint to which the injured finger may be secured, or, with proper dressings applied, the finger may be supported by a mass of gauze in the partially clenched fist and bandaged in this position. With fingers ankylosed in the straight position attempts may be made to correct the position under an anesthetic. Similarly, in the flexed position, correction may be attempted if the function of the tendons has not been impaired, with the hope of obtaining voluntary motions after a period of treatment by passive movements and massage. The half-flexed position during the healing process gives better opportunity for passive movements than either full extension or full flexion.

Habitual contractures are observed in those following certain occupations, such as coachmen. The constant flexion of the fingers leads to a shortening of the flexor tendons and palmar fascial bands, and to adhesion of the synovial folds within the joints.

Cicatricial contractures are very frequent after burns and other injuries of the fingers and hand. When large traumatic defects of the skin exist, the skin transplantation method of Thiersch

may be tried. The result, as far as restoration of function is concerned, is not very satisfactory. When applicable, the method of *transplantation of skin flaps with a pedicle* is to be preferred. The flap may be taken from the chest wall or other available region, according to the location of the defect.

OPERATIONS UPON THE VASCULAR SYSTEM.

The prominent complications are **secondary hemorrhage** and **disturbances of circulation.** The larger the vessel involved, the greater the danger of these complications. Prevention does much to guard against secondary hemorrhage, such as care in the application of the ligature, or if this is impossible clamps left *in situ* and packed around with gauze. In venous oozing a tight packing is used. In spite of all efforts at prevention, hemorrhage may occur as a result of a ligature cutting through a diseased vessel wall; or *infection* may result in secondary hemorrhage. If infection occurs the patient must be constantly watched and the attendant instructed to exert digital pressure directly in the wound on its occurrence. If clamps are employed they are allowed to remain in place for forty-eight hours. The patient must be kept quiet in order to avoid any disturbance of the clamps. After the clamps have been removed if there is no renewal of the hemorrhage a small strip of gauze may be led down to the suspected place and the wound closed for the most part by secondary sutures.

If the hemorrhage has been controlled by tight packing, this should not be disturbed for from two to four days. Its removal should be accomplished carefully in order to avoid a renewal of the bleeding. A renewed bleeding calls for a second packing.

Lateral ligature of a vein or artery may be packed as an additional support to the wounded vessel wall. As a rule, however, this is undesirable.

Disturbances of circulation depend upon the size of the vessel and the site of the ligature. In moderately sized and small vessels no disturbances are noted. Following the ligature of the *external iliac, femoral, axillary,* or *subclavian* artery in the normal state, the collateral circulation is usually sufficient to carry on the nutrition of the parts. In arteriosclerotic conditions danger

of gangrene is imminent, due to the weak heart action and lack of elasticity of the arterial wall. The larger the vessel and the nearer to the heart, in such cases, the greater the danger. A prognosis can only be given after the case has been studied for some days. For example, ligature of the *common carotid* is followed by no ill effect in some cases, while in others sudden death results, and in still others, brain softening. Faintness, impaired vision or hemiplegia may be recent, immediate or remote effects of the ligation. Following ligation of the innominate or subclavian artery muscular weakness, stiffness and numbness persist for some time. Pain due to inclusion of nerve filaments in the ligature, injury to the pleura, phrenic nerve or subclavian vein occasionally occur due to accident during the operation.

Symptoms of disturbed circulation become evident at first in the most distal part of the extremity involved. The surface becomes cold, pulsation in the terminal artery (radial, dorsalis pedis, posterior tibial) is absent or only thread-like. Sensation is blunted. There may develop paresthesia, formication, and in some cases severe neuralgia. Should the collateral circulation prove equal to the task of reestablishing the balance of the circulation, the above symptoms gradually subside. If, on the other hand, the collateral circulation is insufficient, gangrene of at least a part of the limb will ensue. This is marked by an increase of the symptoms, the rapidity of which is controlled by the extent of the collateral circulation. There is edematous swelling, loss of sensation, the skin becomes bluish in places, and gangrene extends from the distal portion upward until a point is reached where the circulation is sufficient not only to supply nutrition but to successfully combat the spreading septic process secondary to gangrene.

Treatment does not have any influence. Light diet is indicated. Sufficient morphin is given to keep the patient comfortable. The parts should be enveloped in cotton and kept warm. Absolute rest in bed should be enforced. The equilibrium of the circulation should be maintained as nearly as possible by keeping the part in a horizontal position or but slightly elevated. High elevation or allowing the part to become dependent is to

be avoided. Care should be exercised in applying the dressings that no pressure be used.

Varicosities of the Saphenous Veins.—Following Trendelenburg's operation (ligation of the internal saphenous at the saphenous opening) or excision, the patient is kept in bed with the limb snugly bandaged and kept slightly elevated for seven to ten days when the sutures are removed, the limb rebandaged and the patient allowed to walk about. Snug supporting bandages should be applied daily for several weeks. The bandage is removed at night and reapplied in the morning. It should extend from the base of the toes to the knee. Complicating eczema and ulcers are treated by strapping with adhesive plaster. These ulcerated areas are much benefited if exposed for a few hours daily to direct sunlight.

In impending **gangrene following high ligation of the femoral vein,** vertical suspension of the limb is indicated. The artery should not be tied, as was formerly taught. There are marked congestion and edematous swelling. The superficial veins become dilated and the power of resistance of the parts greatly lowered. The limb should be bandaged to support the superficial circulation. If these means fail amputation must be resorted to. If gangrene does not occur massage and passive movements are to be employed for the edema. Several months elapse before the edema subsides, and in some cases swelling may persist indefinitely. This is also true in case of the subclavian and axillary veins.

In the removal of small varices no disturbance of circulation is apparent.

Thrombosis and Embolism.—The thrombus organizes as soon as the next collateral branch is reached, in case infection is not present. Thrombosis will occasionally ensue when no injury has been done to the vein involved. Massage of the limb tends to prevent their formation by maintaining the equilibrium of the circulation. The swelling may not become apparent until the patient walks about. When thrombi are suspected rest should be enforced to prevent embolism.

Aneurysm.—Following operation for aneurysm there is danger of embolism. Pulsation disappears immediately after proximal

ligation, slowly after distal ligation; it is present after arterioplasty. The aneurysmal tumor shrinks. Rest must be enforced for several weeks after ligation. The blood pressure should be kept low. Following ligature operations there is danger of secondary hemorrhage due to the ligature cutting through the diseased vessel wall.

Following *Matas arterioplasty* the hollow on the surface left by the obliteration of the aneurysm sac is filled with gauze and the parts overlying and in the neighborhood of the operation are supported by cardboard splints accurately molded to the parts and exerting even elastic pressure. The entire limb in the case of an extremity is loosely bandaged with cotton to maintain the temperature. The parts are kept at absolute rest by means of splints, a long posterior splint for the lower extremity, a molded plaster splint for the upper extremity. The fingers or toes are left exposed to watch the circulation. The extremity is kept snugly bandaged for ten days when all dressings and sutures are removed. Usually the limb will require rebandaging owing to loosening of the bandages several times before the tenth day. In the upper extremity slight movements are permitted after the tenth day and these may be gradually increased until at the end of three weeks full use of the extremity is allowable. In the lower extremity the period of rest should be longer, two to three weeks before much movement is allowed. Bandaging is desirable to support the circulation.

Complications.—Infection is rare. *Secondary hemorrhage* uncommon. The chief danger is from embolism which if the collateral circulation is not sufficient, will result in gangrene requiring amputation.

OPERATIONS UPON THE LYMPHATIC SYSTEM.

Lymphangitis (see p. 271).

Lymphadenitis (see p. 272).

Lymphatic Edema.—In cases in which there is obstruction of lymphatic drainage of a part as after axillary adenectomy for carcinoma (p. 428) a quite diffuse lymphatic edema of the limb may persist for some months. This is best overcome by frequent massage and bandaging, at least twice daily. The massage is

employed gently from the finger tips upward to the shoulder. As a rule this form of edema is quite easily pressed out of the tissues. Following each massage the part is snugly bandaged without too great pressure. Under treatment even severe cases will subside in several months, and may in time completely disappear. In some cases, however, there remains a more or less localized edema on the inner side of the arm above the elbow which is particularly persistent. Elevation of the affected member aids lymphatic return and should be insisted upon as a part of the treatment. In persistent cases *lymphangioplasty* is indicated.

Lymphangioplasty (Samson Handley).[1]—The precise amount of shrinkage caused by this operation is shown by careful measurements before and after the operation. The massage and bandaging instituted for the original condition (lymphatic edema) should be persisted in.

Lymphorrhea may follow injury to any large lymphatic channel. Such injuries are apt to occur in the course of operations on enlarged glands, particularly in the clavicular, axillary, and inguinal regions. Infection of the lymph channels may follow. The lesion is characterized by a large effusion of lymph necessitating frequent change of dressings. The escape of lymph may be concealed by the wound discharges. In injury of larger lymph ducts there will be profuse discharge of thin, clear, yellowish fluid. Usually by stimulating the granulating process the lymphatic openings heal over, though a considerable time may elapse before final healing is effected. Sometimes the flow of lymph is controlled by the simple pressure of the dressing. Pressure upon the wound, however, with this object in view is likely to be followed by lymphatic varix of the tributary lymphatics. Should healing be delayed the wound may be cauterized with the thermocautery, thus sealing the openings in the lymphatic vessels. In case a large lymphatic trunk has been injured it may be necessary to expose and ligate it. Lymphorrhea may complicate compound fractures.

Injury to the Thoracic Duct (p. 394).

Lymphangiectasis occurs as a complication of inflammations

[1] *Lancet*, Jan. 2, 1909.

or obstruction from bandage and cicatrices (lymphatic varix). As the trouble is an obstructive one excision is not recommended. Treatment such as is used in lymphatic edema is first indicated—support, compression and massage. If this is not effectual lymphangioplasty or anastomosis with a neighboring vein[1] is recommended.

Persistent fistula following excision in suppurative adenitis. If the entire gland has not been removed a sinus will persist. Treatment of such a sinus is unavailing unless the remaining gland tissue be removed. Excision of the tract and gland tissue is best. If suppuration is prolonged other glands in the neighborhood are apt to become infected.

Adenectomy for Tuberculosis.—The patient should be placed in as hygienic conditions as possible. Many excellent results have been reported from the use of tuberculin as a prophylactic against recurrence. Persisting sinuses are best treated by thorough excision.

Adenectomy for other causes (chancroid, infections) requires the determination of the exciting cause and the initiation of treatment for it.

OPERATIONS ON THE NERVOUS SYSTEM.

Peripheral Nerves. Nerve Resection, Nerve Suture, Nerve Anastomosis.—It is presupposed that healing has occurred without the interposition of much intermediate connective tissue. Centrally the sensory fibers, distally the motor fibers, degenerate. Fibers regenerate from the center to the periphery. The more accurate the approximation of the severed ends, the more rapid the regeneration will be. The position of the parts should for fourteen days following operation be such that there is no tension on the united nerve. At this time mild galvanism, faradism and massage should be employed daily to avoid atrophy and contraction of the paralyzed muscles. Passive movements, specially constructed splints, and elastic apparatus should be used to counteract the opposing muscles. Atrophy, however, cannot be entirely prevented. The daily use of the galvanic and

[1] Godlee and Manson, Clinical Society Transactions, London, vol. xxxv, p. 209.

faradic currents aids also in the study of the process of regeneration and therefore in the prognosis. Electric contractility at first lessens and in from seven to twelve days disappears entirely. Following this the reaction of degeneration occurs, while later the reaction becomes gradually normal, the galvanic reaction appearing first, then the faradic. It is possible that active movements may occur before electric contractility is present. Usually about nine months elapse before a functional result is obtained. The nearer the periphery the nerve has been cut, the more rapid the return to normal. Sensation returns first, often very early. In such a case a recovery may occur in six months. At times quite astonishing results are obtained. The author has completely sectioned the musculo-spiral nerve in removing a fibroneuroma and had a return of function on the thirty-third day, whereas there had been total musculo-spiral paralysis for three months before the operation.

Course following Nerve Anastomosis for Facial Paralysis.— Nerve disturbances will depend upon which nerve has been selected for the anastomosis. If the *spinal accessory* nerve has been sectioned there follows temporary inability to raise the arm above the horizontal, drooping of the shoulder and partial atrophy of the sterno-mastoid and trapezius muscles. Whether the spinal accessory nerve has been sectioned or not associated movements of the shoulder and face muscles commonly follow the operation where regeneration has been effected. No definite rule can be laid down in this regard.

Shoulder movements are not usually possible without movements of the face, though coordinate face movements may occur without shoulder movements. Some cases do not have associated movements. Once present, associated movements are apt to prove permanent, though cases are reported which have learned to disassociate completely the voluntary movements of the face and shoulder.

If the *hypoglossal nerve* has been used, section will result in paralysis and atrophy of one-half of the tongue and at first difficulty in speech and swallowing. For this reason lateral anastomosis is preferred. Associated face and tongue movements follow.

Other nerves have been employed and give the expected physiologic complications.

The first result noted in a successful case is a return of facial symmetry, then follows return of voluntary control. Perfect restoration of expression and emotion is not to be expected, though if the subject is young the new cortical centers might be educated.

The treatment is as for nerve operations in general, electricity and massage. Improvement may be noted in from a few weeks to a few months, though the extent of improvement may not be final for a year or more.

Following *suture of the brachial plexus*, the forearm is supported by a sling during the period of paralysis to avoid strain on the cords from the weight of the extremity. In applying the primary dressing the shoulder is brought forward and elevated, and the neck inclined toward the injury to avoid tension. Immobilization of the entire extremity and neck is maintained for three weeks. Regeneration is slower than after injury to more superficial nerve trunks and complete restoration to function is rare.

The after-treatment in cases of paralysis caused by pressure from callus, cicatricial tissue, exudate, and tumor, is along the same lines, the cause having been removed.

Nerve-stretching depends for its success upon the removal of pressure from exudate. If the stretching has been thoroughly done, temporary partial paralysis will result.

Needling the nerve produces temporary partial paralysis.

Following **neurotomies** and **neurectomies** for painful conditions the disappearance of pain is usually immediate, though in rare cases the pain may persist for a few days and necessitate the use of morphin. It often follows that the resulting anesthesia is limited to a much smaller area than was expected and feeling may return without being accompanied by the original neuralgia. Many patients are permanently cured, while in others there is rapid recurrence of the pain. *Trophic disturbances* may follow nerve suture. *Edema* is treated by massage and supporting bandages; *dryness of skin* by warm baths and vaselin; *disturbances of circulation* by elevation and massage.

Following neurectomy of the second branch of the trigeminus trophic keratitis may develop. This is treated by protecting the eye with cotton, the instillation of atropin, and the usual eye treatment.

OPERATIONS UPON THE SPINAL CORD AND POSTERIOR NERVE ROOTS.

Underlying Principles.—Surgically the spinal cord is divided into the cord proper, composed of nonneurilemmatous elements beginning above at a line between the articular surfaces of the atlas and the condyles of the occipital bone corresponding to the decussation of the pyramidal tracts and ending at the twelfth dorsal vertebra; the cauda, composed of neurilemmatous elements, and the anterior and posterior nerve roots, nonneurilemmatous in the cord and neurilemmatous outside the cord.

The value of operative interference in injuries or diseases of the spinal cord depends primarily upon the character of the structures involved. Regeneration is possible only in those portions of the cord in which neurilemma is present; that is, in the spinal nerve roots external to the cord proper and in the cauda. Regeneration never occurs in the spinal cord proper. What does at times occur is that some of the work of a given segment may be taken up in part at least by the segment above and below the one affected through already existing anastomoses between the spinal nerves outside the spinal cord itself. These facts are the fundamental principles upon which must rest all operative interference. A knowledge of them combined with an exact knowledge of the anatomy and physiology of the nerve roots, the cauda and the cord proper with an exact knowledge of the pathology of the lesion is essential. The most important underlying principle is that where there is neurilemma regeneration occurs; where there is no neurilemma regeneration is impossible. Whatever structure is involved degeneration is certain but only in structures containing neurilemma may regeneration be expected.

Knowing these fundamental facts, we can state with a fair degree of exactitude what may be expected or accomplished in the treatment of given lesions. If the lesion, traumatic or other-

wise, destroys the spinal structure itself, whatever damage has been inflicted to the cord by it is permanent, though some improvement of symptoms may be expected through already existing nerve anastomoses. There is no anatomic proof of cord regeneration. All experimental studies disprove it. The most that has been observed is the beginning growth of nerve-fiber in the scar itself or in the uninjured dura, both devoid of any functional value. Our hope of better results in such cases is through already existing nerve anastomoses or through making such anastomoses.

CHAPTER XII.

OPERATIONS UPON SPECIAL TISSUES (Continued).

Bones and Joints.—Chisel operations. Osteomyelitis. Benign bone tumors. Disturbance of function. Disturbance of growth. Acute osteomyelitis. The after-treatment of resection wounds. Functional result. Nearthrosis. Flail-joint. Ankylotic union. The after-treatment of resection of the elbow-joint. After-treatment of operations for contractures and ankylosis of the hip. After-treatment of resection of the hip for tuberculosis. The functional results of resection of the hip. After-treatment of arthrotomy for detached semilunar cartilage or joint mice. Functional results of resection of the knee-joint. After-treatment of resection of the knee-joint. Partial resection. Result of resection of the knee-joint. Tarsectomy. Ogston's operation. Contracture at the astragalotarsal joint. Talipes equinus operations. Lisfranc's operation. The after-treatment of fractures. Late complications of fractures. The after-treatment of fractures treated operatively. Impacted fracture of the neck of the femur. Fracture of the patella. Amputations and disarticulations. General rules. Stay in bed. Care of the wound. Drainage. Shock. Infection. Necrosis of the flaps. Bone necrosis. Thrombosis and embolism. The cicatrix. Painful condition of the stump. Bandaging of the stump. Cases in which primary suturing is done. Traumatic cases. Stump dressing. Shock. Cases whose condition is so serious that no immediate operative intervention can be employed. Cases in which no primary suturing is done. Senile gangrene. Operations through or near the shoulder girdle. Amputations below the shoulder. Amputations below the elbow. Amputations through or near the hip-joint. Amputations through the thigh. Amputations of the toes or forefoot. Amputations below the knee. Prosthesis. Hallux valgus. Osteotomy of the tibia for bow-legs. Osteotomy for genu valgum.

OPERATIONS UPON BONE.

Chisel Operations (Osteomyelitis. Benign Bone Tumors).—In operations in which the chisel has been used there results a

cavity in the bone which is slowly filled by granulation. Generally speaking, the skin wound is closed except for a small opening to permit the emergence of the packing strip. The healing process is much delayed on account of the unyielding bony walls. To hasten healing in the case of aseptic cavities, if skin-grafting, flap operations, bone chips, sponges, Moorhoff's bone wax or a Schede clot has been the method used the wound will have been closed completely and will be treated as a wound healing by primary intention. If infection occurs it becomes necessary to open the wound, cleanse and pack it. In cavities treated by the open method the packing should be renewed every four to six days, each time using a smaller packing. The discharge from such wounds is always free. The healing process may take two to three weeks or three to six months, according to the size of the cavity and the disease for which the operation was done. By reason of the large amount of discharge the general system suffers and anemia may result. Such patients should be out of bed and in the fresh air as soon as and as much as possible. To accomplish this, various forms of apparatus will be necessary. Following operations for osteomyelitis amyloid degeneration of the viscera may complicate the after-treatment on account of the long-continued suppuration. Such patients, being much weakened by the long-continued discharge, are predisposed to tuberculous infection.

In cases which have been drained the skin becomes adherent to the bone. In cases which heal by primary union the cicatrix may at first be adherent to the bone, but becomes loosened in time. An adherent cicatrix, unless painful, is not important in operations upon an extremity. Occurring on the face it may be very deforming. The treatment consists in massage, and if this fails a secondary plastic operation may be done. Such cicatrices occurring over the tibia are always sources of irritation to the patient. They are easily injured, and break down, causing ulcers. Such a scar should be protected. A plastic operation may be done to bring healthy skin over the bony prominence. Persistent fistula is a common sequel of inflammatory bone disease.

Disturbance of Function.—Function of the part may be greatly

disturbed, and an apparatus may be necessary until new bone has replaced the lost substance. In healthy patients new bone forms quickly and the support is not required very long.

Disturbance of Growth.—This usually results from the disease, not from the operation. If the epiphysis itself is diseased the amount of shortening will depend upon the age of the patient. This causes, in the case of the forearm and leg, a bowing when one bone is involved and the other has remained normal.

Acute Osteomyelitis.—Fever may continue in spite of drainage. This means that a lymphostatic infection has occurred, or that the entire focus has not been removed. In the latter case the fever will not subside until the cavity has been cleared of all septic products. Vaccine therapy is usually indicated.

The After-treatment of Resection Wounds.—The parts are to be enveloped in copious dressings of aseptic gauze. If drainage has been employed, these should be specially thick in the neighborhood where the tubes emerge. The copious dressings, reinforced by thin basswood or pasteboard splints, which should extend beyond the next adjacent joint and be secured in position by starched gauze (crinoline) bandages, first wetted and then applied will secure sufficient immobilization of the parts for the first few weeks at least, without the aid of plaster of Paris. The ordinary rules governing redressing should be followed.

If all goes well a large resection wound may heal by primary union, except, in cases in which drainage is employed, the points where the drains emerge. Even in the knee-joint no more time is occupied in uncomplicated cases than is necessary for recovery from a fracture.

As the wound approaches complete healing, the surgeon's chief efforts should be directed toward securing the desired *functional result.* In the lower extremity solid union is to be obtained, and with this in view, a fixed form of dressing, such as will permit the application of aseptic measures and at the same time completely immobilize the parts, is to be applied. The bracketed splint (Fig. 171), employed in connection with a plaster-of-Paris casing, serves the purpose admirably.

In the case of the upper extremity, if a subcapsular and sub-

periosteal resection has been possible, not much difficulty will be experienced in obtaining an artificial joint (*nearthrosis*). The new bone is molded into shape and even articular extremities may form. Passive motion in the normal range of the limb will assist in the molding process. The synovial membrane resumes its function. In due time active movements supplement those of a passive character. Atrophy of the muscles resulting from nonuse is to be treated first by the galvanic current, and subsequently by faradization.

When it is found impossible to preserve the synovial capsule and periosteum, an artificial joint may still be secured. The perisynovial connective tissue seems to assume the function of the synovial membrane. Aseptic healing materially aids in producing a nearthrosis, even when no passive movements are made. But *flail-like joints* may result from excessive mobility, the joint permitting movements in all directions like a flail. This condition may arise from injury to important muscles by the incisions, defective preservation of the periosteum, severe and prolonged suppuration, the removal of too much bone and excessive passive movements during the after-treatment, and insufficient stimulation of the muscular apparatus, paralysis of the latter from nerve injury, and paresis of the same from want of use.

In case of the elbow-joint a flail-like joint is of not infrequent occurrence after resection for tuberculous disease. Under these circumstances it is recommended to attempt to secure bony ankylosis in a proper position (Billroth).

Solid or ankylotic union must be secured at the knee and ankle; and even at the hip it is not a great disadvantage. Good functional results have been obtained, however, with an artificial hip-joint. Whether solid union is intended or not, in case of its occurrence, the limb is to be placed in a position most convenient for use, *i.e.*, the elbow at a right angle and the knee in the extended position.

During the period of childhood every effort should be made to preserve the epiphyseal cartilages in resection of the joints. Injury of these structures, with the enforced rest necessary in resection, leads to lessened longitudinal growth of the bone and consequent relative shortening of the limb.

The After-treatment of Resection of the Elbow-joint.—The arm is to be thickly enveloped with aseptic gauze dressing and aseptic cotton-wool and placed at first on a right-angled wire splint, or a fenestrated plaster-of-Paris splint may be employed. If a movable joint is aimed at, the use of an open-wire frame suspended in an easy position, with bandage material stretched across from side to side, will be indicated. When total resection is performed, under which circumstances bony union of the sawed surfaces gives the most useful arm, a splint which will keep the parts immobile, and at the same time permit access for dressing purposes, is to be used. The form of splint shown in Fig. 167 is

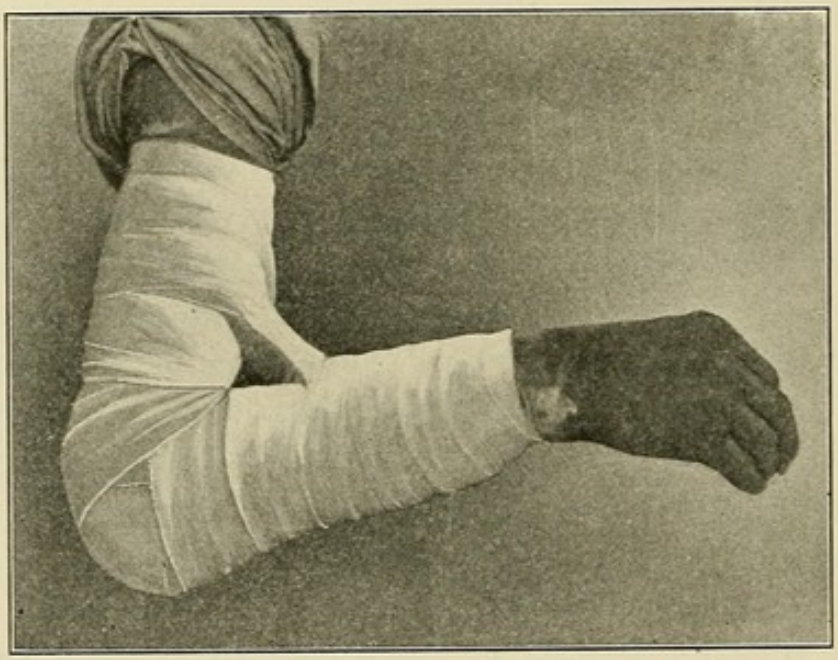


Fig. 167.—Plaster bridge elbow splint. For the after-treatment of resection of the elbow-joint. Only the parts connected together by the "bridge" are of plaster of Paris. The remainder is simple bandage material retaining the dressings in position. (Fowler's Surgery.)

very useful. It is of plaster of Paris and embraces the arm and forearm only, with a connecting "bridge" on the anterior surface. A number of turns of plaster-of-Paris bandage encircle the forearm and arm alternately, the bridge being formed of the same bandage as it passes to and fro from the forearm to the arm.

As a rule, the patient may leave the bed after the first week. In the movable joint cases daily passive movements in the normal directions may be commenced as soon as healthy granulations fill the wound. In injuries cicatrization is under way in from four to six weeks; in shot injuries the period is longer.

These movements are to be followed as soon as practicable by the patient's voluntary movements. These are to be persisted in, particularly those of flexion, supination, and pronation, the arm being held alongside the body and slightly abducted.

After-treatment of Operations for Contractures and Ankylosis of the Hip.—An extension apparatus (Fig. 168) and a heavy weight, with the thigh in abduction, is to be applied after all of

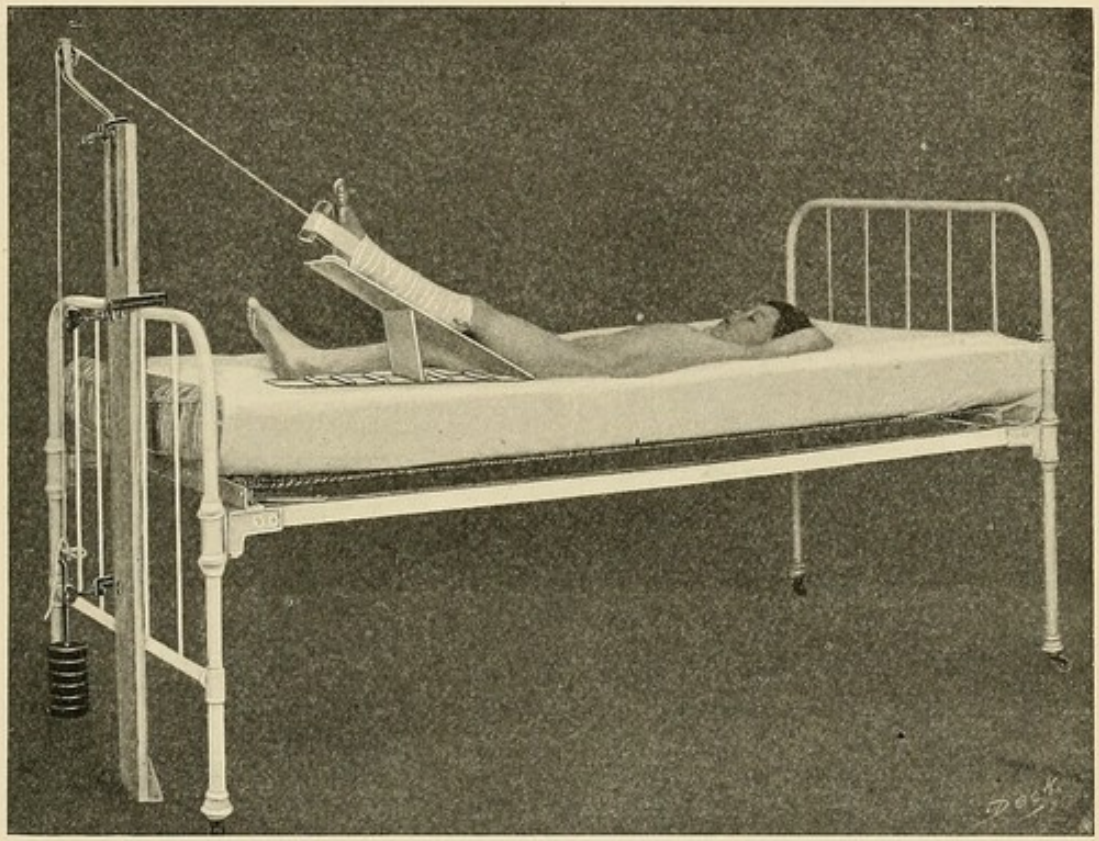


Fig. 168.—Combined extension and inclined plane for reduction of contracture of the hip. (Fowler's Surgery.)

these operations, and its use continued until healing takes place. After recovery, to prevent recurrence, the patient should use the weight and pulley extension at night by means of a garter, laced well up on the limb.

After-treatment of Resection of the Hip for Tuberculosis.—In the after-treatment extension and abduction must be made and continued for some time, particularly in children. The discharge is considerable for the first few days. To facilitate dressing of the parts without producing pain, to enable the nurse to prevent fecal matter and urine from soiling the dressings, and

to relieve pressure on the sacrum and prevent the development of bed-sores, the limbs should be placed in the position of vertical suspension sometimes employed in fracture of the femur in children, with the limbs abducted, and the sacrum just free from the surface of the bed. This position also greatly facilitates the changing of the dressings, the pelvis being elevated during this procedure by shortening the cord connecting the foot-piece to the cross-bar of the apparatus (Fig. 169). When

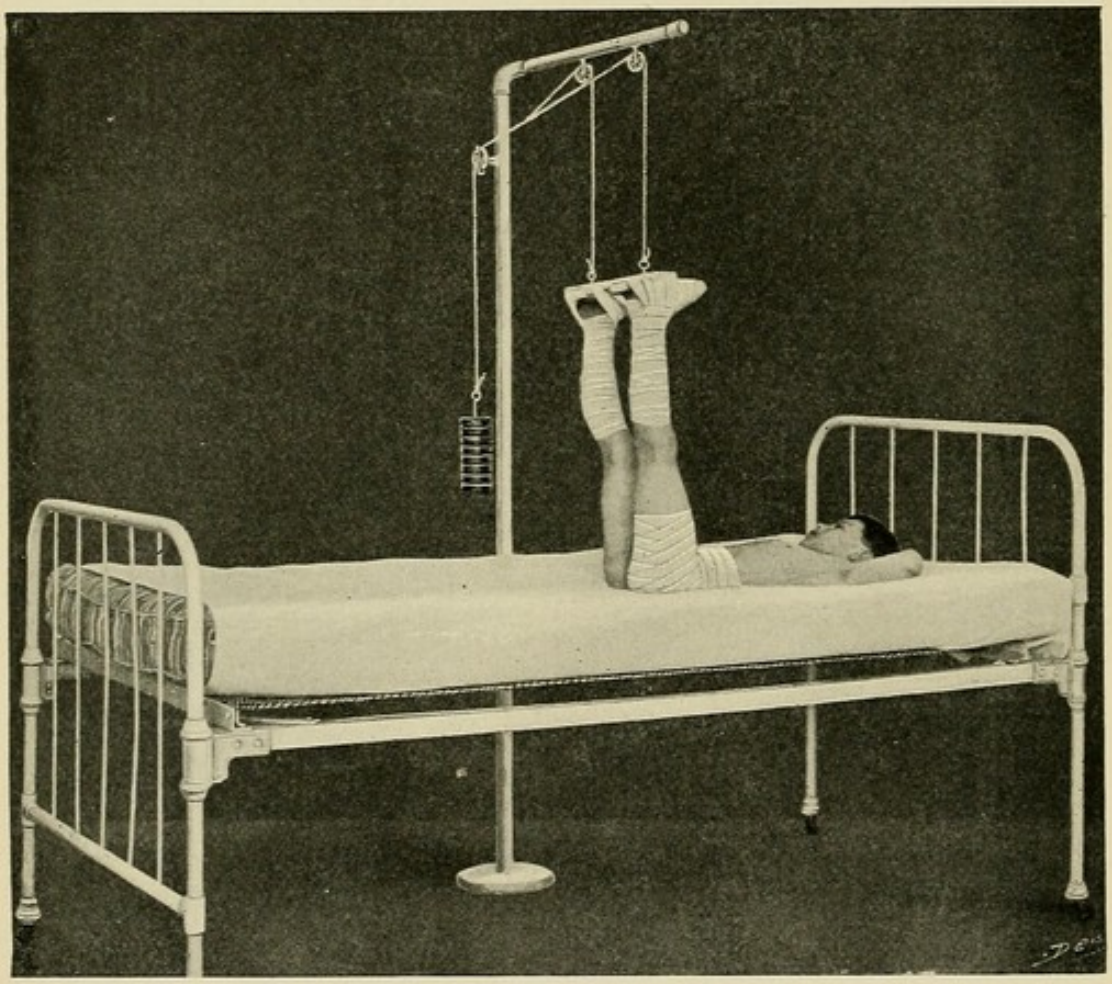


Fig. 169.—Vertical extension in the after-treatment of resection of the hip-joint in children. (Fowler's Surgery.)

the discharge is less and the patient can be moved without great pain, extension in the horizontal position with abduction is to be made. Later on, during the period of simple cicatrization, Taylor's hip splint (Fig. 170) should be worn in the daytime and the patient encouraged to walk. Extension by weight and pulley is to be kept up at night. Fistulous openings which lead to tracts lined with tuberculous granulations should be fre-

quently curetted, treated with pure carbolic acid and alcohol, and packed with gauze saturated with antituberculous medicaments. These will finally heal under this treatment if all the diseased bone has been removed at the operation

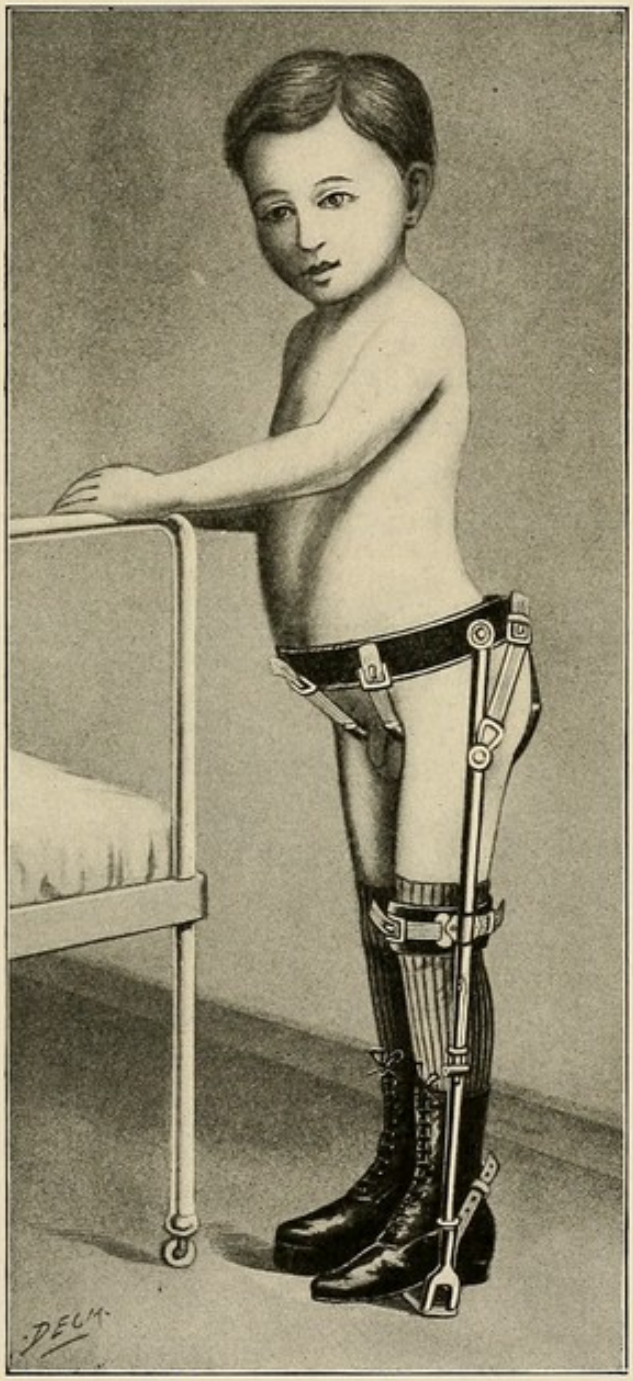


Fig. 170.—Taylor's long traction splint applied. (Fowler's Surgery.)

The Functional Results of Resection of the Hip.—These are now conceded, and the value of the operation is no longer doubted. In some instances a reorganization of the joint takes place. In

others, the lesser trochanter, covered with cartilage, has been found resting in the acetabulum, thereby forming a substitute for the head. There can be no question that resection gives a better limb than the average result obtained without operation in the class of cases in which resection is indicated according to the rules laid down. If the operation is performed before it is positively indicated, it may be performed unnecessarily; the functional results following cure by orthopedic methods would certainly be better as regards the shortening and the supporting strength of the limb. On the other hand, in those cases in which the indications for resection are present, the longer it is delayed, the greater the mortality, the more pronounced the flail-like character of the limb, and the greater the amount of shortening. When the latter conditions are present to the extent of a comparatively useless limb, the result is to be attributed to the ravages of the disease which required such an extensive removal of bone, and not to the operation.

After-treatment of Arthrotomy for Detached Semilunar Cartilage or Joint Mice.—The limb is *immobilized* on a posterior splint, with lateral splints of light basswood, or put up in plaster of Paris for a week, after which the ordinary gauze dressings suffice to restrain the movements of the joint as much as necessary. The patient should be encouraged to move the limb as much as possible after ten days have elapsed. Should there be a tendency to restriction of flexion, this should be corrected by *passive movements and massage.*

The Functional Results of Resection of the Knee-joint.—While in the case of all other joints a *nearthrosis* or movable articulation replacing the one removed is aimed at, immobility is the ideal result after resection of the knee-joint, so that a proper and natural support for the body may be obtained (Park). The shortening present, which, in the majority of cases, is not great, is readily compensated for by an extra thickness of the sole of the corresponding shoe; even without this, in many cases, a scarcely perceptible limp is present after a time, on account of the lateral tilting of the pelvis. Experience shows that, even in young children, if only a very thin slice of bone is removed, particularly in the case of the tibial epiphysis, the restriction of

growth is not very great. Unfortunately, however, the epiphyseal line of the femur at least is almost always encroached on, owing to the extent of the disease. Eulenburg reported several cases of paralysis due to angulation of the tibial nerve in the coaptation of the sawed surfaces. Heinke demonstrated at autopsy in one case that the paralysis depended on the involvement of the nerve in the surrounding cicatricial tissue. H. Braun was compelled to amputate in a case in which the sawed surface of the tibia projected backward and made pressure on the popliteal nerve. In a second case in which the same displacement was present this did not occur; the displacement was shown to exist by a subsequent amputation on account of recurrence of the tuberculous disease.

After-treatment of Resection of the Ankle-joint.—Copious dressings are applied, and the foot supported by a Volkmann's posterior splint with foot-piece, and two side splints.

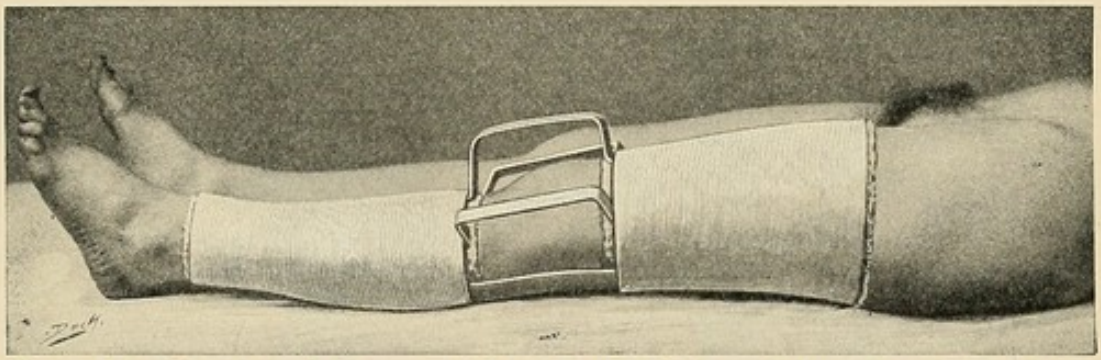


Fig. 171.—Bracketed plaster-of-Paris splint for use after resection of the knee-joint. (Fowler's Surgery.)

Constant care and watchfulness must be used in the after-treatment to maintain the foot at a right angle to prevent abduction or adduction, and to preserve the foot in a position midway between pronation and supination. *Partial resection* does not give such good final results as complete resection, and efficient drainage is not so easily secured.

The Result of Resection of the Ankle-joint.—In the absence of damage to the periosteum from suppuration, with the exception of tuberculous cases, rapid repair and early usefulness of the foot after subperiosteal resection of the ankle-joint is the rule. The malleoli are reproduced, often at first exceeding in

size the original. The shortening is slight in proportion to the amount of bone removed, an extra thickness of the sole of the shoe supplying the deficiency. A joint may form in the fibrous new formation. The mortality, in properly selected cases, is small. In gunshot injuries resection, as a rule, is to be preferred to amputation. An unfavorable prognosis, however, is warranted in cases of tuberculous caries in individuals beyond the period of growth; such cases usually require amputation. If performed early, resection in children and young persons admits of a good prognosis, as regards both life and function.

Tarsectomy.—The operation must be followed by redressment and pressure to maintain the reposition. As soon as the wound has healed, the foot is overcorrected and a plaster-of-Paris bandage applied.

Ogston's Operation.—The foot is forced in position, the thin shell left behind readily adapting itself to the corrected shape of the tarsus, the wound sutured, and the parts immobilized with plaster of Paris.

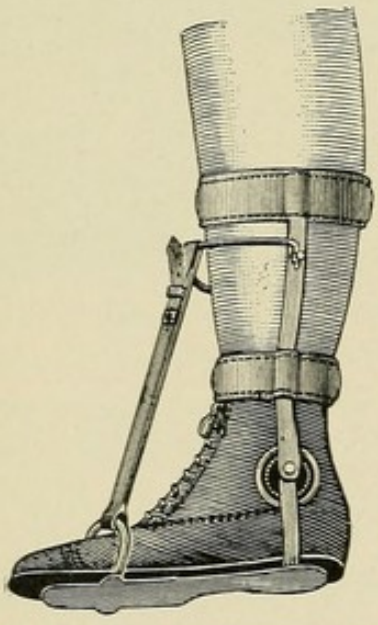


Fig. 172.—Sayre s apparatus for correction of Talipes Equinus. (Fowler's Surgery.)

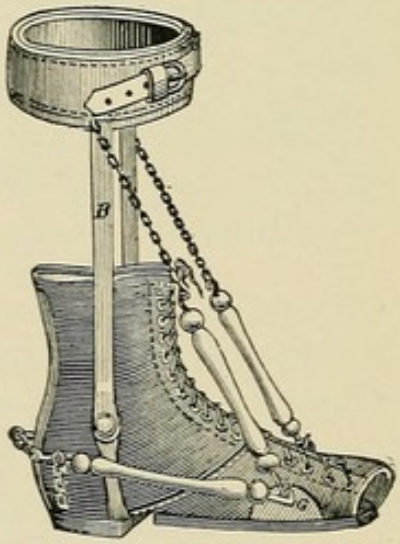


Fig. 173.—Sayre's shoe for clubfoot. (Fowler's Surgery.)

Contracture at the Astragalotarsal Joint.—After thorough and efficient correction, orthopedic apparatus is applied to maintain the correction (Fig. 172).

Talipes Equinus Operation.—Following successful correction

the foot is first maintained in position by a plaster-of-Paris splint; later an apparatus (Fig. 173) consisting of a leg girdle connected to a laced boot by two lateral splints and lever springs attached to both sides of the boot to maintain the foot at a right angle, should be worn. The patient should be encouraged to walk about.

Lisfranc's Amputation.—The loss of support following Lisfranc's amputation is such that the patient must wear a specially constructed cork sole made thick on the front and inner side, to compensate for the resulting equinovarus position.

The After-treatment of Fractures.—In fractures of the extremities the distal portion of the extremity should be examined frequently in order to determine the condition of the circulation. If pressure at the periphery produces a blanched appearance which is slow in turning to its normal color, and if the parts are slightly swollen, the dressings should be removed and reapplied in such a manner as to preclude undue pressure. Should the pain which is a natural consequence of fractures persist for more than a few days following the injury, the dressings should be removed and reapplied. This should also be done in case the pain in the first few days is extremely severe, as ordinarily the pain following fractures is such as to be borne by the average patient. Any complaint of burning pain over the bony prominences or at the heel should be inquired into without delay, otherwise an intractable pressure sore may develop. In an uncomplicated fracture there should be practically no fever forty-eight hours following the injury. Should fever persist beyond this period, the parts should be inspected, as it may be that the fracture has become the seat of a septic process. In compound fractures frequent inspection of the parts and dressing of the wound are necessary. Simple fractures may be allowed to remain uninspected for from four to six weeks, unless the dressings become loose. In very oblique fractures the dressings should be removed at the end of the second week in order to ascertain whether displacement has occurred. Fractures in the neighborhood of joints in which there is practically no tendency to displacement should be massaged daily. The patient should not be confined to bed, in any event, longer than is absolutely

necessary. The proper reduction of the fracture should be verified by the X-ray.

Late Complications of Fractures.—These consist in edema, hematoma, adhesion to muscles and tendons, atrophy from nonuse, interference with the movements of neighboring joints through excessive callus or inflammatory exudate, undue shortening, and vicious callus. The first four are benefited by massage, elastic bandaging, passive movements, warm baths, and electricity. The interference with the movement of neighboring bones and joints from excessive callus will require operative interference. This should not be done until some months have elapsed. Inflammatory exudate is treated by massage. Undue shortening requires, in the case of the lower extremity, a thicker sole on the shoe worn on the injured side. Partial union or delayed union is treated by fitting a suitable brace to the part and allowing the patient to get about, and the injection of a few minims of an irritating substance, perchlorid of iron, between the bone ends (Dawbarn).

The *after-treatment of fractures treated operatively* differs only by having the care of the wound added to the usual fracture treatment. Occasionally foreign bodies introduced to maintain apposition will require subsequent removal. The general health should be improved. Ununited fractures require operation and subsequent orthopedic treatment. Union with deformity should be treated by refracture.

Impacted Fracture of the Neck of the Femur. *Whitman's Method.*—The patient is anesthetized. The trunk is supported by a box seven inches high having an extension to support the pelvis (Fig. 174). Assistants support the limbs. The uninjured hip is abducted to the normal extent both to demonstrate the amount of abduction and to fix the pelvis. Under extension the injured hip is slowly abducted by an assistant, the surgeon supporting the joint and exerting gentle pressure downward upon the trochanter. Traction and abduction are continued until the normal limit is reached when any outward rotation is corrected. The parts are then fixed in position by a plaster-of-Paris cast including the limb of the injured side, the pelvis, and a sufficient amount of the trunk to produce a stable

effect. If the *fracture* is *complete*, with the patient in the same position and the sound limb held in abduction the injured limb is flexed to disengage any portion of the capsule which may have fallen between the fragments, then extended and rotated to the normal position. With combined extension and counterextension shortening is overcome as demonstrated by measurement. Still keeping up the extension the limb is slowly abducted by an assistant, the surgeon supporting the joint and pushing the thigh upward from beneath to force the two fragments against

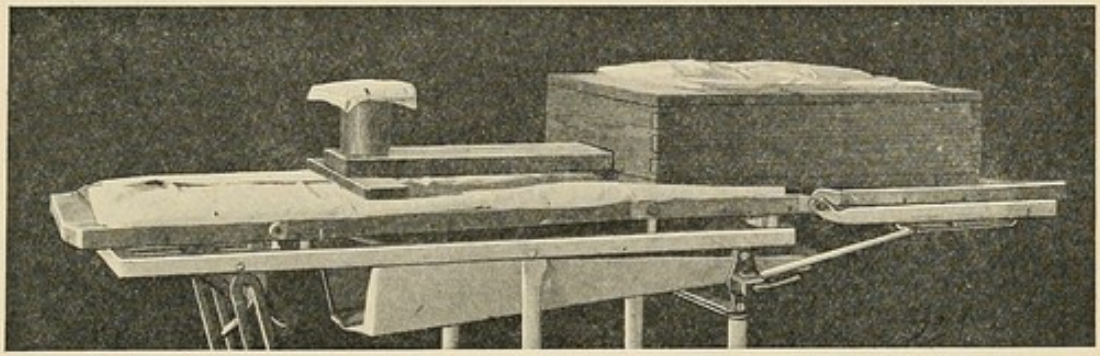


Fig. 174.—Whitman's box for application of plaster cast for fracture of the neck of the femur.

the anterior part of the capsule. In extreme abduction the capsule is tense, therefore the fragments must be directed toward one another by it and the trochanter will be in relation with the side of the pelvis thus preventing upward displacement, and the muscles whose contraction favors deformity will be completely relaxed. A plaster cast is then applied. In elderly patients the head of the bed is raised one or two feet; this lessens the danger of hypostatic pulmonary congestion and serves to increase the blood supply at the seat of injury. Repair is slow and weight must not be borne upon the limb for many months. The course of bone healing should be observed by a series of X-ray plates. After six or eight weeks the cast may be removed and a modified hip splint substituted. In the course of the after-treatment massage and passive and active exercises should be given. Whitman considers by far the most important exercise the frequent complete abduction of the limb.

Fracture of the Patella. *Open Operation.*—The splint (Fig. 175) is to be abandoned at the end of ten days, and, as soon

thereafter as the skin wound is strongly healed, the patella *should be moved from side to side* once or twice daily to prevent the formation of adhesions (McBurney). The patient may

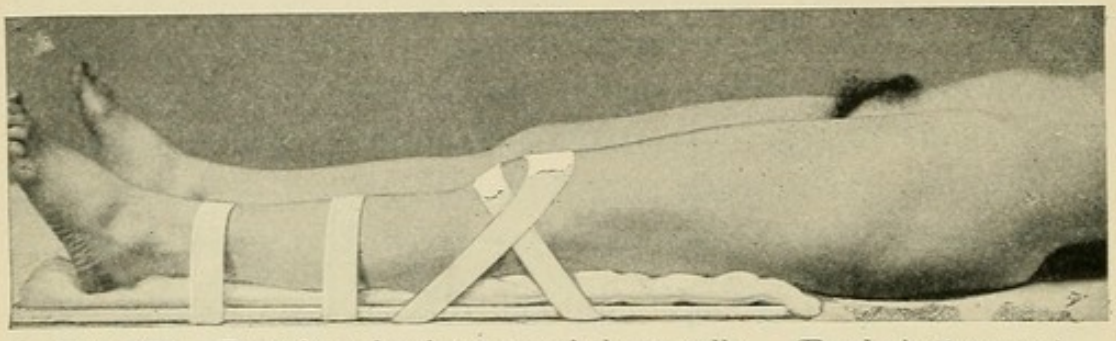


Fig. 175.—Dressings for fracture of the patella. (Fowler's Surgery.)

walk about in three weeks at the most, the knee being supported on a posterior splint while he is up. This should be removed when he lies down. Some passive movements may be cautiously attempted from time to time after the first three weeks; these may be increased as time passes. To prevent refracture from an accidental fall, the patient may wear a "check" apparatus (Fig. 176).

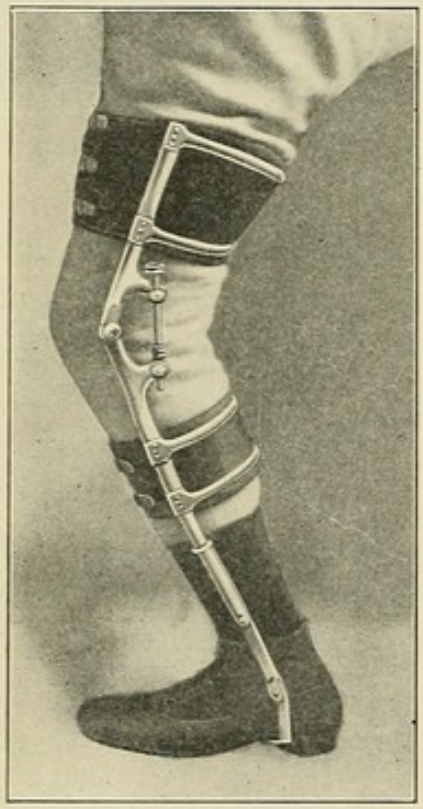


Fig. 176.—Brace for fracture of the patella. (Fowler's Surgery.)

Amputations and Disarticulations.—The after-treatment of these cases depends somewhat upon whether the wound is left open or is sutured, upon the lesion necessitating the operation, and upon the technic employed.

General Rules. Stay in Bed.—It is desirable to get these patients out of bed and in the sunlight as quickly as their general condition will permit. Usually four or five days' rest in bed will be sufficient. The patient may then be lifted into a wheel chair if this will not interfere with the rest of the wound which must be kept quiet for ten days. Crutches after amputation upon the lower extremity may be used on the tenth day or as soon thereafter as wound healing is practically complete.

Care of the Wound.—The regular *stump dressing* is applied (p. 345) in all cases. The outer dressing is changed at the end of forty-eight hours or sooner if soiled. Sutures are removed on the tenth day. The tender cicatrix is then supported by narrow strips of adhesive plaster. *Drainage* in cases treated openly has been sufficiently discussed. In cases sutured primarily it is, as a rule, unnecessary to employ drainage, the spaces between the sutures being usually sufficient to allow of the escape of serum. Should oozing be expected, due to the great vascularity of the parts, it is well to provide for its escape by placing a small drainage tube in each angle of the wound. In such cases a provisional suture is placed at the point of emergence of each drain to be tightened upon removal of the drains. These are removed on the second day and the wound redressed without drainage.

Shock depends upon the condition of the patient and the site of the amputation. It is minimized by cocainizing the principal nerve trunks of the extremity (Crile). When present it is combated by the usual measures.

Infection.—As the areas involved in the operation are large, yet in intimate relation infection once initiated rapidly attacks all parts of the wound and the danger of general infection is imminent. Immediately upon the occurrence of infection the site of infection must be widely opened, if necessary removing all the sutures. Absolutely free drainage must be provided. A copious alcohol-bichlorid dressing is applied to the infected surfaces. These are renewed several times daily until the subsidence of the infection. When the wound is clean secondary suturing is done.

Necrosis of the Flaps.—This may arise from trauma, sepsis, or arteriosclerosis, or a combination of these causes. The trauma may be the result of the original injury or may result from an injudicious primary suturing. Dead portions of the flap are removed at each dressing and both local and general stimulating treatment inaugurated to bring the parts to a healthy condition. The separation of dead from healthy tissue is thus hastened. Should the sutures be at fault, these are removed and perfectly free drainage established. Necrosis may involve

the bone itself, in which case the bone is curetted. Should necrosis prove extensive, a second amputation will be necessitated, and in performing this it is well to bear in mind and guard against those conditions which produced necrosis in the first instance.

Bone Necrosis.—Every operation upon bone involves traumatism which may result in bone necrosis. This necrosis may be only superficial and result in a small fistula which readily heals following curetting or more extensive necrosis with formation of sequestra and persistent sinus may result. In the latter event it will be necessary to enlarge the sinus sufficiently to remove the sequestra and in some cases to even remove a considerable portion of the end of the bone.

The *cicatrix* in cases sutured primarily or secondarily will be linear; in other cases it will depend upon the care of the open wound. If healing occurs by granulation alone there will result a broad cicatrix, but if the healing process is aided by support of the structures and the partial approximation and partial closure of the wound by adhesive plaster and skillful bandaging, then a fairly good cicatrix will result. It is desirable that as little scar tissue as possible be in the stump, as this scar tissue is frequently the cause of pain, either through inclosure of nerve filaments or by external pressure.

Painful conditions of the stump may ensue. These may be due to inclusion of nerve filaments in the callus, to neuromata developing at the severed ends of large nerves, to bony necrosis and resulting fistulæ, and to inefficient protection of the severed end of the bone. If these conditions prove persistently painful it will be necessary to perform a secondary operation for their cure. They may in great measure be prevented by skillful technic in the operation and in the after-care. To guard against them the formation of scar tissue must be reduced to the minimum, large nerves must be cut squarely across and at as high a level as possible. This is accomplished by traction on the nerve in the wound. Careful asepsis and avoidance of unnecessary traumatism to the bone will guard against bony necrosis. The end of the bone itself may be covered by a bone graft (Bier) or the medullary cavity of the larger bones may be plugged with an appropriately shaped piece of bone taken from

the amputated portion. This is driven tightly into the medullary canal for an inch, and one-quarter of an inch left projecting beyond the sawed end of the bone.

Bandaging of the stump should be done daily until an artificial limb is applied. The patient should be instructed how to properly apply the bandage. Flannel makes the most desirable bandage and the one most easily applied by the patient. The bandage should be removed at night and the stump massaged, at first gently, later more vigorously.

Cases in which Primary Suturing is Done.—This should be employed in all cases which admit of it as it undoubtedly not only induces more rapid healing, but produces a more perfect stump. The severed ends of opposing muscles should be sutured together in order to limit, to some extent at least, the amount of atrophy. The skin sutures should be sufficiently distant from each other to permit the escape of serum from the depths of the wound, and should interfere in no way with the blood supply of the flap. There should be no tension. In cases sutured primarily there should be no indications for disturbing the stump dressing proper before the tenth day. At this time the skin sutures are removed. It may have been necessary to change the outer dressing on the first or second day on account of oozing.

In *traumatic cases* it frequently happens that the condition of the patient does not allow of more than the control of hemorrhage, the rapid removal of the limb, and the trimming of the flaps. To do more—*i. e.*, to accurately suture the flaps—would be more than the weakened condition of the patient would permit. Moreover, the contused condition of the soft parts is such that to suture them accurately would be to invite sepsis. The flaps in such a case are left unsutured or only partially sutured and the wound cavity filled with dry sterile gauze. The stump is then enveloped in gauze and this *stump dressing* secured by a gauze bandage. Over this again are placed other layers of gauze, and this in turn is secured by a bandage which includes the neighboring parts sufficiently to prevent slipping; in the case of the thigh, the pelvis should be included; in the case of the leg, the knee and thigh. The dressing is applied in

this manner because in such cases there is expected a large amount of oozing. This quickly saturates the dressing and predisposes to sepsis. By having an outer as well as an inner dressing the outer one can be changed, as soon as the oozing is apparent, without disturbing the stump dressing proper. This not only conduces to the comfort of the patient, but guards against infection of the wound by too frequent change of dressing. In cases in which there is a joint between the site of amputation and the trunk, as in case of the forearm or leg, it is well to apply a well-padded splint to control the movements of the extremity and to prevent contractures. The splint should extend a few inches beyond the stump to protect it from injury. The parts should be supported and elevated by soft pillows.

Shock should be treated on the lines already laid down, but infusion should not be employed until the source of the hemorrhage has been secured. The stump dressing proper need not be disturbed for three or four days, except in case of hemorrhage or infection. At this dressing, if the parts are uninfected and the patient's condition warrants it, secondary suturing should be done under local anesthesia. Otherwise the wound is treated openly until a more opportune time arrives for further interference. In those cases which cannot be sutured secondarily the use of adhesive-plaster straps will greatly aid in reducing the size of the wound and producing a well-formed stump. There are a few of these *cases whose condition is so serious that no immediate operative intervention can be employed.* In such cases the tourniquet is left in place for from twelve to twenty hours until stimulation has decreased the primary shock. Such cases may be infused intravenously, or, better, intracellularly. They must be closely watched to prevent slipping of the tourniquet and a recurrence of the hemorrhage. Overstimulation must be guarded against. Of course this is only done in very serious cases, as the pressure of the tourniquet, while it may not severely injure the skin, does produce, if left on for more than a few hours, a vasomotor paralysis of the vessels, which results in a very persistent oozing upon the final removal of the tourniquet (p. 260).

There remain two other classes of *cases in which no primary*

suturing is done—those in which infection is indubitably present or very apt to occur, and those in which the reparative process of the tissues is weakened. As notable examples of the first we have *osteomyelitis, moist gangrene,* and *extensive septic conditions;* of the second, *arteriosclerotic conditions,* such as *senile gangrene.* To secure the flaps by suturing in the first class would be to invite an inevitable sepsis; in the second class would still further impair the integrity of the flap by interfering to too great an extent with its already poor blood supply. The first class are, therefore, treated as open wounds until proved clean. Such wounds should be dressed at the end of forty-eight hours and daily thereafter. As soon as the septic condition is under control adhesive-plaster straps are employed to aid in reducing the area of the wound. Secondary suturing is done in whole or in part as soon as the wound presents a healthy appearance.

In *senile gangrene* and allied conditions one or two sutures may approximate the flaps, but for the most part no interference with their blood supply is allowable. The dressing in such cases must not exert the least pressure. As soon as time has demonstrated the integrity of the flaps secondary suturing is done. This can usually be determined in seven or eight days. Such cases are so treacherous and so apt to result in necrosis of the flaps that high amputation is advisable in most cases, but for this no general rule can be laid down. The condition of the artery wall will aid to some extent. If one is quite sure of the viability of the flaps primary suturing may be done. Cases of arteriosclerosis are best left in their primary dressing for three or four days. Later these are dressed every second or third day.

Operations through or near the *shoulder girdle* are more apt to be complicated by pneumonia. Following these operations the patient is propped up in bed as soon as out of the anesthetic. In *amputation upon the upper extremity below the shoulder* proper rest to the parts is secured by bandaging to the chest. If the *amputation* is *below the elbow,* the joint should be kept extended by a posterior splint. Following *operation through or near the hip-joint* care is necessary to avoid soiling of the dressing by fecal matter; the bowels may be kept quiet for three or four days. The dressing is inspected frequently and changed as

often as soiled. There is usually considerable serous discharge which will necessitate more frequent change of outer dressing than is the case in other amputations. Following *amputations through the thigh* a splint should be applied to overcome the action of the flexors and abductors, otherwise through their contraction a stump useless for prosthetic purposes will result. The same is true following amputation below the knee; a posterior splint should be applied. Following *amputation of the toes or forefoot*, weight must not be put on the foot before two weeks or until union is firm. A plantar splint is kept applied and the ankle bandaged to limit motion for the same length of time.

Prosthesis.—The question of a prosthetic apparatus is too often left to the patient and instrument-maker. It will repay the surgeon to make a study not only of prosthetic apparatus as applied to stumps, but also those used to overcome defects in other parts of the body. An artificial limb should not be applied until cicatrization is complete and the stump has assumed the proportions which may be expected to be permanent. From six weeks to three months may elapse. During this time the patient goes about on crutches. Massage and passive and active movement of the stump should be employed to minimize the amount of atrophy. As soon as the process of atrophy has become stationary, as determined by occasional measurements, the artificial limb should be applied. After some months further atrophy of the stump may occur, necessitating change in the prosthetic apparatus.

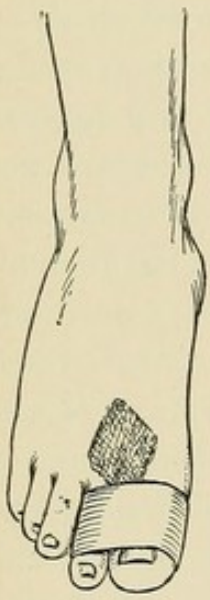


Fig. 177.—Dressing after operation for hallux valgus. (Fowler's Surgery.)

Hallux Valgus.—The toe is maintained for two weeks in the corrected position in slight flexion by a side splint or by packing gauze between it and the adjacent toe and securing it in position (Fig. 177). To prevent recurrence a divided stocking and a leather insole (Fig. 178) with a vertical partition should be worn. If slight flexion has not been maintained and ankylosis follows, a pressure sore is apt to develop on the under surface of the toe.

Osteotomy of the Tibia for Bow-legs.—After the limb has been straightened a plaster-of-Paris casing is applied extending from the base of the toes to the gluteal fold. After ten days this is bivalved laterally, the sutures are removed and if any additional correction is necessary this may be done and a second plaster cast applied. The treatment from now on is that of simple fracture. It is particularly necessary if the curve has been low down on the tibia that the foot be prevented from falling backward. In any event the foot must be kept at a right angle with the leg,



Fig. 178.—Inside sole for use in hallux valgus. (Fowler's Surgery.)

otherwise, shortening of the tendon achilles will result. Atrophy is prevented by daily massage, the splint being bivalved for this purpose. Massage also hastens firm union. The treatment of any underlying constitutional disturbance is essential. At the end of four weeks there will usually be sufficient union to prevent recurrence of the deformity. At the end of the sixth week the plaster cast may be replaced by a molded plaster splint and the child allowed up and about. A light splint should be worn for six months at the end of which time all apparatus may be removed.

Osteotomy for Genu Valgum.—After the limb has been straightened a plaster-of-Paris cast is applied which should include the pelvis and ankle. At the end of ten days this cast is bivalved laterally and the sutures removed. Daily thereafter the anterior portion of the cast is removed and the muscles massaged to prevent atrophy. At the end of the second week or as soon thereafter as slight union is present passive movements of the knee-joint may be added to the muscular massage. At the end of the fourth week the cast may be removed and if the union is moderately firm as is usually the case, the patient is allowed to move about in bed, but walking, sitting or standing should not be allowed until the end of the sixth week, and only then when union is good. Subsequently, particularly in young adults,

if there is any doubt as to union being firm it is best that the patient wear some form of apparatus to prevent recurrence of

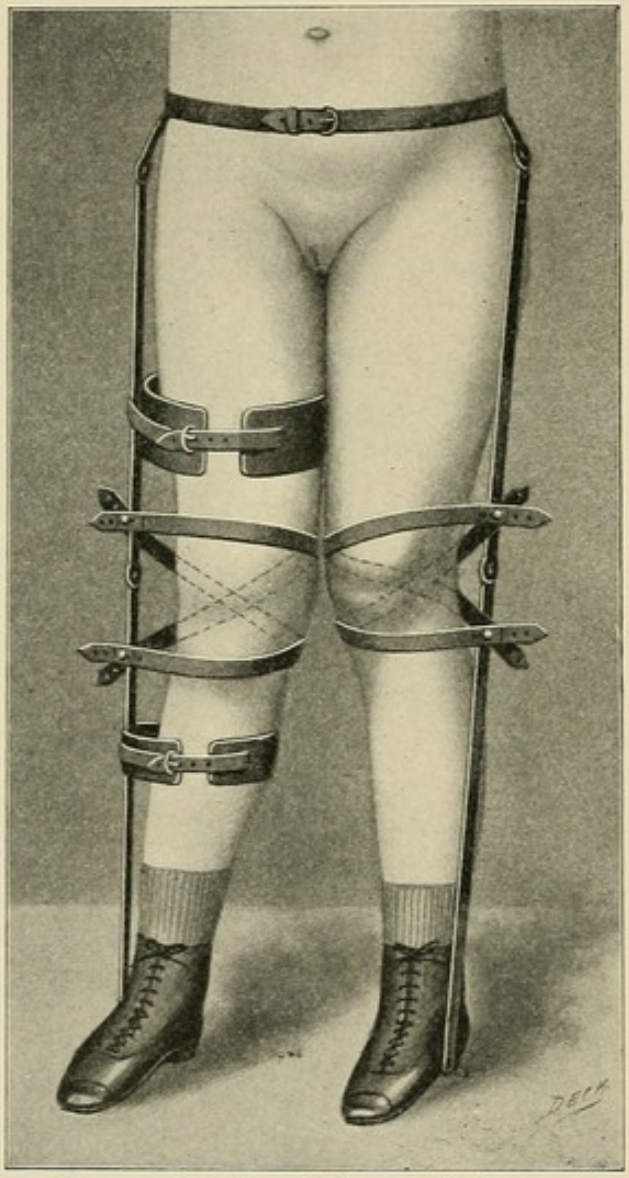


Fig. 179.—Genu valgum, showing Tiemann's brace applied. (Fowler's Surgery.)

the deformity (Fig. 179). It may be necessary to wear an apparatus of this kind for six months. Here, as in all such conditions, any underlying constitutional cause must be treated.

CHAPTER XIII.

OPERATIONS UPON THE HEAD.

The Scalp.—Wounds of the scalp heal readily and are rarely subject to infection by reason of the excellent blood supply of the parts and the accuracy with which such wounds can be sutured. The evenness of the underlying hard parts prevents the formation of pockets. Careful asepsis must be observed, for if infection occurs, it may readily be carried to the meninges through the extensive direct communications between the vessels of the soft parts and those of the diploe, and through these with those of the cerebral membranes. Abscess of the brain, meningitis or osteomyelitis of the cranial bones may complicate even apparently insignificant infected scalp wounds. Thrombosis, embolism and pyemia may be caused by infection carried through the parietal emissary vein into the superior longitudinal sinus; through the occipital and posterior auricular veins and their communications with the mastoid vein into the lateral sinus; through the diploic veins and the pericranial veins into the sinus alæ parvæ; through the fronto-sphenoid diploic vein into the cavernous sinus; through the anterior temporal diploic vein into the superior petrosal sinus; through the posterior temporal and occipital diploic veins into the lateral sinus. Clean wounds are treated along the lines already laid down. Infection is usually the result of carelessness on the part of the patient. Should infection occur free drainage with prompt and careful mechanical cleansing of the wound should be immediately instituted.

In *plastic operations*, such as covering in defects, it will be found that even large flaps heal readily, though they may be placed on bare bone. This is probably due to the accurate apposition and immobilization of the parts which is possible in this neighborhood, as well as the generous blood supply. In covering in such defects the hairy parts of the scalp should be utilized as much as possible to avoid the occurrence of bald

spots. If this is impossible the bald spots should be so placed as to allow of their being concealed by hair from other parts of the scalp. If this also is impossible a wig may be worn. Ingenuity will do much toward avoiding such deformity. Following operations for *tuberculous* bone disease, repeated curettements and daily dressing with Peruvian balsam will usually effect a cure. Skin-grafting may later be necessary. The same applies to *syphilitic necrosis* with the addition of iodid of potassium and mercury. In such cases the hypodermic use of the salicylate of mercury is beneficial. In *bone necrosis* complicating injuries to the scalp, superficial thin plates of bone exfoliate as granulation progresses beneath them. Areas the size of a silver dollar may exfoliate in this way. These plates should be removed with forceps. Beneath them are seen healthy granulations.

Erysipelas is an uncommon but dreaded complication of wounds of the scalp. The redness which accompanies erysipelas elsewhere is not shown in erysipelas of the scalp. Instead there is a pale edematous swelling which spreads to the lower margins of the scalp. When the margins of the scalp are reached redness occurs, as the mechanical conditions which prevented its occurrence above do not here obtain. The absence of redness is due to the fact that the tension of the tissues of the scalp pressing upon the bony wall beneath prevents the overfilling of the capillaries. An edematous puffy condition of the scalp, accompanied by a chill and an elevation of temperature, should always be looked upon with suspicion as the probable initial stage. Cerebral symptoms—headache, restlessness, delirium and sleeplessness—are more marked than in erysipelas elsewhere. There is great danger of meningeal infection, septic arachnoiditis or leptomeningitis should the infection be a mixed one, *i.e.*, complicated by streptococcus or staphylococcus (see Erysipelas p. 276). The cortex of the brain may finally take part in the process. Should a phlegmonous process complicate the erysipelatous inflammation, multiple incisions should be made and copious evaporating dressings applied.

Phlegmonous inflammation of the scalp is fortunately rare. The infection travels rapidly and the entire scalp may be raised from the cranial bones from the sinciput to the occiput. The

scalp pits upon pressure and there is acute tenderness, accompanied by severe pain and high fever. Fluctuation is not usually present. It is best to shave the entire scalp and make a number of parallel incisions two to three inches in length. These incisions should run from before backward, and should be in portions of the scalp which will subsequently be covered with hair. The flaps so made should be raised up and the large cavity curetted and thoroughly cleansed. Strips of gauze should be placed under the flaps and the flaps should be kept from growing fast to the underlying bone until the phlegmonous process has subsided. If this is not done great difficulty will be experienced later in performing secondary suture of the incisions as the flaps become readily adherent to the underlying bone. During the height of the inflammation copious evaporating dressings should be used. These should be changed frequently as they become soiled and the wound irrigated twice daily.

Differential diagnosis between erysipelas and phlegmonous inflammation in the early stages is not possible. They are frequently found in combination. The peculiar redness of the skin in erysipelas when the bony boundaries have been passed is a diagnostic point of value. The rapidity with which phelgmonous inflammation suppurates is also of use in the differentiation.

Compound Fractures Without Depression.—The initial treatment consists in trimming the wound edges and thorough disinfection of the wound. To provide adequate drainage for the lines of fracture these should be exposed and the edge of the fracture beveled with a chisel and mallet, or burred with a surgical engine, to drain the diploe. This is made necessary by the fact that when these fissures are formed they gap widely though momentarily, and foreign bodies and hairs enter and become imprisoned as the fissure closes. Drainage is obtained by means of several strips of green-silk protective led out of the wound in pairs so that capillary drainage is affected. For the most part the wound may be closed. In the absence of contraindications the drains may be removed in from twenty-four to forty-eight hours and the wound allowed to heal. Rarely does infection occur in such wounds.

After-treatment of Trephining.—The complications in the after-course of trephining operations depend to a large extent upon the lesion for which the operation is done. In cases of *compound fractures with depression* if the dura has not been torn the wound usually pursues a normal course following the elevation of the depressed portions and removal of the comminuted pieces of bone. The same rules apply as in compound fracture without depression. Fissures should be followed up and burred or beveled; drainage should be more free and should not be removed so soon as serous discharge is more profuse. In addition a careful watch of the general condition must be maintained, especially in cases which were accompanied with symptoms of concussion or compression. It cannot be too forcibly impressed upon the attendant that all symptoms are to be noted, the pulse, respiration, temperature, blood pressure, mental condition, headache, twitching, paralysis, restlessness, sleeplessness, condition of the nerves of special sense, disturbance of speech, reaction of the pupil, the ophthalmoscopic findings, and disturbance of the bladder and rectum. Half-hourly observations of the pulse and respiration are of special importance in all cases of head injury. All these symptoms have a very important bearing on the course, treatment and prognosis of the case. In cases in which the dura was opened the additional complication of hernia cerebri and escape of cerebrospinal fluid must be considered.

In operations for **cerebral compression** certain symptoms may improve during the course of the operation, the breathing may become less stertorous, the pulse more rapid, and a certain degree of consciousness may develop and the previously paralyzed extremities may move. Complete consciousness does not return as a rule for several hours (2–24). The choked disc disappears. Sleepiness, lassitude, and dull headache usually persist for several days. Complete return of motion to the paralyzed parts is slow. In cases of actual destruction of brain tissue, *laceration,* the paralysis persists and recovery of motion, if it occurs at all, is imperfect, though in time and with careful treatment much may be done even for these cases. In paralysis of long standing, contractures must be guarded against.

In cases of *compression from middle meningeal hemorrhage* after the operation and after the symptoms have cleared up, secondary unconsciousness may occur and the symptoms of compression again develop. This is more apt to happen in cases in which the original operation consisted simply in clearing out the clot and affording drainage without ligation of the middle meningeal. The hemorrhage recurs, the drain becomes clogged, and the brain is again compressed. Removal of the dressing and examination of the wound reveals the true trouble. The treatment is to open the wound in its entirety and repeat the original operation with the addition of ligating the bleeding vessel. Hemorrhage from the vessels of the brain itself is usually insignificant and promptly subsides if free drainage is provided. In any event pressure must be avoided. Slow pulse occurring on the day following the operation is not of itself sufficient to warrant renewed intracranial exploration for it not infrequently happens in cases of concussion that while the pulse is accelerated for the first day, a subnormal pulse occurs on the day following the injury. This may be due to ecchymosis in the neighborhood of the vagus center.

In the case of an **abscess** which has been drained, or brain **tumor** which has been removed and drainage inserted, drainage must be maintained sufficiently long to ensure complete emptying. Should symptoms of compression develop it is probable that the drain has become clogged and retention of secretion has occurred. This necessitates prompt removal of the drain, gentle irrigation of the cavity, and the reestablishment of drainage by means of strips of green-silk protective. The symptoms of compression may occur later, after the removal of the drain, and when the case is apparently pursuing a normal course. If so, the wound must be opened and drainage instituted, as the cause of such pressure symptoms is an accumulation of fluid in the old abscess cavity or in the cavity left by removal of the tumor. It is better to remove such drains slowly (three to five days), in order to avoid this complication. *Hemorrhage* may occur into the cavity left from removal of a growth. If it occurs before the drain has been removed, no symptoms other than the increased discharge of blood will be noted. Following the

removal of the drain, however, symptoms of compression will develop. Treatment is to open the wound and reestablish drainage. *Edema of the Brain and Cerebral Softening.*—These are the result of injury to the brain substance. The symptoms appear a few days following the operation and usually disappear quickly. This is usually limited to the immediate neighborhood of the operation and is temporary. In some cases, however, the process is more extensive and amounts to an encephalitis. The occurrence of the lesion is shown by symptoms traceable to derangement of brain function occurring after the lapse of some days.

Treatment.—If the drain has been removed it should be reinserted. If the drain is still in place a careful investigation should be made to see if it is not obstructed. This will be followed by a discharge of fluid or even of brain substance following which the symptoms will usually subside.

Congestion of the brain may develop after any operation involving the dura, but it is more likely to develop in cases of injury to the brain itself. Its presence is shown by general headache, restlessness, sleeplessness, and finally wild delirium. The face becomes congested, and the pulse rapid and full. Should the temperature remain normal the case is one of congestion of the brain, but should fever accompany these symptoms, then the case has developed a meningitis. There is an exception to this rule, *i.e.*, cases in which the original injury has involved the heat-controlling center. This is rare, however. The most frequent cause is infection. Change of dressing will show pus coming from the interior of the skull, through the injury or site of operation. The prognosis is bad.

Meningitis.—The first symptom is usually a rise of temperature and some acceleration of the pulse. The pulse is not rapid in proportion to the height of the fever on account of the intracranial pressure. The onset of symptoms is rapid. A chill may precede the rise in temperature. The patient becomes gradually unconscious and comatose, the breathing stertorous. If the motor area is affected, paralysis develops. If the base is affected, there develops paralysis of the nerves of special sense. At first there is irritation and later paralysis of the vagus and

respiratory center. Death occurs in from one to five days. Treatment is drainage at the site of the original injury or operation, but rarely does the patient recover.

Escape of Cerebrospinal Fluid.—This occurs whenever the dura has been invaded. In compound fracture involving the middle fossa its escape through the ear is commonly noted. Following operation, the amount of fluid which escapes varies. After several days the discharge lessens and finally ceases. Such wounds must be kept scrupulously clean. The soaking of the dressing with the cerebrospinal fluid will necessitate redressing at sufficiently frequent intervals to keep the dressing dry; usually three or four changes of dressing daily for the first few days. Drainage must be absolutely free. Blockage of the drain must be guarded against. The wound-opening must be sufficiently large to avoid pressure on and interference with the drainage strips. Several strips of green-silk protective serve admirably for drains in such cases. Their use avoids the possibility of blockage, as they drain by capillarity and cannot absorb the discharge and become clogged. Upon the first symptom of change in the condition of the patient, inspect the wound to see if drainage is interfered with or if infection has occurred.

Hernia cerebri occurs in cases in which the dura has been opened and the brain injured. It is caused by increase in intracranial pressure due to increase of cerebrospinal fluid from irritation of the meninges, congestion or edema of the brain. The effects depend upon the function of the part of the brain which is prolapsed. In large prolapses through comparatively small openings in the dura the part prolapsed becomes doughy and disintegrates. In case the opening in the dura is large the mass is not so liable to disintegration. Infection is common. Treatment consists in supporting the mass with even, gentle pressure. Forcible attempts at reduction must not be made. **Cerebral prolapse** occurring after operation for abscess or tumor is due either to a reaccumulation of secretion or to a collection of cerebrospinal fluid in an adjacent ventricle. In case of the latter, lumbar puncture is recommended (Krönlein). In fact, no attempt at reduction should be made while the causes pro-

ducing the hernia are active. If no infection is present the skin flaps may be sutured partially over the herniated brain, but proper drainage for the escape of cerebrospinal fluid must be provided. Upon the subsidence of the causes, the edema, the meningeal irritation or the congestion, the prolapsed portion will recede somewhat into the cranial cavity. Gentle reduction may then be attempted and a plastic operation done to cover in the defect, but drainage must be provided for.

Hernia occurring in silent areas of the brain may be amputated if reduction is impracticable and if plastic operations for covering the tumor are not possible. Infected brain tissue should be treated conservatively, using gentle irrigations of saline at a temperature of 100° F. and multiple drains of green-silk protective. Hernia cerebri naturally presents a very bad prognosis.

Hemorrhagic Granuloma.—This is due to infection arising usually from the presence of splinters, foreign bodies, or other sources of irritation occurring in an open wound of the skull. The granulations spring from an ulcerated area on the surface of the brain. The protruding mass may be the size of a walnut or larger. It is soft, pulsating, bleeds readily, and may contain small suppurating foci. Microscopic examination may be necessary to distinguish it from hernia cerebri. Its removal, together with splinters of bone, foreign body, or necrotic tissue that may be present, is usually followed by cure.

Wound Healing in Bony Defects, Trephine Openings.—Healing takes place by dense fibrous tissue, and not by bone. Consequently these places are not so safeguarded from injury as before. Slight blows upon such defects produce disastrous results. Exposure to the sun is productive of intense headache. If the opening is so placed the hat band may press upon it and produce discomfort. Sudden changes of the position of the body or sudden jars may produce convulsions. Such defects should be protected by the wearing of suitable apparatus, and later when the patient's condition warrants it an osteoplastic flap should be so placed as to protect the opening. The introduction of silver, gold or celluloid plates at the time of the primary operation has not proved successful. The osteoplastic flap

method advocated by König is far more preferable. Beck's method of periosteal transplantation has shown good results.

In treating the wound itself antiseptics should not be employed. An antiseptic solution should never be allowed to come in contact with brain tissue. It is permissible if infection is present to use normal salt solution at a temperature of 100° F. as an irrigation. In general in drainage cases the drain is removed at the end of twenty-four or thirty-six hours. Subsequently the wound, if clean, is undisturbed for from seven to ten days, when the sutures may be removed. If any granulations have developed at the point of emergence of the drains these are removed with the curette. Suppurating wounds are dressed daily with large absorbent dressings.

In *fractures of the base involving the anterior fossa* the nasal cavities should be irrigated daily with boric acid solution, and packed lightly with iodoform gauze. In case the *middle fossa* is involved and there has been escape of cerebral fluid from the ear the same treatment by irrigation and gauze packing is employed to guard against infection through these channels.

General Rules for the After-treatment of Intracranial Operations.—Each case must be carefully and constantly observed and all symptoms noted. Complete bodily and mental rest must be enforced. The patient is kept in the dorsal position with the head comfortably supported. Each of these patients should have a room to himself. There should be absolute quiet in the room and the room should be kept darkened. The patient should never be left alone. Restraining sheets are to be used for restlessness. It is best not to stimulate the circulation. If restlessness is marked, morphin should be administered in sufficient doses to ensure rest. Hyoscin hydrobromate, gr. 1/120, is also useful. The diet should be liquid and easily assimilable. Absolutely no alcohol should be given. The bowels are to be kept open by laxatives, preferably salines, such as magnesium sulphate. In case involuntary defecation and urination occur the patient is to be kept scrupulously clean to avoid decubitus. A colon irrigation once a day is beneficial. Overdistention of the bladder should be guarded against, and the catheter should be used every eight hours or more often if

necessary. An ice coil is to be kept applied to the head and an ice-bag to the base of the neck. In plethoric cases venesection is of value. In such cases venesection quiets the patient, the headache disappears and they fall asleep. On the occurrence of any complicating symptoms the first step should be to investigate the condition of the wound. A regular record of the blood pressure should be kept and when with symptoms of congestion or unconsciousness this falls below the normal, the position of the patient is to be changed and the *head lowered.* This increases the blood pressure. After all symptoms have subsided a more liberal diet may be allowed. The sitting posture should be gradually resumed. The patient should be kept under observation for many months and the mental condition noted. Reading, studying, and application of the mind to business should be prohibited after all severe injuries or operations. The patient should have open air exercise and suitable amusement, but excitement should be avoided. Travel and change of scene serve to keep the patient from worrying. By judicious management even severe injuries and operations will result favorably. *Later Complications.*—After all such operations or injuries there may develop continuous headache, epilepsy, idiocy, loss of memory, neuralgia, and various psychoses. These in their turn require treatment, but their consideration here would lead us too far afield. In regard to continuous headache, if due to exudates, potassium iodid will be useful. Persistent paralyses are the result of the lesion for which the operation was performed. The most that can be done is in preventing contractures as much as possible and, in some cases of isolated paralyses of certain sets of muscles, doing nerve or tendon transplantation.

Mastoid Operations. *Simple Mastoid Operation.*—After operation the cavity is lightly packed with plain gauze—tight packing prevents drainage, interferes with granulation and may cause a temporary facial paralysis. The packing is undisturbed for five days, unless there is excessive or foul discharge, rise of temperature or marked pain.

At each dressing the wound is *lightly* packed—firm packing prevents the filling in of the wound by granulations and by so doing the wound may be kept open for months.

Irrigation is used only when there is excessive or foul secretion.

Radical Mastoid Operation.—The packing consists of single strip introduced through the external meatus, the posterior wound having been sutured. The dressings are left undisturbed for a week unless discharge is foul or profuse. Sutures are removed in seven days. The cavity of the ear is repacked every second day for the succeeding week following which the packing is discontinued. Ordinary cleanliness thereafter suffices. The cavity is not irrigated at the dressings but if, when the packing is left out, there is excessive discharge irrigation may be used. As a rule these cases do better if kept perfectly dry. If the lateral sinus has been injured the bony cavity is tightly packed. The wound must be allowed to granulate from the bottom. If the sinus has been injured the packing is removed very carefully at the end of forty-eight or seventy-two hours and the wound firmly repacked if bleeding recurs. Such a wound should not be irrigated. Subsequent packings may be lightly applied if no hemorrhage occurs. In all cases the external ear should be cleansed daily. *Dermatitis* is prone to occur if irritating discharges are left on the skin. Its occurrence calls for more frequent cleansing. It is apt to occur in children if iodoform gauze is employed. *Caries.*—If the open operation has been a complete one, *i.e.*, if all carious bone has been removed, healing should be complete between the sixth and eighth week. If carious bone has been left this will require subsequent curettement for its removal before healing can occur.

Complicating Brain Abscess.—There is localized headache, with disturbance of function of separate portions of the brain. The fever is not high at first. Chills are at first absent. There may be vertigo, vomiting, and meningeal irritability. Irritability or convulsive movements of groups of muscles occur if the motor area is involved. The symptoms are progressive, and the suppurative collection if left to itself in time will infiltrate the surrounding brain tissue, or reaching the surface set up a meningitis. The abscess is usually located in the cerebellum or temporo-sphenoidal lobe. *Treatment.*—Immediate exploratory craniotomy.

Extradural suppuration may occur, or *meningitis* or *pachymeningitis*. There is steady pain either in the temporo-sphenoidal region or temporo-parietal region, or in the region back of the mastoid process. This pain is increased by percussion. The overlying soft parts may be edematous. *Treatment.*—Removal of sufficient bone to provide drainage.

Sinus phlebitis is characterized by sudden high temperature, irregular fever, rapid pulse, chills, and headache at the site of the disease. The jugular may be thrombosed and be felt as a hard, enlarged, tender cord. Pyemia quickly follows. *Treatment.*—Immediately open and drain the lateral sinus, ligate the jugular below the thrombosis and excise or drain it. This may be done in time to prevent pyemia. It should be done even if pyemia is already present in order to prevent further manufacture of sepsis in the original focus.

Intracranial Neurectomies.—The treatment of the wound itself is that for aseptic wounds in general. If tamponade has been used to control hemorrhage the packing is carefully removed at the end of forty-eight hours and if there is no further bleeding it is not replaced. In such cases secondary suturing is indicated. If the operation has been successful the pain disappears either immediately upon recovery of the patient from the anesthetic, or after a few days. In such cases sensation is lost in the region supplied by the resected or excised nerve and does not return completely. The extent of the anesthesia indicates whether all branches of that particular trunk of the trigeminus have been sectioned. Anastomotic branches between the trigeminus and the facial may result in rapid restoration of sensation in the area supplied by the resected nerve, though this of course will not be complete. Later restoration of sensation is due to regeneration of the nerve-fibers. Generally speaking the longer the anesthesia persists the greater the probability that the pain will not return.

Trophic Disturbances.—Keratitis may follow resection of the trigeminus or intracranial extirpation of the gasserian ganglion. The nutrition of the cornea may be so impaired as to result in suppuration of the eyeball; careful cleansing may save the eye. The eye of the affected side should be irrigated every two or

three hours with warm boric acid solution. Later a protecting eye shield should be worn to prevent entrance of foreign matter.

Secondary hemorrhage from the middle meningeal artery may follow in cases in which this vessel has not been effectively ligated, or in which a piece of gauze or plug forced into the foramen spinosum to control hemorrhage from this vessel has become loosened. The symptoms will be those of compression; if such occur the wound must be opened, the clot expressed and an attempt made to secure the vessel. Infection of the wound is almost unknown. In those cases in which it has occurred collections of pus have formed in the retro-maxillary fossa and the infection has been transferred to the meninges. Small areas of bone necrosis may cause fistulæ until the necrosed portion has separated. Usually, however, healing is uneventful. Patients habituated to morphin should be given the drug in sufficient doses if its withdrawal is followed by untoward symptoms.

Operations upon the Face.—*Small wounds* of the face, such as those resulting from the removal of wens or small fibroid tumors do not need large dressings. The blood supply of the face is so extensive that if accurate coaptation of the wound edges is secured, healing rapidly follows. Moreover, the mobility of the parts is such that a large dressing would rather irritate than do good as it would allow the wound to move against the dressing. Again, many people object to wearing a bandage upon the face, it is difficult to apply such a bandage so as to be comfortable, and in many cases to cause their proper retention it would be necessary to include one or both eyes. In wounds with well-coapted edges such dressings are unnecessary. Painting the surface for a space of one inch either side and over the wound with collodion, or a dressing of collodion and cotton fulfils all the indications. The contraction of the collodion as it dries serves to still further relieve any tension which may exist. It is of course desirable to have as *insignificant* a *scar* as possible on the face; to favor this the young scar and neighboring skin may be painted every other day with collodion after healing has occurred under the primary dressing; this supports the scar until firm contraction has taken place. The collodion acts also by limiting the mobility of the part of the face to which it is applied.

In cases in which *hemorrhage* is to be expected with oozing, larger dressings must be applied with pressure. Larger dressings without pressure are also indicated in infected wounds or in wounds through infected tissues in which the dressing must be large enough to receive and absorb the wound secretions. If the *eye* must be included in the dressing it should be protected by placing over the closed eye a small compress of cotton, and care must be taken not to apply the bandage so as to cause pressure. When such dressings are applied under anesthesia, at the conclusion of an operation care should be taken that the eyelashes are not turned in, also that there is no conjunctivitis, the result of ether vapor. If *conjunctivitis* is present the dressing over the eye should be moistened with a saturated solution of boracic acid. At each redressing the eye should be examined and if conjunctivitis occurs this should be treated by frequent boracic acid irrigations and instillation of 5 per cent. argyrol solution. Eyes not the seat of disease can be kept occluded by a dressing for a long time without fear of injury. Should soiling of the dressing occur it should be changed at once, otherwise conjunctivitis may occur. *Infected wounds in the neighborhood of the eye* should be dressed frequently and the eye should be irrigated at each dressing, otherwise an intense conjunctivitis or even a panophthalmia may result. In cases of infection near the eye it is advisable to instil a drop of 5 per cent. argyrol solution into the eye at each dressing. If intense conjunctivitis does occur the occlusive dressing should be discontinued and energetic treatment of the conjunctivitis at once instituted.

Wounds of the face heal rapidly and hence the sutures may be removed early, where there is no tension in forty-eight hours, and even where there is tension in five to six days. In case of large defects Thiersch skin-grafting should be used early to prevent scarring. The final cosmetic effect should always be considered.

Operations on the Eyelids.—Following plastic operations upon the eyelids the lids cannot be completely opened; as soon as wound healing occurs, however, the retraction of the scar allows of complete opening of the lids. The process of cicatrization may proceed too far so that it will not be possible to completely close the lids; this is followed by conjunctivitis and even

ulcerative keratitis especially if the lids become inverted so that the eyelashes rest on the cornea. In such cases the eyelashes should be removed, and a secondary plastic operation performed. Edema of the eyelid which sometimes persists following plastic operations is treated by massage and graduated pressure.

Enucleation of the Eye.—Very few, if any, of the major operations require less subsequent treatment, or cause the surgeon less anxiety than enucleation of the eyeball. The mortality is very slight, not more than one-tenth to one-fifth of one per cent. Meningitis sometimes follows enucleation for suppurative panophthalmitis, but it must be remembered that meningitis may follow this condition without any operation. Usually there is but little hemorrhage, although profuse and persistent hemorrhage occasionally occurs in old people with atheromatous and dilated blood-vessels and in hemophiliacs. In the event of hemorrhage the socket is packed with gauze dipped in some hot antiseptic solution, preferably bichlorid 1 to 5000. As a rule, the tampon should not be left in place more than half a day because the difficulty of removal increases hourly. Before attempting to remove, douche thoroughly with boric or some similar solution, as hot as the patient can bear and then make very gentle traction on the gauze. This is a task which requires time and patience. The routine treatment after enucleation is as follows: The immediate bleeding is controlled by pressure of gauze wrung out of hot water. The tendons and conjunctiva are brought together by sutures and a protective bandage is applied. To lessen the ecchymosis which always follows enucleation the nurse is directed to continue the application of hot boric compresses to the lids, for several hours before putting on a bandage. This does not entirely prevent ecchymosis and swelling, but tends to diminish these unpleasant complications.

The patient is kept in bed, most of the time for one or two days. Once or twice a day, for a week or more, the lids are to be separated and the parts gently cleansed with boric acid solution. The sutures are removed on the fourth day. By the end of the third week, the stump has sufficiently healed to admit an artificial eye.

A slight mucopurulent discharge may persist for several weeks. This is relieved by the daily instillation of two or three drops of a solution of nitrate of silver, one grain to the ounce.

Plastic Operations upon the Nose.—As a rule these operations are unsatisfactory because of the difficulty in gauging the correct size of the flaps needed. To be even moderately successful osteoplastic flaps are necessary. Such wounds cannot be kept aseptic. The newly formed nasal cavity should be irrigated every two or three hours with saline or two per cent. solution of boracic acid. This may be done with the patient in Rose's position, or the patient may be sitting up and leaning forward and the nose gently irrigated by a small catheter attached to a douche bag. By this means septic processes may be averted. The wound itself should be inspected frequently and upon evidence of lack of circulation in any part of the flap the sutures at that point should be removed. Some necrosis of the flap is sure to occur but by careful asepsis, septic infections and necrosis due to infection will be limited. When such operations are done in several stages there is less danger of circulatory disturbances. Such wounds should only be covered loosely with gauze and should be inspected frequently and irrigated.

Plastic Operations upon the Cheek.—*Cicatricial contraction* may be so pronounced after plastic operations upon the cheek as to prevent the patient from chewing. The lower jaw may become fixed by the contraction. Months of treatment are necessary to overcome contractions of this nature. Treatment consists in gradually stretching the scar tissue. This is accomplished by placing a dilating gag between the teeth of the upper and lower jaw and gradually opening the gag so as to force the jaws slowly apart. At least twenty minutes should be taken in securing even a small amount of separation.

Operations on the Parotid Gland. *Complications.*—Facial paralysis follows accidental or unavoidable injury to the facial nerve. The conjunctiva of the paralyzed eye should be protected and cleansed. Later, if anatomical conditions permit of it, nerve anastomosis may be done. *Parotid fistula* may follow partial excision of the gland or injury to the parotid duct and require a plastic operation for its cure.

Superficial Neurectomies.—Following subcutaneous divisions of the infraorbital nerve within the infraorbital fissure hemorrhage into the retrobulbar tissue may result from injury to the infraorbital artery. The retrobulbar hemorrhage causes protrusion of the eyeball. The hemorrhage is usually slight in amount and resorption of the extravasation occurs.

Plastic Operations on the Lip.—The result here depends upon the amount of tissue removed and the variety of operation selected. Following removal of a wedge-shaped piece healing is rapid and deformity slight. The mouth which is small at first soon becomes larger, though of course it never assumes the normal proportions except in those cases where the wedge-shaped piece is very small. In case it was not possible to bring the vermilion edges of the lip in apposition in operations upon the lower lip cicatricial contraction occurs and in time the cicatricial tissue forming the lower lip presses against the teeth as it retracts. This results in ulceration of the scar tissue and also allows the saliva to flow from the mouth continuously. If it was not possible to leave any mucous membrane on the lower lip the lip retracts in the direction of the jaw; this exposes the teeth and alveolar process of the lower jaw. The deformity is great.

Secondary operations should not be undertaken for at least six months following operations for epithelioma of the lip, as experience shows that recurrence in these cases usually takes place in the first few months. All cases of *epithelioma* of the lip should be examined frequently, at least once every two weeks following operation in order that recurrence may be quickly recognized. Cases in which the primary operation did not include the removal of the submental and submaxillary glands even though apparently unaffected should be examined once each week.

Harelip Operations.—A thin layer of collodion and cotton may be applied to slightly support the wound. In case it was necessary to make lateral incisions to relieve tension, these incisions may be dressed with plain gauze held in place by strips of adhesive plaster. As the line of the incisions made for the purpose of relieving tension is in the cheek and the naso-

labial fold a disfiguring scar is not apt to occur. A dumbell-shaped piece of adhesive plaster is applied in such a manner as to force the cheek in the direction of the wound and so avoid tension. A small pledget of cotton keeps the plaster from adhering to the lip. The hands should be restrained to prevent picking at the dressing. The patient should be fed by spoon or soft pharyngeal tube for the first seven days. If the cicatrix contracts so that a depression is formed in place of a slight protuberance, as in the normal lip, Nelaton's operation should be done; if on the other hand, the protuberance is prominent after cicatrization is complete, a small V-shaped piece may be excised. Care must be taken to accurately coapt the vermilion border. If the wound heals per primam the superficial sutures are removed on the third to the sixth day, the deep sutures on the seventh day. In adults the sutures may be left somewhat longer. If infection has occurred the suture affected should be removed. The freshly healed wound is supported by a strip of adhesive plaster. This is shaped narrow at the point where it rests on the wound, broadening out over the cheeks. The cheeks are pressed toward the nose and the adhesive plaster applied with the cheek so pressed together as to relieve tension on the wound. The edges of the adhesive plaster may be painted with collodion to ensure against the plaster becoming loosened. In case healing has in part occurred through granulation and the final cosmetic effect be disfiguring a secondary operation may be done. Such an operation, however, should be performed after from four to seven years in the case of young children, since the purpose of the primary operation is to further the nutrition of the child by increasing its ability to nurse. Should the wound fail to heal in its entirety, the surfaces should be freshened and a secondary suturing be performed. If there is marked edema of the wound edges the secondary suturing must be left until the inflammation has subsided.

The child is very slowly *fed* by spoon or pharyngeal tube for the first few days. If spoon feeding is done too fast the milk will regurgitate through the mouth or nose and some may enter the larynx. The mother's milk should be used when possible. After the first few days the baby may be allowed to nurse. The

first bowel movements after the operation will contain digested blood. After each feeding the mouth should be swabbed out gently with small pieces of gauze wrung out of a 2 per cent. boracic acid solution. Should the baby cry a great deal and by so doing endanger the primary union of the wound a few drops of paregoric may be administered, remembering that children bear opium very poorly. As these children have been accustomed to breathing freely through the mouth some embarassment of respiration and even asphyxia may follow the closure of the defect in the lip. This should be watched for and on its occurrence the attendant is instructed to open the baby's mouth by pressure upon the lower lip. A piece of adhesive plaster may be used to depress the chin and to keep the mouth open but this becomes easily displaced. The sutures are removed in three to six days. During their removal tension is prevented by pressing the cheeks toward each other. The wound is dried, a little collodion is painted on and a dumbell strap applied. This strap is renewed as soiled. Support of this kind should be afforded for three weeks.

After-treatment of Operations on the Nose, Frontal Sinus, Antrum and Cavity of the Mouth.—In the after-treatment of operations upon the *nose* the special points to be borne in mind are the displacement of the bony or cartilaginous structures, hemostasis, the prevention of infection and the prevention of adhesions.

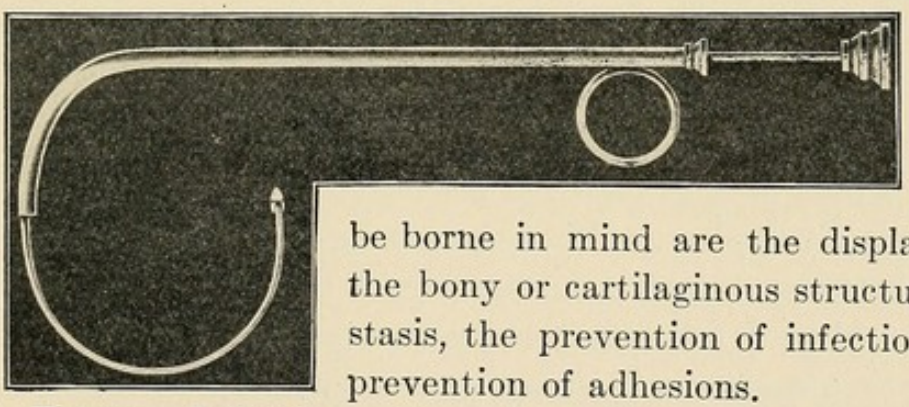


Fig. 180.—Bellocq's cannula with the spring carrier projected. (Fowler's Surgery.)

Prevention of Hemorrhage.—After the removal of mucous polypi bleeding ceases spontaneously, as a rule. If slight bleeding persists this is controlled by packing lightly with dry gauze; if the bleeding point comes readily into view a strip of gauze is packed directly against it, otherwise the end of the strip of gauze is carried deep into the nose and the strip packed into it layer by layer until the entire nasal cavity is

filled; the other end of the gauze is then tucked out of the way just within the anterior nares. If such a packing does not control the hemorrhage it will be necessary to pack the posterior nares as well. A Bellocque cannula (Fig. 180) is passed through the nose into the pharynx, the end of the cannula is then withdrawn through the mouth and to it is fastened a tampon of gauze. A small thread is also fastened to the tampon for subsequently removing it. By drawing on the cannula the tampon is drawn into the posterior nares and the threads which fasten it to the end of the cannula are drawn out through the affected nostril. The proper placing of the tampon is further facilitated by pressure of the finger against the tampon in the pharynx. After the posterior tampon is firmly fixed in place the anterior nares are packed as described above.

The tampon is removed at the end of twenty-four to forty-eight hours; by this time the secretions of the mucous membrane of the nose and naso-pharynx will have softened the tampon so that there is slight adhesion of it to the mucous membrane. Care should be used in removal so as not to excite renewed hemorrhage.

Bernay's Plugs.—These are made of compressed cotton in several sizes conforming to the natural curve of the anterior nares. They are gently pushed into position while dry, the oozing from the bleeding point saturates them and causes them to swell and so arrests hemorrhage. At the end of forty-eight hours such a plug may be removed piece-meal.

Prevention of Adhesions.—When the nasal cavity is very narrow adhesions between the two surfaces tend to form. The raw surfaces should be gently separated with a flat probe and aristol applied by an atomizer. A strip of green-silk protective is laid on the raw surfaces and held in place by a light packing. This is renewed daily and the nose gently irrigated with Dobell solution.

Prevention of Displacement.—Plugging of the anterior nares is used following operations upon the bony septum and following osteoplastic operations upon the nose. The packing need not be so tight as that for the prevention of hemorrhage, for if the parts have been properly placed there is slight danger of dis-

placement. Following removal of dead bone in syphilitic and tuberculous necrosis nasal splints (Fig. 181) are useful, not so much for the purpose of preventing deformity, as to insure a free breathing space.

Infection.—On account of the impossibility of perfect asepsis and the large number of germs which have their normal habitat in the nose wound disturbances by infection are common but fortunately rarely serious. Wounds of the nose heal under a scab. Erysipelas is much rarer now than formerly, due to improved antiseptic methods; more rare still is progressive phlegmon. When either of these infections occur death may result through extension of the inflammation to the ethmoid and from there to the meninges, or by thrombophlebitis and pyemia, or decomposed products of putrefaction may be inspired and septic pneumonia result. They cannot always be prevented by the most careful preparation nor by care in the operation.

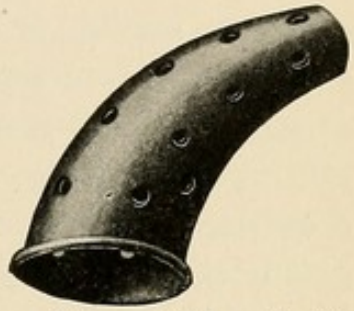


Fig. 181.—Asch's vulcanized tube splint. (Fowler's Surgery.)

Disadvantages of Nasal Tamponade.—Packing of the nares causes an annoying full sensation in the head. The patient is compelled to breathe through the mouth and speech becomes nasal in tone. The pressure may be severe enough to cause actual pain. Secretions collect behind the tampon and result in a rise of temperature. In case of a tamponade of the posterior nares the soft palate may be injured and this may result in some slight temperature. As a result of the presence of the tampon in the posterior nares slight inflammation of the tonsils may persist for a few days; this as a rule disappears rapidly. From the above it is evident that tamponade should not be used unless strictly indicated.

Complication by Otitis Media.—Inflammation following operations upon the nose may spread to the naso-pharynx and through the Eustachian tubes to the middle ear. The first symptom will be sharp pain in the ear; this may be treated by leeches in front of the tragus, by local applications of cocain, or if the pain is more severe, by injections of morphin. Usually the process

subsides rapidly though sometimes it goes on to suppuration. The ear should be examined frequently and destruction of the drum membrane forestalled by an early paracentesis. As soon as any symptoms of ear invasion take place the tampon should be removed from the nose and the nose douched several times a day with warm boric acid solution; the mucous membrane should be carefully cleansed and all inspissated secretions removed.

General Rules.—In all cases the patient should be warned not to scratch the nose or pick at it, and in children the hands should be muffled in such a manner as to prevent this. Douches are not used unless indicated by excessive secretion, retention of secretion or rise in temperature. They should not be given in the first twelve hours for fear of causing bleeding. In douching the nose the stream should be directed upward and not backward; otherwise the fluid may be forced into the Eustachian tubes. If a chronic catarrhal condition of the mucous membrane persists the mucous membrane should be painted with a 1 or 2 per cent. nitrate of silver or 1/2 to 1 per cent. solution of alum or a solution of tannin may be snuffed up the nose.

Opening of the Frontal Sinus.—Too early closure must be avoided. The cure of a *suppurative condition* requires weeks and sometimes months; this is only obtained by free exit for the secretions. The first few dressings are done every day by packing the wound with plain gauze; following this balsam-of-Peru gauze should be used and the sinus washed out with a mild antiseptic solution. The interior of the sinus will be filled up at first by the swollen mucous membrane; after the infection has subsided the external wound may be kept open by a rubber drainage tube; the sinus need not be packed. A mild antiseptic and astringent solution should be used several times daily to irrigate the cavity and to reduce the swollen mucous membrane lining it. When this is accomplished the communication with the nose is reestablished. When the sinus drains readily through the nose and the character of its secretion is such as not to clog up the opening into the nose the external or operative wound may be allowed to close. Upon the removal of the drainage tube this will close rapidly. There

will be some adhesion of the scar to the bone. Sounds should be passed from within the nose into the sinus to insure the patency of the canal. If catarrh of the duct persists the wound must be kept open and the sound passed from within the sinus. In obstinate cases it may be necessary to open the entire canal.

Opening of the Antrum of Highmore.—The same principles hold good for the treatment of *empyema of the antrum,* whether opened through the nose, through the alveolar process, or through the anterior wall; the after-treatment is the same, the drainage opening must be kept open by a stiff-walled drainage tube to prevent too early closure. After opening through the anterior wall the cavity may be tamponed with plain gauze for twenty-four hours to arrest bleeding; following this the cavity should be irrigated every two or three hours, at first with boric acid solution, later with a weak solution of nitrate of silver. If the amount of discharge is large one-half strength peroxid of hydrogen may be used to irrigate, followed by stronger solutions of nitrate of silver. The normal opening into the nose would only allow of slight drainage, therefore the operative opening should be kept open until discharge has ceased and the inflammation of the mucous membrane entirely subsided. In draining such a case through the alveolar process a special apparatus may be fastened to an adjoining tooth, the apparatus consisting of a gold tube of small caliber having fitted to it a stopper which is held in place by a bayonet joint; this prevents entrance of food into the antrum and allows of ready removal. For purposes of cleansing the antrum such a tube, as well as any tube draining the antrum, should not project beyond the level of the floor of the antrum.

Dangers after Operations upon the Mouth.—The principal danger is loss of blood during the operation, next the interference with respiration by the entrance of blood into the air-passages, and finally septic pneumonia from inspiration of blood or secretions.

Bronchopneumonia.—This is probably always due to inspiration of particles of food, or vomitus, or decomposed wound secretions. The danger increases in proportion to the amount of disturbance of function of the muscles of the tongue, palate and

pharynx, therefore such a complication is more apt to follow operations upon the lower jaw, tonsil and floor of the mouth, than for removal of the upper jaw.

To prevent particles of food from entering the larynx the patient should be fed through a stomach tube. It may be passed either through the nose or the mouth. After very extensive operations upon the floor of the mouth owing to the amount of oozing or wound discharge it may be necessary to leave a stomach tube and also a tracheotomy tube in place and pack the pharynx solidly with gauze; this is very annoying to the patient and causes a flow of saliva and mucus; it should, therefore, only be used after very extensive operations, and only during the first few days.

Phlegmonous inflammation of the tissues of the neck may complicate tonsillotomy or other operations in the mouth and pharynx. There is marked swelling and redness of the mucous membrane overlying the infected area internally, while externally the overlying skin presents a red and brawny appearance, pitting deeply on pressure. There is pain on deglutition, and breathing may be interfered with by the intense edema. Owing to the virulent nature of the infection, it is accompanied by high temperature, rapid pulse and general malaise. Unless prompt treatment is instituted, edema of the glottis will ensue. Incisions may be made through the mouth or from without. A point of fluctuation is sought for and drainage instituted by the nearest route. Very little free pus is found as a rule, perhaps only a dram. Should the symptoms continue, additional pus foci must be searched for and drainage provided for. Scarification of the mucous membrane will relieve pain and lessen edema. If the case is seen late it may be necessary to resort to tracheotomy. Such abscesses sometimes open spontaneously into the pharynx. There is then danger of suffocation or death from foreign body pneumonia. If pus has not been evacuated though a search has been made, the infection may in a few hours or days find its way out through the exploratory incision. The abscess cavity and infected area should be cleansed every three hours with peroxid of hydrogen and then irrigated with a mild alkaline antiseptic solution.

Ranula Operations.—After extirpation of the ranula or other tumor or cyst of the floor of the mouth that part of the wound over which the mucous membrane has not been sutured should be packed with gauze; this may remain in place from forty-eight to seventy-two hours. Following this the mouth should be frequently irrigated with a mild weak antiseptic solution; healing rapidly ensues.

Tongue-tie.—After this slight operation there is usually little bleeding but occasionally oozing will persist. As the patient is usually an infant even the loss of a slight amount of blood must be immediately controlled. If an examination of the wound shows a bleeding vessel this is ligated. Persistent oozing is controlled by drawing the tongue forward, elevating it, packing a small piece of dry gauze against the oozing area and still holding the tongue forward depressing it to make pressure upon the packing. Two or three minutes pressure is usually sufficient.

Adenoids.—The patient is quieted and told to avoid coughing, sneezing or snuffling. The head is kept high. Bleeding varies greatly; except in cases between the ages of ten and eighteen it is rarely severe. It occurs more often if shreds have been left. Should the bleeding be prolonged direct pressure is made with a curved stick sponge. Usually two minutes pressure is sufficient; if not, the naso-pharyngeal space is tamponed. Usually, however, the hemorrhage ceases spontaneously. An occasional fatal case is reported. The patient is instructed not to swallow any blood as this is apt to occasion vomiting and so cause a recurrence of the hemorrhage. If there has been much bleeding the nose and naso-pharynx become filled with blood clot. In such a case twenty-four hours after the operation nasal irrigation of warm boric acid solution may be employed to wash away the clots. Clotted blood left in the naso-pharynx may become infected and lead to middle ear complications. Middle ear and Eustachian tube complications are fortunately rare and are more apt to follow bad technic at the operation.

Usually no after-treatment is necessary. Healing is complete in from eight to fourteen days.

Tonsillectomy.—The patient is to be watched until all hemorrhage has ceased. Hemostasis is spontaneous in most cases. In

hemophiliacs and in cases of injury to the larger branches of the tonsillar artery bleeding is severe. In such cases pressure by a stick sponge must be kept up for a few minutes. If this does not suffice pressure may be applied with a Mikulicz clamp; or an attempt may be made to ligature the bleeding points or the pillars of the fauces may be sutured over a gauze sponge. Tongue movement and coughing are to be avoided in all cases for the first few hours. In the cases which ooze small pieces of ice are retained in the mouth and ice water slowly sipped for ten minutes at a time. The movements of obstreperous patients must be controlled. Gargling does not help in the slightest.

Course of the Wound.—The stump of the tonsil will become covered with a grayish-white deposit of fibrin which disappears in about a week. In rare cases a streptococcus inflammation will complicate.

Wound Treatment.—Usually no wound treatment is required. For purposes of mouth cleanliness gargles of a mildly alkaline antiseptic solution may be employed, but this rarely reaches the wound surface. This is to be kept clean by spraying every three or four hours with peroxid of hydrogen after the first twenty-four hours. For the first twenty-four hours rest is required for the pharynx and tongue. It is not necessary to keep the patient in bed longer than twenty-four hours in ordinary cases. If severe inflammatory symptoms develop, as evidenced by intense redness of the tonsillar stump, pharynx, pillars of the fauces and uvula, accompanied by fever and swelling of the glands in the neck, the patient is placed in bed, the pharynx and wound surfaces are sprayed thoroughly and frequently with peroxid of hydrogen. Ice externally to the neck is grateful to the patient. For the first twenty-four hours give ice-cold drinks and ice by the mouth. Ice cream and ices will be acceptable, particularly to cnildren. For the second and third day give fluid diet, not necessarily cold. As soon as pain on swallowing has stopped full diet may be resumed.

Lymphadenitis may accompany infection in the mouth and naso-pharynx. If the infection be severe the cervical lymph glands draining the infected area become enlarged. Perilym-

phadenitis accompanies this. Should suppuration ensue the glands affected are to be promptly incised and drained.

The *voice* after removal of the tonsils becomes deeper in volume. This must be considered before removing the tonsils of patients whose living depends on the quality of their voices.

Peritonsillar Abscess.—Following incision and digital curettage of the infected area the resulting cavity is gently irrigated every few hours with a mildly antiseptic alkaline solution using a blunt-pointed hard rubber syringe. As the inflammation subsides the irrigation is done less frequently. The mouth is kept clean by frequent rinsing. The patient is kept on a diet of soft food as long as swallowing is painful.

Retropharyngeal abscess is incised widely through the cavity of the mouth at as low a level as possible to prevent the formation of a pocket. Care must be taken to avoid strangulation from the pus, especially in children. Inspiration of pus leads to bronchopneumonia. The danger of reinfection by the bacteria of the mouth and naso-pharynx is slight but the mouth and throat should be rinsed frequently with an antiseptic solution. The opening is to be dilated daily with anatomical forceps. In large cavities the entrance of food is prevented by the use of the stomach tube. Should the cause of the infection reside in caries of the cervical vertebræ, an external incision must be made and the cause treated. *Edema* of the glottis is a common complication in neglected cases and those not drained properly.

Tonsillectomy for Carcinoma.—This leaves a much greater area for infection. If removed from within, the wound is to be treated, as in amputation of the tongue from within the mouth and as in tonsillectomy. Complications are more apt to ensue. *If removed from without, external pharyngotomy,* the severed stylohyoid is sutured, the retracted muscles returned to their normal relation and the greater part of the wound sutured. A tight packing is introduced into the wound, sufficient to entirely close off the cavity of the pharynx and the gauze strip led out at the lower angle of the wound. This is left *in situ* for from four to seven days unless its removal is indicated by some of the complications before noted. On removal the wound will be found in a surprisingly healthy condition, considering the prox-

imity of the pharynx. For the most part the wound will have healed by primary union. The wound is gently irrigated and packed with a small amount of gauze. This is renewed every forty-eight hours until healing is complete. If resection of the lower jaw has been done in order to gain more space the after-course may be complicated by necrosis, and a second operation may be necessary to remove necrotic bone before the resulting fistula will close. *Feeding* is conducted as in amputation of the tongue and resection of the lower jaw.

Uranoplasty. Staphylorrhaphy.—In adults the mortality from wound complications in these operations is small. In children, under four years, the mortality is high. In all cases the healing process may be so complicated by infection or giving way of sutures as to partially or completely negatize the object of the operation. During the first few hours after the operation the head should be kept lowered and turned to one side to afford ready outlet for secretions and blood. There is always some oozing from the raw surfaces of the flaps and from the lateral incisions made for the purpose of relieving tension. The blood may be expectorated, swallowed, or in rare cases in young children, may be drawn into the lungs by forcible inspiration and set up a pneumonia.

Feeding by mouth should not be begun until all danger of post-anesthetic vomiting is passed. Saline enemata are given for the first twenty-four to forty-eight hours. At first the food consists of milk, either plain or modified. The food should be introduced far back on the side of the tongue, or should be given through a tube. After the fourth day in the case of older children small quantities of farinaceous food may be added to the milk diet. No solid food should be given for at least two weeks. The patient should be kept quiet, talking, laughing or crying should be avoided. In young children excessive crying will cause the flaps to separate. It may be necessary to administer opiates to prevent children from crying. In young children the arms should be fastened to prevent picking at the mouth; this is best accomplished by splinting the elbows. In this way free motion of the hands is possible but the mouth cannot be reached. Older children should be instructed to

keep the tongue away from the roof of the mouth. The stitches should be removed in ten days. If union is not firm they may be allowed to remain for from four to seven days longer. The wound should be inspected daily but should not be interfered with. In young children if examination of the mouth causes crying, it will be better to leave the patient undisturbed. If inflammation develops a mild antiseptic solution should be sprayed gently on the palate and through the nose. Unless inflammation develops no spraying is necessary. No peroxid spray should be used at any time.

Complications.—Hemorrhage is controlled by pressure with dry sponges at the time of operation. Sponges wrung out of hot water should not be employed as the excessive heat may injure the flaps. Sometimes the source of bleeding will be found to be a vessel not completely severed in one of the lateral incisions used for the purpose of relaxation of the flaps. If the bleeding recurs when the patient has recovered from the anesthetic the parts should be cleansed of the blood clot by spraying with ice-cold boric acid solution. The removal of the clots is further facilitated by gently sponging. Pressure with ice-cold sponges may be tried. Usually this treatment is effectual; if not the patient must be anesthetized and the source of hemorrhage located, and if possible a ligature applied. If the source cannot be identified the post-palatine canal should be sought for and plugged with Horsley's wax. This is forced into the canal with a small probe. Packing the lateral incisions with small pieces of gauze will sometimes suffice for hemorrhage at these points. If these means are not sufficient it may be necessary to tracheotomize the patient and pack the cavity of the mouth firmly. It must be remembered that young children bear the loss of blood very poorly.

Failure of Union may Occur.—This is commonly due to necrosis of a portion of the flaps. The necrosis may be due to traumatism inflicted during efforts to control hemorrhage, to infection, a strangulation of the tissues through too tightly applied sutures; the relaxation incisions may not have been liberal enough to prevent tension of the flaps; or the paring of the flap may not have been completely accomplished. This latter is apt to happen

if the strip of mucous membrane is not removed in one piece. The coaptation may not have been accurate, the flaps may have been injured after the operation by the patient chewing some hard article of food, bacteria from the mouth or nose may attack a flap, excessive crying or vomiting may cause the sutures to loosen or to pull out entirely, coryza may develop and the inflammation extend to the flaps. Rarely will the flaps become gangrenous and slough away entirely. The loss of tissue may be so great as to render subsequent operations impossible. The cleft may be thus made considerably larger than before the operation.

The naturally poor blood supply of the transplanted flaps is in all operations still further interfered with by the approximating sutures so that there is always some danger of necrosis. The operation may be done in two stages to insure the utmost stability to the flaps by secondary suturing or a staphylorrhaphy may be done as a secondary procedure. As a rule, the flaps unite for the most part, though here and there there may be a small gap which fills in later, the lateral incisions granulate and quickly become covered with mucous membrane, the main object of operation, that of preventing the passage of food into the nasal cavity will usually have been obtained. If infection occurs pus collects upon the upper surfaces of the flap, but as drainage is free there is no abscess formation and the fever incident to such infection disappears on the occurrence of granulation. Such infections may result in septic pneumonia through aspiration. When infection occurs there will be noticed a slightly fetid odor to the breath, the patient will refuse nourishment on account of the pain.

Treatment of Complications.—The cause of any separation of flaps should be determined. If mechanical and due to the stitches or to not sufficient relaxation this may be remedied by loosening the stitches and putting in new sutures, or in the latter event by increasing the length of the lateral incisions. At the point where union fails from necrosis secondary suturing should not be done until the wound is clean and granulation is well established. Small defects will heal in by granulation without subsequent operation, larger defects may at times be closed

by paring of the edges and secondary suturing. If the parts are not sufficiently relaxed to accomplish this a secondary flap-splitting operation must be employed. Secondary operations in cases in which there has been much sloughing are not so apt to be successful as primary operations; in such cases it would be better to fit a plate. Septic inflammation in flaps is treated by spraying the parts every two hours with a mildly antiseptic solution. Gangrenous and ulcerated areas may be gently touched with a 10 per cent. chlorid of zinc solution.

In necrosis of the flap great care should be used in preserving the posterior sutures and these should not be removed except their usefulness has entirely been negatized. If they are removed union may be despaired of for the flaps speedily retract. If they are left in place even if they serve no further purpose than to hold the flaps posteriorly in apposition they will serve to allow of granulations springing up between the edges of the flap anteriorly and some union being effected.

Older patients should be taught to breathe through the nose with the mouth closed. Elocution lessons should be taken to develop the soft palate and so get rid of the nasal quality of speech which these patients have acquired. The development of normal speech depends upon the anatomical condition of the parts alone. *In cases in which the soft palate is deficient,* in order to overcome the nasal tone of the voice a mucous membrane flap, with the base left attached, may be dissected from the posterior wall of the pharynx and united to the pared posterior edge of the hard palate or the rudimentary soft palate. The after-treatment will be the same as in simple uranoplasty and staphylorrhaphy. Great care must be exercised to keep the cavity of the nose clear of mucus, as drainage through the pharynx is interfered with by the mucous membrane flap. After several weeks or months the base of the flap is separated from the posterior pharyngeal wall. This operation gives good functional results. Labials and sibilants will be particularly hard for these patients to pronounce. Should the operation fail completely through extensive sloughing of the flaps nothing remains but the proper fitting of an obturator to cover in the defect.

Amputation of the Tongue.—The after-treatment varies with the amount of the tongue removed and the operative technic employed. If the anterior half or two-thirds of the tongue or the lateral half of the tongue is removed through the mouth, treatment is comparatively simple and consists mainly in keeping the mouth free from secretions. The tongue stump heals rapidly. Feeding is done as in case of resection of the lower jaw. If preliminary ligation of the lingual vessels has been done the neck wound is treated on general principles. If the operation has been more extensive and part of the floor of the mouth removed as well through an incision below the lower border of the inferior maxilla, with or without resection of this bone, the wound is drained from below and treated as outlined for resection of the lower jaw, and is liable to similar complications. If glands have been removed from the neck, the resulting wounds are treated on general principles. A preliminary tracheotomy may have been performed. Though a fistula follows the more extensive operations, this will at most only necessitate a second plastic operation. Infection of the tongue will result in rapid swelling, on account of the numerous lymphatic vessels of that organ. This can only be prevented by rigid cleansing of the mouth. All carious teeth should have been filled or removed prior to operating. The teeth are kept clean by rubbing them three or four times daily with cotton sticks dipped in antiseptic solutions, and the mouth cavity cleansed by frequent sprayings. Should infection occur the tongue stump is to be freed of any constricting sutures and thoroughly sprayed with peroxid of hydrogen, with the patient leaning forward to facilitate free exit of the antiseptic. Gangrenous areas are to be touched daily with 10 per cent. chlorid of zinc.

Edema of the glottis may follow, and if a preliminary tracheotomy has not been done, death from suffocation is an immediate danger. The only remedy is rapid tracheotomy. In cases in which edema of the glottis is expected, a tracheotomy set should be placed near the bedside. *Feeding* is done with the stomach tube, pharyngeal tube or by rectum until the patient can control the movements of the tongue. *Speech.*—If less than

two-thirds of the tongue or only the lateral half has been removed impairment of speech will be astonishingly slight. If the entire tongue has been excised to the level of the epiglottis, the tongue sounds are lost and the patient must substitute lip sounds for these. In these cases if the pillars of the fauces have been sutured over the base of the tongue speech is fairly well preserved as a natural moving diaphragm results.

Extraction of Teeth.—The surgeon is rarely called upon to extract teeth. Hemorrhage following teeth extraction usually subsides spontaneously; if not the alveolar cavity may be packed with plain gauze or cotton; subsequently the mouth should be cleansed frequently with a mild antiseptic mouth wash. Alveolar parodontitis, parulis or even a suppurative osteomyelitis may follow removal of a tooth. Such complications are more apt to occur if the tooth was extracted while suppuration was already present. In such a case the cavity should be packed with iodoform gauze and repeated irrigations used. After extraction of upper molars the possibility of opening of the antrum of Highmore should be borne in mind. This need occasion no alarm; the mouth should be kept thoroughly cleansed with an antiseptic wash. Should infection occur opening and draining of the antrum may be necessary.

Parulis.—As soon as fluctuation occurs an incision should be made. If symptoms of osteomyelitis develop, fever, intense pain, swelling, redness and apparent thickening of the bone, the bone should be trephined.

Resection of the Alveolar Process.—A plain gauze tampon should be used to control oozing; this is removed at the end of twenty-four hours and the mouth kept clean with repeated irrigations.

Fractures of the Jaw.—All cases which are not readily retained in position by ordinary bandaging should have an interdental splint made. The patients are fed by passing a small rubber catheter along between the teeth and the cheek and behind the last tooth. The same means are used to frequently irrigate and cleanse the mouth. In compound fractures circumscribed suppuration at the seat of fracture is common. This is treated by frequent spraying of the infected cavity. If the pus tends

to extend toward the neck a counter-opening and free drainage must be made. In compound fractures it is common for sequestra to be thrown off; it is best to allow this to occur naturally and not to hasten it by frequent curettings.

The Interdental Splint.—When this method of treatment can be made available, it is by far the best method for fractures of the mandible. The patient's mouth and teeth are carefully cleansed beforehand. It may be necessary to administer a general anesthetic. An impression is taken as for upper and lower dentures, no attempt being made to reduce the fragments. The method of procedure is as follows: The ordinary modeling cups of the dentist are filled with yellow beeswax; the latter is gradually heated over an alcohol flame and worked with the fingers until it is soft. Impressions of the upper and the lower

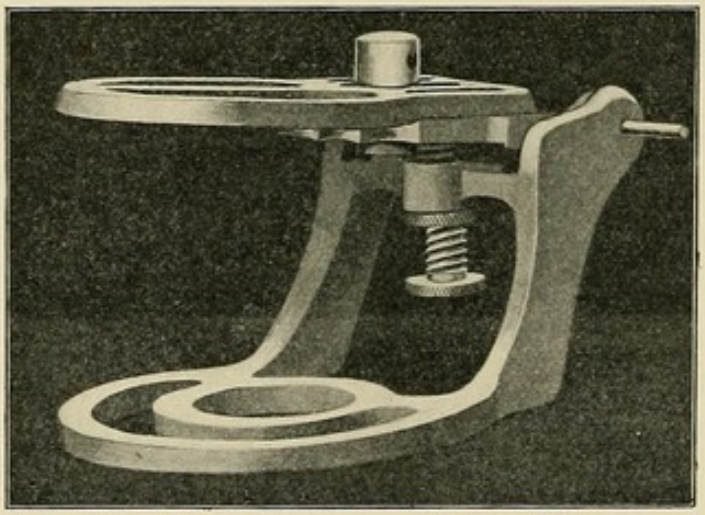


Fig. 182.—The articulator. (Fowler's Surgery.)

teeth are taken and the wax allowed to harden. A plaster-of-Paris cast of the upper jaw is then made and this is secured by means of plaster cream to the upper part of an articulator (Fig. 182). In the same way a cast of the lower jaw is made, the site of the fracture recognized and marked, and the cast sawed in two at that point in a line corresponding as nearly as possible with the fracture.

The two pieces of the cast of the lower jaw are now brought into their proper relation so that the lower and upper teeth articulate normally; they are then fastened together by means of plaster cream on the lower arm of the articulator (Fig. 183).

On this model of the reduced fracture an interdental splint of vulcanite (Fig. 184) is made by a mechanical dentist. The splint is trimmed so as not to impinge on the gums. In placing the splint in position it is first adjusted to the upper teeth; the

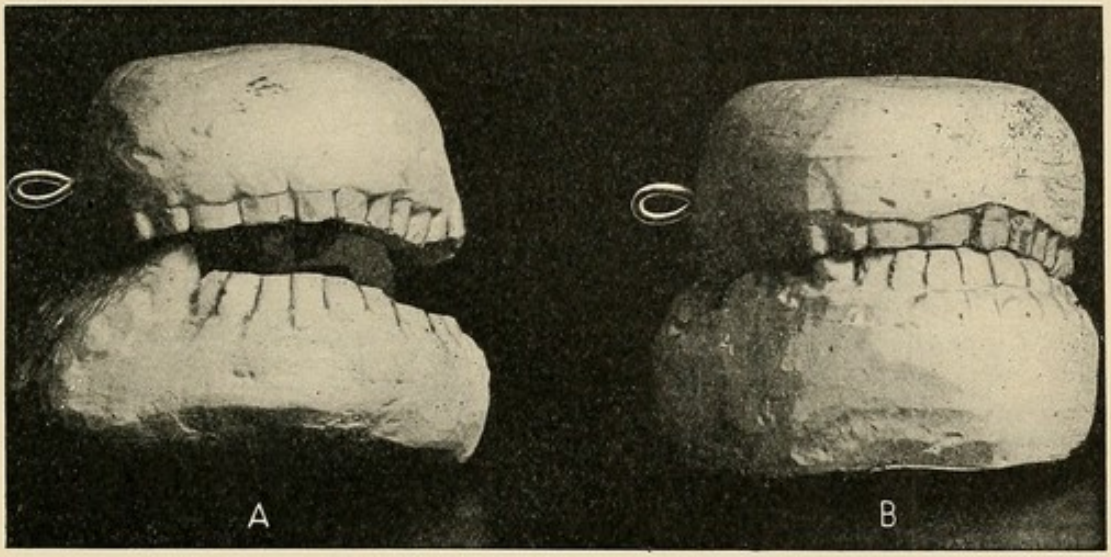


Fig. 183.—Plaster-of-Paris models of upper and lower teeth molded in the articulator. A, Cast of fracture of the lower jaw; B, the same after the site of the fracture has been sawed across and the normal relations of the parts restored. (Fowler's Surgery.)

teeth of the lower jaw are now forced into the recesses made for them on the corrected model, the displacement thus being rectified. Suitable bandages (Barton's or a modification thereof) are applied so as to hold the lower jaw firmly against the splint. The latter is worn for from thirty to fifty days.

The interdental splint is suitable for the treatment of fractures through the dental arch. Various slight modifications of its form may be rendered necessary for feeding purposes so as to take advantage of any gaps in the teeth that may exist.

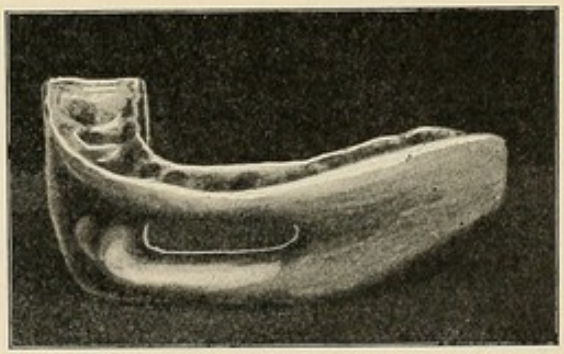


Fig. 184.—Interdental splint of vulcanite. (Fowler's Surgery.)

In fractures in the region of the molar teeth special care must be exercised not to separate the jaws any wider than is absolutely necessary in the application of the splint, lest failure of the front teeth

to articulate when the healing is completed result. Here the portion of the splint interposed between the teeth should be as thin as is consistent with strength, for it is evident that the greater the separation of the jaws, the greater will be the stress on the posterior fragment. The thin gold splint of Ottolengui (Fig. 185) answers the purpose best under these circumstances.

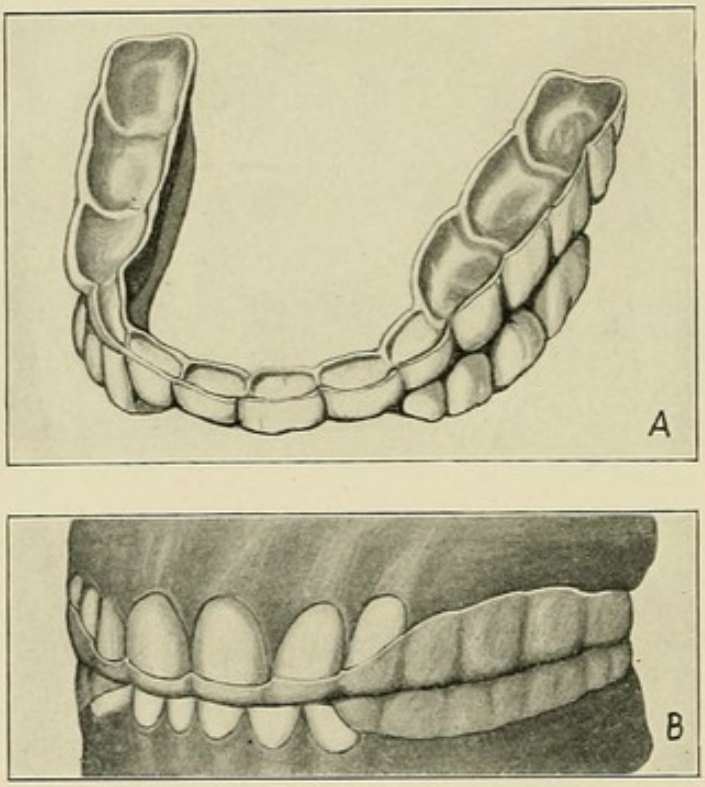


Fig. 185.—Gold interdental splint. For use in cases of fracture posterior to the last molar. A, The splint; B, the splint shown in place on the plaster model. (Fowler's Surgery.)

If the fracture is in front of the bicuspid teeth, a short splint or a simple capping of the lower teeth in cases where there is little deformity will fulfil all requirements.

In cases of double fracture an interdental splint is indispensable; if one break is at or near the angle, the splint should be as thin as possible so as to avoid increasing the deformity at this point.

Dislocation of the Jaw.—Dislocations of the jaw are prone to recur and therefore a retaining bandage should be applied for five to seven days following the dislocation. After this the patient should be warned not to yawn or laugh immoderately. In recurrent dislocations of the jaw the retaining bandage should

be kept in place for a longer time, the patient should not be allowed solid food, or to chew vigorously for several weeks. If in spite of this treatment the dislocation recurs an operation for the formation of a more prominent eminentia articularis is indicated.

Resection of One-half of the Upper Jaw.—*The primary dressing* is placed in the wound at the time of operation, directly the individual bleeding points have been secured. This dressing consists of a strip of gauze, either iodoform or zinc oxid, four inches wide and of sufficient length to fill the entire wound cavity. This is very tightly packed to prevent hemorrhage or the entrance of extraneous matter from the mouth or naso-pharynx, and is retained in position by suturing the skin flaps over it. The line of incision is painted with collodion. Primary union is the rule in the skin incisions and a linear scar will result, except in those portions of the skin flap where an angle exists. In those cases in which a vertical incision joins a horizontal incision below the orbital arch, the resulting skin angle is likely to necrose and may result in a persistent fistula communicating with the cavity of the mouth. To avoid this, sutures should not be placed too near such an angle. The wound at this point should be inspected at the end of twenty-four hours. If the flap at this point shows any lack of circulation, one or more sutures in the neighborhood are to be removed. Aside from this angle, frequent inspection of the wound is to be deprecated here as elsewhere. The remaining sutures are removed on from the fifth to the seventh day.

If *preliminary ligation of the external carotid* has been done bleeding may be so slight as not to require wound packing. Such cases require very frequent, careful and gentle douching and spraying of the nose, the mouth and wound surfaces.

Nourishment.—The patient must be fed by the stomach tube for the first four days. A small quantity of sterile water may then be given, and if this be swallowed without gagging, fluid diet may be begun by mouth. If a large amount of muscular tissue has been removed, gagging may persist and the use of the stomach tube be required for as long a period as two weeks. Semi-solid and finally solid food may be given, beginning in the third week. *Care*

of the Mouth and Nose.—The mouth, nose and throat should be sprayed with weak antiseptic alkaline solutions every two or three hours. Spraying is to be done gently to prevent gagging and to be continued at frequent intervals until the wound cavity is healed. *Position of the Patient.*—Here, as in all operations in which saliva may enter a wound, the patient should lie on the healthy side to facilitate the flow of saliva away from the wound. *The wound cavity* is kept clean by the tight packing preventing the entrance of saliva or liquid food. This primary packing is left *in situ* for eight days, at the end of which time granulations have been established, and the dangers arising from secondary hemorrhage and infection are practically passed. If, previous to this time, the outer layers of the packing have become soaked by saliva or food, the soiled portion may be removed without disturbing the main portions of the packing. Even this will hardly be necessary before the fourth day if the directions have been strictly adhered to for keeping the mouth and nose clean. The removal of the packing is effected without difficulty. If done gradually, no bleeding will result, or at most a slight oozing. The portion of the gauze in contact with the wound surface will be found fresh and clean. No irrigation should be used at this dressing. The wound cavity is repacked, but not so tightly as before, and this process is repeated every forty-eight hours. At the third and at subsequent dressings the wound cavity is to be irrigated with an anti-septic solution, preferably a weak solution of potassium permanganate. The amount of packing is decreased as granulation rapidly proceeds. It is only by the strictest cleanliness that a healthy condition of the cavity can be maintained. After the primary tight packing has been removed, bacteria, as well as saliva and particles of food, readily finds access to the wound. The granulations are apt to become gray and sluggish, and require curetting or painting with nitrate of silver solution. If the cavity is neglected, a very foul discharge will result. After the second week, as granulations proceed more rapidly, irrigation and packing are to be more frequent. The wound cavity may take weeks or months in completely cicatrizing, the epithelium of the neighboring mucous membrane slowly creeping over the granulating surface. If the wound secretions seem dammed

back by the packing, this is to be left out for several days and more energetic means employed to clean the cavity. The patient is instructed to syringe out the cavity after each meal and at frequent intervals.

Complications.—In cases in which hemostasis has not been carefully practised or in which the gauze packing has not been methodically placed or has become displaced through the restlessness of the patient, a profuse primary *hemorrhage* may result. This is to be watched for in the first forty-eight hours and a prompt repacking of the cavity done.

Secondary hemorrhage is not apt to occur in aseptically treated wounds. Erysipelas was formerly greatly dreaded, but its occurrence at the present time is almost a surgical curiosity. *Edema* of the soft parts may occur soon after the operation, but need occasion no anxiety. Loosening the retaining bandage is all that is necessary for the comfort of the patient. Occurring later it indicates a septic condition of the wound or a retention of secretion, which more rigid wound cleansing will cause to subside.

Deformity.—The skin scar is hardly noticeable if primary union has taken place. The amount of falling in of the cheek will depend upon the amount of tissue removed. If the operation has been a subperiosteal one, the resulting deformity will be comparatively slight. If practically only a skin flap has been preserved, a correspondingly greater deformity will result. If the orbital plate is removed, the eye will be drawn downward. Operations which destroy the nerve supply of the cheek will necessarily result in loss of expression upon the affected side. Conjunctivitis or even panophthalmia with loss of the eye may occur.

Prosthesis.—Prosthetic apparatus should not be employed until cicatrization has been effected. Their earlier use interferes too greatly with wound healing. Such an apparatus will support the cheek and obviate the deformity from the sinking in of the soft parts. Care should be taken, however, that no irritation is caused by pressure, more especially in cases in which the operation has been done for malignant disease.

Speech.—By reason of the loss of the alveolar process and the free communication with the nasal cavity, articulation will be

greatly embarassed. A good prosthetic apparatus will cause these patients to speak more distinctly. *Vision.*—If the operative procedure has involved the removal of the inferior orbital wall, the eyeball will sink downward. Its displacement will be further increased by the cicatricial contraction of the wound. As a consequence the muscular apparatus of the eye is affected, in some cases, to the extent of causing double vision. Ocular circulation and innervation may be so affected as to cause loss of the eye. This may be due in part to injury to the infraorbital and facial nerves. The primary symptoms of conjunctivitis should be carefully watched for. Treatment can only be of avail when initiated in the early stages; when such complications ensue the case should be referred to an experienced ophthalmologist. *Recurrence* of malignant disease should be expected and its appearance should be met by prompt local interference when this is possible, or at least by such local and general treatment as will most relieve the patient. In general it may be stated that the more radical the original operation, the more extended will be the period of quiesence.

Resection and Disarticulation of the Lower Jaw.—On account of the invasion of the floor of the mouth, defects in speech and difficulty in eating and in keeping the mouth clean are greater after operations upon the lower jaw than is the case in operations upon the upper jaw. The tongue muscles being divided, the movements of the tongue are difficult and painful. For this reason saliva and wound secretions more easily pass over alongside the tongue and enter the glottic opening, and foreign-body pneumonia more readily occurs. Infection of the deep tissues of the neck is also prone to develop, owing to the increased difficulty in keeping the wound surface clean. *Dressing.*—The primary dressing varies with the operative technic employed. With *preliminary tracheotomy* the wound treatment is simplified. In such cases the wound may be sutured to a great extent and the remainder tightly packed with gauze, the ends of the gauze strips emerging so as not to interfere with the tracheotomy tube. This dressing may remain in place for forty-eight to seventy-two hours, or may be removed only on the occurrence of retention of secretion or upon its becoming soaked with saliva and wound

secretions. The care of the tracheotomy tube is outlined on p. 398. In these cases it may be removed as soon as granulation of the wound is established. Dressings are renewed daily after the first dressing. Irrigation may be practised if wound secretion is profuse. The flow of saliva may be controlled, in part, by atropin in sufficient doses to produce dryness of the mouth. If a preliminary tracheotomy has not been done, the care of the wound is more difficult. It is impossible to wall off such a wound from the cavity of the mouth and nose. This is attempted by partial suturing of the mucous membrane of the cheek to that of the floor of the month and gauze drainage, but a communication will always persist. The drains emerge below. A copious outer dressing of plain gauze serves to catch the saliva and wound secretions. This outer dressing is changed as often as soiled, about every six hours for the first day, less frequently thereafter. If it has not been possible to suture the mucous membrane of the cheek to that of the floor of the mouth at least in part, the entire wound cavity is crowded with gauze. This must be changed after the first twenty-four hours and a new packing introduced daily. In addition the wound is to be irrigated with mild alkaline antiseptic solution. Another and more preferable method of wound treatment consists in suturing as much of the mucous membrane as possible, not employing packing and applying an external dressing to catch the secretions. Atropin is administered to keep the mouth as dry as possible for the first three days. The patient's mouth is kept free from secretions by constant swabbing with cotton sticks until the effects of the anesthetic and of the operation have passed off, when the patient is bolstered up in bed to allow the wound secretion to drain immediately into the outer gauze dressing. This is changed every two hours and the wound frequently irrigated with saline solution until granulation is established. The patient may be placed on his back, with the head turned to one side while sleeping. The possibility of closing the mouth cavity by suturing the mucous membrane greatly decreases the danger of *foreign-body pneumonia*. Bolstering the patient up also decreases this danger, and also that of infection of the neighboring cellular tissues. Should retention of secretion occur,

it should be met by more rigorous disinfection and the removal of any sutures which may be at fault. Should *infection of the cellular tissue of the neck* complicate, free incision and adequate drainage must be afforded.

Suffocation.—This is a real and constant danger in those cases in which section of the genioglossi muscles makes possible the closure of the glottic opening by the falling back of the tongue. This danger will continue until wound healing has advanced sufficiently to afford a fixed point of attachment to the genio-hyoglossi muscles. During the period of anesthetic unconsciousness the patient must be watched, and at the first sign of difficult respiration the tongue is to be pulled forward. This will be facilitated by passing a stout silk suture through the tongue and fastening the silk loop with adhesive plaster to the cheek or ear. This suture may be removed on the third day, or as soon as the patient can be taught to draw his tongue forward on the first intimation of suffocation. *Course of the Wound.*—With constant watchfulness on the part of the attendant, healing rapidly ensues until the wound contracts to a fistula. This closes readily as a rule, though if large and kept open by the entrance of saliva and particles of food, a secondary plastic operation may be necessary. Swallowing is markedly interfered with. This not only makes feeding difficult, but allows the saliva to collect in the mouth cavity and "dribbling" results. Speech is difficult and thick. As the healing process proceeds, the severed ends of the bone sink more and more together. In case of unilateral disarticulation the remaining side encroaches on the operated side. If the chin portion of the jaw has been removed, the cut surfaces approach each other almost immediately. This occurs whenever a section of bone is removed from the continuity of the lower jaw and causes great disfigurement. To avoid this it is advisable, whenever possible, to leave a bridge of bone connecting the two lateral portions. If this is impossible, an attempt to prevent the disfigurement may be made by prosthesis. To be successful this must be done at the time of operation or very shortly thereafter, before cicatrization has begun. If no attempt be made to keep the lateral portion of the jaw in its proper relations not only will great

disfigurement result, but by reason of the loss of alignment of the teeth, mastication will become impossible. In time changes will take place in the conformation of the upper jaw as well. *Prosthetic apparatus* introduced after cicatrization is well under way, while they aid somewhat, do not overcome entirely these serious defects. The introduction of pieces of steel wire between the fragments at the time of operation has been done with partial success. It has been recommended (Nussbaum) that an accurate, hard-rubber model be made of the lower jaw in each individual case. This is provided with numerous openings to facilitate irrigation and drainage. On removal of the diseased segment, a corresponding portion of the cast is sawn off and placed in the gap. This is retained in position by wiring it to the remaining portion of the jaw. Eternal vigilance must be exercised to ensure the successful healing of the artificial portion. A section of bone from another portion of the body may be wedged in the gap. This latter procedure aided by prosthesia will give the best result. Unless successful the final condition of these patients will be one of deformity, imperfect speech and difficult deglutition. They are forced to subsist on soft or liquid food.

CHAPTER XIV.

OPERATIONS ON THE NECK.

General Rules following Operations upon the Neck.—The elevated head and trunk position is useful in lessening oozing or the liability to secondary hemorrhage. Care should be taken to protect the dressing from contamination by vomitus and expectorated material while the patient is still unconscious.

Complications following Operations upon the Neck.—Owing to the large number of important structures all wounds and injuries of the neck require special care in the after-treatment. In **ligature of the jugular vein** venous stasis rarely follows in the face even after ligature of both the internal and external jugular, the collateral circulation allowing of the rapid establishment of the venous return. Only occasionally does a thrombosis form in the ligated vein as far as the next collateral branch; more

rarely still is a portion of such a thrombus carried into the circulation to result in pulmonary embolism. Suppuration of such a thrombus with multiple embolism and pyemia is still rarer.

Temporary venous stasis of the face may result following operations upon the neck through too tight bandaging.

Ligature of the Carotid Artery.—Acute anemia of the brain may result. This is preceded by irregularity of the pupils, headache and attacks of dizziness; later unconsciousness develops. Hemiplegia of the opposite half of the body may occur, aphasia may result, epileptiform convulsions may result, an increasing weakness of the mentality may slowly develop. These are the results of permanent insufficient brain nutrition. In such cases cerebral softening finally becomes complete. Usually, however, in otherwise healthy individuals collateral circulation is rapidly established. In those suffering from arteriosclerosis, extensive thrombi and permanent disturbance of nutrition will result.

Aneurysms and malignant tumors of the neck are more apt to be complicated in the after-course.

Injury to the Thoracic Duct.—This is shown by a copious flow of milky fluid from the wound. The flow increases during digestion. It coagulates spontaneously when exposed to the air. If food is withheld the fluid becomes clear. Treatment consists in packing the wound firmly. If the duct has been injured within the chest the chylous fluid will accumulate in the pleural cavity. Such cases are frequently fatal through inanition. As in other wounds of lymph channels a granulating condition of the wound should be brought about as quickly as possible. If these granulations do not close the defect in the duct a lateral suturing may be attempted. If this fails the duct must be ligated. Such a procedure should not be too long delayed in thoracic injuries, for unless there happens to be a free anastomosis or a right as well as a left duct rapid inanition results. If chylothorax follows, the thorax should be opened and the fluid evacuated. The lesion is not so fatal as was formerly supposed, fourteen recoveries in fifteen cases (Allen and Briggs).

Secondary Hemorrhage.—While secondary hemorrhage is no more liable to occur following operation upon the neck than elsewhere, it is accompanied by greater danger on account of the

size of the vessels likely to be involved. Suppurating wounds predispose to its occurrence and should be carefully watched for this complication. Such wounds must receive special attention as regards frequent and careful redressing, rigid cleanliness and efficient drainage. Keeping the patient quiet in the elevated head and trunk position is beneficial. Upon the occurrence of hemorrhage digital pressure over the bleeding area is immediately applied and kept up until everything is ready to ligate the vessel. Packing and expectant treatment are only mentioned to be condemned.

Operative injuries to the supraclavicular nerves are generally of little significance; they result in loss of sensation, paresthesia, neuralgic pain; these disappear within a few months. Injuries to the *brachial plexus* are of more importance; motor and sensory paralysis from actual section of part of the plexus is rare. More common are irritative lesions produced by pressure and stretching. In extensive dissections in the region of the plexus contraction of cicatrical tissue and consequent pressure is apt to occur. Prophylactic treatment consists in securing primary union. If actual section in any part of the brachial plexus has occurred immediate suture should be done upon the discovery of the symptoms. In pressure from later contraction of scar tissue excision of the scar tissue is indicated. For painful conditions the constant electric current is useful.

In some operations on the neck it is not possible to avoid injury to the **spinal accessory nerve.** Section of this nerve causes paralysis of the sterno-mastoid muscle and a malformation of the neck may result.

The recurrent laryngeal nerve is sometimes injured in thyroidectomy (p. 417).

Injury to the vagus of one side produces paralysis of the vocal cord on that side with consequent disturbance of voice and respiration. Increase in the pulse rate is not observed in man. There later may develop suppurative bronchitis, lobar pneumonia or other lung complications. A direct relation of these lesions to the section of the vagus is not proven. In addition to the paralysis of the vocal cord there are sensory and motor disturbances of the pharynx and esophagus; these interfere with deglutition. A

foreign-body pneumonia may easily result. In cases in which a vagus has been injured the patient should be fed by stomach tube for seven or eight days on account of the danger of aspiration pneumonia.

Injury to the phrenic nerve is not common. Section of the nerve causes collapse of a portion of the lower lobe of the lung on the injured side and partial paralysis of the corresponding half of the diaphragm. The five lower intercostals give some innervation to the diaphragm. The accident is not necessarily fatal. In the reported fatal cases following this injury there were other possible causative factors present.

After section of the *sympathetic* there is contraction of the pupil of the corresponding side, congestion of the eyeball, flushing of the face and in some cases headache and dizziness. Division of the *cervico-facial*, as happens occasionally in extensive dissections, paralyzes the angle of the mouth. This is rarely permanent. It may occasion considerable anxiety to the patient.

Disturbances of the Respiratory Organs.—These frequently occur after extensive dissections of the neck, particularly for malignant disease. For a few days following such operations there is acute catarrhal bronchitis; to cough is painful, and therefore expectoration is suppressed; for this reason in children and old people particularly the deeper air-passages readily become affected. The occurrence of pneumonia after extensive dissections of the lower regions of the neck should be borne in mind and prophylactic treatment instituted.

Infection.—The anatomical structure of the neck predisposes to a very rapid diffusion of infection. Infection follows the connective-tissue planes and may extend into the mediastinum. If infection occurs drainage should be instituted at once. In extensive dissections at the root of the neck where it is impossible to entirely obliterate a dead space it is better to drain at the time of operation through a stab wound just above the sternal notch.

Dressings for wounds of the neck should include the head and chest as well as the neck; if the ears are included these should be protected from pressure by cotton.

When **deep infection of the neck** occurs the overlying parts

become brawny and fixed, and examination is difficult. The brawny area must be opened up and the nidus of infection drained. This may be done through a small incision and the pushing of a slender-pointed artery clamp toward the center of the infiltration, and withdrawing the clamp open. Only a few drops of pus may escape. Tube drainage should be instituted and a copious evaporating dressing applied. Should the fever not subside more liberal incisions must be made. A rapid septicemia may follow unless free drainage is instituted. Edema of the glottis may occur.

Ludwig's Angina. Diphtheritic and Scarlet Fever Lymphadenitis.—Early and adequate incision in these conditions is necessary to prevent fatal edema of the glottis or septicemia. The actual amount of pus found is very small, the surrounding infiltration very great. Fenestrated multiple tube drainage is employed. If the temperature does not fall further incision is indicated. Irrigation cannot take the place of adequate incision and it is folly to wait in the hope that the unopened focus will escape by way of the existing incision. Copious absorbent alcohol-bichlorid dressings are employed and frequently changed.

Edema of the Glottis.—There is always danger of edema of the glottis in any acute suppurative process in the neighborhood. If the cause has been early and effectively treated the beginning edema may subside and a tracheotomy be avoided. In cases in which it may reasonably be expected to progress a tracheotomy set should be kept at the patient's bedside or a preventive tracheotomy done. Scarifications are useless before the seat of infection has been efficiently drained.

Lymphadenitis and Lymphoma.—A radical cure is not always certain; glands which are small at the time of operation subsequently become infected and require removal. In only about one-third of the cases is a permanent cure secured. The cause of the enlarged glands should be sought out and treated. In tuberculous cases in which some of the glands were broken down persistent sinuses may follow.

Actinomycosis.—Recurrences are frequent and require splitting of the sinuses.

Hematoma of the sterno-mastoid may follow section and

suture. If extensive the incision should be opened and the clot expressed. If the hematoma is small and occurs late it may be left alone and will in time be absorbed. Infiltration of the muscle disappears rapidly under massage.

Tracheotomy. *Choice of Operation.*—Under circumstances of extreme emergency the trachea may be opened by a single cut, *rapid tracheotomy* (Dunham), without reference to the presence of large veins or the thyroid isthmus. The trachea and larynx are steadied laterally by the thumb and finger of the left hand, or a large tenaculum hooked deeply and firmly into the cricoid or cricothyroid membrane. Though a plexus of veins lies on each side of the line of incision, yet not infrequently a large vein or two, increased in size by obstructed breathing, crosses the trachea. The only normal artery likely to be met with is the cricothyroid, and this is placed so high (at the lower border of the thyroid cartilage) as to be practically out of the way in almost all of the operations of choice. An occasional arterial abnormality, the *arteria thyroidea ima,* is met with; it rises from the arch of the aorta and passes directly upward in the middle line to the lower border of the thyroid. In a low or *infrathyroid tracheotomy* the innominate artery may be endangered. In young children the thymus gland may be an obstacle. In spite of these latter objections and of the fact that the trachea in children is more deeply placed and smaller, in diphtheria cases in which it is desirable to place the tube as far away as possible from the pseudomembranous exudation, as well as in cases of malignant disease in which the cannula must be permanently worn, the low operation should be performed. Where the isthmus can be severed between two ligatures, the tube may be placed at its site. In an emergency requiring rapid tracheotomy, and under circumstances which demand prompt interference on account of threatened suffocation, the most superficial portion of the tube is chosen (*laryngotracheotomy*).

The Operation.—The patient, if a child, is wrapped in a blanket which is snugly pinned so as to confine the arms at the lateral portions of the body; they should not be crossed over the chest. He is placed on the table so that a good light may be obtained. The parts to be operated on are brought into prominence by a

hard pillow made by wrapping a wine bottle in a towel, or some similar device. The instruments required are a scalpel, half a dozen artery clamps (French's clamps are the most convenient Fig. 186), four small retractors (Fig. 187) (two sharp and two blunt), two pairs of thumb forceps, a grooved director, a strong and well-curved tenaculum for fixing the trachea (Fig. 188), curved and straight blunt-pointed scissors, an aneurism needle,

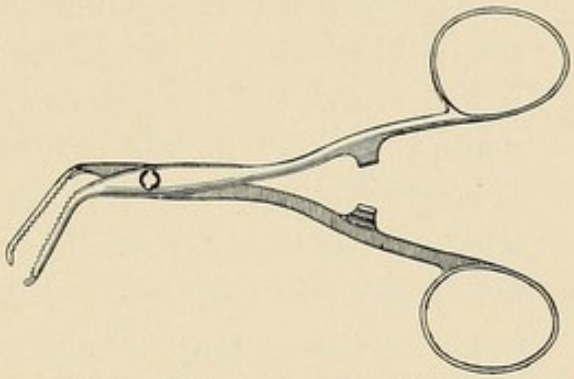


Fig. 186.—French's combined hemostatic forceps and retractor. (Fowler's Surgery.)

and curved and straight needles. Silk and catgut are also needed for suture and ligature purposes. An assortment of tubes must be at hand. The one best adapted to the case is prepared, with tapes attached, and placed conveniently near. The other instruments are placed in the order in which they are to be used. A median incision is made from the lower edge of the cricoid cartilage downward for from an inch and a half to two inches,

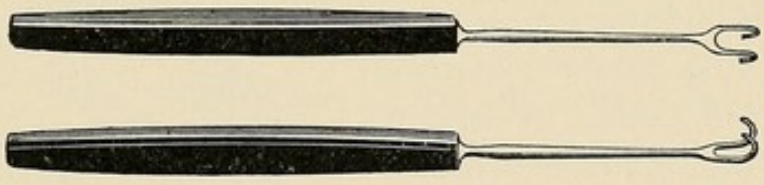


Fig. 187.—Pilcher's retractors. (Fowler's Surgery.)

including the skin and superficial fascia; the anterior jugular veins, one on each side of the larynx and trachea, pass downward and are joined by a transverse trunk just above the sternum. The lateral ribbon-shaped muscles (the crico-thyroid above and the sterno-thyroid below) are separated by the handle of the scalpel and drawn apart by small blunt retractors, so that the deep fascia is brought into view. The latter divides into two

layers to inclose the isthmus of the thyroid, which is recognized by its pinkish-red appearance, resting on the second and third rings of the trachea. The deep fascia is carefully nicked just below the lower border of the isthmus and divided on a grooved director, the incision baring the rings of the trachea with some loose connective tissue in front. A stout tenaculum is now inserted, point upward, at the lower border of the isthmus into the trachea to steady the latter while it is being incised. Whenever possible, a loop of strong silk is passed through each edge of the tracheal incision for purposes of retraction, or the incision held apart by tenacula and as large a tube as can be passed without crowding is introduced.

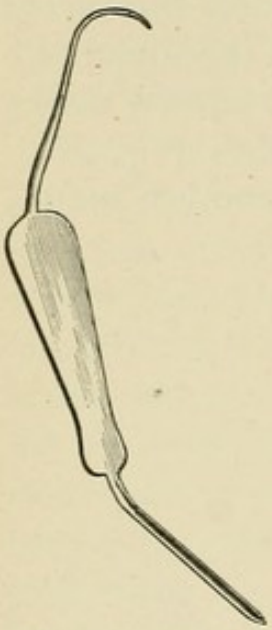


Fig. 188.—Combined grooved director and tenaculum. (Fowler's Surgery.)

Various *tracheotomy tubes* have been devised; the best is that known as the Cohen model (Fig. 189). It is flattened from side to side, so that its introduction is facilitated and the tendency of the posterior wall to bulge forward, as a consequence of wide separation of the edges of the divided tracheal rings, is lessened. A pilot trocar aids in the introduction in emergency cases and during the after-treatment, but if the loops of thread above mentioned can be placed in position and retained, this, as well as tracheal dilators, can be dispensed with. The wound is closed by interrupted sutures, except at the point where the tube emerges, and dressed with iodoform gauze.

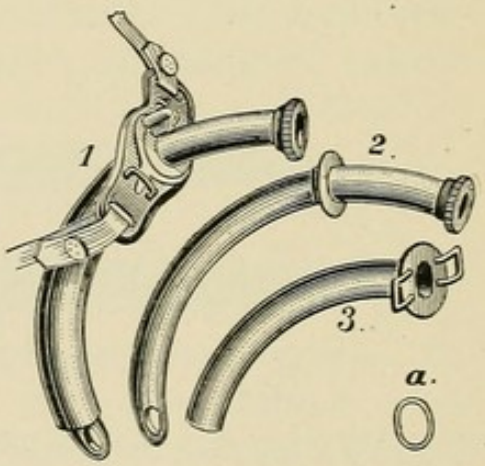


Fig. 189.—Cohen's tracheotomy tubes. 1, Outside tube and obturator; 2, obturator; 3, inside tube; *a*, cross-section of the tube. (Fowler's Surgery.)

The tube is secured in place by tapes about the neck and covered by a few thicknesses of gauze saturated with sterilized normal salt solution. The atmosphere of the room is kept moist and at a temperature of at least 80° F.

In croup and diphtheria cases a watchful care is to be exercised to prevent the tube from becoming blocked by pieces of false membrane. The inner tube is to be removed and cleansed from time to time. In an emergency both tubes are to be removed at once and the patency of the opening maintained by the loops of thread. The tube should be dispensed with at the very earliest possible moment.

The Importance of the After-treatment.—Tracheotomized patients should be constantly watched in order to rectify immediately any displacement of the tube. This is especially important in laryngeal stenosis from whatever cause. There should be an attendant constantly by the bedside for the first few days, or until such a time as the trachea becomes fixed in the wound and the danger of asphyxia from the displacement of the tube is no longer imminent.

Method of Retaining the Tube in Position.—The tube is held in place by two tapes, one end of each being attached to either side of the shield of the tube through an aperture made for the purpose. To ensure the tapes lying smoothly on the neck a small slit is cut in one end of each tape, the slit ends are passed through the aperture at either side of the shield of the tube and the free end of each tape is then passed through the slit in the other end forming a slip-noose. This is drawn down snugly. The free ends of the tape are then tied together at the back of the neck. The tapes should be one quarter of an inch broad and sufficiently long to allow of easy tying. Care must be taken that they are not tied too tightly or the return circulation in the large veins of the neck will be interfered with; on the other hand if too loosely tied there is danger that an attack of coughing will displace the tube.

Care of the Wound.—The wound in diphtheria cases is best left open; in other cases one or two sutures may be placed at each extremity of the wound. A four-inch square of gauze several layers thick is cut from one side to just beyond its center and slipped under the shield to prevent the latter from pressing on the wound and skin edges. Over the external opening of the tube is laid, not fastened, a single thickness of gauze moistened for the first few days with a weak solution of

turpentine or boracic acid solution. This is renewed every few hours. When patient is up and about a simple gauze covering to filter the air is sufficient.

Course following Introduction of the Tube.—The introduction of the tube always excites some cough. Mucus slightly tinged with blood is expelled through the tube. This quickly disappears, quiet respirations ensue, and normal color replaces the cyanosis. It is not uncommon for patients who have been fighting for air previous to the introduction of the tube to sink into a quiet slumber as soon as the free passage of air is established.

Occlusion of the Tube by Mucus.—Next in importance to keeping the tube in place is the necessity for keeping its lumen clear of mucus. This is accomplished by removing the inner tube, cleansing, and replacing it. The periods at which this should be done vary according to the case. In the ordinary case three times a day is sufficient. Upon the recurrence of dyspnea the inner tube should be immediately withdrawn, cleansed, and replaced. In cases uncomplicated by involvement of the tracheal mucous membrane there will be but slight mucous discharge. In diphtheria cases a cast of the entire tracheal mucous membrane may be thrown off. Particles of tenacious mucus easily adhere to the opening and inner surface of the tube. More and more mucus collects and dries until the lumen is so encroached upon that dyspnea sets in. By constantly changing the moist gauze over the external opening of the tube the drying of the mucus in the tube may be materially lessened. In cases in which the mucus is very tenacious a steam kettle should be used to keep the air in the room moist. An alkaline spray (bicarbonate of soda in the strength of ten grains to the ounce) may be used through the tube every two hours to aid in loosening the tough membrane in diphtheria cases. As fast as mucus is coughed through the tube it should be sponged away and never allowed to remain in the external opening where it may be drawn back into the trachea again. In replacing the inner tube after cleansing, be sure that it is completely replaced and caught by the catch on the shield, as otherwise there will be left a small opening at

the lower end of the tube between the inner and outer tube. In this crevice, mucus will gather and glue the two tubes together so that when it again becomes necessary to remove the inner tube in order to cleanse it, it will be found that this can only be done by removing both tubes, so intimately will they be glued together.

A large piece of membrane may block the tube by becoming lodged against its inner orifice and dyspnea become extreme. In such a case remove the inner tube and if the membrane is not expelled, break it up by introducing a soft catheter and it will usually be expelled by the next violent cough. Should this maneuver fail to give relief, both tubes should be removed.

Displacement of the Tube.—This is usually caused by a violent cough. If it occurs before the trachea has become fixed in the wound, immediate dyspnea results. Occurring later the symptoms are not urgent as the opening in the trachea has become part of the external wound and is rigidly held open. The tube may only slip forward a short distance and yet be outside the trachea. Should this occur shortly after the operation the slit in the trachea will collapse, dyspnea ensues and death from asphyxia will be imminent. The projection of the tube forward may be hardly noticeable externally, especially in low tracheotomy. The impulse of the untrained attendant is to push the tube deeper and tighten the tape but this does not relieve the symptoms as the inner end of the tube only pushes the trachea before it, or is pushed downward in the pre-tracheal tissue. This latter favors infection of these tissues if the patient survives. Should the case not die in a short time of asphyxia, emphysema of the tissues of the neck and body will result. Without intervention this emphysema will extend to all the superficial tissues of the body. The tape fastening the tube will cut deeply into the swollen tissues of the neck. Upon replacing the tube in its proper position in the trachea these symptoms subside. The emphysema is not fatal unless it should enter the mediastinum and prevent the expansion of the lung. Naturally, however, it favors sepsis.

Replacement of the tube.—The reintroduction of the tube requires as much, if not more skill, than the tracheotomy itself. The patient is placed as for tracheotomy, a sandbag

under shoulder, the head bent backward slightly to thoroughly expose the parts. An assistant sitting at the patient's head fixes it by grasping the temples. A second assistant holds the body, preferably by pressing both arms to the patient's thorax with shoulders down by traction on the arm and by a slight pressure of his body upon the lower extremities prevents the child's struggling. Remove the tube completely, retract the edges of the wound with *blunt* hooks, raise and steady the trachea with a tenaculum introduced at the upper angle of the wound, separate the tracheal wound edges with tenacula or tracheal retraction forceps, and introduce the tube. If the original tube is too short on account of the swelling a longer tube must be used. If no other tube is at hand a thick-walled rubber drain or catheter may be used temporarily, or the trachea may be sewed to the skin. Proceed methodically taking care that wound secretion is not inspirated.

Wound Complications.—Immediate hemorrhage is due to errors in technic during the operation. Hemorrhage should have been controlled before opening the trachea whenever the emergency permits. Bleeding from the tracheal wound or tracheal mucous membrane is rarely marked. If the bleeding from the wound is profuse its source must be looked for and checked. If slight, tamponade of the wound will be sufficient. *Secondary hemorrhage* may occur on the third day or later and is due to suppuration in the wound, thrombosis of the tracheal veins, or injury to the thyroid gland, more rarely to the erosion of a large vessel. In the latter case the hemorrhage will not occur until the seventh to the tenth day. The treatment consists in immediately controlling the hemorrhage by digital pressure and then formally clamping and ligating as quickly as possible.

Ulcers of the tracheal mucous membrane caused by pressure from the tube will cause slight repeated hemorrhages; at first blood-stained mucous is coughed out, later pure blood. The blood-stained sputum will first call attention to the condition. This is caused by using too large a tube or by faulty position of the tube. It may be accompanied by edema. The treatment is to remove the tube and replace it by one of different curve and size.

Wound infection rarely occurs. An aseptic tracheotomy wound cannot be obtained but usually infection is only of a mild character. More rarely the wound edges become indurated, a grayish-white slough forms on the wound surface but as drainage is very free the inflammation does not tend to progress and when granulation progresses the infection rapidly clears up. If there is any tendency to spread incisions should be made, so placed as to prevent pocketing and extension toward the mediastinum.

Wound diphtheria is now rare, antitoxin controlling the spread of the inflammation. The wound surfaces are covered by fibrous exudate and this may extend into the tissues; the margins of the wound are ulcerated and the tracheal cartilages exposed in the incision become necrotic. There is a tendency to extend downward to the mediastinum. Usually such a case is fatal. Occasionally the wound will clean up and healing follow but cicatricial stenosis is apt to follow the tracheal ulceration. The case may be further complicated by a streptococcus infection of the submaxillary and submental glands for which free incisions with drainage are necessary.

Removal of the Cannula.—As soon as normal breathing can be established the tube is removed, usually on the fifth to the tenth day. The tube may be removed earlier in many cases, especially in operations for foreign body. Dyspnea usually occurs to a slight extent; if severe, the tube should be replaced and an attempt at removal made a few days later. Some cases are compelled to wear the tube for months owing to dyspnea following attempts to remove it. In such cases a fenestrated cannula is useful. Air escapes partly through the cannula and partly through the convex opening into the larynx. This accustoms the patient to breathe through the larynx and usually permits of removal of the tube in a few days. If respiration is free it may be permanently left out. Children and nervous people become alarmed at removal of the tube. In diphtheria cases the tube is removed after the membrane disappears. Edema may follow the removal of the tube in the first few hours. This complication should be watched for and on its occurrence the tube is reinserted. At first, in diphtheria cases following the

removal of the tracheotomy tube the voice is harsh, husky and stridulent; there is no dyspnea during quiet breathing. In some cases, however, the dyspnea returns repeatedly for from twenty-four to forty-eight hours and follows coughing; this is due to some inflammatory swelling of the larynx even after the diphtheritic membrane has disappeared. These cases should be watched carefully for forty-eight hours following removal of the tube, and the tube should be replaced if urgent symptoms arise. A smaller tube should always be at hand as the opening rapidly closes.

Stenosis of the trachea sometimes occurs due to extensive ulceration. An attempt at dilatation should be made but it is usually necessary to continue to use the tube.

Granulomata occasionally form on the edge of the tracheal wound, more rarely on the tracheal wall. Long-continued pressure from the tube seems to favor their occurrence. They impede respiration by narrowing the lumen of the trachea. The interference with respiration may occur late, after the wound has healed, in which event bronchoscopy will determine the cause of the obstruction. Occurring early the granulomata may partially occlude the tube lumen. Treatment is pressure by a specially constructed tube (Dupuis) or removal with the curette. Some cases must continue to wear the tube.

Operations on the Larynx.—Endo-laryngeal operations are always followed by more or less temporary inflammatory reaction causing hoarseness or aphonia; the duration and severity of which depend upon the amount of injury to the vocal cords the result either of the operation or of the disease. This inflammatory swelling of the mucous membrane is marked after extensive cauterization and may progress so rapidly as to threaten suffocation and demand tracheotomy.

Dilatation Treatment.—As the after-treatment is apt to be prolonged the general practitioner should familiarize himself with the technic of dilatation. This is necessitated in many cases to prevent cicatricial contraction and patients must be warned of the necessity of such treatment. The passage of hard-rubber bougies, Schroetter's bougies, must be done every second day for months in some cases. The throat is cocainized

or the first few times and the confidence of the patient secured. An instrument of a suitable size is lubricated and passed in the same manner as an intubation tube. After a few times this can be done without cocain. It is allowed to remain in place for a few minutes and then withdrawn and the next larger size introduced. This is repeated every few days until full dilatation is secured. There will be at first some swelling of the mucous membrane. This should be allowed to subside before proceeding with the dilatation. Do not dilate enough to cause much reaction on account of the danger of edema. After full dilatation has been secured the bougies are passed at longer and longer intervals until the tendency to contraction has been completely overcome. Some cases will not respond to treatment and these must be subjected to operative interference. The cicatricial tissue is incised with the knife or galvanocautery and dilatation continued. Two or more extensive operations may be necessary. In cases in which portions of the laryngeal cartilages have been destroyed the whole cartilaginous frame-work may collapse. This necessitates the continued wearing of a tracheal cannula. Such cases may follow suppurative perichondritis, syphilitic or tuberculous inflammation, and in fractures which have been united with deformity.

Laryngotomy.—A preliminary tracheotomy is done either at the time of the operation or several days previously if possible. Following the completion of the laryngeal operation the cavity of the larynx is packed with gauze. The thyroid cartilage is sutured and the end of the gauze packing is led out of the inferior angle of the wound or in case a high tracheotomy has been done alongside of the tracheal tube. This packing ensures the arrest of the hemorrhage and prevents the entrance of food which might occur during the first few days. It also prevents the growing together of the anterior portion of the vocal cords. If it is thought wise to allow of late inspection of the interior of the larynx the gauze strip may be brought out between the two halves of the thyroid cartilage. In such cases a secondary suture of this cartilage is done upon the removal of the packing at the end of twenty-four or forty-eight hours.

All packing is removed in from five to ten days, but the tra-

cheotomy tube must not be removed at this time because of the swelling of the mucous membrane which follows the removal of the packing. This swelling disappears spontaneously in a few days. As soon as normal breathing is assured the tracheotomy tube may be removed. The cure is not yet complete. Catarrhal conditions of the mucous membrane, proliferating papillomata and more particularly the tendency to cicatricial contraction demand extended endolaryngeal treatment.

Laryngeal stenosis may be caused by the growing together of the anterior portion of the vocal cord, to an approximation of the arytenoid cartilages, or to a lateral or circular swelling of the mucous membrane. In the latter case not only is the relation of the vocal cords interfered with but the lumen of the larynx is lessened and breathing made difficult. Suffocation may even ensue.

Laryngectomy.—Total extirpation of the larynx has a high mortality. The percentage of cases which are free from a recurrence of carcinoma at the end of three years is extremely small. Many of the cases die of septic pneumonia caused by aspiration of secretion and of particles of food or by an infection which travels rapidly along the trachea into the mediastinum. This infection is due to the close proximity of the mouth.

Complete occlusion of the wound is impossible. The most that can be accomplished is to suture as completely as possible the pharyngeal membrane to the thyrohyoid membrane below the hyoid bone. In case of high tracheotomy the trachea is sewn to the skin edges at the lower angle of the wound. This tracheotomy should have been done preliminarily, if possible at least one week before. If the trachea is cut directly across and sewn into the wound no tracheotomy tube is necessary. The large wound resulting from the extirpation of the larynx is packed with gauze or closed with strip drainage if good approximation has been secured.

Nutrition is carried on through a stomach tube which emerges at the upper angle of the wound, or feeding can be done per rectum for three or four days and then by mouth. The stomach tube is left in position for two or three days. After this the tube may be withdrawn and thereafter introduced through the mouth

as occasion requires. In eight to ten days the patient will be able to take small quantities of fluid food without the aid of the tube as by this time the process of granulation is well under way. It is highly important that the *mouth and teeth be kept scrupulously clean.* The flow of saliva is usually so great as to soak the packing in a short time. This should be changed as frequently as soiled, usually three or four times a day at first. Minute doses of morphin and atropin will help greatly in controlling the excessive secretion of saliva. On the tenth day many patients are able to take soft food. If the epiglottis has been removed fluid will flow readily through the wound cavity soaking the packing. This necessitates frequent change of dressing. As time passes the tendency of saliva and fluid to flow through the wound cavity becomes markedly less. If it is found that the patient cannot swallow satisfactorily the stomach tube must be employed. If a low tracheotomy has been done the tube may be removed and the wound allowed to heal, a large tube being introduced through the laryngectomy wound. The wound cavity closes rapidly and in two or three weeks packing may be discontinued and an *artificial larynx* (Fig. 191) inserted. This should be done before final contraction of the parts above the stump of the trachea occurs. The speech thus obtained is such as can be easily understood, though it is absolutely monotone. The vocalizing portion of the apparatus obstructs the breathing as soon as mucus collects upon it, and patients must be taught to remove it for purposes of cleansing. Without it, conversation can be carried on in a whisper, the consonant sounds being formed by the closing of the external opening and the forcing of the air through the pharyngeal, oral, and nasal cavities.

When eating, the patient replaces the vocalizing apparatus by an obturator which closes the upper or chimney portion of the artificial larynx (P. Bruns) and prevents food from being forced into the tube. He soon learns to substitute the base of the tongue for the removed epiglottis and dispenses with the obturator entirely.

Partial laryngectomy is treated along the same lines as the complete operation. Whether the tracheotomy tube can be left out entirely and the tracheal wound allowed to close must be

determined in the individual case. In extirpation of one-half of the larynx the voice may become almost normal owing to the tendency of the remaining vocal cord to go toward the median line and meet the cicatrical tissue following the extirpation.

Intubation of the Larynx (O'Dwyer).—This operation has largely replaced tracheotomy in cases of diphtheria. It is also employed in stenosis of the larynx from causes other than malignant disease. As in the case of tracheotomy, it should be per-

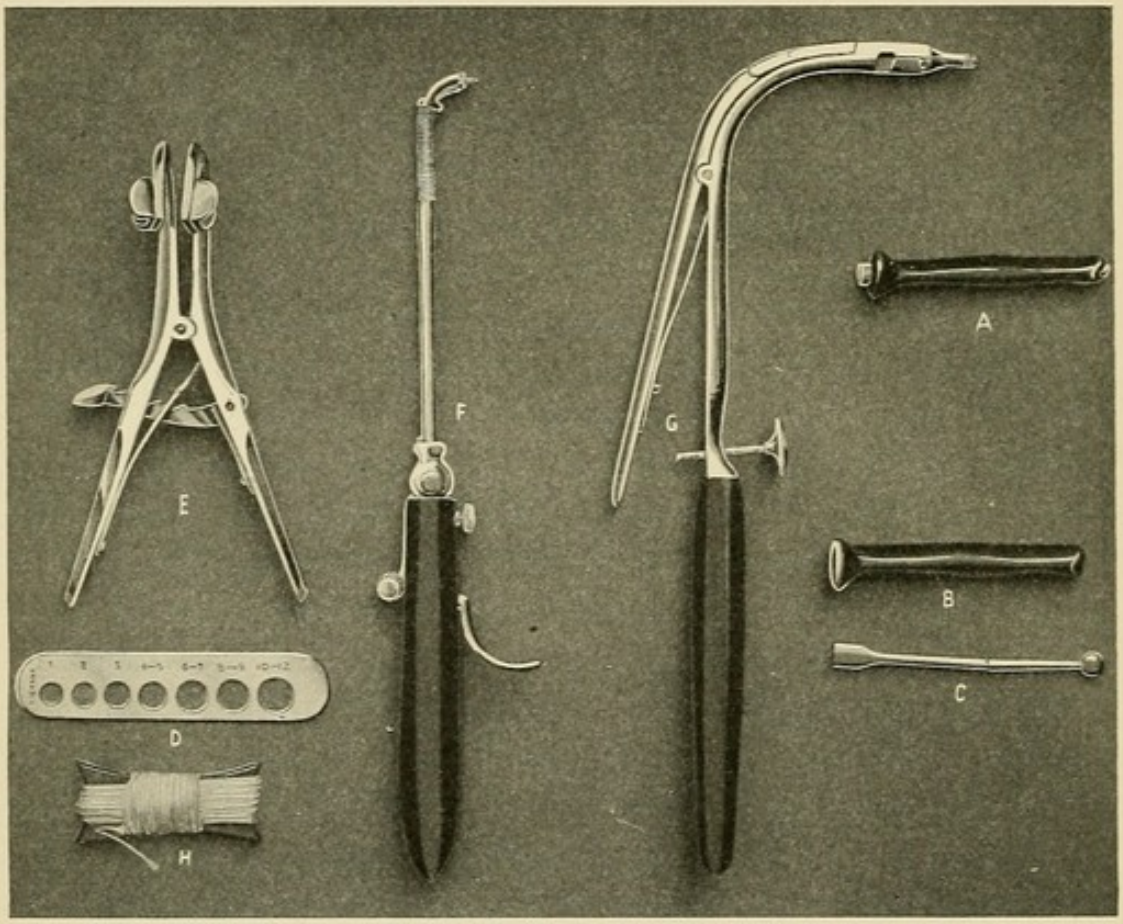


Fig. 190.—O'Dwyer's intubation instruments. A, Tube with obturator; B, tube; C, obturator; D, metal gauge; E, mouth-gag; F, introducer; G, extractor; H, silk cord. (Fowler's Surgery.)

formed early in order that the greatest benefit may be derived from its use. It has the disadvantage of requiring special instruments for its performance, whereas in tracheotomy the urgently demanded relief can be obtained by means of instruments usually at hand. This disadvantage is offset, however, by the fact that it entails neither loss of blood nor shock, and can be speedily performed.

The instruments as ordinarily supplied are (1) a set of tubes with obturators, adapted to the ages between one and twelve years; (2) a metal gauge to aid in the selection of the proper tube; (3) a mouth-gag; (4) a tube introducer; (5) a tube extractor (Fig. 190).

Operation.—The child is held upright on the lap of an attendant, with its head resting on the latter's left shoulder, so that the body, head, and neck are in a straight line. The arms are held securely against the patient's body. The mouth-gag is inserted in the left angle of the mouth as far back as possible between the teeth, and the latter forced apart as far as possible. The proper sized

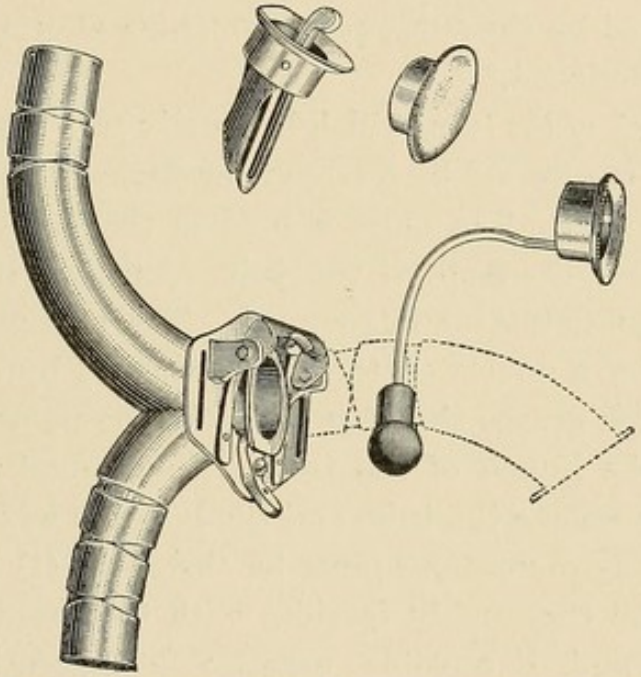


Fig. 191.—Park's modification of Gussenbauer's artificial larynx. (Fowler's Surgery.)

tube is attached to the introducer by its obturator, a piece of thread attached to the tube by passing it through a hole provided for the purpose, and the thread wound around the little finger of the right hand of the operator. This thread is to facilitate the immediate withdrawal of the tube should it become improperly lodged. The introducer is grasped in the right hand while the tip of the left index-finger is passed to the epiglottis, identifying it. The latter is raised so as to uncover the glottic opening and the tube is passed, guarded by the index-finger. As the tube glides over the now vertically placed epiglottis and enters

the glottis, the guiding index-finger is shifted posteriorly toward the pharyngeal wall, where it prevents the tube from slipping into the esophagus. The proper position of the tube being assured, it is at once driven home and at the same time released from its obturator and the introducer by pushing forward the slide on the latter with the thumb of the right hand. The introducer with the attached obturator is now withdrawn. The left index-finger then identifies the tube in position, and, if not placed well down in the glottic opening, it is pressed home by the same finger. The gag is then removed. If the breathing is relieved, the gag is again introduced and the tube steadied with the finger as before, while the thread is withdrawn. In case the tube is expelled by the subsequent coughing efforts, a larger one should be introduced.

The *removal of the tube*, which is usually safe after from three to nine days, is effected by a maneuver similar to that by which it was introduced. The child is held in the same manner, the gag introduced, the top of the tube identified by the index-finger, and the extractor introduced. The blades of the latter are released by a device on the shank worked by the thumb of the hand which grasps the instrument as the point of the latter passes into the lumen of the tube. The spread-out blades of the extractor engage the tube and the latter is withdrawn.

The following *precautions* must be observed: (1) The operator should become thoroughly familiar with the mechanism of the instruments, and, if possible, practise the operation upon the cadaver; (2) the finger should not be held too long over the glottis lest suffocation take place.

The *dangers* of the operation are the following: (1) Membrane may be pushed ahead of the tube and produce obstruction. This will necessitate withdrawing the tube immediately and waiting until the loosened membrane has been expelled before reintroducing it. (2) Failure to remove the thread may lead to the swallowing of the latter, followed by the tube itself. Should this occur, another tube must be introduced at once. The swallowed tube will be expelled with the bowel movements.

Following intubation if a string is left attached to tube, the child's hands are fastened so that the tube cannot be withdrawn.

The child should be watched for an hour or so to see that the tube is not coughed up. The tube should be changed on the third or fourth day but is not to be replaced oftener than necessary. Some recommend leaving it in place a week before changing. The main problem is the feeding. O'Dwyer recommended placing the patient in a horizontal position with head hanging over the knee, or edge of table, and feeding fluids or semi-solids with a spoon. However, many now feed their patients in the upright position from the beginning, and although at first this causes coughing, in a few hours the children become accustomed to the tube and swallow without any difficulty whatever.

Feeding through a catheter passed through the nose or mouth into the esophagus is now seldom practised.

Pharyngotomy.—The same rules apply as in operations upon the mouth. Preliminary tracheotomy may have been performed. In case of extirpation of tumors of the pharynx or epiglottis the wound is closed as much as possible and packed; if large defects of the mucous membrane are present the tampon is left undisturbed for from five to seven days unless soiled. The external dressing is changed frequently. If infection occurs the packing is removed and the wound frequently irrigated with a mild alkaline solution. Resulting fistulæ are closed by secondary operations. The patient is nourished by tube until he is able to swallow, usually for four or five days. After five days granulations have sprung up in the wound and infection of the para-esophageal tissues is no longer feared. The mouth is kept scrupulously clean.

Operations upon the Esophagus.—The conditions calling for operation have usually resulted in emaciation and extreme weakness before operation is resorted to. Rectal feeding and the administration of saline by rectum or by hypodermoclysis is therefore a requisite to success.

Esophagotomy (for foreign bodies).—The patient is fed twice daily for six days using a small stomach tube, directed as far as possible away from the line of suture. On the second day small sips of hot water may be taken at long intervals. On the third day the intervals are shorter and on the fourth day if there has been no leakage small sips of other sterile fluids are

allowed. Large swallows must not be taken before the tenth day. Thereafter solid feeding is gradually instituted. Wound treatment differs whether the external wound is sutured or not. If unsutured the tamponade is left undisturbed for four days when if there has been no leakage or infection the wound is sutured or strapped. If sutured except for the emergence of a small drain this is removed at the end of twenty-four hours. External dressings are changed as frequently as soiled by vomitus or discharge. Esophageal fistula if persistent requires secondary plastic operation. The occurrence of fistula calls for cleaning of the wound by frequent irrigation, frequent change of dressing and tube feeding.

Excision of Esophageal Diverticula.—The treatment is similar to esophagotomy for foreign body.

Esophagectomy.—The principal dangers are *sepsis* occurring in the peri-esophageal tissues and secondary *hemorrhage.* The prognosis is serious, especially so if infection is already present. Infection may travel to the mediastinum or pleura or general sepsis may occur. The wound in the esophagus is completely closed if there is no nearby infection. The entire wound may be closed; if infection is present, however, the outer layers of the wound are not closed but the wound is tamponed down to the line of sutures in the esophagus. Such a wound is closed by secondary suturing as soon as infection has subsided. Feeding is conducted as following esophagotomy. Solid food should not be allowed for fourteen days, or until the healing of the esophageal wound is complete. After esophagectomy for carcinoma accurate suturing is impossible; the lower end of the esophagus may be either partially or completely sutured in the wound as near as possible to the upper end. A stomach tube is introduced through the wound and the wound tamponed. The care of the wound is as outlined in fistula following esophagotomy. A secondary operation may be necessary to close the fistula.

Stricture caused by cicatricial contraction of the esophageal wound is rare. Should it occur it must be treated by the passage of bougies. *Secondory hemorrhage* may result from the erosion of a vessel by sepsis; the hemorrhage is usually from the inferior thyroid artery. Cases complicated by septic processes

must be watched for the occurrence of hemorrhage and the attendant should be instructed to immediately open the wound and apply digital pressure; subsequently the inferior thyroid artery is ligated.

External or internal esophagotomy done for stricture must be followed by months of methodical dilatation by bougies. In case of internal esophagotomy soft bougies only should be used following the operation as there is some danger of perforation of the esophagus.

Operations Upon the Thyroid Gland. *The Primary Dressing.*—The primary dressing should be applied as for all operations on the neck requiring extensive dissection. In addition a loosely rolled compress, four inches in length by one in thickness, should be placed to either side of the trachea on the skin, to exert slight lateral pressure. In case of scabbard trachea the retaining bandage should be reinforced by a sufficient number of turns of a plaster-of-Paris or starch bandage to ensure the retention of the neck in a straight position, otherwise the turning of the head might interfere seriously with respiration. The fixation bandage should be so placed as to allow of ready access to the wound. In exophthalmic cases the dressing should consist of an abundance of fluffed-out gauze loosely applied and loosely bandaged in place to provide ready absorption of the discharge.

General Rules.—The patient is placed in bed in the elevated head and trunk position to lessen the amount of oozing and the possibility of secondary hemorrhage. The degree of elevation will depend upon the amount of shock. Murphy proctoclysis is given in all cases. It is particularly indicated in cases which have lost considerable blood and in exophthalmic cases. *In exophthalmic* cases it is imperative that the tissues get water to combat the effect of the hyperthyroidism set up by the operation. In these cases it is well to give a hypodermoclysis of 500 to 750 c.c. immediately after the operation. In case Murphy proctoclysis is not retained on account of intestinal relaxation, repeated hypodermoclysis should be used (250 to 500 c.c. every three hours). All cases are given fluids by mouth as soon as anesthetic vomiting has ceased and a return made to normal diet as quickly as the stomach will tolerate it. As soon as the patient

is strong enough, usually at the end of twenty-four hours, the head of the bed is lowered and the patient given a back rest. At the end of the second twenty-four hours the patient is allowed out of bed in a chair and at the end of the third twenty-four hours may walk about if so inclined. In *exophthalmic* cases the course is not so rapid. There is usually some rise in temperature for the first three days and in the bad cases some acceleration of pulse. The patient also complains of headache, is restless, and the sleep is interfered with. Drugs have little if any influence unless the cause is neurotic when morphia will aid in controlling the restlessness. Usually the cause is not free enough drainage or absorption of thyroid secretion in spite of free drainage. The treatment is first to see that free drainage exists and in addition to force the ingestion of water. The Murphy proctoclysis is given as fast as it can be absorbed and if the symptoms persist hypodermoclysis is added, 750 to 1000 c.c. being given at first and 250 to 500 c.c. at four hour intervals. In exophthalmic cases also all sources of irritation should be avoided. If symptoms of hyperthyroidism develop the patient should be placed in a separate quiet room with special attendants. In these cases the entire problem resolves itself into free drainage and dilution of the toxins.

Care of the Wound.—There is a rise of temperature for the first few days. This is due to traumatism to the remaining portion of the gland incidental to the operation, and absorption of wound secretion. It need occasion no alarm in any save the exophthalmic cases. In other than exophthalmic cases packing used to control oozing or drains are removed at the end of forty-eight hours and a small drainage strip introduced. This is renewed every forty-eight hours as long as drainage continues. The character of the drainage will be straw-colored serum, becoming somewhat gelatinous as the amount decreases. Sutures are removed on the fifth day. In exophthalmic cases the dressing, except the drains, should be removed as frequently as soiled and dry fluffed out gauze loosely applied. It is important that the gauze quickly absorbs the secretion and thus aids the drains. The drains themselves (glass spools with gauze and green silk protective strip) are removed on the fourth day or as soon there-

after as the lessening of the amount of drainage permits. As long as they drain they are not disturbed. Upon their removal green silk protective strips are substituted. These are renewed every forty-eight hours until all drainage ceases. In removing the original drain, the glass spool is first removed and on the following day the gauze and green silk protective drain. If any retention of secretion occurs the drain is to be immediately removed and a tube drain inserted. If in spite of this symptoms of hyperthyroidism persist the wound is to be opened sufficiently to ensure free drainage.

Secondary Hemorrhage.—This should be a rare complication if the operation has been properly planned, *i.e.*, if the thyroid vessels have been ligated as the first step in the operation and if all minute bleeding points have been secured by ligature or circumsuture. Its occurrence necessitates tamponade of the wound for forty-eight hours. The tamponade should be carefully removed and renewed to avoid recurrence of the bleeding.

Disturbances of Respiration.—These may be due to *tracheitis* from pulling upon the trachea in the course of the operation; to *edema* of the trachea from sudden removal of the pressure in *scabbard trachea;* to *collapse* of the trachea following removal of pressure in *scabbard trachea;* to *occlusion* of the trachea from sudden turning of the neck in *scabbard trachea;* to *injury* to the *recurrent laryngeal* nerve causing paralysis of the corresponding *vocal cord* resulting in *aphonia, weakened voice,* or *foreign body pneumonia; bilateral injury to the recurrent laryngeal* resulting in asphyxia. These complications are almost always preventable; gentleness in manipulation, maintenance of the head in the position in which breathing is easiest in scabbard trachea, leaving the posterior portion of the capsule intact to avoid injury to the recurrent laryngeal. In regard to *laryngeal paralysis* the nerve may have been pressed upon by the enlarged thyroid and hoarseness and possibly aphonia been present before the operation. If the pressure has not been too long continued the symptoms will gradually disappear following relief of the pressure. Paralysis and collapse of the corresponding vocal cord will follow injury to the nerve, while if both nerves are injured bilateral paralysis will result and death from asphyxia follow unless the

condition is promptly recognized and tracheotomy performed. The injury to the nerve may be by section, clamp, ligature or traction in dislocating the enlarged lower lobe.

If due to clamp, ligature or traction the resulting hoarseness will gradually disappear as the nerve resumes its function. Months may elapse before this occurs. Even if the nerve has been completely sectioned with resulting weak and hoarse voice the condition will improve very materially for in time the opposite vocal cord encroaches on the paralyzed cord and so lessens the gap between the two. Suture of the cut nerve has been performed with resultant restoration of function. Care in swallowing must be exercised as a foreign-body pneumonia is apt to ensue. If these patients temporarily cannot swallow as occasionally occurs nourishment is given by stomach tube. In scabbard trachea discomfort due to the distortion of the trachea will persist for some time.

After Care of Enucleation of Thyroid Tumors (adenomata and cysts).—The wound is drained and a copious dressing applied. In this and in similar operations involving more or less traumatism to the substance of the gland, in spite of most careful hemostasis during the operation oozing will follow. If more severe hemorrhage occurs, perhaps caused by post-anesthetic vomiting, the blood will first fill the cavity in the gland from which the tumor has been removed and, if drainage is not free, will then extend beneath the deep fascia. In the latter event there will be danger of asphyxia. Treatment consists of the removal of a sufficient number of the sutures to permit the free escape of the effused blood.

Escape of gland secretion may occur in cases in which there is much tearing of the gland tissue. The secretion escapes into the tissues of the neck and forms a soft swelling in and around the gland if drainage is inefficient. If rapidly absorbed, symptoms of acute thyroidism will appear. The treatment is to open the wound and provide efficient drainage.

Complications due to Interference with the Function of the Thyroid and Parathyroid Bodies. *Tetany.*—Fortunately this complication is rarely seen at the present time; formerly it was a common complication following thyroidectomy and was

thought to be due to the removal of the entire gland; but now it is known to follow only, and not necessarily always, the removal of the parathyroid bodies.

When this fact became recognized the technic of thyroidectomy was improved to safeguard the parathyroids by leaving the outer and posterior portion of the capsule. According to the latest statistics the complication now occurs in less than one-half of one per cent. of cases; even this for a preventable complication would seem high.

Tetany first makes its appearance a few days following the operation. The first symptoms usually appear in the upper extremities; a tingling or twitching of the muscles may be first noted, convulsive seizures follow, the fingers are first flexed and then rigidly contracted; the wrist and elbow are flexed and the knee and hip extended. The feet are in plantar flexion and supinated. The muscular contractures are tonic, continue for a variable length of time, and recur at intervals. The muscles of the face and neck may become involved. Formerly in about 60 per cent. of the cases death followed in a few days. The diaphragmatic muscles are at times involved. The onset of this complication sometimes occurs at the end of weeks or months following the operation. If the patient survives the first few days the tetany may rapidly subside after a duration of eight to fifteen days; in some cases it is prolonged for months and years with remissions. Finally death results from respiratory paralysis. Occasionally a case will recover.

Treatment.—As soon as the first symptoms appear the patient should be given parathyroid gland extracts; the diet should be light and low in nitrogen. Elimination should be increased by active stimulation of excretion through the skin, bowel and kidneys. Saline infusion is useful in diluting the toxemia and increasing the elimination. Transfusion will temporarily check the symptoms. Intravenous saline infusion acts in the same manner. Feeding with parathyroid glands and injection or parathyroid emulsion temporarily and often rapidly stops the symptoms. Following any of these methods the symptoms may be held in abeyance for twenty-four hours. The use of these measures, however, will probably not prove of any permanent

value should all of the parathyroids have been removed, but if, as is conceivable, one or more of the parathyroids were removed and the remaining ones traumatized during the operation, then, in the event of the development of tetany, the above mentioned measures would be of extreme value in tiding the patient over until the traumatized parathyroids resumed their function.

Beebe's nucleo-proteid is of value particularly when combined with parathyroid feeding; fresh ox parathyroids are used. The administration of soluble calcium salts will quickly stop severe tetanic symptoms. In a case of Halstead's in which the administration of parathyroid gland extracts had averted tetany for two years, the attacks were also averted during the third year by the use of calcium salts.

Experimental transplantation of parathyroids in animals has proved successful in about 60 per cent. of cases according to Halstead. In some of his experiments a beginning tetany was tided over by the administration of *calcium salts*. Eiselsberg transplanted a parathyroid in a woman who had suffered for many years from severe tetany following parathyroid extirpation. In Kocher's experiments transplantations into the tibia are made in two stages; first the tibia is opened and a small cavity made by forcing a silver ball into the marrow; the wound is then closed. After several days when granulations have formed the silver ball is removed and fresh gland tissue implanted in the resulting cavity. In this manner interference by hemorrhage is avoided. Kocher found that this method proved efficacious in dogs. One of his most interesting observations is that resection of the bone containing the implanted tissue quickly caused death from acute tetany.

Myxedema (cachexia strumipriva) develops slowly and for this reason seldom comes under the notice of the surgeon as the case has long since passed from under his observation. Only rarely does an acute myxedema develop. Usually it is months before the disease is noticed. The most marked early symptom is increasing anemia. Gradually all parts of the body become affected. The skin is at first waxy and pale; later, owing to the almost complete inhibition of the sweat and sebaceous glands the skin becomes dry and fissured. Following this the skin be-

comes thick and brawny due to an edema which affects the entire body; this edema is general and does not pit upon pressure. It has no resemblance to nephritic edema and cannot be massaged away. The hair, particularly of the head and pubes, falls out. A curious fact in this connection is the growth of coarse hair in parts of the body which are normally free from hair. The body temperature is lowered, the skin is cool. In the majority of cases the pulse is slowed, though in rare instances it may be increased. The amount of urine is diminished and its specific gravity is below normal. More marked even than the bodily changes is the change in mentality. Slowly but steadily the intelligence of these unfortunate patients disappears; the speech becomes slow and stuttering; movements become uncertain; memory is lost; the features are dull and apathetic. The process is a slow one and may continue for years, the patient finally dying from gradually increasing cachexia.

Cases in which an accessory thyroid is present or in which a portion of the thyroid is left may present the early symptoms of myxedema but upon the hypertrophy of the remaining thyroid tissue these symptoms will gradually disappear.

Treatment. Thyroid Therapy.—Malignant disease constitutes the sole indication for the entire removal of the thyroid gland. Such cases, and in cases in which but a small portion of the gland has been left, are to be watched carefully. In the first instance it is better to begin thyroid feeding at once; in the second as soon as it becomes apparent that the amount of thyroid tissue remaining will not be hypertrophied sufficiently to provide the secretion necessary for metabolism. By means of thyroid feeding, we may hope to avert indefinitely the changes which inevitably follow the removal of all thyroid tissue. In many cases this treatment will prove successful. In cases in which symptoms of myxedema have already appeared feeding will prevent an increase of the symptoms and cause their gradual disappearance. The secretions become normal, there is an increase in weight and the mentality is improved. The final condition of the patient becomes quite normal. Whether this is true in every case it is impossible to state at the present time. The treatment must be continued indefinitely. At

intervals of weeks or months the treatment may be discontinued for a time if there are no symptoms in order to determine if hypertrophy of remaining thyroid tissue or accessory gland has occurred. Upon the occurrence of any symptoms treatment is to be immediately begun. Chloral hydrate is a useful adjunct to thyroid feeding. The implantation of normal thyroid tissue is the ideal treatment but naturally presents great obstacles. The conditions necessary for success are, a fresh portion of active gland and a favorable implantation soil (Kocher). *Administration of thyroid preparation.* As the secretion of the thyroid gland in large doses is a powerful poison, care must be exercised in its administration. The dosage must be determined in the individual case. The fresh gland was formerly given twice a week, one-half a sheep thyroid at a dose, cut up raw and spread on bread. This was made more palatable by the addition of a little pepper and salt. At the present day a dried extract of the gland is prepared in tablet form. Each tablet represents five grains of the dried gland. The dose of this dried extract is one tablet given after a full meal once a day for several days; if no bad symptoms are noted a tablet may be given twice a day. The number may subsequently be increased to from three to five tablets a day. The actual strength of the extract varies according to its manufacture. A more staple preparation is thyroiodin (three grains of iodin and one grain of the dried gland) or thyroid colloid, the active principle of the thyroid gland. The dose of the latter is one-half to one grain but it is better to begin with the smaller dose and test the tolerance of the patient before giving larger doses. Should an overdose be given very alarming symptoms will arise. A single dose may prove too large or a series of moderate doses may prove cumulative. Acute thyroidism will develop. The temperature rises rapidly, the pulse becomes rapid, small and irregular; there is headache, vertigo, nausea, pains in the joints and muscular tremors. Upon the appearance of these symptoms the drug is to be discontinued at once.

Torticollis.—Irrespective of the character of the operation, whether on muscles and fascia or nerves or both, a final cure will depend upon the after-treatment. At the operation the condi-

tion is remedied, the position of the head overcorrected and a well-padded plaster-of-Paris splint applied.

If the deformity has not long been present and consequently but slight organic change in the muscles and fascia has taken place the plaster may be omitted and the proper position maintained by sandbags for seven to ten days when the sutures are removed. In such cases apparatus may be dispensed with and passive and active motion and manipulation be commenced. Usually this is sufficient to effect a cure.

In cases of longer standing and in young children a head extension is applied, a weight of three to five pounds being usually sufficient, and the head of the bed raised sufficiently high to cause the body to form the counterextension. The head is fixed by sandbags placed to either side. This position is maintained for two to three weeks. If the patient is restless it will be necessary to apply a molded plaster splint to the head, neck and shoulders. In the mild cases two or three weeks extension is sufficient and manipulation and passive and active motion may then be commenced.

In the more severe cases after removal of the plaster splints, in addition to massage and passive and active motion, a Sayre apparatus should be applied. This consists of two circlets, one for the head and one for the chest, connected by a stout rubber band one end of which is attached to the head circlet close to the mastoid process on the sound side, the other end attached to the chest circlet close to the anterior axillary fold on the same side. This maintains a constant elastic pull against the deformity. It may be necessary to carry out the treatment for several months. Upon final removal of the apparatus, regular calisthenic exercises (not violent exercises) should be instituted. These directions will be better followed out if the patient attends a gymnasium.

If the case is one of spastic torticollis it will be more difficult to maintain the head in proper position. In such cases it is better to apply the molded plaster splints under anesthesia directly after the operation and after several weeks to employ Sayre's apparatus.

CHAPTER XV.

OPERATIONS UPON THE THORAX.

Typical Operation for Carcinoma Mammæ. *Retentive and Supporting Dressing.*—In dressing such an extensive wound as that following typical excision of the breast, pectoralis major and minor, and removal of the glands and fatty tissue of the axillary and supraclavicular spaces, great difficulty is met with. But this may be overcome with the dexterity coming from practicing this as well as other dressings and bandages upon the model. The chief difficulty met with in dressing a wound the result of an extensive operation for carcinoma mammæ lies in obliterating the large dead spaces, supporting and relieving the tension on the skin flaps, and immobilizing the arm and shoulder of the affected side. If loosely applied the dressing does not fulfil these indications. If tightly applied, respiration is embarrassed or a mastitis of the remaining breast may result. A dressing which exerts slight, constant elastic pressure is an ideal one. The choice of a retentive dressing is between bandages and the breast binder. In any event the shoulders and upper half of the abdomen should be included. The material employed should be unbleached muslin. Bandages are objectionable as a rule for the primary dressing, for they require an amount of shifting of the patient which is arduous, particularly if the patient be a heavy individual. Moreover, they cannot be made to fit snugly nor exert even pressure while the patient is in the semi-unconscious state of anesthesia. Bandaging may be used, however, at subsequent dressings when the movements of the patient can be better controlled. If used for the primary dressing, the chest and abdominal turns should be applied with the patient in the dorsal position. For the shoulder and arm turns the shoulders are to be elevated. To facilitate bandaging, the Volkmann block may be employed with advantage.

A breast binder will be found to better comply with the indications. One that will fit the patient is selected and sterilized with the wound dressings.

Primary Wound Dressing.—Plain gauze compresses in a dry state are shaken out, and with the patient's arm abducted to twenty degrees, are packed closely in the apex of the axilla and between the abducted arm and the lateral chest wall, so as to fill the space between the abducted arm and the chest down to the level of the lower third of the upper arm. The suture line is covered with compresses folded flat, care being taken that the ends of the sutures lie flat against the skin, to guard against irritation from this source. If much tension exists, the flaps may be further supported by broad adhesive plaster straps. Flat layers of gauze cover the chest wall, shoulder and upper arm of the affected side. Over all and in the axilla of the opposite side is placed a thick even layer of non-absorbent cotton. This latter not only protects the parts, but aids in exerting the elastic pressure necessary. During the manipulations incident to the application of the dressing, one assistant should devote his entire attention to keeping the axillary pack in position by controlling the movement of the partially abducted arm.

Application of the Binder.—The body of the binder is placed beneath the patient and the lateral edges brought to the median line in front, where they are pinned temporarily. The shoulder piece of the unoperated side is fitted and pinned temporarily, then the long shoulder piece of the affected side is brought over the shoulder, down the front of the binder, between the abducted arm and the lower lateral chest wall and carried smoothly up over the posterior surface of the binder to its starting point. The opposite shoulder strap is then fastened. The temporary pins are now removed and the remaining breast supported and held flat against the chest wall while the front of the binder is snugly pinned. The forearm of the affected side is secured by a sling fastened to the binder. Before applying this the circulation is supported by bandaging the hand, wrist and forearm as far as the elbow. When the patient has been placed in bed, soft pillows support the shoulder and the arm of the operated side.

Primary Complications.—More or less discomfort is incident to the first twenty-four hours. This will lessen as the pain from the traumatism of the operation subsides. *Venous congestion* of the extremity may result if the dressing has been inefficiently applied,

or if lateral branches of the axillary vein have been tied close to the vein, or if a lateral ligation of the axillary or subclavian vein has been necessary. Associated with congestion there is decided pain along the arm. If congestion and pain persist, the binder may be slightly loosened. *Edema* may develop as a result of continued pressure, or in the cases in which ligation of the axillary or subclavian vein has been necessitated by cancerous growth involving the vessel wall. If due to continued pressure, the binder is still further loosened, and the hand and forearm rebandaged. If due to ligation, the condition may be alleviated by supporting bandages and massage. Massage, except for the hand and forearm, must not be instituted while there is any danger of disturbing the process of wound healing. *Soreness of the Opposite Axilla.*—The secretions of the hair and sweat follicles of the healthy side may collect under the protecting cotton and not only cause local irritation, but, theoretically at least, lead to infection of the wound by the bacillus pyocyaneus, whose normal habitat is in the axilla. This is prevented by daily cleansing of the axilla without disturbing the binder.

Mastitis of the remaining breast is an occasional complication. It is due to traumatism from badly fitting dressings. The treatment is support of the breast and application of atropin-glycerin solution. Later very gentle massage is of value.

Disturbance of Drainage.—If drainage has been employed, the tube or gauze drain is usually brought out through a supplementary opening. Its presence serves to prevent collections of serum from forming, but this is usually equally well done by the proper application of the primary dressing without the disadvantage possessed by the tube or gauze drain. The drain is removed at the end of forty-eight hours. In the event of palpable wound infection, such as broken-down axillary glands, drainage is necessary. Its use in such cases must be prolonged until infection subsides. *Redressing.*—After seventy-two hours the binder may be loosened and movements of the elbow encouraged. This also allows of slight movements of the shoulder but not enough to interfere with wound healing. The wound dressing is not to be disturbed, except as noted above or to meet complications which may arise in any wound, infection, until

the tenth day. The binder and the entire dressing are carefully removed, the arm being supported by an assistant, the patient sitting. The sutures are removed. The skin of the axilla and those parts which have been covered by the dressing is sponged with alcohol and dried, with the exception of the skin in immediate proximity to the wound. This sponging proves particularly grateful to patients and adds greatly to their comfort. The tender cicatrix is supported by strapping and a flat gauze dressing applied. A fresh binder is applied but the arm is placed outside the binder and a separate dressing applied to the scar on the arm. This allows of free shoulder movements. The forearm is supported by a sling. Small granulating surfaces the result of imperfect wound approximation are treated. Surfaces the result of separation of the wound edges due to tension of the flaps are covered with Thiersch *skin-grafts* if this was not done at the time of the operation. In uncomplicated cases healing is complete on the fourteenth day. *Wound complications* are those common to all wounds. One would expect with such an extensive wound complications in the healing process, but under aseptic technic such occurrences are extremely rare. The *bacillus pyocyaneus,* whose natural habitat is the axilla and the groin, is so easily destroyed by the ordinary disinfection by bichlorid of mercury that it rarely infects the wound. Should infection occur it is to be combated by the usual means.

General Care of the Patient.—The patient may be allowed to sit up in bed on the first or second day following the operation, allowed in a chair on the third or fourth day, and on the day following to walk about. Movements of the fingers, hand and wrist are encouraged after forty-eight hours and movements of the elbow after seventy-two hours. Slight shoulder movements are encouraged at the same time. Following removal of the sutures passive and active movements of the shoulder are instituted so that by the twenty-first day patients are able to place the palm of the hand on the top of the head. It is advisable in hard-working patients, or those with a gouty diathesis, to prescribe daily massage of the fingers throughout this period.

Contraction of the Cicatrix.—After the second week contraction of the scar tissue begins to be manifest. It must be remembered

that in such an operation as we have under consideration there has been a considerable loss of muscular substance. This does not mean that the movements of the shoulder and arm will be interfered with as regards range of motion, for the deltoid and coraco-brachialis muscles take upon themselves the drawing of the arm forward and inward, movements in which before removal of the pectoralis major they served to assist that muscle, but the strength of these movements is largely impaired at first. A compensating hypertrophy later takes place, which materially decreases the loss of power in these movements. The primary disability of the arm does not depend upon this, however, but upon the cicatrix, which may prevent abduction, and it is important at the time of operation that the incision should be so placed as to interfere subsequently as little as possible with abduction of the arm. The abducted position of the arm, as described in the primary dressing, still further guards against disability from this source. To still further obviate this contraction, early use of the arm is to be insisted on. An additional cause of disability is found in the adhesions formed in the axilla by the removal of the glands and fatty tissue therefrom. These adhesions, by subsequent contraction, may cause *edema* if the vein is involved, or a very *painful condition* of the arm if the brachial plexus is involved. If suppuration has intervened, disability from contraction will be more marked. On the removal of the sutures gentle *passive motion* is to be instituted, and gradually increased and supplemented by active movements of the arm. The final condition of the patient in cases in which the after-treatment has been rigidly enforced may be such as to show no loss of motion and but slight loss of power. If, however, a large amount of scar tissue has formed, the outlook is not so favorable. The edema and pain produced by scar formation and contraction in the axilla may be such as to demand excision of the mass of scar tissue, or this failing, even amputation of the arm.

Lymphatic Edema.—On account of the removal of the lymphatic glands in the axilla, there may follow a condition of lymphostasis in the arm. This occurs independently of any compression of the axillary vein. A condition of the skin may ensue similar to that found in elephantiasis. Bandaging and massage,

usually cause its subsidence; if not, lymphangioplasty may be done.

Keloid.—This affection of the scar is particularly prone to occur after operation upon the chest wall.

Recurrence.—Recurrence of the disease is to be carefully watched for. It may occur at any time, from a few weeks to many years. During the first six months the patient should be examined monthly, after this every two months for a considerable time, and finally should be instructed to report immediately on any untoward general symptoms or upon the growth of any nodule in the scar or elsewhere. Local recurrences are to be extirpated without delay and as often as they recur. General metastasis is to be treated by measures calculated to alleviate as far as possible the condition of the patient.

Amputation of the Breast.—As the dissection here is not extensive and the flaps ample it is not necessary to immobilize the shoulder of the affected side. Flat gauze compresses with broad straps of adhesive plaster to exert even pressure form the primary wound dressing. A snug fitting breast binder serves to support the remaining breast. The arm of the operated side is carried in a sling.

Resection of the Breast.—When a segment of the breast is removed or a tumor enucleated the resulting cavity must be obliterated by pressure. To accomplish this flat gauze compresses are laid about the breast and built up to exert even pressure. These are held in place by adhesive plaster straps and a very snug-fitting breast binder applied. The arm is supported by a sling.

Suppurative Mastitis.—If the disease has involved most of the breast tissue (multiple abscesses), amputation will probably have been performed. In such a case, if the incision has been wide of infected tissue, primary union will result. If it has been impossible to keep entirely clear of the infected area, the wound will have been closed in part only and secondary suturing will be necessary. If only a segment of the breast is involved (simple abscess or submammary abscess), the treatment will be as for abscess. If radiating incisions have been practised for multiple abscess, rigorous disinfection must be done daily,

and unopened pus foci continually sought for and drained. Cavities should be irrigated with a mild antiseptic solution, dried, Bier's hyperemia applied for five to fifteen minutes, the cavities again dried and filled with balsam of Peru and olive oil. The incisions are kept wide open by packing or soft drainage tubes and an absorbent gauze dressing applied. The breast is supported but pressure is contraindicated during the height of the infection. The dressing is repeated frequently enough to avoid stagnation of secretions. A culture should be made at the time of operation and a vaccine prepared and administered. The after-course is usually tedious. Abscess usually occurs during lactation. If the abscess is small the child may nurse from the other breast. If multiple abscesses are present the process of lactation should be stopped.

Lacteal fistula may persist on account of the presence of pus and infected granulations. Thorough curetting and repeated cauterization with silver nitrate will effect a cure.

Should the condition of *multiple mammary fistulæ* be present, in which, through neglect early in the case, multiple foci of suppuration have formed and the function of the gland is practically destroyed by cicatricial contraction and obliteration of the lactiferous ducts and acini, and in which the fear of supervention of fibrous carcinoma (scirrhus) may be reasonably entertained, extirpation of the mamma is to be resorted to.

Subpectoral Abscess.—The after-treatment is particularly wearisome. Tuberculous infection is usually the cause. Such abscesses, to be cured, must not only be incised and curetted, but all infected tissue must be removed; otherwise a long-continued process of suppuration will follow, resulting in the formation of extensive scar tissue, the subsequent contraction of which greatly disables the arm. If such an abscess has opened spontaneously or has been inadequately incised under a mistaken idea that a cure will result, it is necessary to make a free incision and follow up and dissect out all of the sinus and the scar tissue. Passive and active motion should begin on the third day following operation and must be continued conscientiously if a favorable result is to be hoped for.

Fracture of Ribs.—A supporting dressing of adhesive plaster

is applied, extending slightly beyond the middle line in front and back and a chest bandage applied. The progress of healing depends upon the existence of other complicating injuries, particularly injuries to the lung. Such complications may demand operative treatment. The stabbing pains produced by the respiratory movements of the chest wall are remedied by the restraining effect of the adhesive plaster dressing. The dorsal position may not be tolerable, and a semi-reclining position may have to be maintained. The ice-bag will serve to relieve excessive pain. If cough is persistent, some preparation of opium should be used to control it. Usually the healing process is uneventful. Union is complete in from fourteen to eighteen days, and the dressing may then be removed. If a floating rib has been fractured, and this is rare, union will in all probability not result. In such a case if pain persists, the distal portion or, in fact, most of the rib may be excised.

Resection of the Ribs.—The retentive dressing is the same as for fracture of the ribs. The danger of dislocation of severed bone surfaces is not to be apprehended. These surfaces approach each other somewhat. If the operation has been a superiosteal one, new bone will fill the intervening space and even bridges over to the adjoining ribs. No functional defect will result unless a considerable extent of several ribs has been removed.

Resection of the Sternum.—Mediastinitis may complicate this operation as a result of infection at the operation or at subsequent dressing.

In rib or sternal resection if performed for caries a *fistula* is likely to result. Infection from caries may follow the course of the rib and an abscess point at some distance from the original site of the primary disease. The site of the primary focus on the inner aspect of the rib may render the search for it difficult.

Treatment.—The usual treatment for fistulæ by curettage and the injection of antiseptics does little good in such cases. Spontaneous closure, if it occurs at all, takes place only after a long period and following the discharge of carious bone or the healing in of the diseased portion. Temporary closure may occur from time to time. The only rational treatment is freely opening the irregular sinuses and tracing them to their source. The deeply

situated focus of disease must be actually seen in order to remove it thoroughly. Such wounds are packed and allowed to heal by granulation.

Pleuritis may complicate operations on the soft or bony parts of the chest wall if such wounds become infected, particularly if the pleura has been opened at the time of operation, either accidentally or otherwise. *Pericarditis* may also result. Should fever persist after an operation of this character, such complications are to be thought of.

Paracentesis Thoracis.—In large effusions the intercostal spaces are usually prominent and the puncture is easily made. The index-finger of the left hand is pressed in the intercostal space selected (usually one just below and in a line with the angle of the scapula), and the point of the needle is brought in contact with the skin and at right angles to the ribs. The pressure of the finger in the intercostal space in the neighborhood of the needle-point prevents deviation of the needle if the patient should involuntarily move as the needle enters the skin. If this is not done, involuntary movement of the patient may cause the point of the needle to strike a rib. Guarded by the forefinger lying along the needle the latter is thrust quickly into the chest for the required distance. If, by reason of the physical signs, a point for puncture is selected lower than the angle of the scapula—say, in the ninth or tenth intercostal space—the point of the needle should be directed obliquely upward in order to avoid injury to the diaphragm. In any event the point of the needle should first enter the chest close to the upper edge of a rib in order to avoid the intercostal artery. If it is desired to remove all of the fluid, this should be done slowly; otherwise circulatory disturbances may ensue as a result of the rapid relief of pressure on the heart and large vessels. These precautions are particularly necessary in left-sided effusions.

Complications Arising From Opening the Pleural Cavity.—Should the pleural cavity be accidentally opened, the aperture is immediately closed with the finger, and later by suturing or a gauze packing. The entrance of small quantities of air produces no disturbances of respiration, and the air is quickly absorbed. The entrance of a large amount of air produces symptoms of

acute pneumothorax. Such an accident may result disastrously in a few minutes. The opening must be immediately plugged, artificial respiration by the Meltzer method begun, cardiac and respiratory stimulants given, and oxygen administered. It is likely that the withdrawal of the air by an aspirating apparatus would be beneficial. If the patient survives the first shock of the entrance of a large amount of air, and no infection has occurred, recovery may prove uneventful, providing the opening can be hermetically sutured. If the opening is too large to close by suture, the wound may be filled with gauze, in which event the subsequent treatment will be as for empyema. Should pus enter the pleural sac, as for example during an operation for tuberculous disease of a rib with abscess formation, pleuritis is likely to follow. The characteristic hissing should be watched for whenever a wound is dressed which is in proximity to the pleura. *Healing Process in Wounds of the Pleura.*—Small wounds close in a few days. Larger tears heal by agglutination of the visceral and parietal pleuræ.

Serous Pleuritis.—Should this complication occur, paracentesis should be practised. The relief experienced will be immediate. If a small amount of fluid remains, this is quickly absorbed. The fluid may reaccumulate to a slight extent, as shown by the line of dulness the day following the paracentesis. This is only temporary. In most cases a single aspiration is sufficient for a cure. In a few cases two or more will be necessary.

Suppurative Pleuritis. Empyema Thoracic.—The after-treatment does not differ when simple incision is performed, or when one or more ribs are resected. *Drainage.*—It is presumed that the operation has completely emptied the pleural cavity of pus and masses of fibrous exudate. In very recent cases in children in which the lung completely expands at the time of operation, simply packing the wound with gauze may be sufficient. Such cases are rare. In most cases it will be necessary to employ a rubber drainage tube. There are many ways of arranging this tube. The tube may be slender, fenestrated, curved on itself, the coils held in place by strands of catgut, thus forming a mat which rests on the floor of the cavity, the proximal end

of the tube emerging from the opening; or it may be short and thick and simply serve to preserve an opening in the chest wall, through which the secretions may escape. Various other methods of placing the tube are used, but the above represent the two extremes. Care must be taken that the tube does not press upon the lung, or injury may result. The tube may be retained in place by passing a large safety-pin through its walls, but not through its lumen, close to the chest wall, and a piece of tape passed through the pin and fastened around the chest or to a piece of adhesive plaster. The tube at its entrance into the chest wall is surrounded with gauze. If the *pus be thin* and no fibrous deposits are present, the coiled tube or a tube which lies at the bottom of the cavity during the ordinary movements of the patient may be employed. The dressing around the tube is fastened in place by a chest binder, through which an opening has been provided for the emergence of the tube. To the chest tube a long tube is connected, the distal end of which is submerged in a bottle of bichlorid of mercury (1–1000) placed beside the bed. The respiratory movements of the affected lung or its fellow will cause the antiseptic solution to rise and fall in the tube, and this will aid in causing the pus to flow down the tube and into the solution, thus keeping the cavity thoroughly drained, and by keeping the chest dressing clean, allow of ready closure of the thoracic wound around the tube. The catgut on the coiled tube loosens in from three to six days and the tube may then be withdrawn by gentle traction, and if the discharge is profuse, be replaced by a short drainage tube. If the coiled tube has been properly arranged, the chest dressing will not need changing until the tube is changed.

If the *pus be thick or if fibrous deposits are present*, a thick-walled tube of large calibre will be used, which will project but slightly into the cavity. Such a tube may be sewn into the wound by stitches including its wall, but not encroaching on its lumen, or may be fastened by tapes as described above. A copious gauze dressing is applied to receive the discharges. *This dressing should be changed as frequently as soiled, and each renewal of dressing should be done with aseptic precautions.* This large tube may be connected with a bottle as described above. *Position of the*

Patient.—Such patients are not allowed to sit up for at least twenty-four hours. Indeed, they should resume the sitting position by degrees. These patients are, as a rule, emaciated by long illness. Their respiratory and circulatory apparatus have experienced a shock, and a sudden change in position may produce a severe and even fatal syncope. Even during the first few hours the head may be supported by a pillow. After the affect of the anesthetic has passed off, the head and trunk may be gradually elevated to ensure more efficient drainage by causing deeper respirations. The patient is encouraged to lie on the diseased side as much as possible and to assume such positions as will provide the most efficient drainage, in order to prevent stagnation of secretions. *Significance of Fever.*—Rise of temperature, if it occurs early in the first forty-eight hours following the operation, may be due to the supervention of pneumonia or the extension of latent or subsiding pneumonia. The history would lead us to expect such a complication. If pulmonary tuberculosis existed prior to the operation, an acute pneumonic process may be grafted on the already existing chronic one. By far the most common cause of fever, however, will be *stagnation of the secretions* or the presence of an undrained sacculation. This is to be avoided as outlined above. If, however, the thick pus refuses to flow from the tube, it will be necessary to employ *irrigation of the cavity.* An empyema should be kept as fresh and clean as an abscess occurring elsewhere. Well-placed drainage and a favorable position of the patient will usually accomplish this. Irrigation is only to be used in cases which refuse to drain by the ordinary methods. The temperature of the irrigating fluid should be 100° F. to avoid shock, and a sufficient amount of the fluid, at least one quart, employed to thoroughly cleanse the cavity. Solutions of carbolic or bichlorid of mercury are to be avoided. Normal saline solution or boro-salicylic acid solution may be employed. If masses of fibrinous exudate persist, they are to be removed by long-handled blunt forceps. Their disintegration may be facilitated by the use of small quantities of peroxid of hydrogen injected through the tube. If the fever is due to an undrained sacculation this may be opened by the

finger through the wound, or if this is impractical a second external opening may be made.

In case several *sacculations* or cavities are present these can be drained through separate tubes, or may be converted into one cavity. If drainage is properly provided for and if no complications such as pneumonia supervene, or if the case is not a tuberculous one, the temperature soon reaches normal. The amount of *shock* will depend upon the previous condition of the patient, the acuteness of the process, and somewhat upon the rapidity with which the cavity has been emptied. It will be greater in those cases in which irrigation has been used. It is to be looked for in all cases and combated by the usual means. *Hemorrhage* may occasionally occur from an improperly ligated intercostal artery in cases in which this has been unfortunately injured; rarely from the cavity itself unless extensive adhesions have been disturbed, either by manipulation or by too rapid emptying of the cavity. In the former case the bleeding vessel must be sought for and ligatured; in the latter, if excessive, the temporary closure of the opening in the chest wall will control the hemorrhage. This is affected by strapping a compress over the opening.

Emphysema of the Subcutaneous Tissues may occur if the dressing or tube becomes disarranged in such a manner as to allow air to be drawn into the cavity and yet interfere with its free exit. The air is then forced into the wound and emphysema results. The treatment is to revise the dressing. No attempt should be made to force the air out of the tissues. Its absorption is usually prompt.

Infection of the cellular tissue rarely occurs as wound drainage is free. It is treated by multiple incisions. *Gravitation* abscess occasionally occurs, necessitating incision at the most dependant point of the infection.

Complicating Empyema of the opposite side rarely occurs. It is best treated by repeated aspiration with injection of 10 per cent. formalin glycerin solution until the expansion of the lung on the operated side is sufficient to permit of drainage of the complicating empyema. Whenever possible the operation should be done, and the patient kept, under negative pressure.

Lung Gymnastics.—The patient is to be gotten out of bed and in the open air as soon as he is able to move about and calisthenic exercises calculated to expand the chest enforced. He is instructed in the use of water bottles in order to expand the lung as quickly as possible. Their use may be begun on the second day. The longer expansion of the lung is neglected the more difficult it will become, as the adhesions will become more dense. Expansion of the lung and free drainage is facilitated by the use of a vacuum cup applied to the sinus or *Bryant's*[1] *method of aspiration combined with drainage* may be employed.

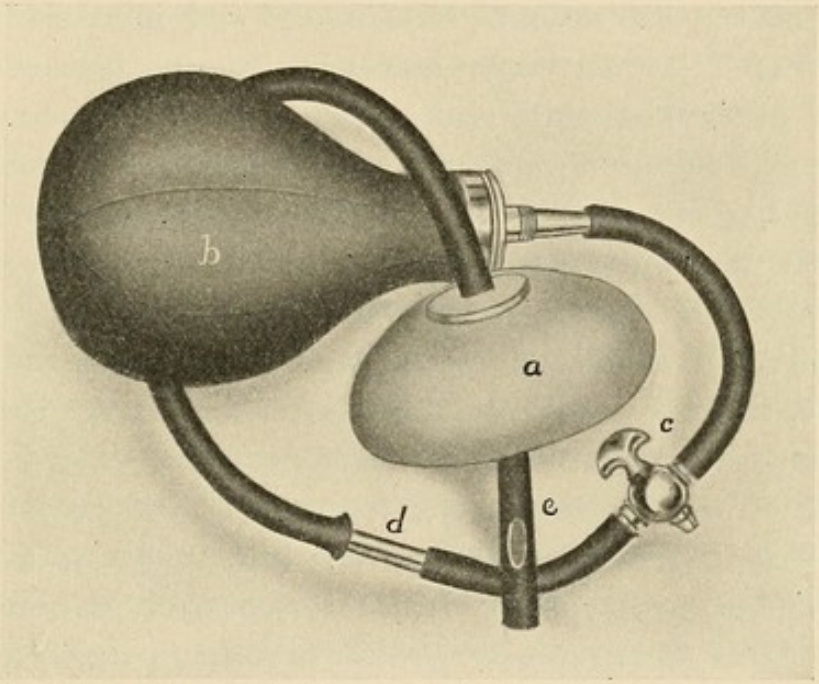


Fig. 192.—Bryant's aspiration and drainage apparatus. *a*. Hollow rubber cushion (the author now uses wet rubber tissue as the cushion was not satisfactory in all cases); *b*, rubber bag; *c*, stop-cock; *d*, glass observation-tube; *e*, drainage tube.

This method combines aspiration for the purpose of expansion of the lung and drainage by means of a special apparatus (Fig. 192). The drainage tube is placed into the cavity for the proper distance and the cushion is placed in contact with the wall of the thorax in such a manner as to cover the area surrounding the opening into the pleural cavity. The nozzle of an ordinary 6-oz. rubber syringe is then inserted into the distal end of the apparatus, the cavity emptied of all liquid, and sufficient air exhausted

[1] Operative Surgery, Bryant, 1901, vol. ii, p. 1026.

to cause the rubber cushion to fit closely enough to the chest wall to prevent the passage of air beneath it. The stop-cock is then closed, the syringe removed and the nozzle of the rubber bag with the air exhausted inserted into the open end of the tube. The stop-cock is then opened thus establishing aspiration which will be maintained so long as the bag is expanding. A suitable retentive dressing is then applied. When the rubber bag is nearly distended the stop-cock is again closed, the bag emptied, cleansed, collapsed, reapplied and the stop-cock opened. The degree of distention of the bag should be frequently observed so that this procedure can be repeated frequently enough to obviate interruption of the aspiration. Continuous and mild aspiration is quite as effective as more vigorous. The patient can be instructed in the procedure and can go about with the apparatus in place without attracting special attention. The rubber vacuum cup has not proved thoroughly satisfactory. Dr. Bryant now uses wet gutta-percha tissue to surround the tube and cover the wound opening to prevent leakage.

Duration of Healing.—In acute cases the lung expands readily as a rule, and the cavity quickly closes. In babies the process may take from fourteen to twenty-one days. The longer the duration of the empyema the longer will the cavity persist. In long-standing cases, as in those in which tuberculous infection is superadded, an extremely long after-course is to be expected. In such cases means (decortication or other plastic operation) other than gymnastic must be considered with the view of obliterating the cavity.

Secondary Scoliosis.—As a result of the approximation of the ribs of the affected side, by reason of the lack of necessity for the muscular apparatus of that side to take part in the respiratory act, the dorsal portion of the spine becomes scoliosed, with the concavity of the deformity toward the affected side. Compensatory curves in the cervical and lumbar region will follow in time. These deformities will disappear in case the lung can be subsequently made to expand. This is best accomplished by decortication of the lung (George Ryerson Fowler).

Fistula following Empyema.—This is frequently met with in those cases in which a system of lung gymnastics has not been

thoroughly carried out, in those cases in which the empyema has been present for a long time and many adhesions have formed, and in tuberculous cases. Fistulæ may also be caused by a retained drainage tube. Here, as in operations upon the ribs alone, necrosis may cause the fistula to persist. Should a fistula persist eight weeks after an operation for empyema, its cause must be ascertained. A thorough examination of the patient will reveal any tuberculous disease. The general condition is to be improved as much as possible, lung gymnastics are to be insisted upon, and a vigorous cleansing and disinfection of the cavity, with breaking up of adhesions with the finger or blunt curette done. Should the cavity still persist, several courses are open to us with the view of obliterating the cavity. Either the chest wall can be sunk in by an extensive resection of the rib overlying it (Estlander's or Schede's operations), or the affected pleura can be resected, removing with it the dense adhesions, and thus freeing the lung (Fowler), or a combination of these methods may be employed. If a retained drainage tube is the cause, removal of this will usually suffice for a cure. Operative methods should not be resorted to until it is seen that the cavity will not close by nature's aid alone. Nature tends to close such cavities by expansion of the lung on the diseased side, by expansion of the opposite lung, by the increased use of the diaphragm upon that side and by a narrowing of the intercostal spaces by a gradually encroaching of the ribs until finally they may even overlap. Not all cases can be cured even by extensive operations, and in obstinate cases several operations may be necessary. These cases make poor subjects for operation by reason of the long period of suppuration and the possible tuberculous diathesis. Radiography is useful in determining the size of the cavity or the presence of foreign bodies.

Thoracoplasty (Estlander, Schede); Decortication of Lung (Fowler).—The after-treatment of the operation consists in a primary abundant dressing of sterile gauze. If a small cavity still persists, a drainage tube may be employed or the cavity may be drained by gauze. Serous discharge is free and frequent change of dressing necessary. The remainder of the after-treatment is carried out along the lines already outlined.

Operations involving the Lung.—The lung may be invaded in cases of *abscess, gangrene, tumors,* or *tuberculous* cavities. In whichever event an important step consists in preliminarily suturing the visceral to the parietal pleura if adhesion is not already present. This serves not only to steady the lung, but more important still tends to prevent infection of the pleural sac. *Septic pneumonia* gives these cases a high mortality. The wound is treated as an empyema, with the exception that it should not be irrigated, in which case the lung might be flooded through a bronchus opening into the wound cavity. Should pleuritis complicate or supervene, it is to be treated on the principles already laid down. *Subcutaneous emphysema* may develop.

General Rules.—Absolute rest in the recumbent position with slight elevation of the chest aids spontaneous arrest of hemorrhage and tends to prevent complications. If *hemorrhage* occurs the wound is tightly repacked or if the cavity is small it is sufficient to seal the external opening in the chest. Wounded lungs not sutured to the chest wall will bleed until retraction of the lung is complete. Attempts to fix the chest wall with a view of controlling the hemorrhage are useless on account of the compensatory action of the diaphragm. The chest wall, however, should be fixed if painful wounds of the wall are present.

The odor in abscess cases is very offensive. It is best controlled by very frequent change of dressing. Such wounds heal very slowly and frequently require plastic operation or thermocauterization for the cure of bronchial fistula.

Operations upon the Heart.—*Bleeding* is favored by anything which increases the rapidity of the heart action or by anything which strengthens the force of each pulsation, therefore the patient is to be kept absolutely at rest, both mental and physical, and stimulation if given at all, should be very cautiously administered. The patient is kept free from all excitement in a comfortable recumbent position in an absolutely quiet and partially darkened room. The patient is reassured as to his condition. Morphin is given hypodermically to relieve the pain and ensure quiet. Ice to the precordial region tends to relieve pain.

Complications.—*Primary shock* occurs on the receipt of the

injury or in set operations at the time of making the cardiac manipulations and is immediately fatal.

Hemorrhage is the most frequent cause of death. Severe hemorrhage may be delayed for some hours after the operation.

Secondary carditis follows laceration or contusion.

Endocarditis is a frequent complication and is often associated with carditis. It is due to traumatism.

Pericarditis is the most frequent complication. It may be circumscribed or general. If accompanied by effusion, aspiration is indicated and if the fluid recurs, drainage.

Paracentesis of the Pericardium.—Usually the heart, in cases of pericardial effusion, is crowded well back and out of the way, while the pericardium presses forward, producing bulging of the intercostal spaces. By percussion the area of dulness is readily mapped out. The most favorable point for puncture is just above the upper edge of the sixth costal cartilage, near the left lateral edge of the sternum. The exploring needle should be introduced carefully and slowly away from the apex. As soon as fluid ceases to flow, the needle should be withdrawn, and the entrance of air avoided.

Pleuritis either circumscribed or general is a frequent complication whether the pleura has been directly injured or not. It often results in empyema.

Pneumonitis of varying degree may occur whether the lung has been injured or not.

Embolism is a frequent cause of death if the wound involved the cavity of the heart.

Entrance of air may cause immediate or subsequent death. Its entrance following operation is caused by failure of wound union through loosening or too early absorption of the sutures.

Abscess may occur in the heart wall, in the pericardium or pleura or in the mediastinum. Free drainage is indicated.

Aneurysm in the heart cicatrix has been observed.

Asthenia may be the result from any of these complications.

CHAPTER XVI.

OPERATIONS UPON THE ABDOMEN.

General Considerations.—The post-operative treatment in all acute abdominal conditions and in many chronic cases begins when the patient is first taken ill and consists in early recognition of the possible need of surgical intervention and the intelligent pre-operative treatment of the condition. This is particularly true in perforations and acute infective processes. The so-called operative mortality can be very materially lowered by the observation by the medical attendant of a few simple rules. In acute conditions of the abdomen all *feeding by stomach* is contraindicated. Nothing, not even water should be given, for the reason that the ingestion of anything in the stomach results in peristalsis with its accompanying spread of whatever infection is present. The tissues must not, however, be deprived of water or the possible operative procedure will have a disastrous effect upon the general metabolism. *Fluid* is administered by rectum either by slow frequently repeated enemata or by Murphy proctoclysis, or in urgent cases by hypodermoclysis. Morphin must be withheld until a diagnosis is reached. If these rules are followed out an earlier diagnosis is possible, and if a surgical operation is indicated the patient is in the best possible condition for it.

The after-treatment of operations on the abdomen differs but little from the after-treatment of operations in general. The difference depends upon two or three underlying principles which, if understood, simplify the after-treatment to a great extent. Removal of a patient from the operating table to the bed is done with the usual care that no additional injury be inflicted or strain put upon the operated part. The treatment of shock is as for other operations and the treatment of the wound itself is as for wounds of a similar nature in other parts of the body. It is to be noted, however, that kidney complications and lung complications occur more frequently after laparotomy

than after operations on other parts of the body, and that shock is a more frequent complication. For these reasons it is best to give saline by rectum following all laparotomies. Either the repeated slow saline enemata or Murphy proctoclysis may be used.

Our knowledge of these cases has so increased of late years that these three main complications, shock, nephritis and pneumonia, are rarely met with. With care in the preparation of patients and with the anesthesia, and with proper technic and speediness in operating, they will become less and less common. In former years the complication of intraabdominal hemorrhage and of post-operative intestinal obstruction and peritonitis in various forms were the commoner complications. Nowadays, due to better technic at the operation and to a better regard in the treatment of tissues these complications are seldom met with.

The lesser complications of vomiting and distention are still frequent, but not so common as formerly. Careful anesthesia precludes the one and an efficient pre-operative preparation excludes the second.

Given a clean laparotomy in which no operation has been done upon the intestinal canal and in which the abdominal wound has been properly made and sutured, the after-course should be as uneventful as an operation upon any other part of the body. Irrespective of what operation has been done intraabdominally there are usually no complications. The post-operative treatment is the same as in operations elsewhere. The patient is kept quiet for twenty-four hours or until the anesthetic nausea has ceased and may then sit up or be propped up in bed. Wound quiet is maintained by the use of a tight-fitting abdominal bandage of adhesive plaster after the method of Boldt, reenforced by a snug-fitting abdominal binder. The intraabdominal pressure acts with the extraabdominal support to maintain rest of the wound. Abdominal tension is relieved by placing pillows beneath the knees. The period of rest in bed depends almost entirely upon the patient's general condition. For instance, if the patient has lost a large amount of blood at the operation, or is anemic from long continued illness, general

conditions which would affect wound healing, it would be best to keep the patient quiet in bed until such a time as the blood examination showed rapid improvement in the blood condition. It is well known that wounds in anemic persons do not heal with the rapidity of wounds in robust persons. Such a wound would need support and rest for a longer time. Barring this complication, however, there is no reason why such patients should not be allowed up in bed at the end of twenty-four hours, out of bed in a chair in two or three or four days and be allowed to take a few steps on the following day. Reiss of Chicago who originated the "ambulatory treatment" of laparotomy gets his patients up even earlier. The size of the wound does not contraindicate this providing the wound has been suitably made and sutured and properly supported to ensure rest. In hundreds of laparotomies treated in this manner I have not had one untoward symptom. In fact convalescence has been hastened and wound healing made more rapid. If infection occurs it will occur irrespective of the position of the patient. Should infection occur it is treated on general wound principles and the patient is kept in bed until the infection has cleared up. When the wound has reached the condition when it can be strapped the ambulatory treatment can again be initiated.

Diet in this class of cases should be brought, as rapidly as the condition of the stomach will permit, to the normal diet. For the first twenty-four hours the diet is as in all post-anesthesia cases; following this the diet is rapidly increased. It is to be remembered that the stomach is in a weakened condition following the use of any general anesthetic and that food must not be forced at first. Nor should the ingestion of large quantities of fluid at one time or at frequent intervals be allowed as this is apt to result in a dilatation of the stomach.

Bowels.—The bowels should be moved daily for the first few days by a copious enema of soapsuds and water. After the first few days some form of pill may be given preferably containing aloin, belladonna and strychnin in just sufficient doses to produce evacuation without purgation. Distention is not apt to occur in these cases except in debilitated subjects or in elderly people, or in cases in which very large intraabdominal growths

have been removed. In such cases distention is carefully watched for and its relief by enemata initiated before great distention has occurred. In the case of large growths a preventive consists in filling the abdomen with saline after removal of the growth. In this and in the other two cases mentioned above the distention is due to the paretic condition of the intestine. Of all the drugs which act in this regard atropin is the best. Atropin sulphate gr. 1/50 given hypodermically will aid in toning up the afferent intestinal nerve impulses. Opium or any of its derivatives should be avoided in these cases. If the distention does not subside following an ordinary enema of soapsuds and water, an efficient enema is one quart of warm water in which one ounce of alum has been dissolved. This enema will succeed in bringing away the gas unless paresis is complete or unless a mechanical obstruction exists.

Pain.—Pain in the first few hours following the operation is due to distention or to the traumatism inflicted at the operation to the wound itself or to the abdominal muscles through retraction. In the former event the pain is relieved by enema; in the later event one dose of one quarter of a grain of morphin is administered hypodermically. One does not like to use morphin because of its after-effect in favoring intestinal distention. If, however, the enema fails to relieve the pain one quarter of a grain of morphin may be given. This dose should not be repeated except in rare instances.

Operations upon the gastrointestinal canal should be treated as above except as regards diet and catharsis. The after-treatment of these operations will be taken up in detail later. In general it may be said that following intestinal resection it is best to give repeated small doses of magnesium sulphate, one dram of a saturated solution every hour or two in order that the contents of the intestinal canal may be kept liquid and that impaction at the site of the Murphy button or suture line may not occur. Active cathartics should not be administered before the ninth day at which time intestinal wound healing is complete. Intestinal wounds are supported for the first three days by sutures; from the third to the fifth day which is the weakest time, the sutures loosen somewhat and the parts are held together by weak union;

from the fifth day on the union is firmer until by the ninth day it is complete. During this period no cathartics should be administered which will act in a forceful manner on the musculature of the intestine. Following appendectomy on account of the nature of the intestinal wound this rule is not so important; it is a good plan, however, to move the bowels by enemata for the first ten days even in these cases. The diet should not be forced in intestinal resection cases but the patient should be kept on fluid and farinaceous diet until the ninth day when intestinal wound healing is complete.

Posture in Operations upon the Upper Abdomen.—Following all operations upon the upper abdomen, if the patient is placed in the semi-sitting posture or in the elevated head and trunk posture a smoother after-course will be noted than if the patient is kept flat. There is distinctly less reaction following the operation, the stomach emptying itself more easily into the intestine, breathing is easier, pulmonary complications are not as frequent and the patient is very much more comfortable.

Post-operative Complications of Abdominal Section.—*Peritonitis* may immediately follow the operation due to failure in aseptic technic. Such a peritonitis is usually general from the outset. A certain amount of *local peritonitis* complicates practically every operation in the abdominal cavity. This is a *conservative* process. In simple cases without drainage it rarely gives enough symptoms to have attention directed toward it. There may be some pain about the neighborhood of the operation but it is hard to distinguish this pain from the soreness of the abdominal wall produced by the wound. In drainage cases this conservative peritonitis is more marked and causes a rise of temperature for the first few days. This is particularly noted in operations upon the upper abdomen and calls for no treatment other than raising the head of the bed to retard absorption. It may extend beyond the field of operation but still occupy a limited area. The symptoms are comparatively mild. Pain and tenderness are present; within the area of inflammation there is a limited amount of distention. The pulse and temperature are only moderately accelerated. The inflammation usually subsides at the end of forty-eight hours.

It may, however, extend (*spreading peritonitis*) if the infection is a severe one and may prove to be the precursor of diffuse septic peritonitis.

If localized no treatment is necessary as the process is a conservative one. If the process is more extensive saline by rectum is given to eliminate the septic material and distention is prevented by enemas. These measures, together with the elevated head and trunk position to prevent the rapid absorption of infective products, will usually suffice. If, however, the process has a tendency to spread, feeding by stomach should be discontinued in order to prevent peristalsis with consequent spread of the infection.

Cryptogenic peritonitis after operations for infectious processes in the abdomen. It occasionally happens that an intraabdominal abscess develops at a point distant from the original focus. The secondary abscess may be on the other side of the abdomen, may be in the pelvis, under the liver or in the neighborhood of the kidney. It is always a question whether such an abscess is caused by the direct extension of the infection, or through the lymph channels causing a secondary infection. In any event, some time after an operation for peritoneal abscess the temperature rises and symptoms of further infection are shown. An examination of the wound fails to disclose any cause therein for the symptoms. A thorough examination of the abdomen, loins and rectum will show signs of inflammation at a point remote from the original focus. Such abscesses are opened by the route affording the best drainage. Pelvic abscesses in females are opened per vaginam and abscesses in the neighborhood of the kidney, through the loin. Those not far distant from the wound are opened through the original wound.

Wound treatment and *wound complications* are the same as found in wounds elsewhere.

Infection of the abdominal wound may be expected following operations for acute infective processes in the abdomen such as acute appendicitis and pyosalpingitis. Such infections will occur regularly if suitable preventive measures are not taken. Such measures consist in the protection of the wound surfaces by pads from the infected organ, the handling of the infected organ with

instruments which are discarded as soon as used, the frequent rinsing of the gloved hand in an antiseptic solution, and the handling of the wound with instruments other than those used in caring for the infected organ. Kocher's old adage of "noli me tangere" in regard to the treatment of wounds in general applies particularly here.

Protecting the wound at the expense of the peritoneum by drawing the peritoneum up and attaching it to the skin may be done. The rich lymphatic system of the peritoneum is better able to care for infection than the other tissues of the abdominal wound.

Rupture of the Wound.—This accident is at the present day exceedingly rare. The exciting cause is some muscular effort such as occasioned by vomiting, coughing, straining at stool or conscious or unconscious struggling. The predisposing causes are those conditions of the blood tending to slow union, anemia, syphilis, tuberculosis; conditions of the wound such as infection or secondary hemorrhage; lack of efficient technic in the suturing or incomplete suturing in drainage cases, imperfect ligature material, improperly placed incisions, lack of proper wound support, etc.; and maniacal acts.

Rupture may occur at any time but in clean wounds is usually met with in the first twenty-four hours; in septic wounds later. The whole wound may be involved or only a part.

Treatment.—Occurring in clean wounds the indications are to immediately gently cleanse the extruding viscera, replace them and resuture—without drainage unless certain soiling has occurred through the escape of some of the bowel from beneath the dressing. Rupture in suppurating wounds requires cleansing and replacement of the viscera, and graduated tamponade of the wound with such suturing as is necessary to support the tamponade. An adhesive-plaster scultetus is applied. Cases of rupture in septic wounds are in addition treated as diffuse septic peritonitis cases.

Ventral Hernia.—This complication occurring as it does weeks or months following the operation is largely preventable. It is due to improperly placed incisions, particularly incisions in the linea alba in place of through the rectus muscle, and incisions so placed as to destroy important nerves. Poor technic

at the operation may have allowed infected material to come in contact with the wound thus favoring infection. Hernia may also be due to improper suturing of the wound, infection of the wound, to drainage and to conditions such as meteorism or lack of sufficient support to the wound producing strain. Poor wound healing may be due to complicating general disease.

Hematemesis.—This occurs most frequently following operations for acute appendicitis. It is rare. The blood comes from minute ulcerations of the gastric mucosa caused by plugging of the gastric terminal vessels with infectious emboli derived from the infectious focus (Van Cott). The symptoms are persistent vomiting of dark brown or black material consisting of altered blood. The prognosis is bad. The treatment consists of repeated lavage with alkaline solution, salines by rectum and general supporting measures.

Suppurative Hepatitis.—This complication also most frequently follows operation for acute appendicitis though it may occur after any operation for sepsis involving the veins of the mesentery. Septic thrombi in the mesenteric veins are displaced and carried into the portal vein and thence to the liver where they lodge and form septic foci with characteristic symptoms. Usually these foci are multiple and operation is unavailing. Occasionally, however, but one large abscess will result. This latter type presents a more favorable prognosis

Purulent pericarditis may follow hepatic abscess.

Purulent pleuritis may occur in the same way. It may be the only complication of an acute appendicitis.

Subphrenic abscess may complicate.

Iliac Phlebitis with Thrombosis.—An edema of one or both of the lower extremities occurs as a complication of apparently clean as well as of septic cases. It occurs more frequently as a complication of acute appendicitis where the appendix is in relation with the right iliac vein. Displacement of septic thrombi in this situation is followed by *pulmonary thrombosis and septic pneumonia.*

Portal phlebitis has been noted.

Mesenteric thrombosis is a rare complication. It may occur even in clean cases.

Distention due to Intestinal Atony.—This occurs in elderly patients with thin flaccid muscles, particularly in those from whom large tumors or cysts have been removed. It occurs quickly following the operation and is probably due to sudden relief from pressure of the growth. Inspection shows a much distended abdomen, a condition which later becomes extreme meteorism. Occasional slow peristaltic movements are seen through the thin abdominal wall. There is no pain. The abdomen is at first soft and yielding to the hand; later extreme meteorism develops unless active measures are taken to relieve the condition. If active measures are not taken paresis results and the patient dies.

Treatment.—Preventive treatment is best. Following the removal of large growths the peritoneal cavity should be filled with saline or saline and oxygen to take the place of the growth and so equalize the intraabdominal pressure. A tight binder is applied. Stimulating enemata are given as soon as the patient is out of the anesthetic. Strychnia hypodermically in doses of 1/30 of a grain every four hours and atropin hypodermically in doses of 1/200 of a grain every four hours are given to combat the intestinal paresis. On the occurrence of distention high stimulating enemas such as alum enemas or enemas containing turpentine are given frequently. These may be alternated with enemas not producing so much irritation of the intestinal mucosa; for instance, milk and molasses enemas. As the condition is one of atony a secondary operation is not indicated, though in extreme distention multiple incision and evacuation of many segments of the intestine may, in desperate cases, prove of value.

Analagous to this condition, though a very rare complication, in that the producing cause of the same is **post-operative general oozing** from the peritoneum after removal of large growths and sudden relief from pressure. It will be noted before closing the abdomen that oozing occurs from different points of the parietal peritoneum, particularly in the neighborhood from which the mass was removed.

Treatment.—The treatment here also is preventive. The abdomen is filled with saline, or preferably, saline and oxygen, and a tight binder applied. Should the oozing continue as shown

by continued dullness in the flanks and prolonged shock the usual general treatment for shock and hemorrhage is employed.

Intestinal paresis follows in cases of long-continued distention and in cases in which the muscular wall of the intestine is involved in a septic process. The distention is relieved to a slight extent by enemata but rapidly recurs. The treatment consists in repeated enemata, lavage, elevated head and trunk posture, single or multiple enterotomies, the formation of an artificial anus and the repeated administration of doses of atropin by hypodermic. The atropin should be given to the physiological limit. Paralysis of the bladder and mild delirium follow its use. The catheter will be necessary in the former event. The prognosis is bad.

Hormonal.—Hormonal is a name given to a preparation of hormones, substances secreted by certain cells of the gastric mucosa during the digestive process, the physiological action of which is the regulation of intestinal peristalsis. Zuelzer[1] calls the substance peristaltic hormone and after experimentation determined that it was stored in the spleen and in largest quantities at the height of digestion. Zuelzer's work follows along the lines initiated by Starling.[2] Many other observers are investigating the problem.

Hormonal is prepared by macerating under aseptic conditions the spleen of a guinea-pig killed at the height of digestion. The spleen is macerated and extracted with physiologic salt solution or 4/10 per cent. hydrochloric acid. The extract is filtered; the resulting liquid, if protected from light, remains stable for about one year. According to the experiments of Zuelzer this substance when introduced into the blood stream of animals promptly effects vigorous intestinal peristalsis. In human beings the reaction does not take place so rapidly, from two to twenty-six hours ensuing before its manifestations are noted. The injection is accompanied by a slight rise of temperature which disappears in most instances after twenty-four hours. No anaphylactic phenomena are observed.

During the past two years a number of favorable reports have

[1] Zuelzer, *Internationales Zentralorgan für Blut und Serumforschung II.* Folia serologica, 1910, vol. vi.

[2] Starling, *Zentralblatt für die Physiologie und Pathologie des Stoffwechsels*, 1907, Nos. 5 and 6.

been made both in the treatment of post-operative ileus and chronic constipation. More recently, however, certain dangers have been pointed out.

Dittler and Mohr[1] found that a marked fall in blood pressure regularly follows its injection. They cite a case convalescent from pneumonia accompanied by acute hemorrhagic nephritis in which 14 c.c. of hormonal were given intravenously on account of persistently troublesome meteorism. One-half hour later profound collapse occurred. The patient responded to active stimulation and finally recovered. The meteorism lessened.

Sabatowski[2] from the result of animal experimentation and clinical observation concludes that: (1) Intravenous injections of hormonal are followed by a marked, but transient, fall in blood pressure; (2) during this period of depression, there is lack of coagulability of the blood, and, at times, marked salivation; (3) movements of the intestine are somewhat stimulated, but only to the degree by which intestinal peristalsis is increased by a lowered blood pressure; (4) neither after single nor repeated injections (both subcutaneous and intravenous), was an effect of long duration observed; (5) hormonal acts neither upon the gut wall nor upon Auerbach's ganglia; the effect is a central one, and is evoked by way of the blood; (6) all its pharmacological characteristics indicate that hormonal contains vasodilatin (Popielski), with which its action is identical. Vasodilatin is obtained from animal tissue by the same method employed in preparing hormonal.

Sabatowski tested hormonal clinically on eight cases. In these, forty-eight hours were allowed to elapse before considering the effect negative. The results of his experience showed that: (1) Large doses of hormonal, intravenously, caused sudden fall in blood pressure, loss of coagulability of the blood, and an insignificant increase in movements of the intestine—all these manifestations lasted a short while, after which there was a return to normal; (2) following intramuscular injection, the above symptoms were barely noticeable; (3) hormonal acts exactly like Popielski's vasodilatin; (4) Sabatowski warns against the intravenous use of hormonal on human beings, especially after an

[1] *Münch. med. Woch.*, 1911, No. 46, pp. 24–27.
[2] *Wien. klin. Woch.*, 1912, p. 116.

anesthetic. For the reason cited above, the preparation has no therapeutic use. The observations which have just been reviewed would seem to make superfluous any further argument about the value of hormonal.

From these observations it must be deduced that hormonal is still in the experimental stage, at least so far as post-operative treatment is concerned.

Indications.—Hormonal has been used in chronic constipation of the atonic as well as the mixed atonic and spastic type and in post-operative intestinal paresis. Many brilliant results have been reported in the latter class of cases. In the treatment of chronic constipation H. W. Lincoln reports thirty-six cases successfully treated out of a total of sixty-seven.

Administration.—Hormonal is furnished in vials of 20 c.c. The solution for intramuscular administration has added to it 1/4 per cent. beta-eucain hydrochlorid. The dose intramuscularly is 20 c.c. administered one-half into each gluteal region. Intravenous injection is preferable to intramuscular. The injection should be at body temperature. Forty cubic centimeters are now advocated by Zuelzer as the adult dose; in children one to fifteen cubic centimeters according to age. The patient is kept quiet until the subsidence of the reactive temperature. Castor oil, one-half to one ounce, is administered two to four hours following the injection. If the patient is under the influence of opiates the effect of hormonal is prevented.

Post-operative Intestinal Obstruction.—Owing to the improvement in operative technic, post-operative intestinal obstruction is not nearly so common as formerly. The symptoms of obstruction may occur immediately after operation, or may be delayed for a period of weeks or months, or even years. If it occurs immediately after operation it is due either to an overlooked obstruction complicating the conditions for which the operation was done, or else an error in technic at the operation itself. The omentum or even the intestine has been caught by a suture in sewing up the abdominal incision; violent retching may force a loop of intestine between two sutures in case individual sutures have been used; or, a portion of the wound may be ruptured by severe straining caused by vomiting and a loop of omentum or

intestine forced into the wound. In such instances it is usually the small intestine that is involved and the obstruction is acute. The symptoms are vomiting, pain in and around the wound, distention and collapse. Such symptoms occurring soon after abdominal section call for immediate inspection of the wound. The large intestine may be the seat of obstruction; in supra-vaginal hysterectomy in suturing the utero-sacro ligaments to the stump, these ligaments are dragged upon and as they embrace the rectum they constrict it even to the extent, in some instances, of producing total obstruction. This should be suspected in cases of hysterectomy developing acute obstruction of the large intestine immediately following operation. Vaginal and rectal examination reveal the ligaments as tense bands embracing the rectum. For the obstruction, if absolute, a colostomy should be performed (Christopher Martin).

Another form of post-operative obstruction occurring following intraabdominal gynecological conditions which are post-operatively complicated by an *hematocele of the broad ligament*, is that in which the hematocele causes an annular constriction of the rectum. Whenever obstruction of the large intestine immediately follows the formation of the hematocele this form of constriction should be suspected and rectal examination made. Usually the stricture will admit the forefinger, but in rare cases it will entirely obstruct the lumen of the bowel.

Treatment.—The hematocele should be emptied and if this does not give relief an attempt to dilate the stricture is made. If the symptoms are urgent colostomy is performed (Christopher Martin).

Post-operative Intestinal Obstruction due to Peritonitis.—The peritonitis may be local or general. If local a single loop is involved either by kink through plastic exudate, by involvement of the muscular coat of the intestine in the inflammation or by torsion of a loop of intestine through plastic exudate in the mesentery. These forms of obstruction may occur as the result of the original inflammation, or may be due to traumatism at the time of operation. If the former, the symptoms will immediately follow the operation; if the latter, several days or a longer interval will elapse before symptoms present. The symptoms may be

those of incomplete obstruction, recurring attacks of painful distention relieved by enemata and stomach lavage.

If due to general peritonitis many segments of the intestine are involved through infiltration of the muscular coat by septic inflammation. Intestinal paresis rapidly follows. *Treatment.*—The abdomen is opened and adhesions are separated. The process is usually so extensive, however, that in most cases treatment will prove unavailing. Occasionally multiple enterotomies with emptying of the various distended loops, and the establishment of an artificial anus will be of value.

Post-operative Obstruction occurring Weeks, or Months, or even Years after the Operation.—The same causative factors are responsible as in the cases just considered but it is not until time has tightened the adhesions, or further kinked the bowel, or until some indiscretion of diet has produced a sudden distention of the bowel above the site of the adhesions, that the symptoms develop. *Treatment.*—Immediate laparotomy.

Paracentesis Abdominis.—In general ascites the site selected for puncture is in the linea alba, half way between the umbilicus and the pubes. The bladder should be empty and the patient should be placed in a semi-sitting posture. Percussion will show dulness from the symphysis upward toward the umbilicus, and tympany above, the dulness representing the fluid, and the tympany the intestines floating above. A Scultetus bandage should be passed around the body, the ends of the corresponding tails of the bandage being held in place by the first half of a knot. The previously sterilized skin is incised with a scalpel, and a straight trocar and cannula are pushed forcibly and quickly into the abdominal cavity. The trocar is withdrawn, and, as the fluid flows from the cannula, it is caught in a suitable vessel. As the abdomen decreases in size the tails of the Scultetus bandage are drawn together, and, when the fluid ceases to flow from the cannula, this is withdrawn and the Scultetus is pinned in the usual manner. The fluid should not be too quickly removed. The Scultetus bandage serves two purposes; it causes an even flow of the fluid, and, by combating the loss of intraabdominal pressure caused by the withdrawal of the fluid, prevents syncope.

Operations upon the Stomach. Gastrostomy.—The comfort

of the patient depends upon the technic of the operation. If a permanent fistula is desired the technic of Albert-Franks, Witzel, Emanuel Senn, or their modifications should be employed. Whatever the method employed, it has for its object the securing of a fistula, through which nourishment may be introduced through a tube into the stomach, and which will prevent the escape of gastric juice. If there is sufficient stomach wall to form an artificial esophagus two inches in length there is not much likelihood of leakage.

After-treatment.—The wound heals without complication if the escape of gastric juice is prevented. Should gastric juice escape, it must be removed immediately from the wound surfaces. Otherwise it will irritate the skin and set up an obstinate eczema. Dressings are changed frequently, and the parts cleansed with normal salt solution if leakage occurs. A tube should be left in the fistula which will completely fill it, so that for the first few days at least no gastric juice will come in contact with the wound. Further protection is afforded by painting the wound surface with Wölfler's solution. In order to prevent the escape of gastric juice through the tube, its lumen is closed by clamping the tube. As this operation is usually performed on patients who have become or are rapidly becoming emaciated by reason of a cicatricial or malignant closure of some portion of the esophagus, nourishment must be begun immediately. Saline enemata are given every few hours. In addition liquid nourishment is to be introduced into the stomach through the tube as soon as the primary effects of the anesthetic have passed off. Two ounces of warm peptonized milk are introduced every two hours for the first twenty-four hours. During the second and third twenty-four hours two ounces may be given every hour. Equal amounts of other fluids may be given alternately with the milk. At no time until healing is complete is a large amount of fluid to be introduced into the stomach. After the fifth day six ounces at a time may be given, and after the second week larger amounts. A list of fluid and farinaceous food is furnished the patient who is instructed in feeding himself. The diet should include albumin, fats and carbohydrates. A funnel is used in conjunction with the tube. The patient may masticate the food first and

then place it in the funnel. By so doing a greater variety of food may be given and all the pleasure of eating and drinking with the exception of the actual act of swallowing is enjoyed. It will be found that if the tube is allowed to remain in place permanently, it will not only be eroded by the gastric juice but will in time cause a dilated condition of the fistulous tract, allowing gastric juice to escape alongside it. It is better, therefore, after wound healing is complete, to remove the tube except during the periods of feeding. Should there be a tendency of the artificial esophagus to close the tube should be retained for longer periods. The escape of gastric juice is prevented by gentle elastic pressure over the fistulous tract, causing the walls of the fistula to come in contact. In the Albert-Franks or similar operations even this is not necessary, as the pressure of the muscular walls of the abdomen is sufficient to keep the walls of the fistulous tract in contact, and thus prevent the escape of stomach contents. Apparatus which act by plugging the fistula are to be avoided, because even if they are successful for a time, they will finally cause a dilatation of the fistula.

Retrograde Dilatation of the Esophagus.—If such a procedure is employed the after-care is carried out on the lines already laid down. As the stomach opening is larger than in ordinary gastrostomy, more care is necessary, both to prevent the escape of stomach contents and to keep up the nutrition of the patient.

Closure of the Fistula.—Should the primary condition which necessitated the operation be cured and the probable permanent permeability of the esophagus be assured, the fistula may be closed. This will necessitate laparotomy, with careful dissection of the artificial esophagus (fistula), the closure of the opening in the stomach, and the closure of the abdominal wall. Caustics or the thermocautery are not to be employed in an attempt to close the fistula.

Gastrotomy.—This operation is performed most frequently for the removal of foreign bodies, infrequently for the divulsion of stricture of the esophagus. If the patient is a robust one, nutrition may be kept up by enemata alone for three, four or five days. If the patient is weak, it will not be safe to wait this long before giving some nourishment by the stomach as well.

For this purpose, should great weakness be present, ounce doses of peptonized milk may be given at frequent intervals. If such a course is followed it must be remembered that healing of the wound may be interfered with by the motility of the stomach, and the question resolves itself into whether it is safer to allow an already emaciated patient to perish of inanition or run the risk of giving small quantities of liquid nourishment by mouth. Each case must be decided on its merits. Liquid food may be given in larger quantity, four ounces, after the fifth day without danger. The amount of each individual dose is gradually increased until, by the tenth day, the patient is taking ninety ounces a day. Farinaceous diet may then be given, and after the second week solid food be gradually resumed.

Gastrorrhaphy.—This operation is necessitated by wounds of the stomach, and as the patients are well-nourished as a rule, rectal enemata will suffice until the fifth day, following which small doses of liquid nourishment may be given by the stomach, as in gastrotomy. *Complications* are to be watched for, as other viscera may have been injured, notably the pancreas, or infection may have entered with the weapon or missile.

Gastroenterostomy.—The anastomosis is usually made posteriorly with a short loop (the no-loop operation of Mayo).

Malignant cases present themselves for operation after they have exhausted the resources of medicine. Consequently the operation is a last resort and these patients are particularly poor subjects for any operative procedure. They are reduced in strength by weeks or months of semi-starvation.

The most we can promise is the relief of the malnutrition. This is explained to the patient's friends, though not necessarily to the patient. It is not advisable to take from any patient the victim of an incurable disease the last ray of hope, and so perhaps embitter the few remaining months of life. Should the operation prove successful the patient's condition will be greatly improved. He will increase in weight and be free from the terrible gnawings of hunger. By allaying the irritation produced by the passage of food through the pylorus, for the stenosis is rarely absolute and small quantities of fluid will pass, the rapidity of the malignant growth is decreased. In some

cases an almost curative effect is obtained and the disease may remain stationary for a long period. In nonmalignant cases (duodenal ulcer) the relieving of irritation in time effects a complete cure.

Complications. Aside from those resulting from the disease itself, these are mostly traceable to errors in technic. Nor are these always avoidable. *Intractable Vomiting.*—This may follow anesthesia, as in other operations, and the continued movements of the stomach must have a weakening effect upon the sutures. In many of these cases no general anesthetic is employed, yet vomiting sets in and persists and the patient dies from exhaustion. Some of the cases are explainable on the ground of faulty anastomosis. The intestinal loop selected for the anastomosis may have been too distant from the duodenum. Stomach contents may enter the proximal anastomotic loop instead of the distal loop. The sutures securing the opening in the mesentery of the transverse colon may loosen allowing the opening to descend on the intestinal loops and so occlude them. The site of the anastomosis may be so dragged upon as to close or partially close its opening; the gut below the anastomosis may be closed by kinking or adhesion. Such conditions are demonstrable. There still remains a class of cases which die, exhausted by intractable vomiting, and in which at autopsy no sufficient cause can be found. In such cases there must be reversed peristalsis of the stomach. There is no other way to account for the intractable vomiting. Employing the no-loop method of Mayo will give most satisfactory results.

Formerly nourishment was maintained by nutrient enemata until the fifth day. The cases are few in number, however, which can stand long abstinence from feeding by stomach. Weakness and exhaustion become pronounced and nourishment must be given by the stomach or these patients will die. Here, as in all intestinal anastomoses, the wound is weakest from the third to the fifth day, following which union progressively becomes firmer and is practically complete on the ninth day. However, if the technic elaborated by Mayo is used the cases can be given water at the end of twenty-four hours, at first one ounce each hour. If nausea is not produced the amount is gradually in-

creased until at the end of twenty-four to forty-eight hours more the case is given other fluids. To tide over the thirst of the first twenty-four hours Murphy proctoclysis is used. Farinaceous food is added after the seventh day and normal feeding on the tenth day. These patients should be instructed to chew their food well.

Should *continued vomiting* occur, the stomach is carefully washed out, feeding by the stomach stopped, and the head of the bed raised eighteen inches to favor normal peristaltic movements and to employ the aid of gravity in causing the stomach secretions to flow out of the anastomotic opening. Should small intestinal contents and bile be vomited, and this is not relieved by lavage, the elevated head and trunk position and the employment of stimulating enemata to promote normal peristalsis, a second operation must be performed and the two loops of the anastomosis opened and made to communicate so that complete drainage of the proximal loop will be effected, and by no possibility can the proximal loop become filled and empty into the stomach. Such a condition is highly improbable if the no-loop method is employed. It is unnecessary to say that such an operation holds out small hope of saving the patient. Death may ensue in gastroenterostomy for malignant disease in from one to four days as the result of inanition. In cases in which the technic has been perfect, and in subjects whose reparative powers are sufficient to withstand the restricted diet for a few days following the operation, improvement is marked. Cases of dilatation of the stomach and obstruction of the pylorus with cicatricial or spasmodic stricture from the proximity of an ulcer, are cured. Duodenal ulcer cases are cured. Malignant cases are so improved that one sometimes doubts the correctness of the diagnosis. Of course in the latter cases the improvement is only transitory.

Jejunostomy.—Jejunal feeding. Liquid food may be given at the completion of the operation. If Mayo's method[1] is followed there is no danger of leakage, nor does leakage follow the removal of the tube. If the tube should slip out accidentally it should be replaced within twelve hours or the tract may be-

[1] *American Journal of the Medical Sciences*, vol. cxliii, p. 469.

come obliterated. All kinds of liquid food are applicable: Milk, eggs, meat ground fine and mixed with fluid, carbohydrates in liquid form, etc. The food should be administered slowly, fifteen to twenty minutes for each eight ounces at body temperature as in duodenal feeding by the Einhorn method. Before and after each feeding a small quantity of saline should be run through the tube to cleanse it. Preferably feedings are at frequent intervals, every two hours at first using 6 to 8 ounces; later every four hours using larger quantities. The patient may be allowed to hold the fluid in his mouth thus mixing it with the saliva and then ejecting it into a funnel connected with the tube. The bed may be screened while the patient is feeding himself if he is sensitive of observation. He must be warned not to swallow the food. At the end of a week or later if the chromic-gut stitch holding the tube in place has not been absorbed, the tube is removed between feedings for purposes of cleanliness. As before noted it should not be left out longer than twelve hours. If there is a tendency for the fistulous tract to contract the tube need not be removed so frequently; on the other hand if there is a tendency of the tract to become more patent the tube can be left out for longer intervals. Following the final removal of the tube the tract rapidly closes, usually without leakage. No subsequent ill effects from the jejunostomy have heen observed. Patients gain rapidly in weight as a rule. The operation is particularly indicated in any lesion calling for rest of the stomach and at the same time maintains excellent nutrition.

Gastrectomy, Complete or Partial; Pylorectomy.—The nourishment of the patient is carried out as in gastroenterostomy. Much of what has been said concerning the latter operation applies here. Malignant cases which survive the operation will improve rapidly for a time. In cases in which the greater part or all of the stomach is removed, partially digested food must be used so that the small intestine receives the food as it would come from a normal stomach.

A complication which may follow these operations is *gangrene of the transverse colon* due to injury to its blood supply. These cases do well for four or five days at which time the gangrene of the transverse colon results in peritonitis with a final fatal result.

This complication was formerly common but owing to improved technic is rarely seen at the present day.

Suspension Operations upon the Abdominal Viscera.—These cases require longer rest in bed than ordinary cases, twelve days being the usual length of time. The abdominal binder is reinforced and applied with great care so as to support the suspended organ.

Operations upon the Intestines done in Two Stages (Mikulicz Operation).—It is at times desirable in the case of a tumor the immediate removal of which would involve too great a dissection with immediate grave risk to life to loosen the portion of the intestine the seat of the growth and fasten it outside the abdominal wall. If obstruction is present the intestine is either immediately opened or, if possible to delay it, at the end of twenty-four hours. At the end of forty-eight hours, adhesions having formed, the mass is cut away. The primary dressing consists of abundant fluffed out gauze. This is changed several times daily as soiled. Later a secondary operation either by Mickulicz clamp or a formal laparotomy, is undertaken to restore the continuity of the intestinal canal.

Appendicitis.—*Interval cases* are treated as any clean laparotomy. *Acute cases limited to the appendix* or with but *slight local peritonitis* are treated similarly. The peritoneum easily cares for the peritonitis. In these cases the only complication will be possible superficial wound infection from some of the infection from the appendix being transferred to the wound in the course of the operation. The treatment is preventive.

Appendicitis with more marked local peritonitis or in which excision of the appendix was accompanied by traumatism causing oozing for which drainage has been used.—These cases are treated similarly to the above with the exception of the drain which is removed at the end of forty-eight hours and replaced by a drain down to the peritoneum. This is removed after twenty-four hours. As a rule no further wound treatment is required. The patient is not allowed up until twenty-four hours after removal of the drain and not then if the drainage opening has been large.

Appendicitis with Localized Abscess.—If the abscess is well walled off and the peritoneal cavity not invaded at the operation

the treatment is as in the above with the exception of the treatment of the drain. The outer dressings are kept moistened to promote drainage; the drain is shortened at the end of each twenty-four hours and removed by the fourth day when it is replaced by a smaller drain. The wound is dressed daily, shortening the drain or using less of a drain with each dressing. The patient is placed in a position which will favor drainage, usually with a pillow under the opposite hip.

Appendicitis with Spreading Peritonitis without Local Conditions requiring drainage.—Infection of the wound may occur as in all acute cases. The stomach is kept empty for twenty-four to forty-eight hours or until twelve hours following approximately normal temperature when all signs of peritonitis have subsided. If vomiting occurs lavage is employed siphoning the stomach dry. The elevated head and trunk position is used to cause slower absorption of the peritoneal effusion. The peritoneum serves as its own scavenger and drinks up the outlying infection. Slowly given saline enemata every three or four hours or Murphy proctoclysis every alternate two hours serves to dilute the peritoneal infection and less reaction is observed from its absorption.

Appendicitis with spreading peritonitis with local conditions requiring drainage are *treated* as above and the drain is treated as in appendicitis with abscess.

Appendicitis with diffuse septic peritonitis is treated by a large glass tube to the pelvis, such local drainage as is indicated, the elevated head and trunk position, nothing by stomach (the mouth may be rinsed frequently if nothing is swallowed), lavage with dry siphoning if vomiting occurs. The stomach is kept empty to limit peristalsis and saline enemas are slowly given every three or four hours or Murphy proctoclysis to dilute toxins. After forty-eight hours or longer, or twelve hours after the temperature is approximately normal dram doses of water, hot or cold, are given every fifteen minutes and if no rise of temperature results the size of the dose is gradually increased and the intervals gradually lengthened and at the end of a few hours broth is added. Thereafter the quantity is rapidly increased so that at the end of twenty-four hours or at most thirty-six hours full

fluid diet is reached. As the quantity of fluid is increased by mouth the amount by rectum is lessened. *Treatment of the Drain.*—The local drain is treated as already outlined. The tube to the pelvis has its loose drainage strip removed at the end of four hours, and the tube is aspirated with a "sucker" and a new strip loosely packed in. This procedure is repeated at first every four hours and later as the amount of discharge decreases at six- and eight-hour intervals. Usually on the third day the discharge is slight and then the large tube is replaced by a smaller rubber tube passed to the bottom of the glass tube, and held in place while the glass tube is withdrawn, following which the wound is dressed daily and the tube gradually shortened. After the seventh day this tube is removed a still smaller tube taking its place and the shortening process repeated. When the tube is shortened so that it does little more than extend through the abdominal wall it is removed entirely and a gauze strip substituted.

Cases presenting evidence of general infection are treated as are all general infections, at first by stock vacines, later by autogenous vaccines.

Complications.—Any case of acute appendicitis may develop any complication arising from infection anywhere or occurring after any operation. These complications are almost all avoided by very early operation, therefore, the prevention of complications is for the most part in the hands of the general practitioner. Certain locations of the appendix favor certain complications as, for instance, if an acutely inflamed appendix is in relation with the mesentery of the small intestines infection through the blood stream of distant parts is more likely to follow.

Operations for the Purpose of Intestinal Irrigation in Chronic Inflammatory Diseases of the Colon. Dysentery. Colitis. Enterocolitis. Appendicostomy.—At the end of forty-eight hours sufficient adhesion has taken place between the appendix and the wound to prevent leakage. Without anesthesia the extruding portion of the appendix is cut off one-quarter of an inch above the abdominal wall. A rubber catheter is inserted through the appendix into the cecum and colonic irrigation begun. Many varieties of irrigation are recommended; of the silver

preparations, argyrol 1–1000; protargol 1–100; silver nitrate 1–2000. In amebic dysentery quinin sulphate solutions 1–750 to 1–1500 are especially indicated, either in weak or strong solutions. In the latter class of cases Manson recommends silver nitrate 1–1000 following preliminary saline irrigation. All medicated irrigations should be preceded by a large cleansing flushing of one or more gallons of saline. The patient can be instructed in this method of irrigation after wound healing has been effected. The usual time for wound healing is as for other laparotomy wounds, but the patient is kept quiet in bed longer on account of the possibility of wound infection through the intestinal opening. Daily irrigations are indicated. For the first irrigation it may be necessary to pass a rectal tube after introducing the fluid into the colon but the patient quickly learns to relax the sphincter ani so that he can control the distention of the colon. The improvement under this method is extraordinary. Patients pick up flesh, are relieved of their pain, are able to eat practically any ordinary food. The diarrheal condition is replaced by one thorough and painless evacuation occurring coincident with the irrigation. This allows the patient to get about. Weight and strength increase. In the milder infections cure is rapid and even in chronic cases of amebic dysentery cure is more likely to occur than under any other method of treatment.

Later, after the indications for its use have disappeared, a plastic operation closes the appendicostomy opening.

Valvular Cecostomy.—Where it is not possible to use the appendix for the irrigation opening either by reason of its location or because of its condition, a valvular opening similar to that in Senn's gastrostomy is made and a small catheter inserted, secured by fine catgut to the funnel-shaped opening in the cecum, the cecum itself being attached to the abdominal wall. After such an operation colonic irrigation may be begun at once.

Gant's Operation.—Gant, in cases of enterocolitis, through a plastic operation upon the colon places two small catheters, one in the small intestine and one in the large intestine, so that irrigation of both can be carried out.

Artificial Anus.—Following artificial anus done for gangrene of

the intestine even if the operation itself is not severe the patients will usually die of general debility or peritonitis in from twenty-four to forty-eight hours. The case has usually progressed too far before surgical measures are instituted. Done formally the prognosis is good. The after-treatment is troublesome. The suture line is painted with collodion or Wolfler's peritoneal varnish. An abundant absorbent dressing of paper wool covers the wound; this is renewed every three hours. The wound in the neighborhood of an artificial anus is particularly liable to infection from the presence of the discharges. Immediately upon the appearance of infection the sutures should be removed. The infection may be deep-seated and not show at first except through the temperature; in such cases the sutures are removed and the wound opened. This will present a nasty sloughing appearance. A moist antiseptic dressing hastens the separation of the sloughs.

Skin irritation may be prevented in part by anointing the skin in the neighborhood of the artificial anus with vaselin. A moist eczema is liable to develop and can only be kept in check by strict cleanliness. After a week or ten days when wound healing has become somewhat firm the patient may be placed in a warm bath for one-half hour twice daily; this is a source of great comfort to the patient, and cleanses the wound. The granulations in the neighborhood of an artificial anus are apt to become grayish owing to the discharge. The sutures which are used to hold the intestine in position as a rule take care of themselves; they loosen and come away. The wound cicatrizes slowly, the mucous membrane of the gut proliferates until finally cicatrization between it and the skin is complete.

The effect of an artificial anus upon the general health depends upon the portion of the intestine from which the anus was formed. If in the sigmoid nutrition does not suffer; if in the cecum or the small intestine in the neighborhood of the ileocecal valve nutrition is not markedly interfered with. It is to be borne in mind, however, that it is in the large intestine that absorption of fluid for the most part takes place. The higher up in the small intestine the fistula is placed the more marked the inanition. If in the duodenum or jejunum inanition rapidly follows and the

patient dies of debility. If high up in the ileum patients may live for some weeks or months. The only treatment for fistula placed high up is early operation before the patient has become too much enfeebled. The site of the fistula can be determined by the character of the stools. The patient should be weighed daily, and if loss of weight is shown operation should not be delayed. The diet should be highly nutritious and such as to leave the smallest possible residuum in the intestines. Soup, eggs, milk, farinaceous food, scraped beef, peptones, rice pudding, young chicken, lamb, form the best diet; this is supplemented by rectal alimentation. *Jejunal Feeding.*—An attempt may also be made to place predigested foods in the efferent loop of the fistula. If this is possible it not only nourishes the patient better but prevents contracture of the portion of the bowel below the fistula. Reverse peristalsis tends to prevent feeding through the efferent loop. Spontaneous closure while possible should not be waited for as in the meantime the patient is losing

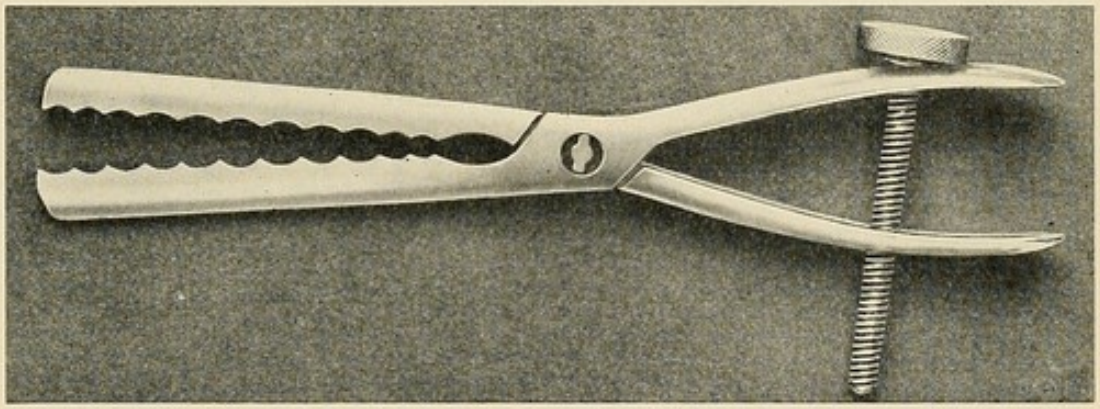


Fig. 193.—Dupuytren's clamp.

more and more strength. The only radical treatment is an early operation either intraabdominal or by *Dupuytren's clamp* (Fig. 193) and a subsequent plastic operation. After operating by means of Dupuytren's clamp it will be necessary to quiet the pain with opium. It takes six or eight days for the clamp to ulcerate through; in the meantime adhesions form which guard the peritoneal cavity against infection. If the attempt is successful a fecal fistula results in place of the artificial anus, the fecal current for the most part passing along the channel made by the clamp. This may be aided by plugging the external wound. Such

fistulæ have a tendency to close, but it is better to aid in their closure by a plastic operation.

Inability of the Artificial Anus to Functionate.—Occasionally it happens that while gas passes more or less freely through the tube usually left in the enterostomy opening at the time of operation, yet the passage of fecal matter does not occur. A condition of partial obstruction is present. This may be due to too much traction on the intestine or to too tight closure of the abdominal wound in an attempt to make an ideal anus, or to paresis of the loop operated upon. It is overcome by inserting the tube further into the gut and the use of frequent enemas through the tube.

Fecal Fistula.—If the fistula is small and free drainage exists healing may be expected without further operative interference. The lower bowel should be kept empty by enema night and morning. The diet should be such as to leave the smallest possible residuum in the intestine. If there is any tendency to fecal phlegmon the external wound should be freely opened. If the fistula is of larger size with eversion of mucous membrane, or if it is persistent, a secondary plastic operation must be undertaken for its cure. The dressing in all fecal fistulæ should be changed every two or three hours, and the skin in the neighborhood kept clean and well greased in order to avoid eczema. If a plastic operation for the cure of the fistula fails, a formal laparotomy must be undertaken, and either resection or short circuiting of that portion of the intestine the site of the fistula done.

Herniotomy. Inguinal.—The after-treatment of herniotomy varies according to the conditions present at the operation. Simple cases in which neither inflammation nor obstruction is present follow an uncomplicated course, cases which are inflamed and obstructed are somewhat more difficult to care for, while those cases in which gangrene is present may offer many complications.

Radical Cure in Simple Cases.—Though the technic of the operation varies, the after-course is practically the same. The patients are kept in bed from eight to twenty-one days according to the size of the hernia and the condition of the tissues.

Primary Wound Dressing.—This consists of sterile gauze covered with nonabsorbent cotton for the wound itself, or the wound may be occluded by a collodion and cotton dressing. A spica bandage is applied, the buttocks being supported by the Volkmann block or an inverted basin. The thighs should be separated and slightly flexed. If these precautions are not taken too much traction by the weight of the limb will be put upon the recently sutured wound, and in addition when the patient is placed in bed a hiatus will be present over the lower portion of the wound, through which infection can readily enter. *In males* the scrotum is supported by placing a band of adhesive plaster three inches broad under the scrotum, the ends being fastened to the anterior surface of the thighs. If desirable, as in children, the dressing is protected from urine by cutting an aperture in a foot square of rubber protective. This is slipped over the penis. In children or violent patients the wound may be further protected by a few turns of plaster-of-Paris bandage. During the stay in bed tension on the wound is prevented by placing a folded pillow beneath the knees, and thus slightly flexing the thighs on the pelvis. The dressing is removed on the seventh to the tenth day and the skin stitches removed. The recently healed wound is protected by a gauze compress and a spica bandage. If removable cross sutures of silkworm gut have been used these are removed on the twelfth day. On the eleventh day the patient sits up in bed and on the twelfth in a chair. Males should wear a suspensory bandage for three months following the operation. No work involving strain on the parts should be undertaken for at least three months. No truss should be worn under any circumstances, as its pressure will cause a recurrence of the hernia by stretching and thinning the lines of suture. In case union is defective the question of the necessity for a truss or a second operation must be decided in the individual case. *Drainage* will only be necessary in cases in which an extensive dissection has been done, in which large surfaces of loose connective tissue have been opened up, or in some cases in which removal of the testicle has been advisable and the connective tissue of the scrotum invaded. Its purpose is to provide for the escape of the large amount of serum resulting from opening up large areas of loose connective tissue.

In two or three days this drain is removed. *Recurrence* depends upon the technic employed, the exact suturing, primary union, upon the strain which is brought upon the wound, and upon the size and duration of the hernia and the age of the patient. The lax tissues and weak reparative powers of old age predispose against good results. In no case can a cure be guaranteed. Recurrence may follow in a few months or after a lapse of years. *Extravasation of blood into the cellular tissue of the scrotum* occurs after operations in which the loose cellular tissues of the scrotum have been invaded, as in operations for scrotal hernia. Oozing occurs into the loose cellular tissues of the scrotum resulting in an ecchymosis which may even involve the cellular tissue of the pelvis. If the extravasation is extreme, which is rarely the case, puncture of the scrotum at its dependent portion may be necessary. Usually support of the scrotum with strapping is sufficient to cause the blood to be absorbed in a few days. Prophylactic measures, as strapping, should be employed to prevent this complication in cases in which extensive dissections of the loose cellular tissues of the scrotum are necessary and drainage should be provided for. *Ecchymosis without marked extravasation* may occur. The skin of the penis, scrotum and surrounding parts may become black as from a bruise. No treatment is necessary. *Necrosis of the sac* may follow methods in which the sac has been used as a support for the internal ring, or in which the sac has been dislocated. This may be due to deficient blood supply or to sepsis. This accident is shown by pain, swelling and fever. It will be necessary to open the wound freely and drain. *Necrosis of the testicle* may follow if the spermatic artery has been injured, or may result from torsion of the cord. In either event the affected testicle will be painful and will enlarge. There will be fever. Opening the lower angle of the wound will allow the escape of pus and some stringy grayish masses from the testicle. The treatment is removal of the testicle and free drainage of the resulting wound. Orchitis is comparatively frequent. It is due to injury to the cord at the operation, or to pressure upon the cord by the sutures. In either event it is not serious. The testicle and scrotum may attain the size of the fist, but the swelling rapidly disappears as a rule and demands no treatment

other than the support afforded by a suspensory. Should swelling be persistent, local inunctions of belladonna, ichthyol or mercurial ointment help somewhat, or the testicle may be strapped. *Hydrocele* will only rarely be a post-operative complication. *Phlebitis of the femoral vein* rarely occurs in aseptic wounds.

Difficulty in urination is more likely to follow in males, and is due in part to reflex inhibition. Retention may result and necessitate the use of the catheter for a few days. As a rule these simple cases do well throughout and never give any cause for anxiety.

Femoral Hernia.—The same rules of dressing apply as in inguinal hernia. Complications are rare and are due to infection.

Phlebitis may ensue as a result of undue pressure from a retractor upon the femoral vein (Fabricius' operation) or as a result of infection. In the former case it will be transient and is avoidable with care at the operation. A clot may, however, become displaced and be carried to the heart, causing death.

Umbilical Hernia. Ventral Hernia.—These forms are dealt with as ordinary laparotomy wounds, except that in long-standing hernia requiring extensive plastic operation the stay in bed should be longer.

Incarcerated Hernia.—Inguinal, Femoral, Umbilical, Ventral. In cases in which there is slight damage to the gut and few adhesions, the after-course is as satisfactory as in simple herniæ. Should it be necessary to open up much loose connective tissue, a small gauze drain is used for two or three days. When the discharge of serum is profuse the outer dressing is changed daily. Usually aseptic healing rapidly ensues and the course of wound healing is the same as in simple cases. A radical operation can usually be performed. If not, a supporting pad must subsequently be worn. An enema is given to move the bowels directly the patient has recovered from the anesthetic. Small doses of magnesia sulphate, a dram of the saturated solution, are given every few hours to keep the bowel contents liquid for the first few days.

Complications.—These are rarely due to infection at the time of operation, but are due to the condition of the parts. *Intestinal*

toxemia. The patients recover from the shock of the operation and the bowels move freely, the stools being very foul smelling. The abdominal pains continue, pulse about 100, temperature 100° to 101° F. There is neither rigidity nor distention. *Treatment* consists in repeated enemata to rid the intestinal tract of the toxic products of putrefaction. *Obstipation.*—The vomiting stops, the patients react from the operation, but the bowels do not move and the patients do not feel well, though all else is favorable. In such cases enemata will relieve the distress. *Peritonitis.*—This may be caused by the entrance of the infected fluid in the hernial sac into the general peritoneal cavity. The onset will be immediate, the course will be rapid and death quickly supervenes. *Treatment.*—Immediate laparotomy and drainage with the patient in the elevated head and trunk position. An autopsy will show but slight changes in the intestinal loop which was the seat of the incarceration.

Secondary Perforation of the Affected Loop.—Following operation for strangulated hernia in which intestine, the condition of which is questionable, has been returned to the abdomen secondary perforation of the loop may occur. Under ordinary circumstances such suspected intestine would be resected, but in some cases the condition of the patient is such that prolonged operative interference is out of the question and one must return to the abdomen intestine the vitality of which is questionable. Of course, if one was positive that gangrene would follow one would resect or form an artificial anus at first; in any event such suspicious loops should be sutured to the peritoneum in the neighborhood of the wound and a drain led to them. Occasionally, however, gut is returned which appears to be recovering its normal appearance but which subsequently undergoes gangrene and perforates.

We have then to deal with two classes of cases: first, those in which perforation may be expected and for which provision has been made at the time of operation by suturing the suspected loop in the neighborhood of the wound and by drainage, or by the formation of an artificial anus with the affected loop; second, cases in which the returned gut is apparently recovering and yet later perforates. In the first class as perforation has been

expected a suitable provision has been made and providing the case survives the operation recovery may be expected with an artificial anus. In the second class of cases a normal course may be followed for twenty-four or forty-eight hours, the bowels may move and recovery be confidently expected, when suddenly there occur abdominal pain and collapse with evidence of a rapid peritonitis, the picture of a perforation without adhesions. Treatment will probably be of no avail. However, the abdomen should be immediately opened, either the gut resected, or preferably an artificial anus made, the peritoneal cavity cleansed and the elevated head and trunk posture employed. Perforation may be preceded by the formation of sufficiently strong adhesions to allow of abscess formation. Such cases usually recover as the site of perforation is apt to be in the neighborhood of the wound and the abscess may point into the wound or be opened through the wound when evidences of this condition (septic temperature, dulness and tenderness) present themselves. Should these symptoms occur the wound is to be carefully opened and the fecal abscess evacuated. The opening of such an abscess should not be delayed in the hope that stronger adhesions will form, as intestinal adhesions surrounding fecal abscesses rarely become very firm, and if opening of the abscess is delayed these weak adhesions may be broken down by the tension of the accumulation. On account of the weak nature of these adhesions these abscesses should be opened very carefully in order to avoid soiling the peritoneal cavity. Suitable drainage, at first gauze, should be gently inserted; this should be changed twice daily and in two or three days when the adhesions are stronger, a soft rubber drainage tube is inserted. The outer dressings are changed every two or three hours. Phlegmon of the abdominal wall or gravitation abscesses may complicate wounds of this character.

Paresis of the Affected Loop.—At the operation the intestine may apparently recover its tone and be returned to the abdomen, yet the symptoms of obstruction persist, vomiting continues, meteorism is extreme and collapse and death follow in from twenty-four to forty-eight hours. At autopsy the affected

portion of the gut is found dilated. This is due to a paresis occurring at the site of obstruction.

The same symptoms will persist and be due to mechanical conditions when *reduction en masse* has occurred. In reduction en masse forced taxis causes a separation of the peritoneum from the abdominal wall and the whole sac is separated from its coverings and forced between the peritoneum and the abdominal wall with its contents still unreduced, forming a peritoneal hernia. If a hernia is reduced en masse the gurgling sound heard in hernia properly reduced is not noted. Adhesions may also keep up the obstruction even after the hernial contents have been reduced.

Treatment.—In cases of paresis following operations for obstruction a secondary laparotomy should be undertaken and an artificial anus made above the affected loop. In cases of hernia in which symptoms of obstruction persist after apparent reduction an immediate exploratory laparotomy should be made.

Stenosis of the intestine may occur some months following operation for strangulated hernia. The stenosis occurs at the site of the previous strangulation and is caused by a cicatricial contraction of a gangrenous area in the mucous membrane.

General Treatment.—In cases not resected the diet should be fluid for the first few days, and the contents of the small intestine kept liquid by giving dram doses of sulphate of magnesia every few hours. In *resection* cases water is given as soon as anesthetic vomiting ceases, other fluids in twenty-four hours and soft diet after the fourth day, following which other foods are added. The bowels are moved with enemata in the case of small intestinal wounds. In wounds of the large intestine enemas are contraindicated; small doses of dilute magnesium sulphate every two or three or four hours being given to ensure the liquid condition of the bowel contents. The dose of magnesium sulphate must not be sufficient to produce purgation. Under this treatment collection of fecal masses in the colon is avoided.

Wound Treatment.—If the wound is completely sutured the treatment is the same as any aseptic wound. If a drain has been led down to the affected loop to afford an outlet in case of

leakage or perforation this should be removed at the end of forty-eight hours; if the gauze comes away clean it should be replaced by a small strip leading down to the peritoneum which is removed but not renewed at the end of twenty-four hours. If leakage occurs as shown by the telltale drainage strip it will follow the course of the provisional drain. Leakage requires enlargement of the drainage opening and the gentle insertion of a tube if retention is present.

Following Murphy button operations the button usually passes in nine to eighteen days but may be delayed a great deal longer. Radiography will show its change of position. The button may pass as far as the rectum and become lodged there. In this event the patient will complain of rectal irritation. Digital examination will result in its discovery and removal. Occasionally the button will not pass into the large intestine and will require removal by secondary operation. Obstruction at the site of the button occasionally occurs.

Operations Upon the Liver. *Abdominal Hepatotomy.*—The treatment of *cysts* and *abscesses*. A biliary fistula may persist. So long as the flow of bile is not excessive, this need not occasion alarm. Repeated packing with gauze will usually effect a cure. If not the thermocautery may be employed.

Transpleural Hepatotomy for Cysts and Abscess.—In such operations care must be taken to avoid infection of the pleural cavity. This is best done by suturing and gauze packing before opening the liver substance.

Hepatotomy for Stone.—Keep the parts aseptic until the stones lodged in the intrahepatic bile ducts have escaped, then treat as an hepatic biliary fistula.

Hepatectomy.—For whatever cause this operation is performed the after-treatment is the same. Four things are to be guarded against: excessive oozing, secondary hemorrhage, the escape of bile, and the extension of the localized peritonitis which occurs after these operations. *Oozing and secondary hemorrhage* are prevented by accurate hemostasis at the time of the operation by means of circumsuture of the larger vessels suturing raw surfaces in apposition and where this is impossible thermocauterization of the raw surfaces. These measures also lessen

the discharge of bile after operation. Should the raw surface be large, it is advisable to fix it to the abdominal wall in the neighborhood of the wound. This permits firm packing against the oozing surface and obviates the risk of respiratory movements interfering with the efficiency of the packing. The packing is allowed to remain in place for from forty-eight to seventy-two hours and is then very carefully removed and replaced by a smaller packing. Should secondary hemorrhage occur, the packing is to be renewed, and should this fail to arrest the bleeding, the abdominal wound is to be reopened and the bleeding surface fixed in the wound. This brings the bleeding area under absolute control and its treatment by circumsuture or thermocauterization is rendered easy. The packing is renewed every forty-eight hours until the liver wound is covered with granulations, when dressing may be done every third day. No irrigation is to be employed as adhesive inflammation occurs very slowly if there is any leakage of bile. The escape of bile will usually be slight if thermocauterization has been thorough. Should a persistent biliary fistula follow, tamponade with plain gauze will usually suffice for its cure. The thermocautery may also be employed. The danger of spreading peritonitis from the escape of bile is slight. The bile will follow the gauze and no more than a localized peritonitis will result.

Hepatopexy.—The after-treatment is as for laparotomy in general. The patient should remain in bed for two weeks, and should wear a supporting binder for at least a year after the operation. Properly fitting corsets should be advised.

Operations upon the Gall-bladder and Ducts.—The after-treatment of cases requiring these operations is important. It must be remembered that operations upon the gall-bladder and bileways are performed for the relief of symptoms and that the cause of the conditions present may not be permanently influenced by the operation.

A thorough and efficient course of treatment looking to the cure of the cause should be instituted. Gall-stones can rarely be expelled by the action of cholagogues and are never dissolved by the action of Carlsbad water. What the Carlsbad sprüdel salts do accomplish is to relieve the acute inflammatory proc-

esses which occasion the distress, and so the disease becomes latent. Rarely do any but small stones pass as a result of the treatment. Patients who have passed stones before treatment may continue to pass them irrespective of the treatment employed. Unless the stones are removed by operation, attacks are liable to recur from time to time. On the other hand, by removing the stones and enforcing a rigid after-treatment, a possible recurrence will be avoided. Operations performed while the stones are yet in the gall-bladder, give the best results and afford the greatest freedom from recurrence. Surgeons for the most part believe that recurrences are the result of stones overlooked at the operation. Patients should be placed in as good hygienic surroundings as their resources will admit. All patients can secure the simple articles of food which are of benefit in their condition, and can afford to purchase the artificial Carlsbad sprüdel salt. The amount of meat and alcohol should be limited.

Cholecystostomy.—Accessory drainage, split tube and gauze strips are removed on the fourth or fifth day and the resulting sinus allowed to heal. The tube draining the gall-bladder is allowed to remain in place at least until protecting adhesions have formed around it and a drainage tract has been formed. This will prevent peritonitis from the escape of bile and infective material into the general peritoneal cavity. After ten days the tube is removed for purposes of cleansing. If more prolonged drainage is indicated, *i.e.*, if the stools have not resumed their normal color, or if the normal colored bile has not passed through the tube, the tube is replaced and only removed at intervals of several days for cleansing. The flow of bile or muco-pus will continue until the condition of the gall-bladder and ducts approaches normal. Following the removal of the tube the resulting fistula usually closes in from a few days to six weeks. The operative procedure which allows of quickest closure consists in suturing a half-inch rubber tube into the gall-bladder incision. Two purse-strings are placed in the gall-bladder wall surrounding the tube. Pressure on the tube causes inversion of the gall-bladder wall. The purse-strings are now tied down securing the tube in position. Plain

catgut is used for the tube sutures, chromic catgut for the purse-strings. Upon removal of the tube there is no eversion of mucous membrane consequently more rapid healing ensues. The stools are watched, as by observing them, an idea is gained of the condition present in the common or hepatic ducts. When the stools regain their normal color it means that the catarrhal inflammation or the conditions producing an acute obstruction have subsided and drainage may be dispensed with. If, however, the stools remain light after a lapse of time sufficient to allow of the subsidence of acute inflammation search must be made for the cause of the obstruction. This may be the result of sufficient traumatism having been inflicted on the common bile duct, or in rarer cases, the hepatic duct, by the passing of stones to have led to the formation of a cicatricial stenosis; or the gall-bladder may have been improperely fastened to the abdominal wall or a stone may have been overlooked; or a malignant stenosis of the common duct may obtain. In order to determine the point and character of the obstruction a close study must be made not only of the stools but of the amount of bile which is discharged through the tube, and of the general symptoms. Should the obstruction be due to calculus in the hepatic duct or disturbance of the bile producing function in the liver by malignant disease of that organ involving the hepatic duct, bile will pass, if at all, in only small quantities either through the fistula or through the common duct into the duodenum. The stools will be slightly if any colored. Jaundice will be extreme. If the obstruction be due to an impacted calculus or to cicatricial contraction or to malignant disease of the common duct, the stools will remain light colored and the discharge of bile through the fistula will be profuse. Should the obstruction be caused by a kinking of the common bile duct due to a malposition of the gall-bladder, this may be determined by blocking up the tube or fistula by plugging it with cotton or a wooden plug and cotton combined; if due to kinking of the common duct, the distention of the gall-bladder by the accumulating bile will produce a dilated condition of the cystic, hepatic and common bile duct which will result in a straightening of the latter so that the kinking will be temporarily overcome and bile will appear in the

stools. Should the cause not be kinking but actual obstruction, no bile will be found in the stools. Should a ball-valve stone be lodged in the common duct it may happen that the coloring of the stools will be intermittent and the amount of bile discharged through the tube or fistula will vary accordingly. The removal of the stone is indicated by choledochotomy or duodenotomy if the stone is found in the ampulla of Vater. Should the cystic duct be obstructed by stone or cicatricial contraction or persistent catarrh no bile will flow from the tube but only the secretion of the gall-bladder itself, mucus or muco-pus. The stools will be of normal color. With the exception of kinking, the result of imperfect technic, or cicatricial stenosis which may supervene at any time as a result of traumatism, the causes of complicating obstruction should have been diagnosed or at least suspected by the digital examination of the parts at the time of operation. No time is to be lost in ascertaining the cause and promptly removing it. Should this be found impossible a cholecystenterostomy must be performed.

Primary Dressing.—The wound is covered with plain gauze covered with rubber protective to prevent eczema and disturbances of wound healing due to the irritating effects of the infected bile. The end of the tube is connected with a longer tube the end of which is submerged in a bottle of bichlorid suspended at the side of the bed (subaqueous drainage). This also allows of an estimate of the amount of bile passed. If the wound dressing becomes soiled it is to be immediately changed. If asepsis has been successfully maintained, the wound dressing is not changed until the fourth day when the accessory drain usually used is removed. A light repacking of the point of emergence is all that is necessary. On the seventh day the sutures are removed. Should bile escape alongside the tube the dressings are changed as soiled. The care of the tube has been indicated. When its period of usefulness has passed, *i.e.*, when discharge of bile is reduced to a small amount daily it is removed. The elevated head and trunk position is used for the first forty-eight hours, after which the bed is leveled and the patient propped up in bed. He may get

out of bed when the gall-bladder tube is removed. When the patient sits up in bed the subaqueous drain is dispensed with and the end of the gall-bladder tube placed in a six ounce bottle which is attached to the binder by tape and safety-pins.

There may be considerable temperature reaction after drainage operations in this region. This reaction is lessened by employing the elevated head and trunk position or the sitting posture. This also makes the patient more comfortable by relieving pressure on the diaphragm and so rendering respiration easier.

Biliary Fistulæ which Persist even after the Stools have become the Normal Color.—Such fistulæ may discharge mucus alone or in addition a small amount of bile. The reason for their remaining open will be found in eversion of the mucous membrane of the gall-bladder which has grown into the fistula or in obstruction of the cystic duct. In the first instance the use of the thermocautery may close the fistula by destroying its walls and the everted mucous membrane. This failing, the fistulous tract is dissected out in its entirety and the opening into the gall-bladder closed. In the latter case, cholecystectomy is indicated.

Operations upon Jaundiced Patients.—Hemostasis must be exact. Such patients bleed easily and at times lose such an amount of blood through mere oozing that death ensues. Calcium lactate may be administered in ten grain doses every four hours and three ounces of human or horse serum administered hypodermically each day.

Cholecystotomy.—If this "ideal" operation is performed strictly according to the indications, there should be no resulting complications. But even when all the stones are in the gall-bladder, and no inflammatory symptoms are present the traumatism incident to the removal of the stone or stones may be sufficient to set up a catarrh of the gall-bladder. This if communicated to the ducts might work disastrous consequences. If but one large stone be present, the probability of a successful issue is excellent, but if more than one are present, the operator cannot be quite sure whether all the stones have been removed or not so the after-course of the case will be watched with greatest anxiety. The operation precludes a thorough examination of the gall-bladder and ducts on account of the danger of trauma-

tism as cited above. Should a provisional drain be employed leading to the line of sutures in the gall-bladder, this is removed on the fourth day if no leakage has occurred. If leakage does occur, a rubber drainage tube must be introduced surrounded with gauze to prevent peritoneal infection. The treatment of the case subsequent to leakage is as for cholecystostomy.

Cholecystectomy.—If the mucous membrane of the cut end of the cystic duct has been destroyed by the thermocautery no fistula will follow. The after-treatment is as for wounds of the liver. The cystic duct may become dilated after a lapse of time and partially compensate for the loss of the bladder. This has been observed in experiments upon dogs.

Cholecystenterostomy.—The telltale drain is removed on the fourth day and if there has been no leakage is not replaced. Leakage calls for enlargement of the drainage opening and the employment of tube and gauze drainage. Ascending *infection* of the bile ducts and liver from intestinal bacteria may occur at any time.

Choledochostomy.—Accessory drains are removed on the fourth day. The small rubber tube draining the duct is removed on the following day or, if very extended drainage is desired, on the tenth day.

Choledochotomy.—If there is no leakage the telltale drain is removed on the fourth day. Leakage requires tube drainage.

In the various other plastic operations upon the ducts the same rules apply.

Operations Upon the Spleen. *Splenotomy for Abscess.*—The wound is firmly but gently tamponed to guard against hemorrhage. The tamponade is removed on the fourth day and the cavity lightly repacked every second day. No irrigation should be used for fear of setting up bleeding. Large masses of splenic tissue will slough. These should not be removed forcibly but should be allowed to separate themselves. *Sepsis* is a common complication. *Secondary hemorrhage* is always imminent. The condition of the patient from the time the lesion is recognized is, as a rule, such as to preclude any major operative procedure such as splenectomy. With great care and gentleness in the management of the wound an occasional case will be saved.

Splenopexy.—These patients should be kept in bed for four weeks, and should recline for the most part on the left side. A supporting binder should be worn for three months. Corsets affording proper support should be advised.

Splenectomy.—The after-course is usually uneventful unless the disease for which the operation is done was accompanied by prolonged anemia. *Secondary hemorrhage* is apt to occur if the pedicle was ligated *en masse*, or if the ligature was applied while the pedicle was tense. It is caused by retraction of the tissues following relief of the tension. The treatment is immediate operation with more exact hemostasis. In those patients already suffering from severe anemia blood transfusion is essential to success.

Thrombosis of the Splenic Vein.—The thrombus may extend into the superior or inferior mesenteric vein or both and completely or partially occlude the vessels. Recovery has been reported (Summers) following secondary laparotomy with infolding of the gangrenous intestinal areas and drainage. The prevention would seem to be more gentle operative manipulation of the pedicle. The symptoms are those of shock, abdominal pain and vomiting. The possibility of the complication should always be borne in mind (Delatour).

Transabdominal Operations upon the Kidney (Large Cysts, Tumors, Hypernephroma).—The after-care combines that of laparotomy with that of extraperitoneal operations upon the kidney.

Operations upon the Pancreas.—The care of the wound resolves itself into the care of the tubing and packing which have been used for purposes of drainage and for controlling hemorrhage. The amount of drained material will be greater by the lumbar than by the anterior route and will require more frequent change of outer dressings. The wound dressing itself is left undisturbed until the fourth day unless high temperature develops traceable to damming back of secretions.

Post-operative hemorrhage from the pancreatic artery and neighboring blood-vessels is frequent following operation in the stage of abscess formation and necrosis. These hemorrhages are severe and usually occur in the second week after the opera-

tion. They are generally fatal. The only possible treatment is tamponade as the necrotic condition of the pancreas renders recognition of individual vessels impossible. The hemorrhage results from erosion of the vessels. Frequent small hemorrhages have also been noted. Early operation before the stage of necrosis and abscess formation does not entirely obviate the danger of hemorrhage.

Thrombosis of the large venous channels, mesenteric and splenic, with consequent sequellæ such as metastatic abscess in the spleen occur.

Pancreatic fistula has a tendency to heal spontaneously but healing is much prolonged, from two to seven and a half months, and is not influenced by diet. The post-operative course of lumbar incisions is very tedious. By either route done in the stage of abscess formation there will be considerable discharge of small pieces of necrotic fat and in some cases large pieces of the pancreas. As complications of the lumbar incision, hernia of the colon through the wound has been noted and also fecal fistula of this portion of the intestine.[1]

Fifty per cent. of the cases show disease of the gall-bladder in addition. If this receives operative treatment the post-operative care of such a wound is added to that of the pancreatic wound.

The mortality of operations upon the pancreas for acute lesions is 60 per cent.

Recurrence of the disease after operation requiring a second operation has been noted (Beck, Bardenheuer, Porter, Haenel).

When a patient has sufficiently recovered a course of treatment should be given such as that at Carlsbad, Vichy, Neuenahr and Hamburg. Pawlow has shown that sodium solution markedly influences the activity of the gland. In the few cases which the author[2] has had the course of convalescence has been apparently influenced by starvation of the patient for forty-eight hours following operation. Patients have been placed in a room by themselves and with as perfect rest as may be obtainable. All mention of food or food odors have been withheld for forty-eight hours, not even water being administered by mouth

[1] Korte, *Annals of Surgery*, lv. p. 23.
[2] *L. I. Medical Journal*, vol. ii, 1908, p. 393.

with the idea that complete digestive rest would predispose to earlier resolution of the pancreatic wound. Fluid has been furnished by repeated saline enemata.

Abdominal Cysts.—Occasionally cysts are encountered which it is not advisable to extirpate on account of the difficulties and dangers attendant on such a procedure, for example, adherent serous, chylous, blood, dermoid and echinococcus cysts of the mesentery or abdominal or pelvic viscera. In such cases the cyst wall is attached by suture to the abdominal wall, and either opened immediately or after forty-eight hours have elapsed to allow of the formation of protecting adhesions. This latter constitutes essentially an extraperitoneal operation and almost certainly precludes the occurrence of peritonitis through peritoneal contamination by cyst contents. On account of the large surface of the lining of the sac, in many instances a secreting membrane, and the impossibility of efficient drainage, asepsis is particularly difficult to maintain. *Healing* occurs by shrinkage and collapse of the sac wall. This latter is hastened by intraabdominal pressure. Should, however, the healing process proceed too quickly adhesions will form between adjacent folds of the sac and pockets result. Fortunately, if such an accident happens, it will be easier for the retained secretions to find an escape through the recently formed adhesions than through the sac wall. Nevertheless, pocketing is to be avoided as much as possible. When shrinkage is complete, the sac cavity is obliterated and the fistulous opening in the abdominal wall closes readily as a rule. The process occupies from three to six weeks, unless infection has supervened, when a much longer time may elapse before healing is complete. *Wound Treatment.*—The most efficient drainage is obtained by a combination of a thick-walled rubber tube, one inch in diameter, through which is introduced enough sterile gauze to loosely fill the cavity. This prevents too rapid collapse and the subsequent formation of pockets. It does not interfere at all with the shrinkage of the sac. The rubber drainage tube should not extend more than a short distance into the sac cavity. It must not press against the opposite wall of the sac or necrosis and perforation may ensue. A short glass tube with a wide flange to prevent it slipping into

the sac cavity may be employed. If of rubber the tube is held in place by a large safety-pin passed through its wall. To the pin is fastened a tape which is tied around the body or fastened with adhesive plaster. The flanged glass tube will be found more comfortable. The purpose of the tube is twofold, to keep the fistulous tract leading into the sac cavity dilated until complete closure of the sac is effected and to provide drainage for the sac secretions. It is not removed, except for cleansing, until complete closure of the sac has occurred, although it may be shortened somewhat or a shorter tube introduced in its place as healing progresses. It also acts as a safety valve in case pockets have been formed. The loose gauze packing is removed at the end of forty-eight hours and a smaller amount of gauze introduced. This gauze is changed twice daily, once daily or every other day according to the amount of secretion until complete closure is effected. Plain gauze fulfils every indication and promotes the formation of granulations. At each dressing a smaller quantity of gauze is introduced *pari passu* with the decrease in the size of the cavity. The outer gauze dressings are changed as frequently as soiled. Drainage will be facilitated here, as in empyema cases, by frequently changing the position of the patient. Should infection supervene in spite of every precaution, disinfecting measures must be introduced. Irrigating will be found the most efficient of these. According to the amount of the discharge and the virulence of the infection, the cavity may be irrigated with saline or borosalicylic solution once, twice or thrice daily, the gauze packing being renewed at each irrigation. The employment of stronger antiseptics is hardly justifiable, as they tend to increase the necrosis of the sac wall, and from such a necrosis, perforation and peritonitis may result. Prolonged suppuration here, as elsewhere, will cause great deterioration in the health of the patient, and may even result in death. Asepsis must be rigid throughout the entire course of wound healing. After removal of the tube, the resulting fistula is stimulated to promote more rapid closure.

Echinococcus cysts are treated on the same principle as other cysts, but in order to effect a cure the sac lining containing the

echinococcus hooklets must be either removed or destroyed. This latter is not surely effected by shrinkage of the sac, and the introduction of chemicals of sufficient strength to destroy the lining membrane is dangerous. The procedure which has met with greatest success consists in the gradual separation of the mother sac from its fibrous capsule by allowing a stream of saline solution to flow between them. Some seven to fourteen days may be occupied by this procedure, the mother cyst being gently and gradually separated until finally it is entirely removed. It is preferable to accomplish this gradually rather than quickly, especially in echinococcus cyst of the liver, in order to avoid a biliary fistula. A rapid shrinkage of the fibrous capsule follows. The cavity is irrigated daily with mild iodin solution. Should *calcification* occur in the cyst lining, the calcareous deposits must be removed with a sharp curette, or healing will be greatly prolonged and a persistent fistula result.

Exploratory Laparotomy.—If the abdominal cavity is opened and its contents explored without disturbing adhesions or inflicting injury to the peritoneal surfaces, the after-course of the case will not give any cause for anxiety. On the other hand, if in the course of the exploration extensive adhesions are disturbed or a tumor partly enucleated, the outlook is more grave. The prognosis depends upon the impairment of the reparative power of the peritoneum. The after-care of those cases in which operative procedures were of no avail is conducted along symptomatic lines. In those cases in which inoperable malignant disease is present it is better not to take away from such patients the last ray of hope, and thus make the few remaining months of their lives gloomy with impending death. As a rule, such patients are only too willing to be deceived. One should always protect oneself, however, by fully informing the patient's relatives or friends of the true condition of affairs. In many cases a temporary cessation of previously existing symptoms will follow an exploratory procedure. This is accounted for by the separation of adhesions and the removal of peritoneal fluid. The separation of adhesions relieves pain caused by their dragging or pressure. The manipulation of the peritoneum frequently produces sufficient trauma to set up fresh adhesions,

through which new-formed blood-vessels act as an adjunct to the portal circulation, and thus tend to prevent a reaccumulation of the peritoneal fluid. The general condition of patients the victims of metastatic peritoneal cancer with ascites is much improved, especially the breathing, as the removal of the fluid allows of freer action of the diaphragm.

Tuberculous Peritonitis.—After abdominal section for tuberculous peritonitis, even though nothing more be done than the mere opening of the peritoneal cavity, it is quite common to have a cure follow. Should ascites have been present before the operation, this does not, as a rule, recur. The opening of the abdomen and the entrance of air produces sufficient traumatism to enlist the services of a large army of leucocytes. These attack the miliary tubercles, with a resulting formation of new connective tissues and consequent cicatricial contraction. It is not necessary for a cure that the tuberculous foci be removed. Indeed, in most cases this is inadvisable for the reason that a fecal fistula is quite apt to follow disturbance of intestine the seat of tuberculosis. Following simple laparotomy or laparotomy with the introduction of oxygen the patients are relieved of their symptoms, and in many cases are permanently cured. The after-treatment differs in nowise from that of ordinary cases, except that in those cases in which adhesions are separated *fecal fistula* will probably follow, and for this reason drainage is provided. Nourishing diet and plenty of outdoor exercise in a suitable climate are to be insisted upon, as most of these cases have pulmonary involvement.

INTRAABDOMINAL OPERATIONS UPON THE UTERUS AND ADNEXA.

Drainage.—Without drainage the care is the same as for any clean laparotomy. If drainage has been used the drain emerges through a vaginal incision (see posterior colpotomy).

Abdominal Hysterectomy.—*Injury to the bladder or ureter* or more rarely, the rectum may occur (see complications of vaginal hysterectomy). *Concealed hemorrhage* is a rare complication. *Retention of urine* is common. *Cystitis* seems to occur more frequently than after any other operation. *Slow wound healing* and *wound infection* may be expected in anemic patients. *Pelvic*

hematoma is more apt to occur after supravaginal hysterectomy than after panhysterectomy. It is rare in either case. Vaginal incision is indicated with expulsion of the clot and drainage. Failure to express the clot is apt to result in infection and abscess formation.

Extrauterine Pregnancy.—*Tubal abortion treated by* posterior colpotomy, removal of clots and drainage; the packing is removed in forty-eight hours and the vaginal wound allowed to close. Rest in bed is maintained for five to seven days.

Salpingo-oophorectomy for Intraabdominal Rupture.—In the majority of such cases the hemorrhage has been severe. Seven hundred and fifty cubic centimeters of saline are given subcutaneously as soon as the bleeding has been controlled. The treatment does not differ from laparotomy in general except for the treatment of the shock and the longer wound rest by reason of the anemia. This latter should receive appropriate treatment.

Operations upon the ovaries, tubes, or ligaments do not differ in their post-operative treatment from laparotomy in general. Occasionally in young women the artificial menopause produced by double oophorectomy will be severe enough to require the use of ovarian extract or warrant ovarian transplantation.

Myomectomy.—Adhesion of the small intestine to the uterine wound may cause an early or late *intestinal obstruction.* This is particularly to be watched for if the uterine wound is on the posterior surface.

Extraperitoneal Shortening of the Round Ligaments. (Alexander's Operation).—The care of the wound is as for inguinal herniotomy. The uterus is supported in its new position by packing the cul-de-sac. The patient is allowed to move about in bed as she wishes. The vaginal packing is so placed as to allow proper drainage of the cervical canal. To accomplish this two packing strips are used, one anterior to the cervix tightly applied, the second below this loosely applied. The latter is removed on the third day and not replaced. The upper packing is replaced as it becomes foul. The support of the uterus in its new position is maintained until the next menstrual period. The patient should remain in bed two weeks and avoid all strain.

CHAPTER XVII.

OPERATIONS UPON THE RECTUM AND ANUS.

The chief *dangers* following operations upon the rectum and anus are sepsis and hemorrhage. Temporary disturbances of urination are common. Pain is marked as a rule. In addition incontinence of feces or cicatricial stenosis may result.

Sepsis may follow any wound or operation involving the rectal mucous membrane. The more soiling with feces the more danger there will be of infection. The entrance of feces into the wound prior to the formation of protecting granulations may cause most untoward symptoms, varying from those of slight inflammation to pyemia and death. The loose perirectal connective tissue readily allows of a rapid progressive phlegmonous inflammation (*fecal phlegmon*). The patient complains of great lassitude, headache, poor appetite, and there is a fecal odor to the breath. There is rise of temperature and acceleration of pulse. Should the inflammation approach the surface there will be found the local symptoms of inflammation. Unfortunately this is not always the case. The infection may be deep in the retrorectal connective tissue and not show itself externally. Thence it may spread to the retroperitoneal connective tissue and ascend behind the peritoneum, to form an immense retroperitoneal abscess. In addition the infection may spread anteriorly and involve the tissues around the bladder. In any event unless prompt and efficient drainage is instituted the patient will die of septicemia or peritonitis. It must be remembered that a cryptogenic peritonitis may result from any wound about the rectum or vagina.

Treatment.—Such a process can be avoided by the strict preparation of the patient for operation, care during the operation, an efficient packing of the wound, and care in the after-treatment. The wound should be inspected and a digital examination made on the occurrence of fever or any of the symptoms noted above. Abscess formation should be met by

prompt incision and efficient drainage. Should the infection already have extended to the retroperitoneal tissues, free incisions should be employed and two or more fenestrated drainage tubes be introduced. Smaller abscesses in the perirectal tissue are treated as ischio-rectal abscess. *Thrombosis* of the hemorrhoidal veins occurs through traumatism in the course of the operation. Such a condition is not necessarily septic. These thrombi may break down, however, and *emboli* be carried to various parts of the body with resulting pyemia. Emboli may enter the inferior vena cava through the portal vein and be carried to the lungs. If these are not of a septic character the symptoms will usually subside in a few days. Pulmonary thrombosis may result.

Hemorrhage.—This danger is watched for during the first forty-eight hours. Even in so minor a procedure as the removal of isolated internal hemorrhoids there may result so severe a secondary hemorrhage as to endanger the patient's life. This is favored by the vascularity of the parts and the dilatation of the hemorrhoidal veins. In case the sphincter is able to contract the blood may not show externally and herein lies the danger that this complication may be overlooked until valuable time has been lost. The blood fills the rectum and ascends into the colon. The symptoms of internal hemorrhage develop rapidly or slowly according to the size of the bleeding vessel. There is desire to go to stool. When the bowels do move a large amount of fluid blood and semi-solid clots are passed. *Treatment* consists in accurate hemostasis at the time of operation. This is to be accomplished by the ligature and thermocautery. Oozing areas are to be firmly tamponed. If the hemorrhage is but slight ice-water enemata will be sufficient; if severe, insert a speculum, search for the bleeding point, and ligate it. If this latter is impossible the thermocautery may be employed and the entire rectum tightly tamponed. This will best be accomplished by the forcing into the rectum of a large gauze tampon, to the middle of which is fastened a stout string. The tampon is compressed and its apex anointed with vaselin to facilitate its entrance. It is forced well above the bleeding area. The speculum is then withdrawn and sufficient traction

made upon the string to cause the tampon to reverse the folded position in which it was introduced, so that its inner dry surface is brought forcibly in contact with the bleeding area. This is a painful procedure. The tampon is allowed to remain in place for from two to four days, by which time it has become soaked with secretion and comes away easily. The loss of blood may necessitate intravenous infusion and the usual treatment for shock. The "umbrella tampon," a ten-inch square of gauze surrounding a thick-walled rubber tube may be introduced in place of the folded gauze tampon. The interior of the square of gauze is firmly packed with strips of gauze until the rectum is filled.

Pain varies with the treatment of the sphincter ani and the extent of the operation. In hemorrhoids and partial prolapse the pain is apt to be severe unless the sphincter has been thoroughly dilated. The insertion of a suppository containing two grains of powdered opium will do much to allay the primary pain of the operation. This should be done directly on the completion of the operation. Operations involving the sacral nerves (Kraske's) may be followed by severe pain. **Urinary Disturbances.**—Retention of urine may occur after any operation on the rectum or anus. This will necessitate the use of the catheter for a few days. As a rule the disturbance disappears spontaneously. Incontinence of urine is rare.

Wound Treatment.—In case of hemorrhoids, as in operations for partial prolapse of the rectum, in which no oozing occurs no dressing other than an outer pad is necessary. If oozing is present after any rectal operation or if secondary hemorrhage is feared the rectum is to be packed. If provision is not made for the escape of gas the patient will experience great discomfort. To obviate this a thick-wall rubber drainage tube surrounded with a sufficient number of layers of plain sterile gauze to fill the rectum at the level at which bleeding is expected is inserted. The gauze is tied or sewn to the tube. Introduction is facilitated by smearing the apex of the "umbrella" tampon with vaselin. Iodoform gauze should never be used in the rectum on account of the danger of absorption. Whether packing is used or not a suppository containing two grains of powdered opium is placed

in the rectum. This allays the pain and keeps the bowels from moving spontaneously. The outer dressing or perineal pad is held in position by a T-bandage. This is made to exert pressure in case of external oozing. The bowels are kept closed for four days. If the pre-operative instructions have been followed this will not occasion any great discomfort. Opium is given by mouth in rare cases when a desire for stool is present. The diet is light, fluid for the most part. The bowels are moved on the fifth day by castor oil supplemented by an olive oil enema. If a large cavity connects with the rectum as in resection of the rectum for carcinoma, or in large perirectal abscess cavities, the entrance of fecal matter into the wound before the formation of protecting granulations might result in severe infection. In case of small fistulæ and hemorrhoids the bowels may be moved on the third or fourth day and every other day thereafter until granulation is well-established, following which a daily evacuation of the bowels is desirable. The dressing will, as a rule, come away with the first bowel movement. In cases of resection of the rectum or in cases of large cavities connected with the rectum in which the packing is left *in situ* for a longer period in order to prevent contamination of the wound with feces the packing is removed from the fourth to the tenth day. The rectum is flushed out with a high enema of soap suds. The wound cavity is carefully cleansed by irrigation with boro-salicylic solution and with sponge sticks. Following this the wound cavity is tamponed. This second packing is left in place for four to six days and the process repeated until the wound has passed beyond the risk of complications arising from fecal contamination. In moving the bowels there will necessarily result some disturbance of wound healing. The parts are stretched by the passage of fecal masses. This is somewhat obviated by softening the fecal masses with injections of olive oil. Such a passage is necessarily quite painful. Should the sphincter have been left intact, narcosis may be necessary to repack the parts effectually in case of large cavities. In resection of the rectum when there is much tension on the sutures or when infection of the peritoneal cavity is imminent the bowels are kept locked with opium. In cases in which there

is slight danger of fecal contamination such a course is unnecessary. Following each bowel movement the parts are to be thoroughly cleansed and the wound irrigated with boro-salicylic solution, dried with sponge sticks and packed with plain gauze, each time using a smaller quantity of gauze. To facilitate dressing the patient is placed on his side and the buttocks widely separated by the hands of an assistant. Strong antiseptics, such as carbolic acid or bichlorid of mercury, must not be employed. An outer gauze pad held in place by a T-bandage completes the dressing. Aside from the dressing after each bowel movement, the parts surrounding the wound should be cleansed at least once in every twenty-four hours following the first bowel movement. The number of daily dressings will depend upon the amount of discharge and the number of movements. Large fistula and abscess cases may require as many as three dressings daily for the first few days after bowel movement has occurred. As soon as granulations have sprung up over the wound surface dressing may be done at more extended intervals according to the amount of discharge. Should the granulations assume an unhealthy appearance, become covered with a grayish deposit, painting with tincture of iodin will prove beneficial, or the nitrate of silver stick may be used. Too profuse granulations are to be curetted or cut away with scissors.

The comfort of the patient and the satisfactory course of the wound depends in a great measure upon the cleanliness of the parts. Prior to the period of granulations this must be attended to by the attendant, but when the wound is once granulating the patient may do the cleansing. With this end in view he is instructed to wash with a soft sponge, warm water and castile soap after each movement and place clean gauze against the parts. At least once daily, preferably just before retiring for the night, the patient sits down for fifteen or twenty minutes in a bath of plain water as hot as can be comfortably borne. This is done every night until complete healing is effected. Not only is this a great source of comfort to the patient, but it promotes healing. A saline enema once or twice daily is indicated if there is discharge from the rectum. Rectal wounds, as a rule, must heal by granulation or a fistula is likely to result. To attain

this the wound must be kept open and bridging over at any point which will result in pocket formation is to be prevented. This is particularly the case in cavities which communicate with the rectum, fistulæ, and those separated by the rectal wall above, perirectal abscesses. In such cases drainage must be very free and an extension of the infection watched for. In simple fistula cases in which the fistulous tract has been completely excised and the wound sutured with the view of obtaining primary union, the bowels should be kept closed as long as possible and a daily inspection of the wound made. On the first symptom of wound infection the sutures should be removed and the wound allowed to heal by granulation

Extirpation of the Rectum.—If preceded by sigmoid colostomy, or if the operation is carried out by the abdomino-perineal route (Quenu) the operation loses much of its danger and the after-course is simplified. *After-treatment.*—There remains a large cavity which is packed firmly. The packing is allowed to remain for from four to eight days and repacked every other day thereafter until healing is effected. The case is different, however, if the extirpation is done from below alone or with temporary resection of the sacrum, and then the cut edges of the rectum united to the skin or in the wound. Such a case will be subject to fecal contamination on account of the size and depth of the wound. An additional danger will be found in case the sutures should tear out on account of tension. Fistulæ may develop.

After-treatment.—The suture line is covered with plain gauze and the parts thoroughly packed following accurate hemostasis. The bowels are kept closed by opium for twelve hours before the operation and for from six to ten days following operation. Should they move early before protecting adhesions have shut off the peritoneal cavity there will be great danger of peritonitis. If several days have gone by and the peritoneal cavity is shut off there will still be some danger that the adhesions will be torn away. Following the movement the parts are carefully examined and the condition of the suture line noted. If *separation* has occurred the resulting raw surfaces or cavities are carefully disinfected and packed. The posterior sutures are the ones

generally at fault. As soon as the sutures have fulfilled their function, by the eighth to the tenth day, they are removed. Following the second dressing the parts are dressed every second or third day according to the amount of discharge. It will be advisable in every case to keep the bowels closed with opium until granulation is well under way, generally the eighth to the fourteenth day. To facilitate the removal of the sutures the ends should be left long. Complete union of the suture line is rare. A *fistula* may form connecting the mucous membrane of the attached gut to the skin at some little distance from the new anus. If small such a fistula may close spontaneously. If persistent the intervening tissues between it and the rectum may be incised or the treatment be left until the remainder of the wound has healed and the condition of the patient has improved. *Partial resection of the sacrum* does not seem to weaken the pelvis. *Temporary resection* heals by bony callus. Removal of the *coccyx* has no bad after-effect. *Urinary disturbances*, aside from that common to operation in this neighborhood, may result from interference with the sacral nerves. This disappears spontaneously, but will necessitate the use of the catheter for a few days. The higher the bony resection the more liability there will be to this complication. *Operations for the formation of a new sphincter ani* may be advisable in non-malignant cases if the cicatricial contraction of the wound is not sufficient to ensure a fair degree of comfort.

Course of Rectal Wounds.—After operations for hemorrhoids or fistula the patient may be allowed out of bed on the third day. Usually they will prefer to remain in bed for a week. More extensive operations require from ten days to two weeks in bed. An air cushion or rubber ring will be necessary for the patient's comfort as soon as he sits up. Debilitated patients should be gotten out of bed in a wheel chair at least for a short time daily beginning on the second day.

Stenosis.—*Cicatricial contraction* may result after any operation upon the rectum involving the removal of considerable tissue. It may occur after operation for hemorrhoids, as well as after more extensive procedures for prolapsus or tumor. *Following operations in which the sphincter has not been removed* its occurrence

is to be regretted. Should contraction occur a course of anal dilatation is begun at once. The prognosis will be better in those cases which are recognized early, before firm cicatrization has been effected. As large a dilator as can be easily introduced is first used. The size is increased daily until full dilatation is secured. Following this, dilatation is done every other day, then twice a week and finally at longer and longer intervals. Even after an apparent cure has been effected these patients should report every few months, or sooner if there is any pain on defecation, for a passage of a dilator to ensure against contraction. No force is to be used in dilating, for fear of injury to the delicate rectal mucous membrane. Intelligent patients may be furnished with a suitable dilator and instructed in its use. Such dilators are worn during the night. Recurrences are quite frequent. Plastic operations, such as linear incision, multiple incision or resection of the stricture, may be necessary for a cure.

Following operations in which the sphincter ani has been removed or so damaged as to be useless, a certain degree of cicatricial stenosis is welcomed, as it helps bowel control. If too complete stenosis occur, however, gradual dilatation must be employed.

Incontinence of feces may occur when the sphincter has been sectioned or removed. In the former case the incontinence is usually temporary. If persistent, excision of the scar tissue between the cut ends of the sphincter and suture of the freshened muscular surfaces will suffice for a cure. Following removal of the sphincter cicatricial contraction may greatly aid in preventing incontinence, but in most cases there will remain incontinence of gas and liquid feces. The patient may train himself by going to stool at regular intervals to control his movements to a great extent. Absorbent pads must be worn to prevent soiling the clothes. Should the gluteal muscles be involved in the cicatricial tissue, their action may serve to control the movements in part. Plastic operations have been devised by which slips of the gluteal muscles (Lennander) are stitched around the rectum to act in place of the sphincter.

Prolapse of the rectum may recur, though not often to such an extent as was present before operation. The patient should be instructed to immediately reduce any prolapse which occurs.

They should be warned against straining. Urinary disturbances producing straining should be corrected.

Diet.—For the first few days the diet is fluid, then thicker foods are permitted, but of a character to leave as small residual matter as possible in the intestinal canal. In extensive operations in strong patients albumin water may be employed for ten days as in Kelly's treatment of complete laceration of the perineum. Following the occurrence of granulation a more varied diet may be allowed. Cases in which incontinence is not present are later instructed to eat freely of fruit and easily digested food in order that the feces, while formed, will not produce irritation of the rectum. Straining is to be avoided. Tendency to *constipation* is overcome by drugs if necessary. Usually proper diet and exercise will suffice. Cases of incontinence are placed on a diet which will result in more solidly formed movements; articles of food tending to cause diarrhea are avoided. All cases are instructed to pay strict attention to cleanliness and to go to stool at the same time each day.

CHAPTER XVIII.

EXTRAPERITONEAL OPERATIONS UPON THE KIDNEY AND URETERS.

THE AFTER-TREATMENT OF OPERATIONS UPON THE KIDNEY.

General Rules in the After-treatment of Operations upon the Urinary Apparatus.—Many operations are fatal through lack of care in the preparatory treatment. Many cases die of kidney insufficiency. If the renal condition is approximately normal the prognosis is good even after the most severe operation, but if there is already an element of sepsis present or the functionating power of the kidneys is impaired, uremic septicemia will often follow even minor procedures.

General anesthesia markedly raises the mortality in such cases. Toxemia through the use of antiseptics must be prevented. Cystitis must receive rigid treatment. The functionating of the kidneys must receive careful attention.

In the after-treatment of operations upon the kidney and in operations upon other parts of the urinary apparatus, as in operations upon other viscera, a thorough knowledge of the functions of the kidney is indispensable. Here, as in other operations, alteration in function is to be watched for and serious symptoms combated with prompt remedial measures.

The Urine.—*The amount of urine* is noted, at first every few hours, later daily. The daily amount is of especial significance in nephrectomy, as showing the capability of the remaining kidney. This amount will vary with the amount of secreting kidney tissue removed. In nephrectomy for long-standing hydronephrosis hardly any change may be noted, as the other kidney has undergone gradual hypertrophy to compensate for the increasingly disabled diseased kidney. With the removal of a considerable amount of functionally active kidney tissue, the danger of disturbing the equilibrium of the remaining kidney is greatly increased.

Anuria will rarely follow in cases in which properly indicated operative procedures have been instituted. It is caused by reflex shock to the renal plexus of nerves and may occur not only after nephrectomy, but after other operations upon the urinary apparatus, or independent of the character of the operation, may result from the effects of the anesthetic on the kidney structure itself. It may last for hours or days and fortunately, if properly dealt with, only in rare instances eventuates in death. The cause must be immediately sought.

Following nephrectomy the first supposition would be that there had been but one kidney and that the extirpated one. Careful preliminary examination should prevent this accident or if there remain any doubt of the existence of the second kidney, its presence should be demonstrated at the operation by actual palpation through the wound. If there has been a history of nephrolithiasis the anuria may be due to the blockage of the ureter of the unoperated kidney by a calculus. This can be remedied by nephrotomy. The *amount of urine* passed in the first twenty-four hours depends greatly upon how much hypertrophied the remaining kidney has become or how well fitted it is to carry on the function of the extirpated kidney. In general

it may be stated that the amount will be one-half that usually passed during the first twenty-four hours following operations other than those upon the renal organs. At the end of one week the amount of urine should become approximately normal. This does not mean in all cases that the *compensating hypertrophy* has become complete, but only that the remaining kidney is capable of performing the work and will in all probability become sufficiently hypertrophied to completely compensate for the loss of the diseased kidney. Following this there may follow a period of polyuria, the amount gradually becoming normal at the end of several weeks. In those cases in which the remaining kidney is not fitted to entirely carry on the work unaided, there will be found a compensating hypertrophy of the left ventricle as a result of an attempt on the part of nature to relieve the overworked kidney by a greater cardiac activity. If the remaining kidney is diseased this compensation may not suffice and the patient will succumb to uremia. The time at which death will supervene will depend upon the extent of the lesion in the remaining kidney.

The first symptoms of anuria, if the urinary secretion is carefully watched, will be the failure of any passage of urine. Catheterization will quickly determine whether this failure is due to simple retention or to suppression. If the former, there will be a quantity of urine in the bladder sufficient to demonstrate the functional activity of the unoperated kidney. If less than an ounce is found in the bladder, and a sufficient time has elapsed for the proper secretion of a greater amount at that time following operation, a condition of anuria is to be suspected. A high tension pulse will lead to investigation of the functional activity of the unoperated kidney. With the high-tension incompressible pulse is associated a peculiar brilliant appearance of the eyes and a rosy flush of the skin, particularly of the skin of the face, and a degree of restlessness. These symptoms are of themselves sufficient to cause an immediate resort to remedial measures. If in addition to the above there be added violent, continuous headache, vomiting and marked drowsiness, there can remain no doubt of the diagnosis. To these symptoms, unless intervention prove immediately successful, will be added partial or

complete unconsciousness, convulsions and the symptoms of uremic coma.

The *treatment* for anuria, to be effective, must be undertaken early in the course of the complication. By far the greater number of nephrectomies in which uremia develops die. The best treatment is preventive. A careful selection of cases, a thorough examination of the supposed healthy kidney, the selection of an operative procedure proper for the individual case, care in the operative technic to avoid unnecessary injury, and a carefully systematized after-treatment will do much toward lessening the number of fatal cases. Yet there always will remain a certain proportion of cases in which this complication will occur either from some one of the causes noted above, from the anesthetic, or from some apparently unexplainable reason. *Preventive after-treatment* consists in efficient pre-operative study and preparation. In the first twenty-four hours, in wrapping the patient in warm blankets to produce diaphoresis, the administration of digitalis in ten-minim doses every four hours by hypodermic injection or by the stomach if it will be retained, and the giving of *enemata* of one quart of normal saline solution at a temperature of 115° F. every four hours. In addition, hot fluids are to be given by the mouth as soon as the cessation of anesthetic vomiting permits. Saline, 750 to 1000 c.c. is given by hypodermoclysis while the patient is still under anesthesia. In addition whatever stimulation is necessary through weak heart or respiratory action, or through shock is administered. The digitalis should be stopped at the end of the first twenty-four hours. The enemata are continued until the patient is taking a full amount of fluids by mouth, usually at the end of thirty-six hours. A close watch is kept upon the condition of the heart, skin and amount of urine passed. Should symptoms of beginning anuria develop in spite of every precaution, an *intravenous infusion* of normal saline solution at a temperature of 120° F. is to be given immediately in order to raise the blood pressure, and this by lessening arterial tension, permits the kidney to resume its function. Saline infusion serves the additional important purpose of diluting the toxins in the blood. The quantity of saline solution injected varies from forty to

sixty ounces and may be repeated several times, as often as the blood pressure diminishes or until the cases become hopeless. Hot baths may be employed. Nitroglycerin gr. 1/150 combined with caffein citrate gr. 1 are the two drugs which act best in this condition. These doses may be given hypodermically every three hours until the tension of the pulse is relieved. The entire body may be wrapped in cloths wrung out of hot water, and evaporization from them prevented by covering the patient, with the exception of the head, with mackintosh or similar impervious material. This latter is done to stimulate the activity of the skin. A tent may be constructed over the bed and the air around the patient's body kept at a high temperature by live steam from a croup kettle. The head should be kept outside the tent. Purgatives are given to help in the elimination of the toxins in the blood. It is to be remembered that the inactivity of the kidney may be due in part to the irritating quality of the fluid which is to be excreted, and if this irritating quality is diluted by infusion and partially removed by catharsis and diaphoresis, there is present a condition which is most favorable for the renewed activity of the kidney. At the very least we can extend by these means the time during which the kidney can recover from any shock inflicted through the renal plexus, and can adapt itself to the new conditions. *Venesection* may prove useful, particularly in plethoric patients, by removing a quantity of the toxins with the withdrawn blood. Ten to sixteen ounces may be withdrawn, and the volume of the blood increased and the toxin diluted by the injection of double the quantity of saline solution.

The *chemical* and *microscopical examination* of the urine will show the condition of the remaining kidney. The pressence of a small amount of *albumin* is not of significance, being usually due to the anesthetic and but transitory. The use of strong antiseptics in the course of the operation or of the after-treatment will cause albumin to appear in the urine. The withdrawal of the objectionable drug will usually be sufficient to cause the disappearance of the albumin in a few days. For this reason no strong antiseptic should be used in a kidney wound either for irrigation or gauze drainage. Iodoform and carbolic acid par-

ticularly are to be avoided. The continued presence of albumin in the urine, particularly if there are also present blood and pus, can only mean that the remaining kidney is diseased. This condition is rendered all the more certain if a purulent cystitis or ureteritis of the operated side has not existed. Following nephrotomy the *presence* of *pus* or *blood* must be excluded as coming fron the operated side. The first point to determine in such cases is the patency of the ureter of the operated kidney. This should have been determined during the operation by passing an ureteral catheter downward if the pelvis of the kidney had been opened. Decisive evidence is furnished by the cystoscope.

Hematuria.—Following any renal operation in the course of which there is more or less handling of the organ, there will result a temporary hematuria. This will particularly be the case when the kidney has been separated from its fatty capsule, brought into the wound and palpated for stone, and following exploratory puncture or incision and nephrolithotomy. Following nephrorrhaphy in which sutures have been passed through the substance of the kidney, there will also be noted a transitory hematuria. The amount of blood will vary according to the amount of traumatism inflicted. If slight, the presence of blood may be only determined by the microscope; or if the exploration has been extensive, blood will appear in appreciable quantities. Such hemorrhage stops spontaneously after a period varying from a few hours to four days. No treatment is necessary.

Renal Wounds.—If any portion of the kidney has been left antiseptics must be rigorously avoided. Kidney tissue is peculiarly sensitive to the toxic influence of carbolic acid, iodoform and bichlorid of mercury. These drugs will cause a fatty degeneration of the renal tissue, and if their use is continued, result in parenchymatous nephritis. We cannot at the present time avoid, except by spinal analgesia, the occurrence of temporary albuminuria from the anesthetic, but we can and should prevent the damaging effects produced by the action of deleterious drugs, either directly in contact with remaining kidney tissue in the wound or brought in contact with the other kidney through absorption. Therefore asepsis is to be preferred to antisepsis.

Nephrorrhapy.—The main care in the after-treatment, whatever form of operation has been performed, is the proper support of the kidney by a suitable dressing until such time as sufficiently strong adhesions have developed to maintain the kidney in position. In order to *support the kidney* several folded towels are placed in front on the abdominal surface of the operated side the upper edge of the pad at the level of the umbilicus, and retained in place by adhesive plaster and a snugly fitting binder. This, after wound healing and before the patient is up and about, is replaced by a manufactured support for a period of from two to six months following the operation, such support being removed only for purposes of cleanliness. During this period every strain must be avoided. The patient is to be kept quiet in bed for two to three weeks, following which sitting up, out of bed and walking follows as strength permits. Allowing the patient up too soon or too early exercise is quite likely to result in a recurrence of the trouble or a stretching of the scar tissue. In any event there may be a period attended with some discomfort, during which a slight stretching of the scar tissue occurs.

Nephrotomy.—The difficulties in the after-treatment of nephrotomy cases depend largely upon the diseased condition for which the operation is done. The chief complications of the operation, aside from those common to all renal operations, are hemorrhage and urinary fistula. The simplest operation is *exploratory puncture.* This operation necessitates the dislocation of the kidney from its fatty capsule. The after-treatment is somewhat similar to that of nephrotomy. Less packing is necessary and a more complete closure of the wound is permissible. The final packing may be removed earlier, on the eighth day, and secondary suture used at that time to complete the closure of the wound. The patient may be allowed out of bed on the fourteenth day. If the kidney has not been much disturbed this period may be even shorter. A kidney support should be worn for a period of six to eight weeks. If in addition an exploratory incision has been made or **nephrolithotomy** performed, the stay in bed will be slightly lengthened. The primary dressing in such cases (except in those cases which allow of immediate suture of the kidney wound in which event the case

will be treated as one of exploratory puncture) will be so graduated as to exert pressure on the bleeding surface of the kidney, and will be supplemented in this endeavor by a supporting pad over the kidney and a binder. This dressing will not be removed for from forty-eight to seventy-two hours, and then very carefully to avoid a renewal of the hemorrhage. Should *hemorrhage* occur before this time, as evidenced by bright red blood soaking the dressing, the gauze packing is to be changed. Should the loss of blood exercise a depressing effect upon the patient's heart, a second operation is to be considered. Such an operation would consist first in an attempt to arrest the hemorrhage by suture, and this failing, an extirpation of a part or the whole of the kidney. An intravenous infusion should be given as soon as the bleeding is under control and other appropriate remedial measures applied. The *discharge of urine* from a wound of this kind renders frequent changes of dressing necessary. A satisfactory outer dressing is furnished by paper wool in flat bags. These are changed as freguently as soiled. The wound dressing of plain or zinc oxide gauze is changed once or twice daily, according to the amount of discharge. Such wounds are liable to fat necrosis and saprophytic infection. The discharge of urine through the wound will soon cease if the ureter is not obstructed. The rapidity of its stoppage also depends somewhat upon the area of the secreting surface exposed. Those cases in which the pelvis of the kidney alone has been opened, pyelotomy, are dressed in a somewhat different manner. If for exploratory purposes and the wound in the pelvis sutured, a small strip of gauze will be led directly to the suture line. This serves as a drain in the event of leakage. If the wound in the pelvis has been left open to drain the kidney, a thick-walled rubber drainage tube of large caliber surrounded by gauze is placed so that it will serve as a conduit. The gauze packing is renewed at the end of forty-eight hours. Thereafter dressing is done daily until the eighth day, when the wound surface will have granulated and the danger of wound infection be passed. The tube may be removed at this time if drainage of the pelvis is no longer desirable, a small packing taking its place, and the wound allowed to close. If the condition of the pelvis or ureter does not permit of this, the tube may be left *in situ* until

the necessity of draining the pelvis has passed. In any event on the eighth day the tube is to be removed and thoroughly disinfected before being replaced. This should be done every third day thereafter. Care should be taken that undue pressure be not exerted by the tube. The discharge from the tube is caught by thick pads of paper wool. This procedure for *pyelonephrosis* usually results in a cessation of the fever. If, however, the fever continues high, an infection of the parenchymatous kidney structure is present, provided cystitis, disease of the other kidney or of some other organ can be excluded. Operation upon the substance of the kidney is then indicated. Nephrotomy for *pyelonephrosis* is still more difficult to care for. Here not only is the pelvis of the kidney opened and drained, but the kidney tissue itself is freely incised and all pus pockets opened. If the process has been long standing there may have been some attempt at isolation of the abscess cavity, but usually we have presented for wound treatment a large mass of completely or partially destroyed kidney tissue and a large suppurating sac, the pelvis of the kidney. The wound is left open. Thick-walled drainage tubes of large caliber are placed in parts of the wound where they will act most efficiently. The remainder of the wound is loosely packed with gauze unless there is considerable hemorrhage, in which case tight tamponade must be adopted for forty-eight hours. If hemorrhage is feared, the dressing is undisturbed for forty-eight hours and then carefully renewed. Otherwise the wound is dressed at the end of twenty-four hours and once or twice daily until the discharge materially lessens. The drainage tubes are to be taken care of in the same manner as when the pelvis alone is drained. The outside pads of paper wool are to be changed as frequently as soiled. If the process is a *tuberculous* one a moderate, irregular fever may be expected to continue. Nephrotomy only affords temporary relief in these cases, and is performed in those cases in which a more radical operation, nephrectomy, would prove too great a shock in an already emaciated and feeble individual. These cases almost invariably require a secondary nephrectomy before a final cure is obtained. In such cases the determination of the condition of the second kidney is imperative. Should the case not be tuberculous, a

probable cure will be effected by drainage. Wound cleanliness may be secured by daily irrigation of saline solution. Dilute solutions of potassium permanganate or nitrate of silver are of considerable value. If pus still finds its way into the bladder, this may be irrigated daily with the above mentioned solutions to keep the bladder or other kidney from becoming infected. If sluggish granulations develop, they may be scraped away with a sharp curette and the wound packed with plain gauze wrung out of a fifty per cent. aqueous solution of alcohol. Balsam of Peru is not to be used for this purpose, as the cinnamic acid it contains may prove harmful to the kidney structure. The indication for the removal of the tube or tubes is found in case they no longer drain, or in case of the tube draining the pelvis when the urine escaping through this becomes normal. Urinary infiltration under the foregoing treatment cannot occur. After removal of the tube the *urinary fistula* remaining will readily close if it leads to parenchymatous tissue and the ureter is not stenosed or contracted. If an opening into the pelvis of the kidney exists, as cited, the fistula will not close readily. A course of wound stimulation and cicatrization is started, curetting, the nitrate of silver stick, and the thermo- or galvanocautery being employed. If, after an interval of several weeks, no improvement is noted the fistulous tract is dissected out in its entirety and the edges of the opening in the pelvis of the kidney freshened and united. A small gauze drain is left in case of leakage. If there is any *obstruction* whatever *in the course of the ureter*, such a procedure will not be successful. Obstruction may be caused by stone, by narrowing, by cicatricial stenosis, by kinking, or from disease (tuberculosis). Should the other kidney be diseased, the patient must remain content with the urinary fistula except the obstruction in the ureter be low down near the bladder, in which event ureteral-vesical, ureto-ureteral anastomosis or an implantation of the ureter into the rectum might be advisable. The dilation of stricture of the ureter, either by passing flexible sounds from the pelvis of the kidney or by cystoscope through the bladder, is practicable and should be tried. If the remaining kidney is healthy and other means of closure fail, the affected kidney may be extirpated. The ad-

visability of this procedure must be decided in individual cases. A secondary operation of this kind offers greater technical difficulties, on account of the adhesions, than a primary procedure. In cases of *hydronephrosis* alone greater efforts are to be made to save the kidney. The hydronephrotic sac contracts with great rapidity. The most frequent cause for the persistence of the fistula lies in a kinking of the ureter from malposition of the kidney pelvis. If so, correction of the position of the kidney may result in restoring the patency of the ureter. In any event the course of the ureter should be explored and the possibility of correction of the obstruction by resection, dilatation, ureto-ureteral anastomosis or rectal implantation demonstrated before resorting to nephrectomy in those cases in which a fair amount of kidney tissue is present. It is to be remembered that the greater the amount of urine flowing through the fistula, the greater amount of parenchymatous tissue present, and hence the greater need for saving such a kidney.

Fat Necrosis.—By reason of the amount of fat surrounding the kidney, the after-treatment of operations upon that organ may be complicated by extensive fat necrosis. If infection occurs in addition, the wound will assume a greasy, indolent aspect and a saprophytic odor will be noticed. Gauze wrung out of a fifty per cent. aqueous dilution of alcohol is quite effective in combating the infection and restoring a normal appearance to the wound.

Partial Nephrectomy.—A partial nephrectomy, in which for some reason secreting kidney tissue is left, or when it is found impracticable to remove the entire pelvis of the kidney, is treated by packing the wound firmly with gauze and suturing the wound in part, allowing room for the emergence of the gauze at the lower angle. This dressing is changed at the end of forty-eight hours and a lesser quantity of gauze introduced. Dressings are done daily or every second day, according to the amount of wound secretion. The wound is allowed to close as rapidly as possible. Secondary suturing may be employed as soon as the secretion from the kidney surface has ceased. When possible any secreting kidney substance left or the lining of the pelvis of the kidney should be treated with the thermocautery

at the time of operation. A urinary fistula resulting from the leaving behind of parenchymatous tissue is to be treated as previously set forth. A fistula the result of leaving behind some of the lining membrane of the pelvis of the kidney is to be treated in the same manner. If, however, much of this lining membrane has been left it will be found that ordinary means are not sufficient, and a second operation will be necessary to completely destroy, or better, remove the secreting portions. *Complete nephrectomy* with destruction of the exposed lining of the remaining portion of the ureter with the thermocautery is treated by almost complete closure of the wound, a very small gauze drain being placed over the stump of the ureter to guard against retention of secretions and to warn of hemorrhage from the ligated vessels. This is removed at the end of forty-eight hours and the wound allowed to close. If much serum has collected it will be well to replace the gauze drain with a small, one-quarter inch rubber drain until such secretion lessens. Hemorrhage is rare, but should be watched for. Should it occur, the wound is to be rapidly opened and the vessels grasped with the left hand while one or more heavy, long-handled clamps are applied with the right hand. These clamps are allowed to remain *in situ,* supported by a gauze packing, for a period varying from three to four days. Their removal is to be accomplished with great care. After nephrectomy, as in all kidney operations in which hemorrhage may occur, the patient is to be kept at absolute rest for a period of at least four days. The occurrence of *hernia* following lumbar incisions is very rare.

Following *extraperitoneal plastic operation* upon the ureters, a tell-tale drain is left in place for forty-eight hours. There is rarely any leakage and following the removal of the drain the tract heals readily.

CHAPTER XIX.

OPERATIONS UPON THE BLADDER.

Puncture of the Bladder.—This operation may be employed as a temporary or permanent procedure in cases in which it is

not deemed advisable at the time to resort to more extreme measures, and by it acute cases of retention may be tided over for a few hours until they can receive more radical treatment. In some cases emptying the bladder sufficiently relieves the congestion at the neck of the viscus to allow normal evacuation later. Chronic cases with an acute exacerbation may be also tided over. Debilitated subjects may be permanently drained by puncture, or at least until such time as their general condition sufficiently improves to warrant a removal of the cause of the obstruction.

The safest and most direct method of puncture is the suprapubic route. The parts are shaved and disinfected, the operator's hands cleansed and a large aspirating needle sterilized. If a permaennt puncture is to be made a large trocar and cannula (Fig. 194) and a knife are sterilized. The trocar and cannula

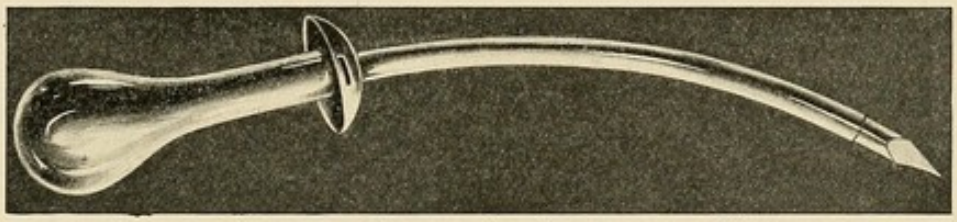


Fig. 194.—Curved trocar and cannula for suprapubic puncture of the bladder. (Fowler's Surgery.)

should be curved, the trocar having a groove in its side to permit of the urine passing as soon as the bladder is entered. The distended bladder is mapped out by percussion and a point in the median line selected one-half inch above the symphysis. The skin is made tense, and in case it is wished to tide the patient over for a few hours only, the aspirating needle is plunged in a downward direction into the bladder, the urine evacuated, the needle withdrawn, and the minute skin opening covered with a piece of sterile adhesive plaster. This procedure may be repeated at intervals should occasion demand, nor need the same site of puncture be used, but to one side or the other. If *multiple puncture* is to be performed a smaller needle should be employed.

If, however, *permanent drainage* is desired, a small skin incision is made and the curved trocar and cannula concavity downward

to avoid any possible injury to the peritoneum, plunged downward and backward through the tissues and into the bladder. *Precautions.*—It must be remembered that the fold of peritoneum reflected on the superior bladder wall is, in the normal condition of the organ, below the level of the upper border of the symphysis, and that even in extreme distention seldom exceeds two inches above the symphysis. In some instances this fold does not even rise ubove the symphysis. So that while the fundus of the bladder may reach the umbilicus, the portion uncovered by peritoneum may be relatively small. This is mentioned to emphasize the importance of directing the puncturing instrument downward. The trocar having been withdrawn, the cannula is fastened in place with two tapes passed around the body. A dry gauze dressing may be applied, or better, a small rubber catheter is introduced through the cannula and the urine syphoned off by a Dawbarn's apparatus. As soon as granulations have formed, the apparatus is withdrawn and replaced by a Bangs suprapubic drain, the catheter of which is cleansed regularly to prevent incrustation. When the patient is up and about the catheter is connected with a rubber urinal. Apparatus having in view the prevention of the escape of urine through the tube so that the flow may be under the control of the patient are impractical. When the case has been drained for a sufficient period, the catheter is withdrawn. As a rule the resulting fistula heals readily, providing the normal flow has been reestablished.

Retrocatheterization.—In case of severly lacerated urethra it sometimes is advisable not to spend too much time and effort in an attempt to enter the bladder by dissection through the perineum. In such cases a small sound may be introduced through a suprapubic cannula and made to engage in the urethro-vesical orifice, whence it is crowded into the perineum. This acts as a guide and greatly facilitates the dissection of the perineum.

Infiltration of urine complicates bladder wounds if drainage is not adequate. Normal urine is aseptic but makes a good culture medium so that if efficient drainage is not provided infection quickly occurs and *diffuse cellulitis* results.

Healing in wounds of the bladder is *retarded* by the flow of

urine over the wound. Ammoniacal urine causes marked interference with healthy granulation. The granulations are sluggish and grayish. Triple phosphates form incrustations in the wound. The treatment is directed toward securing a better condition of the urine.

Suprapubic Cystotomy without Drainage. *Ideal Suprapubic Cystotomy with Complete Closure of the Wound.*—An adhesive-plaster Scultetus is applied over a small wound dressing of plain gauze and the patient placed in the elevated head and trunk position so that the intraabdominal pressure will serve to obliterate any dead space in the space of Retzius. The patient is allowed up in twenty-four hours. A retained catheter is worn for seven days. If, as in children, this proves irritating, frequent catheterization may be substituted. Aside from the usual wound complications pocketing of serum, later undergoing *infection* may occur in Retzius' space. This requires opening of the wound and drainage. If opening is delayed extensive *cellulitis* will result.

Course of the Bladder Wound with Tamponade of the External Wound.—The same care is taken to prevent distention of the bladder. A tight binder is applied and the patient allowed to move about in bed freely. The tamponade is removed in four days and the wound strapped. Subsequently, if no complication has occurred the patient is allowed up and about.

Following either operation *failure of union of the bladder wound* may occur. This calls for the introduction of bladder drainage. Two tubes are preferable as they permit of easier irrigation of the bladder. Here, unlike temporary drainage introduced at a set operation (Gibson's method) it is difficult to effect proper syphonage and frequent change of urine-soaked dressings is necessary. Following removal of the cause of the leakage (complicating cystitis, infection, infrequent catheterization with bladder distention, general debility), the bladder wound usually heals rapidly; if not, a secondary operation is indicated.

Suprapubic Cystotomy with Temporary Drainage (Gibson's Method).—The after-care of these cases is less irksome than where separation of the bladder wound following complete closure

has occurred. The technic of the operation results in a channel with inverted mucous membrane. This channel closely grasps the drainage tube and leakage is unlikely. Upon withdrawal of the tube wound closure promptly follows. If *permanent suprapubic drainage* is desired the suprapubic opening is prevented from closing by Bangs' suprapubic drain (Fig. 195), a catheter retained in place by a specially constructed hard-rubber pad to which tapes are attached.

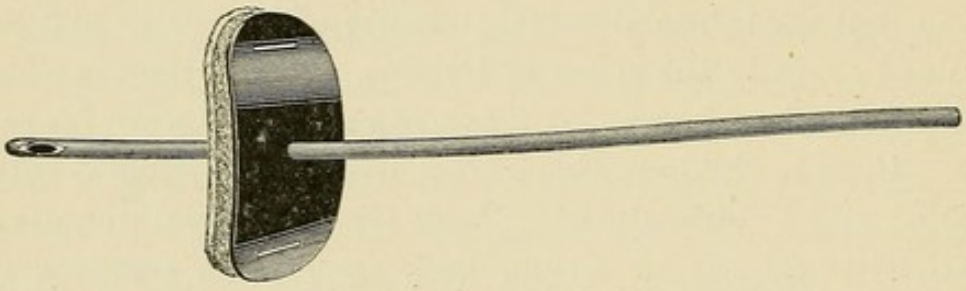


Fig. 195.—Dr. L. Bolton Bangs's suprapubic drain. (Fowler's Surgery.)

Dawbarn's Apparatus for Suprapubic Drainage of the Bladder (Fig. 196).—Properly arranged this serves excellently in keeping the parts dry. The illustration and legend explain the application.

The bladder may be kept from overflowing and the patient kept dry by a vacuum-creating water nozzle attached through the medium of a large vacuum bottle to a vacuum tube. The vacuum tube should rest inside the drainage tube and should be so fastened as to be suspended in the bladder and not touch the mucous membrane. There should be plenty of room alongside the vacuum tube for air to enter the bladder. The vacuum-creating water nozzle with various tips and needles forms the best method of aspirating cavities or of keeping the operative field dry.

Lithotrity.—The patient is kept in bed for a few days. The diet should be nonirritating and as much fluid given as the patient can comfortably assimilate. Morphin is given to relieve pain which is for the most part urethral and caused by large instruments. Pain is more severe if parts of the stone have been overlooked and blood and epithelium will persist in the urine. Small particles pass or may form nuclei for more stones. There is some blood and epithelium in the first urine

passed, but no detritus if the bladder has been thoroughly washed. There may be slight fever and malaise for which sodium salicylate in ten-grain doses every four hours may be given. If

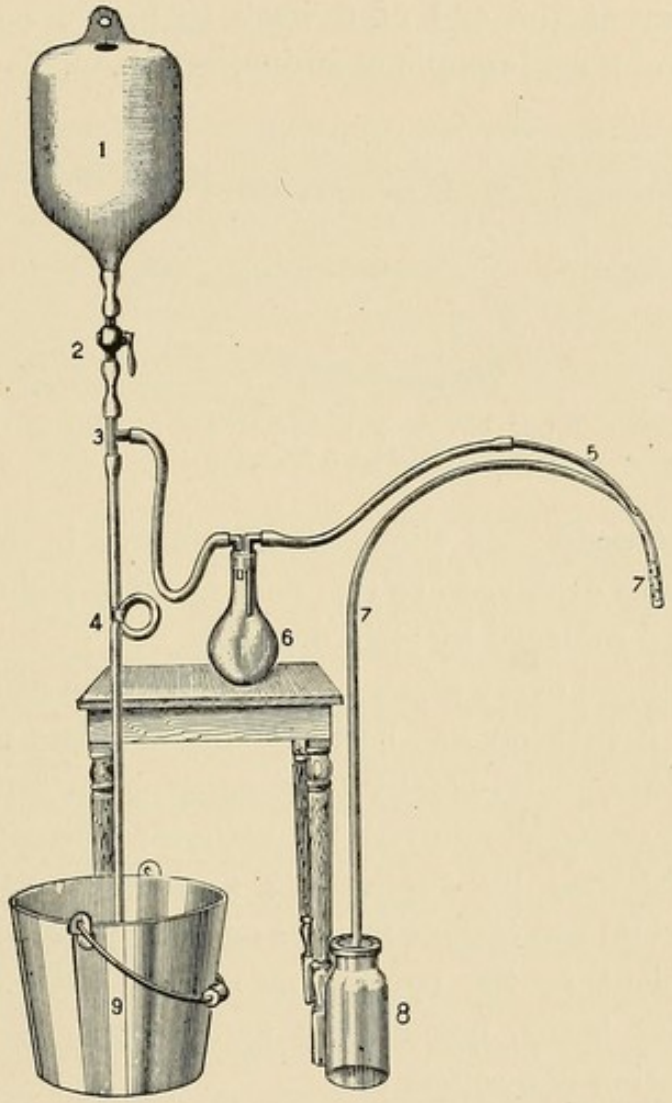


Fig. 196.—Dawbarn's apparatus for suprapubic drainage of the bladder (modified). 1, Fountain syringe; 2, shut-off cock; 3, T-connection; 4, trap made by coiling the rubber outlet tube on itself and securing it with adhesive plaster; 5, catheter passing through the wall of the perforated outer tube 7, which passes through the suprapubic opening and rests in the bladder; 6, Wolfe bottle for collecting the urine; 8, bottle in which tube 7, intended to carry off the urine in case the apparatus fails to work from blocking of the catheter or any other reason, terminates; 9, receptacle for discharges of water from apparatus. (Fowler's Surgery.)

there is complicating cystitis the fever is more marked. *Cystitis* is prevented and treated by urotropin gr. viiss combined with benzoate of soda gr. x every four hours. If the urine is diminished in quantity saline is administered by rectum every three or

four hours. If cystitis persists the bladder is irrigated (Fig. 197) two or three times daily with warm boric acid solution and a half ounce of 10 per cent. argyrol left in the bladder at each irrigation. The bladder should be thoroughly washed out with the evacuator at the end of a week to insure removal of all fragments and a cystoscopic examination made.

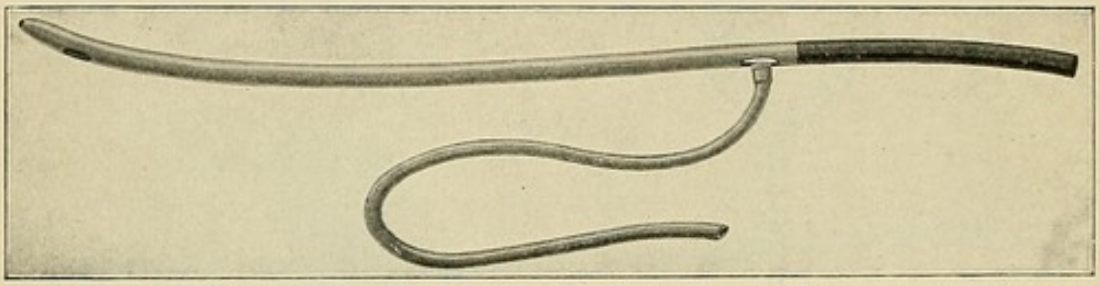


Fig. 197.—Soft-rubber two-way catheter for irrigating the bladder. (Fowler's Surgery.)

Prostatic Abscess.—If the urethra has not been opened the tube and gauze drainage are removed in forty-eight or seventy-two hours and replaced by strip drainage.

This is changed every second day. Irrigation of the wound is unnecessary if incision has been adequate unless stagnation of secretion occurs. The usually *accompanying urethritis* is treated. *Retention of urine* is relieved by catheter unless urethritis is present, otherwise by suprapubic aspiration, using a small needle. Several aspirations may be necessary; usually, however, one is sufficient as the congestion rapidly subsides following incision. Hot baths, hot enemas and morphin should be tried before aspiration is resorted to.

Perineal Cystotomy. *After-treatment.*—The *bed* ready to receive a perineal section case should be prepared with a rubber sheet, and a quart bottle should be swung at the side of the bed by means of a piece of roller bandage, so fastened as to allow of ready removal. The bottle is concealed by pinning a folded towel around it. As soon as the patient has been placed in bed the perineal tube is connected with a tube, thick-walled, to prevent blockage by kinking or by the patient's limb resting upon it, and of sufficient length to reach under the thigh and over the side of the bed, there to enter the collecting bottle. The connection should be of annealed glass. The tube should be

of sufficient length to allow of the patient's changing his position in bed without dragging upon the tube. Gauze or other absorbent material should be placed against the perineum to receive any urine which may leak out alongside of the perineal tube and so prevent wetting the bed. This gauze is changed as frequently as it becomes saturated not only for the sake of comfort, but to prevent septic complications of the perineal wound. The same rule applies to the bedding. The bottle is to be emptied and cleaned frequently to prevent overflow and odor. Two ounces of 5 per cent. carbolic solution in the bottle will prevent odor. Its contents are noted, both as to quantity, appearance and odor. A daily urinalysis is made as long as the tube is in place and at sufficiently short intervals thereafter to give warning of the presence of cystitis or of its progress if it is already present, or of complicating renal disease. If for any reason the tube does not carry off the urine, an immediate investigation is in order. This stoppage may occur early, in the first twenty-four hours, or during the second twenty-four hours, or after a considerable time. The first step in investigating the cause of this accident will consist in thoroughly investigating the patency of the tubes, both connecting and perineal.

In the first twenty-four hours it may happen that a blood clot from the bladder has become lodged in the tube. It is to be remembered that the ideal perineal tube projects but a short distance, three quarters of an inch into the bladder. The short distance is sufficient to allow for the pull on the tube caused by swelling of the perineal wound and the tube projects but a few inches beyond the perineum where it is connected with the larger tube leading to the bottle. The advantage of this is that the tube being short, a blood clot can be displaced by introducing a probe or thin forceps into the tube. If the patency of the tube is assured it may be that a large clot or a number of clots have collected within the bladder and are pressing against the opening in the tube. This is a more serious matter. A study of the urine in the bottle will aid in arriving at this conclusion. If a number of clots and a quantity of fluid blood have passed into the bottle, this complication may be suspected. Irrigating with a warm solution of boracic acid or a minute

quantity of equal parts of peroxid of hydrogen and bicarbonate of soda followed by saline irrigation aids in disintegrating the clots and allowing them to pass or in bringing them in reach of a pair of slender forceps. The bladder is carefully watched to prevent distention. If all else fails, the tube is removed and the clots scooped out with the finger or a blunt spoon, aided by irrigation. The tube is then replaced. A similar condition attends when the tube has become displaced inward, so that its opening is impinged upon by the bladder wall. In this case clots will not be present and a slight withdrawal of the tube will reestablish the flow. Or the tube, through the restless tossing of the patient incident to his recovery from the anesthetic, may have been displaced outward, the neck of the bladder closing behind it or on the opening if a tube with lateral opening alone has been used. A slight intromission will cause the urine to pass. In this latter case no urine will be likely to pass alongside of the tube, the bladder will become distended, possibly a dribbling will ensue, but this will in all likelihood be through the tube and not alongside of it. In stone cases a calculus which has been overlooked may cause the blockage, though this would be a rare occurrence, the treatment for which would be temporary removal of the tube and securing of the calculus. Not only must the tube be short in order to satisfactorily attend to these complications, but it must also be thick walled, or the contraction of the neck of the bladder will shut off the flow. A thick-walled rectal tube, 36 French, with the opening at the end will be found most satisfactory.

In the second twenty-four hours the danger from blockage greatly decreases. The patient has recovered from the anesthetic and is content to rest quietly. The danger from hemorrhage is less, though clots may still occur. The principal cause of blockage during this time is from *swelling of the perineum,* which will result in dragging outward the tube which has been fastened there by stitches. To guard against this the tube, at the time of operation, is placed three quarters of an inch beyond the neck of the bladder to allow for this swelling. Accurate hemostasis, as well as careful suturing of the tube at the time of operation, will tend to prevent excessive swelling. In addition to slight

perineal swelling, swelling from *extravasation* must be watched for and dealt with radically. Any boggy or reddened areas are to be opened up freely and drained. If stoppage from this cause does occur the sutures are to be cut and the tube gently pushed along until the flow is reestablished, when the tube is again sutured in place. Displacement may occur at intervals during the course of the after-treatment. After the fourth day, however, granulations have sprung up around the tube and leakage is not apt to produce untoward symptoms. In cases requiring long-continued drainage if the tube is not regularly removed and cleansed about every third day, *phosphatic deposits* may occur on the tube and produce blockage, or even if not extensive enough for this, these deposits will keep up a degree of cystitis which would otherwise yield to treatment. Part of this deposit may become separated from the tube, remain in the bladder and produce calculi.

In cases in which oozing is expected with consequent clot formation and in cases of cystitis continuous bladder irrigation with saline is employed beginning on the operating table (Young). This is accomplished by using a double-current perineal tube or two tubes may be laid in the bladder side by side the intravesical ends being sewn together and the ends cut obliquely. Using two tubes in this manner simplifies the care of the bladder. If blockage does occur the irrigation is changed from one tube to the other until the obstruction is overcome. If a clot becomes engaged in the lumen of one tube and the irrigation fails to displace it, it can be removed by stripping the tube with the finger thus sucking it along the tube. In hemorrhage cases it is important that the bladder be entirely freed from clots at the time of operation and then the continuous irrigation at once instituted. A large irrigating tube is necessary. At first the fluid is allowed to flow rapidly but as it becomes less bloody the flow is slowed by clamping the irrigation tube. After several hours it can be stopped entirely not to be renewed unless hemorrhage recurs.

While the patient is being transferred from the table to the bed the bladder is left full of fluid to prevent clotting and both tubes are clamped.

The *diet* for the first few days should be nutritious, but of a

character to leave small residue in the bowel. Fluids should be given freely to prevent kidney complications, or if such already exist, to assist in flushing out the kidneys. It is to be borne in mind that blockage of the flow causing back pressure on the kidneys may result in kidney complications of a serious nature, aside from the discomfort such an accident gives the patient.

In *simple uncomplicated cases,* such as stricture or cases in which prolonged bladder drainage is not indicated the urine being acid and aseptic the *tube may be removed* on from the second to the sixth day and the patient allowed out of bed. In stricture cases the sooner the tube is removed, and the sooner sounds are passed, the less likelihood there is of urinary fistula. In cases of *resection of scar tissue* the tube should not be removed except in emergency before the second day, for it takes that much time for the anterior portion of the urethra to become fixed in the wound.

Protecting granulations which prevent infection of the wound and consequent cellulitis do not form until from the fourth to the eighth day. Subsequent to removal the patient is instructed to *urinate standing* with the thighs pressed close together and a folded towel against the perineum. A full-sized sound is passed on the withdrawal of the tube and repeated every other day for at least two weeks, subsequently at more and more extended intervals according to the amount of contraction for one year succeeding the operation. At least once every six months thereafter for some years the urethra should be explored to ascertain if any recontraction has occurred. Any such should at once be treated by graduated sounds. The introduction of an instrument into the urethra may be followed, even in aseptic cases, by a rise of temperature and a chill. The temperature may go as high as 104° or even higher. This need not occasion alarm. The administration of urotropin in five-grain doses with sodium benzoate five grains every four hours for several doses preceding and following instrumentation acts as a prophylactic.

In cases of *anterior urethrotomy* in connection with perineal section or when there has been much instrumentation, the patient will experience great comfort from an occasional irrigation of the anterior urethra. The urethra should be irrigated with

potassium permanganate 1–5000 at a temperature of 100° F. before and following each instrumentation. Ignorant patients who cannot be made to understand the importance of the passage of sounds may expect a recurrence. The closure of the perineal fistula depends largely upon the systematic passage of sounds to keep the anterior urethra dilated. Healing is usually effected in from three to six weeks.

In *complicated cases,* such as extravasation complicated by cystitis, cases in which the urine is alkaline and septic the tube is to remain *in situ* for a longer period, and is not to be removed, except for cleansing, until the cystitis has subsided. It may be necessary in cases of intractable cystitis to insert a permanent drain. The question whether such a drain should be perineal or suprapubic is not in our province to discuss here. Such patients do better, however, if they are gotten out of bed early. Subsequently the tube may be connected with a urinal worn inside the trouser leg.

In *mild cases of cystitis* complicating stricture, the tube may be removed early and the cystitis treated at frequent intervals by intravesical irrigation. The medication may consist of boracic acid solution or of a weak solution of permanganate of potash, a half ounce of 10 per cent. argyrol being left in the bladder.

Care of the Wound.—The wound is inspected daily. Should infection or retention of secretion occur in a wound partially sutured this will be evidenced by redness, swelling and imbedding of the sutures. The sutures should be removed, the wound edges separated and a light packing introduced. As the connective tissue planes are not separated by dense barriers, infection is apt to spread rapidly unless free drainage is provided. Usually final healing is uneventful if the anterior urethra is not obstructed.

Perineal fistula may result from errors in technic at the operation or in stricture cases from the patient's failure to present himself for the passage of sounds. Sluggish fistulæ are cauterized with a nitrate of silver stick and sounds passed frequently enough to ensure the patency of the urethra anterior to the fistula. *Persistent fistula* will need a plastic operation for its closure.

Suprapubic Prostatectomy.—The suprapubic drainage tube is of large caliber and short (seven-eighths inch by five inches, Freyer). It has two large lateral openings and projects but a short distance into the bladder. It must not impinge on the opposite bladder wall. Dressings are renewed as often as wet. Owing to the large size of the tube clots are readily removed with long dressing forceps. Clots are most frequent in the first twenty-four hours and are removed at each dressing. The bladder is irrigated once or twice daily using a long glass nozzle through the tube. Free outflow of the irrigation fluid alongside the nozzle must be provided to avoid distention of the bladder. The tube is removed in three or four days and irrigation continued daily through the wound, guarding against undue bladder distention which might interfere with contraction of the vesical prostatic wound. After the ninth day the irrigations are done through the urethra and more distention of the bladder produced. Irrigations are discontinued when natural urination is established. Occasionally *secondary hemorrhage* occurs; if clots collect in the bladder the suprapubic tube should be replaced for a few days and irrigation done through it.

Perineal Prostatectomy (Young).—Continuous irrigation with two tubes (see perineal section) is employed for the purpose of preventing interference with the drainage by clots.

Care of the Wound.—The packing is removed eighteen to twenty-four hours after operation. This usually causes some hemorrhage; to prevent disturbance of drainage by clot formation the continuous irrigation is again started before removing the packing and continued, usually several hours after, until the flow is clear. The tubes are removed several hours later. Neither the packing nor the tubes are reintroduced. For the first few days the urine escapes through the perineal wound necessitating change of dressing sufficiently often to keep the patient comfortable. Infection is prevented by gently irrigating the wound several times daily with boric acid solution. Infection rarely occurs even when the urine is foul. Urine soon begins to pass through the natural channel and by the end of three weeks, often sooner, the perineal fistula is healed. If healing is delayed through unhealthy granulation the wound is curetted or a

thorough application of the nitrate of silver stick used twice weekly.

General Treatment.—That the tissues receive fluid is all important. Saline is administered by hypodermoclysis 750 to 1000 c.c. while under anesthesia. Murphy proctoclysis is given and continued while the patient is in bed. Fluid, especially water, is forced by mouth; two quarts of water by mouth at least should be insisted upon daily.

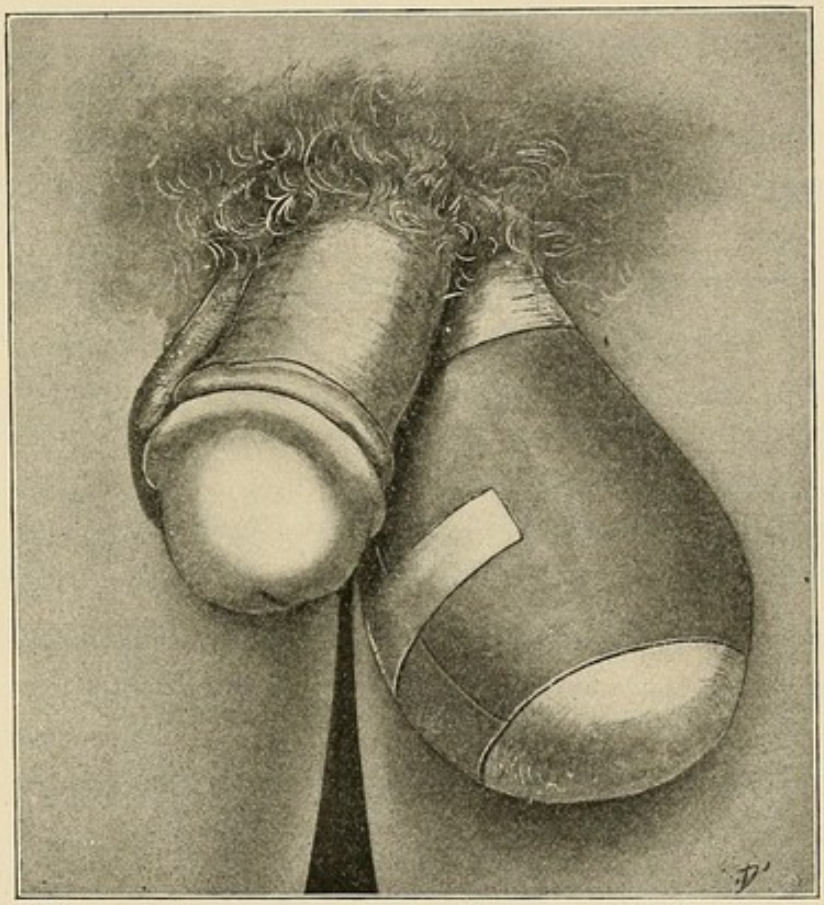


Fig. 198.—Chetwood's compression bandage for epididymitis in the subsiding stage. The diseased organ is isolated with its scrotal coverings and enveloped with a piece of thin rubber dam, fitted to the parts by stretching. This is held in place by strips of adhesive plaster. (Fowler's Surgery.)

The position of the patient is changed frequently to avoid *hypostatic pneumonia.* He is propped up in bed after removal of the tubes and is placed in a wheel chair on the second day. As soon as his strength permits he is encouraged to take a few steps and is wheeled out of doors.

Diet is increased rapidly. Urotropin is given, seven and one-half grains three times daily to control cystitis.

The passage of sounds is unnecessary *unless there has been considerable traumatism to the urethra.* A final examination of the bladder is made to determine its condition and the presence of residual urine.

Post-operative hemorrhage rarely occurs. It is controlled by repacking the wound.

Epididymitis (Fig. 198) is rather frequent and suppurative epididymitis may occur.

Stricture is very rare.

Incontinence of urine disappears rapidly.

Perineal fistula is rare and must be treated by subsequent plastic operation. Occasionally a pin-point fistula persists which occasions so little inconvenience that no operative procedure is advisable.

Recto-urethral fistula rarely occurs. This seems to be obviated by approximating the levator ani muscle at the operation (Young).

Sexual power is lost in a few cases, and delayed sometimes as long as a year in many others.

Natural urination is restored in almost all cases. If obstruction persists it means that the operation was incomplete.

CHAPTER XX.

OPERATIONS UPON THE MALE GENITALS.

Meatotomy.—No dressing is required other than cotton or gauze to protect the clothing while bleeding persists. A full-sized sound is passed every other day to prevent recontraction until bleeding no longer follows its passage. Irritation from the urine is prevented by alkaline diuretics.

Circumcision.—The main object of the after-treatment is to keep the line of incision back of the corona otherwise the healing process contracts rapidly and subsequent retraction becomes impossible. This is best accomplished at the time of operation by the primary dressing. After the catgut sutures have been tied the ends are left long. A small roll of iodoform gauze is placed around the penis on the suture line and the long ends of

the sutures tied together over the gauze. Healing is complete in seven days at which time the sutures being absorbed the dressing is readily removed. Confinement to bed is unnecessary after recovery from anesthesia. Upon getting about the penis is protected from friction by enveloping it in cotton held in place by a diaper in children or a jock strap in adults. Adults are given full doses of bromids for the first few days to prevent painful erections.

Complications.—Hemorrhage is rare. Oozing is controlled by a pressure bandage without disturbing the dressing. More pronounced hemorrhage is controlled by ligature. Should a hematoma form, sufficient sutures are removed to allow of expression of the clot and ligature of the bleeding point. The wound is then resutured. *Edema* occasionally occurs and is most marked in the neighborhood of the frenum. It usually subsides spontaneously but if persistent or marked is treated by multiple punctures with a fine needle and gentle massage to express the fluid. *Infection* is very rare. Done in an uncleanly manner the operation has been followed by gangrenous cellulitis of the penis, scrotum and thigh and death has resulted from septicemia.

Operations for Paraphimosis.—If *edema* persists employ multiple punctures with a fine needle and gently massage to express the fluid.

Suture of the Perineal Urethra.—The retained catheter is kept in place for seven to ten days. Wound treatment differs whether complete wound closure has been done or the urethra alone sutured and the rest of the wound left open. In the former event the wound is subject to the usual wound complications; in the latter, healing by granulation occurs. Subsequent to removal of the catheter stricture is guarded against by the careful use of sounds.

Closure of urethral fistula is treated on similar lines.

Excision of Stricture of the Urethra.—A retained catheter is used for ten to fourteen days by which time healing has occurred. The careful passage of sounds is then instituted to ensure against contraction at the site of suture.

Amputation of the Penis.—If the *galvanocautery method* has

been used the cauterized surfaces are protected by gauze kept moist with saline or a very mild antiseptic. Sloughs should not be forcibly detached but should be removed as they become loose. The retained catheter requires the usual care.

If the amputation has been done *by knife* the primary dressing consists in a moist iodoform bandage of the stump held in place by attaching it to a double T-bandage. The retained catheter is held in place by tapes. The dressing is changed as soiled.

Following either method the urethral orifice may tend to contract. This is remedied by the occasional passage of sounds.

Extirpation of the Penis.—The retained catheter, if used, serves to keep the dressing dry. It is attached to a bottle as in perineal section. The dressing is the usual aseptic wound dressing. The meatus does not, as a rule, show any tendency to contract; if it does, the passage of sounds corrects it. After healing is effected, soiling of the clothing through inability to properly direct the urinary stream is avoided by pressing the larger end of a small funnel against the perineum. A short rubber tube at the small end of the funnel directs the stream.

Epispadias. Hypospadias.—The complications are such as may be present in all wounds plus the danger of flap necrosis and shrinkage due to inefficient blood supply and the difficulty of perfectly gauging the size of the required flap. The bladder is drained by a retained catheter for seven to ten days when the newly formed canal, if ever, is in condition to allow of withdrawal of the retained catheter. Subsequently the bladder is emptied by catheter at sufficient intervals, every six or eight hours, to prevent distention in cases of epispadias and in other cases if small granulating defects exist. It is frequently necessary to perform additional operations for the cure of small defects. After union is complete further dilatation with graduated sounds is employed to prevent contraction.

Complications of operations involving the scrotum are those of wounds made in loose connective tissue. *Hematoma* is due to error in operative technic. If slight, pressure and rest will cause absorption; if extensive, the wound must be opened and the clot expressed. In the latter event it is better to insert a drain for a few days. *Cellulitis* is rare. Its occur-

rence is followed by rapid extension in the loose cellular tissue and calls for immediate incisions, drainage and the application of abundant absorbent dressing changed frequently and kept moist with an evaporating mildly antiseptic solution. *Retention of urine* occasionally occurs.

Varicocele. *Open Operation.*—The scrotum is supported by a snug-fitting suspensory. Two or three days' rest in bed are sufficient. The complications are such as any clean wound is susceptible to with the additional danger of *slipping of the upper ligature* through retraction of the cord. This is prevented by care at the operation in sewing the cut ends of the cord together. Unfortunately if it does occur the upper portion may retract high up in the inguinal canal and make its securing by ligature involve a dissection as for hernia.

Atrophy of the testicle may occur with or without known injury to the vas at the operation.

Injury to the vas in the course of the operation may result in *gangrene of the testicle.* It is better to castrate at once on the appearance of this complication rather than to subject the patient to the dangers of long-continued suppuration by removing the sloughing tissues as they disintegrate.

Undescended testicle offers the same complications as hernia plus the complications which may follow operations involving the scrotum, testicle and cord. *If Hahn's operation* has been employed the exposed portion of the testicle is painted with Wolfler's solution to protect it against infection. On the seventh day the testicle sutures are removed, the testicle returned to the scrotum and one or two interrupted sutures employed to partially close the scrotal wound. The operation has no effect, except through error in technic, upon the functionating power of the testicle.

Hydrocele. *Tapping a Hydrocele.*—The proposed site of tapping, which should always be in front, is first anesthetized by a hypodermic injection of a 4 per cent. solution of cocain or by freezing with chlorid of ethyl. The needle of a hypodermic syringe is first introduced until the fluid flows. This needle is left *in situ.* The hydrocele is now grasped behind with the left hand, the fluid contents forced forward and the trocar

introduced by a slight boring motion. The point of the index-finger of the hand grasping the instrument is placed firmly against the trocar about an inch from its point, in order to prevent the latter from entering the cavity too suddenly and injuring the testicle (Fig. 199). As a further precaution against the latter accident the point should be depressed as it enters the cavity. An ordinary aspirator may be employed. When the sac is emptied, 20 to 100 minims, according to the size of the hydrocele, of a 95 per cent. solution of pure liquid carbolic acid is introduced through the previously inserted

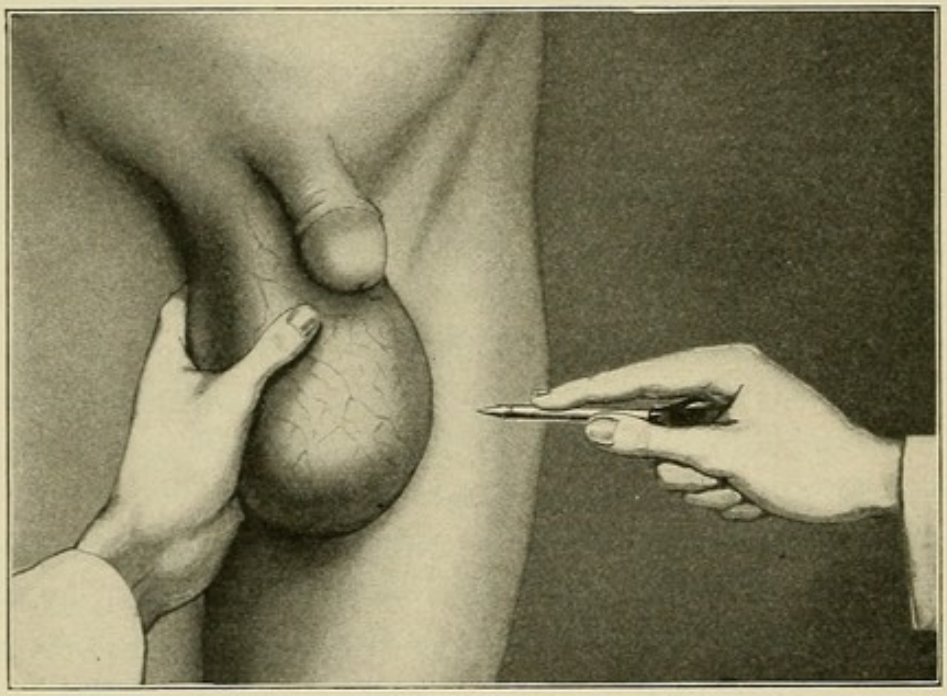


Fig. 199.—Tapping a hydrocele. (Fowler's Surgery.)

hypodermic needle. The cannula is now withdrawn and the sac manipulated so as to distribute the carbolic acid evenly about the interior. Some swelling follows, which subsides in the course of a week or ten days, during which a suspensory bandage, padded with cotton, is worn. It is not usually necessary to confine the patient to the house after twenty-four hours. Should excessive reaction occur with evidences of tension from the presence of fluid in the tunica vaginalis, secondary aspiration should be performed and the patient kept in bed for a few days with the scrotum supported. A permanent cure is usually effected at one sitting. Exceptionally, a recurrence may take place, when a larger amount of carbolic acid should be used.

Injection methods except in young children and in recent hydrocele are unsafe and unreliable. The scrotum is supported. The injected agent, usually carbolic, may produce severe inflammatory changes. This is controlled by rest in bed, elevation of the scrotum and ice locally.

Operation Securing Cure through Granulation (Volkmann).—The primary packing is removed after four days, the cavity being lightly repacked. Repacking is done every second day thereafter until healing is effected. A suspensory is worn. One or two days are sufficient for the patient to be in bed.

Operation without Packing (Longuet).—The wound is sealed and treated as any clean wound in the skin. A suspensory is worn.

Castration.—At the operation the vas is not ligated but is removed by torsion at a higher level than the cord, consequently the artery of the sac may later bleed and cause a hematoma deep in the pelvis. This rarely occurs. *Hemorrhage* may follow slipping of the ligature as in varicocele operations. *Hernia* is prevented by suturing the walls of the canal. Seven or eight days' rest in bed are necessary if a partial hernia operation has been added to the castration, otherwise two or three days are sufficient. The wound is subject to the usual complications, involving the scrotum. If extensive or for infective processes, drainage is employed.

CHAPTER XXI.

OPERATIONS UPON THE FEMALE GENITALIA.

Curettage.—The after-treatment will differ according to the condition of the uterus curetted. In case of *simple endometritis* the patient is allowed to move about in bed freely for the first day, sit up in bed on the second day, out of bed on the third day and walk about on the fourth day. A uterine packing is now rarely employed save in case of profuse oozing. If *oozing* is expected, ergotol should be administered, the first dose thirty minims by hypodermic while the case is still under the anesthetic, succeeding doses, one teaspoonful in amount, three in number

at two-hour intervals upon recovery from anesthesia. If vomiting is persistent half the latter amount may be given by hypodermic in place of by mouth at the same intervals. Hypodermics of ergotol are to be made as seldom as possible as they are painful and occasionally produce intense local irritation. A warm, not hot, bichlorid of mercury (1–10,000) vaginal douche of two quarts is given on the third day and on each succeeding day, alternate day or each third day according to the amount of the vaginal discharge. Subsequently in cases of stenosis of the cervix dilatation by bougie is done at sufficiently frequent intervals to ensure proper patency of the os or a Dudley operation may be indicated. The dilatation by bougie should be done shortly after menstruation. If done shortly before menstruation it might interfere with a possible impregnation and so defeat the object for which dilatation of the stenosed os is frequently done. In severe cases of stenosis, obstructive dysmenorrhea, dilatation must be done more frequently and the marital relations arranged accordingly.

Following curettage for *incomplete abortion* the treatment is as above outlined except that uterine inertia is more apt to occur and may necessitate a more prolonged use of the ergotol but at more extended intervals. Unless every particle of the fetus and placenta has been accounted for such cases should be observed over a period of several months to see if metrorrhagia or too frequent menstruation develops, in which event a second curettage will reveal an overlooked portion of placenta. If the abortion is after the third month of fetal development the stay in bed should be prolonged to five or seven days but the patient may move about in bed or sit up in bed if she wishes. When curettage is done for subinvolution a longer rest in bed, from ten to fourteen days, is preferable.

Following curettage for *septic endometritis* usually accompanied with more or less metritis and parametritis (the curettement in these cases being usually a gentle removal of detritus with a dull irrigating curette) the treatment consists in elevating the head of the bed in an attempt to establish better drainage of the uterus, to localize the pelvic infection and to favor expulsion of gases; in warm intrauterine douches of bichlorid of mercury 1–10,000 one

quart or more if the return flow is cloudy, using a dilating intrauterine douche nozzle which will allow a free return of the irrigating fluid, at intervals of four hours if the temperature continues high and at longer intervals as the progress of the infection is subdued. The rectum should be emptied daily by a copious enema of soap suds and hot water. Small doses of magnesia sulphate should be given to ensure a fluid condition of the intestinal contents, usually one dram of the saturated solution every two or three hours will suffice. The diet should be highly nutritious, small in amount and of a character to leave the smallest residue in the intestinal canal. Should the case in spite of the above go on to *pelvic cellulitis and peritonitis*, hot vaginal douches, bichlorid of mercury, 1–10,000, four quarts, should be given every four hours, the bowels should be kept at absolute rest, a continuous trickle of hot saline solution into the rectum should be instituted to cause reverse absorption in the hemorrhoidal veins and lymphatics and so lessen the danger of general sepsis, the extreme elevation of the head and trunk should be employed to aid in localization of the infection, nothing should be allowed by mouth in order to prevent peristalsis, and the patient should be kept quiet. If at the end of forty-eight hours improvement occurs brandy water in ounce doses may be allowed by mouth every hour or two and feeding by rectum at six-hour intervals may be instituted. Vaginal examination will reveal either a subsidence of the inflammation or a localization in the form of beginning abscess formation. If the latter, the process is allowed to continue until the formation is sufficiently evident to allow of easy incision. This may be done by simple puncture of the abscess with slightly-curved sharp-pointed scissors under local anesthesia. Should, instead of localization in the pelvis, evidence of general infection develop, posterior colpotomy with gauze packing of the pelvis should be performed and the general treatment of sepsis instituted *i.e.*, strychnia sulphate, whiskey, nourishing diet, injection of the appropriate vaccine and repeated saline enemata.

Complications of Curettage.—The operation may be complicated by a *tear* of the cervix by the dilator. This is rare and usually easily repaired unless the tear involves the broad ligament when

troublesome bleeding is apt to result and a hysterectomy may be necessary to control it. If hysterectomy is not necessary the after-treatment is as for trachelorrhaphy. The uterus may by *perforated* by the sound or curette. This need occasion no alarm unless septic conditions are present; the uterus should be gently curetted, the cavity of the uterus packed and the patient placed in the elevated head and trunk position until danger of peritoneal infection is past. No intrauterine irrigation should be employed on account of the danger of forcing the fluid into the peritoneal cavity. The packing should be left *in situ* for forty-eight to seventy-two hours and then removed gently so as to avoid both bleeding and the dragging down into the uterus of the omentum which in these cases glues itself into the puncture.

Trachelorrhaphy.—The patient should be kept in bed for a week to ten days but allowed to move freely about in bed and sit up in bed if no perineal operation has accompanied the trachelorrhaphy. The only reason for keeping the patient in bed at all is the dragging down the uterus has received during the operation, though there is nothing to prove that cases would not do equally as well up and about after the third day. The care of the diet and bowels is as usual for patients confined to bed. The care of the cervix differs according as absorable or non-absorbable suture material has been used. If absorbable, chromic catgut, douches should not be given until the tenth day when the vagina may be gently cleansed with a quart of warm two per cent. boric acid solution using a large glass nozzle with the openings on the sides and none on the tip. Douches given early in cases in which chromic catgut is the suture material employed are apt to result in premature softening and loosening of the sutures and severe secondary hemorrhage even though great care is observed. If nonabsorbable sutures of silver wire are used, douches may be given earlier without danger of loosening of the sutures but in no event should douches be given if possible before the tenth day. By the tenth day if the proper technic has been carried out by the operator, *i.e.*, the removal of all scar tissue, the leaving of a broad enough strip of mucous membrane to allow for a sufficient canal, complete hemostasis, accurate apposition of raw surfaces and proper, not too tight, tension of the sutures, cervix

wounds are usually healed though not firmly. It is not perhaps the place in a book on after-treatment, to call attention to operative technic but most of the bad results of trachelorrhaphy are directly due to transgressions of the ordinary rules of wound treatment. On the twelfth to fourteenth day if nonabsorbable sutures have been used, the patient is placed in the Sims' position, a Sims' speculum introduced and the sutures removed. In removing sutures it is best to grasp the uppermost suture on each side at the knot, or twist if wire has been used, cutting the suture to one or the other side of the grasping forceps and withdrawing each suture as cut. The cervix should not be pulled down with a tenaculum as this tends to disturb the recently healed wound. If a perineorrhaphy has also been performed it is best to leave nonabsorbable sutures until the eighteenth day in order not to subject the perineum to strain. Absorbable sutures do not, as a rule, require removal; they come away of themselves when the deeper part of the suture has been absorbed. Sometimes, however, an occasional suture is not absorbed. If so it may be removed at the final examination of the patient at which time a sound should be passed to demonstrate the patency of the cervical canal. While removing the sutures it will be noted that even those not too tightly tied at the operation have become slightly imbedded in the tissues and the outline of the cervix will be accordingly slightly nodular. This irregularity evens out in the course of time. If the time for the operation has been badly chosen or if an irregular menstrual period occurs at the time set for removal of the sutures, the removal should be delayed until after the period. Small cleansing douches should be ordered if there is any vaginal discharge. Frequently the sutures will come away with the douche.

Amputation of the Cervix. Dudley Operation for Cervical Stenosis.—The after-treatment is as for trachelorrhaphy.

Complication of Operation upon the Cervix.—Hemorrhage occasionally occurs. It may follow injudicious douching. If not controlled by removal of the clots and vaginal tamponade it must be controlled by suture.

Anterior Colporrhaphy.—If absorbable suture material has been used a vaginal douche should not be given until the tenth

day. Distention of the bladder with consequent pressure on the suture line is prevented by catheterization every six or eight hours. If the anterior colporrhaphy is done in connection with perineorrhaphy the rules applying to the after-treatment of that operation apply. If done independently, however, the bowels may be moved on the second day, the patient allowed up in bed on the fourth day, and out of bed as soon thereafter as she desires.

Urethral Fistula.—A retained catheter is kept in place for seven days. Cystitis is treated along the usual lines.

Vesico-vaginal Fistula.—The retained catheter is kept in the bladder for seven days. A careful watch is kept and if it becomes displaced accidently it is at once replaced. Should cystitis be present or supervene the bladder is washed out two or three times daily through the retained catheter with boric acid solution, allowing not more than two ounces of the solution to be in the bladder at one time. If hemorrhage into the bladder occurs from the cut mucous membrane the bladder is irrigated more frequently until all danger of clotting is passed. Should more severe hemorrhage occur so that there is danger of the bladder becoming filled up with blood clots continuous irrigation is instituted through a double-current catheter. This is continued until the flow is clear and renewed upon the reappearance of bleeding. Continuous irrigation in this manner requires very careful watching as the outflow tube may become blocked and the bladder overdistended. During the irrigation it must be continually watched. It will rarely happen that such a measure will need to be instituted. Distention of the bladder either by urine or blood clot through obstruction of the retained catheter will cause too severe a strain upon the recently sutured wound and its consequent probable separation. The bowels are kept closed for three days to avoid strain upon the sutures. If, owing to error in operative technic a ureter has been included in the suturing there will be a diminution of the amount of urine and pain in the kidney region of the affected side; if both ureters have been included in the sutures there will follow anuria and pain in both kidney regions. This error can only be remedied by immediate removal of the sutures. No vaginal douches are given. After the removal of the retained catheter, catheteriza-

tion is employed every six hours to prevent distention of the bladder unless the patient urinates freely. The patient is kept in bed while the self-retained catheter is in place but is allowed to move about freely.

Recto-vaginal Fistula.—The after-treatment is as for complete laceration of the perineum.

Perineorrhaphy.—Perineorrhaphy for *recent complete laceration* is treated by absolute rest in bed for fourteen days. The patient should not attempt to move herself about; she should be moved from side to side and on one side and the other by the nurse. The catheter should be used for ten days at eight-hour intervals. The external parts are irrigated with warm boric acid solution following catheterization and subsequently dried and a dry soft absorbent gauze pad applied. If the patient is restless it is better to restrain the limbs for ten days by a loosely applied figure-of-eight bandage of the knees, at least during the sleeping hours and while recovering from anesthesia. The preparation of the patient should have been such as to leave the intestinal tract empty. An opium suppository is given by rectum to control tenesmus and severe pain. The bowels are not allowed to move for ten days nor, for the same period, is anything given by the mouth except brandy-water, plain water as much as desired, albumin water (Kelly), two ounces every two hours and orange juice in small amounts much diluted. On the tenth day the bowels are moved with repeated small doses, one or two teaspoonfuls, of the saturated solution of sulphate of magnesia every one or two hours to produce an osmosis of the intestinal canal, followed by an eight-ounce oil enema given low when there is a tendency for the bowels to move. The latter renders the movement much easier. At the time of the movement the perineum should be supported by the nurse. Following the movement the external parts are irrigated and thoroughly dried. If there is much pain an opium suppository may be administered. Subsequently the bowels are moved daily by enemata, the diet rapidly increased and on the fourteenth day the patient allowed to sit up in bed, on the sixteenth day out of bed in a chair and on the eighteenth day to take a few steps. The wound should be inspected frequently

and treated on general wound principles. Sutures should be removed on the tenth to fourteenth day. These wounds are in *edematous* tissues and require the most absolute rest for a proper final result.

In *old complete laceration, i.e.,* laceration without *edema* of the tissues, the treatment need not be so rigid though the same general principles obtain. Catheterization may be dispensed with, the patient need not keep so quiet. The diet should, however, be extremely light and of such a nature as to leave the smallest possible residue in the intestinal tract, preferably plain water, orange juice, brandy-water and albumin water for the first five to seven days, then fluids of all kinds, moving the bowels with the precautions outlined on the tenth day. Otherwise the treatment is for recent complete laceration.

Following operation for *incomplete laceration,* whether *old* or *recent* the principal treatment is frequent cleansing and drying of the operated parts. The diet should be light, the bowels moved on the third day with castor oil to produce one movement, rather than with salts which produces several watery movements. When desire for stool is felt olive oil should be injected into the rectum. Subsequently the bowels are moved daily by small high enemata. Enemata are given high to avoid distention of the rectum and too severe strain on the levator ani muscles. In the after-treatment of all operative work in this region in the female due thought must be given to the physiology of defecation. The patient may move about freely and be propped up with pillows on the twelfth day. The sutures are removed on the twelfth day. The patient is allowed to sit out of bed on the fourteenth day and walk about on the fifteenth day.

Following all perineorrhaphies the wound must be kept *dry* and *clean* in accordance with the principles of wound treatment. If the sutures draw the parts somewhat inward or, as in fat patients, the skin surfaces lie in contact, maceration and irritation are prevented by placing a narrow strip of dry gauze between the surfaces. This strip is changed frequently.

Interference with Wound Healing.—Occasionally and usually due to the poor general condition of the patient, the wound will be slow in healing and may even separate to some extent. Such

wounds are encouraged to granulate by ordinary wound treatment, the only difference being that the dressing is done more frequently than in the case of wounds elsewhere, *i.e.*, several times daily. Occasionally as a result of improper preparation the rectum will become packed with feces. In such an event the patient will complain of pain with tenesmus which may be accompanied with leaking of liquid feces but an inability to move the bowels properly. A digital examination of the rectum will reveal the condition and the hardened feces should be removed with the finger or with a spoon.

Rarely a hematoma forms in the perineal tissues. Once started it usually extends rapidly and calls for opening of part of the wound and expression of the clot. The cavity is packed and a secondary suturing done at the end of forty-eight hours.

Should the perineum prove too high a second slight plastic operation may be necessary. This should be left for several months. The patient is instructed to avoid all strain for at least two months.

Care in Operating.—No amount of care in the after-treatment will take the place of proper operative measures for the cure of vaginal and perineal lacerations. The final result will be bad if the proper operative procedure has not been well carried out or if the patient was not a fit subject for operation. Anemia, next to improper technic, is the chief reason for failure.

Excision of Urethral Caruncle.—If the excision has been made by knife and subsequent suturing no wound treatment is necessary. Sutures which have not been absorbed are removed on the fifth to the seventh day. If the excision has been by cautery vaselin is frequently applied to the resulting raw surface. Rest in bed is unnecessary. Coincident cystitis requires appropriate treatment. In properly selected cases the results are immediately good.

Posterior Colpotomy.—If gauze is employed this is removed on the second to the fourth day to prevent damming back of the wound secretions, and a second packing of less bulk introduced. This is best done with the patient in the dorsal position, retraction being used to give a clear view of the procedure. Care should be taken not to break up adhesions. The vagina is

loosely packed. Forty-eight hours later the second packing is removed, using retraction as before, and the wound gently irrigated with boro-salicylic solution. The retraction permits of a free return of the irrigating fluid and obviates the possibility of breaking up the newly formed adhesions which shut the wound off from the peritoneal cavity. These changings of dressing and irrigation are repeated daily until the tenth day when one or more daily douches may be instituted in their place. Every second or third day, however, the parts are to be examined ocularly and treated on general wound principles, peroxid of hydrogen being used if the discharge is pussy, stimulation by means of balsam-of-Peru gauze, and gentle curettage of exuberant granulations. If tube drainage has been combined with gauze drainage, either alongside the tube or throughout its lumen, the gauze is removed as outlined above, but the tube is allowed to remain *in situ*, being withdrawn a short distance each day, on the second and fourth day. On the fifth day it is removed entirely, and the resulting cavity loosely filled with gauze. If the colpotomy wound proper contracts too rapidly, a short tube may be introduced to keep it open until the main wound cavity has contracted in due proportion. After the second day the bowels are to be moved by enema or saline laxative. These patients are allowed to move about in bed after the fourth day. They should be allowed to sit up in bed early as the downward intra-abdominal pressure serves to cause an earlier obliteration of the dead space in the pelvis and facilitates drainage. If secondary hemorrhage is feared the dorsal posture should be maintained for seventy-two hours.

Septic cases do much better if they are allowed up in bed. If too weak to sit up in bed the elevated head and trunk position should be employed. They are allowed out of bed any time after the fourth to the sixth day and walk about as soon as their strength permits, usually on the sixth to the eighth day.

Complications.—Fecal fistula occasionally follows posterior vaginal section. It is due in most cases to an extension of the infective process involving the wall of the adjacent intestine and occurs four or five days after the operation. Occasionally the rectum itself is injured at the operation. The occurrence

of this complication calls for the removal of all packing and frequent irrigation. The lower bowel is kept empty by irrigating with a Kemp's tube. These fistulæ usually heal spontaneously. A tube introduced into the rectum during the vaginal irrigation allows of the ready escape of any fluid which enters the intestine. For the same purpose while the rectum is being irrigated a vaginal speculum is introduced.

Vaginal Hysterectomy. *Clamp Method.*—The clamps, the handles tied with silk to preclude accidental loosening, are removed at the end of seventy-two hours. The blades are first separated very gently and are held separated for ten minutes before removal so that if bleeding occurs they can be reclamped. The packing is renewed twenty-four hours later and daily thereafter. Douching is employed only if there is foul discharge. Care must be exercised in douching that no fluid be forced into the peritoneal cavity. The patient sits up in bed on the second day following removal of the clamps and thereafter is treated as if operated by the suture method. It is better to keep the patient on a light diet and not move the bowels until the third day.

Suture Method.—The drainage strip is removed at the end of forty-eight hours and the vaginal vault tamponed daily thereafter until the wound is healed. Douches are given, when indicated only, with great care. The patient sits up in bed on the fourth day, is lifted out of bed to a chair on the fifth or sixth day, takes a few steps on the following day and thereafter gradually increases the amount of daily exercise. The bowels are moved on the third day by laxative. To avoid straining an olive-oil enema is given when the bowels show a tendency to move.

Method by Clamps and Multiple Iodoform Packing Strips in Septic Conditions.—The patient is immediately placed in the elevated head and trunk position. As soon as the anesthetic sickness has passed the bed is leveled and the patient is sat up in bed. When the patient desires to sleep the elevated head and trunk position is again used. Perineal pads are changed as soiled. The clamps, preferably Pryor's, are removed with care at the end of forty-eight hours. The iodoform pack is not removed until the fifth or sixth day unless increased tem-

perature develops in which case it is removed on the increasing of the fever. Only those strips or parts of strips which come away easily are removed; those which "stick" are cut level with the vulva and left for twelve hours longer or until they are sufficiently loose to be removed without danger of causing bleeding. Each day a portion of the packing is removed until the ninth day when the remainder is removed and the wound repacked lightly. On the succeeding day the patient sits out of bed and on the day following takes a few steps. The vaginal wound rapidly contracts so that in a few days after the final removal of the original packing all dressing may be omitted and a daily douche given. The bowels are moved daily, at first by enema, later by laxatives.

Complications of Vaginal Hysterectomy.—These are due for the most part to errors in operative technic which are in large measure unavoidable. *Injury to the ureter* occurs occasionally, due in most instances to shaving the ureter too closely in operating for malignant disease. Rarely is the ureter cut or ligated. Most frequently the injury is to the blood supply which results in necrosis of a part of the ureter days or in some instances weeks after the operation. The existence of such an injury is shown by part, or the whole in case both ureters are involved, of the urine passing per vaginam. The exact location of the lesion can only be determined by a cystoscopic examination. At first the wound is kept clean and stimulated daily for several weeks until all hope of the fistula closing spontaneously has passed. A second cystoscopic examination is then made to verify the first and the appropriate plastic procedure instituted.

If the *ureter has been cut* the symptoms will be immediate. If the *ureter has been ligated* there will be pain in the kidney region of the affected side and a lessened quantity of urine. Cystoscopy is employed to determine the exact condition. *Treatment* consists in reopening the wound, and reapplying the ligatures with the ureteral catheter in position for manipulation, a tedious and difficult procedure.

The prevention of injury to the ureter consists in the preliminary introduction of catheters into the ureters to serve as a guide to their location.

Injury to the bladder or rectum is rare. Daily careful cleansing of the raw surfaces usually suffices to cause spontaneous closure of the defect. If not, a second plastic operation must be undertaken.

Hemorrhage is rare.

Infection unless already present is almost unknown. It is treated by the elevated head and trunk position and by the usual methods of combating infection.

Intestinal obstruction occasionally occurs through adhesion of a small intestinal coil to the raw surfaces in the pelvis. Before proceeding to laparotomy for its treatment the pelvic pack is removed and an attempt made to free any adherent gut by the finger introduced through the vaginal wound. If this is not successful laparotomy is indicated.

Intercourse after Plastic Operations upon the Female Genitalia.—The time at which intercourse may be begun depends upon the character of the operation and the general condition of the patient. So far as the mechanical part of the operation is concerned, two months or until after the third menstrual epoch is sufficiently long. The patient and her husband should be instructed as to the nature of the operation as it affects the act of intercourse; for example, the change in the direction of the vaginal canal after high perineorrhaphy, or the shortening of the canal after panhysterectomy. Following curettage the interdiction of intercourse depends upon whether pregnancy is desired. If so, intercourse should be begun just before the expected time of the next menstruation. In any case if the general condition of the patient is poor, intercourse should be but sparingly indulged in until the general condition markedly improves. In gonorrheal infection, intercourse is interdicted until both husband and wife are free from infection.

Obstetric Operations. The Surgery of Pregnancy.—1. The after-care of *an impacted pregnant uterus which has been reduced* preferably under nitrous oxid adesthesia consists in inserting a large-sized Smith Hodge pessary to be worn till the fourth month and rest in bed for a few days after the operation. 2. The after-care of *all abortions and inductions of labor* is similar to that employed in normal labors, rest in bed for seven days and no

vaginal treatment. 3. The after-care of *all abdominal operations undertaken during pregnancy* is the same as when these operations are done when pregnancy does not exist; save for the regular administration, for the first five days, of morphin in minute doses or codein hypodermically, to try and prevent abortion.

The Surgery of Labor.—1. *The after-care of the delivery of the child per vagina by any means except cutting operations* is similar to the management of normal post-partum cases. Douching should never be employed. Packing is used only for the control of hemorrhage and when employed the entire genital tract is to be tightly tamponed. 2. The after-care of *cases in which vaginal extraction is preceded by*:

a. Section of the pelvis, either *symphysiotomy* or *pubiotomy,* consists in holding the patient's legs in abduction immediately after the cutting of the bones to prevent undue separation. The vagina should be snugly tamponed to prevent the formation of a vaginal hematoma. The patient's pelvis immediately after the completion of the extraction is to be surrounded by a band of adhesive plaster ten inches wide extending from below the trochanters to above the brim of the pelvis. The ends of this band are split into two strips for a distance of ten inches and these are applied anteriorly similarly to the Boldt binder. No further restriction is placed on the patient's movements. The vaginal packing is removed at the end of twenty-four hours. Catheterization is employed every eight hours prior to the removal of the packing. The bowels are moved by enema on the third day, the patient being carefully lifted on to a very low douche pan for this purpose. The patients are gradually allowed to sit up in bed from the twelfth to the sixteenth day, are out of bed on the seventeenth day and allowed to walk on the twentieth day.

b. Section of the Perineum—Episiotomy, or Section of the Cervix by Multiple Incisions.—The after-treatment of Dührssen's operation consists in carefully suturing all wounds with No. 2 chromic catgut, and in applying the usual care of the puerperium.

c. Section of the Lower Zone of the Uterus—Anterior Vaginal Hysterotomy—Vaginal Cesarean Section.—Hemorrhage from the uterus is controlled by hypodermics of thirty minims of ergotol

followed by thirty minims of pituitrin. A small drain of iodoform gauze should be left along the suture of the uterus and extending out through the suture line of the vagina. This is removed after twenty-four hours. Tamponade of the vagina for twenty-four hours prevents undue oozing from the under surface of the bladder where it was separated from the vagina and uterus. This is removed at the end of twenty-four hours. The patient, after reacting, is placed in the elevated head and trunk position to aid drainage and involution. Catheterization is employed every eight hours until the gauze is removed from the vagina. All packing used should be from a strip seven yards long and twelve inches wide folded into a strip two inches wide. Great care is exercised to close all small lacerations of the vagina or perineum with chromic catgut to prevent infection. The patient is allowed out of bed on the twelfth day. 3. *The after-care of cases in which the child is delivered by the abdominal route.*

a. Classical Cesarean Section.—The uterus is kept firmly contracted by the administration of pituitrin immediately after its closure by sutures; in addition ergotol is given hypodermically, thirty minims repeated every two hours for three doses. The abdomen is strapped firmly from the pubes to one inch above the height of the incision and a many tailed binder is applied. The external genitals are cleansed and a sterile dressing applied and changed as in any puerperal case. As soon as reaction has occurred the patient is placed in the elevated head and trunk position to aid drainage and involution of the uterus. Saline, one pint, is given by rectum every six hours for forty-eight hours, the first two containing one ounce each of whiskey. Distention of the upper abdomen, particularly the stomach, is watched for and met promptly by lavage and enemata. Unless infection is suspected the wound is not dressed until the twelfth day when the sutures are removed. The abdomen again is strapped and the patient allowed out of bed on the fourteenth day.

b. Suprasymphyseal Section and Extraperitoneal Section by Inguinal Incision.—The after-care is as in the classical Cesarean operation.

c. Celiohysterectomy with intrapelvic treatment of stump, is the same as in any abdominal hysterectomy.

d. Celiohysterectomy with Extraperitoneal Treatment of the Stump.—Separate collodion gauze dressing of the upper part of the abdominal wound prevents its infection. The clamps across the pedicle of the cervix are kept carefully wrapped in sterile gauze. The danger of hemorrhage is much less where clamps are used in preference to pins. The surface of the stump is kept well powdered with 10 per cent. iodoform in boric acid and the dressings changed once a day. In two weeks the slough will permit of the gentle separation of the clamps. The granulating surface is kept carefully cleansed. Suppuration seldom occurs if this is done, and the usual treatment for granulating wounds applied. The patient should not sit up until the wound is firmly healed. In other regards the treatment of these cases is as in all abdominal wounds. Sterile dressings should be kept applied to the external genitals as long as any vaginal discharge is present.

CHAPTER XXII.

OPERATIONS ON THE VERTEBRAL COLUMN.

Laminectomy.—If there is no paralysis the after-treatment is simple. The extradural drain, if employed, is renewed at the end of twenty-four to forty-eight hours. Escape of cerebrospinal fluid is minimized by pressure. Infection is prevented by careful and frequent renewal of dressings if leakage occurs. Otherwise the treatment is as for any clean wound. As the rigidity of the spine is not impaired by the operation no supportive dressing is necessary. The lateral posture prevents undue pressure on the wound. If paralyses complicate they receive appropriate treatment, massage, electricity, passive motion of the joints, apparatus to prevent deformity. The patient should be gotten into a wheel chair and out in the fresh air and sunshine as soon as possible, usually at the end of seven days when wound healing is fairly strong. Since the spine does not need support there is no reason for keeping these patients in bed after superficial wound healing has occurred.

Operations for Fracture or Fracture Dislocation.—The patient

is placed on a water or air bed to prevent bedsores. The utmost care must be used in handling patients to prevent further injury to the cord. Fractures in the cervical region are treated by an extension and immobilization apparatus similar to that used in torticollis. After six weeks the head and neck are supported as in the after-treatment of cervical spondylitis. In fracture of the dorsal and lumbar region immobilization is secured by a plaster-of-Paris jacket. The most scrupulous cleanliness must be observed. Parts exposed to urine and feces should be frequently cleansed, dried and powdered. Pain is relieved by morphin. Owing to the insensibility of the skin and the trophic disturbances due to the injury these patients are prone to develop acute decubitus. The sacrum is particularly liable to this; such a sore may be so extensive as to involve the bone and give rise to general septic infection. The catheter should be employed early to avoid ischuria paradoxa (retention of urine with dribbling). If the pressure on the cord has not been early relieved progressive myelitis will develop later. In any event with injury to the cord other than commotion complete return to normal is not possible. Later ascending myelitis develops. The points subject to pressure should be protected by air cushions and rings of gauze and cotton. Later in the case electricity, massage, hot and cold bathing and passive exercises are indicated. Contractures are prevented by these measures and by apparatus.

Treatment of the Wound.—The extradural drain either wicking or soft-rubber tube is removed in twenty-four or forty-eight hours. The drainage during the first twelve hours is usually very free requiring frequent change of outer dressings. Persistent leakage is treated by pressure. Special care must be exercised to prevent infection through soiling by the discharges from the paralyzed bowel and bladder. The chief post-operative dangers are shock and infection. Other complications result from the paralyses and enforced rest; cystitis and kidney infection and pneumonia are common causes of death.

Treatment following the Forcible Corrections of the Deformity in Pott's Disease.—A plaster-of-Paris jacket is applied including the pelvis, dorsal and lumbar regions and the head. A small window is left open over the point of greatest deformity. If an

open operation (Calot) has been done as when the spines and laminæ are fused together (synostosis) the wound is treated as for operations for fracture.

Treves' Operation for Caries.—Dressings are changed as soon as the discharge soils the externl portion of the dressing. Irrigation of the wound is practised at each change of dressing. The large rubber drainage tube is shortened as healing progresses. Treves uses iodoform gauze for the packing.

Post-operative Treatment of Pott's Disease.—Incision is usually delayed until the overlying skin has become involved. The external dressings should be copious and changed as frequently as soiled. Daily antiseptic irrigation of the wound should be practised with gradual shortening of the drainage tube. In favorable cases the intraabdominal pressure may finally lead to obliteration of the abscess cavity.

Spina Bifida.—Following plastic operations the patient is kept on the side to avoid pressure on the wound. There is usually considerable leakage of spinal fluid for the first few hours and in some cases this continues for days requiring frequent and careful change of dressing. Most cases surviving radical treatment finally die of hydrocephalus or the secondary effects of existing paralyses. Operative deaths may be due to sudden evacuation of cerebrospinal fluid. Meningitis through wound infection may occur.

Cervical Spondylitis.—The abscess should be emptied early. This may be done through a small incision, in order to avoid entrance of pus into the glottic opening, or the abscess may be incised freely with the head in the dependent head position of Rose. The walls of the abscess contain the constrictor muscles of the pharynx; hence, their elasticity is such as to lead to rapid emptying and collapse. This favors early resolution, the healing process frequently being completed in a remarkably short space of time.

In the further treatment of Pott's disease in the cervical region it will be necessary to apply some form of support for the head and vertebral column. This may be accomplished by the use of a jury mast attached to a plaster-of-Paris jacket (Fig. 200), by an anteroposterior support with head-piece

(Taylor, Fig. 201), by a padded leather collar (Thomas, Fig. 202), or by a brass wire collar (Burrell, Fig. 203), or Volkmann's method of extension in the recumbent position may be employed (Fig. 204).

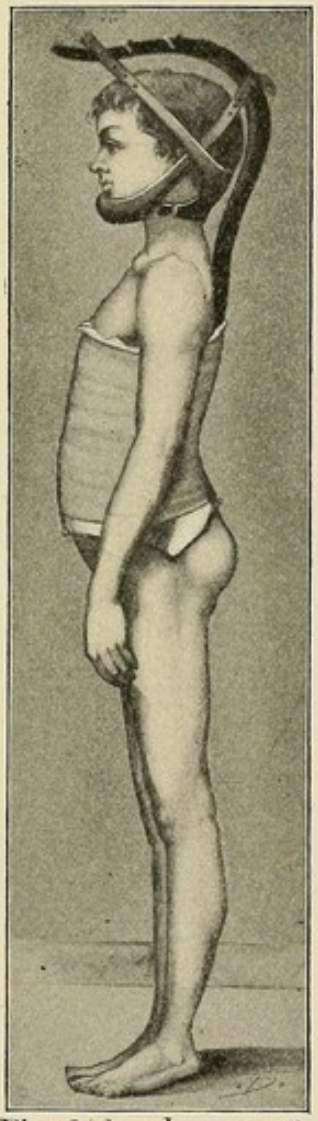


Fig. 200.—Jury mast. (Fowler's Surgery.)

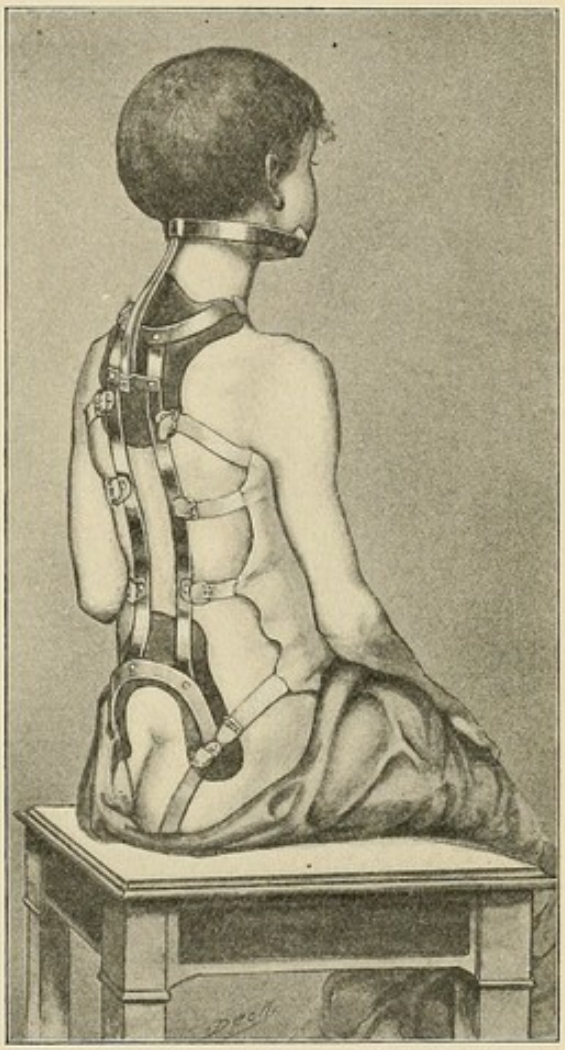


Fig. 201.—Anteroposterior support with head-piece. (Fowler's Surgery.)

Tuberculous Spondylitis.—The *mechanic treatment* is of the highest importance. Its application should not be delayed after the discovery of the disease. While it cannot correct already existing kyphosis, on account of the processes of consolidation which have already taken place, progressive deformity is prevented by arrest of the disease. Two types of appliance may be mentioned, the one a solid fitting corset or cuirass of plastic material, while the patient is suspended (Sayre, Fig. 205)

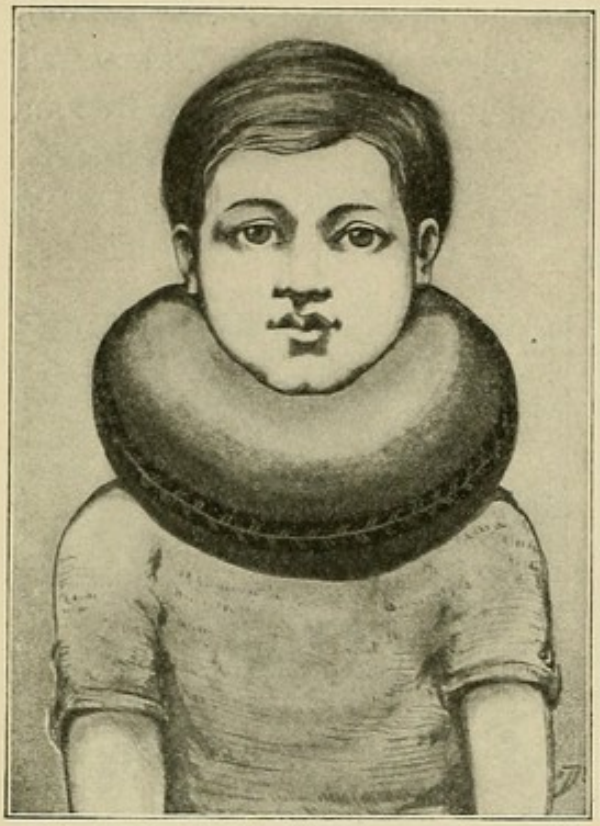


Fig. 202.—Padded leather collar. (Fowler's Surgery.)

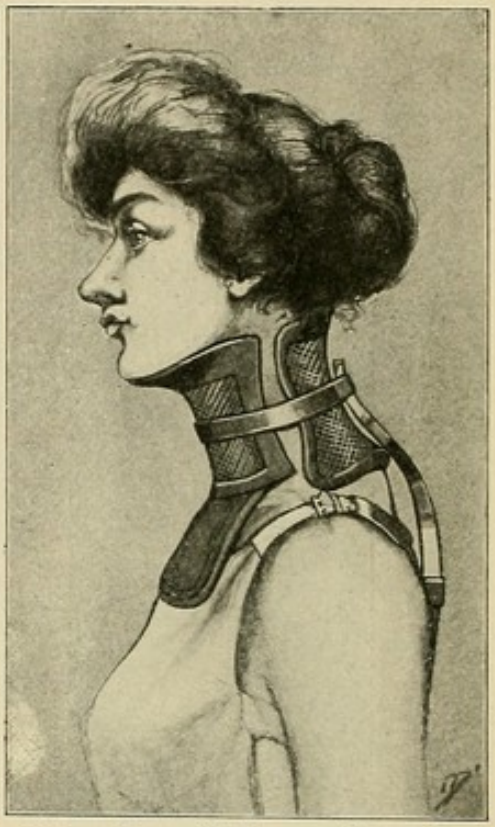


Fig. 203.—Burrell's brass wire collar. (Fowler's Surgery.)

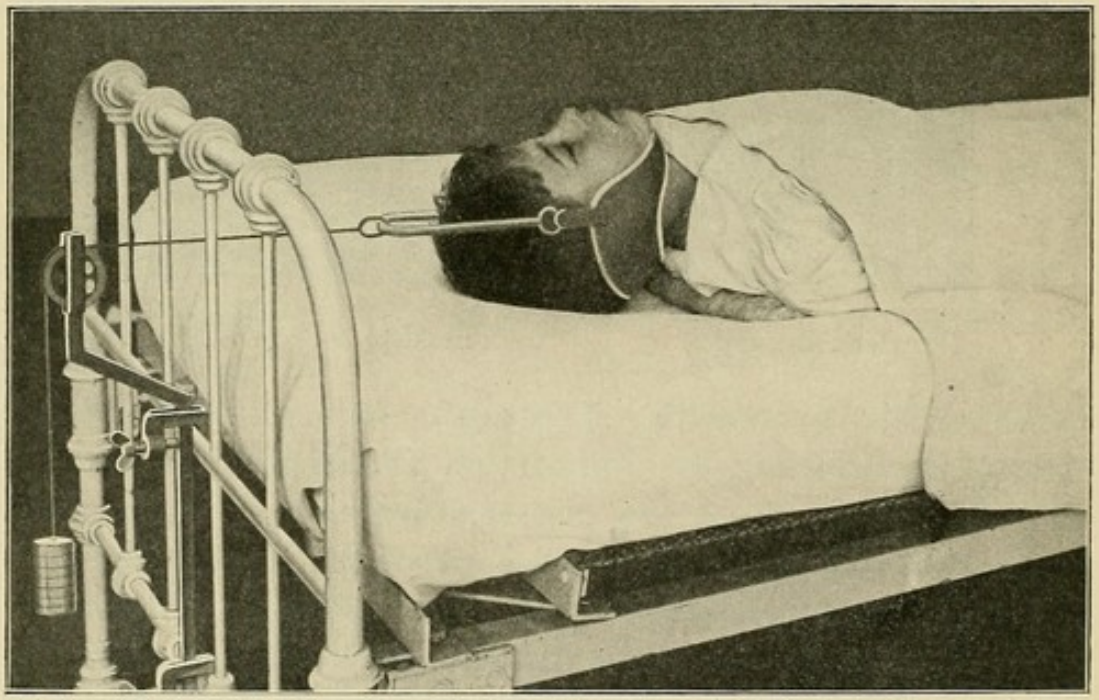


Fig. 204.—Volkmann's method of extension in the recumbent position. (Fowler's Surgery.)

or while he is lying supine in a hammock in a position tending to correct the deformity (Richard Davy, Fig. 207), and the other a brace whose object is to open the angle anteriorly placed at the kyphosis and thus relieve the pressure on the diseased

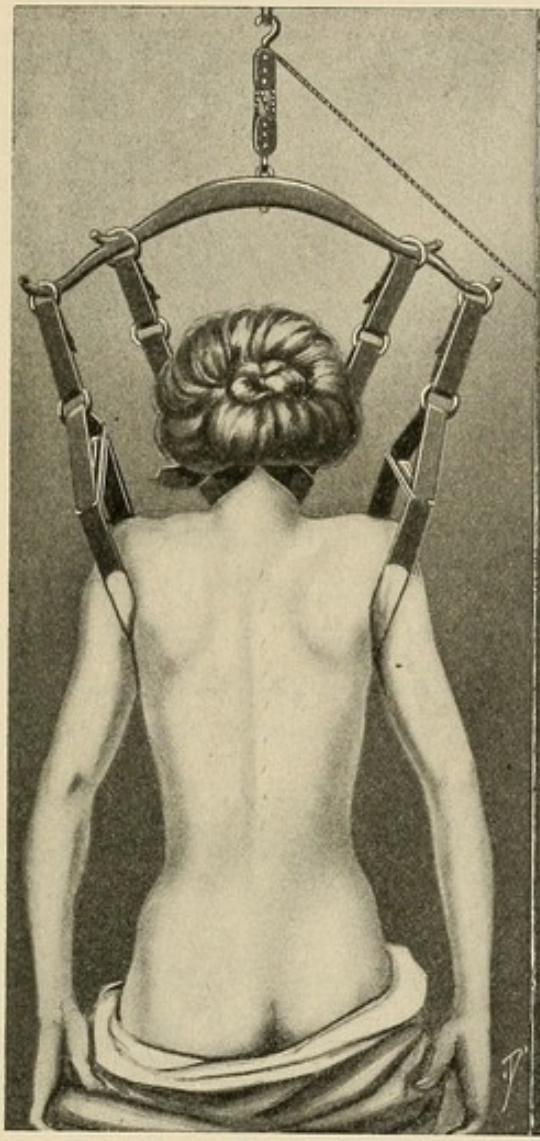


Fig. 205.—Patient suspended, ready for plaster-of-Paris jacket (Sayre.) (Fowler's Surgery.)

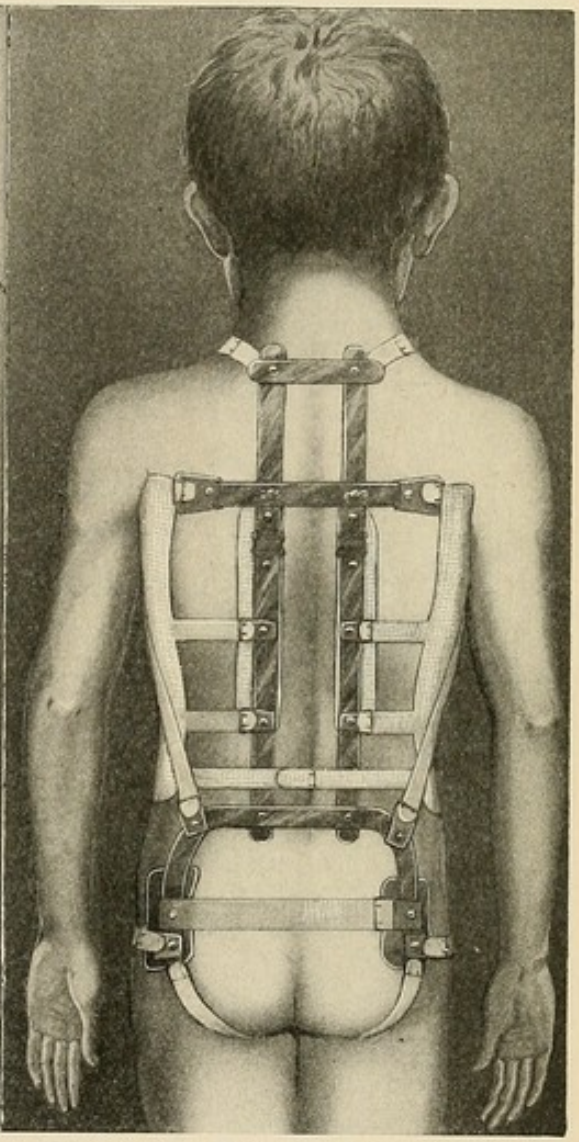


Fig. 206.—Taylor's brace for Pott's disease. (Fowler's Surgery.)

bodies of the vertebræ (Taylor). The first appliance may be made either of plaster of Paris or of poroplastic felt material, the second appliance of light rods of steel with properly fitted and padded bands of webbing and leather adjusted and held in position by straps and buckles (Fig. 206).

The plaster-of-Paris jacket is applied either while the patient is suspended or while he is lying in a hammock. A seamless knitted shirt of wool is placed next to the skin, with layers of wadding or lamb's wool to protect bony prominences from undue pressure. The rolls of plaster-of-Paris bandage wetted in weak alum water are circularly applied in successive layers,

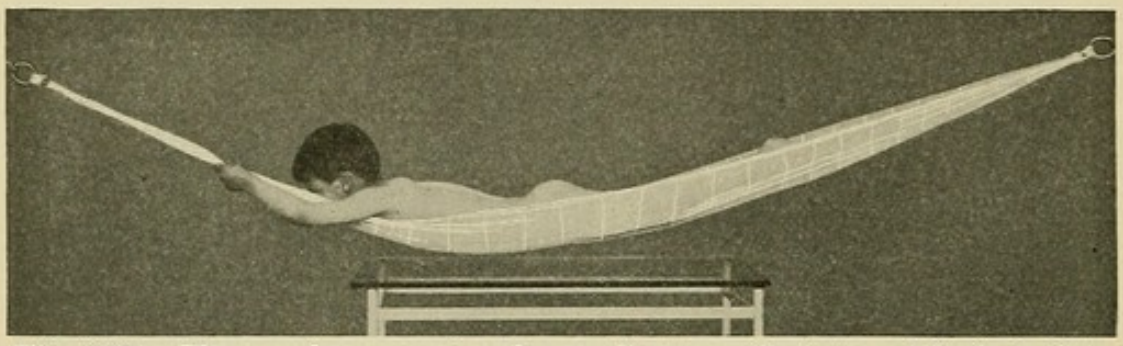


Fig. 207.—Hammock suspension for application of plaster-of-Paris jacket. (Fowler's Surgery.)

reaching from below the line of both iliac crests upward to the axillæ. Strips of the bandage should be curved upward behind and in front to gain additional support. Vertically applied strips either of pasteboard or of perforated tin are incorporated in the jacket between its layers to strengthen the apparatus. When the jacket is sufficiently hardened, the patient is lowered

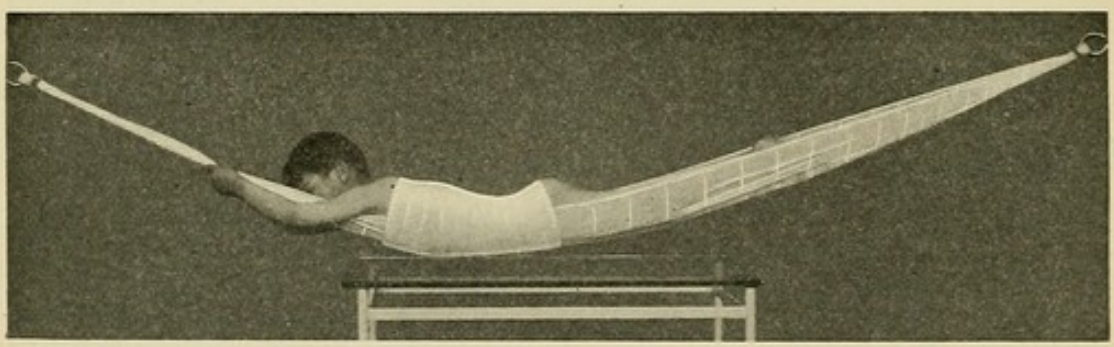


Fig. 208.—Plaster-of-Paris jacket applied. (Fowler's Surgery.)

and the upper edge at the axillæ trimmed so as to prevent excoriations. If the hammock is used (Fig. 208), it should be made of cross-barred crinoline or twilled Canton flannel, and the portion beneath the jacket allowed to remain *in situ*, the edges above and below the jacket being trimmed down and secured by a few additional turns of a bandage (Fig. 209).

The jacket is to be renewed sufficiently often to insure cleanliness and prevent ulceration at prominent points. It has been suggested that the jacket be cut open in front and secured by lacing; this, however, lessens the efficiency of the apparatus.

Poroplastic felt corsets have been employed, particularly in Germany. Models of different sizes and shapes representing the more common forms of the disease at different periods of life, are made, and on these a poroplastic material, the basis of which is woolen fiber and gum shellac dissolved in alcohol, is molded in the shape of a cuirass. When needed, one of these is selected, softened by heating, and applied to the patient while suspended, burning of the skin being prevented by first enveloping the trunk in an accurately applied wetted muslin bandage. The corset is secured in position by turns of a roller until it cools, when it may be removed, its edges lined with chamois leather to prevent chafing, and eyelet holes or shoe hooks placed in position for lacing.

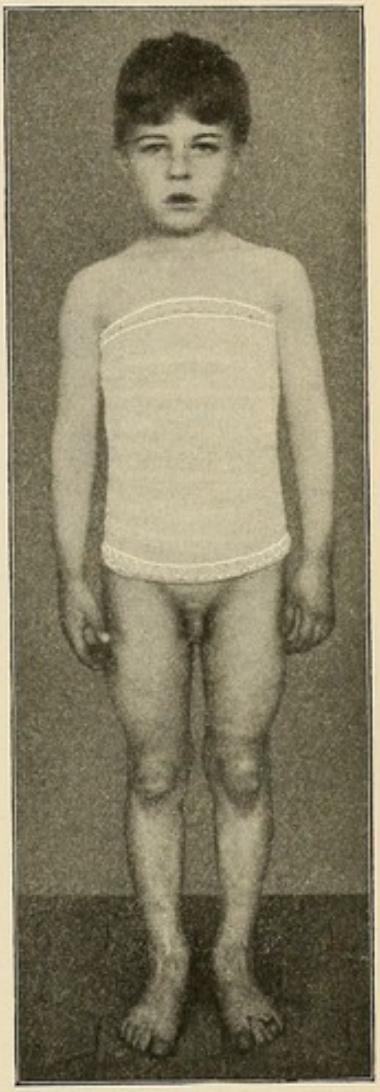


Fig. 209.—Jacket finished by trimming away hammock and turning up and securing its edges. (Fowler's Surgery.)

The *indications* governing the surgeon's choice in the use of these systems of support will depend on the location of the disease. In Pott's disease high up in the dorsal region, the plaster-of-Paris jacket or the poroplastic felt corset answers the purpose. In the middle and lower dorsal, as well as in the lumbar region, the Taylor type of support will be preferable. Care should be taken that the appliance is kept properly adjusted and renewed as the child outgrows it. The poroplastic corset is also employed after the plaster-of-Paris jacket during convalescence (Golding Bird).

These supports permit the patient to walk about. In case he

is compelled to maintain the recumbent positon for any length of time, or for night use, an apparatus designed for this purpose may be used (Schapp's Fig. 210). Extension may be applied by means of a weight and pulley. The latter is more frequently used for Pott's disease in the cervical region.

The *constitutional treatment* includes medicinal and dietetic measures and fresh air. Patients should be kept out of doors as

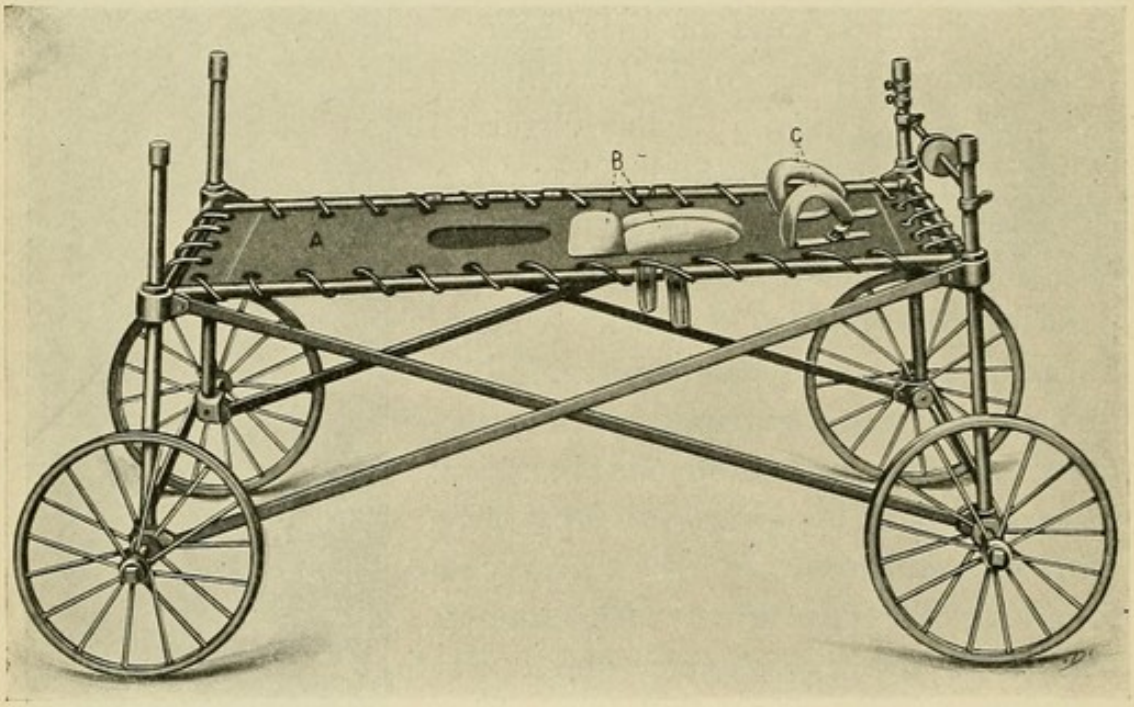


Fig. 210.—Schapps's recumbent apparatus for the treatment of Pott's disease. A, Stretched canvas laced to the frame by stout cords; B, cushions stuffed with hair between which the bony projection rests; C, padded straps of webbing arranged to pass around the shoulders and through the axillæ. (Fowler's Surgery.)

much as possible. Iron, cod-liver oil, and the most easily digested as well as the most nourishing food should be given. Much will depend on the healthful character of the patient's surroundings.

The Treatment of Scoliosis.—*Prophylactic treatment* is embraced in the care of the general health, the correction of anemic conditions, the selection of proper chairs and writing-desks, and the furnishing of sufficient and properly directed light while at work in school. Finally, a watchful care must be exercised to prevent parents from sacrificing the health of the child to excessive mental culture.

General Measures of Treatment.—The cause should be removed

where it can be ascertained. The extremities should be equalized by wearing a high shoe; change of occupation and methods of recreation are to be insisted on and a proper sitting position, or attitude, while standing or walking is to be advised. The general health should be carefully inquired into, and remedies administered that are calculated to correct any existing constitutional

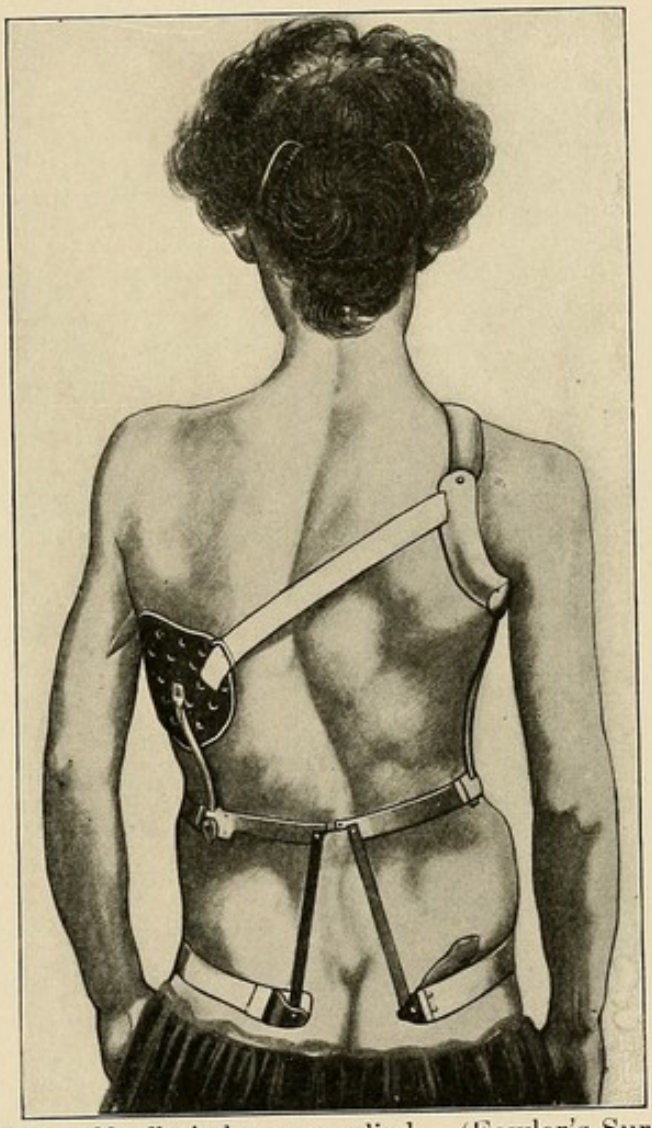


Fig. 211.—Shaffer's brace applied. (Fowler's Surgery.)

vice and restore the health and strength, such as cod-liver oil, preparations of iron, iodin, and the phosphates.

Correction of the Deformity.—The most important means at our command for this purpose are embraced in properly directed gymnastic exercises. The results of treatment will depend largely on how thoroughly the patient appreciates the importance of this part of the treatment and how persistently he devotes

himself to the task of carrying it out. The system known as the Swedish, when the exercises are administered by a person thoroughly familiar with the method as taught in Sweden, is by far the best. In addition to these dumb-bell exercises or self-suspension by Sayre's apparatus, should be practised, or the horizontal bar should be used several times a day; the patient should lie down for a short time after each séance. In all exercises the hand on the concave side should be kept on a higher level than its fellow. While the patient is sitting a Volkmann's wedge-shaped cushion (Fig. 212) is used to correct the deformity. When the patient is lying on his back, a hard pillow should be placed beneath the convexity. The Sayre head-piece for self-correction is very useful.

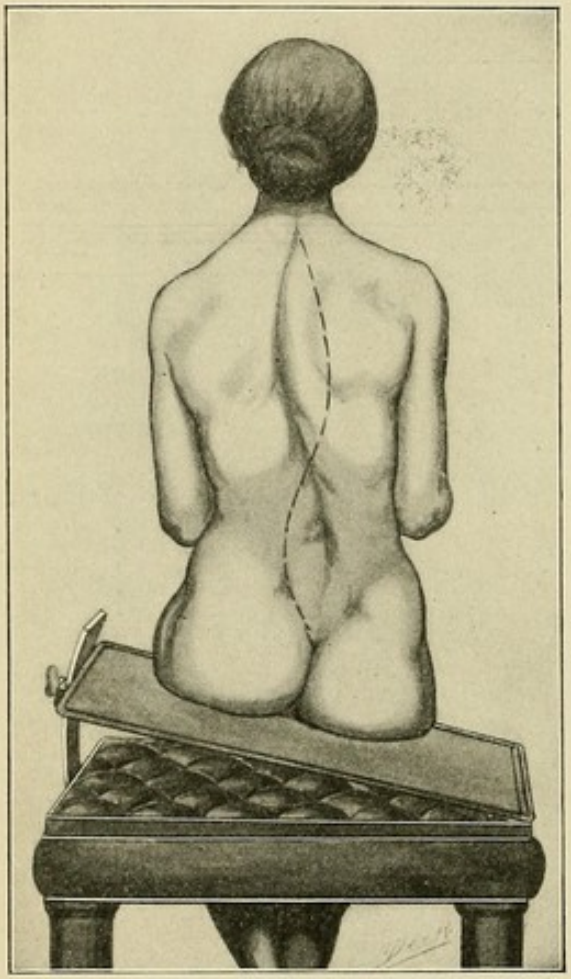


Fig. 212.—Volkmann's wedge-shaped seat for correcting the lumbar curve. (Fowler's Surgery.)

In the intervals of exercise and recumbency a Shaffer modified brace (Young) may be worn as a slight support and, in addition, as a reminder to the patient of the necessity of assuming an upright position (Fig. 211). The object of this apparatus and its modifications is not to correct the deformity by attempting to force the parts into a correct position. If worn constantly for this purpose and the exclusion of other measures, it will certainly be productive of harm by restraining the action and development of muscular structures already weakened.

Jaboulay has suggested an operation for correcting the scoliosis by separating the ribs from the sternum and permitting the former to glide over the latter. For instance, in case of a

scoliotic thorax the oblique diameter of which is lengthened from behind forward and from right to left, and shortened in the opposite direction, a separation of the right ribs at the sternum would cause the ends of the latter to project forward and inward. The transverse processes of the dorsal vertebræ would be thereby drawn anteriorly and the primary vertebral curves corrected by a rotating movement on the costal tubercle.

CHAPTER XXIII.

INSTRUMENTS AND DRESSINGS COMMONLY EMPLOYED.

I. Articles Required for all Operations.

Ligature catgut, medium and fine.
Chromic catgut, medium and fine.
Silk, paraffin silk, or linen thread, medium and fine.
Silkworm gut.
Curved, sharp-pointed scissors (for cutting ligatures and sutures).
Long, straight, spear-pointed needle (for skin sutures).
Medium-sized, curved, cutting-edge needle (for skin sutures).
1 needle holder.
Soft rubber male catheter, No. 15 F.
Glass female catheter.
2 irrigators, nozzles, tubing, various sized glass connections.
Safety-pins.
Towel clamps.
Basin for specimens.
Probe.
Protectors.
Towels.

II. Operations upon the Scalp (preparatory to trephining and for operations upon the soft parts).

Junker or intubation anesthesia apparatus.
1 three-foot length of small-sized rubber tubing and tape (for tourniquet).
2 scalpels.
2 pairs anatomic forceps.
12 Kocher clamps.
2 blunt hook retractors.
18 medium-sized, half-curved, cutting-edge needles (threaded in pairs with silkworm gut).
1 pair curved-on-the-flat, blunt-pointed scissors.
4 gauze compresses.
1 twelve-inch square of nonabsorbent cotton.
2 three-inch gauze bandages.

30 hand sponges.
12 stick sponge holders.

III. Trephining and Craniectomy (in addition to list II).

1 cyrtometer.
1 periosteal elevator.
1 set trephines.
Gigli saws.
Saline irrigation (to keep operative field clear).
2 craniectomy forceps.
1 rongeur forceps.
1 set large chisels.
1 mallet.
Horseley bone wax.
1 exploring syringe and needle.
Basin of saline solution, 100° F. (for temporarily removed bone).
1 telephonic brain probe.
Electric battery and brain electrodes.
1 small, narrow-bladed scalpel.
2 pairs mouse-tooth forceps.
2 small, full-curved, cutting-edge needles (threaded with fine catgut, for suturing dura).
Green-silk protective (for drains).
Bits of gauze with black silk thread.
Cushing wire ligature set.
Blood-pressure apparatus.
2 three-inch plaster-of-Paris bandages, salt solution, and additional plaster.

IV. Excision of the Trigeminus (in addition to Lists II and III).

2 Crile clamps (for temporary occlusion of the carotids).
1 brain retractor with cold electric light.
50 small stick sponges.

V. Excision of the Upper Jaw.

Junker's apparatus or intubation anesthesia.
Tracheotomy set (List XIII).
Trendelenburg cannula.
2 tooth-forceps.
2 full-bellied scalpels.
2 pairs anatomic forceps.
1 periosteal elevator.
12 Kocher clamps.
1 pair curved-on-the-flat, blunt-pointed scissors.
1 set large chisels.
1 mallet.
1 lion-jaw forceps.
1 straight bone-cutting forceps.
1 angular bone-cutting forceps.
1 rongeur forceps.

3 blunt hook retractors.
2 Volkmann sharp spoons.
2 medium-sized, full-curved, cutting-edge needles (threaded with catgut loop sutures).
1 twelve-inch square of zinc oxid gauze.
12 one-inch zinc oxid packing strips.
12 medium-sized, half-curved, cutting-edge needles (threaded in pairs with silkworm gut).
Thermocautery or electric cautery.
1 medium-sized, full-curved, cutting-edge needle (threaded with silk for tongue suture).
4 gauze compresses.
1 twelve-inch square of nonabsorbent cotton.
2 three-inch gauze bandages.
12 stick sponge holders.
50 stick sponges.
50 hand sponges.
Iodoform-collodion, glass, and brush.

VI. Resection of the Lower Jaw (in addition to List V).

1 chain saw and carrier.
2 Gigli saws.

VII. Opening the Mastoid.

2 scalpels.
2 blunt hook retractors.
1 self-retaining retractor.
1 periosteal elevator.
6 Kocher clamps.
1 set mastoid chisels.
1 set mastoid gouges.
1 mallet.
1 small trephine.
2 Volkmann sharp spoons.
1 small sinus curette.
1 probe.
1 grooved director.
1 pair curved-on-the-flat, blunt-pointed scissors.
Saline irrigation.
20 hand sponges.
30 small stick sponges.
1 one-inch zinc oxid packing strip.
4 medium-sized, half-curved, cutting-edge needles (threaded in pairs with silkworm gut).
3 gauze compresses.
1 twelve-inch square of nonabsorbent cotton.
2 three-inch gauze bandages.

VIII. Harelip.

1 tongue-forceps.
1 tongue depressor.

1 mouth-gag.
2 medium-sized, half-curved, cutting-edge needles (threaded with silk, for traction sutures).
1 small, narrow-bladed scalpel.
1 straight, sharp-pointed bistoury.
2 pair mouse-tooth forceps.
1 pair curved-on-the-flat, sharp-pointed scissors.
6 medium-sized, half-curved, cutting-edge needles (threaded with silk).
6 small, half-curved, cutting-edge needles (threaded with silk).
1 pair small hook retractors.
6 pointed artery clamps.
12 hand sponges.
Iodoform-collodion, glass, and brush.
2 narrow strips of adhesive plaster (to relieve tension).

IX. Staphylorrhaphy and Uranoplasty.

1 Whitehead gag.
1 mouth-gag.
2 cheek retractors.
1 tongue depressor.
12 stick sponge holders.
50 stick sponges.
2 single tenacula.
1 narrow, flat-bellied scalpel (for section of levator palati).
1 small-bladded scalpel (for paring edges of cleft).
2 pairs long-handled, mouse-tooth forceps.
1 pair long-handled, curved-on-the-flat, sharp-pointed scissors.
1 dull-edged periosteal elevator bent at a right angle.
1 sharp-edged periosteal elevator bent at a right angle.
3 small, half-curved, cutting-edge needles (threaded with silk loops, for guide suture).
12 paraffin silk sutures.
6 artery clamps (to attach to sutures).
1 long-handled needle holder.
1 right spiral curved, sharp-pointed aneurysm needle.
1 left spiral curved, sharp-pointed aneurysm needle.

X. Tonsillectomy.

1 mouth-gag.
1 tongue depressor.
1 pair tenaculum forceps.
1 pair long-handled, curved-on-the-flat, blunt-pointed scissors.
1 curved, probe-pointed bistoury.
1 tonsillotome.
2 stick sponge holders.
12 stick sponges.
Ice-water, tumbler, and pus basin.

XI. Adenoids.

1 mouth-gag.
1 tongue depressor.
2 Gottstein curettes.
1 pair Lowenbury's forceps.
6 sponge holders.
20 stick sponges.
1 uvula retractor.
1 No. 20 F. sound.
Solution of adrenalin chlorid, 1 : 1000.

XII. Deviated Septum.

1 mouth-gag.
1 tongue depressor.
6 sponge holders.
20 stick sponges.
Solution of adrenalin chlorid, 1 : 1000.
Small pieces of cotton on wooden applicators.
2 Douglas knives.
1 Mial saw.
1 Curtis saw.
1 Bosworth saw.
1 elevator.
1 pair Asch's scissors.
1 pair Asch's compressors.
1 Douglas perforator.
1 set Asch's splints.

XIII. Tracheotomy.

1 full-bellied scalpel.
18 Kocher clamps.
2 hook retractors.
2 pairs anatomic forceps.
2 single tenacula.
1 flat-bellied scalpel.
1 pair curved-on-the-flat, blunt-pointed scissors.
1 pair curved-on-the-flat, sharp-pointed scissors.
1 cartilage-cutting forceps (for enlarging tracheal opening).
1 set tracheotomy tubes.
Tapes for tube.
3 medium-sized, half-curved, cutting-edge needles (threaded with silk).
Flexible applicator and absorbent cotton.
20 hand sponges.
20 small stick sponges.
6 stick sponge holders.

XIV. Cervical Adenectomy.

1 small flat sandbag (placed under the shoulders to extend the neck).
2 scalpels (dissecting handles).

24 Kocher clamps.
12 pointed artery clamps.
2 pairs anatomic forceps.
2 pairs curved-on-the-flat blunt-pointed scissors.
2 small, smooth retractors.
2 blunt hook retractors.
2 Volkmann sharp spoons.
6 medium-sized, half-curved, cutting-edge needles (threaded in pairs with silkworm gut).
2 long, straight, spear-pointed needles (threaded with silk for subcuticular sutures).
1 medium-sized, half-curved, cutting-edge needle (threaded with silk for subcuticular sutures).
12 stick sponge bolders.
50 stick sponges.
6 gauze compresses (shaken out).
2 one-inch gauze strips (in drainage cases).
2 four-inch fenestrated rubber tubes (in drainage cases).
2 twelve-inch squares of nonabsorbent cotton.
3 three-inch gauze bandages.
2 three-inch plaster-of-Paris bandages (in children).

XV. Goiter (in addition to Lists XIII and XIV).
2 aneurysm needles (threaded with medium-sized catgut).
2 glass drainage spools.
Thermocautery.

XVI. Cut throat.
Combine Lists XIII and XIV.

XVII. Occlusion of the Carotids, Temporary or Permanent.
List XIV, minus sharp spoons and drainage.
2 aneurysm needles (threaded with two strands of medium-sized catgut).
2 Crile clamps (for temporary occlusion).
Paraffin injection syringe, paraffin, alcohol lamp, basin of hot water (in occlusion of terminals of external carotid).

XVIII. Amputation of the Breast (radical operation for carcinoma).
1 flat sandbag.
2 large protectors.
1 arm and hand protector.
1 bandage (for securing arm).
24 towels.
1 towel wringer.
Hot saline in pitcher (for hot towels).
3 full-bellied scalpels.
1 small scalpel.
50 artery clamps.
2 pairs anatomic forceps.

2 pairs curved-on-the-flat, blunt-pointed scissors.
1 pair blunt hook retractors.
1 pair small, smooth retractors.
1 aneurysm needle.
1 single tenaculum.
50 large, half-curved, cutting-edge needles (threaded in pairs with silkworm gut).
1 long, straight, spear-pointed needle (threaded with silk for subcuticular suture).
1 skin-grafting set (List LXXX).
75 hand sponges.
12 gauze compresses (shaken out).
2 squares nonabsorbent cotton.
1 breast binder.
1 three-inch Canton-flannel bandage.

XIX. Empyema (resection of rib).

1 flat sandbag.
Exploring syringe.
Stethoscope.
2 scalpels.
12 artery clamps.
2 blunt hook retractors.
1 periosteal elevator.
1 costotome.
1 angular, bone-cutting forceps.
1 rongeur forceps.
1 bone-grasping forceps.
2 Volkmann sharp spoons (in caries cases).
1 pair curved-on-the-flat, blunt-pointed scissors.
1 pointed artery clamp (for opening pleura).
1 blunt curette.
6 stick sponge holders.
20 stick sponges.
20 hand sponges.
1 eight-inch large-caliber drainage tube and glass connection (for subaqueous drainage).
8 medium-sized, half-curved, cutting-edge needles (threaded in pairs with silkworm gut).
1 medium-sized, half-curved, cutting-edge needle (threaded with silk to retain tube in place).
Boro-salicylic and saline irrigation (in case of fibrinous masses).
3 gauze compresses (slit to allow tube to emerge).
4 adhesive plaster taped straps.
1 chest binder.

ABDOMINAL OPERATIONS.

XX. Accessories (extraabdominal).

1 laparotomy sheet or two protectors.

XXI. Laparotomy Incision (making).

2 single tenacula (to steady the skin).
1 skin knife, small-bellied.
2 pairs anatomic forceps.
6 pairs artery clamps.
1 pair curved-on-the-flat, blunt-pointed scissors.
1 pair narrow retractors.

XXII. Laparotomy Incision (retraction).

1 self-retaining retractor, 3 sets of blades.
2 medium-sized retractors.
2 large retractors.
2 small retractors.

XXIII. Accessories (intraabdominal).

12 crash laparotomy sponges.
12 gauze laparotomy sponges.
50 stick sponges.
12 stick sponge holders.
Woelfler's solution and medicine dropper.
1 ligature carrier.
1 visceral grasping forceps.
1 basin of hot bichlorid.
1 basin of hot saline.
Towels, towel wringer, and pitcher of hot saline.

XXIV. Articles Required in Drainage Cases.

Equal parts hydrogen peroxid and sterile water (can be used slightly warm).
1 Chamberlain douche nozzle.
Saline solution, 120° F.
2 curved, fenestrated, glass drainage tubes.
Plain wicking.
Cigarette drains.
Zinc oxid wicking.
Gauze strips, two and four inches wide.
Rubber dam (to slip over tubes and to protect wound dressing).
Rubber tubing (in gall-bladder cases and for lateral drain in appendicitis with abscess).
1 uterine dressing forceps.
1 narrow-bladed scalpel (for making accessory drainage opening).
1 straight, blunt-pointed bistoury (for making accessory drainage opening).
1 pair long-handled, sharp-pointed, curved scissors (for vaginal drainage).
1 pair long-handled, blunt-pointed, curved clamps (for vaginal drainage).
1 large glass syringe.
1 vulvar pad and T-bandage in cases drained *per vaginam*.

XXV. Laparotomy Incision (closing).

18 large, half-curved, cutting-edge needles (threaded in pairs with silkworm gut).
12 artery clamps.
8 Halstead clamps for the peritoneum.
1 pair curved-on-the-flat, blunt-pointed scissors.
1 medium-sized, half-curved, round needle (threaded with loop suture of catgut, for suture of peritoneum).
2 medium-sized, half-curved, cutting-edge needles (threaded with loop sutures of chromic gut, for aponeurosis suture and muscle suture).
1 long, straight, spear-pointed needle (for subcuticular suture) (threaded with linen thread or silk).
10 rubber bolsters.
1 one-inch gauze strip (as a subcuticular drain in fat patients).

XXVI. Laparotomy Incision (dressing).

4 compresses of plain gauze.
1 packet of nonabsorbent cotton.
6 adhesive plaster taped straps.
1 binder.
18 safety-pins.
2 perineal straps.

XXVII. Appendectomy: (*A*) in acute cases, in addition to Lists XX to XXVI, inclusive.

2 small, round retractors.
1 ligature carrier (armed with catgut for mesoappendix).
1 small, round needle threaded with paraffin silk (for first purse-string).
2 small, half-curved, round needles (threaded with chromic gut for purse-strings or Lembert suture).
Thermocautery (knife or pointed tip).
Carbolic acid, glass, and sterilized wooden tooth-picks (in case thermocautery fails to work).
Special forceps for grasping and inverting appendical stump.

(*B*) Appendectomy in the interval, as above except List XXIV.

XXVIII. Oöphorectomy, Salpingo-oöphorectomy (in addition to Lists XX to XXVI, inclusive).

1 ovary forceps.
4 Keith clamps, light weight (for deeply situated bleeding points).
2 medium-sized, round needles (threaded with catgut loop sutures to cover in raw surfaces).
4 strands braided catgut (placed in pairs on ligature carrier).
Thermocautery, pointed tip (to destroy any remaining lining of tube at uterine end).

XXIX. Extrauterine Pregnancy (in addition to List XXVIII).

Saline infusion (List LXXXII).
1 large Chamberlain douche nozzle.

Oxygen for intraperitoneal introduction.
1 one-gallon pitcher.
Saline solution, 110° F.
4 gauze compresses (to absorb blood).

XXX. Hysterectomy (in addition to Lists XX to XXIII, inclusive, that part of XXIV referring to vaginal drainage, and Lists XXV and XXVI).

1 eight-pronged tenacula forceps.
4 braided catgut ligatures.
4 Keith clamps (heavy).
4 Keith clamps (medium).
4 Keith clamps (light).
2 medium-sized, half-curved, round needles (threaded with catgut loop sutures to cover in raw surfaces).
Thermocautery, pointed tip (to disinfect cervical canal in supravaginal amputation of uterus).
Long catgut ligatures (medium size for deeply situated bleeding points).
1 aneurysm needle.

XXXI. Resection of Intestine (in addition to Lists XX to XXIII, inclusive, and Lists XXV and XXVI).

4 intestinal clamps (blades armed with rubber tubing).
4 tapes.
1 small, full-bellied scalpel.
1 pair straight, sharp-pointed scissors.
4 half-curved, round needles (threaded with silk for guy sutures).
4 straight, round (cambric) needles (threaded with fine paraffin silk).
1 ligature carrier.
10 strands of medium-sized catgut for mesentery.
2 medium-sized, full-curved, round needles (threaded with catgut for mesentery).
1 set Murphy buttons.
1 set Chlumsky buttons.
1 set McGraw's elastic ligatures (used only in very emergent cases).
Towel wringer, towels, pitcher of hot saline.

XXXII. Ileocolostomy.

Same lists as for resection of intestine.

XXXIII. Inguinal Colostomy (in addition to Lists XX to XXIII, inclusive, and Lists XXV and XXVI).

First stage:

20 medium-sized, half-curved, round needles (threaded with silk).
Silver wire (for occlusion ligature).

Second stage:

2 pairs mouse-tooth forceps.
1 pair straight, sharp-pointed scissors.

1 straight, probe-pointed bistoury.
1 pus basin.
10 hand sponges.
2 paper wool pads.
1 abdominal binder.

XXXIV. Gastrotomy, for foreign body (in addition to Lists XX to XXIII, inclusive, and Lists XXV and XXVI).

2 medium-sized, half-curved, round needles (threaded with silk for guy sutures).
1 narrow-bladed scalpel.
1 pair straight, sharp-pointed scissors.
6 slender-pointed clamps.
1 smooth-bladed grasping forceps.
2 medium-sized, full-curved, round needles (threaded with loop sutures of fine chromic gut, for mucous membrane sutures).
2 straight, round (cambric) needles (threaded with paraffin silk, for Lembert sutures).

XXXV. Gastrostomy, permanent stomach fistula (in addition to Lists XX to XXIII, inclusive, and Lists XXV and XXVI).

15 medium-sized, half-curved, round needles (threaded with paraffin silk).
1 narrow-bladed scalpel.
1 pair straight, sharp-pointed scissors.
2 medium-sized, half-curved, round needles (threaded with fine chromic gut loop sutures, for mucous membrane).
1 soft-rubber catheter, No. 24 F.
1 twelve-inch square of green-silk protective (slit to allow tube to emerge).

XXXVI. Gastrectomy (in addition to Lists XX to XXIII, inclusive, and Lists XXV, XXVI, and XXXVII).

1 ligature carrier.
18 medium-sized catgut ligatures.
2 medium-sized, half-curved, round needles (threaded with fine catgut loop sutures.
1 long-bladed stomach clamp (jaws armed with rubber tubing).
6 medium-sized, half-curved, round needles (threaded with fine chromic catgut, for mucous membrane).
2 medium-sized, half-curved, round needles (threaded with paraffin silk, for Lembert sutures).

XXXVII. Gastroenterostomy, posterior (in addition to Lists XX to XXIII, inclusive, and Lists XXV and XXVI).

1 blunt-pointed anatomic forceps (for separating mesocolon).
1 set gastroenterostomy clamps.
4 medium-sized, full-curved, round needles (threaded with catgut for suturing mesocolon to stomach).

2 needle holders (the nurse arms one while the other is in use).
2 intestinal clamps (jaws armed with rubber tubing).
1 small-bladed scalpel (for marking out visceral openings).
2 medium-sized, half-curved, round needles (threaded with paraffin silk, eighteen-inch lengths, for continuous Lembert sutures).
2 pairs mouse-tooth forceps (for steadying intestines and stomach while incising).
1 pair straight, sharp-pointed scissors (for visceral incisions).
3 mosquito clamps.
6 Kocher clamps.
1 medium-sized, half-curved, round needle (threaded with fine chromic gut loop suture, for overcasting cut edge of intestine and stomach).
1 medium-sized Chlumsky button (for lateral intestinal anastomosis).
2 straight, round (cambric) needles (for closing lateral anastomosis openings in intestine up to each half of button.)
1 silver-wire ligature, medium weight, twelve-inch length (for occlusion suture).
2 slender-bladed clamps (for fastening wire.)

XXXVIII. Cholecystostomy (in addition to Lists XX to XXIII, inclusive, and Lists XXV and XXVI).

1 large, smooth retractor (for liver).
2 medium-sized, full-curved, cutting-edge needles (threaded with silk for guy sutures).
1 aspirating syringe and needle.
1 narrow-bladed scalpel.
1 medium-sized scoop.
1 small curette.
1 Blake stone-grasping forceps.
1 flexible duct probe.
1 gall-bladder tucker.
6 medium-sized, full-curved, cutting-edge needles (threaded with chromic gut, to secure drainage tube to gall-bladder).
1 twelve-inch rubber tube.
1 medium-sized, half-curved, cutting-edge needle (threaded with chromic gut, used as a purse-string for securing inverted gall-bladder to tube).
1 split tube for additional drainage.
1 twelve-inch square of rubber dam (to protect wound dressing).

XXXIX. Cholecystectomy (in addition to Lists XX to XXIII, inclusive, and Lists XXV and XXVI).

2 medium-sized, full-curved, cutting-edge needles (threaded with silk, for traction sutures).
1 small scalpel (dissecting handle).
1 medium-sized scoop.
Thermocautery, knife tip.
2 braided catgut ligatures.
1 one-inch zinc oxid drainage strip.

XL. Cholecystenterostomy (in addition to Lists XX to XXIII, inclusive, and Lists XXV and XXVI).

1 small scalpel.
2 pairs mouse-tooth forceps.
2 medium-sized, full-curved, round needles (threaded with silk for guy sutures).
2 intestinal clamps (jaws armed with rubber tubing).
1 pair straight, sharp-pointed scissors.
1 small Murphy button.
2 medium-sized, full-curved, round needles (threaded with silk, to close anastomosis openings up to each half of button).
4 medium-sized, half-curved, round needles (threaded with silk for supporting sutures).
1 one-inch zinc oxid gauze drainage strip.

XLI. Abdominal Cysts (in addition to Lists XX to XXIII, inclusive, and Lists XXV and XXVI).

1 large trocar, cannula, tube, and pitcher.
2 medium-sized, half-curved, round needles (threaded with catgut loop sutures, in case cyst-wall is to be attached to the incision).
Thermocautery.
24 Kocher clamps.
6 light-weight Keith clamps.
1 ligature carrier.
2 aneurysm needles (threaded with catgut).
2 braided catgut ligatures.
2 medium-sized, half-curved, round needles (threaded with catgut loop sutures, for covering in raw surfaces).
2 four-inch zinc oxid gauze strips.

XLII. Cesarean Section (in addition to Lists XX to XXIII, inclusive, and Lists XXVI and LXXXII).

1 large, full-bellied scalpel.
1 three-foot length of rubber tubing.
12 Kocher clamps.
6 light-weight Keith clamps.
Saline solution, 120° F.
Braided silk for umbilical cord.
1 Large pad of gauze and towels (to protect peritoneum).
6 large, half-curved, round needles (threaded with catgut, for uterine sutures).
12 medium-sized, half-curved, round needles (threaded with chromic gut for uterine sutures).
1 vulvar pad and T-bandage.
1 breast binder.
Fluid extract of ergot.
For the baby: Tape, hot and cold baths; olive oil, toilet powder, and a warm blanket.

XLIII. Ventral and Umbilical Hernia (in addition to Lists XX to XXIII, inclusive, and Lists XXV and XXVI; in strangulated cases List XXXI).

8 medium-sized, half-curved, cutting-edge needles (threaded with kangaroo tendon or chromic gut).

XLIV. Inguinal Hernia (if strangulated include List XXXI).

2 large protectors.
1 one-inch gauze bandage for penis.
6 towels.
2 full-bellied scalpels (dissecting handles).
1 straight, probe-pointed bistoury.
2 pairs anatomic forceps.
18 artery clamps.
1 twelve-inch tape (for retracting cord).
1 pair curved-on-the-flat, blunt-pointed scissors.
1 ligature carrier.
4 small retractors.
1 medium-sized, half-curved, round needle (threaded with medium-sized catgut for transfixing neck of sac).
2 needle holders (the nurse arms one while the other is in use).
12 medium-sized, half-curved, round needles (threaded with kangaroo tendon or chromic gut for canal aponeurotic sutures).
1 spatula (for retracting posterior wall of canal).
1 medium-sized, half-curved, cutting-edge needle (threaded with fine catgut loop suture, for deep layer of superficial fascia).
1 long, straight, spear-pointed needle (threaded with silk, for subcuticular suture).
12 stick sponge holders.
30 hand sponges.
30 stick sponges.
1 small hand basin (inverted to support pelvis while applying dressing; the limb should also be supported to relieve strain on the sutures).
3 gauze compresses.
1 adhesive-plaster strap (placed across thighs to support scrotum; to protect the scrotum a folded compress is placed on the edge of the strap).
1 twelve-inch square of nonabsorbent cotton.
2 four-inch muslin bandages (spica of groin).

XLV. Femoral Hernia, Fabricius operation (if strangulated, include List XXXI).

2 large protectors.
6 towels.
2 full-bellied scalpels.
1 straight, probe-pointed bistoury.
2 pairs anatomic forceps.
12 artery clamps.

1 medium-sized, half-curved, round needle (threaded with catgut, for transfixing neck of sac).
2 small retractors.
1 round retractor (for retracting femoral vessels).
6 medium-sized, full-curved, round needles (threaded with kangaroo tendon or chromic gut, for suturing Poupart's ligament to the pectineus muscle).
2 needle holders (the nurse arms one while the other is in use).
1 medium-sized, half-curved, cutting-edge needle (threaded with fine catgut loop suture, for loose cellular tissue).
1 long, straight, spear-pointed needle (threaded with silk for subcuticular suture).
12 stick sponge holders.
30 stick sponges.
30 hand sponges.
1 small hand basin (see Inguinal Hernia).
3 gauze compresses.
4 adhesive-plaster taped straps.
2 four-inch muslin bandages (spica of groin).

XLVI. Vaginal Operations (accessories).

1 Kelly pad.
1 anus protector.
1 pail.
1 perineal sheet.
Dusting powder to apply to clitoris after separating adhesions.

XLVII. Curettage (in addition to List XLVI).

1 self-retaining speculum, three interchangeable blades (for dorsal position).
1 large Sims' speculum.
1 self-retaining and expanding Sims' speculum (when operating without assistants).
2 curved tenacula forceps.
1 cervix cleaner (applicator wound with gauze or cotton).
1 uterine sound.
1 small dilator.
1 large dilator.
1 polypus forceps.
1 medium-sized dull curette.
1 medium-sized sharp curette.
1 small, sharp curette (for curetting cornua).
6 stick sponge holders.
1 pair curved-on-the-flat, blunt-pointed scissors.
20 stick sponges.
1 uterine dressing forceps.
Normal saline solution, 120° F. (in simple cases).
Boro-salicylic solution, 120° F. (in suspicious cases).
Bichlorid solution, 120° F., 1 : 10,000 (in septic cases).

Cervix strip (in septic cases).
1 gauze strip four inches wide for vaginal pack (to correct displacements).
1 paper-wool vulvar pad.
1 T-bandage, single.
4 safety-pins.

XLVIII. Trachelorrhaphy (in addition to Lists XLVI and XLVII).
2 lateral vaginal retractors.
1 pair hawksbill scissors.
1 scalpel.
1 pair tissue forceps.
1 pair long-handled, curved-on-the-flat, sharp-pointed scissors.
30 stick sponges.
1 pair anatomic forceps (to hold first knot of sutures).
10 straight or quarter curved cervix needles (threaded with medium-sized chromic gut).
2 needle holders (the nurse arms one while the other is in use).
1 counterpressure hook.
10 artery clamps.
1 angle cleaner (similar to cervix cleaner, for removing clots before tying ligatures).

XLIX. Colporrhaphy, anterior and posterior (in addition to Lists XLVI and XLVII).
2 lateral vaginal retractors.
1 anterior vaginal retractor.
4 medium-sized, half-curved, round needles (threaded with silk, to serve as retractors).
1 scalpel.
1 pair tissue forceps.
1 pair curved-on-the-flat, sharp-pointed scissors.
6 artery clamps.
4 medium-sized, half-curved, cutting-edge needles (threaded with chromic gut).
1 pair anatomic forceps.
30 stick sponges.

L. Colpotomy, anterior and posterior (in addition to Lists XLVI and XLVII).
2 lateral vaginal retractors.
1 intraperitoneal blade of self-retaining speculum.
1 pair long-handled, curved-on-the-flat, blunt-pointed scissors
1 needle holder.
2 medium-sized, half-curved, round needles (threaded with stout silk, to serve as guy sutures).
6 light-weight Keith clamps (for oophorectomy).
4 braided catgut ligatures (for oophorectomy).
2 medium-sized, half-curved, cutting-edge needles (threaded with

catgut loop sutures, for securing drainage tube or suturing wound).
Gauze drainage strips, two inches wide (for cellulitis cases).
Fenestrated rubber drainage tubes (three-fourths inch caliber, for pus cases).
Small-sized "horse tracheotomy tube" (for prolonged drainage).
Harrison's rubber drainage tube.
30 stick sponges.

LI. Perineorrhaphy (in addition to Lists XLIV and XLVII).

1 pair curved-on-the-flat, sharp-pointed scissors.
1 pair curved on-the-flat, blunt-pointed scissors.
1 full-bellied scalpel.
1 pair tissue forceps.
1 needle holder.
6 medium-sized, half-curved, cutting-edge needles (threaded in pairs with silkworm gut).
2 medium-sized, half-curved, cutting-edge needles (threaded with chromic gut loop sutures).
1 medium-sized, half-curved, cutting-edge needle (threaded with chromic gut, for skin and mucous membrane suture).
6 artery clamps.
2 four-inch rubber bolsters.
30 stick sponges.

LII. Urethral Caruncle (in addition to Lists XLVI and XLVII).

2 lateral retractors.
Thermocautery or electric cautery (fine tip).
1 slender-bladed knife.
2 pairs mouse-tooth forceps.
6 slender-pointed clamps.
12 small, half-curved, round needles (threaded with fine silk).
1 needle holder.
1 pair slender, sharp-pointed, curved scissors.
1 rubber catheter, No. 20 F.
12 artery clamps (to use on sponge sticks).
30 small stick sponges.

LIII. Vaginal Hysterectomy (in addition to Lists XLVI and XLVII).

2 lateral vaginal retractors.
1 anterior vaginal retractor.
1 intraperitoneal blade of self-retaining speculum.
1 long-handled scalpel.
4 medium-sized, full-curved, round needles (threaded with stout silk, for traction sutures).
1 pair long-handled, curved-on-the-flat, sharp-pointed scissors.
1 pair long-handled, curved-on-the-flat, blunt-pointed scissors.
4 light-weight Keith clamps.
4 medium-weight Keith clamps.

4 heavy Keith clamps.
4 curved Péan clamps.
2 six-pronged tenacula forceps.
8 Kocher clamps.
12 stick sponge holders.
8 braided catgut ligatures.
4 medium-sized, half-curved, round needles (threaded with catgut loop sutures, for covering in raw surfaces and suturing incision).
2 zinc oxid gauze strips eight inches wide.

LIV. Fistula, vesicovaginal, rectovaginal (in addition to Lists XLVI, XLVII, and XLIX).

2 paring knives.
4 small half-curved round needles threaded with silk.

LV. Circumcision.

1 strong, flat-ended, silver probe (to break up adhesions).
3 artery clamps.
1 circumcision clamp (in adults).
1 pair curved-on-the-flat, sharp-pointed scissors.
2 pairs mouse-tooth forceps.
1 pair anatomic forceps.
6 small, half-curved, cutting-edge needles (threaded with fine catgut).
1 three-inch iodoform strip gauze.
12 hand sponges.

LVI. Varicocele.

1 one-inch gauze bandage (wet with bichlorid, for penis).
2 scalpels.
2 pairs anatomic forceps.
6 artery clamps.
2 aneurysm needles (threaded with medium-size catgut for ligating veins).
1 pair curved-on-the-flat, blunt-pointed scissors.
1 pair blunt hook retractors.
2 pieces of tape.
1 medium-sized, half-curved, cutting-edge needle (threaded with fine catgut loop suture, for sewing vein-stumps together).
1 medium-sized, curved, cutting-edge needle (threaded with medium-sized chromic gut, for suturing skin incision).
1 medium-sized, curved, cutting-edge needle (threaded with fine catgut, in case tunica is opened).
12 hand sponges.
1 strip of adhesive plaster eighteen inches by four inches (placed across thighs to support scrotum).
1 gauze compress, folded (to protect scrotum from edge of adhesive plaster support).
3 gauze compresses.

1 small hand basin (pelvic support).
1 twelve-inch square of nonabsorbent cotton.
2 three-inch gauze bandages (single spica of groin).

LVII. Hydrocele, open operation.

1 curved, sharp-pointed bistoury.
1 scalpel.
12 artery clamps.
1 pair curved-on-the-flat, blunt-pointed scissors.
2 pairs mouse-tooth forceps.
1 pair small, blunt hook retractors.
12 hand sponges.
1 zinc oxid gauze drainage strip, two inches wide.
6 medium-sized, half-curved, cutting-edge needles (threaded with silk or chromic gut).
1 adhesive-plaster strip for scrotum (see Varicocele).
1 gauze compress, folded (see Varicocele).
3 gauze compresses.
1 twelve-inch square of nonabsorbent cotton.
1 four-inch gauze bandage.

LVIII. Hypospadias (methods of Anger and Duplay).

2 small, flat-bellied scalpels.
6 towels.
2 pairs small mouse-tooth forceps.
1 pair slender, anatomic forceps.
6 slender-pointed artery clamps.
1 pair small, curved-on-the-flat, sharp-pointed scissors.
12 small, half-curved, round needles (threaded in pairs with fine silk).
6 small, half-curved, round needles (threaded with fine silk).
6 small, half-curved, round needles (threaded with fine catgut).
1 soft-rubber catheter, No. 14 F.
1 gauze compress, shaken out (held in place with safety-pin).

LIX. Internal Urethrotomy.

6 towels.
2 ounces of olive oil in a glass.
1 glass piston syringe.
3 dozen filiform bougies.
1 set tunneled sounds.
1 urethrotome.
1 complete set of sounds.
1 soft-rubber catheter, No. 20 F.
Boro-salicylic irrigation and glass connection to fit catheter (to flush out urethra).
4 well-padded pieces of basswood four inches by one-half inch, to splint penis in case of severe hemorrhage.
1 one-inch gauze bandage and safety-pin to secure splint.

LX. Perineal Section, for stricture and drainage, in addition to List LIX.

1 perineal sheet.
Trocar and cannula.
1 set lithotomy staffs.
1 full-bellied scalpel.
1 long, grooved director.
1 straight, probe-pointed bistoury.
1 perineal director.
1 gorget.
2 blunt hook retractors (when dissection of urethra is necessary).
6 artery clamps.
1 large examining cystoscope.
1 slender forceps (to aid in passing perineal tube).
3 soft-rubber perineal tubes, Nos. 32, 34, 36 F.
1 large, curved, cutting-edge needle (threaded with stout silk to secure tube).
3 medium-sized, full-curved, cutting-edge needles (threaded with silk).
20 hand sponges.
30 stick sponges.
12 stick sponge holders.
Saline irrigation and glass connection to fit perineal tube.
1 umbrella tampon (in case of severe bleeding). This is made by passing the perineal tube through the center of an eight-inch square double thickness of gauze. The gauze near the aperture in it is sewn fast to the tube at a point which, when the tube is in position, lies just within the bladder. The tube is inserted and the interior of the umbrella tightly packed with small strips of gauze the ends of which emerge alongside of the tube.
3 gauze compresses (with apertures cut to allow passage of tube).
1 T-bandage, double.
1 glass connection (to attach perineal tube to rubber tube leading to urine bottle).

LXI. In Impassable Stricture Cases: Perineal Section Without a Guide (in addition to List LX).

2 pairs mouse-tooth forceps.
6 small, half-curved, round needles (threaded with silk, to aid in retraction and to identify remains of urethra).
1 needle holder.
1 pair curved-on-the-flat, sharp-pointed scissors.
1 long silver probe.
2 single tenacula.

LXII. In Stone Cases (in addition to List LX).

1 Thompson searcher.
1 set of stone-crushing and stone-grasping forceps.

LXIII. Prostatectomy, perineal (in addition to List LX).

6 half-curved, cutting-edge needles.
1 bifid retractor (Young).
1 prostatic retractor (Young).
2 lobe forceps (Young).
2 narrow retractors (Young).
1 posterior retractor (Young).
1 blunt dissector (Young).
1 pr. long, curved, blunt-pointed scissors.
1 sharp half-curved hook.
2 hemorrhoid clamps.
1 dressing forceps.

LXIV. Suprapubic Cystotomy.

2 scalpels.
2 blunt hook retractors.
1 pair curved-on-the-flat, sharp-pointed scissors.
2 narrow-bladed retractors.
4 small, full-curved, round needles (threaded with silk for guy sutures).
1 electric-light bladder retractor.
1 electrocautery set, for removing tumors.
1 set of stone instruments (List LXII).
4 small, full-curved, round needles (threaded with chromic gut, for suturing bladder).
1 soft-rubber suprapubic drainage tube, No. 40 F., with glass connection to fit. (This is attached by a rubber tube to a Dawbarn apparatus at the bedside.)
1 three-inch zinc oxid gauze packing strip.
2 narrow strips of adhesive plaster (to retain tube in position).
2 gauze compresses.
1 twelve-inch square of nonabsorbent cotton.
1 abdominal binder (split to allow passage of tube).
2 perineal straps.
18 safety-pins.

LXV. Kidney Incision (for exposing kidney).

1 oblong sand pillow eighteen inches long, twelve inches wide, and eight inches thick, covered with sterile towel or an Edebohls' cushion.
2 full-bellied scalpels.
2 pairs anatomic forceps.
6 artery clamps.
2 pairs curved-on-the-flat, blunt-pointed scissors.
2 medium-sized retractors, one with six-inch blade and one with four-inch blade (for deep retracting).
50 hand sponges.
30 stick sponges.
12 stick sponge holders.

LXVI. Kidney Incision (closing).

12 full-curved, cutting-edge needles (threaded in pairs with silkworm gut).
1 long, straight, spear-pointed needle (threaded with silk for subcuticular suture).
1 gauze strip four inches wide by three yards long (if kidney support is needed).
3 gauze compresses.
3 folded towels (to serve as anterior support for kidney).
4 taped adhesive-plaster straps.
1 twelve-inch square of nonabsorbent cotton.
1 abdominal binder.

LXVII. Kidney Exploration (in addition to Lists LXVI and LXVII).

2 long, blunt-pointed, steel pins (hat-pins with ends blunted).
1 exploring syringe and needle.
Thermocautery knife (pointed tip).
1 flat-bellied knife with dissecting handle (for splitting or removing capsule).
1 large, flat-bellied, broad-bladed knife for splitting kidney.
1 special forceps for compressing pedicle (jaws armed with rubber tubing).
6 long, straight, round needles (threaded in pairs with paraffin silk, eighteen-inch lengths, for through-and-through sutures).
6 medium-sized, full-curved, round needles (threaded with paraffin silk for hemostatic sutures).
1 ureteral probe (hollow).
2 long, silver probes.

LXVIII. Nephrotomy (in addition to Lists LXV, LXVI, and LXVII).

3 Keith clamps.
2 large, dull curettes.
Saline irrigation.
Peroxid and sodium bicarbonate solution.
1 pair dressing forceps.
2 fenestrated rubber drainage tubes.
3 zinc oxid gauze packing strips.

LXIX. Kidney Suspension (in addition to Lists LXV and LXVI).

6 artery clamps (for traction on the fatty capsule).
4 medium-sized, half-curved, round needles (threaded with silk, eighteen-inch lengths, for suspension sutures in pairs).
4 medium-sized, full-curved, round needles (threaded with kangaroo tendon, for suspension by band from quadratus lumborum).

LXX. Nephrectomy (in addition to Lists LXV and LXVI).

2 long, curved, Péan clamps.
3 Keith clamps.
2 braided catgut ligatures.
1 ligature carrier.
1 pair long, curved-on-the-flat, blunt-pointed scissors.

OPERATIONS UPON THE RECTUM AND ANUS.

LXXI. Fistula in Ano.

1 perineal sheet.
2 silver probes.
1 wire rectal speculum.
1 long, grooved director.
1 scalpel.
1 curved, sharp-pointed bistoury.
1 curved, blunt-pointed bistoury.
2 mouse-tooth forceps.
1 pair curved-on-the-flat, blunt-pointed scissors.
1 medium-sized sharp curette.
2 blunt hook retractors.
Hydrogen peroxid.
1 large glass syringe.
12 artery clamps.
1 medium-sized, half-curved, cutting-edge needle (threaded with catgut for circumsuture in case of troublesome hemorrhage).
1 large umbrella tampon.
6 stick sponge holders.
30 stick sponges.
1 2-grain opium suppository.
Vaselin for anointing suppositories.
1 three-inch strip of balsam-of-Peru gauze.
1 paper-wool pad.
1 T-bandage.

LXXII. Hemorrhoids (combined ligature and cautery operation).

1 perineal sheet.
1 rectal speculum.
6 large hemorrhoid clamps (ring clamps).
6 small hemorrhoid clamps (ring clamps).
1 pair curved-on-the-flat, blunt-pointed scissors.
6 large, half-curved, cutting-edge needles (threaded with eighteen-inch lengths of catgut for transfixing hemorrhoids).
6 artery clamps.
1 thermocautery (button or knife tip).
6 medium-sized, half-curved, cutting-edge needles (threaded with catgut for use as a purse-string in covering in raw surfaces).
1 2-grain opium suppository.
Vaselin for anointing suppositories.
1 Kelsey hemorrhoid clamp (in simple cautery operations).
30 stick sponges.
6 stick sponge holders.
1 large umbrella tampon.
1 paper-wool pad.
1 T-bandage, double.

LXXIII. Prolapsus Recti (suspension of rectum).

2 scalpels.
2 pairs anatomic forceps.
12 Kocher clamps.
1 pair curved-on-the-flat, blunt-pointed scissors.
3 blunt hook retractors.
1 pair tissue forceps.
1 large, curved, cutting-edge needle (threaded with chromic gut or kangaroo tendon for circumsuture of rectum).
6 medium-sized, half-curved, cutting-edge needles (threaded with chromic gut or kangaroo tendon, for suspension sutures of rectum).
12 medium-sized, half-curved, cutting needles (threaded with silkworm gut).
3 gauze compresses.
1 T-bandage.

LXXIV. Extirpation of Rectum by the Abdomino-perineal Route (in addition to Lists XX to XXIII, inclusive, and Lists XXV and XXVI).

1 ligature carrier.
2 heavy silk ligatures (for sigmoid).
1 pair straight, sharp-pointed scissors.
10 eighteen-inch lengths of catgut (for mesorectum).
2 aneurysm needles, right and left (threaded with catgut, for ligating internal iliac arteries).
1 six-inch iodoform gauze strip (to wrap around ends of sigmoid).
12 medium-sized, half-curved, round needles (threaded with silk, for artificial anus).
1 perineal sheet.
2 heavy Keith clamps.
12 light Keith clamps.
1 six-inch zinc oxid gauze strip.
2 paper-wool pads.
Collodion, brush, and glass.
6 gauze compresses.
1 T-bandage.

LXXV. Resection of Joints.

1 large sheet.
2 small protectors.
Hand or foot bags.
1 rubber bandage.
1 Esmarch constrictor.
2 scalpels.
1 resection knife.
2 pairs anatomic forceps.
24 artery clamps.
1 pair curved-on-the-flat, blunt-pointed scissors.
1 periosteal elevator.

3 blunt hook retractors.
2 sharp hook retractors.
2 Gigli saws.
1 chain saw and carrier.
1 butcher saw.
1 metacarpal saw.
1 bone-cutting forceps.
1 rongeur forceps.
2 sharp Volkmann spoons.
1 lion-jaw forceps.
2 medium-sized, half-curved, cutting-edge needles (threaded with silkworm gut).
6 stick sponge holders.
50 stick sponges.
30 hand sponges.
1 three-inch zinc oxid gauze strip.
6 gauze compresses.
3 packets of nonabsorbent cotton.
3 muslin bandages.
Splints (Richardson's in shoulder cases, right-angled in elbow cases, basswood in wrist cases, Volkmann in knee and ankle cases).
Plaster-of-Paris bandages, salt solution, and additional plaster.

LXXVI. Amputations.

1 large sheet.
2 small protectors.
Foot or hand bags.
1 rubber bandage.
1 Esmarch constrictor.
Wyeth's pins, corks, and three-foot-length of rubber tubing in hip and shoulder cases.
2 scalpels.
2 pairs anatomic forceps.
24 Kocher clamps.
2 blunt-nosed clamps (for artery and vein).
1 large amputating knife.
1 Catlin knife (for leg and forearm).
1 pair curved-on-the-flat, blunt-pointed scissors.
1 periosteal elevator.
2 Gigli saws.
1 chain saw.
1 butcher saw.
1 mallet and chisel.
1 bone-cutting forceps.
1 rongeur forceps.
1 bone-grasping forceps.
3 blunt hook retractors.
1 bandage retractor (two-tailed for arm and thigh, three-tailed for forearm and leg).

2 medium-sized, half-curved, cutting-edge needles (threaded with catgut loop sutures).
10 medium-sized, half-curved, cutting-edge needles (threaded with silkworm gut).
30 hand sponges.
1 four-inch zinc oxid gauze strip.
6 gauze compresses.
1 six-yard gauze roll.
2 adhesive-plaster taped straps.
1 four-inch gauze bandage.
Basswood splints.
2 three-inch muslin bandages.

LXXVII. Suturing of the Patella.

2 large protectors.
1 foot and leg bag.
6 towels.
2 scalpels.
2 pairs anatomic forceps.
12 Kocher clamps.
1 pair curved-on-the-flat, blunt-pointed scissors.
2 blunt hook retractors.
2 sharp hook retractors.
1 sharp Volkmann spoon.
1 bone drill (silkworm gut for carrier).
4 medium-sized, full-curved, cutting-edge needles (threaded with kangaroo tendon or chromic gut, for lateral sutures).
medium-sized, half-curved, cutting-edge needles (threaded with kangaroo tendon or chromic gut, for capsule sutures).
2 strands of kangaroo tendon, chromic gut, or silver wire (for through-and-through suture).
1 long, straight, spear-pointed needle (threaded with silk for subcuticular suture).
1 Volkmann splint.
2 gauze compresses.
1 six-yard gauze roll.
3 packets of nonabsorbent cotton.
2 three-inch muslin bandages (for foot and leg).
1 four-inch muslin bandage (for thigh).

LXXVIII. Varicose Veins (method of Trendelenburg).

2 large protectors.
6 towels.
2 scalpels.
2 pairs anatomic forceps.
6 Kocher clamps.
2 blunt hook retractors.
1 aneurysm needle (threaded with two strands of catgut).
1 pair curved-on-the-flat, blunt-pointed scissors.

1 long, straight, spear-pointed needle (threaded with silk, for subcuticular suture).
6 hand sponges.
2 gauze compresses.
2 adhesive-plaster taped straps.
2 two-inch muslin bandages (for foot and leg).
2 three-inch muslin bandages (for thigh and pelvis).

LXXIX. Abscess.

1 exploring syringe and large needle.
1 scalpel.
1 narrow-bladed artery clamp.
6 Kocher clamps.
1 grooved director.
2 pairs anatomic forceps.
2 blunt hook retractors.
1 pair curved-on-the-flat, blunt-pointed scissors.
2 sharp Volkmann spoons.
6 medium-sized, half-curved, cutting-edge needles (threaded with silkworm gut).
Peroxid of hydrogen.
1 large glass syringe.
Boro-salicylic irrigation.
6 stick sponge holders.
30 stick sponges.
30 hand sponges.
Carbolic acid (in tuberculous cases).
Alcohol (in tuberculous cases).
Peroxided zinc gauze strips (oxid of zinc gauze strips wrung out of peroxid of hydrogen).
2 fenestrated rubber drainage tubes.
6 compresses.
3 three-inch gauze bandages.

In Bone Cases (in addition to above).

1 periosteal elevator.
1 sequestrum forceps.
1 rongeur forceps.
3 bone gouges.
3 chisels.
1 mallet.
Mixture of whale oil and iodoform (for filling bone cavities).

LXXX. Skin-grafting.

1 skin-grafting razor.
1 pair sharp hook retractors (to steady skin).
2 pairs anatomic forceps.
2 flat-ended silver probes.
Basin of saline, 105° F.
Green-silk protective (cut in one-inch strips).

6 hand sponges.
4 compresses (wet with saline).
2 three-inch gauze bandages.

For Surface to be Grafted (in addition to above).

1 pair curved-on-the-flat, blunt-pointed scissors.
1 pair straight, sharp-pointed scissors.
1 Volkmann spoon.

LXXXI. Plaster-of-Paris Outfit (application of cast).

Vaselin.
Nonabsorbent or French cotton rolls.
Canton flannel bandages.
Plaster bandages.
Additional plaster.
Salt solution in basin (deep enough to allow immersion of bandages).
Sandbags.
Vinegar (for removing plaster from the hands).
Adhesive plaster and sharp plaster knife (if cast is to be fenestrated or cut down at once to facilitate rapid removal).
Soft-iron strips and basswood splints (for strengthening casts).

Removal of Cast.

Small circular saw.
Heavy plaster shears.
Heavy plaster knife.
Vinegar or strong bichlorid solution (to soften plaster).

LXXXII. Intravenous Infusion.

1 muslin bandage (for constriction).
1 scalpel.
2 pairs anatomic forceps.
1 aneurysm needle (threaded with silk).
2 Kocher clamps.
1 pair curved-on-the-flat, blunt-pointed scissors.
1 pair slender, curved-on-the-flat, sharp-pointed scissors.
Infusion cannula and connecting tubing with cut-off.
Glass infusion jar and thermometer.
Stand for infusion apparatus.
Saline solution, 120° F., 1200 c.c.
1 medium-sized, half-curved, cutting-edge needle (threaded with silk).
2 hand sponges.
1 gauze compress.
1 three-inch gauze bandage.

LXXXIII. Transfusion.

2 scalpels, one with small blade.
2 pairs anatomic forceps.
1 pair blunt scissors.
3 mosquito clamps.

2 pairs tissue forceps (fine).
1 pair curved sharp-pointed scissors (fine).
2 Crile clamps.
3 single tenaculæ (very fine).
1 set Crile cannulæ, Elsberg's cannula, or Brewer's tubes.
1 needle holder (fine).
6 very fine (No. 16) cambric needles threaded with vaselined silk.
Rubber tubing to fit Crile clamps.
Saline.
12 hand sponges.
2 medium-sized, half-curved, cutting-edge needles (threaded with silk).
2 three-inch gauze bandages.

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