

THE
OPERATING ROOM
AND THE
PATIENT

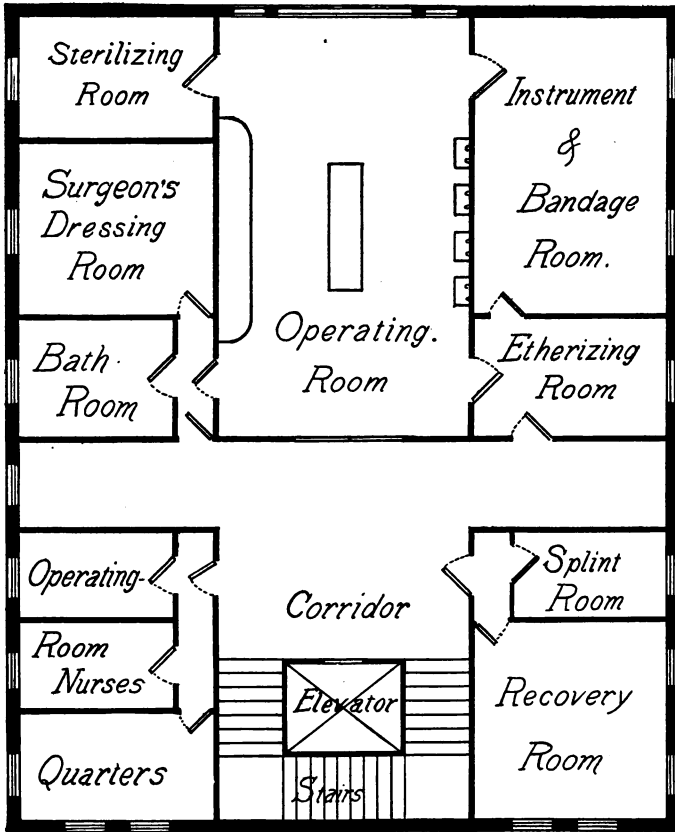
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RELATION OF OPERATING ROOM AND ADJOINING ROOMS.

PREFACE TO THE SECOND EDITION

THIS edition is much enlarged, having had added to it several chapters on "General Considerations in the After-treatment." I am indebted to Miss Kurtz, Supervisor of Nurses at the German Hospital, for help in revising the chapters on the Instrument and Supply Room and to Dr. Carl Fulda, Clinical Assistant at the German Hospital, for translations from the German and aid in many ways. It is hoped that the new chapters dealing with wound complications and treatment will prove of value to the general practitioner, who is at times called upon to carry out the after-treatment of surgical cases.

85-112

R. S. F.

PREFACE

I WISH to thank Miss Kurtz, Supervisor of Nurses at the German Hospital, for many kind suggestions in the chapters upon supplies; Mr. Francis A. Deck for his admirable illustrating; and last, but not least, the W. B. Saunders Company for the excellent manner in which they have brought out this little book.

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THE OPERATING ROOM

AND

THE PATIENT.

CHAPTER I.

THE OPERATING ROOM AND ITS PERSONNEL.

General considerations. Arrangement during operations. Preparation of table. Sinks. Scrub-up tray. Disinfection of operating room; table; nickel; brass; glass. Personnel. Costumes; nurses; anesthetist; orderly; operator and assistants; visitors. Operating room nurse. Senior operating room nurse. Junior operating room nurse. Anesthetic nurse. Preliminary training for nurses. Operating room orderly.

General Considerations.—The operating room should be on the top floor, should have a large floor space and lofty ceiling. The central skylight should be double, air-tight, and made of ribbed glass. The east side of the room should have large double windows. The floor, walls, and ceiling should be tiled. There should be no corners. Heating should be by hot water or steam. The relation of the operating room to the adjoining rooms is shown in the frontispiece.

General Operating Room Rules.—There should be no confusion in the operating room. 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 should be no unnecessary talking. Each

be on a small table near the sinks. Bottles which are to be handled should have bichlorid towels pinned around them or should be covered with bottle bags with draw-strings to fasten around the neck of the bottle. This prevents slipping.

The scrub-up tray is placed on a small, movable table in a convenient part of the room. It contains a large flask of sterile water with aseptic cotton plug, a large flask of acid-bichlorid, sterile brushes in 10 per cent. bichromate of potash solution, liquid green soap, tincture of iodine, Woelfler's solution, alcohol, turpentine, ether, razor, safety-pins, bandages, and scissors.

Disinfection of the Operating Room.—The walls of the operating room should be washed down at least once a month with soap and water. The furniture should be scrubbed with soap and water and wiped off with bichlorid (1:1000) or carbolic (1:20) after every operation, when practicable, and certainly after every series of operations. This must also be done after every septic case. The room should be dusted daily and should always be ready for use. Dusting or cleaning should not be done just before an operation. The air of the room should be moist. All windows must be 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 85° F. All ventilators are covered with nonabsorbent cotton filters. After each series of operations the floor is flushed and scrubbed with bichlorid solution, 1:1000. Once each month the operating room is disinfected by the formalin process. This method is also used after cases of streptococcic infections. Steaming of the operating room should be done daily in order to keep the air moist and prevent dust.

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. Tables are scrubbed with soap and water, then rinsed with bichlorid, 1 : 1000. Nickel work is cleansed daily with "*bon ami*" and polished with chamois-skin.

Brass work is cleansed daily with "*bon ami*" and polished with a dry, soft cloth.

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

Personnel of the Operating Room.—The operating room staff proper consists of an operating room nurse, a senior operating room nurse, and two junior operating room nurses. The position of operating room nurse is a permanent one. The senior and junior nurses serve in each position for at least one month, during which time they are excused from duty elsewhere in the hospital. There is an operating room orderly; also an anesthetic nurse who remains with the patient until anesthesia is established and later accompanies the patient to the bed, remaining until the patient has recovered from the anesthetic.

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 employed in the operating room shall wear over their regular nurse's costume (sleeves and cuffs detached) a plain linen gown with sleeves reaching below the elbow. These gowns fasten in the back, are snug fitting, and of sufficient length to entirely cover the dress. A gauze mask is worn which covers the nose and mouth. A cap, linen or gauze, is so arranged as to entirely cover and confine the hair. The operating and sponge nurses wear rubber gloves. Gowns

are changed after each case unless the operator otherwise orders. Rubbers or rubber-soled shoes should be worn to prevent slipping.



Fig. 2.—Nurse's costume.



Fig. 3.—Assistant's costume.

The anesthetist is provided with a long-sleeved gown having a breast pocket. 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 are long sleeved. Rubber gloves are used at the discretion of the operator.

Visitors are provided with freshly laundered, long-sleeved, loosely fitting linen gowns. Each gown is rolled up in a compact package and is not unrolled until needed. They are put on by the visitors before entering the operating room. The number of visitors is limited to the capacity of the visitors' stand.

Operating Room Nurse.—The operating room nurse is responsible for the care of the operating room, the anesthetic room, the instrument room, and all the furniture and apparatus pertaining thereto. She is responsible for the preparation of all instruments, dressings, ligatures, sutures, and appliances necessary for each operation; also for the preparation of all dressings and bandages used in the hospital. She should keep a record of all dressings and appliances issued to the different wards of the hospital, with the date and amount of each issue, and make a monthly statement of the same. She issues to each ward the necessary dressing sets, inspects these instruments frequently, and instructs the ward nurse in the care of such instruments. She stands at the instrument table during operations and passes such instruments to the surgeon as he may require. She should endeavor in every way to anticipate his wants. She watches closely the nurses who assist her in the operating room and who are under her direction, and sees that they properly perform their duties. She must not leave her post at the instrument table except at the request of the operating surgeon. She personally prepares all ligature and suture material. She allows no instrument, apparatus, or dressing to leave the operating room without a written requisition. She delivers such messages as are reported to her to the person for whom such message is intended.

She keeps the key to the operating room, instrument room, and anesthetic room. These rooms are kept locked when not in use. The operating room nurse also sees that all specimens are sent to the pathologic laboratory, properly labeled with the name of the patient and the hospital number. She also sees that all stains are removed from the gowns, sheets, etc., before these are sent to the laundry.

Senior Operating Room Nurse.—The senior operating room nurse should have four weeks' experience as junior operating room nurse before becoming senior. Under the direction of the operating room nurse she has charge of all the sterilizing and preparation of material, except the ligature and suture material. Assisted by her junior she prepares all the supplies used in the operating room and also those sent to the wards. On operating days she lays out the requisite number of towels, protectors, caps, masks, rubber aprons, gowns, etc. (everything except the suture and ligature material), necessary for the operations to be performed that day.

During the operation, her post is at the sponge table, and she shall not leave her post except at the request of the operating room nurse. She places bichlorid towels or protectors around the edges of the hand basins. She hands the operator and his assistants their gowns. She passes all sponges, towels, and protectors, anticipating the needs of the operator as much as possible, and is responsible for the correct counting of all sponges.

After operations she cleans all instruments and returns them to their places. She also 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. At operations in which but one sterile nurse is required the sponge table is taken care of by the operating

room nurse. The senior's term of service should be at least one month.

Junior Operating Room Nurse.—The junior operating room nurse should serve for at least four weeks before becoming senior. She is responsible for the dusting of the instrument and supply room, the cases and drawers of which should be cleaned at least once each week. The room itself is dusted each night before she goes off duty. She prepares the ward packages of towels for sterilization by the senior nurse. She cuts and folds all the compresses, and assists the senior nurse in making bandages, sponges, etc. She is responsible for the cleanliness of all the operating room and anesthetic room furniture. Before going off duty, she shall see 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, anesthetic room, and the anesthetic table. When the patient is wheeled into the operating room, the junior nurse assists in placing the patient on the table. She fastens the patient's arms above the head in operations upon the upper abdomen or thorax, across the chest, in other abdominal and pelvic operations. She assists in placing the patient in the kidney, lithotomy, or Sims' position as required. 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 removes the bandages and bichlorid towels from the site of operation, taking care not to bring her hand in contact with the patient's skin. She then assists the assistant house surgeon in preparing the field of operation, pouring for him liquid green soap and warm water, alcohol, ether, alcohol-bichlorid, acid-bichlorid, or iodine-

bichlorid as required. In abdominal cases she brings Woelfler's solution for the umbilicus.

She then fastens the gowns of the operator and his assistants; places hand basins on either side of the table, changes the hand solutions as they become discolored; sees that the anesthetist is supplied with anesthetic; picks up all sponges and towels which drop to the floor and places them in their proper receptacles; picks up fallen instruments, cleanses them, and, if so ordered, 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 during the operation; prepares and gives hypodermic injections as ordered; operates the thermocautery; collects, counts, and places in a pail near the sponge nurse all soiled sponges used in a laparotomy, and reports the number to the senior nurse and to the operating room nurse. She must be ready at all times to give the sponge count; sees that the saline solution is kept 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 chloroform mask or ether cone, changes the covers, and replaces the soiled hair bag of the latter with a fresh one. She brings a dry, warm blanket 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 case; removes the protectors from the hand basins, flushes the basins with sterile water and refills them with bichlorid; cleans and prepares the operating table for the next case; collects soiled gowns, towels, sponges, etc., and places them in their respective receptacles.

On the completion of an operation or series of operations she rinses out the stains in the operating room 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 must watch the operating room nurse, the senior nurse, and the anesthetist and anticipate their needs as much as possible. 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* should be familiar with the duties of the first, so that when two operations are proceeding simultaneously she may help. At other times she is employed in preparing dressings and material.

The Anesthetic Nurse accompanies the patient from the ward to the anesthetic room and remains there 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 to do so by the anesthetist. She must be familiar with the use of the oxygen tank. She sees, just previous to the patient's being taken to the operating room, that the patient's cap is on properly and that the blankets are smoothly arranged.

Course Preliminary to Entering Operating Room Training.—The supervisor of nurses should arrange a list of nurses for operating room training. These nurses attend operations and by observation and study acquaint themselves with their future duties.

Operating Room Orderly.—The operating room orderly remains with the patient while in the anesthetic room, controls any struggling on the part of the patient, wheels the patient into the operating room, assists the anesthetist in placing the patient on the table, and sees that the pad of the anesthetic cart and the pillow remain on the cart. He removes the "lifter" (small stretcher) from under the patient and then removes the cart to the anesthetic room. Should the cover of the pad or pillow be soiled, he removes the cover, places it in the soiled clothes receptacle, wipes off the soiled rubber coverings with bichlorid, 1:1000, and puts on fresh linen covers. He brings the tray containing the anesthetic outfit from the anesthetic room and places it upon a table placed at the right and behind the anesthetist. Should the operation be one involving the male genitalia, the orderly should remain. He places screens around the operating table, brings to the assistant house surgeon the soap and water, alcohol, ether, and bichlorid or acid-bichlorid solution as required, and performs such duties ordinarily performed by the junior operating room nurse as shall be assigned to him. 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.

CHAPTER II.

THE INSTRUMENT AND SUPPLY ROOM.

General Considerations.—The instrument and supply room should communicate directly with the operating room. It should be a large room fitted with numerous drawers and shelves capable of 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 a dust-proof instrument case. Glass bowls, mortar and pestle, glass graduates, and mixing rods 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 should be kept in their proper places in the instrument case when not in use. Knives should be kept in racks to prevent dulling. Needles should be 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 should be kept in a separate drawer. No rubber goods should be kept in the instrument cabinet. Sets of instruments the property of individual operators should be kept separate from the hospital instruments. Duplicate sets of instruments may be conveniently kept in linen holders.

Metal instruments (except edged instruments) are sterilized by boiling from ten to thirty minutes in a 1 per cent. solution of carbonate of soda. This should be

done just before the instruments are to be used. They are taken from the sterilizer, drained, placed on a sterile sheet, arranged, and covered with sterile towels. Instruments for different operations may be boiled in separate

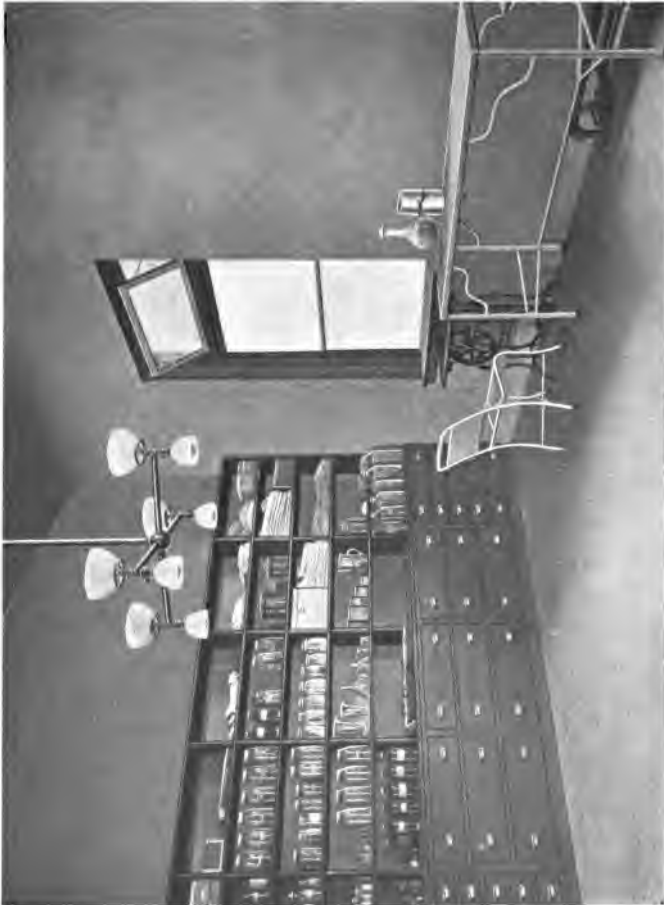


Fig. 4.—Instrument and supply room. First view.

trays, then placed, tray and all, upon the instrument table and covered with sterile towels until required. 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 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.

Directly after use, instruments should be washed, piece by piece, in running cold water until all blood-stains are removed. This cleansing is facilitated by the use of a piece of gauze. Particular attention is paid to locks and crevices. Instruments are then boiled from ten to thirty 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 instrument nurse should be able to sharpen the knives. Instruments out of repair should be sent at once to the maker.

Brushes.—Brushes are sterilized by boiling for one-half hour in a 10 per cent. solution of bichromate of potash. They are transferred and kept in covered glass jars containing the same strength solution of bichromate of potash in 1:1000 bichlorid. After using they are boiled for ten minutes and replaced in the glass jars. 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.—Several varieties of soap should be kept in stock. The soap commonly used is the *sapo viridis* of the pharmacopœia. Tincture of green soap is a convenient form. A good antiseptic soap may be made as follows:

R. *Ætheris*,
Spiritus,
Terebinthinæ,
Glycerini,.....āā ℥iss.
Saponis viridis,.....℥vj.
Hydrarg. bichlorid.,.....gr. vj.

M.

Or:

R. *Saponis viridis*,.....℥x.
Spiritus,.....℥xx.
Glycerini,.....℥vij.
Ol. bergamottæ,.....℥ij.

M.

Nail cleaners, nail files, and nail scissors should be kept in a special tray near the sinks. In addition to the nail cleaners usually employed, much satisfaction will be experienced in using the one devised by Dr. George R. Fowler. By its use injury to the matrix of the nail is avoided and thorough cleanliness is assured.

Chlorinated lime and **sodium carbonate** should be kept in separate stone jars. That containing the lime should be air-tight. A ready means of disinfecting the hands after septic operations consists in making a paste with a small quantity of each of these ingredients and water. This is rubbed well into the skin for a few minutes and then rinsed off 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 the

chemical solutions. A simple lotion may be made as follows:

- R. Acid. acetic. dilut.,
 Spiritus,
 Glycerini,
 Acid. boric. (sat. sol.),.....āā ʒj.
 Aquæ rosæ,..... ʒiv.
- M.

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

Caps are made of bleached muslin in three styles: surgeons' caps, nurses' cap, and patients' caps. They

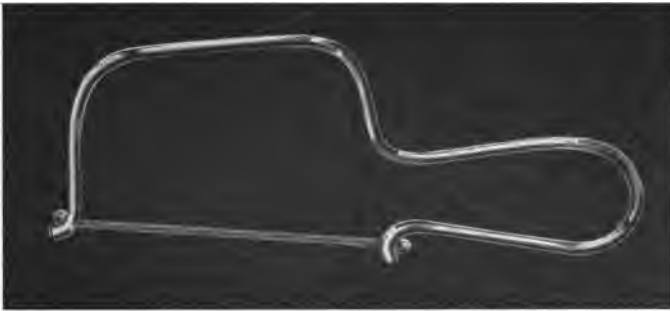


Fig. 5.—Nail cleaner.

should be made in several sizes and be large enough to come well over the occipital protuberance, covering all the hair. Patients' caps may be made of unbleached muslin. In form they resemble the ordinary bath cap, except that in place of an elastic they have a drawstring 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 drawstring 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 long and twenty inches wide makes the average apron. Elastic rubber tubing is preferable to tape for holding the aprons in place. The 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.

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. Gowns are washed and laundered in the usual manner, then each gown is rolled into a compact package inclosed in heavy sheeting material. They are sterilized by steam for one-half hour on the day of the operation.

Rubber gloves are sterilized by boiling for five minutes in saline solution. They are then immersed and filled with bichlorid, 1 : 3000, and put on. The gloves should have gauntlets which come well up on the forearm. They should be tested before each time of using by filling them with bichlorid solution to detect any needle holes or tears. They are worn during all operations by the nurses and assistants, but they should not be put on until after thorough mechanic disinfection of the hands. The objection to their use is that they macerate the skin and so bring hordes of bacteria to the surface. Should a needle hole or tear exist or be made during the course of the operation, these bacteria are likely to escape. If injury to the gloves occurs, the nurse should immediately retire from the operation, disinfect her hands, and put on fresh gloves. The use of a drying powder,—*i. e.*, alum,—as advocated by Dawbarn, prevents sweating to a certain extent. 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. The surfaces may be kept from coming in contact and adhering by

blowing into the glove occasionally or by packing the fingers with strips of gauze. They should be boiled immediately before they are to be used.

Gloves are also useful in vaginal and rectal examinations, in the examination of infected wounds, and as a safeguard to surgeons in septic cases.

Finger cots of thin rubber are useful in examinations and to protect small abrasions on the surgeon's fingers against infection. They may be put on the first and little finger 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 frequently 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. They are so cheap, however, that they may be thrown away after each use.

Protectors are made of heavy linen or of unbleached 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 by fractional steam sterilization in sets of two, one large and one small, rolled into a compact package done up in heavy sheeting material.

Laparotomy sheets are made of heavy linen or unbleached muslin. They should be long enough to cover the entire body and drape over the sides and foot of the table. Through the center of that part of the sheet which covers the abdomen a twelve-inch slit is made and the edges hemmed. Each sheet is sterilized in an individual package.

Perineal sheets are used to cover in 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 arrange-

ment which covers the patient's foot. Through the center of that portion which covers the perineum and vagina is a twelve-inch slit. Each sheet is sterilized in an individual package.

Anus protectors for use in vaginal operations are made in two patterns. One, a two-tailed bandage 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. The other pattern is a piece of toweling to the two upper corners of which are sewn double pieces of tape. These pieces of tape tied around the lithotomy posts serve to draw the towel tightly over the anus. An anus protector should be sterilized in the package with the perineal sheet. A third and convenient variety of anus protector consists of a towel held in place over the anus and buttocks by a broad strip of adhesive plaster, one-half of the towel being folded back over the adhesive plaster.

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

Blankets for use in the operating room should be the ordinary single blanket 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 should be 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 should be 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 during dressings.

Kelly pads, two in number, should be scrubbed with soap and water and wiped off with 1 : 40 carbolic solution after each use.

Covers for the rubber pads used on the operating table and anesthetic cart should be of stout muslin. These are fresh for each case. *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 at least one hour before operations. If these sterilized bundles have not been opened for forty-eight hours they are resterilized before using.

Powders for use in making up dressings and solution should be kept dry in wide-mouthed, screw-cap jars.

Iodoform.—This should be finely powdered by the mortar and pestle before using.

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

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

R.	Sodii chlorid.,.....	3iv gr. vj.
	Sodii sulphat.,.....	gr. xj.
	Sodii phosphat.,.....	gr. iii $\frac{1}{4}$.
	Sodii carbonat.,.....	gr. vss.
	Calcii phosphat.,.....	gr. ix $\frac{1}{4}$.
	Magnes. phosphat.,.....	gr. iv $\frac{1}{4}$.

M. Sig.—One powder to six quarts and nine ounces of sterile water.

Potassium permanganate crystals should be made up in one ounce packages.

Oxalic acid crystals should be made up in one and one-half ounce packages.

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

Boric acid for making Thiersch powder, gauze, and solutions and for use as a dusting powder.

Salicylic acid for making Thiersch powder.

Bichlorid of mercury made up in tablets of $7\frac{1}{2}$ grains (one to one pint of fluid makes a 1:1000 solution) and for making stock solutions. Sufficient acid should be added to make the solution acid in reaction.

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

Bicarbonate of soda, to make up a saturated solution (℥ii ℥iiss to the quart) for mixing with equal parts of peroxid of hydrogen for use as an irrigation.

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

Magnesium sulphate made up in one ounce packages for use in intestinal obstruction cases.

Bichromate of potash in packages (℥iiss gr. xlviiii) for making the solution for the 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.

Solutions.—All water used in making solutions should be sterilized and all solutions should be carefully labeled.

Bichlorid of mercury.—The stock solution may be either 5 per cent. or $12\frac{1}{2}$ per cent. bichlorid in alcohol. It should be kept in a blue 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 strengths in proportion. 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 after the water has cooled; then filter.

Normal saline solution.—Sterile sifted salt, ℥j to the pint. Dissolve in sterile water. Filter into flasks (sterilized by washing with bichlorid solution, then rinsing with sterile water), stopper with nonabsorbent cotton, sterilize for one hour for three successive days at a temperature of 220° F., and cover the cotton stopper with a small square of rubber tissue held in place by a rubber band. When needed, place the flask in a deep basin filled with hot water until raised to the required temperature. A special saline powder may be used, but this is not essential. Stock salt solution may be kept in order to make normal salt solution quickly. The sodium chlorid used should be dried sufficiently to granulate. Add ℥iiss (47 gm.) of the salt to ℥viii (237 cubic centimeters) of water. Boil in a closed vessel for fifteen minutes; ℥j of the solution to ℥viiij of sterile water makes normal saline solution.

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,..... ℥ix.

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

Chlorid of zinc solution, 10 per cent., for using as an escharotic in cancer of the cervix and in sloughing processes.

℞. Zinci chloridi,..... gr. 384.
Aquæ destillatæ,..... ℥viiij.

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. Sufficient bichlorid of mercury to make a strength of 1:1000 may be advantageously added. For use as a peritoneal varnish; to fill the umbilicus after cleansing; to coat the nipple in breast operations.

Tincture of iodine, for painting on the proposed line of incision to disinfect the skin. Bichlorid to make a 1:1000 solution may be added.

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

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 should be 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. The bottles should not be filled entirely, but an air space should be left above the solution.

Sodium bicarbonate (saturated solution), for neutralizing the hydrogen peroxid just previous to use.

Commercial ether, for cleansing purposes.

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

Balsam of Peru, for gauze dressings.

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

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

Olive oil, for use as a lubricant. Should be sterilized after each use.

Whale oil and iodoform mixture, for filling bone cavities.

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 $\frac{1}{2}$ per cent. solution is $2\frac{2}{3}$ grains to the ounce; 1 per cent. solution, $4\frac{2}{3}$ grains to the ounce; other strengths in proportion.

CHAPTER III.

THE INSTRUMENT AND SUPPLY ROOM. (Continued.)

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. In the preparation of all gauzes, strict asepsis of the hands and all utensils is to be observed. Rubber gloves should be worn.

Iodoform Gauze No. 1.—Formula :

Iodoform powder,.....	gr. 116.
Glycerin,.....	ʒj.
Alcohol,.....	ʒij.

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 gauze should first be sterilized by fractional steam sterilization for three successive days. 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,.....	ʒss.
Glycerin,.....	ʒj.
Hydrarg. bichlorid (1 : 2000),.....	ʒj.

Mix thoroughly. The bichlorid solution is made with

sterile water. Cut the gauze by drawn thread into strips five yards long and four inches wide and fold or roll.



Fig. 6.—Instrument and supply room. Second view.

Sterilize. Immerse in the above mixture, then sterilize by steam heat, 212° F.

Iodoform Gauze No. 3.—Formula:

Iodoform powder,.....	℥j.
Glycerin,.....	℥viii.
Alcohol,.....	℥j.
Sterile water,.....	℥viii.

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,.....	℥j.

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),.....	℥j.

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, as it deteriorates.

Boric Acid Gauze.—Cut gauze in strips as above, boil for one-half hour in 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),	12½ 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,.....	℥xiiiiss.
Carbolic crystals,.....	℥iiiss.
Alcohol,.....	Oiv.
Castor oil,.....	℥ii℥.

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

Gauze Drains.—Cut gauze strips one to three yards long and two to six inches wide. Cut by drawn thread to avoid frayed edges. Turn in the raw edges. Cervical and uterine drains are eighteen inches long and one inch wide, with the edges turned in. Gauze drains may be impregnated with antiseptics and sterilized accordingly.

Wicking Drains.—Material is string lamp-wicking which comes in lengths of several yards rolled up in balls. Cut in lengths of nine inches, place in bundles of four wicks each, fasten ends with silk, boil for one-half hour in saline solution, place in jars, sterilize, and seal. The wicking may be impregnated with antiseptics. The wicking drain may be inclosed in fenestrated green silk protective or rubber tissue stitched in place. These

latter are known as "cigarette drains." They are sterilized for twenty minutes at a temperature of 212° F.

Rubber Tissue Drains.—The rubber tissue is cut in strips two by three to six inches, boiled in water for five



Fig. 7.—The sterilizing room.

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.

The **Mikulicz drain** acts as a capillary drain and by compression arrests oozing. It is simply a square 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 square bag, emerge from the wound.

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.

Cotton, Absorbent.—Small pieces are used on wooden applicators for cleansing wounds or applying caustics. Absorbent cotton may be rolled up in small packages and sterilized for use in the operating room.

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.

SPONGES.

Sponges are made of gauze in three sizes: the hand sponge, eighteen inches square; the stick sponge, one-sixteenth of a yard square; and the laparotomy sponge, eight, ten, or twelve inches square.

Hand sponges are made of a single thickness of gauze. 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 may be made 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 (as 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 held in shape by stitching. They are put up in packages of fifty. Smaller stick sponges are made of gauze for use in small cavities.

Laparotomy sponges are made in three sizes: eight, ten, or twelve inches square. They are made of six thicknesses of gauze, the edges being 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.

Laparotomy sponges may also be made of crash. 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 by the sponge nurse. Any inaccuracy in the count must be at once reported to the operating room nurse. The sponge nurse must be able to give the correct count whenever called upon.

COMPRESSES.

Compresses are 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.

Laparotomy Dressing.—This consists of one laparotomy pad, three one-yard compresses, and an abdominal binder. These are done up in one package.

Laparotomy pads are used to save gauze; they are made by inclosing a twelve inch square of nonabsorbent cotton in a gauze bag or by filling the bag loosely with shredded tissue paper.

Paper Dressing.—Bags of gauze, twelve by eight inches, are loosely filled with shredded tissue paper. This form of dressing is very absorbent, and is therefore very 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 should be 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.

BANDAGES.

Dimensions.—*Muslin:* 7 yards long by $1\frac{3}{4}$, 2, $2\frac{1}{2}$, 3, and 4 inches wide. *Gauze:* 8 yards long by 3 and $3\frac{1}{2}$ inches wide. *Flannel:* 6 yards long by $1\frac{1}{2}$, 2, $2\frac{1}{2}$, 3, and 4 inches wide. *Crinolin:* 6 yards long by 2, $2\frac{1}{2}$, $3\frac{1}{2}$, and 4 inches wide. *Finger bandage:* 4 yards long by $\frac{1}{2}$ and

$\frac{3}{4}$ inch wide. *Double roller head bandage*: 10 yards long by $1\frac{1}{2}$ and 2 inches wide. *Chest or abdominal roller*: 10 yards long by 4, 6, and 8 inches wide. *Plaster bandages* are made by incorporating plaster-of-Paris in the meshes of the crinolin bandage as it is rolled. They should be kept in tin boxes in a dry place. If they become damp they may be baked in an oven. *Starch bandages*: usually there is sufficient starch already in the crinolin to make a fairly stiff supporting bandage. If not, powdered starch may be incorporated in the meshes of the bandage as it is rolled. They should be kept in tin boxes in a dry place.

Bandage Box.—Bandages may be made rapidly in quantities in the following manner: A wooden box one foot deep, three feet long, and wide enough to accommodate the bolt of material is required. This box is fitted with half a dozen wooden rollers to guide the material to be used and a removable metal roller with a crank attached on which to wind the material. The number of yards of material required 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 "Christy" bread knife. To steady the roll while cutting, a small sized carpenter's mortise board is useful.

Retractor bandages are used to retract the soft parts in amputations. They are two-tailed for amputation of the humerus or femur, and three-tailed for amputation of the forearm or leg. They are made of several thicknesses of unbleached muslin twenty inches long by eight inches wide.

T-bandages are mostly used to hold perineal or vulvar dressings in place; they may be modified to secure dressings in other parts of the body. The single T-bandage 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 is made by sewing two short strips to the middle of the long strip. Several sizes of each variety should be made up.

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 in the region of the groin, in the gluteal region, and in the anal region.

Slings.—The sling is one of the most frequently used of the compound bandages. A yard square of unbleached muslin is cut diagonally and suffices for two triangular slings. 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 at the back of the neck, enough traction being 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.

Breast binder. Made of two thicknesses of unbleached muslin. It resembles an armless jacket; length, $1\frac{1}{4}$ yards; width, back, 16 inches; front, 11 inches; under arm, 6 inches.

Abdominal binder. Made of two thicknesses of unbleached muslin or one thickness of Canton flannel. Made in several sizes, 18 inches wide by $\frac{3}{4}$, $\frac{7}{8}$, 1, $1\frac{1}{8}$, $1\frac{1}{4}$, $1\frac{1}{2}$ yards long. The abdominal binder may be transformed into a scultetus or many-tailed bandage by tearing each side lengthwise of the binder into six or eight strips extending to within six inches of the center or body of the binder.

Adhesive plaster. For strapping the ankle and other joints and leg ulcers adhesive plaster should be cut in

long strips one-half to three-fourths of an inch in width. These strips should be neatly rolled on glass or metal rods six or eight inches long for convenient handling. For general use the strips should be two, three, and four inches in width. Adhesive plaster may be used to retain an abdominal dressing in position. For this purpose, four strips are used, each strip ten to twelve inches in length and three inches wide. One end of each strip is folded on itself, adhesive surfaces together, for one inch. This is to facilitate removal. The other end of each strip is folded on itself, adhesive surfaces together, for a space of two inches. Through this double thickness a triangular cut is made with the scissors, and a half-inch tape is passed and knotted. Each tape should be long enough, eight to ten inches, to admit being tied in a bow knot to its fellow of the opposite side over the abdominal dressing. Two of these prepared adhesive plaster strips are placed on the skin well back on each flank. The skin should first be dried to insure thorough adhesion. By applying straps 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 is more economical in retaining dressings in most parts of the body. They 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.

Waxed or paraffin paper is used to wrap packages of dressings, sponges, etc. 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 the sheets of paper on a flat surface, melt the wax or paraffin, and

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*, 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, covered jars. Change the solutions at least once each week. *Rubber dam* is sterilized by boiling for one-half hour in soda solution, rinsed, and preserved in carbolic solution, 1:20. *Green silk protective* is cut in strips fourteen inches long by two inches wide, washed with soap and water, placed in bichlorid solution 1:1000 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.

Filiform bougies should never be boiled. They are washed with soap and water and placed in carbolic solution, 1:100, just before using. 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.

Rubber bolsters are used in tying cross-sutures in pairs. They are one inch in length (three inches for perineal bolsters), cut from rubber aspirating tubing. The cut edges should be rounded with scissors. They are prepared and preserved in the same manner as rubber drainage tubes. In addition they should be boiled for five minutes just before using. They should be preserved after removal, cleaned, 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.

STERILIZATION OF SUTURE AND LIGATURE MATERIAL.

Plain Catgut.—The catgut is wound evenly on glass spools, one meter 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 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.

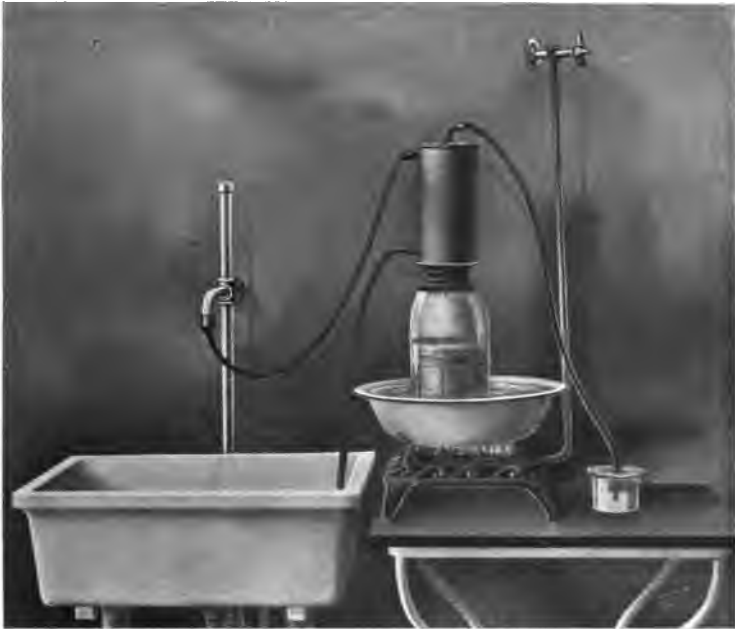


Fig. 8.—Dowd's condenser.

The catgut is boiled in the alcohol three successive times for one hour at intervals of twenty-four hours (fractional sterilization). It is not removed from the sterilizer 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.

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 for twelve hours. Following this, it is allowed to dry thoroughly, wound again on spools, and prepared as plain catgut.

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,.....	ʒj.

It is then thoroughly dried and prepared as plain catgut.

Formalin Catgut.—Immerse the catgut for twelve hours in absolute alcohol, ʒj; formalin (40 per cent.), ʒij; then boil in this solution for one-half hour in the condenser. Replace the alcohol-formalin solution with absolute alcohol. Leave the catgut in this for twenty-four hours, then sterilize as for plain catgut. The addition of glycerin, ʒj, to the alcohol-formalin solution is useful in softening the catgut.

Antiseptic Catgut No. 1.—Immerse catgut for twenty-four hours in chloroform, 1 part; ether, 2 parts. Then place for twenty-four hours in a solution of equal parts of formalin, alcohol, glycerin, and carbolic acid. Finally preserve in alcohol-bichlorid, 1 : 500.

Antiseptic Catgut No. 2.—Proceed as above, but instead of placing catgut in alcohol-bichlorid, 1 : 500, place it for twenty-four hours in a solution of equal parts of water,

alcohol, and glycerin. Then preserve in alcohol-bichlorid, 1:5000.

Antiseptic Catgut No. 3.—Immerse for twenty-four hours in ether; six hours in bichlorid, 1:1000; preserve in absolute alcohol. Before using boil for one hour in 95 per cent. alcohol.

Iodin Catgut.—Roll the catgut on glass spools, immerse for twelve hours in ether, then for eight days in 1 per cent. iodine and 1 per cent. iodid of potassium in 80 per cent. alcohol. Preserve in this solution. Kangaroo tendon may also be prepared in this way.

Braided Catgut.—Cut eight strands of catgut No. 1 of the required length, 20 inches; knot together at the end; sterilize in absolute alcohol for one hour; then braid. Finally sterilize the strands as plain catgut, placing two braided sutures in each small jar.

Kangaroo tendon is sterilized like plain catgut or it may be boiled for one-half hour in albolin, at a temperature of 245° F., then transferred to absolute alcohol 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. *Linen thread* is prepared in the same manner as silk.

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 ten minutes in 1 per cent. soda carbonate. 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 one-half hour in normal salt solution.

PERCENTAGE TABLE.

To make four fluid ounces of solution.

$\frac{1}{10}$ of 1	per cent.	equals	1.92	grs. ; approximately,	$1\frac{1}{2}$	grs.
$\frac{1}{8}$ of 1	"	"	2.40	"	"	"
$\frac{1}{6}$ of 1	"	"	3.20	"	"	"
$\frac{1}{4}$ of 1	"	"	4.80	"	"	"
$\frac{1}{3}$ of 1	"	"	6.40	"	"	"
$\frac{1}{2}$ of 1	"	"	9.60	"	"	"
1	"	"	19.20	"	"	"
2	"	"	38.40	"	"	"
$2\frac{1}{2}$	"	"	48.00	"	"	"
3	"	"	57.60	"	"	"
4	"	"	76.80	"	ʒj.	"
5	"	"	96.00	"	ʒiss. gr. 6.	"
6	"	"	115.20	"	ʒj gr. 55.	"
7	"	"	134.40	"	ʒij gr. 13.	"
8	"	"	153.60	"	ʒij gr. 33.	"
10	"	"	192.00	"	ʒiij gr. 2.	"

Other strengths in proportion.

Thermocautery.—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 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 come in contact with the operator. 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 appendical operations the point tip is most frequently employed; for hemorrhoid operations, the button tip; for liver operations all three may prove useful.

Sand-bags.—Sand-bags (used for maintaining the patient in the required position and for supporting plaster-of-Paris casts while drying) are made in six convenient sizes: 25 by 8 inches; 18 by 10; 12 by 10; 10 by 9; 12 by 5; 20 by 15.

Splints.—These 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.

CHAPTER IV.

THE ANESTHETIC ROOM.

Anesthetist. Selection of the anesthetic. Ether anesthesia. Chloroform anesthesia. Ethyl bromid. Nitrous oxid. Junker's apparatus. Trendelenburg cannula. Anesthol. Spinal analgesia. Cocain anesthesia.

The furniture of the anesthetic room consists of the anesthetic cart, anesthetic table, oxygen apparatus, gas apparatus, and a stool for the anesthetist. On the anesthetic table is placed the anesthetic tray.

The anesthetic cart is provided with a long rubber pad; a rubber pillow; small stretcher; and two medium-weight, woolen half-blankets. The rubber pad and pillow are covered with linen covers. The blankets are folded neatly at the foot of the table.

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 inhaler; chloroform, chloroform drop-bottle, and chloroform mask; ethyl bromid, tongue forceps, aseptic tongue sutures, mouth-gag, sponge forceps, stick sponges, vaselin, hypodermic syringe charged with a solution of sulphate of strychnin, gr. $\frac{1}{30}$, aseptic hypodermic needles, an atomizer, unbleached muslin bandages, bandage scissors, safety-pins, pus basin, towels; two small glasses, one containing sterile water, the other empty; a minim dropper, a glass graduate, and the restoratives. These consist of a 4-ounce bottle of whisky; tablets of strychnin sulphate, gr. $\frac{1}{30}$; digitalin, gr. $\frac{1}{100}$; caffein benzoate, gr. j; Magendie's solution of morphin, a box of amyl nitrite pearls, and

ergotol. The ergotol solution is made by adding 1 drachm of the solid extract of ergot to 1 ounce of a 1:3000 solution of formalin. The hypodermic dose is 30 minims.



Fig. 9.—The anesthetic room.

There should be in reserve a second tray completely equipped.

The chloroform and ether should be poured into blue glass bottles and a reserve supply should be kept in their original packages.

The ether inhaler is prepared by pinning tightly around it a folded towel which has been somewhat stiffened by folding in it a few sheets of wrapping paper. The stiffened towel should project an inch or so below the face part of the inhaler and is intended to protect the patient's face against pressure from the hard edge of the inhaler. In administering ethyl bromid a rubber face piece should be used in place of the stiffened towel in order to exclude all air. There should be kept in a con-

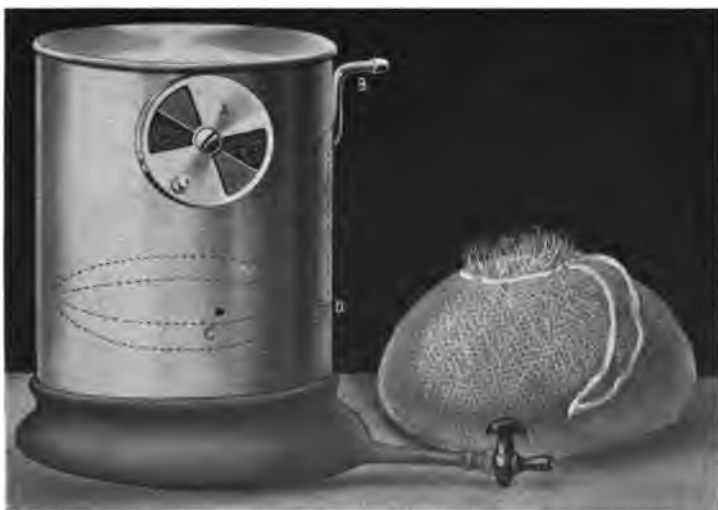


Fig. 10.—Author's modification of Dr. George R. Fowler's ether inhaler.

venient place fresh hair bags and clean chloroform mask covers. The ether inhaler is washed, dried, a fresh hair bag inserted, and a fresh cover put on for every case. The chloroform mask is washed and a fresh cover put on for every case. The tongue forceps, mouth-gags, and stick sponge holders are washed and sterilized after each case. The tongue suture is renewed as often as used.

On a reserve anesthetic tray in the instrument room

should be kept, always ready for use, Junker's apparatus for chloroform anesthesia and Trendelenburg apparatus for chloroform anesthesia.

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 should be employed. Alcoholic patients should be given morphin sulphate, gr. $\frac{1}{4}$ to $\frac{1}{2}$, hypodermically fifteen to thirty minutes before the anesthetic is begun. Morphin habitués should be given a dose of morphin proportionate to the amount to which they have been accustomed. The nose, lips, and skin in the neighborhood should be anointed with vaselin to avoid irritation from the anesthetic. The eyes should be protected by covering them with a folded towel. Should, in spite of this precaution, some of the anesthetic enter the eyes, they should be irrigated with boric acid solution as soon as practicable and a compress wet with boric acid solution kept on them. The patient's head should be turned to one side and should be lower than the body 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 may remain under the patient's head to protect the head from the table.

The anesthetist should call the operator's attention to

any deviation from the normal course of anesthesia and see that stimulation is properly administered. He is not to leave the patient for any reason unless some one is at hand to relieve him. He assists in placing the patient upon the operating table, and is then provided with a mask by the junior nurse. He will be notified by the operator when to discontinue the anesthetic. Ether vapor is inflammable; so care must be exercised in using the thermocautery not to bring it near this anesthetic. The anesthetic should be discontinued during dilatation of the sphincter ani preliminary to operations upon the rectum. Otherwise the deep inspirations which this procedure occasions would cause the patient to become too profoundly anesthetized. This would be 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. 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.

Nitrous oxid is the safest of general anesthetics, but unfortunately its field is limited. It is useful in short operations and in tiding over the primary stages of ether anesthesia. It may be employed in longer operations,

but is not satisfactory where absolute relaxation of the patient is essential. In cases in which the heart muscle is much weakened or in which there is considerable difficulty in respiration, it is not safe to employ it alone, though it may be combined with oxygen. As a preliminary to ether anesthesia, it is thoroughly satisfactory. Given alone, in children, there is apt to be pronounced muscular twitchings; in pronounced anemia there is danger of respiratory or cardiac failure; in arteriosclerosis there is danger from the strain upon the circulatory apparatus. These dangers are considerably lessened if oxygen is combined with it.

Spinal analgesia should only be employed in those cases in which a general anesthetic is contraindicated. Anesthesia can always be relied upon up to the level of the anterior superior iliac spines, and in many cases still higher.

Ether Anesthesia. The patient's confidence is strengthened by pouring a small amount of ether on the cone and holding the cone a few inches from the face, thus accustoming him to the smell. He is directed to take deep breaths and to expire freely. The cone is gradually approached to the face until it covers the mouth and nose. The anesthetist's left hand grasps the cone, and one finger of the same hand is hooked under the jaw to hold it forward; the jaw should be kept forward throughout the anesthesia. The nurse should keep a finger constantly upon the pulse. The patient now breathes through the cone. 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. 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 alco-

holics 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. 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. The 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 ether 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 in the cone from time to time. Just enough ether should be added to keep the pupil midway between contraction and dilatation. The pupil should respond at all times to light. To insure

against the patient coming out of the anesthetic while being transferred from the anesthetic room to the operating table, the cone should be kept closely applied to the face.

With the patient properly placed on the table, the anesthetist must watch the respiration, pulse, and pupil. In the majority of cases the pupil will be the best guide to the degree of anesthesia, but occasionally cases will present themselves in which the pupillary reflex is lost early while muscular rigidity still persists. In such cases the respiration will be the best guide as to the depths of the narcosis. The anesthetic must be continued until muscular relaxation is complete, but oxygen should be combined with the ether. In other cases the rigidity will persist even after the pupils have ceased to respond to light and the respirations have become deep and stertorous. Oxygen should be combined with ether in these cases also. A hypodermic injection of morphin sulphate, gr. $\frac{1}{4}$, often aids in overcoming the rigidity. These atypical cases are to be 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.

Cyanosis may occur during any stage of anesthesia and result from insufficient air-supply. Occurring in the early stage it is due to spasm of the glottis or to accumulation of mucus in the pharynx. The former results from too rapid administration of ether. The cone should be

immediately removed, a mouth-gag inserted, and the tongue pulled forward, but not forcibly. 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 cone should be replaced and the administration of the anesthetic continued. In the case of an 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, or may be due to falling back of the tongue, to accumulation of mucus in the pharynx, or rarely to paralysis of the larynx. 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 to 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; strychnin sulphate, gr. $\frac{1}{100}$, and atropin sulphate, gr. $\frac{1}{50}$, 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 should be carefully watched.

The condition of the blood in the field of operation is a guide to the operator of the administration of the anesthetic. Should the blood become dark, he 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.

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. $\frac{1}{10}$, repeated, if necessary; whisky, one syringeful after another at two minute intervals until the pulse responds; ergotol, mxxx , given when the pulse first begins to flag; all these alone or combined may be useful. Rarely acute cardiac dilatation will occur.

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 slowly 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 progress is slow the patient will go under the anesthetic without a struggle. If the process is hastened, 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. Anesthesia should be gradually produced. 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. 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. Opening the pericardium and massaging the heart has not met with success in our hands. 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 the chloroform. To facilitate this, the oxygen tube is pinned to the inside of the chloroform mask.

Ethyl bromid is useful as a precedent anesthetic to ether, especially in alcoholics. The amount necessary to produce anesthesia varies according to the weight of the patient. Patients weighing one hundred pounds or under require one to two drachms; patients weighing under one hundred and fifty pounds require two drachms; patients weighing over one hundred and fifty pounds require two to three drachms. It must be given without the admixture of air. It should not be employed in young children, the aged, or in patients suffering from sepsis or shock.

The mode of administration is as follows: The required amount is poured into a small graduate. The ether inhaler is placed close to the patient's face and the patient is told to breathe deeply through it. After two or three deep breaths have been taken, the ethyl bromid is poured into the cone through the slit in its side, and the slit immediately closed. With the next inspiration, the patient inhales all of the ethyl bromid and becomes immediately anesthetized. There is usually a general convulsive muscular contraction, following which there is general relaxation and abolishment of all but the pupillary reflex. The breathing is deep and stertorous, the pulse is accelerated, and the face becomes cyanosed. In from thirty to forty-five seconds the slit in the cone is

opened and ether anesthesia produced by the constant drop method. It will only be necessary to repeat the administration of ethyl bromid in those cases in which it is not possible to keep the cone in close contact with the face and exclude the air. By this method surgical anesthesia should be complete in seven minutes, generally in from three to five minutes. The anesthetic effect of the ethyl bromid is transitory and is only intended to abridge the primary stage of ether anesthesia. The smell of the drug persists on the breath for about twenty-four hours, and being of a garlic odor is disagreeable to some patients.

Nitrous Oxid and Oxygen.—The nitrous oxid apparatus devised by Bennett is the one most employed in this country. The average time for the production of anesthesia is about two minutes. The amount of oxygen varies with the reaction of the patient to the nitrous oxid. Nitrous oxid is administered pure at first until slight stertor is developed. Then oxygen is admitted in sufficient amount to prevent further stertor. The color should be natural, the pupils contracted, the conjunctiva insensitive, and the muscles relaxed. Should stertor and cyanosis or muscular twitchings develop more oxygen must be admitted. Symptoms of excitement call for more oxygen. It may happen that even the admission of all the oxygen possible will not be sufficient to prevent stertor, cyanosis, etc. In such cases the face piece is to be removed from time to time. In this way satisfactory anesthesia can be maintained for fifteen to twenty minutes. Nausea may occur after prolonged nitrous oxid and oxygen anesthesia.

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 the 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. It is our practice, however, to change to our own inhaler as soon as the anesthesia is established and continue the anesthetic with it. The change should be made quickly and the inhaler should



Fig. 11.—Junker's apparatus.

have been saturated with ether just previous to the change.

Junker's Apparatus.—This is very clearly shown in the illustration. 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 necessary 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 through the catheter and will suffocate the patient. After testing the apparatus to insure its proper assembling it is customary to lightly 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.



Fig. 12.—Trendelenburg cannula.

The Trendelenburg cannula 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.

Anesthol was first used by Prof. Willy Meyer, October 15, 1898. It is a chemic combination of ether (47.10 per cent.), chloroform (35.89 per cent.), and ethyl chlorid

(17 per cent.), having a specific gravity of 1.045 and a boiling-point of 104° F.

Anesthol is administered drop by drop. An Esmarch mask is used covered with several layers of gauze and a piece of oiled silk. An aperture the size of a silver dollar is cut in the oiled silk. There is no struggling. If the anesthetic is pushed too rapidly the patient will turn pale and respiration will become very shallow or apparently cease. The heart does not seem to be influenced. As soon as the second stage of general anesthesia is reached one or two drops every two or three seconds will suffice to keep the patient under. *The administration of the drops must be regularly continued.* Anesthol does not seem to affect the circulation. Occasionally the respirations will become very shallow during the administration. If this occurs the withdrawal of the anesthetic is sufficient to cause the patient to breathe more deeply. The appearance of the patient is one of light slumber.

With the relation between the boiling-point of the anesthetic and the internal body temperature so close as they are in anesthol it holds true that a patient will come out of the anesthetic very quickly, and in many cases the reflexes will not be lost at any time during the anesthesia. To prevent this it is desirable to give a hypodermic injection of morphin (gr. $\frac{1}{8}$ or $\frac{1}{4}$) one-half hour before anesthesia.

When under anesthol, the respirations are slow, quiet, and full without being stertorous. The color is natural and the pupils slightly contracted (morphin having been administered previously), the pulse slow, full, and regular. There is no excess of mucous secretions. Muscular relaxation is complete. The return to consciousness is prompt. There is vomiting in only a very few cases, and, as a rule, this is not so distressing as after ether anesthesia.

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 intra-abdominal 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 proved 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, tropacocain, 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. $\frac{1}{10}$, 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 persist-

ent. 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, usually frontal in character and may be mild or severe. It comes 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 a 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. $\frac{1}{10}$.

RULES FOR MAKING THE INJECTION.*

1. The instrument employed may be a fine aspirating needle and an ordinary solid-piston hypodermic syringe. A special needle enclosed 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 $\frac{1}{10}$ grain of sulphate of strychnin, a quarter of an hour before the injection, and have a cup of hot coffee ready to administer should nausea occur.

3. Place one or more tablets of hydrochlorate of cocain,

*G. R. Fowler, "Medical Review of Reviews," April, 1901.

according to the character and site of the proposed operation, in a sterilized teaspoon or other convenient article, crush them, and pour on a few drops of chloroform to form a paste (Bainbridge's method of sterilization of cocain). When the chloroform has evaporated, add from 15 to 30 minims of boiled water, according to the amount of cocain employed. Half a grain is the usual quantity used.

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 one of three postures: (a) The sitting position upon the edge of the operating table, leaning well forward. (b) The semiprone or Sims' position. (c) The left lateral decubitus, with both thighs flexed upon the abdomen, the shoulders and head thrown forward, 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, may be 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 dimple made with the point of a rather blunt 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 cerebro-spinal fluid appears flowing from the needle in clear or slightly blood-tinged drops.

9. Screw upon the needle the hypodermic syringe previously charged with the 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 colodion 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 reaches to varying points between the umbilicus and the level of the fourth rib in the line of the nipple; it reaches a higher level 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.

Cocain Anesthesia.—Hydrochlorate of cocain is employed in $\frac{1}{2}$, 2, and 4 per cent. aqueous solution either alone or combined with minute quantities of morphin. Rarely is a 4 per cent. solution necessary. 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 hydrochlorate,.....	gr. $\frac{1}{4}$.
Sodium chlorid,.....	gr. j.
Sterile water,.....	℥j.

No. 2 (MEDIUM).

Cocain hydrochlorate,.....	gr. $\frac{1}{2}$.
Morphin,.....	gr. $\frac{1}{4}$.
Sodium chlorid,.....	gr. j.
Sterile water,.....	℥j.

No. 3 (WEAK).

Cocain hydrochlorate,.....	gr. $\frac{1}{8}$.
Morphin hydrochlorate,.....	gr. $\frac{1}{8}$.
Sodium chlorid,.....	gr. j.
Sterile water,.....	℥j.

When possible the blood-supply of the part should be arrested in order to maintain the local effect of the cocain. 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, $\frac{1}{2}$ 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 shall overlap 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 needle or with the knife, and, as soon as this is established, usually in less than two minutes, the skin incision is made. If deeper dissection is necessary, injections of $\frac{1}{2}$ 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 by the injection of a 2 or 4 per cent. solution. As the period of anesthesia is variable, it is well to proceed with the operation as speedily as possible and so obviate the need for renewed anesthesia. 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 will it be 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.

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

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. Cocain solutions should never be boiled or submitted to a high temperature.

CHAPTER V.

THE PATIENT.

General preparation; mental condition; blood; heart and lungs; kidneys; skin; bowels; diet. Local preparation; general directions; head; face; neck; thorax; abdomen; extremities; body cavities; mouth; nose and pharynx; esophagus and stomach; small and large intestine; rectum; urethra and bladder; vagina. Preparation just previous to leaving for anesthetic room; clothing; bladder; stimulation. Position of the patient for various operations. Preparation of operative field in the operating room. Duties of House Surgeon; of Assistant House Surgeon; disinfection of the hands. Application of dressings.

The **general preparation** of the patient begins from the time he is admitted by the house surgeon. Patients should be received in such a manner as to maintain, and indeed increase, their confidence in a successful solution of their trouble. They should be placed at a distance from patients likely to complain, or whose condition would discourage them. Nervous patients should be insured a good rest during the night prior to the operation by the administration of a sedative, preferably a combination of the bromids. Emergency cases, of course, are prepared for immediate operation; other cases, with the exception of laparotomy cases, require twenty-four hours' preparation; laparotomy cases require forty-eight hours' preparation. 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 possible, before the operation. A stained specimen should be prepared for the examination of the attending surgeon.

An **examination of the heart and lungs** is made by both the house surgeon and the anesthetist and their findings compared. Any deviation from the normal is reported to the operator in time to allow of possible change in the preparation for operation.

The Kidneys.—Immediately following the first bath the patient is asked to urinate. Before procuring a specimen from females the vagina is douched and the external genitalia completely cleansed. Catheterization in females should only be resorted to in case the examination of the first specimen is made difficult by the admixture of epithelium and pus-cells from the vagina or in case the patient is menstruating. The specimen should be sent to the pathologist for immediate examination. In addition, the total quantity passed in, the first twenty-four hours of the patient's stay in the hospital is to be saved and a sample of the mixed urine sent for analysis. In the event of the discovery of any pathologic condition of the kidneys, bladder, or urethra, suitable treatment is at once inaugurated and subsequent urinalyses made sufficiently often to note the progress of the condition. The urinalysis reports form an important part of the history of the case.

The Skin.—A soap and hot water tub bath is given immediately following admission and before the patient is put to bed. 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 should be cut short, and the subungual spaces well scrubbed. The bath is repeated daily until the day of

operation, when a sponge bath is substituted for it. Patients too weak to be given tub baths receive sponge baths instead.

The Bowels.—Those cases which permit of it, forty-eight hours before the operation, should be given one-half ounce of magnesia sulphate in cool water. The dose may be made more palatable by substituting equal parts of orange-juice and lemon-juice for the water, and adding only enough of this to liquefy the magnesia, then adding a small quantity of cracked ice. This is repeated every six hours until the bowels move thoroughly. The evening before the operation, the lower bowel is washed out with a liberal soapsuds enema. This is repeated four to six hours before the operation. In cases allowing of but twenty-four hours' preparation, the same plan is followed, except that the interval between the doses of magnesia is shortened to two hours. In emergency cases the magnesia is omitted, and a large soapsuds enema given immediately following the sponge bath.

The 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 fluid up to within six hours of the time set for the operation. In these six hours nothing should be introduced into the stomach. The meal directly preceding the operation should be omitted as far as solid articles of food are concerned. There is no objection, however, to the ingestion of water, tea, or thin soup so long as six hours elapse between the time these are taken and 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 stomach.

Local Preparation.—*General Directions.*—Twenty-four hours preceding the time set for operating the skin of

the field of operation should be shaved and thoroughly cleansed with hot water, green soap, and a gauze compress. The surface should then be carefully wiped off with alcohol and the entire area covered with towels wrung out of boro-salicylic solution. These in turn are covered with oiled muslin protective and secured by bandage or binder. Twelve hours later the surface is again cleansed with hot water and green soap and the loose epithelium removed by sponging with alcohol. The surface is then covered with towels wrung out of 1:5000 bichlorid and then by a layer of non-absorbent cotton, the whole being secured by bandage or binder. In emergency cases following the cleansing with green soap and hot water the bichlorid towels are applied, the cotton being omitted. While the local preparation of the parts should be thorough, it is well to remember that an overzealous and too vigorous preparation will tend to defeat the end aimed at by abrading the skin and thus opening up avenues of infection.

The Head.—The hair of the entire head, except in the case of small tumors or wounds, is first cut short with scissors and then shaved. In any event, the hair must be removed wide of the site of operation. The remaining hair is cleansed by shampooing with soap and hot water; thoroughly rinsed in cold water; then rubbed with alcohol and bichlorid, 1:5000, finally thoroughly dried, braided in the case of females, and covered with a cap or bandage. 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.

The Mouth.—Preceding all operations upon the mouth the condition of the teeth should be investigated and made as perfect as possible before the patient enters the hospital. 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. 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. chromic acid solution. Weak solutions of permanganate of potassium make good washes in this condition.

The 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 rest of 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.

The 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.

The Abdomen.—The disinfection should include all the skin from the line of the nipple to the middle third of the thigh and as far back as the postaxillary line; also the perineum, genitalia, and inside of the thighs.

The Genitals.—The preparation should include the lower abdomen and upper third of the thigh, as well as the external genitalia and perineum. 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 mucous membrane is cleaned by douching twice or thrice daily with hot boro-salicylic solution. In septic conditions the boro-salicylic douche is preceded by a 1:2000 bichlorid douche.

The Rectum and Anus.—The preparation includes the perineum, buttocks, genitalia, and upper third of the

thigh. Copious soapsuds enemata should be given to cleanse the rectum, but sufficient time should elapse between the last enema and the time set for the operation (six hours) to allow the enema to entirely come away; otherwise it may be expelled during the course of the operation.

The 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. In these areas the borosalicylic compresses should be renewed every four hours and the loosened epithelium removed by sponging with alcohol.

The Nose and Pharynx.—In addition to nasal douching and sponging minute doses of atropin and morphin will be found valuable in limiting excessive secretion.

The Esophagus and Stomach.—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 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 accomplished by thorough purgation and the ingestion of food leaving the smallest residue.

The Urinary System.—By increasing the amount of fluids taken by the patient and by repeated doses of such drugs as urotropin and caffein citrate we can increase the functional activity of the kidneys and so flush out the urinary tract. In operations involving the bladder and

in which a septic condition of the urine exists, we can, when time permits, catheterize every six or eight hours and wash out the bladder with boro-salicylic solution,



Fig. 13.—Dorsal position; operation suit.

following this with boric acid solution. An ounce or two of the latter may be left in the bladder. In operations

involving the urethra, should septic conditions be present, thorough irrigation through a small catheter with boro-salicylic solution should be practised.

Preparation Just Previous to Anesthetization.—A freshly



Fig. 14.—Dependent head position.



Fig. 15.—Extended neck position.

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. These latter should come well up on the thighs. The patient should be asked

to urinate. If this is impossible or if the quantity passed is small in amount catheterization is employed if the patient be a female and the operation involves the pelvic viscera; otherwise catheterization may be omitted. In any case the fact should be recorded, and those cases which do not urinate voluntarily or which are not catheterized should be subsequently watched for distention of the bladder. As a rule, strychnin sulphate, gr. $\frac{1}{120}$ to $\frac{1}{20}$, is administered hypodermically just previous to anesthetization.



Fig. 16.—Position for breast amputation.

The position of the patient on the operating table will vary according to the nature of the operation. It should be such as will render the part involved in the operation prominent and ready of access, and yet such as to interfere as little as possible with respiration and circulation, and there should be no pressure on important nerves. In short, the position should be as natural as possible. The musculo-spiral nerve is the nerve most frequently injured. This occurs through allowing the arm to rest against the

edge of the table. It may be caused by an assistant leaning against the arm.

The *dependent head position* 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 the hand of an assistant.

The *extended neck position* is produced by placing the



Fig. 17.—Thoracotomy position.

patient in the dorsal position, arms by the side, with a large, 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.

The *position for amputation of the breast* 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. 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.

The *position for thoracotomy* 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



Fig. 18.—Position for operations upon the upper abdomen.

side to lie across the chest. The affected side should be well over the side of the table.

The *position for operations upon the upper abdomen* is the dorsal position with a moderately large sand-bag under the dorsal spine. The arms should be placed above the head.

The *dorsal position* is with the patient flat on the back. The arms may be either folded across the chest, fastened naturally above the head, or allowed to rest at the side. This position is the one usually employed.

The *Trendelenburg position* is secured by placing the

patient in the dorsal position, with the shoulders resting against shoulder supports. The head of the table is then depressed as much as required. For operations upon the



Fig. 19.—Dorsal position.

small intestine or appendix, a moderate degree of Trendelenburg position is useful. In demonstrating intra-

pelvic operations an exaggerated Trendelenburg position is necessary. The weight of the body should rest on the shoulders. To prevent pressure effects, rubber pads should be placed between the skin and the supports. The arms should be fastened loosely across the chest.

The *reversed Trendelenburg position* is useful in operations for varicocele and varicosities of the lower extremity and in limiting infection to the lower abdomen. The patient is secured to the table by bandages and ad-



Fig. 20.—Trendelenburg position.

hesive plaster strips so arranged as to distribute the weight.

The *lithotomy position* is obtained by placing the patient in the dorsal position and flexing the thighs on the abdomen with the legs flexed at a right angle. 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. To do this, a large sheet is folded diagonally and placed with the apex hanging

slightly over the foot of the table. The patient is then placed on the table in the lithotomy position, with the buttocks resting upon the apex of the sheet and the shoulders upon the upper folded portion. Each lateral corner of the sheet is then passed around 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-



Fig. 21.—Reversed Trendelenburg position.

holders and lithotomy posts. Care should be taken not to overflex the thighs nor to allow the inside of the legs to be pressed tightly against the posts.

The *exaggerated lithotomy position* 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 supports should be so placed as to

prevent the patient 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, and in rectal operations, and in examination of the female bladder.

The *Sims* position is obtained by placing the patient



Fig. 22.—Lithotomy position, with sling sheet.

upon the left side, the left side of the face, left shoulder, and 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.

The *kidney position* is secured by first 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 sand-bag should be sufficiently large to cause a flattening of the affected side by widening the space between the



Fig. 23.—Lithotomy position.

ribs and the iliac crest. The patient should lie more upon the side than in the Sims position. This is maintained by a second large sand-bag placed parallel to the abdomen or by securing the patient to the table by a broad, adhesive plaster strip crossing the body at the level of the ensiform. The *ventral position* 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 sand-bag under the abdomen. The arms lie above the head.

The *knee-chest position* is useful in direct examinations 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



Fig. 24.—Exaggerated lithotomy position.

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.—The assistant house surgeon should have thoroughly disinfected his hands before anesthesia is established. 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. In handling the patient he should make use of bichlorid



Fig. 25.—Sims' position.



Fig. 26.—Single kidney position.

towels. The anesthesia being established, the patient is wheeled to the operating table, on which are rubber pads and a rubber sheet, and lifted from the cart to the table by means of the small stretcher, the anesthetist support-

ing the head and shoulders, while the body is supported by the orderly lifting on the cart side of the stretcher, and the assistant house surgeon lifting from across the table.



Fig. 27.—Ventral position.



Fig. 28.—Knee-chest position.

The stretcher is then removed and the patient placed in the required position. The half blankets are arranged smoothly so as to widely expose the field of operation, the

bichlorid towels and bandages removed, and the area to be disinfected surrounded with sterile towels. The parts



Fig. 29.—Dorsal position, arms fastened ready for final preparation. ✓

are then carefully scrubbed for three minutes, in emergency cases five minutes, with green soap, hot water, and

a sterile gauze compress. The soapsuds are washed away with sterile water. The skin is then gone over carefully with alcohol and ether, and finally flushed with bichlorid, 1:2000, a fresh compress being used for each solution. In place of this elaborate preparation, if the ward preparation has been thorough, it is only necessary to sponge the parts with the acid-bichlorid solution for two minutes. The line of incision is painted with iodine on a stick sponge. Sufficient bichlorid should have been added to the iodine to make a 1:1000 solution. In ulcerative conditions of the skin, the area, after scrubbing, is painted with tincture of iodine. Sinuses are disinfected by curetting and packed with sterile gauze. The nipple in breast operations and the umbilicus in abdominal operations is coated with Woelfler's solution to which sufficient bichlorid has been added to make a strength of 1:1000. 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 borosalicylic 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 a boro-salicylic solution. During dilatation of the sphincter the anesthetic should be discontinued, otherwise a dangerous depth of narcosis might result. The assistant house surgeon discards the heavy pair of gloves and dons a gown preparatory to assisting at the operation. The house surgeon assists the operating room nurse in arranging the protectors and towels. Every part of the patient except the immediate field of operation should be covered. No bichlorid towels should be used except in operating upon the extremities. The patient should be kept as dry as

possible. The towels and protectors are held in place by sterile safety-pins or special clamps.



Fig. 30.—Dorsal position; ready for operation.

Hand Disinfection.—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 green soap and a soft brush in hot, running water. The hot water causes sweating, thus bringing to the surface at least some of the bacteria residing in the depth of the skin. The vigorous scrubbing facilitates this and removes the bacteria on the surface. A good lather should be raised, which is rinsed off in hot water. 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 another five minutes in hot water with green soap and a second brush. 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. After a final rinsing, the hands are immersed for one minute in a 1 : 1000 bichlorid of mercury solution, then for one minute or until deeply stained in a hot bichlorid-permanganate solution. This latter serves three purposes: the permanganate penetrates the skin deeply, and so carries the bichlorid into the depth 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 of infection 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 lodge on the surface or work out from the depths of the skin, and 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 then immersed in a hot saturated



Fig. 31.—Dorsal position; abdominal dressing applied.

solution of oxalic acid. This removes the permanganate. The hands are rinsed in warm water and then in cold ammonia solution, one ounce of ammonia to two quarts of water. This neutralizes the effect of the oxalic acid, and when a little liquid green soap is added it results in thoroughly cleaning the hands, leaving them 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.

The application of dressings is done by the house surgeon under the direction of the adjunct. Prior to applying the usual dressing, the skin in the neighborhood is cleaned with hydrogen peroxid, flushed with saline solution, and thoroughly dried. The wound dressing is then applied. The parts which will be covered with the outer dressing and bandage or binder are next dried and the dressing completed. In securing bandages with pins care should be taken not to wound the skin. In moving the patient about care should be taken to place no additional strain upon the sutures. The purpose of the dressing is to relieve strain and insure rest of the parts as well



Fig. 32.—Dorsal position; abdominal binder applied.

as to protect the wound against infection. Dead spaces should be obliterated. The back-rest or an inverted basin is used to facilitate the application of dressings to the trunk. All dressings should fit smoothly and be a source of comfort to the patient. 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. In applying the abdominal binder the binder should be rolled up half-way 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, to the lower extremities 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. Recovery from anesthesia. Anesthetic vomiting. General appearance of the patient. Parotitis. Pain. Thirst. Nutrition. Digestion. Dilatation of the stomach and duodenum. General hygiene. Urine. Albuminuria. Cystitis. Anuria. Retention of urine. Catheterization in the female. Post-operative pneumonia. Causes of sudden death following operation. Temperature. Pulse. Respiration.

General Considerations.—A successful issue in many cases depends upon the care which is exercised in the after-treatment. The surgeon'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. It would be of slight avail to cut a urethral stricture if the passage of sounds were not rigidly enforced; nor would a good result be obtained following resections of bones and joints if no attention were paid to the position of the parts. The occurrence of pressure sores in patients who have long been confined to bed, has caused many surgeons to regret that they did not pay more attention to the details of their work.

The *purpose* of the after-treatment is to recognize complications early, be they simple or grave, and so intelligently to treat them as to give the patient not only the best chance for recovery, but the best final functional result. Not only must the wound or injury itself be treated, but the entire organism must be brought to as

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nearly a normal condition as possible. Each case must be studied individually as regards previous habits of life and complicating diseases. The mental status of the patient must be understood. The general physical condition must receive attention. The working of every organ must be known in order to treat the case intelligently.

The *bed* should be easily separable for purposes of cleanliness. Enameled iron bedsteads with wire springs



Fig. 33.—Bed ready to receive patient.

serve admirably. They have the advantage of being cheap, and are practically indestructible.

Preparation of the bed for the reception of the patient: Either a thin hair mattress is placed on the wire spring or a heavy folded blanket is used for the purpose. The bedclothes consist of two sheets, an upper and an under one, and a draw-sheet of thin rubber, two light blankets, a counterpane, and a small, flat pillow. Hot-water bottles are placed between the blankets half an hour before the return of the patient to bed is expected.

The *position* of the patient will depend upon the character of the operation. The position should be as comfortable as is compatible with proper rest of the operated part. Unnecessary movements are to be avoided. During the first few hours shock may necessitate the elevated pelvic posture. Subsequently the patient may be placed on one side, as in empyema or renal operation; or the elevated head and trunk position may be employed if diffuse peritonitis, excessive vomiting, or other indication for its use occur. In uncomplicated cases a small pillow beneath the head will be a source of comfort. Following herniotomy or other abdominal section a pillow under the knees will make the patient more comfortable by relieving the tension on the abdominal wall. Sand-bags will be necessary to maintain quiet of an injured member. Should extension of a limb be necessary, a board must be placed beneath the mattress to give the required stability. Pressure from the bedclothes is avoided by hoops or frames which keep the weight of the bedclothes from the body. Barrel hoops form a good substitute for the manufactured frames. Rubber rings and pillows are useful in maintaining the patient in a comfortable position. The water bed may be necessary in spinal cases or in much debilitated cases. In cases in which hemorrhage or oozing is feared, the parts affected may be elevated to lessen the flow of blood to them and hasten the flow from them; in other words, congestion of the parts is to be avoided. Old and debilitated patients should have the shoulders propped up and their position changed frequently in order to avoid hypostatic pneumonia.

The *bed-rest* will be found useful as convalescence proceeds. The *stay in bed* should be as short as is compatible with wound healing. As soon as possible, the patient should be taken into the open air and sunshine.

Recovery from Anesthesia.—The patient is to be

watched until conscious. Under no circumstances is he to be left alone until he understands his surroundings. Movements tending to bring strain on the operated parts are to be restrained. Too vigorous restraint is to be avoided if possible, as it tends to cause the patient to struggle harder. In case of violent patients a sheet may be 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.

Anesthetic Vomiting.—The chief danger is that some of the vomited matter may be aspirated into the bronchi and set up a foreign-body pneumonia. Vomiting may be prevented to a great extent if proper *precautionary measures* are employed. 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.

Treatment.—Oxygen may be administered for from fifteen to thirty minutes following the withdrawal of the anesthetic, with excellent results. The elevated head and trunk position tends to prevent vomiting. To allay persistent anesthetic vomiting cocain hydrochlorate, gr. $\frac{1}{12}$; bismuth subnitrate, gr. $\frac{1}{2}$; cerium oxalate, gr. $\frac{1}{2}$; may be given dry on the back of the tongue, every half-hour for four doses. 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. Ice tends to keep up the vomiting. Should vomiting continue, lavage may be practised. If this is done early it will remove mucus and anesthetic-soaked secretions from the stomach, and thus tend to prevent retching from this source.

Character of the Vomit.—The vomited matter is watery and usually colorless. It consists of 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 may feel very wretched.

Persistent Vomiting.—It sometimes happens that vomiting is prolonged and persists for several days. This, when not traceable to other causes, 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. These patients continue to vomit in spite of ordinary treatment. Systematic lavage of the stomach must be practised. This may be repeated at intervals

of four hours if vomiting persists. Following a thorough cleansing of the stomach one-fourth to one-half grain of morphin is to be administered hypodermically. In this connection it is well to remark that some persons have an idiosyncrasy to morphin, and that in some cases the drug will itself cause persistent nausea and vomiting. In neurotic individuals the use of counterirritation over the epigastrium by means of a mustard plaster, or even the application of the thermocautery, may be useful. I have seen one patient who vomited for several weeks after an ovariectomy, and in whom no treatment was of avail, the vomiting finally stopping spontaneously. Nutrition in the cases of persistent vomiting is maintained by nutrient enemata. All medication by the mouth is withdrawn while the attacks of vomiting continue. When feeding by the mouth is attempted, half-ounce doses of warm fluids should be first resorted to at hour intervals, and, if these are retained, the amount may be gradually increased.

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 will occasion no anxiety. In *distention* the countenance may be somewhat troubled. In *hemorrhage* the face will be colorless, lips waxy, pupils dilated, respiration rapid and shallow, and the patient thirsty, anxious, and restless. In *peritonitis* the face will be 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

Thirst.—This 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. However, since we have employed repeated saline enema 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 usually repeated at intervals of four hours for four doses. Small quantities of cool or hot fluids, such as peptonized milk or broths, may be given as soon as anesthetic vomiting has ceased, unless the operation has been one involving the stomach. If the latter, feeding will be for the most part by rectum for the first few days. The frequent rubbing of the mouth, gums, and lips with cool water will prove grateful. Ice should be prohibited, as it tends to increase thirst and may disorder the stomach and induce vomiting.

The **nutrition** of the patient must be borne in mind. For the first few hours all nourishment by the stomach is prohibited on account of the irritability of that organ caused by the anesthetic. As soon as anesthetic vomiting has ceased, however, liquid food may be given by mouth. Peptonized milk or light broths are best for the first twenty-four hours, the doses being so graded as gradually to accustom the weakened stomach to retain larger and larger doses at more extended intervals, until 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 charac-

ter of the food should be such as to be readily assimilable. Flatus-producing foods are to be 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. The tongue is coated and the breath foul. The odor of the anesthetic clings to the patient. Particularly is this the case if bromid of ethyl has been used preliminarily. The odor is that of garlic, and is disagreeable to the average patient. The stomach is distended and the eructation of gas is common. Nausea persists after actual vomiting has ceased. 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. The time, material, and amount of each meal should be designated by the surgeon in charge. Youth and old age require the greatest care. 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. This will prove very grateful to the patient. It is well known that 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.

In case of continued loss of appetite a search should be made for the cause, which may prove to be an unfavorable condition of the wound.

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. Distention is relieved by enemata, by the passage of the rectal tube as required, 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. 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. Regulate the diet. Give a natural cathartic water, or one teaspoonful of the fluid extract of cascara (aromatic) may be taken at bedtime. This may be advantageously combined with the fluid extract of licorice. In any event, 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 enemata or a cathartic the bowels move freely and the unpleasant symptoms subside. In the care of the bowels in operations involving the integrity of the intestinal wall reliance must be placed upon enemata. No cathartic is to be given until the tenth day, except in the case of an impending peritonitis. *Fecal impaction* may result if proper attention is not paid to the movements. This will necessitate spooning the hardened fecal masses from the rectum and the administration of a course of calomel and castor oil.

Dilatation of the Stomach and Duodenum.—This post-operative complication is exceedingly rare, though of

late quite a few cases have been reported. Most 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 * describes a condition which he designates as mesenteric incarceration of the duodenum. A case of this character has come under our observation which died in spite of early 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. Miller describes an almost identical condition found at an autopsy in Dresden.

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. This tension on the mesentery causes the duodenum to press against the superior mesenteric artery and vein, and this pressure completes the obstruction.

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 anesthetiza-

* "Deutsche Zeitschrift für Chirurgie," vol. 56, page 486, 1900.

tion, 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 secretions 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 quantity of the vomited material and its character. Following abdominal section this complication should be readily diagnosed, as the treatment of all cases of abdominal section should include 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 be thus early recognized and prompt measures may be instituted for its relief. I have seen in the past three months three 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.

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 the restriction of fluids, and the frequent change in the position of the patient. 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. If in spite of change of posture and repeated lavage 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-jejunosomy must be done. If gastrojejunostomy alone is done, in all probability the symptoms will still continue on account of the reversed peristalsis of the parietic duodenum.

The **general rules of hygiene** must be carried out. The room and surroundings are to be made as pleasant as possible. There must be plenty of fresh air. The bed-clothes 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 kept comfortable, but wounds will heal more quickly, if hygienic conditions are good. General massage may be given. This will increase the action of the skin and tend to prevent pressure sores.

The **urine** must be watched carefully. In all cases the total quantity passed in the first, second, and third

twenty-four hours is recorded. A sample of the urine of each day, together with a slip bearing the patient's name, date, and the amount passed, is sent to the pathologist for chemic and microscopic examination. The same procedure is carried out on the tenth day. In cases in which kidney complications occur 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. The urinalysis report should comprise the name of the patient, date, quantity passed in twenty-four hours, color, odor, reaction, specific gravity, the presence and amount of albumin and sugar, the amount of urea, the presence of bile, the relative amount of chlorids and peptones, the deposit on standing, crystals, casts, and other microscopic findings. The report is signed and filed with the other records going to make up the history of the case.

Cystitis is apt to follow cases in which the catheter is employed, particularly in females. With careful manipulation and cleanliness in the technic, catheter cystitis should rarely occur. Early catheterization is of value as showing whether the kidneys are properly functioning or not.

Anuria may occur after any anesthetization, but is more likely to occur after operation 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. This is one reason why strong antiseptics should not be employed.

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 should be 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 is useful as showing 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.

Placing the patient in a hot bath, 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 operator's or nurse's hands should be scrubbed and thoroughly disinfected. The mucous membrane and skin surrounding the urethral orifice should be cleansed with sterile water, followed by a swabbing with boro-salicylic solution. The patient should lie 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 or vaselin. The instrument is gently inserted within the urethral orifice and pushed without force along the urethra. As soon as the bladder is entered 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 quiet this, twenty drops of spirit of nitrous ether may be given every two or three hours until the irritability subsides. Salol in five-grain doses may also be given. It has at times been our custom to irrigate the bladder after each catheterization with a 2 per cent. boric acid

solution, leaving one ounce of the solution 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 of the delicate bladder mucosa as to infection introduced from without. For this reason the utmost care is necessary in performing the catheterization as delicately as possible, using a very small instrument. In our experience when pain is complained of it is because too large an instrument has been used.

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 (after operations upon the lung, throat, palate, tongue); next in frequency after abdominal operations, particularly those in the neighborhood of the diaphragm (liver, gall-bladder, stomach). Great 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 (the head should be lowered and turned to one side to facilitate the drainage of mucus and saliva from the nose and lower angle of the mouth); 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, and frequent change of position. Oxygen should be administered in cases where a considerable area of lung is involved. Drugs do not seem to exert any influence upon the disease itself. Ten-grain doses of carbonate of ammonia every two hours serve to somewhat stimulate the heart and to aid the larger air-passages in getting rid of their secretions.

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 * 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.

The **temperature** is taken every four hours for the first three days; later night and morning in ordinary cases. In abdominal cases the temperature is taken every four hours for the first ten days; then night and morning until convalescence is established. In septicemic and complicated cases the temperature is taken

* Six cases cited in Fowler's Surgery.

every four hours until all danger is past. In cases of beginning septic abdominal complications, in which the diagnosis is uncertain, whether operative 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*. Auto-intoxication 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. Since we have employed saline enemata as a routine procedure we have not noted as high a "reactive fever" as formerly. 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, if harmful, 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 variation 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 respiration rate may be increased to twenty-four and remain so for several days.

CHAPTER VII.

COURSE OF ASEPTIC WOUNDS. INFECTION.

Revision of dressings. Quiet. Percentage of sterile wounds. Normal course of wounds healing per primam. Primary wound dressing. Removal of skin sutures. Second dressing. Removal of deep sutures. Drainage in aseptic wounds. Aseptic wounds healing per secundum. Disturbance in the course of an aseptic wound; infection; stitch abscess; retention of secretion; retention of secretion with tension; phlegmon, subcutaneous, intermuscular, tendinous; diffuse cellular infiltration; infection in loose cellular tissue.

Revision of Dressings.—The post-operative dressing should be inspected daily to ascertain if the dressing has become displaced. Should this happen the dressing should be at once revised. The revision should not include inspection of the wound unless the wound is exposed. Too early inspection of the wound favors infection.

Quiet.—Local rest of the part must be maintained until healing is effected. General rest of the patient should be maintained only when general body movements would interfere with wound healing.

Percentage of Sterile Wounds.—If cultures are taken from wounds healing per primam it will be found that at least 50 per cent. of such wounds will give a culture, in other words, one-half of the wounds which heal by primary intention have infective agents in them.

The Normal Course of Wounds Healing per Primam.—Usually a wound aseptically made heals without complications. In the course of from five to seven days the skin union has been effected. In portions of the body in which the skin is subject to strain, healing is not firm enough to withstand strain before the tenth

to the fourteenth day. Age also is a factor in the healing of skin wounds. 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 readily in five days, as here the blood and lymphatic supply is very rich. Wounds of other parts of the body 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 is necessary before moderately firm union is accomplished. The extent of the wound is a factor in the 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 completely healed on the fourteenth day. Such a wound, however, must not be subjected to severe strain, as the union is still fresh.

Primary Wound Dressing.—The primary dressing of a sterile wound may be an occlusive dressing or an absorptive dressing. The common form of occlusive dressing is collodion, either alone or in combination with cotton or gauze. This dressing extends beyond the wound for a space of two inches in all directions. Such a dressing 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 serous discharge is not expected. In wounds in which serous discharge is expected, or in which hemostasis has not been exact, an absorptive dressing is used. For this purpose sterile plain gauze is shaken out and applied loosely over the wound, covering the surface about the wound for a space of at least six inches. Enough gauze is so applied to thoroughly protect the wound and form a soft and comfortable dressing. Over this may be placed a layer of non-absorbent cotton, and the whole be retained in place by a suitable bandage or binder.

Combinations of occlusive and absorptive dressings may be employed, and in the case of wounds in which infection is present, or may reasonably be expected to occur, various antiseptics may be incorporated in the gauze. Such special dressings will be described under their appropriate headings. It must be remembered that sterile wounds are to be kept dry. After the arrest of hemorrhage and the drying of the wound of all blood and serum there is no reason why an aseptic wound should not be closed completely and an occlusive dressing applied. As above stated, if serous discharge is expected an absorptive dressing is applied, but under no circumstances should this absorptive dressing be covered by material of such a nature as to prevent free evaporation of the wound secretions.

The first redressing of a wound healing per primam should be done on the fifth to the seventh day, at which time the superficial sutures should be removed. Superficial sutures are removed on the fifth day in case of wounds of the face, in other cases on the seventh day. The treatment of sutures when infection has occurred will be considered later. Without some indication a wound healing per primam should not be dressed before the fifth or the seventh day, preferably the seventh. The general principle of rest to the wound and infrequent dressings should be remembered. Only too often it happens that meddling interference with the dressings on the third or fourth day results in infection of the suture line. At this first dressing the wound itself and the skin in its neighborhood should not be touched by the hands of the attendant. All necessary manipulations should be performed by means of sterile instruments and sponges. No irrigation should be used. Just as much care in asepsis in the preparation of the hands of the attendant, in the isolation of the field of the dressing by means of sterile towels, and in the sterili-

zation of instruments and gauze to be used in the dressing are to be employed as at the original operation. Our care in striving to give the wound rest and not to interfere with the healing process must not cause us to delay the dressing of the wound when indications for such a dressing are present (see infection).

Technique of Removal of Skin Sutures.—The nurse removes the bandage and outer layers of the dressing without touching that next the wound. The attendant places sterile towels in such a manner as to isolate the field of dressing. The final layer of dressing is removed with forceps. As this sometimes sticks to the wound it is removed in the direction of the long axis of the wound. This not only gives less pain to the patient, but does not pull against the edges of the wound and so weaken it. On inspection the wound appears as a thin line marked by the dark thin blood-clot lying between its lips. In the case of a subcuticular suture, one end of the suture is caught by thumb-forceps and slightly pulled upon until it is removed from its bed for the space of a quarter of an inch; here it is cut through with the scissors. The other end of the suture is then caught with the forceps and traction made until the suture is removed. This traction is, of course, in the direction of 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, and without allowing the fingers to come in contact with the wound. Such a wound is never to be pressed or massaged. Should it happen that the subcuticular suture does not come away readily and there is danger of breaking the thread by more pronounced traction, it may be left in place for twenty-four or forty-eight hours longer, when it will be found to come away easily. The wound and its neigh-

borhood are then dusted with oxid of zinc powder, a shaken out gauze compress applied over it, and a sufficient quantity of shaken out gauze applied loosely over this again to cover the wound and its surroundings completely. A layer of non-absorbent cotton is applied and a suitable bandage or binder to hold the dressing securely and comfortably in place. If other skin sutures are employed, such as individual sutures of silk or other material, or a chain stitch, the removal is accomplished with the same regard for aseptic precautions. Each individual stitch, or in the case of the chain stitch each section of suture, is to be raised, cut, and removed. If on inspection it is found that wound healing is not firm, the stitches may be left for a day or two longer.

Second Dressing of a Wound Healing per Primam.—

The second dressing should be done on the tenth to the fourteenth day. In the case of small wounds in healthy subjects, and in parts other than the abdomen, the tenth day is the usual time for the removal of the deep sutures should either through-and-through sutures or a figure-of-eight suture have been used. If removable deep sutures have not been employed, the wound is simply inspected on the tenth to the fourteenth day, and a drying powder dusted over the wound and its neighborhood. In small abdominal wounds the deep sutures may be removed on the tenth day. In more extensive wounds they are removed the fourteenth day, while in cases of long standing herniæ of the abdominal wall, either ventral or umbilical, and in cases where tension is great, these sutures may be kept in place until the eighteenth or twenty-first day, unless they are found loosening before that time. A loose suture means that the suture is no longer serving its purpose in securing apposition of the wound edges and so should be removed.

Technique of Removal of Deep Sutures.—If layer sutures have been employed no removal will be necessary.

If through-and-through sutures have been employed and tied over the wound the removal is accomplished with the same precautions and in the same manner as the removal of individual skin sutures. If the cross suture or figure-of-eight suture has been employed in connection with a rubber bolster, its removal is as follows: The rubber bolster on one side of the wound is raised and traction made upon it so as to cause the suture to emerge one quarter of an inch from the skin, at which point the suture is cut. This process is repeated all along the same side of the wound until the sutures on that side have been cut and the bolster on that side removed. Traction upon the bolster of the other side of the wound will cause the withdrawal of all of the sutures. If the sutures have been tied in pairs through individual bolsters, the process is the same, each bolster on one side of the wound being freed by traction and cutting of the suture after it has emerged slightly from the skin and withdrawing each pair of sutures by traction of the bolster on the other side. There may be an escape of a drop of blood or serum at each suture hole; this is dried and the wound and neighborhood dusted with zinc oxid powder and a gauze dressing applied.

Drainage in Aseptic Wounds.—Rarely is it necessary to drain an aseptic wound. Drainage is only indicated in aseptic wounds in which a dead space has been left which cannot be closed by suitable pressure of the dressings from without. Also in wounds in which large areas have been opened up and extensive dissections made from which a large amount of serous discharge may be expected. The drainage in such wounds usually consists of small strips of plain gauze, the edges of these strips being hemmed to prevent fraying, or strips of green silk protective. Such wounds heal practically per primam and their treatment is the same as wounds healing per primam, except for 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 be not clogged up, it is only necessary at this dressing to renew the copious gauze dressings which have covered such a wound. A dressing of this kind should be done daily until the serous discharge is reduced to a minimum. Usually, however, the discharge of serum has ceased at the end of twenty-four 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 at the end of twenty-four hours without entirely ceasing, that is, 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 the second twenty-four hours.

Aseptic Wounds Healing per Secundum.—By this is meant wounds in which cavities have been left which it is not possible to obliterate by pressure, and which are of such an extent as to require more than small strip drainage. In this class are also included wounds in which one is never quite sure of asepsis and which are left open in whole or in part. Such wounds heal by granulation. The primary tamponade of such a wound should be such as to cause even pressure upon all parts of the wound. In such wounds there is considerable escape of serum, necessitating a change of dressing at the end of twenty-four or forty-eight hours, that is, a change of the outer dressings. The wound dressing itself, if it does not become clogged, need not be changed for three or four days. The same details in asepsis are to be observed at each dressing. No irrigation is to be employed; the wound is not to be touched with the fingers. The packing is removed by means of forceps, and unless there is some damming back of secretion, a new packing is to be immediately introduced. If wound

discharges lie upon the surfaces of the wound such discharges should be carefully sponged away. Redressings are to be done every twenty-four to forty-eight hours following the first dressing, according to the amount of wound discharge.

Disturbances in the Course of an Aseptic Wound.—

Infection.—Mild infections 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 in the wound 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 the 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. When such pain is complained of, the wound should be inspected. If the sutures are found imbedded in the tissues they should be loosened, but not removed, unless there is manifest evidence of infection, as shown by pronounced redness of the wound edges. In such a case of mild infection it may be sufficient to arrest the infection if a compress wrung out of mild alcohol-bichlorid solution is placed on the wound. Such a dressing should be kept moist and its evaporating qualities should not be interfered with. No cotton should be placed over it. The dressing, while copious, should be loosely applied with all aseptic precautions. It should be renewed daily until either the mild infection has subsided or a more decided infection occurs. In many cases of mild infection this course will be attended by a subsidence of the local symptoms. 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 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 where the ligature acts as a foreign body and makes a little nest for itself. 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 sure. The occurrence of one makes the diagnosis probable. The occurrence of a sudden rise of temperature usually marks the development of an infection. *Aseptic 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 following the operation and quickly subsides, never persisting beyond forty-eight hours. It need occasion no anxiety. Since we have used repeated saline enemata aseptic fever has not been so marked as formerly. The character of the operation will also enter somewhat into the amount of aseptic or reactive fever. In cases in which extensive dissection has been employed, 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 may be found in *intestinal fermentation*. For this reason a daily evacuation of the bowels should be insisted upon. In every case of fever occurring within the first week following an operation the condition of the bowels should be inquired into, and if they have not moved freely, a laxative should be given (except in cases of operation upon the gastro-intestinal tract). If the fever is due to constipation or fermentation, a thorough evacuation of the bowels will cause the temperature to become normal. In cases in which the operation has been done through or in the neighborhood of infected tissues such as axillary, cervical, or inguinal glands, the rise and fall of

temperature may vary for several days after the operation. Unless this is excessive it will not be necessary to change the dressing, as the fever is due to increased absorption of outlying infection due to the opening up of new channels of absorption by the operation. Continued fever, with acceleration of the pulse, and interference with the general condition of the patient always call for an inspection of the wound. These general symptoms will vary with the amount of secretion and the extent of the absorbing surfaces. If there is free drainage, and an abundant absorptive dressing, as is the case in wounds healing per secundum, there will be but slight absorption, and in spite of the occurrence of infection the general symptoms will not be marked. On the other hand, in cases of wounds completely sutured even the occurrence of slight infection may cause general symptoms. Upon the institution of free drainage these general symptoms will subside.

The degree of disturbance depends upon the virulence of the infecting agent and the power of resistance of the tissues. It must be borne in mind that even the simplest infection may result fatally.

Clinically we designate infection as early or late according to the time that it occurs. *Early infection* occurs from the third to the seventh day following the operation and is usually superficial. In the mildest cases occurring in the first few days of healing there may be neither general symptoms nor pain in the wound. Upon changing the dressing a slight redness of the edges of the incision or in the neighborhood of the stitch holes may be seen. As a rule, this readily subsides following the removal of the superficial sutures. If the removal of the sutures is not desirable, a compress wet with alcohol bichlorid solution may be applied to the wound. In other infections, also of a mild nature, but slightly more marked than the preceding, upon removal

of the dressing there will be found in addition to the redness of the wound edges a drop or two of pus exuding either from the incision or from the skin suture holes, though for the most part the wound will be found healed. Such a clinical picture, while not frequently seen, is not rare. Both these mild forms of infection are due to bacteria in the depths of the skin itself, notably the staphylococcus epidermidis albus of Welsh. These bacteria are lodged so deeply in the skin that it is practically impossible to eliminate them absolutely. Fortunately not only are they of little infective strength, but the skin itself is possessed of a high degree of resisting power. The removal of the skin suture at the site of infection, thus providing free drainage, and the application of the 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 do not heal but 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. These symptoms will not be severe. Healing may occur with only very slight separation of the wound if the sutures are removed as soon as the infection is discovered and the pus thoroughly expressed from the wound. In addition the wound should be gently irrigated and thoroughly cleansed and dried with small pledgets of gauze. Spraying the infected surface with peroxid of hydrogen through an atomizer is useful to mechanically cleanse the wound without too greatly disturbing it. 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, express the pus, and cleanse these places, keeping them open by small pledgets of gauze to insure drainage. Satisfactory healing may be secured in such cases by thorough, careful, and frequent dressings.

Still another variety of mild infection is shown in cases in which there is oozing of blood under the skin (hematoma). Such oozing predisposes to infection. The prevention is thorough hemostasis. In such wounds the skin healing may be complete, and the only evidence that wound healing is not complete will be a swelling under the skin wound. 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 usually occurs 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 suture 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 heightened 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, which subsequently become infected.

The *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 should be introduced for the first few days, and when the discharge diminishes this should be replaced by gauze drainage.

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 epidermidis 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 more apt to be deep infections endeavoring to find an exit along the suture. Ordinarily the bacillus epidermidis albus has very slight infecting power, but owing to the pressure on the tissues by a too tightly drawn suture this germ may find suitable media for its rapid development. 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, 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 as above.

Retention of Secretions.—If only a portion of the secretion flows away, the remainder will stagnate in the wound and fever will result. The local 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, pain will be marked and the general disturbance will be greater. The pain varies from the pain of mild tension to a con-

stant, agonizing, throbbing pain which is increased by pressure or by movement, and the local symptoms of abscess develop. Fever may occur in the open superficial wound, even if there is no marked infection, in case the secretions stagnate and 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 antiseptic dressings will increase the absorbent power and 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 evaporating antiseptic solutions 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 to be employed. Should the local condition not subside under this treatment, the entire wound is to be opened up and loosely packed with gauze. It may even be necessary to make additional openings at a distance from the original wound for purposes of counter-drainage. In wounds involving cavities, for instance, even the opening of the entire wound may not provide adequate drainage, as is the case

in tuberculous bone disease or in 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. These phlegmons differ clinically according to the location of the infection.

The infection spreads in the direction of the 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 along the line of 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 finally perforations occur. Where the phlegmon is restricted to the subcutaneous tissues the elasticity of the skin prevents any great degree of tension unless 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.—Such a phlegmon may occur following rupture of the urethra, may follow infected compound fractures, or may complicate infected wounds of the neck. The infection follows the course of the deeper planes of the fascia, and being beneath them

is not so readily diagnosed. Such a phlegmon is of much more serious import than the subcutaneous phlegmon, for the reason that the infection can readily travel along the fascial planes and is only limited by the boundaries of these planes. The general symptoms are much more severe than those of subcutaneous phlegmon, the fever is higher, and general infection more easily occurs. 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 diffused; most prominent at the center of the infection. An entire extremity may be involved. In the case of the neck, the infection may spread to the other side. The overlying skin becomes a livid, bluish red. This latter is due to the pressure of the suppuration upon the deep vessels. As the suppuration approaches nearer the skin 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 almost as if a hole had formed in the center of the infiltrated tissues. 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 will promptly occur. Incisions should be made early for the additional reason of preventing widespread destruction and permanent functional impairment of the part.

Tendinous Phlegmon.—This occurs most frequently in the forearm and hand. It most frequently follows insufficient incision of whitlow. The phlegmon is preceded by fever and throbbing pain. Pain is sufficiently

intense to prevent the patient sleeping. 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 may cause swelling to appear 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 as far as the elbow. Redness appears over the infected tendon-sheaths. These rupture and an intermuscular phlegmon is added to the tendinous phlegmon. 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 produced 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. This treatment has seemed to us to be of benefit in such diffuse infiltrations. It is only to be used, however, after the primary focus of infection has been freely incised.

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 providing of efficient drainage. In scrotal cases, for instance, the lower limit of the infection should

be incised and a rubber tube introduced to drain the infected cellular tissues. The position of the infected part should always be such as to favor drainage by gravity; for this reason counter-openings should be made at a point which normally is at the lower part of the infected cavity when the patient is lying down.

CHAPTER VIII.

COMPLICATIONS OF WOUND INFECTIONS.

Lymphangitis. Lymphadenitis. Septicemia. Pyemia. Erysipelas. Hospital gangrene. Malignant edema. Infectious emphysema. Bacillus pyocyaneus infection. Tetanus.

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 are involved. The infection in such an area may extend along 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, and over these hard cords the 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 may be added to alleviate the pain. Upon the subsidence of the acute inflammation mercurial ointment may be gently rubbed along the thickened lymphatic trunk. In the 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.

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 it 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 a 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; however, as the metastatic deposits increase in number the 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 metastatic 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 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 the 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 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 wound 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.

Local Treatment.—The erysipelatous area should be covered by large moist antiseptic dressings of either carbolic acid or bichlorid of mercury. 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 bichlorid of mercury 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 tissues is of value. General supportive treatment of the patient is indicated. In our hands the injection of anti-streptococcus serum has seemed to be of benefit.

Hospital Gangrene.—As before stated, 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 diphtheritic 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, gangrene 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 profuse 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 may be

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.

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, multiple incisions of the infected tissues, curettage of the wound, and the application of copious absorbent evaporating antiseptic dressings may be of value. 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 antiseptic 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.*

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 destroyed, and through carelessness of attendants this germ has been known to infect every wound in a ward.

Tetanus.—Fortunately this dread disease rarely attacks operation wounds. Occasionally, however, cases are

* 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.

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 gastro-enterostomy. 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 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 usually 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. 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 universally 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 proximal to the suspected 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 average dose being twenty cubic centimeters. The antitoxin may be given under the skin in cases which are not extremely urgent, directly into a vein in urgent cases, or from five to seven cubic centimeters may be injected in urgent cases into the frontal region of each brain hemisphere through a trephine opening. The injection should be made slowly. The antitoxin may also be injected into the spinal canal. This would seem the most logical site.

Of ten cases with which I am personally familiar, only one recovered under the use of tetanus antitoxin, and that one a case in which the disease developed forty days after the injury. 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 stomach tube passed through the nose. The room should be dark, absolute quiet should be enforced, and every possible source of excitement or noise avoided. More recently intraspinal injections of sulphate of magnesia have been tried with some apparent degree of success in controlling spasm.

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 IX.

ASEPTIC WOUNDS IN INFECTED TISSUES.

Thermo-cautery wounds. Blockage of the drain. Disturbances of granulation. Sinus. Hemorrhage: primary oozing; secondary hemorrhage; intravenous saline infusion; hypodermoclysis; auto-infusion. Secondary suturing. Skin grafting. Wound disturbances the result of antiseptics; carbolic acid; bichlorid of mercury; iodoform.

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 sloughing tissues. Such wounds are exemplified by furuncle, paronychia, and carbuncles. Such wounds are packed with moist gauze and kept open. The moisture hastens the separation of sloughs. For this purpose carbolic acid is useful. The evaporating qualities of the gauze should not be interfered with. Lead and opium may be added to the carbolic acid solution for the purpose of allaying pain. Should the carbolic acid prove irritating a solution of aluminum acetate may be substituted for it. The dressings should be changed sufficiently often to prevent any stagnation of secretions. This should be at least once daily. The margins of the wound should never be squeezed in the endeavor to evacuate pus. 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 the wound with a large amount of 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 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.

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.

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 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 fresh drainage strip or tube 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. 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.

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, 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 secretions. 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 and healthy, the balsam alone may be used, and finally, when an even surface results, plain gauze or ointment may be used. The general health should be looked after. Powders only serve to delay the healing process, unless they are of a nature to mix intimately with wound secretions. Curetting the wound also serves to stimulate granulation. Criss-cross incisions may be made through the floor of the wound one-eighth of an inch apart and deep enough to reach healthy tissue beneath. Through these incisions healthy granulations spring.

Exuberant granulations are easily recognized and

infusion is contraindicated, but copious hot saline enemata should be employed. The inhalation of carbon dioxid gas has some effect in controlling the oozing. The oozing is best controlled by direct continuous pressure applied to the source of hemorrhage. Adrenalin solution 1:1000 may be applied to the wound. Rectal enemas of 5 per cent. gelatin solution are sometimes useful. Ergot should be administered by mouth. When the bleeding has been finally arrested the patient should be given Blaud's mass, five grains, four times a day, and the diet should be 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 heightened blood-pressure due to the patient thrashing about in coming out of the anesthetic, the increased vis a tergo will be sufficient to displace the small blood-clots in the mouths of the capillaries, and more or less oozing will follow. 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 media for the germs.

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, 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 blood escapes externally, as in the case of operations upon the surface, it is not probable that sufficient blood will be lost to be dangerous. 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 large 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 post-operative 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 be 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. Or 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 an infective 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 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 pathognomonic. 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. These 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 overstimulate 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 fit-

ting rubber bandage, 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.

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 hemorrhage occurs following an operation upon an extremity the Esmarch constrictor 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 nearly 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 bleed-

ing 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.

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 re-established. 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 by the kidneys hastened by raising the blood-pressure.

Technic.—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. With aseptic precautions the vein is bared and cleared for about one inch. Two ligatures are passed around it, one above the point of intended opening and one below. An opening small and valve-shaped is made in the vein with the 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, or by compressing part of the circumference of the tubing with an artery clamp in such a manner as to narrow the lumen of the tube.

The solution used should be $\frac{6}{100}$ per cent. sodium chlorid at a temperature in the jar of 120° F.

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. In shock it may be desirable to combine small doses of strychnin with the saline infusion. This may be done by introducing the hypodermic needle into the rubber tubing and slowly injecting the strychnin into the saline. Adrenalin chlorid in 1:1000 solution may be injected in this manner and may be repeated at intervals of every few minutes until the blood-pressure is manifestly raised.

In cases of shock in which large amounts of strychnin have 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.

Hypodermoclysis.—In cases which are not so urgent hypodermoclysis may be substituted for intravenous saline infusion. The apparatus consists of a hollow needle, an irrigator, rubber tubing, and an ordinary bulb syringe. The needle is introduced into the cellular tissues beneath either breast and from one to two pints of the solution is slowly introduced, usually a pint beneath each breast. 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.

Auto-transfusion.—Auto-transfusion, 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.

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 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.

Skin Grafting.—This is indicated in all wounds of any magnitude 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 granulating, these granulations should be scraped away and bleeding arrested by pressure before the grafts are placed. The entire surface should be covered by Thiersch's grafts. No antiseptic should be allowed to come in contact with the delicate grafts. In cutting and transferring the grafts normal saline solution at a temperature of 100° F. should be employed. The grafted wound should be dressed with narrow strips of green silk protective arranged as a basket strapping. This

is covered with a copious aseptic gauze dressing moistened with saline solution. Over this is placed a layer of non-absorbent 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 should be done in from three to five days. Before removing the gauze and silk straps the dressing should be 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. This moist dressing should be continued and changed every second or third day until healing is complete.

Wound Disturbances the Result of Antiseptics.—Antiseptics are substances directly applied to the wound for the purpose of inhibiting the growth or destroying germs. Clinical experience in this regard is to be placed over that of the laboratory. However ideal a given antiseptic may be from a bacteriologic standpoint, it is upon the practical results following its clinical employment that our main reliance must be based. The value of an antiseptic depends, first, upon its power of destroying or inhibiting the growth of the 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.

We will limit ourselves to those antiseptics the value of which clinical experience has proved. Sternberg demonstrated that bacterial death was produced by bichlorid of mercury in 1:20,000 solution; potassium permanganate in 1:338; iodine in 1:500; 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 micro-organisms. Their inhibiting power was found to be: bichlorid of mercury, 1:30,000; iodine, 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 removed 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, such as aristol, airoil, iodol, nosophen, and others, 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 the 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. Nitric acid is still somewhat used in the treatment of chancroids, and 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 leukocytosis, 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 leukocytosis, 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 leukocytosis pro-

duced. Particularly is this true of carbolic acid. The area of the absorbable 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 iodine. Iodoform is particularly prone to produce unpleasant local effects. Judging from our own clinical experience, 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 to-day 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 micro-organisms, 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 hereto-

fore normal skin is rapidly reduced to a condition of moist eczema, and if the treatment is persevered in, gangrene may develop. Following its continual 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 sulphates are absent from the urine. The discoloration is apparent after the urine has been exposed for some time to light. The *treatment* consists in the 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. Atro-

pin 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 grave apprehension. 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 we limit the use of this antiseptic 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 iodine 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 has become narrowed, both on account of the local necrosing effect common to liquid 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. We employ it in the cases in which carbolic acid was formerly employed, and in our experience we have noted but one case in which it produced constitutional effects. With this, as with other antiseptics, local irritation may be set up if strong solutions are employed or if volatilization 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 is the point in differentiation between poisoning and erysipelas. A general erythema may appear. The treatment is to stop the drug and apply one or two 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 peritoneum 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 per-

sons 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.

The 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.

CHAPTER X.

WOUND DISTURBANCES THE RESULT OF PRESSURE.

Post-operative paralysis. Ischemic muscular paralysis. Decubitus. Disturbance of circulation: Prevention of venous return; thrombosis of the femoral vein; phlebitis of the internal saphenous vein. Air embolism. General complications of operations: Shock; delirium tremens; toxemia.

Post-operative Paralysis.—The occurrence of post-operative paralysis may be disclosed while the patient is recovering consciousness from the anesthetic, at which time the attendant may discover 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 such a dressing is changed. The reasons for these paralyses are numerous.

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 improper 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 an hereditary predisposition to mental disturbances. Some have post-operative amnesia, other delirium or mental confusion. They may resemble hystero-traumatic 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 paralyzes, 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-spiral 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 rest against the leg of a patient in the lithotomy position.

In these paralyzes 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 paralyzes 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 paralyzes 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 in dressings for fracture of the leg.

The vital necessity of using every care and precaution in guarding 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 paralyzes.

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 non-elastic 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 slightest 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 are 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 supuration may result in an extension of the original sore.

Treatment.—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 lanolin. In intractable cases the entire ulcer may be dissected out, including the floor and margins, and the resulting fresh wound skin-grafted.

Disturbances of Circulation.—*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. If untreated, septic emboli will be carried to the lungs and death may ensue either from septic

glycerin and amyl nitrite are contraindicated on account of the vasomotor dilatation which they produce.

Delirium tremens occurs as a complication following injury or operation in men the subject of chronic alcoholism. It more often occurs in whisky 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 failure or a complicating pneumonia may cause death. The mortality is as high as 50 per cent.

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 this. 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 will usually suffice to abort the attack (Warbasse). Whisky may be given by the mouth, being governed by the quantity to which the individual has been accustomed, one-third to one-half of this amount being given. Sudden abstinence in chronic alcoholics seems to favor the occurrence of delirium tremens. In such cases it is well to give some whisky during the entire course of the after-treatment. Capsicum and digitalis are useful. Chloral hydrate should be given for the insomnia. Should the case go on to delirium, opium should be employed and the patient should be 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.

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.

Treatment consists in thorough catharsis, the forcing of fluids, and general hygiene.

CHAPTER XI.

WOUNDS OF SPECIAL TISSUES.

Skin and subcutaneous tissues. Plastic operations. Complications occurring in scar-tissue. Tendon and muscle. Vascular system. Lymphatic system. Nervous system. Osseous system. Amputations and disarticulations.

Wounds of the Skin and Subcutaneous Tissues.—Such wounds usually heal in from five to ten days. Superficial skin wounds may heal in a shorter period. Wounds involving the entire thickness of the skin require seven to ten days to heal. The further process of *cicatrizacion* 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 the most painstaking asepsis 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 combated, 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 best exemplified in cases of post-operative hernia and in the broad scars on the chest following removal of extensive carcinoma mammæ.

It must be borne in mind that it is only the young cicatrix that is susceptible of stretching. 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 contracts 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 technique 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 the normal skin. If the grafts are not of uniform thickness or if they are not very closely applied, considerable cosmetic deformity will result.

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 therefor at the time of operation. If too small a flap is employed, and allow-

ance 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 imperilled, 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 must not be undertaken until 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, accomplishes 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 corrected 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 should be 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 less 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.—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. Negroes seem to be particularly susceptible to keloid. 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 effected 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* is rarely successful. Excision should not be attempted. Electrolysis (Hardaway), elastic pressure (Verneuil), and multiple scarifications followed by inunctions of mercurial ointment are recommended, but none of these in our hands have met with good results. Some few cases have been improved by multiple scarifications done every second day, mercurial ointment being rubbed into the incision on alternate days. Under any treatment months pass before any improvement is noted.

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 non-malignant disease. The disease is of the carcinomatous type, but save in case 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 con-

tribute through irritation to the occurrence 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 plausible 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.

Wounds of Tendon and Muscle.—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 allows of 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 dressings. 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. Absolute immobility during the early days of healing is essential to success.

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. If drainage has been employed this may be removed on the second to the fourth day, but the relation of the parts should not be

disturbed and the same care should be exercised in re-bandaging the parts.

Continuity, the first essential to success, has then been established. 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 non-elastic, and this may only be remedied by 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 the result will be doubtful. The tendon ends slough and direct union fails. The large amount of cicatricial tissue thrown out to 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 diffi-

cult to remedy. Tenosynovitis due to infection may take place and extensive sloughing of the tendon ensue.

Muscle suture is similar to tendon suture. 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. Early voluntary movements should be encouraged.

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. We should strive to preserve the function of the muscle we divide. We wish only to artificially increase its length. To obviate the danger of non-union, 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.

Tuberculous Teno-synovitis.—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.

Wounds of 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 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 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. It is to be remembered that the packing used in the control of hemorrhage differs from that used for purposes of drainage in that the former is very tightly packed, while the latter is but loosely packed.

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 ligature of the femoral, axillary, or subclavian, 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. Each case must be judged by itself. 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.

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 re-establishing 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. The parts should be enveloped in cotton and kept warm. The heart action should be stimulated. Absolute rest 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.

In *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 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. Such cases occur in the femoral and saphenous vein after laparotomy. 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. Absolute rest must be enforced for several weeks. The blood-pressure should be kept low.

Wounds of the Lymphatic System.—*Lymphorrhoea* 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. 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 a lymphedema 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. Lymphorrhœa may complicate compound fractures.

Injuries of the Thoracic Duct.—This is shown by a copious flow of milky fluid from the wound. This flow is increased during the process of digestion. It coagulates spontaneously when exposed to the air. If food is withheld the fluid will become clear. The 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 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).

Wounds of the Nervous System.—*Wounds of Peripheral Nerves.*—*Nerve Resection.*—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 be such that there is no tension on the united nerve. Galvanism and faradism with massage should be employed early 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 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 fibroma 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.

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 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.

Wounds of the Osseous System.—The after-treatment of operations upon the osseous system is often more important than the operation itself.

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, 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. In the case of the Schede clot, however, the clot often breaks down, and it becomes necessary to open the wound, cleanse and pack it. In cavities treated by the open method the packing should be renewed every six to eight days, each time a smaller packing being used. 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.

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.

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. The general health should be improved. Ununited fractures require operation and subsequent orthopedic treatment. Union with deformity should be treated by refracture.

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 technique employed.

In *accident 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 to be left unsutured 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 pre-

vent 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. In other cases no splint is necessary. 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 efficiently 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 it is our practice to leave the tourniquet 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 very persistent oozing upon the final removal of the tourniquet.

There remain two other classes of cases in which no primary suturing should be 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 con-

dition 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.

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 in order to place the parts in as healthy a condition as possible. 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 curette may be employed with advantage. 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.

Primary suturing 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 admit of 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 seventh or eighth day. At this time the skin sutures may be removed. It may have been necessary to change the outer dressing on the first or second day on account of oozing.

Drainage in cases treated openly has been sufficiently discussed. In cases sutured primarily it is, as a rule, unnecessary to employ drainage, the space between the sutures being usually sufficient to allow of the escape of serum. Should an extraordinary amount of oozing be expected, due to the great vascularity of the parts, it is well to provide for its escape by placing a small gauze drainage strip in the depths of the wound extending from one angle of the wound to the opposite angle. This may be removed on the third or fourth day and the wound re-dressed without drainage.

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 skilful 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.

Bandaging of the stump should be done 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 thoroughly massaged.

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 skilful

technique 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). It has been our own practice to plug the medullary cavity of the larger bones with an appropriately shaped piece of bone taken from the amputated portion. This is driven tightly into the medullary canal for a space of an inch, and one-quarter of an inch left projecting beyond the sawed end of the bone.

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 before the atrophy of the muscles has progressed as much as it is liable to. 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.

CHAPTER XII.
INSTRUMENTS.

I. Articles Required for All Operations.

- Ligature catgut, medium and fine.
- Chromic catgut, medium and fine.
- Silk, medium and fine.
- Silkworm-gut.
- Straight, sharp-pointed scissors.
- Long, straight, spear-pointed needle.
- Medium-sized, curved, cutting-edge needle.
- Soft rubber male catheter, No. 15 F.
- Glass female catheter.
- 2 irrigators, nozzles, tubing, various sized glass connections.
- Safety-pins.
- Basin for specimens.
- Probe.

II. Operations upon the Scalp (preparatory to trephining and for operations upon the soft parts).

- 2 protectors.
- 6 towels.
- Junker apparatus.
- 1 three-foot length of small-sized rubber tubing (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 non-absorbent 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.
- Saline irrigation (to keep operative field clear).
- 2 craniectomy forceps.
- 1 rongeur forceps.
- 1 set large chisels.
- 1 mallet.
- 1 aspirating syringe and needle.
- Basin of saline solution, 100° F. (for temporarily removed bone).
- 1 telephonic brain probe.
- 1 small, narrow-bladed scalpel.
- 2 pairs mouse-tooth forceps.
- 2 small, full-curved, cutting-edge needles (threaded with fine catgut, for suturing dura).
- 1 needle holder.
- Green silk protective (for drains).
- 2 three-inch plaster-of-Paris bandages, salt solution, and additional plaster.

IV. Excision of the Trigeminal (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.

- 2 protectors.
- 6 towels.

Junker's apparatus.

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.

1 medium-sized, full-curved, cutting-edge needle
(threaded with silk for tongue suture).

4 gauze compresses.

1 twelve-inch square of non-absorbent 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 protectors.
- 6 towels.
- 2 scalpels.
- 2 blunt hook retractors.
- 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.
- Boro-salicylic 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 non-absorbent cotton.
- 2 three-inch gauze bandages.

VIII. Harelip.

- 2 protectors.
- 6 towels.
- 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 needle holder.
- 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.

- 2 protectors.
- 6 towels.
- 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-bladed 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. Tonsillotomy.

- 1 large protector.
- 6 towels.
- 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 large protector.
- 6 towels.
- 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 large protector.
- 6 towels.
- 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.

2 protectors.

6 towels.

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.

1 needle holder.

20 small stick sponges.

6 stick sponge holders.

XIV. Cervical Adenectomy.

1 small flat sand-bag (placed under the shoulders to extend the neck).

- 2 protectors.
- 6 towels.
- 2 scalpels (dissecting handles).
- 24 Kocher clamps.
- 12 pointed artery clamps.
- 2 pairs anatomic forceps.
- 2 pairs curved-on-the-flat and blunt-pointed scissors.
- 2 small, smooth retractors.
- 2 blunt hook retractors.
- 2 Volkmann sharp spoons.
- 1 needle holder.
- 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 holders.
- 50 stick sponges.
- 6 gauze compresses (shaken out).
- 2 one-inch zinc-oxid strips (in drainage cases).
- 2 four-inch fenestrated rubber tubes (in drainage cases).
- 2 twelve-inch squares of non-absorbent cotton.
- 3 three-inch gauze bandages.
- 2 three-inch plaster-of-Paris bandages (in children).
- XV. Goiter** (in addition to List XIV).
 - 4 aneurysm needles (threaded with medium-sized catgut).
 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 sand-bag.
- 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 non-absorbent cotton.
- 1 breast binder.
- 1 three-inch Canton-flannel bandage.
- 12 safety-pins.

XIX. Empyema (resection of rib).

- 1 flat sand-bag.
- 2 protectors.
- 6 towels.
- 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.
- 12 safety-pins.

ABDOMINAL OPERATIONS.

XX. Accessories (extra-abdominal).

- 1 laparotomy sheet or two protectors.
- 12 towels.
- 4 safety-pins.

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 (intra-abdominal)

- 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 basin of hot bichlorid.
- 1 basin of hot saline.
- Towels, towel wringer, and pitcher of hot saline.

XXIV. Articles Required in Drainage Cases.

- 1 quart 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 scissors (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 purse-string 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 needle forceps.

1 long, straight, spear-pointed needle (for subcuticular suture) (threaded with linen thread or silk).

10 rubber bolsters.

- 1 one-inch zinc oxid 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 meso-appendix).
- 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 stumps.

(B) Appendectomy in the interval, as above except List XXIV.

XXVIII. Oophorectomy, Salpingo-oophorectomy (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 XXVII).

Saline infusion (List LXXXII).

1 large Chamberlain douche nozzle.

1 one-gallon pitcher.

Saline solution, 110° F., 4 gallons.

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 (for omentum).
- 2 medium-sized, half-curved, round needles (threaded with fine catgut loop sutures, for omentum).
- 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).

- 12 medium-sized, full-curved, round needles (threaded with paraffin silk, 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).
- 6 Kocher clamps.
- 1 medium-sized, half-curved, round needle (threaded with fine chromic gut loop suture, for over-casting 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 pronged grasping forceps.
- 6 medium-sized, full-curved, cutting-edge needles (threaded with chromic gut, to secure drainage tube to gall-bladder).
- 1 eight-inch rubber tube, three-fourths-inch diameter.
- 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 one-inch zinc oxid gauze strip (to pack around tube).
- 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. Cæsarean 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.

Chamberlain douche nozzle.

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 non-absorbent 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 curet (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 oöphorectomy).

4 braided catgut ligatures (for oöphorectomy).

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 laparotomy sheet or 2 large protectors.
- 6 towels.
- 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).
- 3 six-inch squares of lint with slit in center just large enough to allow of glans being forced through (to hold back foreskin).
- $\frac{1}{2}$ ounce of melted zinc oxid ointment (not hot enough to burn; to pour between layers of lint; this hardens and keeps the dressing from slipping).
- 1 square of oiled silk protective, slit in center (to protect dressing).

- 1 three-inch gauze bandage (double spica of groin).
- 12 hand sponges.

LVI. Varicocele.

- 1 laparotomy sheet or 2 protectors.
- 6 towels.
- 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 laparotomy sheet or 2 protectors.
- 6 towels.
- 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).

- 1 laparotomy sheet or two large protectors.
- 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.

- 1 laparotomy sheet or 2 large protectors.
- 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 bass-wood 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.
- 3 towels.
- 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).

1 urethral divulsor.

1 rubber retractor and piston syringe (Parker Syms).

2 prostatic retractors.

2 three-prong, blunt-pointed volsellum forceps.

LXIV. Suprapubic Cystotomy.

- 1 laparotomy sheet or 2 large protectors.
- 6 towels.
- 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 needle holder.
- 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 large protectors.
- 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).
- 1 needle holder.
- 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.

6 towels.

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 (see List LX).
- 6 stick sponge holders.
- 30 stick sponges.
- 1 2-grain opium suppository.
- 1 1-grain iodoform 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.
- 6 towels.
- 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 trans-
fixing 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.
- 1 1-grain iodoform suppository.
- Vaseline for anointing suppositories.
- 1 Kelsey hemorrhoid clamp (in simple cautery oper-
ations).
- 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 large protectors.
- 6 towels.
- 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 needle holder.
- 1 large, curved, cutting-edge needle (threaded with
chromic gut or kangaroo tendon for circum-
suture of rectum).
- 6 medium-sized, half-curved, cutting-edge needles
(threaded with chromic gut or kangaroo ten-
don, 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.
- 6 towels.
- 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, bass-wood in wrist cases, Volk-
mann in knee and ankle cases).
- Plaster-of-Paris bandages, salt solution, and addi-
tional plaster.

LXXVI. Amputation.

- 1 large sheet.
- 2 small protectors.
- Foot or hand bags.
- 6 towels.
- 1 rubber bandage.
- 1 Esmarch constrictor.
- Wyeth's pins, corks, and three-foot-length of rub-
ber 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.
- Bass-wood 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.

- 2 large protectors.
- 6 towels.

- 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.

- 2 large protectors.
- 6 towels.

- 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).
- Sand-bags.
- 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 bass-wood 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.

- 6 towels.

- 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.

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