TEXTBOOK

OF

SURGICAL NURSING

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TEXTBOOK OF SURGICAL NURSING

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DEDICATED

IN RESPECTFUL TRIBUTE

TO THE

COURAGEOUS AND DEVOTED NURSES

WHO SACRIFICED THEIR LIVES

TO THE

CAUSE OF SUFFERING HUMANITY

IN THE GREAT WAR

PREFACE

THE authors have endeavored to present as accurately and as simply as possible for the pupil nurse the actual detailed nursing of the various conditions related to things surgical. The various procedures are based on the technic employed in hospitals throughout the country, and therefore the book will be found useful as a text in training schools generally without regard to local conditions. It presupposes a thorough knowledge of the elements of practical nursing. The fundamental treatments, as a rule, have been carefully learned in the probationary periods, but a thorough understanding of the underlying principles of surgery and the necessary surgical nursing are often wanting.

While it is true that all orders are given by the surgeon, and executed with dispatch and accuracy by the nurse, the time has passed when the nurse was a mere automaton. She must know the ante- and post-operative care required for all the patients coming under her supervision. The complete management of an operating room, as well as the conversion of a private home into a suitable place for surgical procedures, should be thoroughly understood, and an operation by name, be it "glossectomy," "thyroidectomy," or "choledochotomy," etc., should immediately summon to mind the condition and the technic involved. The nurse should be well acquainted with the recent surgical developments of the World War, such as the Carrel-Dakin method of wound disinfection, the ambrine treatment for burns, and the suspension treatment for fractures, since her aid is essential for their proper accomplishment.

The chapter dealing with Surgical Dietetics has been based, in the main, on the diet lists used by the Presbyterian Hospital, New York. We are indebted, for the photomicrographs, to the Surgical Department of Columbia University, and for some of the pictures to the "Manual of Splints and Appliances, Medical Department, United States Army."

The authors wish to express their appreciation and thanks to Miss F. Evelyn Carling, Assistant Superintendent of Nurses, St. Luke's Hospital, New York, for her advice and many suggestions, and to Mrs. Ralph Colp, and Mrs. Amy P. Phillips for their keen interest and invaluable assistance in the preparation of this volume.

INTRODUCTION AND HISTORY

SURGERY is as old as human needs. There have always been bleeding wounds and broken limbs, and human ingenuity has always endeavored more or less successfully to relieve the suffering so occasioned. In ancient times, the supposedly supernatural secrets of the healing art were zealously guarded from the laity, and not till the Greek Hippocrates in 460 B.C. wrote his surgical treatises did surgery pass from mysticism to science. So keen were the observations of Hippocrates that some enthusiasts claim that his two works on fractures and dislocations are in many respects unsurpassed even to-day. And until as recently as four centuries ago very little was added to the storehouse of surgical knowledge.

During the early Christian era and the Middle Ages, surgery was practised by many different classes of society, by friars and barbers, by monks and nuns, by the famous Arabian court physicians, and by ladies of noble birth. The universities from the very beginning prohibited research of any kind and demanded that every procedure be justified by the authority of Galen. Now and then solitary thinkers tried to find out things for themselves by observation and reflection. The great occupation of the majority of the people was warfare and much of the little progress in surgical knowledge owed its inspiration to the necessities of war. But even to aid the king's armies the new truths learned by experience and observation were discountenanced by the faculties of the universities. In spite of this opposition, by the fifteenth and sixteenth centuries there was a widespread awakening of the free scientific spirit. It manifested itself in the forming of groups to study and experiment in physics, chemistry, anatomy and physiology. Tremendous progress was made in all the sciences. Harvey discovered the circulation of the blood, the microscope came into use, and Fahrenheit invented the thermometer. "Western Europe broke out into a galaxy of names that outshine the utmost scientific reputations of the best age of Greece," says H. G. Wells; and of these Vesalius and Fallopius, the anatomists, are especially honored by surgeons of to-day.

By the eighteenth century, private dissecting rooms and anatomical laboratories were flourishing. However, the surgeons themselves of this period neither helped nor shared in this great advancement of science. The barber-surgeons were an untutored lot, ready to make use of a few tricks of the trade for practical gain. The task remained to place the practice of surgery on a high plane, and this was one of the many good deeds which make the name of John Hunter shine out in the history of surgery. "More than any other man he helped to make us gentlemen," a contemporary said of him. Through the efforts of Dr. Hunter, the already existing companies of barber-surgeons were forced to study anatomy, comparative anatomy and physiology, and thus the surgical profession by the right of hard and regulated study began to take rank with the high order of scientists. Public museums of anatomy and physiology were founded; the method of clinical teaching was adopted; and in the beginning of the nineteenth century the day of painless operation had come with the discovery of anesthesia.

Still the surgeon was held in disrepute. The dark ages when investigation was forbidden were passed; all the sciences aided the surgeon; he progressed with the great advance in anatomy, physiology and pathology. And yet, the hospitals where he operated were considered houses of certain death. An operation was in truth a sad affair. No matter how great the technical skill of the surgeon, patients, more often than not, died of blood poisoning. Now and then a wound did heal without the formation of pus, but both spontaneous and operative wounds almost invariably became infected, with death as the result. So common was this, particularly in hospitals, that many surgeons feared to operate at all. The term "hospitalism" was coined by Sir James Y. Simpson, who collected statistics proving that private patients were far less liable to succumb from operation than those treated in hospitals.

With the advent of Lister came "a light that brightens more and more as the years give us ever fuller knowledge," as Sir William Osler has said. It was to the researches of Pasteur, the great French scientist, that Lister owed his inspiration. One of the first practical results of Pasteur's studies on fermentation and spontaneous generation was a great transformation in the practice and results of surgery. It is not too much to claim this as one of the greatest boons ever conferred on humanity. Let us quote from Lister's paper on the subject which appeared in the London *Lancet,* 1867.

"Turning now to the question of how the atmosphere produces decomposition of organic substances, we find that a flood of light has been thrown upon this most important subject by the researches of Pasteur, who has demonstrated by thoroughly convincing evidence that it is not to its oxygen or to any of its gaseous constituents that the air owes this property, but to minute particles suspended in it which are the germs of various low forms of life long since revealed by the microscope and regarded as merely accidental concomitants of putrescence, but now shown by Pasteur to be its essential cause, resolving the complex organic compounds into substances of simpler chemical constitution, just as the yeast plant converts sugar into alcohol and carbonic acid."

From Lister's work modern surgery takes its rise and the whole subject of wound infection, not only in relation to surgical diseases but also to childbed or puerperal fever now forms one of the most brilliant chapters in the history of Preventive Medicine. So great have been the results of Lister's work that it is indeed almost difficult from our fortunate position of to-day to glimpse the sad position of the surgeons of his time. In present-day hospitals surgical infection and puerperal fevers are almost things of the past, and for these achievements alone the names of Louis Pasteur and Joseph Lister will go down to posterity as among the greatest benefactors of humanity.

Lister's work was the beginning of antiseptic surgery. Surgeons at last learned to combat with a strong antiseptic the germs which exist in the air, the wound, the room, the surgeon's hands, his instruments. The black-robed, professorial-looking surgeon of earlier times was succeeded by a surgeon clothed in immaculate white. For an operation in the true Listerian style, the part to be operated on was first of all enveloped two hours before the operation in a towel soaked in carbolic acid, to destroy the germs present in the skin. Instruments and sponges lay for a half hour in a flat porcelain dish of carbolic acid. Towels soaked in this solution covered the tables and blankets near the part to be operated on. The hands of the surgeons and nurses were thoroughly washed in the same solution. The operation itself was performed under a cloud of carbolized vapor from a steam spray producer. Then a strip of oiled silk, coated with carbolized dextrin and further washed in carbolic lotion, was placed over the wound and over this was applied a double ply of carbolic soaked gauze, covered with eight layers of dry gauze. Finally came a thin mackintosh cloth, and this whole apparatus was covered with a gauze bandage. The mackintosh cloth served to prevent the carbolic acid from escaping and at the same time permitted the discharge from the wound to spread through the gauze. The vapor given off by the carbolic gauze shielded the wound and the surrounding parts from septic contamination. These conditions were very strictly maintained until the wound was healed.

All these cumbersome and complicated measures may seem a bit unnecessary to us; especially may we sigh when we reflect that the use of carbolic acid made Lister's hands red and raw. Some surgeons produced excellent results by methods of strict cleanliness without following the whole Listerian technic. Gradually, Lister himself gave up most of these measures, much to the advantage of the patient, for that same carbolic acid which so effectively destroyed pathogenic bacteria in and about a wound, also invariably injured the exposed tissues. The great achievement of Lister was not the spray and gauze method but the conclusive proof that cleanliness is the most essential factor in successful operating.

To the antiseptic surgeon of 1867 has succeeded the aseptic surgeon of to-day. The aseptic surgeon uses steam and hot water to sterilize all materials in the operative procedure, and not only does he carefully scrub his hands, but he also renders them absolutely germ-proof by wearing rubber gloves which have been previously sterilized by boiling water and steam. Such is the simple aseptic method which has been gradually evolved from the Listerian antiseptic system. The spray producer has almost passed into oblivion but the spirit of Lister's teachings—scientific cleanliness—still guides the surgeon's work.

In the World War aseptic surgery proved of little avail, because almost all wounds were contaminated and filled with pus. The wound of the battlefield is not similar to the operative wound of the civilian hospital. Even with the utmost efficiency, before those wounded in modern warfare can be conveyed to the nearest surgical station much time will have elapsed with ample opportunity for contamination. To deal with these conditions, the antiseptic method was revived. This time, however, the strong carbolic acid of Listerian fame was replaced by an agent harmless to the tissues, the Carrel-Dakin Solution. This solution is not merely one of historical interest, but widely used by surgeons of to-day for a certain type of wound, and it will be discussed in detail in Chapter XIX.

To-day the vision of surgery is glorious. The surgeon is everywhere recognized as an indispensable worker in the community. The growth of a highly competent, scientifically trained nursing staff has more than doubled the good results of his work. Nurses have indeed existed from earliest Christian times; they have either been gentle, noble-minded Sisters of Mercy in the convents, or uneducated, inefficient maids in hospitals. Neither of these classes was what could be called trained or educated according to the present view of what training and education should be for a nurse. The first training-school for nurses was established as recently as 1836. This little school at Kaiserswerth, Germany, is the mother of the present system; within its walls Florence Nightingale acquired her practical knowledge of nursing in a few months' time. Miss Nightingale was a woman of genius and vision. During the Crimean War the London *Times* roused British public opinion by its vivid account of the terrible conditions in the military hospitals of the war zone, and Miss Nightingale set out for that region with a staff of trained nurses to superintend the care for the sick and wounded. What she actually accomplished was of greater importance to humanity than nursing individual soldiers stricken in the Crimea. She applied the principles of hygiene to hospital administration and brought light, cleanliness and order out of indescribable chaos and misery. The "lady with the lamp" at Scutari showed what a hospital should be and what scientific nursing should mean. Although her work in the Crimea was done more than a score of years before Lister's revolution in surgery, Miss Nightingale's revolution in hospital building, administration and management was based on the Listerian idea of scientific cleanliness. And out of her work in the Crimea arose trained nursing on a large scale. In 1860 the modern hospital school system was inaugurated by her in Great Britain at St. Thomas's Hospital, London. The dignity of the nursing profession has thus been raised; it has become a calling for superior women, with the recognition of the need for a rigid education and training before the nurse can call herself a "graduate." Just as surgeons were made "gentlemen" by the work of John Hunter, so nurses through the efforts of Florence Nightingale were made "ladies," and their profession put on a very high plane of social usefulness.

In the same decade that the Nightingale Fund School was founded at St. Thomas's, Lister's great work was given to the world. That is, the rise of modern surgery is contemporaneous with the beginning of a careful, trained nursing body. This is more than an historical coincidence, for since that time the increasing demands of medical and surgical knowledge have well nigh revolutionized the nursing craft. To-day the surgeon in the operating room of the hospital, or in the private home has come to rely absolutely on a highly educated and trained nurse. To her he leaves the preparation of supplies, the preparation of the operating room and instruments, and the preparation of the patient; she even assists the surgeon in the operation itself in many ways. And finally, most of the after care of the patient is left entirely to the nurse. It is a great need that the nurse fills, a need that will grow with her capacity to fill a greater sphere. She is the Handmaid of Surgery and must live up to that high social calling by being well prepared; she must be so educated and trained that she will not be a mere automatic tool, but an intelligent, enthusiastic co-worker, filled with a zeal for science, and giving her whole mind and heart to the work that is before her—for only recently in the history of surgery is there scientific surgical nursing. The surgical nurse is a pioneer; the trail has been blazed; but it is still a new one, and she must show what she can do.

LIST OF ILLUSTRATIONS

CHAPTER I

PATHOLOGY

THE surgical field may be divided into those conditions which are due to inflammation, injuries, congenital deformities, and new growths. Into these arbitrary four great divisions all modern surgical intervention falls. And since all surgical intervention is to a greater or lesser degree supplemented by surgical nursing, a thorough and intelligent understanding of the underlying pathological conditions is essential. Perhaps the most common field is that of inflammation.

Inflammation.—Inflammation, according to Grawitz, may be said to be the reaction of irritated damaged tissues which still retain vitality. The damaging element may be one of several; it may be physical, such as a cut from a knife, a bruise from a stone, or a contusion from a flying timber. It may be chemical, such as a burn with acid, such as nitric, or from caustic alkali. It may be electrical, resulting from touching a "live" wire; or thermal, such as a burn from fire, or a frost bite from the cold; or it may be bacteriological. The last mentioned is especially important for it results in wound infection. These five agents then are the exciting factors of an inflammatory reaction; they have in some way injured or destroyed the unit structure of the body, the cell, and in order to carry off the dead and dying cells, to replace them, and rebuild the damage done, the process of inflammation must ensue.

What is the process of inflammation? The following, in a brief way, will illustrate what happens grossly, and what occurs if the process were to be studied underneath the microscope:

If a finger is cut, it bleeds. The amount of blood lost is dependent upon the size of the vessel cut. In time, due to clotting, the bleeding ceases and within a few hours the surrounding skin may become red, perhaps slightly swollen, and if it is carefully observed as to temperature, it might be somewhat warmer than the adjacent skin. The wound is said to be inflamed. If this process were examined in sections beneath a microscope, a very interesting and thoroughly instructive picture would be seen, depending upon the time when the section was taken. Within a short period after the original injury, there would be along the line of the original incision a clot of blood, and adjacent to it some dead cells. (Fig. 1.) Already, the products of these dead cells would have stimulated a greater blood flow to the part, resulting in a dilatation of blood vessels and capillaries, and an infiltration of the tissues with white blood cells, red blood cells, and serum. Naturally, it is this that makes the part swollen, red and warm. And as these inflammatory products cause an increased pressure on the nerves the wound will become painful in direct proportion to the exudation. It has already been noted that cells have been destroyed. Dead tissue is of no use to the organism. It must be removed, and the white blood cells carry off the destroyed tissue. It is a known fact that when cells are injured, some which were but slightly traumatized are actually stimulated to growth, and these cells (fibroblasts) immediately begin to reproduce and grow into the blood clot along the fibrin strands (Fig. 2) in an attempt to bridge in the gap caused by the destruction of the cells killed by the knife. In small wounds this is barely visible to the naked eye, but in wounds in which a definite area of tissue has been destroyed, or wounds with definite loss of substance, this new growth of cells together with a new growth of blood vessels is known as granulation tissue. (Fig. 3.) Wounds which are sutured and clean heal with the minimum amount of granulation tissue and simulate small cuts of the finger. This is spoken of as healing by *primary intention.* Wounds in which there is a loss of tissue from one cause or another heal by *secondary intention,* filling in the space with granulation tissue. This is the process of healing which takes place in every wound. It is fundamentally the same in all clean wounds, whether a cut of the finger, the healing of a cyst enucleation, or an incision of the abdomen as a laparotomy.

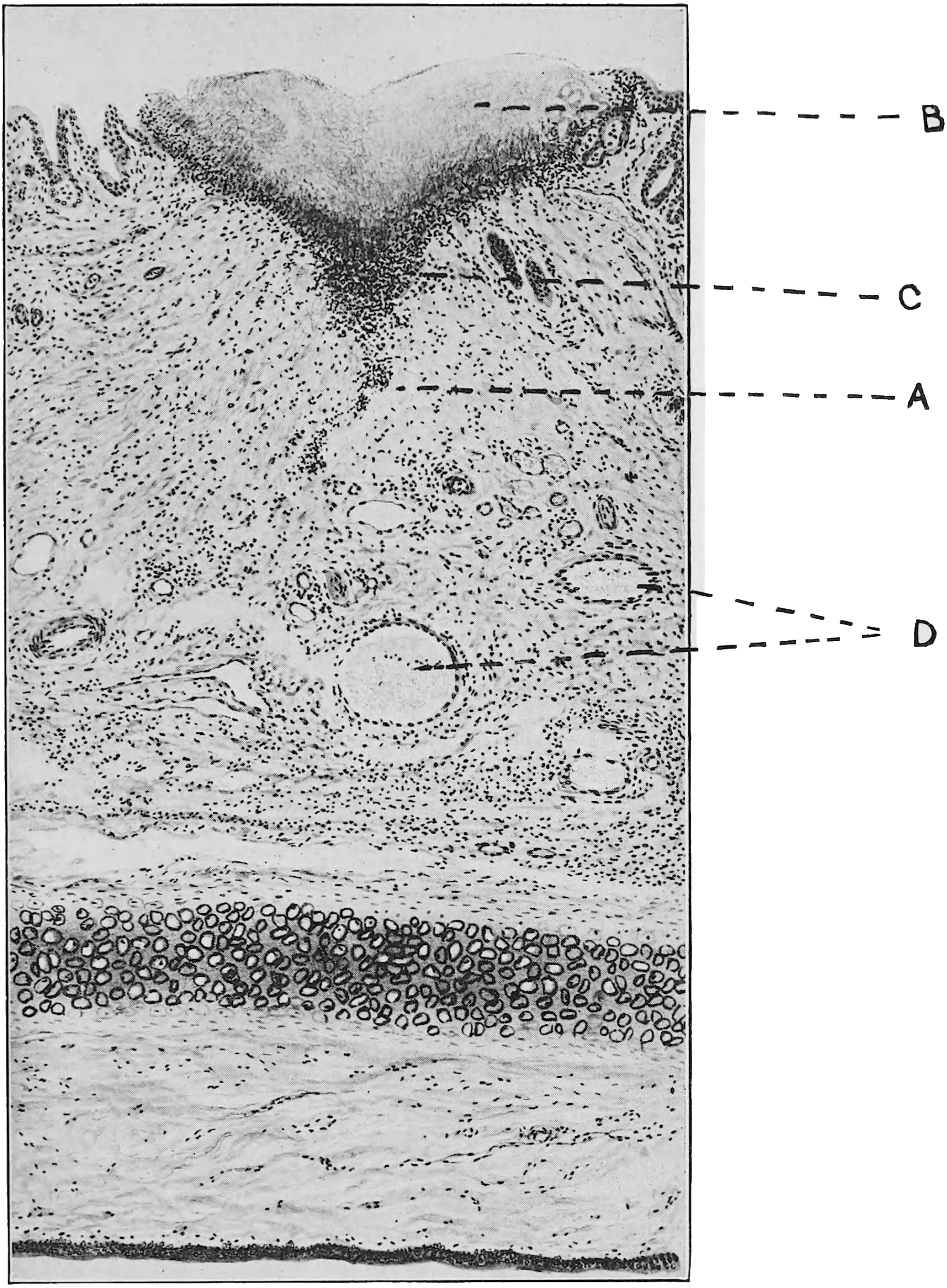


FIG. 1.—MICROSCOPIC DRAWING OF INCISED WOUND 24 HOURS OLD. *A*, line of incision; *B*, blood clot; *C*, cellular infiltration; *D*, relative dilatation of blood vessels. Published by permission of the Department of Surgery, Columbia University.

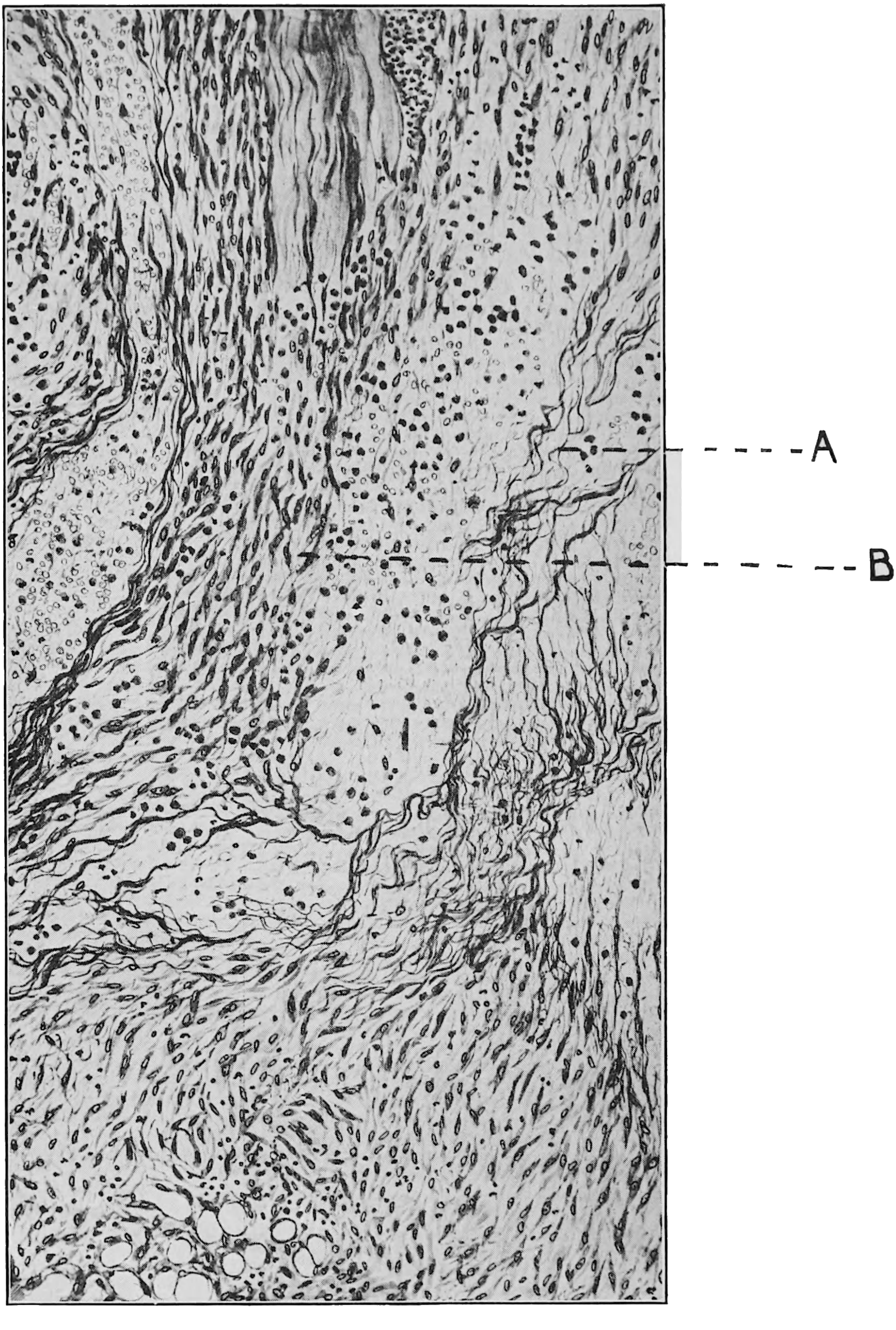


FIG. 2.—MICROSCOPIC DRAWING ILLUSTRATING THE GROWTH OF FIBROBLASTS ALONG FIBRIN STRANDS OF THE BLOOD CLOT. *A*, fibrin strands; *B*, fibroblasts. Published by permission of the Department of Surgery, Columbia University.

The process is slightly different, however, when the wound becomes contaminated by bacteria of the pathological variety.

In a clean wound the minimum amount of damage is done

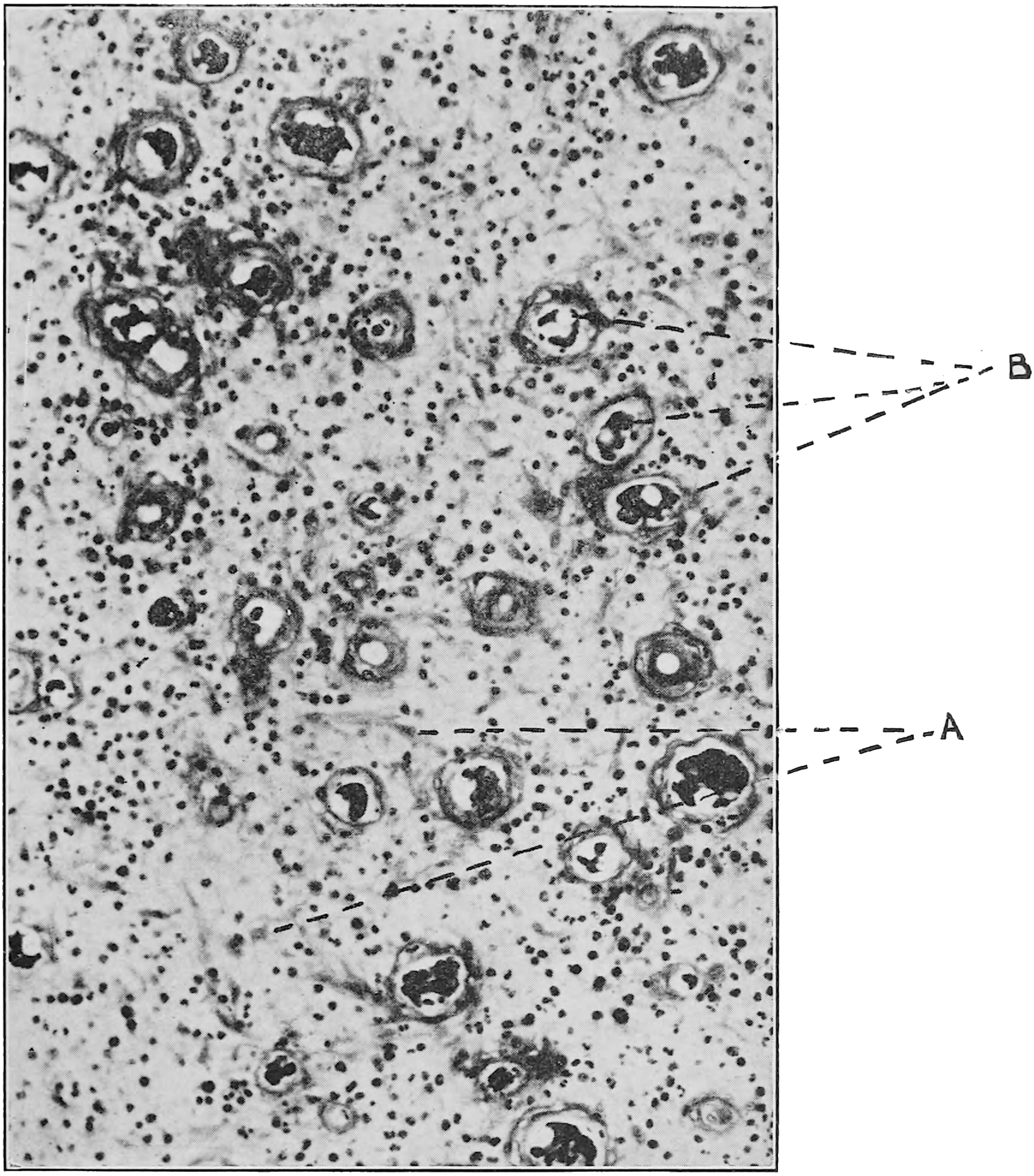


FIG. 3.—MICROSCOPIC DRAWING OF GRANULATION TISSUE. *A,* fibroblasts; *B,* newly formed blood vessels. Published by permission of the Department of Surgery, Columbia University.

because the only cells destroyed are those which have been killed by the knife of the surgeon. But if this knife were not properly sterilized and were laden with bacteria, the result would be an *infected wound* (Fig. 4), and the outcome would

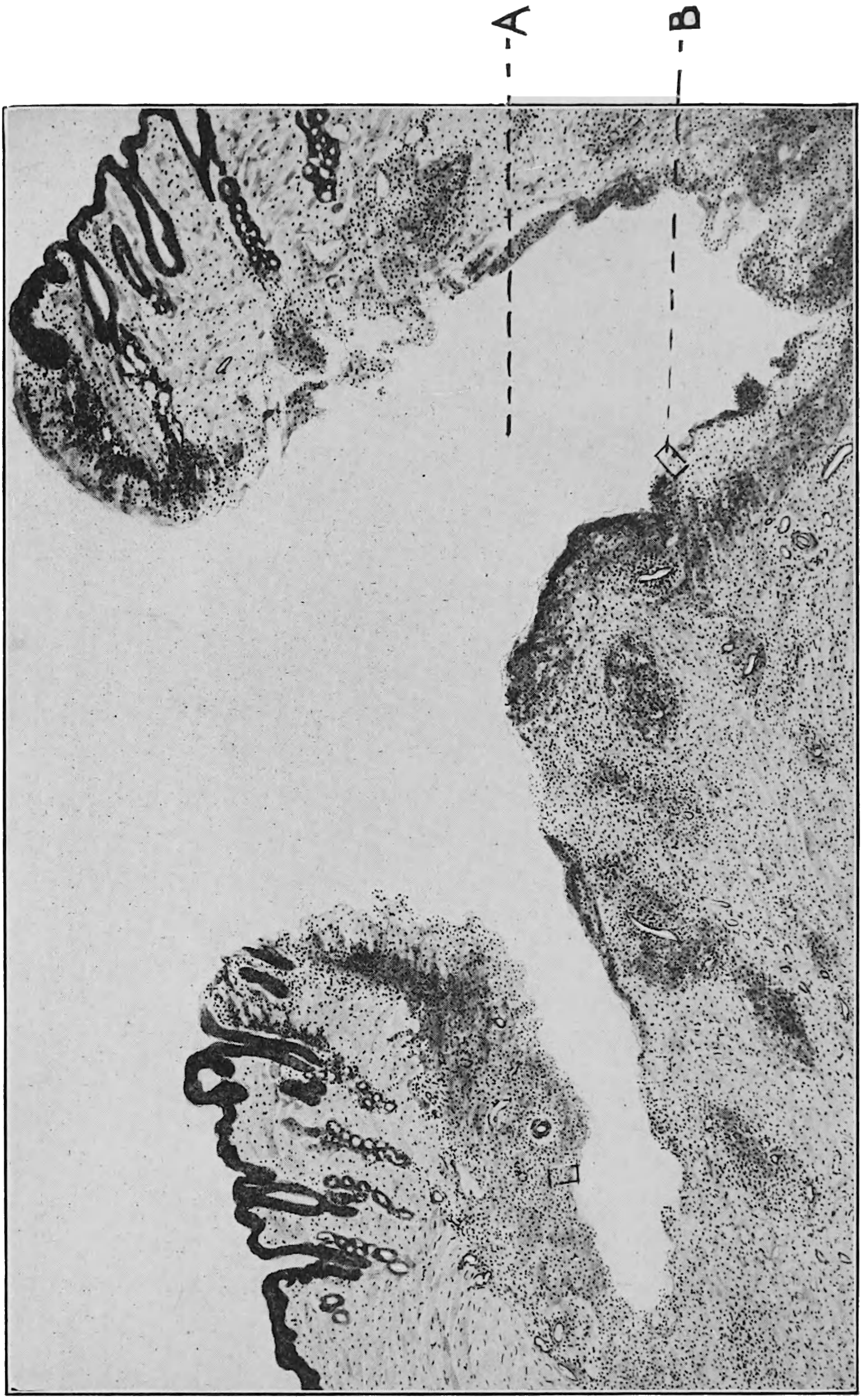


FIG. 4[1].—MICROSCOPIC DRAWING OF AN INFECTED WOUND. *A*, infected wound; *B*, surface granulation tissue.

be dependent upon the resistance of the individual infected, and the severity of the infecting organisms. These bacteria destroy cells in the same way as a knife. And, because of their irritating properties, and their attempts to invade and destroy the body, Nature summons the white blood cells (phagocytes) (called by Metchnikoff the "policemen of the blood") to arrest the onslaughts of the invading foes. These white blood cells attempt to destroy bacteria. If they are successful, the bacteria remain local in position, an abscess is formed (Fig. 5) and the evidences of the combat are found by the appearance of pus in the wound. *Pus* is composed of living and dead bacteria, living and dead white blood cells. Naturally, in such a process, more tissue will be destroyed than in a clean wound.

A wound in which there is pus is spoken of as a *suppurating wound,* and the process is known as suppuration. When tissue has been destroyed by the bacteria and the individual has been fortunate enough to cause the process to remain localized, the dead tissue will fall off from the living; the line formed between the living and dead tissue is called a *line of demarcation.* This dead tissue is spoken of as slough and very often it may be seen lying in a wound as strands of yellow greenish débris. In those instances where the amount of tissue, for one reason or another, is as large as a toe or an entire extremity the process is known as *gangrene* or mortification.

If the individual through some constitutional inferiority has been unable to localize the bacteria, their poisons may be absorbed into the blood vessels directly. The patient then becomes toxic, and the condition is known as *toxemia.* If not only the toxins of the bacteria, but the actual bacteria themselves are absorbed, a sepsis, *septicemia,* or bacteremia results. The laity call this "blood poisoning."

If the pus itself, or collections of bacteria, should localize in different parts of the body and form smaller or secondary abscesses, either in the skin or other organs, the condition is known as *pyemia.* Sepsis and pyemia are indeed serious complications, for they often spell death to the patient. If they follow in the path of clean operations they are due to carelessness on the part of the surgeon or the nurse. They are a

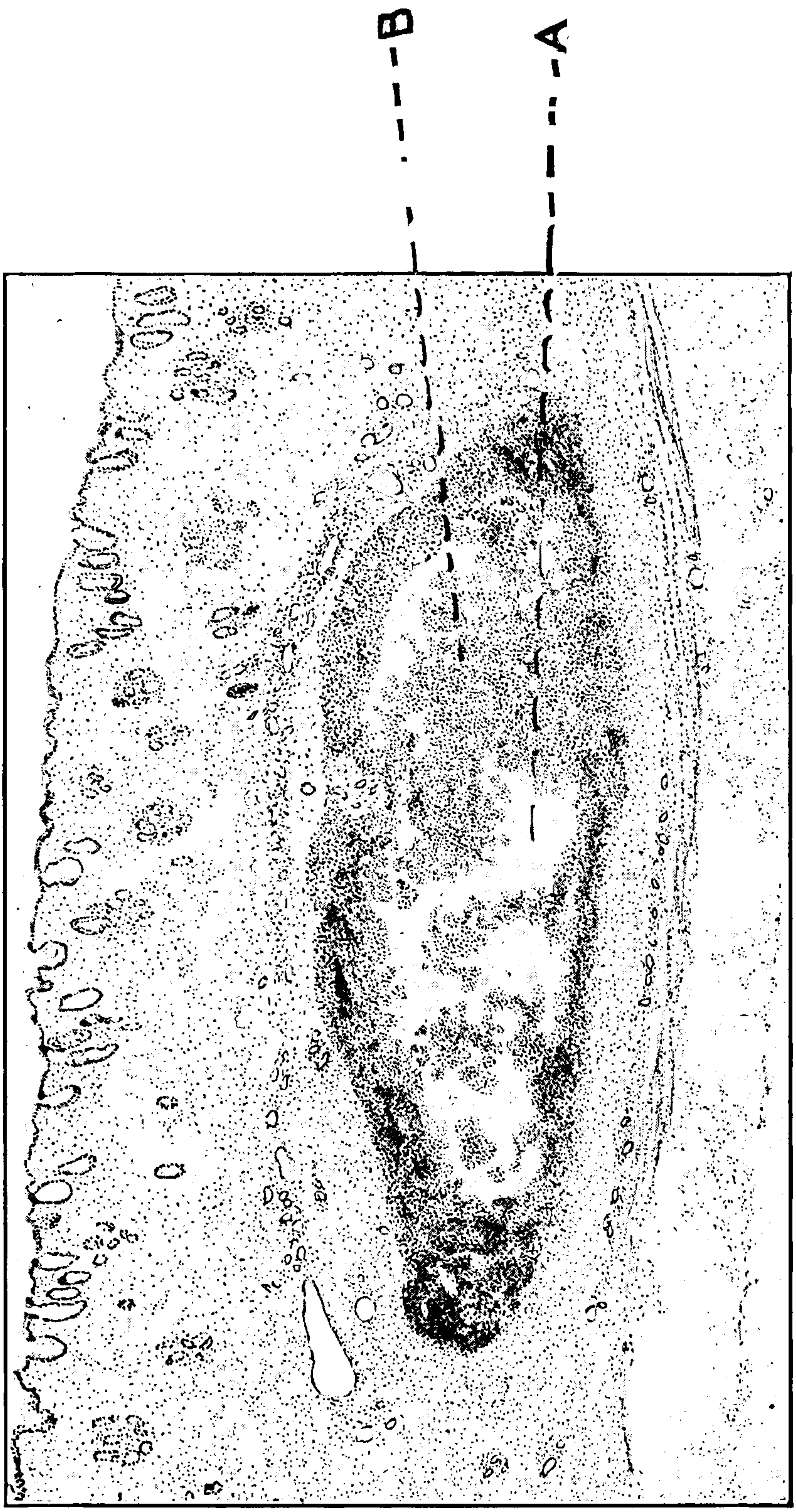


FIG. 5.—MICROSCOPIC DRAWING OF A DEEP ABSCESS. *A*, abscess cavity; *B*, pus. Published by permission of the Department of Surgery, Columbia University.

blot on the scalpel of aseptic surgery. It means that certain bacteria entered the wound either before, during, or after operation. The bacteria which cause wound infections are numerous and varied. A classification of these organisms is herewith given:

Bacteria are of two classes:—saprophytes, those which live on dead organic matter, and parasites, which derive their nourishment from living bodies. The latter class produce the pathogenic or disease bacteria: these are either cocci or bacilli. The various common cocci may be divided into staphylococci, streptococci, pneumococci, meningococci, gonococci; the bacilli, into the bacillus coli communis, bacillus typhosus, bacillus paratyphosus and bacillus pyocyaneus. These are the germs which are concerned in acute inflammation. There are others which cause chronic inflammations, the most important of which are the tubercle bacillus and the spirochæte of syphilis. Then there are those rarer forms of inflammation which are due to the bacillus of anthrax, of glanders, and those due to the fungi group, such as actinomycosis. The pathological process of all of these is essentially the same; it is simply a question of degree and intensity; it is dependent upon the virulence of the organism causing the infection, and the general resistive powers of the patient infected.

How do bacteria enter the body? They may enter through the *broken skin* giving rise to local inflammation with destruction of tissue and abscess formation. In addition they may gain access to the lymphatics draining the infected area causing *lymphangitis,* and often the nodes becoming tender, hard, and swollen (lymphadenitis). Or the bacteria may enter the blood stream directly, resulting in septicemia or pyemia.

Inhalation is the means by which the pathogenic bacteria enter the trachea and lungs causing the majority of respiratory diseases. By *ingestion* of food and drink, the germs may enter the tonsils or the alimentary canal. Another portal of entry in females is through the *Fallopian tubes* directly into the peritoneal cavity causing peritonitis with its various complications.

If the body is in good health and properly nourished, all these portals are safely guarded, but if the individual is weakened and the various protective mechanisms are at fault, disease readily ensues.

Injuries.—Conditions of injury may be caused by the various factors already mentioned. The extent of the injury will depend upon whether the bony skeleton or the soft parts are involved, whether the solid organs, such as the liver or kidney, are torn, or the hollow viscera, such as the stomach and intestines, are perforated or ruptured.

Deformities.—These may be divided into two big classes: those a patient is born with, and those which a patient acquires during life. Among some of the congenital deformities may be mentioned spina bifida, a condition in which part of the bony portion of the spinal canal is missing, harelip, cleft palate, horseshoe kidney, six fingers, an extra arm, or the fusion of two individuals as in the case of the Siamese twins. Acquired deformities may be the results of injuries which have been improperly treated, such as a poor reduction of a fracture, or from paralysis of muscles due to nerve injuries which cause such conditions as drop wrist or drop foot.

New Growths.—New growths, neoplasms, or tumors, may be defined "as growths, non-inflammatory in character, arising from pre-existing tissue but independent of the normal rate or laws of growth of such tissue, subserving no physiological function." They may be classified as benign and malignant. *Benign growths,* as a rule, are localized; they may be excised without danger of recurring, and they do not spread to other parts of the organism and start new tumor formations. Examples of these are fibromas, lipomas, and cysts. They rarely endanger the life of the individual. *Malignant growths* are those which are not localized, which infiltrate tissues and which spread to various parts of the body (metastasize). They are the cancers and the sarcomas. Surgery attempts to remove these with the knife. And those cells which have escaped the knife will start foci for the regeneration of new tumor tissue unless they are killed by the destructive action of subsequent radium and X-ray treatment.

CHAPTER II

SHOCK AND HEMORRHAGE

Shock.—This is one of the most serious conditions with which the surgeon and the nurse have to cope. It may result from several circumstances. It may be associated directly with severe injuries, may occur during the course of an operation, or follow in its path. As to the etiology of shock there are many theories, but its exact mechanism does not concern us here. Shock is characterized by a rapid, thready pulse, a pinched, drawn face, sweating, rapid, shallow respirations, and a persistently low blood pressure. Shock may be associated with hemorrhage, but there is no severe hemorrhage without shock.

Prophylactic Treatment of Shock.—There are several factors which aid in the prophylactic treatment of shock. To begin with, the patient should be kept in a happy and cheerful frame of mind. He should have a good night's rest before his operation and his tissues should be well supplied with water. This latter can be easily accomplished by encouraging the drinking of fluids in copious amounts. Of course, two hours before operation no more water should be permitted. During his transport to the operating room the patient should be warmly clad and when he is placed upon the table he should be covered with blankets.

Of prime importance also is the technic of the operation. As little as possible of the abdominal contents should be exposed, and the exposed parts should be protected with moist, hot saline pads. The tissues should be handled gently, the hemostasis should be perfect, and the operation should be performed with as much speed as is consistent with safety. The patient should be kept under deep surgical anesthesia, the choice of the anesthetic being dependent upon the condition of the patient.

After operation it is customary to administer morphine hypodermically so that the pain which might arise will not reflexly cause a general depression of the nervous system, resulting in shock.

Treatment of Shock.—When a condition of shock is evident, it must be treated energetically. The patient should be placed flat upon the bed and covered with warm blankets; if necessary, hot water bags and electric pads may be employed to rapidly supply additional heat. Inasmuch as the patient is unconscious it is highly important to carefully guard against burns from the electric heating pad, or a too hot water bag. The foot of the bed is raised by means of shock blocks, so that the head is at a lower level than the feet. Shock blocks come in various sizes: low, medium, and high. The medium ones are generally sufficient.

Stimulants.—Morphine is one of the best stimulants and is administered in quarter grain doses with 1/150 atropine sulphate. Fluid is then given by infusion in the form of normal saline at 105 degrees F., and to this, occasionally, is added 30 minims of adrenalin hydrochloride, 1-1000 solution. If the shock is not so severe, fluid by hypodermoclysis or Murphy drip may be sufficient.

Transfusions.—Since hemorrhage may be partially responsible for shock, the imperative need often is to supply the blood which has been lost. Blood transfusions no longer present the obstacles which they formerly did, for the long tedious surgical methods of arteriovenous anastomosis have been practically replaced by the use of the syringe and its modifications.

Grouping for Transfusions.—Before any transfusion is given, it is always necessary to ascertain the blood group of the patient and of the "donor," because if the bloods of different groups are mixed together the red blood cells are destroyed and the patient is liable to suffer a very severe reaction, and derive no benefit from the treatment. Human bloods are divided into four groups. Of these the largest are groups two and four which together constitute about eighty-three per cent. of all individuals.

In selecting a "donor," it is very important that he be in good physical health, and that his blood be free of syphilis as evidenced by a negative Wassermann reaction.

Transfusions may be given by one of three methods,—the direct arteriovenous method; the indirect, as represented by the syringe method; and the one in which sodium citrate is used. The anastomosis of an artery of a donor to a vein of the recipient is no longer done, because this rather cumbersome method (which was rarely very successful) has been replaced by the other two types, which are more efficient, certainly easier of operation, and less trying both to patient and donor. The syringe method first used by Lindeman employs glass record syringes which draw the blood from the vein of the donor; the freshly drawn blood is then immediately injected through a needle into the vein of the recipient. The great disadvantage is the fact that the blood is apt to clot in the needles of the syringes in spite of the fact that these instruments may be flushed with saline during the procedure as is done in the Unger method. To overcome this obstacle, a method frequently used at the present time is the Lewisohn transfusion. It has been demonstrated that chemically pure sodium citrate in solution will prevent blood from clotting, and if used in a strength not exceeding two-tenths per cent. will not prove injurious to the patient. The usual procedure is as follows:

The donor is bled into a flask containing enough sterile sodium citrate solution to prevent clotting, and as the blood flows from the vein of the donor into the glass container, it is slowly shaken so as to insure complete mixing with the citrate. The drawn blood, now rendered uncoagulable, may be given at once, or, if it is not practical, it may be kept on ice and used any time within twenty-four hours, provided it is warmed to the body temperature before injection. As a rule, the blood is given to the recipient by the "gravity method." This permits it to flow by gravity from a container elevated about two or three feet above the head of the patient into the vein of the recipient through the ordinary Luer needle which has previously been inserted. Or, it may be given by the gravity method plus a three-way stop-cock and Luer syringe. The blood flows

rapid thready pulse, shallow superficial respirations, and what is very important—"air hunger." Air hunger is one of the diagnostic signs of hemorrhage. In shock the patient is ordinarily quiet, somewhat depressed. In hemorrhage, the patient is gasping for breath, restless, asking to have the windows open, begging for more air, and feeling as if he were being smothered.

Treatment.—If a large artery has been cut, the first aid treatment is simply to arrest the hemorrhage by applying pressure with a tourniquet. This is a band placed around a limb, and tightened until circulation through the artery is arrested. It is an excellent method for the temporary arrest of hemorrhage until some medical aid can be secured and the vessel clamped and tied.

Ligature.—This is the tying off of a vessel with material which may be either absorbable, such as catgut, or non-absorbable, such as linen. If the vessel is moderately small and has been caught in an artery clamp, sometimes by twisting the arterial wall, hemostasis is secured. This method is known as *torsion.*

Hemorrhage may also be controlled by means of the *cautery;* heat is applied to the bleeding vessel so that it coagulates the tissues and the bleeding stops.

Pressure.—Pressure is indeed a very important means of arresting hemorrhage, and sometimes good steady pressure over a bleeding surface may do much to stop the flow of blood. In bleeding from bone, one of the most efficacious ways of controlling it is to plug the hole in the bone with Horsley's wax. This is composed of seven parts beeswax, one part almond oil, and one part salicylic acid.

Capillary Bleeding.—There are various ways in which oozing can be controlled. One is by means of cold and the other by heat. Cold is especially efficacious in those operations about the mouth. For example, after the removal of adenoids and tonsils, or operations in the nose or upon the palate, bleeding is often controlled by slapping the face and neck with ice cold water. It appears that the contraction of the superficial vessels leads to a contraction of the deeper vessels, thus relieving the hemorrhage. Bleeding from the capillary blood bed of the uterus should not be controlled by the application of cold water as such a procedure might result in shock. Instead, an intrauterine douche with a little acetic acid and water of from 110 to 115 degrees is excellent in controlling this variety of hemorrhage. Often it is necessary to supplement this with packing, either with plain or medicated gauze.

Styptics.—Occasionally for very small pin point oozing, fused silver nitrate is applied directly to the bleeding point.

After Treatment of Hemorrhage.—Inasmuch as a certain amount of fluid is lost, it is very important to supply this to the system either by the blood itself in the form of transfusions, or by saline infusions. After the hemorrhage has been controlled necessity may demand that the patient be treated as a "shock" case.

CHAPTER III

POST-OPERATIVE COMPLICATIONS

THE operation completed, the surgeon has done the major part of his work, and the patient from then on is entrusted to the care of the attending nurse. It is true that all orders are given by the attending surgeon, but their conscientious execution is dependent upon the integrity and efficiency of the nurse. The surgeon may see the case but once a day; the nurse sees the patient at all times; and she, by her careful attention to details and her knowledge of human nature, can do much to make the patient comfortable and the post-operative course smooth in spite of the many complications which might arise. The immediate care of the patient after leaving the operating room is discussed in Chapters XIII and XVI. It is the purpose of this chapter to discuss the treatment of the various post-operative complications. The most important of these are nausea, vomiting, pernicious vomiting, gastric dilatation, tympanites, auto-intoxication, post-operative pneumonia, pulmonary embolism, urinary retention, urinary suppression, phlebitis, thrombosis, and hemophilia.

Nausea is quite common. It is usually present after all operations for a short time. Some doctors are in the habit of ordering cracked ice to relieve this distressing symptom. Whenever it is ordered, care must be taken lest the patient get too much and in this way imbibe large quantities of cold water with the result that vomiting is very apt to ensue. When the feeling of nausea becomes very severe it is accompanied by vomiting. If a patient vomits later than twenty-four hours after operation, there probably is something in the stomach which is causing a persistent irritation. Once this irritation is removed, the vomiting will generally cease. It must be remembered that the patient has just been operated upon, and that the nerves are exhausted, and that conservative treatment is better than radical. The most effective procedure for ridding the stomach of foreign material is gastric lavage; but washing the stomach is trying and tiring and should only be employed when other simpler methods have proven unsuccessful. First the following should be tried:—A glassful or approximately eight ounces of lukewarm water with about a teaspoonful of bicarbonate of soda should be administered by mouth. As a rule, patients are very thirsty after operation, and avariciously drink the proffered water. The result is that they are further nauseated and soon vomit the ingested water, thus washing out the stomach, and instant relief often ensues. Sometimes, in spite of these measures, vomiting will still persist. It is due then to atony, a relaxation of the muscles of the stomach wall. Persistent vomiting is very weakening, and gastric lavage should be given almost immediately, if the bicarbonate of soda and water fail to afford relief. A post-operative lavage must be of hot water, for the heat itself is the efficient agent in stimulating the stomach walls to contract, and therefore the water should be introduced at about 108-110 degrees Fahrenheit. Another point,—as little air as possible should enter the stomach tube, and when the lavage is finished, the water should be carefully siphoned off from the stomach. If the vomiting persists after a good gastric lavage, it then may be due to either pernicious vomiting or possibly, gastric dilatation.

Pernicious Vomiting.—This may occur in children as well as in adults, and is usually a manifestation of what is commonly spoken of as "acidosis," a condition in which the normal alkalinity of the blood is diminished. It is recognized by the sweet and fruity odor of the breath. If this condition be suspected, the urine should be examined for the presence of acetone. If it be present, gastric lavage should be given, everything stopped by mouth, and alkalis administered immediately either by a ten per cent. sodium bicarbonate solution in a Murphy drip, or intravenously in three to five per cent. solution, but never by clysis.

Sodium bicarbonate is given until it is excreted by the kidneys. When the urine is alkaline it is safe to assume that sufficient bicarbonate has been administered to bring the blood back to its normal alkaline reaction, thus reducing the acidosis which is the underlying cause of vomiting in these particular cases. There is one point, however, which needs emphasis in the administration of sterile sodium bicarbonate solutions. After the desired solution has been compounded, it must be sterilized. Sterilization, by its heat, drives off carbon dioxide thereby reducing the bicarbonate of soda to sodium carbonate. This compound is not as good as the bicarbonate because it is more irritating to the tissues, and is not as effective in reëstablishing the alkalinity of the blood. To counteract this, after the solution has been cooled sufficiently, carbon dioxide may again be added by connecting a sterile tube to a carbon dioxide tank and allowing the gas to bubble through the sodium carbonate fluid for a sufficient length of time, thus making a bicarbonate compound.

Gastric Dilatation.—One of the most distressing complications which may arise after an operation, and one which, if not treated radically, energetically, and thoroughly may result in death, is acute gastric dilatation. As the name implies, in this condition the stomach becomes enormously dilated, and presses upward on the diaphragm. This makes respiration very difficult because of the constant pressure on the diaphragm. And, inasmuch as the pyloric orifice of the stomach is atonic, the intestinal contents seep back into the stomach, resulting in persistent vomiting of large amounts of greenish and brownish colored fluids. To relieve this condition those means must be employed which will cause the dilated stomach to contract and approach its normal size.

Treatment.—The stomach should be lavaged with a hot soda bicarbonate solution at 110 to 112 degrees Fahrenheit, and the lavage continued until the return is absolutely clear. While this treatment is under way, turpentine stupes should be applied to the upper abdomen for ten or fifteen minutes. It is important to bear in mind that as these stupes must be hot to be efficacious, the abdomen should be thoroughly greased with vaseline before applying them, as great care must be taken that the skin is not burned. The integrity of the skin must be preserved because this procedure is to be repeated every two or three hours, according to the discretion of the attending surgeon. The stupe probably is the most efficient and reliable method for applying external heat, although some authorities advise the use of huge flaxseed poultices. Strychnine sulphate, gr. 1/60, may be given by hypodermic injection every four hours, following the principle that the strychnine will improve muscle tone.

The patient, of course, during this period, should be given nothing by mouth, but measures should be taken to supply the system with water. By persistent vomiting these unfortunate patients have desiccated themselves of fluid, and it is necessary that fluid be administered by means of a Murphy drip, or that eight ounces of tap water be given by rectum every four hours. If the patients show signs of shock, which they often do, a hypodermoclysis of 500 to 800 c.c. of saline should be given, or, in some instances, an infusion of saline. If nourishment be an essential element, a solution (two to five per cent.) of glucose may be administered intravenously. The glucose may also assist in combating a beginning acidosis brought on by inanition.

After the initial period of vomiting has come to an end, it is advisable to give the stomach an absolute rest for about twenty-four hours, and then to start the patient on what may be called a "gastric tolerance diet." The theory of this diet is to partially desensitize the mucosa of the stomach and make it more tolerant to fluids by the use of small doses of chloroform water. If this is retained, peptonized milk is then started in small doses. The amount of peptonized milk is then gradually increased, the chloroform water is omitted, and the patient, after a period of absolute gastric tolerance, is gradually brought over to a selected soft diet. The exact details of this diet are given in Chapter XII on "Surgical Dietetics."

Tympanites.—The distention of an abdomen following operation is due to a gastric dilatation, a distention of the small or large intestine, or a dilatation of the bladder resulting from urinary retention. The word tympanites or meteorism denotes an inflation of the abdomen with gas. This gas is usually intestinal; occasionally it may be free in the peritoneal cavity from a perforation of the intestines. A condition of gastric dilatation is recognized by distention in the upper abdomen; that of the small or large intestine, by a generalized abdominal distention; that of the bladder by palpation of a rounded mass just above the pubes and the failure of the patient to void after operation. Tympanites is certainly distressing and modern surgical nursing commands many methods to alleviate and relieve this condition, bringing much comfort to the patient.

Treatment.—The theory underlying all treatments is to aid the patient in ridding the small intestines and colon of gas. The means for accomplishing this are many. One of the simplest procedures and one of the most efficient is the introduction of a rectal tube.

A *rectal tube* is a small piece of rubber tubing about three-eighths of an inch in diameter, rounded at one extremity. This is well lubricated with either K-Y or vaseline, and gently introduced into the rectum beyond the internal and external sphincters, and about three to four inches beyond the anus. The purpose is to form an exit for gas which may have accumulated in the colon. This simple procedure is often all that is necessary.

Enemas.— Especially in emergencies when the patient has not had a cathartic, or a thorough intestinal cleansing before the operation, the fecal material is apt to accumulate in the colon causing fermentation and often stopping the passage of gas or flatus by its mechanical bulk. In these conditions it is important to empty the lower bowel by a cathartic enema. The soapsuds enema is usually all that is required. But in those cases where the soapsuds have brought very little return, and the distention is still marked, and it is thought that fecal material is being retained, it is advisable to give a more purgative enema. The solutions which may be added to enemas may be glycerine, one ounce, or turpentine, ½ ounce to the pint. Milk and molasses,—four ounces of milk and four ounces of molasses,—make a good irritative enema. The magnesium sulphate enema is used now quite frequently,—two ounces each of water, glycerine and magnesium sulphate in saturated solution being employed. Some institutions use a mixture with

3. The end of the outflow tube should not be more than a foot below the level of the patient. If it is, a jerky interrupted flow is apt to result because too great a suction is established, and the mucous membrane of the rectum is apt to be drawn about the holes of the rubber tubing.

4. There should always be a return of fluid through the outflow and if for any reason it is not evident, the irrigation should be stopped immediately. For the pressure of fluid through the inflow tube might be so strong as to cause distention with a resulting paresis of the gut; or, what is extremely rare, there might be a perforation in the colon through which fluid empties itself into the peritoneal cavity. The amount of fluid which the patient absorbs can easily be estimated by comparing the amount given and the amount returned.

There are two ways of giving a colon irrigation:—one way is to use an inflow and outflow tube; the other, one tube to serve alternately as inflow and outflow. The second method is less advisable, for it is more like an intermittent enema, and is certainly more uncomfortable to the patient.

Aids to Colon Irrigations.—Just as in a dilatation of the stomach water is applied internally and heat externally by the application of poultices, so, in giving a colon irrigation, to make it more effective, and to aid in stimulating the contraction of the smooth muscle of the bowel, large flaxseed poultices are used for their counter-irritative effects. In addition, very often 1 c.c. of pituitrin is given intramuscularly during the colon irrigation. It is a known fact that a substance in the posterior lobe of the pituitary stimulates smooth muscles to contract. Pituitary extract should not be given by mouth because its administration in that manner is practically ineffectual. In some cases, fortunately rare, rectal tubes, enemas and colon irrigations will not relieve abdominal distention. These cases are spoken of as *paralytic ileus.*

This is a condition in which the smooth muscle of the intestine is practically paralyzed; there is no peristalsis, no passage of gas, the patient becomes more and more distended as the fermentation becomes greater and the toxemia becomes more severe. This condition is helped by immediate surgical interference alone. The mortality, however, is terrifically high. The operation performed is an *enterostomy,* Chapter IV, page 55; an opening is made in the small intestine through which the gas, fluid and solid material may escape. Thus with a diminution of the degree of toxemia, and the intestines relieved of their burden they will have sufficient strength and recuperative powers to regain their normal tone and peristaltic wave action.

Auto-intoxication.—Closely allied to meteorism is auto-intoxication. In this condition the patient absorbs certain products of fermentation and decomposition from the gastro-intestinal tract, resulting in a slight degree of temperature usually associated with headache and general malaise. This is ordinarily relieved by a movement of the bowels, procured by an enema, and a cathartic. This condition is never very serious, and never alarming.

Post-operative Pneumonia.—This is one of the most serious of post-operative complications. Often a patient reacts favorably to an operation only to be dragged down in a day or two by the toxemia of lung involvement; and this, together with the general weakness following surgical interference, often results in death. While pneumonia cannot be absolutely obviated as a post-operative complication, there can be a marked diminution in its frequency if greater attention is paid to the smaller details of ante-operative and post-operative care.

In hospital work and in private nursing the fact is often forgotten that the patient in his home has been accustomed to certain clothing and has been living for years under peculiar hygienic conditions. Upon entering the hospital he is given an abbreviated nightgown and placed in a bed with one or two blankets. When he is physically examined his gown is taken off, and very often there is a draught from a nearby open window. The deep breathing and coughing incident to the auscultation of the lungs often cause a perspiration, and the cool air on the heated skin is a poor combination. Occasionally the patient is asked to get out of bed and stand up, his bare feet very often resting against the cold floor; or often, when the abdomen is shaved and being prepared for operation, the patient is unduly exposed. Then from a warm bed he is placed upon a cold stretcher, wheeled through draughty, chilly halls, and plunged into a superheated operating room. During the operation he is apt to perspire freely, and while it is routine to change a drenched gown, the patient, through neglect, is often permitted to keep it, and in this condition he is sent through the halls again, back into the ward. During the recovery period, he may toss around, uncovering his body, and exposing his depressed system to more draughts, more chilling, opening the way to a pneumonia. When the matter is given thought, the real wonder is that pneumonia is not more frequent. The best method of treating this serious complication is by prophylaxis. Prevention is better than cure, and careful and conscientious surgical nursing will greatly aid in diminishing the incidence of this dreaded complication.

Prophylactic Treatment.—Ante-operative.—All patients before operation should be carefully examined for coryza, bronchitis, pharyngitis, or tonsillitis, and if any of these exist, the operation should not be performed, but temporarily postponed. Of course, acute cases fall into another category, and very often it is advisable to do these under local anesthesia rather than run the risk of ether or gas administration which is sure to spread the infection into the lungs. If the nurse at any time prior to operation notices that the patient sneezes excessively, or that signs of a cold are developing, it is imperative that she immediately notify the surgeon, for few will operate when there is even the slightest infection of the respiratory system.

When patients are being examined physically, or receiving treatments, it is highly important that all windows and doors in the vicinity be closed and that draughts be diminished to the minimum. If a patient has to leave the bed he should be adequately supplied with slippers, a bathrobe, and, if necessary, a blanket. When he is moved to and from the operating room he should be warmly covered, and in the operating room the same general rules hold true. If his gown becomes wet with perspiration, his body should be thoroughly dried and a new gown supplied.

Operative Prophylactic Treatment.—While the patient is recovering from the anesthetic, the lower jaw should be held firmly and pressed forward, exerting pressure at both angles; this will do much to prevent gagging and when the patient vomits the head should be turned to one side, the jaw still being held, and the vomitus eructated into a pus basin. It is highly important that this be always done, because if this procedure is routinely and regularly followed, the danger of the vomitus being aspirated into the lungs is reduced. Aspiration is not an uncommon cause of pneumonia.

Post-operative Prophylactic Treatment.—When the patient arrives in the ward or room he should be warmly covered, and very often in order to maintain a good body heat, the bed may be previously warmed either with electric pad or hot water bottles. If the patient tosses about, the blankets should always be readjusted. If there is a tendency to vomit the jaw should be held firmly forward and the head turned to one side. These instructions have been repeated because it is extremely important that they become deeply impressed upon the nursing mind. In other words, the incidence of post-operative pneumonia may be greatly reduced if the patient before operation is free of any infection of the respiratory tract, and during the period of surgical attention he be fully protected against draughts and unusual changes from cold to hot or hot to cold.

Treatment of Post-operative Pneumonia.—The treatment is really that of any lobar pneumonia. The patient is usually on a Gatch bed. The Gatch bed is one which is made in sections so that the upper portion of the body may be elevated and the knees flexed by adjusting these sections to any desired degree.

The windows are opened wide and as much fresh air is given as is possible. The diet is liquid including milk. Fluids should be forced to about 3,000 c.c. a day, and the intake and output should be accurately measured.

Abdominal distention is always looked for and treated immediately with rectal tube, enemas or colon irrigations.

The cough is particularly distressing and dangerous, for after a surgical operation the pressure caused by straining may break some of the sutures and sometimes the abdominal wound is ruptured wide open, and the abdominal contents eviscerated. To prevent this horrible complication a good, tight, well-placed binder is exceedingly important, for it gives added support to the abdominal wall. If the coughing is very severe, the nurse should support the lateral areas of the abdominal wall with her hands. Should evisceration take place, the intestines should be covered with sterile towels, and the surgeon immediately summoned. For the cough, doctors will prescribe a codeine cough mixture, or leave orders for codeine to be given either by mouth or hypodermic.

As soon as the diagnosis is made, it is routine to administer tincture of digitalis as a cardiac stimulant, the dose being 10 to 15 minims three times a day. If the pulse is very rapid, and the heart overacting, it is controlled by an ice bag placed over the precordium.

Pleural pain, which is very distressing, yields to strapping the affected side with adhesive plaster.

Pneumonia cases must always be watched carefully for cardiac failure and edema of the lungs. The cardiac failure is evidenced by a weak, thready pulse, cyanosis and respiratory difficulty. Edema of the lungs manifests itself by bubbling respirations.

Cardiac failure is treated by stimulants, such as camphor in oil, caffeine or atropine. Edema of the lungs responds best to good dry cupping especially applied to the posterior regions of the chest. This should be done for about twenty minutes at a time. Great care should always be exercised in preventing the patient from being burned with the cups. The use of oxygen in these cases with the present apparatus is practically useless and worthless.

Pulmonary Embolism.—Closely allied to post-operative pneumonia, but of different etiology, is pulmonary embolism. It is not very common, and may occur after the simplest operations; for example, after an appendicectomy, or an operation for varicose veins; it may be preceded by a thrombosis of the veins of the lower extremity, or come as a distinct entity. As a rule, it is ushered in by a sudden pain in the chest, dyspnea, bloody expectoration, rapid pulse, and slight rise in temperature. If the chest is auscultated the doctor may sometimes note a friction sound, or signs of beginning pneumonia may be evident. Occasionally, instant death occurs, and at best the mortality is high, varying from seventy to eighty per cent.

Treatment.—Patients who develop a phlebitis or thrombosis of the veins of the lower extremity, or any other region, should be kept in bed until this condition absolutely subsides, because a small piece of blood clot may break off and lodge in the lung as an embolus. Patients should not be permitted to be too active after operation even if their condition is excellent. The treatment of embolism is to reassure the patients, for they are apt to become greatly alarmed at the sight of their bloody expectoration. To further quiet them morphine is administered. If the diagnosis of its location is made, it is customary to strap that side of the chest in which the embolus is lodged. This will immobilize the affected lung as much as possible.

The family of a patient suffering from a pulmonary embolism should be apprised of the impending danger, for even though the patient may recover from the shock of the embolism itself, it may give rise to an embolic pneumonia and a recovery from this condition is exceptionally rare although it occasionally occurs.

Urinary Retention.—After operation, occasionally, a patient is unable to void urine voluntarily with the result that the urine collects in the bladder, the organ becoming dilated beyond its usual capacity. Pain is very apt to result from this distention, and the patient is very uncomfortable. Urinary retention is more prone to occur after operations about the rectum, the vagina, the cervix, and the bladder itself than after operations involving the upper abdomen. The reason for this is that the center of micturition has been reflexly inhibited by the operative procedures; or it may be due to nervousness, or that conscious control has not as yet been reëstablished after the administration of an anesthetic. As a rule, no patient should be allowed to go more than twelve to twenty hours without voiding. However, every effort should be made to have the patient void voluntarily, because all functions are better performed by nature than if mechanically interfered with.

Treatment.—The treatment of urinary retention is catheterization. A catheterization is a surgical procedure. A surgical procedure in clean cases is an aseptic one, and every bladder which becomes infected after the introduction of the catheter is a horrible reflection upon the individual who has done the catheterization. This procedure should be done with a good light. The urethral orifice is carefully exposed. The catheter, be it rubber, metal, or glass, should be lubricated with a sterile oil, either olive oil or K. Y. The urine which is withdrawn should be saved and examined as a matter of record. While catheterization every eight hours is a routine in some hospitals after perineorrhaphy, it should be remembered that a patient may develop a "catheter habit" because the act of micturition or urination causes slight pain, and catheterization affords instant relief without pain. These cases should be treated firmly but gently and various expedients should be tried to induce voluntary micturition. The drinking of large quantities of water, the sound of running water from turning on a water faucet within hearing distance of the patient, or pouring warm water over the vulva may do much to encourage voluntary micturition.

In those cases where there is an old inflammation of the bladder, it is advisable not to draw off all the urine at once, but to leave about four ounces in the bladder, or if all the urine is withdrawn, to introduce immediately into the bladder about four ounces of a warm sterile solution of boric acid. This will prevent any possibility of an infection travelling from the bladder to the kidneys via the ureter. The details of catheterization are not given here, as they are known to every nurse, but it cannot be emphasized too strongly that this treatment above all must be done by a nurse with a surgical conscience.

Suppression of Urine.—Following some of the more extensive major operations, especially those upon the kidney, either a nephrectomy or a nephrotomy, or prostatectomy, the kidneys may shut down and secrete no urine; the result is, that those substances which should be normally excreted in the urine as

The colon irrigations, as stated previously, not only carry off large amounts of toxins, but they are a means of supplying water to the tissues.

The *kidneys* may be stimulated reflexly by counter-irritants applied to the skin of the lumbar region. This may be accomplished by the use of flaxseed poultices applied at two-hour intervals, or by hot water bottles. Some surgeons employ drugs in order to stimulate the kidneys directly, by the use of such substances as theobromine because of its direct diuretic action. Five to eight grains are given three times a day for the space of three days and then the drug is stopped. There is no doubt that this drug is excellent in stimulating the kidneys and certainly surpasses caffeine in its action. The disadvantage is that it might cause a certain amount of nervousness and insomnia.

Forcing fluids either by proctoclysis or hypodermoclysis will cause enough fluid to be absorbed to dilute the blood, thus resulting in a diminution in the degree of toxemia. This simple method not only relieves the patient of an impending uremia, but the kidneys are stimulated by the added amount of fluid.

In cases of high blood pressure with a high blood urea, the actual removal of part of the blood volume will do much to reduce the nitrogen content of the blood, if only for a short period of time. This is done by a *phlebotomy*, or inserting a canula in a vein in the arm, and permitting the patient to be bled of 250 to 700 c.c. of blood. The amount withdrawn should depend upon the constitution and physique of the patient. Quite often after this procedure, 250 to 500 c.c. of normal saline are introduced intravenously, resulting in further dilution of the toxins.

If, in spite of all these procedures, there is no urine excreted, a rather heroic operative procedure may be resorted to, that of decapsulating the kidneys. This is especially indicated in those cases which have a chronic inflammation of the kidneys, preëxisting Bright's disease. The operation is spoken of as Edebohls's decapsulation. It consists of the excision of the capsule from the kidney so that with this restraint removed, the organ may be able to work more efficiently by establishing new vascular relationships with the surrounding tissues, thereby obtaining better nourishment for itself.

Phlebitis.—This condition is an inflammation of the veins, usually of the lower extremity. It is rather late in onset and is annoying because the patient is confined to bed for a longer period of time. It is manifested by cramp-like pains in the leg, a rise in temperature, and a feeling of general malaise. Examination of the affected extremity shows that the part is swollen and the skin over the veins reddened. Occasionally the veins may be palpated. The treatment calls for absolute rest, elevation of the affected part and immobilization, the part being kept warm by a wrapping of cotton, or the additional heat of an electric pad. Phlebitis may be associated with or followed by thrombosis.

Thrombosis.—This may follow in the path of a phlebitis, and simply means the occlusion of the lumen of the vein with a blood clot. The same condition may occur in arteries. The symptoms are practically those of a phlebitis. The danger of these cases lies not so much in thrombosis itself, but the fact that these thrombi may give rise to small particles of blood clots (emboli) which invade the blood stream and localize in any part of the body. The symptoms and physical signs depend on the area in which these emboli have lodged. If it should localize in the brain, paralysis might ensue; if in the central artery of the retina, blindness; if within the coronary artery of the heart, immediate death. A glance at these possibilities is certainly proof that a thrombosis is potentially a dangerous operative complication.

Treatment.—The acute condition is treated practically the same as a phlebitis, with the exception that the local applications vary, some using ice compresses over the veins, others a 20 per cent. ichthyol ointment, some the electric pad. All surgeons believe in absolute rest of the part involved. It is a good practice to keep the weight of the bed clothing away from the affected area, by means of a wooden or metal cradle. When all the acute inflammation has subsided, the patient should not be allowed up and out of bed until a good firm pressure bandage has been applied. In a leg case, the bandage is wound from the ankle upward to the knee. The patient should be warned that even after leaving the hospital, or home, that a rubber stocking properly fitted should be worn for a long period of time.

Of course when this condition involves the superficial veins it is not so very serious, but it has been known to choke off the femoral artery, the main channel through which the lower extremity gets its supply of blood. This might result in gangrene with subsequent amputation of the leg and thigh. These severe post-operative complications are fortunately rather rare.

Hemophilia.—As science progresses new discoveries are made and some certain operative complications may be prevented by prophylactic measures. A disease no longer dreaded is hemophilia (a condition marked by a tendency to persistent bleeding). It would never occur if routine coagulation times were done on all patients before they entered the operating room. Blood usually clots in seven minutes and if the period of clotting is beyond eight minutes, measures should be instituted to insure the clotting of the blood in a shorter period. There are many conditions which interfere with the normal clotting of blood, but one of the most interesting of these is hemophilia. It is a malady which is transmitted by the female to the male, although rare instances have been reported where women, too, are the sufferers. In this disease, blood does not clot often until 15-20 minutes. Jaundice is another condition which hinders the clotting of the blood. In hemophilia and jaundice and in all cases in which the clotting time is delayed methods must be taken to lower the coagulation time to within normal limits.

Treatment.—Before operation those patients with a prolonged coagulation time should be given calcium lactate, gr. 15, three times a day, in milk. If at the end of three days, the coagulation time has not been materially reduced, they should be given about from 15 to 30 c.c. of horse serum intravenously. This is very valuable in lowering the coagulation time. Before the administration of horse serum, the patient should be carefully tested by the injection of minute doses of horse serum into the skin to determine whether the individual is sensitive to it. Patients who have recently had those diseases in which horse serum is used as a curative agent, as in diphtheria antitoxin or anti-meningococcus serum, have a peculiar idiosyncrasy to it, so that if this serum is given again, a condition of "anaphylaxis" may result.

Anaphylaxis has been defined as "the increased susceptibility to an infection or the action of any foreign substance introduced into the body following a primary infection." This condition is indeed serious, manifesting itself by a sudden, labored respiration, rapid pulse, cyanosis and the appearance of large red cutaneous blotches, or urticaria. Death has been known to occur within a few minutes. If this condition should result, it is best treated by the administration of atropine hypodermically, or adrenalin, minims 15. The elimination should be further promoted by colon irrigations.

Recent investigations have proved that patients with delayed clotting time are often improved by ante-operative transfusions of human blood. The blood of the patient should be tested first for the particular group into which it falls, and then a transfusion of blood from a donor whose blood group is the same as that of the patient should be given. (This is described in Chapter II.)

CHAPTER IV

THE SURGERY AND SURGICAL NURSING OF THE ALIMENTARY SYSTEM

Introduction.—In this and the following Chapters V to XI of surgical conditions involving the systems of the body, the various pre-operative and post-operative nursing measures which are peculiar to the individual case at hand will be indicated, but no standard routine courses of treatment can be reasonably prescribed because every surgeon will have his own. These will necessarily vary from time to time in accordance with differences in patients, operative procedures, general conditions, etc. However, in Chapter XIII, under the subject of "Anesthesia," and in Chapter XVI, under "The Operating Room," there are recorded representative practices which, with what is given here, will give the student the framework for surgical nursing.

Before considering the surgery of the Alimentary System, a brief review of those organs which constitute it may be instructive.

I. ORGANS OF THE ALIMENTARY CANAL:

1. Mouth
2. Pharynx
   (1) Tonsils
   (2) Adenoids
3. Esophagus
4. Stomach
5. Small Intestine
   (1) Duodenum
   (2) Jejunum
   (3) Ileum
6. Large Intestine
   (1) Cecum and appendix
   (2) Colon
      a. ascending
      b. transverse
      c. descending

(3) Sigmoid Flexure
(4) Rectum
(5) Anus

II. Accessory Organs of Digestion:
1. Teeth
2. Tongue
3. Salivary Glands
    (1) Parotid
    (2) Submaxillary
    (3) Sublingual
4. Pancreas
5. Liver and Gall Bladder

The Mouth.—The mouth is of special interest because it comprises part of the operative field of the upper and lower jaws, and the tongue; it is the path through which the tonsils and the adenoids are approached; and the means by which the trachea and esophagus are entered. Its main importance from a surgical standpoint is that it can never be rendered sterile, so that all the operations on the afore-mentioned organs must of necessity be contaminated. Even though the work is done in a contaminated field, the same aseptic surgery should be practised here as is practised in other regions.

This fact should not deter the nurse from getting the mouth as clean as possible for the operation. It is usual to have the patient wash the buccal cavity every two hours with some liquid, either warm saline, or water to which has been added one of the countless pleasant-tasting antiseptics which are in everyday use. This should be begun about two days prior to the operation. It is imperative that mouth washing should be done thoroughly. The nurse should not content herself by simply informing the patient that the mouth is to be washed, but she should stand by and see that it is efficiently done. In addition, the teeth should be carefully brushed at least after each meal. If pyorrhea exists, the teeth should be scraped and the gums treated by a dentist. In this way the amount of mouth contamination may be reduced to the minimum.

The *inflammatory affections* of the jaws, such as inflammation of the gums, or gingivitis, or pyorrhea alveolaris, need no special mention here. But the new growths of the jaws, either benign or malignant, form a very important chapter in surgery because they may necessitate a resection of either the upper or lower maxillæ.

The Jaws.—The jaw may be the seat of a variety of tumor formations:—(1) Cysts arising from some abnormality in the development of the teeth; (2) non-malignant growths, or epulis; and (3) malignant growths.

Treatment of New Growths of the Jaws.—If the cysts are small, they are removed and the membrane which lines the cavity is destroyed. If necessary, the cavity is packed and the wound permitted to heal by granulation tissue. The only treatment is to keep the mouth clean.

In the case of benign tumors, the tooth about which the tumor grows is removed and with it a portion of the bone. The removal is accomplished by a Gigli saw. It is always convenient to have at hand an actual cautery or Horsley's wax to control the hemorrhage which may ensue from the bone.

The cases of malignant growths, either carcinomas or sarcomas, demand radical operation. In the case of the upper jaw this is not so practical because, with the removal of the bone, the eyeball loses its support and drops from its normal anatomical position resulting in a condition of double vision or diplopia; and, by removing the hard palate, a communication is made between the nose and mouth. However, in spite of these two obstacles, the operation is occasionally done.

The removal of the lower jaw, however, is not so difficult; it may be removed either partially or in its entirety. The actual operative technic is more of interest to the surgeon than the nurse and will not be discussed here. The nursing procedures are the same as for any radical operation on either the upper or lower jaw.

Ante-operative Treatment.—As has been mentioned previously, the mouth should be cleansed very carefully. The operative field, in the male, should be prepared by shaving an hour before the operation, as the beard sometimes grows very rapidly and nothing is more disagreeable than to have the patient enter the operating room not properly prepared.

cleansing of the mouth as already outlined in operations upon the jaw.

Operation.—The anesthetic is administered intranasally. The mouth is kept open by a self-retaining gag. A heavy silk ligature should always be at hand for introduction through the base of the tongue. This serves as a tractor, and even after the tongue has been removed the ligature is left in place, the free end being fastened either to the teeth, or identified by an attached pair of forceps that hang from the mouth. This ligature should remain in place for at least twenty-four hours after operation, for it is invaluable in controlling the base of the tongue should any serious hemorrhage occur.

Post-operative Treatment.—In those conditions in which either half or the entire tongue has been removed, the treatment of the raw denuded surface of the floor of the mouth is what most concerns us. The desideratum, of course, is to render this area aseptic. To attain this end, some operators use balsam of Peru, which is applied as gently as possible. The dusting of iodoform powder is to be condemned, as iodine poisoning may result. Other surgeons prefer the use of mild antiseptic sprays.

For about four days, the patient should be fed by enemata. Each morning the bowels should be washed out with a soapsuds enema followed by rectal feedings (Chapter XII) which are given, as a rule, every four hours. If the patient is very weak and emaciated, and demands more nourishment than can be given by rectum, a small stomach tube may be passed through the nostril into the stomach, and left in place. Some operators prefer that the patient be fed directly by mouth; a soft rubber catheter is passed along the normal side of the mouth permitting the patient to swallow the liquids which are poured slowly through the tube. Each feeding should be completed by the administration of sterile water, and the tube withdrawn, after which the mouth should be thoroughly cleansed. Soft diet may be given as soon as the wound heals and swallowing without difficulty is possible. The patient should be permitted to sit up in bed as soon as possible, and so as to afford better drainage to the secretions which collect in the mouth, the head should be kept bent slightly forward. These cases may be allowed up from bed on about the fourth day.

Treatment of Inoperable Cases.—While all patients suffering from inoperable cancer are miserable, there are none who present such a horrible spectacle as those with a large fungating growth of the tongue. Unable to swallow, finding difficulty in breathing, suffering agonies, with an oral stench which is hardly bearable for themselves or others associated with them, they are entitled to all the sympathy possible. If nothing else can be done for these unfortunates they may be kept absolutely free from pain. The local pain is sometimes reduced by dusting the ulcerated areas with orthoform powder. It is applied before any food is taken. Morphine should be given liberally, with a little atropine to prevent its depressing effects. The foulness of the breath may be lessened by the continual use of mouth washes and mouth irrigations. If dyspnea becomes marked because of crowding of the larynx by growth, tracheotomy may be necessary. If difficulty exists in swallowing, rectal feeding may be given. Feeding by stomach tube or nasal gavage is not practical, because the rubber tubes coming in contact with the growths cause excruciating pain. Occasionally, the proper use of radium and X-ray, in selected cases, will do much to give relief where the knife of surgery has failed.

The Pharynx.—The pharynx is important surgically because it lodges the tonsils and the posterior portion harbors the adenoids. As is known, the tonsils may be the seat of acute inflammation, and the bacteria may spread into the surrounding tissues giving rise to what is popularly known as a quinsy sore throat, or a peritonsillar abscess.

Treatment of a Peritonsillar Abscess.—Since this condition is in reality an abscess formation, means should be taken to cause a pointing of the abscess as soon as possible. With this ultimate end, flaxseed poultices should be applied every two hours to the side of the neck that is affected and warm throat irrigations with a quart of saline at 105° should be given at regular intervals. This will not only cause a localization of the pus, but will be very comforting to the patient and relieve much of the pain which accompanies this condition. The abscess is opened by blunt incision under local anesthesia and the pus evacuated. The after treatment is simple, consisting mainly of throat irrigations and antiseptic mouth washes to relieve the oral fetor and promote drainage.

Tonsillectomy.—Tonsils are removed very often, both because of a diseased condition and because of an increase in size, or hypertrophy. As a rule the operation is attended with very little risk and is performed under ether in children, and with local anesthesia in adults.

Operative Treatment.—The patient, if a child, is placed under ether anesthesia in the dorsal position and the mouth held open by a self-retaining gag; an electric head lamp worn by the surgeon supplies the light. The tonsils are removed by one of several methods, either by blunt dissection with a Sluter tonsillotome, or they are dissected out with scissors, and finally enucleated with a snare. The hemorrhage is controlled by the simple pressure of gauze sponges. If necessary, the bleeding vessels may be tied, or a sponge with a piece of tape securely attached may be left in the tonsillar fossa for twenty-four hours. After the operation has been completed, to further stop bleeding and cause the patient to regain consciousness as quickly as possible, the neck and face are bathed with towels previously soaked in ice water.

After Treatment.—While these cases are apt to ooze a little after operation, careful watch should be kept on their pulse, and if they are bleeding briskly, as evidenced by the constant expectoration of bright red blood, or the vomiting of large quantities of altered blood, the attending surgeon should be notified immediately, for cases of fatal hemorrhage have been known to result.

The diet should be liquid, ice cream being given to children, for the cold is gratifying to the throat, and the psychic effect cheering to their depressed spirits, and, in addition, the cream forms a protective layer to the denuded areas of the pharynx. The patient is kept indoors for a day or two to prevent catching cold.

Adenoids.—Adenoids are removed either with a curette or an adenotome. This operation requires no special treatment beyond that already mentioned for tonsillectomy.

The Esophagus.—While the esophagus is as important as any other structure of the body, its surgery is in its infancy and the operations few in number. Those diseases which interest the surgeon have very little need for a nurse, since whatever is done in the way of treatment is non-operative and performed by the surgeon himself.

Diseases of the Esophagus.—The esophagus may be burned by the passage through it of foreign substances, or injured by the passage of foreign bodies. This will result in an ulceration of the esophagus, with a resultant contracture and stricture, making swallowing rather difficult. Of course, as in other locations, cancer may elect the esophagus, but since it involves this organ at its lowermost portion just where it pierces the diaphragm muscle, very little is done for it by active surgical intervention.

Treatment.—If the esophagus has just been burned by acid, then alkali must be given in the form of a solution of sodium bicarbonate. If caustic alkali is the agent which has been ingested, then a diluted vinegar solution is given to neutralize the base. The stricture, resulting from the healing of the injured area of esophagus is treated by the passing of esophageal sounds, or bougies. These are passed at frequent intervals, the diameter of the bougie being increased in size until the esophagus has been dilated to normal. If the ulceration is very widespread, the dilatation of the esophagus is impractical, and because of its extensive nature, more radical procedures must be adopted.

The patient being unable to swallow cannot be nourished indefinitely by rectal enemata, so that an opening must be made directly into the stomach. Through this fistula the food may be introduced and the patient receive the proper nourishment for his existence. This operation is known as gastrostomy which is described in detail on page 46.

Foreign Bodies in the Esophagus.—The esophagus, as well as the trachea and larynx, is often the resting place for swallowed foreign bodies, such as coins, pins, etc. It is very important to really ascertain that the patient has a foreign body, and the X-ray is a valuable aid in determining the presence of many varieties. Some of these may be removed by special instruments; for example, a coin-catcher, or by direct vision through an esophagoscope. If these bodies are of too great a size to be easily dislodged and are caught fast in the cervical region of the esophagus, the esophagus may be opened through the neck, and the object extracted. The operation is spoken of as esophagotomy. If the foreign body is close to the cardiac portion of the esophagus it may be removed indirectly via the stomach by a gastrostomy.

New Growths of the Esophagus.—While a resection of the esophagus is sometimes performed for malignant stricture, the mortality is so high and the results so uncertain that conservative rather than radical measures are invariably employed. Most surgeons are content by introducing radium through an esophagoscope into the esophagus and permitting the metal to exert its rays upon the tumor cells and thus hinder their extravagant multiplication. Occasionally surgeons perform a gastrostomy, so that the patient will not starve to death.

Gastrostomy.—When the esophagus is narrowed either by a benign stricture, or carcinomatous tissue to such an extent that feeding is practically impossible, a gastrostomy must be performed to prevent the patient from starving. This is an operation whereby a communication is established between the anterior surface of the stomach and the anterior abdominal wall. Through this gastric fistula, fluid may be introduced, the patient, in this fashion, being given nourishment without the food actually entering the esophagus. There are different types of operations done but they all are essentially the same: they vary in their technic.

Ante-operative Treatment.—The abdomen is prepared in the usual manner. Inasmuch as these patients are very emaciated and weak, the operation is performed under local anesthesia, preliminary to which morphine gr. ¼ with atropine gr. 1/150 is given hypodermatically.

Operation.—The abdomen is opened by a left rectus incision, the stomach found, and packed off from the rest of the abdominal cavity with hot saline pads. A small opening is made into the stomach and a sterilized catheter is introduced into its interior. The further burying of the catheter within the stomach, so as to prevent regurgitation of stomach contents through the fistula, is one of technical detail. The peritoneum is then narrowed and a few sutures are taken approximating it to the stomach, so that this organ is held firmly to the abdominal wall. The catheter is brought out of the skin incision and clamped.

After Treatment.—The patient is fed every four hours through the catheter. A convenient way of doing this is to connect it with a small funnel so that the fluids may be easily poured into the stomach. The foods which may be given are limited to those which can be made up into or dissolved in fluids, and from six to ten ounces of liquids may be given at a feeding. Their caloric value should always be estimated and great care should be taken to see that the patient is given sufficient food. Some surgeons permit their patients to chew solid food for the taste and because a flow of gastric juice is stimulated by the hormone "secretin" of the saliva; but, naturally, the patients are not permitted to swallow the food.

After the first few days the catheter should be removed and changed daily, a fresh clean one always being ready for immediate insertion. After the feeding the end of the tube should be clamped so as to prevent leakage, and an abdominal binder applied. In about two months' time the tube may be left out of the stomach, and inserted at the feeding periods only. The fistula in the interim may be covered with a piece of vaselinated gauze, held in place by a binder. Patients should be taught to insert their own tubes, the method of feeding themselves, and the foods which may be taken.

It is highly important that the skin about a gastric fistula be kept scrupulously clean. Should gastric contents leak either from or around the tube, the skin should be washed immediately and covered with some bland non-irritating ointment, such as Beck's paste or vaseline. If this is not done, the gastric juice will digest the skin and a painful ulcerated area about the tube may result.

The Stomach.—The surgery of the stomach forms one of the most brilliant and important chapters in general abdominal surgery, for each year brings new gastric operations with a more refined technic.

Operations upon the stomach, or, in fact, any part of the intestinal tract, introduce an element which is of great importance from the standpoint of an operating nurse. The operative field in a simple celiotomy (the opening of a peritoneal cavity) is clean, and under normal conditions, free from all bacteria. Yet the interior of the intestinal tract and colon, and, to a slighter degree, the stomach, are swarming with bacteria. Naturally, in those operations which necessitate an opening into the stomach, intestines, or colon, a previously clean field will be converted into a "dirty" one. However, by carefully padding off the operative field from the rest of the peritoneal cavity, and by later carefully discarding those instruments (needles, ligatures, sponges, towels, etc.) which have come into contact with the contaminated field, it is perfectly possible to maintain the sterile toilet of the peritoneal cavity. This will be discussed in greater detail subsequently. And it is upon the nurses in the operating room that this routine and its observances are partially dependent.

Diseases of the Stomach.—The stomach may be subject to various inflammations of the mucosa from a variety of causes. These are considered under the general heading of gastritis. They are of little interest surgically. The affections of the stomach which demand surgical treatment are those of gastric ulcer and gastric carcinoma.

Gastric Ulcer.—Gastric ulcer starts as an erosion of the mucosa of the stomach, the ulceration gradually extending deeper, at times eating its way through the muscular and serous coats of the stomach causing a communication between the interior of the stomach and the general peritoneal cavity. The ulcer in itself is not so serious but by growing it may open a blood vessel, causing a gastric hemorrhage (hematemesis). Or the scar tissue which follows in the path of a healing ulcer may interfere with the gastric functions by creating various deformities of the stomach. This is especially true when the ulcer

outlined demonstrating the manner in which the sterility of the peritoneal cavity can be maintained although the stomach and jejunum have been opened and the field contaminated. After the skin incision has been made, some surgeons clamp sheets to the subcutaneous tissues. The incision is then deepened through the fascia and muscles, the peritoneum opened, and the stomach and the jejunum delivered into the wound. The jejunum is stripped free of its fecal content, and an intestinal clamp with rubber-covered blades applied lengthwise. The stomach is clamped in a similar manner. The immediate operative field is padded off with hot gauze pads and the surrounding sheets are further protected with additional towels. The stomach and jejunum are then brought into proximity by an approximating Cushing suture, using Pagenstecher linen thread on a straight round needle. This suture should be sufficiently long to completely encircle the stoma between the stomach and intestines. The needle and thread are protected with gauze for the time being. The stomach and intestine are now ready to be opened. From now on until a sterile field is reëstablished everything contaminated from contact with the open gut should be placed on a tray provided for dirty instruments. The surgeon and his assistants must not touch anything on the clean instrument table, and the sterile nurse must avoid touching with her gloved hands anything that has come into contact with the contaminated operative field. After the redundant mucous membrane has been trimmed, the mucous coat of the stomach is ready to be united to the contiguous mucous coat of the jejunum. This is accomplished with through-and-through lock stitch using number 0 or 1 chromic catgut on a round straight needle for one-half the circumference of the opening, a through-and-through Cushing stitch completing the closure. The *contaminated field is now sealed off;* clamps, soiled gauze pads, instruments and towels are removed and the gloves of the surgeon and his assistants are either washed in bichloride or exchanged for a new pair. The suture line is cleansed with saline solution and fresh pads reapplied. The suture is reenforced with Cushing suture of Pagenstecher linen thread, as a continuation of the original approximative linen suture

After the opening of the transverse mesocolon has been sutured around the union between the stomach and the jejunum with interrupted number 1 plain catgut on a round curved needle, the gut is washed with saline solution and fresh towels placed about the operative field. The hands are again washed with bichloride, the gut returned into the peritoneal cavity and the abdomen closed.

This will give an idea of the great care which must be taken throughout the operation to maintain strict asepsis, and the nurse must be ever on the alert to see that the technic is rigidly followed.

After Treatment.—There is some degree of shock following this type of operation, and it is necessary to administer saline hypodermatically, or by rectum by Murphy drip. The drip should be kept on for about four hours and off for two. This will prevent irritability of the rectal mucosa, and insure the proper absorption of the fluid. But as soon as the patient is receiving sufficient nourishment by mouth the drip may be discontinued.

When the patient has recovered from the anesthesia, he should be placed in Fowler's position (page 59), for this position favors the passage of the ingested food through the new opening, the gastroenterostomy stoma. Some surgeons are in the habit of allowing fluids within a few hours after the anesthetic nausea and vomiting have disappeared. Water is given in dram doses every hour, and if it is tolerated, after a few feedings an ounce of peptonized milk is allowed every two hours, alternating with water every two hours. This may be followed on about the second or third day by an ordinary Lenhartz diet. In some hospitals, a special gastroenterostomy diet has been arranged for these patients. Outlines of these diets will be found in Chapter XII.

Complications after Gastroenterostomy.—*Hemorrhage.*—Occasionally, after the operation, the pulse may mount in frequency and the patient exhibit all the clinical symptoms of hemorrhage. This is evidence of gastric bleeding. The patient should immediately be placed in an upright position in bed, and cold applied over the upper epigastrium by ice bags, ice coils or cold compresses. Cold may be applied internally by permitting the patient to swallow small pieces of cracked ice. Adrenalin hydrochloride, 1-1000 may be given in saline solution by mouth to control the bleeding for its local action as a vasoconstrictor is well known, and at times it is a very efficient hemostatic.

Vomiting.—In spite of the fact that an operation has been performed upon the stomach itself, the surgeon will order a gastric lavage eighteen to twenty-four hours after operation if the vomiting is persistent; this may be repeated as often as is necessary.

Perforated Gastric Ulcer.—Ante-Operative Treatment.—Patients suffering from a perforation of a gastric ulcer have, as a rule, a beginning peritonitis, and as they are more or less in a condition of shock, it is advisable that before operation ¼ grain of morphine be given hypodermically. This will relieve to a degree some of the intense cramp-like pains and will make the inductive stage of anesthesia smoother so that the struggling is less. If they are in a state of severe shock, a preliminary infusion of about 550 c.c. of saline should be given.

Operation.—The abdomen is opened, the region about the stomach carefully padded off with moist hot pads and the perforation hunted for. When found, if practical, it is enclosed and inverted with a purse string suture. A thorough lavage of that region of the peritoneal cavity is performed by washing out the upper abdomen with warm saline, sponging out the saline or using an aspirator attached to a suction machine. Some operators are accustomed to leave 500 c.c. of saline in the abdomen before closing. The question of drainage is left to the discretion of the individual surgeon.

Post-operative Treatment.—As soon as possible the patient is placed in the Fowler position, and if greatly shocked a clysis is given, of 500 to 750 c.c. of saline. Some prefer the administration of saline by rectum, given by Murphy drip, four hours on and two hours off. Feeding is begun after eight to twenty-four hours, and the patient may be placed upon a Lenhartz diet. As a matter of fact, treatment for this condition is almost the same as that for a gastroenterostomy.

Cancer of Stomach.—The symptoms of which the patient will complain are determined by the area in which the growth is located. If it is near the cardiac end where it does not interfere with the functions of the stomach there may be no symptoms at all. If it is in the fundus of the stomach there may be pain, vomiting, loss of weight and anemia. If it is in the pyloric portion, these symptoms are duplicated and there is a greater tendency to vomit because of the obstruction. Examination of the stomach contents in these cases may reveal a low acid content, no free hydrochloric acid, and often the presence of lactic acid. X-ray examination is sometimes a valuable aid to diagnosis, and, occasionally, the tumor mass may be felt in the upper abdomen in the position of the stomach.

Surgical Treatment of Cancer of Stomach.—The only hope in cases of gastric cancer is partial or complete excision of the stomach (gastrectomy). The operation is rather shocking and the mortality is high. The technic for operation and the post-operative care are practically the same as that already described in the treatment of gastric ulcer.

Treatment of Duodenal Ulcer.—This is practically the same as the treatment for gastric ulcer.

Surgical Conditions of Intestines.—There are many diseases affecting the intestines but the interesting ones from a surgical standpoint are those resulting in perforations and new growths. The intestines may be the seat of perforation as the result of typhoid, or tuberculous ulcers, or they may be torn by some traumatic condition resulting from a stab or bullet wound. The symptoms are those of peritonitis. The operation at first is in the nature of an exploratory laparotomy. A search is made for the injured intestine and when found the wound, if small, is closed by a purse string suture. If the wounds are multiple, it may be necessary that that part of the intestine be resected, and the two open ends of the gut which have resulted may then be joined together by what is known as an end-to-end, end-to-side, or side-to-side anastomosis (Fig. 6, A, B, & C). Resection is also employed in conditions of intestinal growths, either benign or malignant.

If the condition of the patient is too poor to warrant the time necessary to anastomose the intestines with suture, a Murphy button may be employed (Fig. 6, D). This is a perforated metal button consisting of two halves. One half is introduced into one open end of the intestine and the intestine drawn over it by suture. The other half is inserted into the other open end of the gut. The two parts of the button are then locked together, thus anastomosing the walls of the intestine. The

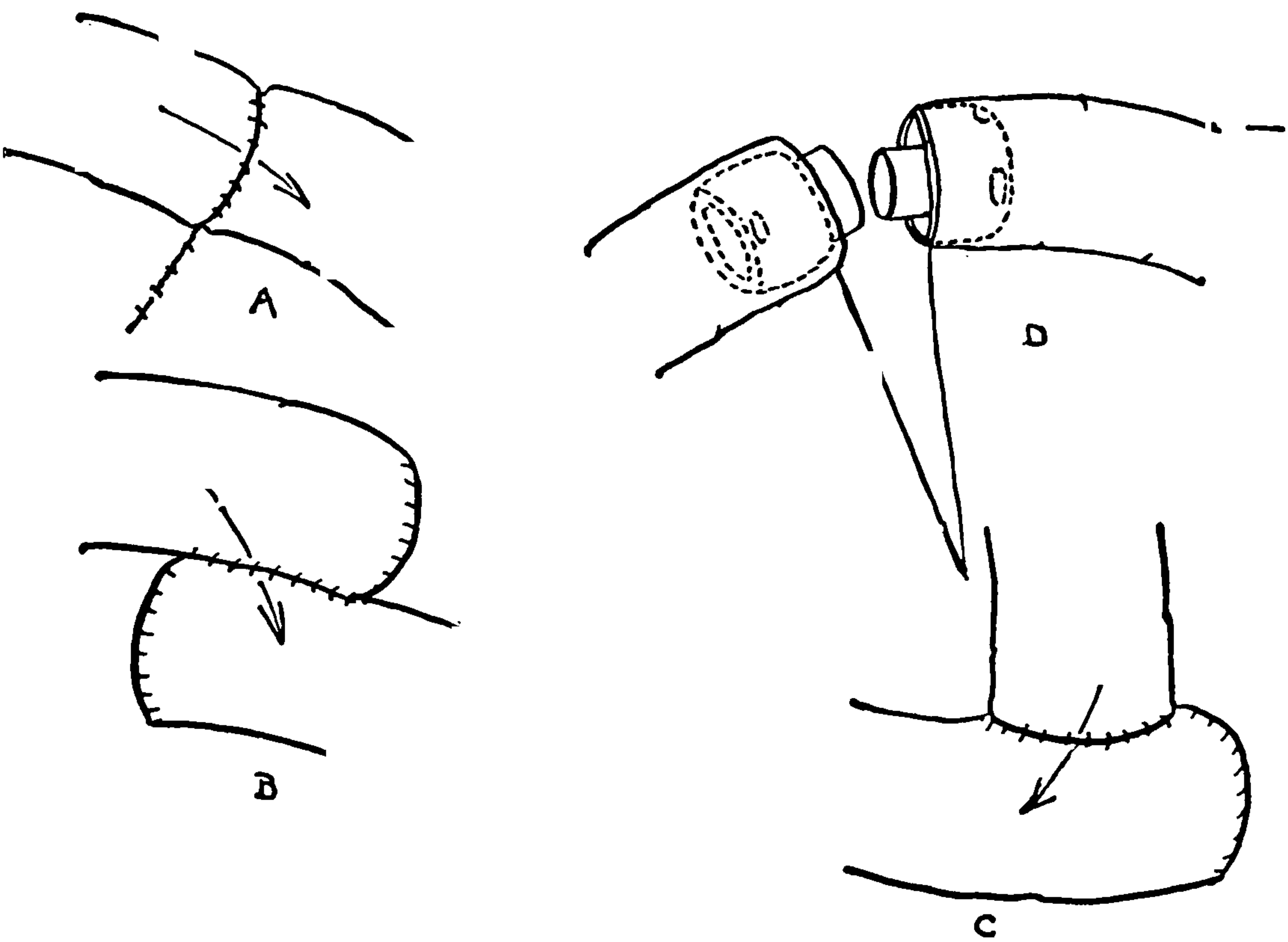


FIG. 6.—TYPES OF INTESTINAL ANASTOMOSES. *A,* end to end; *B,* side to side; *C,* end to side; *D,* end to end by Murphy button.

button eventually passes along the intestine after the union between the bowel segments has become firm.

Post-operative Treatment.—Operations upon the intestines require the same care practically as that following operations upon the stomach, except that cathartics by mouth should not be given too early, and, when one is given, a mild cathartic rather than a severe purgative should be prescribed. While the patient should be kept free from pain, too much morphine should not be administered, for there is always danger of intestinal paresis due to overdosage of this powerful hypnotic. Should the patient become distended, an irritative enema should be administered, and after the fourth day colon irrigations may be employed without any danger. If a Murphy button has been used for anastomosis, all stools should be examined for the presence of the button, and its passage should be immediately reported.

Intestinal Obstruction.—This is a condition in which the normal passage through the intestinal tract is interfered with, either partially or completely. The symptoms naturally will vary according to the locality of the obstruction. If it is high up, near the duodenum, vomiting is an early symptom; if low in the ileum, distention is more marked.

Treatment.—Immediately after a diagnosis of intestinal obstruction, an exploratory celiotomy is performed with the hope of finding the cause of the obstruction and relieving it.

Ante-operative Treatment.—In all cases of intestinal obstruction it is very essential that the stomach be washed just before giving the anesthetic. This will save a great deal of annoyance later, because the danger of aspirating the foul materials stored in the stomach is reduced to the minimum. If the patient is very weak or greatly shocked it is advisable to administer the clysis of saline either before the operation or at the same time the operation is being performed.

Operation.—Inasmuch as the actual surgical conditions in most cases of intestinal obstruction are not diagnosed until the operation, the operating room nurse should be ready at a moment's notice for anything from an *enterostomy* to an extensive resection. Since these operations demand a complete exploration, there should always be on hand plenty of pads and hot saline to care for the intestines as they are brought out from the peritoneal cavity. If, after the obstructive element has been found and removed, the distention is still great to the point of paralysis of the smooth muscle of the intestine, an enterostomy might be performed. This is an incision into the bowel for the purpose of inserting therein an L-shaped glass tube known as a Paul's tube, or a simple rubber one. The open end of the glass is connected with rubber tubing which drains into a bottle provided for the escape of the intestinal contents.

This operation practically amounts to the formation of an artificial anus.

Post-operative Treatment.—If an enterostomy has been done, the treatment is the same as that prescribed following intestinal injuries. If the tube has been placed in a high portion of the jejunum, peptonized milk, beaten egg and other nutritive fluids may be introduced through it via a catheter entering the descending loop of gut; the original enterostomy tube should be temporarily clamped after the feeding has been introduced. It is very important that these cases should be given plenty of fluid either hypodermically, rectally, or by infusion. The skin about the enterostomy opening should be well protected against the irritating influences of the intestinal contents either by albolinated gauze or Beck's paste.

Intussusception.—This condition is a form of intestinal obstruction brought about by the telescoping of one portion of the bowel into the other. The treatment, as a rule, is operative entailing a reduction of the intussusception, or if the bowel is gangrenous, a resection of the involved portions. There is nothing special in its nursing.

Appendicitis.—This is one of the most common operations performed today, and the cases in which the nurse will be called upon to assist may be divided into three great groups.

1. Interval or Chronic Appendicitis.
2. Acute Appendicitis without perforation.
3. Acute Appendicitis with perforation.

1. The Interval Appendix.—This is called an interval appendix because the operation is performed after an acute attack has passed away and before another acute attack makes its appearance. In other words, it is an acute appendix which has subsided, or has become what may be termed a chronic appendix.

Symptoms.—These may vary tremendously from vague digestive disturbances manifested by gaseous eruptions, pain and flatulence, to definite pain localized in the right lower quadrant, the usual anatomical position of the appendix.

Treatment.—After a definite diagnosis has been made, the appendix is removed. The operation is termed appendicectomy.

Ante-operative Treatment.—The routine ante-operative

the public upon this subject. Sudden pain in the right iliac fossa with tenderness and slight fever accompanied by nausea or vomiting point, as a rule, to acute appendicitis.

Treatment of Acute Appendicitis.—While most surgeons are agreed that all cases of acute appendicitis should be operated upon as soon as the diagnosis is made, there are some patients who, in spite of all persuasion, refuse immediate operation. Then again, when there is extensive pulmonary tuberculosis, bad cardiovascular disease, or diabetes, the *expectant treatment* might be followed. Of course this is dangerous. The family should be warned of the consequences, and the patient carefully watched. Blood counts should be taken often, and should the pulse rate and the number of white blood cells increase, although the temperature does not vary, an operation should be performed, even if local anesthesia has to be resorted to. If the non-operative treatment is to be pursued, the patient should be put to bed, the knees flexed with a pillow underneath them and ice bags applied to the abdomen. The bag should be left on for two hours and off for one. Nothing should be given by mouth while there is vomiting. After the nausea has subsided, water may be given in teaspoonful doses. This may be augmented later by albumen water, milk and lime water, broths and meat juices. Enemas should not be given promiscuously, and if at all, in small amounts and with great care. When the acute symptoms have subsided a saline cathartic may be given by mouth.

Ante-operative Treatment.—Fortunately, most of these cases are generally operated upon as soon as the diagnosis is made. Naturally no cathartic is ever given by mouth, but, if the patient is in good condition, the lower bowel may be cleaned by a soapsuds enema. This does much to render post-operative recovery smooth and uneventful.

Operation.—The procedure is the same as that in interval appendicitis and if the appendix has not ruptured, the abdomen is sewed tightly without drainage.

Post-operative Treatment.—The treatment is identical with that prescribed for interval appendicitis, except that occasionally eight ounces of tap water might be administered by rectum and the patient ordered in Fowler's position if there was free fluid in the pelvis. (The Fowler position is a semi-erect position obtained by either elevating the head of the bed and flexing the knees with a pillow or by adjusting the gatch bed.) A cathartic is generally given on the third or fourth day. If everything progresses smoothly the patient is allowed up on the ninth day.

Acute Appendicitis with Perforation.—This is a condition of acute appendicitis complicated by a perforation which either forms an abscess about the appendix or results in a diffuse spreading infection of the peritoneum (peritonitis). The symptoms are those of acute appendicitis, only more severe.

Ante-operative Treatment.—The treatment is the same as that which has been outlined for acute appendicitis.

Operative Treatment.—The appendix is removed and the stump inverted whenever possible. The abscess cavity is freed of its pus, and a drain is introduced into the cavity or into the lower pelvis. The drainage material may be any one of the substances discussed on page 310, Chapter XVII.

Post-operative Treatment.—The treatment is similar to that of acute appendicitis, except that the patient is usually more acutely ill, and occasionally shocked. The patient is placed in Fowler's position and saline is given liberally by Murphy drip. Dressings are generally done daily. The patient is kept in bed until the drainage tube has been removed and the wound is practically healed.

Complications.—The complications apt to occur are those which follow any abdominal operation for peritonitis. Those cases in which there is a persistently high temperature and an increased leukocyte count should make one suspect a *secondary abscess.* If a mass is felt through the rectum, definite proof of a secondary pelvic abscess is established. This condition does not always demand operation to establish drainage of the abscess, as in some cases the mass might be absorbed by efficient hot colon irrigations given at four-hour intervals.

Occasionally a dressing which has been previously pussy, may be covered with blood. This is evidence of a *secondary hemorrhage.* The attending surgeon should be called without any loss of time, and the wound packed temporarily to control the bleeding. The bleeding vessel is then sought and ligated.

Now and then, quite soon after operation, the dressing may be covered with feces; a sign that the dreaded complication of *fecal fistula* has occurred. All drainage tubes are removed, and the wound is treated as any enterostomy or colostomy. Dressings are changed at frequent intervals, and the skin is protected and kept scrupulously clean. Fortunately, most of these cases heal eventually, although convalescence is long and protracted.

Recently, cases of appendicular abscesses have been treated by the Carrel-Dakin method. The technic of its administration is described in Chapter XIX.

The Colon.—Within recent years the surgery of the colon has made tremendous strides because of the attention drawn to it by the much discussed topic of colonic stasis and its relationship to autointoxication. While many of the English surgeons excise the colon in cases of obstinate and obdurate constipation, complete or partial colectomy is done mainly for new growths of the large intestine. In certain types of cases where an artificial anus has to be established as a preliminary measure, *colostomy* is done, or the colostomy may be the only advisable palliative measure for inoperable carcinoma. The surgery and nursing entailed for colon cases is practically the same as that for the intestinal variety both from the ante-operative and the operative standpoint. The only difference is found in the post-operative treatment; all rectal medication should be omitted for as great a period as is possible.

Colostomy.—A colostomy is an incision into the colon for the purpose of short-circuiting the fecal contents and of establishing an artificial anus. The operation of colostomy is simple. The desired part of the colon is brought into the wound, then a glass tube is passed through the mesentery of the colon, so as to prevent the colon from slipping back into the peritoneal cavity. (Fig. 7.) The exposed colon is then sealed off from the peritoneal cavity by suturing it to the parietal peritoneum.

Post-operative Treatment.—The colon is covered with vaselinated gauze, and a sterile dressing applied. The patient is fed but little and to further constipate the patient a pill of opium, grains 2, may be given for the first four or five days. On about the third or fourth day the exposed loop of colon is opened with the aid of an actual cautery, establishing the artificial anus. There are several factors that are of importance in caring for a patient with a colostomy. If possible, an attempt should be made to regulate the movement of the bowels and the food given should be of a constipating variety, so that when the bowels move, the movement should be hard and formed, instead of loose and diarrheal. The skin surrounding the colostomy is apt to become irritated. It should be protected by an ointment of bismuth subnitrate and zinc oxide to which may be added a little oil of eucalyptus.

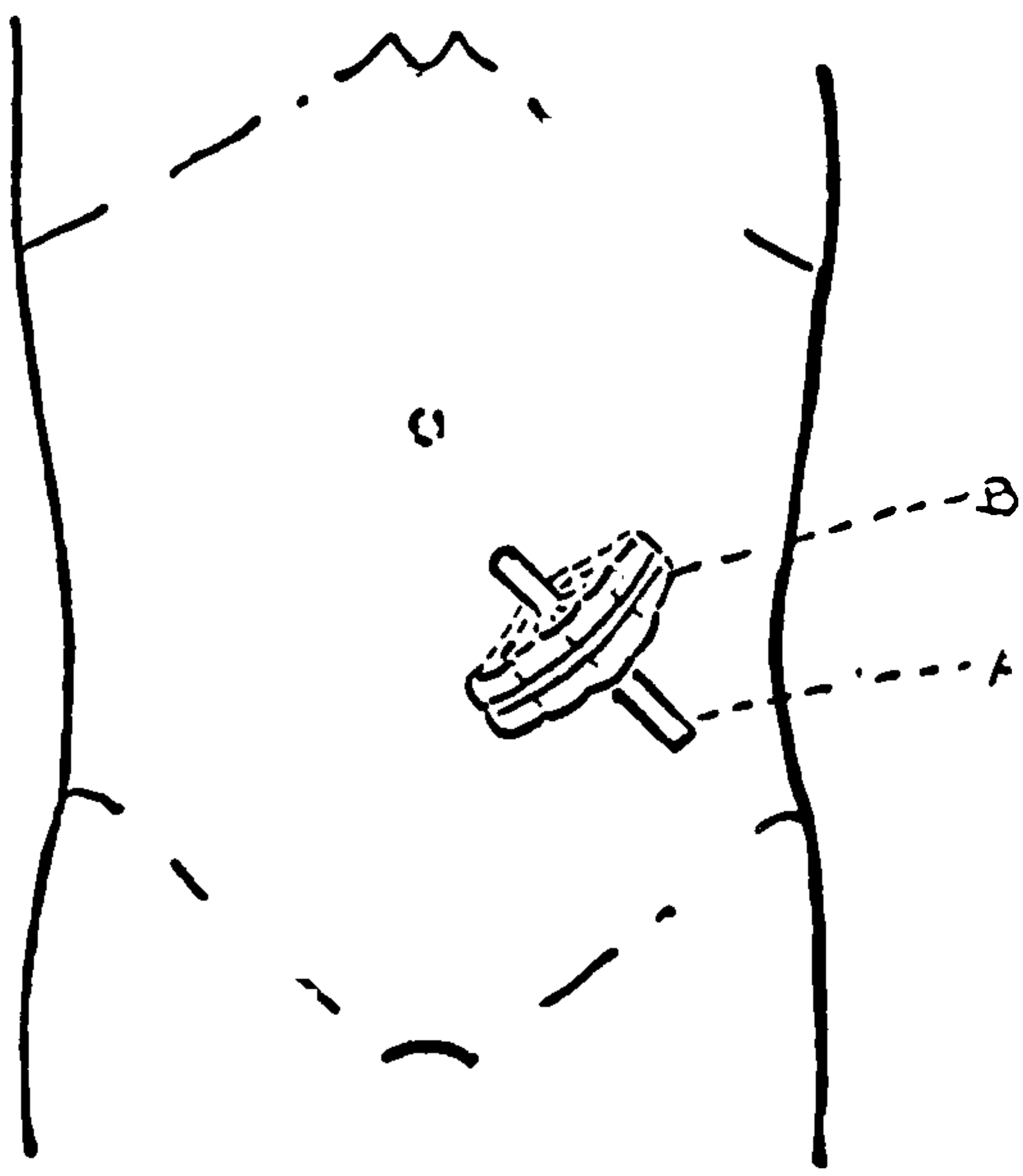


FIG. 7.—COLOSTOMY BEFORE BEING INCISED. *A*, glass rod passed through mesentery of colon; *B*, exposed loop of colon.

If at any time, however, there is no movement from the artificial anus, and general distention is evident, there should be no hesitancy in giving an enema through the colostomy opening. It is not advisable to give cathartics by mouth, especially the saline variety, for it should always be remembered that these patients have practically no control of their bowel movements, and watery stools cause a constant soiling of their dressings. After a while the patient may wear a colostomy bag, a rubber appliance which is worn over the artificial anus to collect the feces. This is held in place by straps. (Fig. 8.)

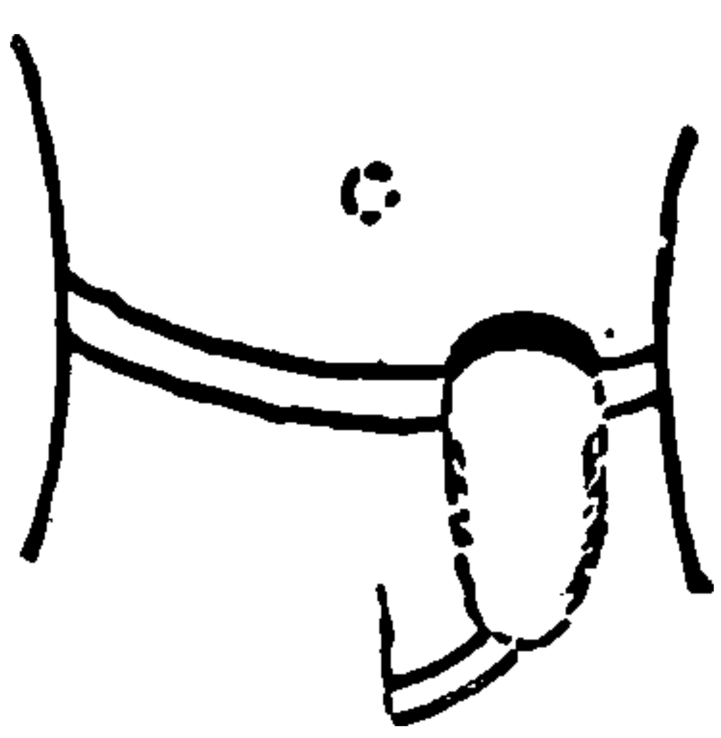


FIG. 8.—COLOSTOMY BAG.

The Rectum.—The important conditions from a surgical standpoint occurring in or about the rectum are: (1) ischiorectal abscess, (2) fistula in ano, (3) hemorrhoids, (4) cancer of rectum.

Ischiorectal Abscess.—An abscess about the rectum is like an abscess in any other part of the body except that it might communicate with the rectum, and if not treated properly a fistula might result. This is a tract connecting the skin and rectum. For this reason it is always better to incise and drain the abscess as soon as possible, packing the abscess cavity and permitting it to granulate from the bottom.

Fistula in Ano.—This may be the result of a poorly treated ischiorectal abscess. It is important in treating the fistula that the tract be excised in its entirety by careful and complete dissection.

Ante-operative Treatment.—A cathartic is given twenty-four hours before operation, usually an ounce of castor oil. Four hours before operation, the lower bowels should be thoroughly washed with a warm soapsuds enema. At least three of these should be given. If the third return is not clear, more enemata should be administered until the rectum is absolutely cleansed. This rectal treatment should not be administered just prior to operation, because much of the liquid material is apt to be retained and the surgeon is hampered in his work by the escape of rectal fluid. Some surgeons inject the fistulous tract with a solution of methylene blue, a dye which colors the tract making its ramifications evident. This may be done before or after the anesthesia has been begun.

Operation.—Until the patient regains consciousness, the legs should be tied together. In operations about the rectum, retention of urine is apt to result and great care should be taken lest the bladder become distended. The diet should be constipating and to further constipate the patient a pill containing opium is given three times a day. The bowels should be moved upon the fourth day, and, after the movement, the parts washed with soap and warm water, and fresh packing introduced. The packing must be changed each time the bowels move, if stained with fecal material. The dressing of these cases is exceedingly important. If the packing of the cavity is left to the nurse, she should very conscientiously see that it is firmly and securely introduced into the depths of the granulating cavity. The proper healing will do much to prevent a recurrence of the fistula.

Hemorrhoids.—Piles are simply dilated veins about the rectum. They are divided into the internal variety (those situated above the internal sphincter), and the external variety (beneath the external sphincter). Piles may be a source of annoyance by their protrusion, their bleeding, or the veins may become inflamed and thrombosed.

Ante-operative Treatment.—The treatment does not differ from that of an ischiorectal abscess.

Operative Treatment.—After the patient is anesthetized, the sphincter ani is dilated manually as a preliminary step to the operation. This gives a better exposure of the interior of the rectum, and by paralyzing the sphincter, the after pain is less, since the muscle about the rectum cannot contract.

The piles are removed by (1) simple excision, (2) clamp and cautery, or (3) by ligating the pile-bearing area. After the operation has been performed, some surgeons insert a rectal tube around which has been wrapped two or three layers of vaselinated iodoform gauze. The advantages of this are twofold: it prevents hemorrhage and it enables the accumulated gas to escape; but it has the great disadvantage of being rather painful and uncomfortable for the patient.

Post-operative Treatment.—The same measures are taken as for an ischiorectal abscess, except that on the fourth day, when the cathartic is given, immediately before the patient moves the bowels, six ounces of warm olive oil are introduced into the rectum through a tube. This softens the accumulated feces and lubricates their passage. Following the movement of the bowels, the patient should be instructed to take Sitz baths, night and morning. These are comforting and are very helpful in healing the denuded areas about the rectum. For a period of two to three weeks after operation, the patient should receive nightly an ounce of licorice powder, as it is essential that the bowels be kept soft and loose. The patient should be put on an anticonstipation diet, a good example of which may be found in Chapter XII on diets.

Complications.—The great danger in a hemorrhoid operation is that of hemorrhage. If a patient begins to faint and to show the signs of hemorrhage, even though no blood is visible externally, which might happen if a rectal tube is not inserted, the attending surgeon should be immediately summoned. The patient is placed under anesthesia, a tube "en chemise" is introduced and the rectum firmly packed. A tube "en chemise" is simply a rubber tube to the rectal end of which gauze is attached. (Fig. 9.) It is inserted into the rectum and packing is introduced between the tube and gauze, thereby exerting pressure on the bleeding area. Sometimes the bleeding point itself may be ligated.

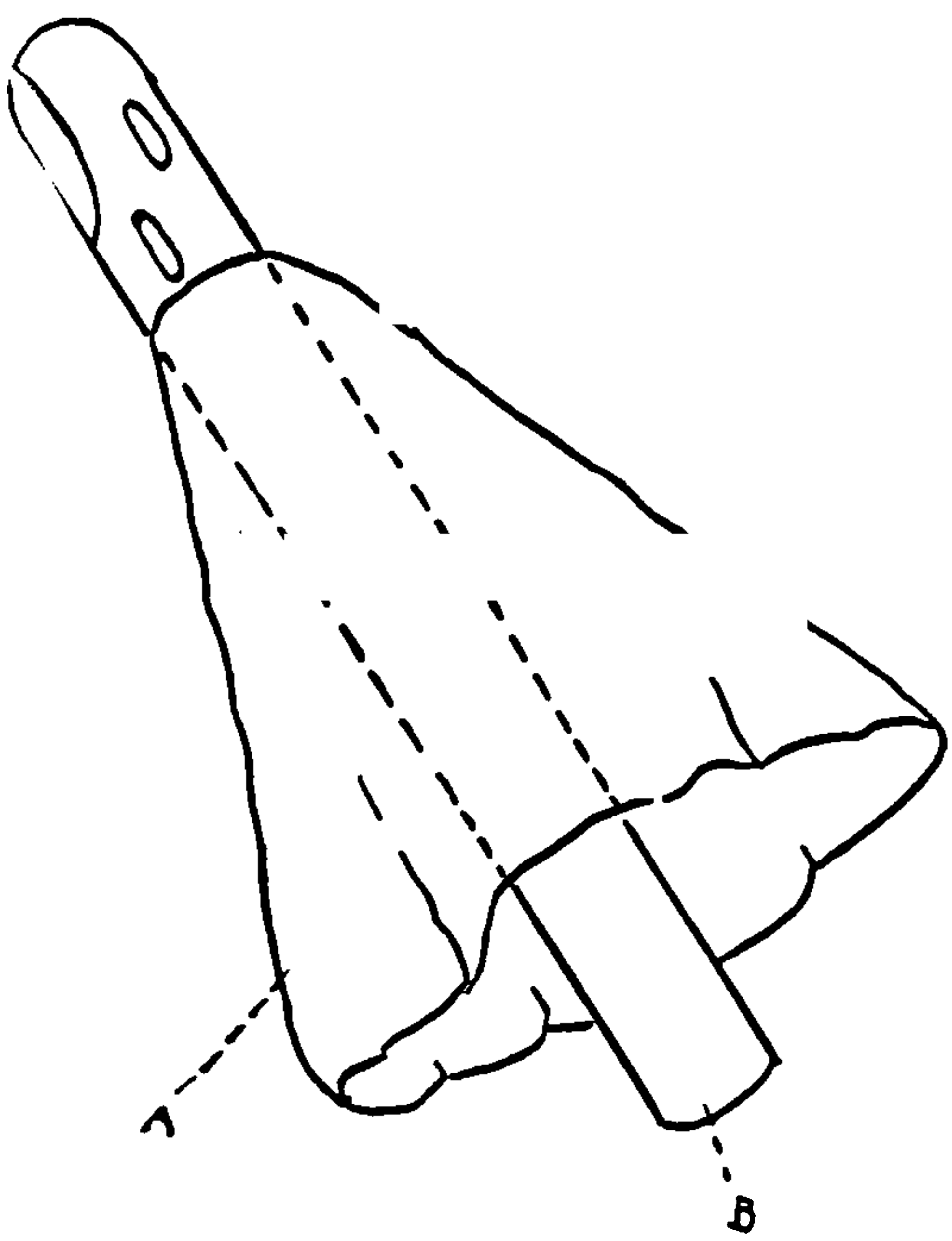


Fig. 9.—Tube "En Chemise." *A*, layer of gauze attached to rubber tube *B*.

Cancer of Rectum.—As in other locations, cancer in this region, provided it has not progressed too far, demands excision. The rectum may be excised by way of several routes, — by the perineal route, the sacral, by the vagina, through the abdomen, or by a combination of these. As a rule any excision of the rectum is preceded by a preliminary colostomy. The technic of this has already been described on page 60.

Excision of Rectum by Perineal Route.—The patient is placed in the lithotomy position (see Fig. 72, page 277), the anus is sewed up, and the rectum is dissected from the surrounding tissues until the upper limit of the growth is reached, and then it is excised.

Excision of Rectum by Sacral Route.—The patient is placed in the Kraske, or reversed Trendelenburg position (see Fig. 70, page 276), and as a preliminary, the coccyx and a portion of the sacrum are removed. This affords freer access to the rectum, and the rectum is dissected freely and excised.

Excision of Rectum through the Vagina.—In this operation

fat. Intestinal elimination should be kept free by using salts, especially sodium phosphate. There is a popular superstition that consuming olive oil aids the free passage of gallstones. This is very much exaggerated and without scientific foundation.

Operative Treatment.—Operative measures are employed when there have been repeated attacks of colic, when the stone has become impacted, or when the gall bladder is acutely inflamed or filled with pus.

Ante-operative Treatment.—The ante-operative treatment is of extreme importance in jaundiced cases because jaundice is one of the factors which prevents or delays the clotting of blood. Naturally, pre-operative measures must be taken to ensure a lowering of the coagulation time. This may be accomplished (previously mentioned in detail in Chapter III) by the administration of calcium lactate, horse serum, or transfusion.

The position of the patient on the operating table is important because the gall bladder and its passages lie deep within the abdomen, and every effort must be made to make them as accessible as possible. This is attained by placing the patient on the table so that the gall bladder bridge may be elevated, thus forcing the liver forward; or a sandbag may be placed in the region of the eleventh or twelfth ribs. Both methods yield good results. (See Fig. 65, page 272.)

Operations.—The operations which may be performed upon the gall bladder and its ducts are cholecystotomy, cholecystostomy, cholecystectomy, choledochotomy, and cholecystenterostomy.

Cholecystotomy.—This is an operation in which the gall bladder is opened, the stones removed, and the original incision in the gall bladder closed. It is not often performed because the gall bladder generally requires drainage.

Cholecystostomy.—In this operation the gall bladder is not removed, but it is drained; the drainage is placed into the gall bladder itself by burying the tube with a purse string suture.

Cholecystectomy.—This procedure is the most frequent; it involves the removal of the gall bladder and the ligation of the cystic duct and cystic artery.

Choledochotomy.—In those cases in which the stone lies impacted in the common duct, the removal of the stone by incision of the duct is spoken of as choledochotomy. This operation entails drainage of the common bile duct.

Cholecystenterostomy.—Sometimes the obstruction of the common duct is such that it cannot be removed; for example, stricture of the duct, either benign or carcinomatous. If the patient is suffering from intense jaundice, an attempt is made to short-circuit the bile. This is done by establishing an anastomosis between the gall bladder and the stomach or between the gall bladder and the small intestines. This operation is spoken of as cholegastrostomy or cholecystenterostomy.

Post-operative Treatment.—Operations in and about the gall bladder are accompanied by a great deal of shock, and as most operations involving the upper abdomen are attended by a large percentage of pneumonias, all means must be taken to insure perfect care of the patient, to prevent him from being chilled or caught in draughts.

In those cases in which the gall bladder is drained, or where a cholecystotomy is performed, the end of the drainage tube should be inserted into a bottle so that the bile may be collected, its character observed, and the amount estimated. Occasionally, bile will leak along the side of the drainage tube, resulting in a general soaking and discoloration of the dressing. If this discharge is very marked, the superficial layers of the dressing may be removed and fresh compresses applied.

It is important that all urine should be examined closely for the presence of bile, and that the stools be sent to the laboratory to determine whether bile is present. While the gall bladder is draining, the patient must be placed upon a diet which is poor in fat, because the bile salts which aid in the saponification of the fats are missing.

Surgical Conditions of the Liver.—The diseases which commonly involve the liver from a surgical standpoint are injuries to the liver, abscesses of the liver and cirrhosis of the liver.

Injuries to the Liver.—The liver may be injured by direct or indirect violence; it may be torn, with an ensuing hemorrhage. This must be treated by immediate laparotomy, packing the tear with gauze, or by suturing the tear of the liver with mattress sutures, employing a round, non-cutting liver needle. The suture material is usually chromic catgut.

Abscess of Liver.—This may be of pyogenic origin, or the direct result of amebic dysentery. These abscesses may be opened and drained directly through the abdomen, or if the abscess is high, an operation may be performed through the posterior lateral area of the chest. The parietal and visceral pleura are sutured together, and after adhesions have taken place, so as to seal off the pleural cavity, the liver is drained through this area. In this way no pus flows through the abdominal or peritoneal cavity, or through the pleural cavity. This operation is done in two stages: the first being a partial resection of the rib, with the suturing of the parietal and visceral pleura; the second is the drainage of the abscess through the area of the adhesions.

Cirrhosis of Liver.—As this condition is associated with a filling of the peritoneal cavity with fluid (ascites), and as it is presumably due to an obstruction of the portal circulation, an attempt is made to establish a collateral circulation by the Talma operation (omentopexy).

Twenty-four hours prior to operation, an ordinary paracentesis abdominalis is done. The patient is then operated upon, and a portion of the omentum brought through the anterior abdominal walls in the midline and sutured to the subcutaneous tissues. In this way the omental veins will establish collateral circulation with the internal mammary vein, thereby lessening the strain of the portal system.

The one important factor in post-operative treatment is when a patient strains, the abdomen should be firmly held so as to prevent further evisceration of the abdominal contents along with the omentum.

Surgical Conditions of the Pancreas.—The operations upon the pancreas are very few in number. The only diseases which need demand our attention are pancreatitis, either in chronic or acute forms, and cancer of the head of the pancreas. In inflammatory diseases of the pancreas, inasmuch as the bile is supposed to be an irritating and causative factor, its flow is short-circuited by draining the gall bladder (cholecystostomy).

In the meanwhile the pancreas, free from the irritating effects of bile, will gain a much needed rest, and the inflammatory process may subside.

Carcinoma of the head of the pancreas may encroach upon the opening of the bile duct in the second portion of the duodenum causing intense jaundice. Inasmuch as new growths of the pancreas cannot be excised without a terrific operative mortality and disastrous after results, the only operation done to relieve the unfortunate jaundice victims is that of drainage of the gall bladder. The nursing procedures employed in these cases are similar to those used in operations upon the gall bladder.

Hernia.—A hernia, or rupture, may be defined as "the protrusion of an organ or part of an organ or other structure through the wall of the cavity normally containing it." The rupture is named from the region in which it appears. There are many locations where, because of certain mechanical weaknesses, hernia is quite common. It occurs very frequently in the inguinal region.

Inguinal hernia is a form of rupture that occupies the inguinal canal either partly or entirely; if it occurs the condition is spoken of as an indirect hernia. A hernia making its appearance almost directly into the external abdominal ring is called a direct hernia.

Under ordinary conditions, the contents of the hernial sac will disappear into the abdominal cavity when the individual is at rest, to reappear when the intra-abdominal pressure is increased, as during coughing or arduous physical labors. A hernia which disappears is known as reducible; if because of adhesions this does not occur it is irreducible. There are several varieties of the irreducible group: Incarcerated,—a type of obstructed hernia containing bowel in which the passage of fecal material is arrested but the circulation of the intestine is unimpaired. Strangulated,—a hernia in which not only the bowel is obstructed but also the blood supply. If this condition is not operated upon very soon after its incipiency a gangrene of the obstructed loops of intestine will result.

Other varieties of hernia are femoral, which is a rupture in the region of Scarpe's triangle occurring through the femoral ring; umbilical, which is a protrusion through the abdominal wall in the region of the umbilicus. Then there are hernias which occur following operation, especially in those cases in which the abdominal wall has become weakened. These are known as post-operative hernias.

Occasionally, especially in children, the hernial sac may contain the testicle; this is known as a congenital hernia and always accompanies an undescended testis. In this condition the testicle is not in the scrotum but within the abdomen or inguinal canal.

Treatment.—Hernia may be treated conservatively with a suitable apparatus or truss (an appliance made to exert pressure over the hernial opening so as to keep the contents of the sac reduced) but since the public are becoming educated to the wonderful results obtained by surgery, it is most always treated radically by operation. There are two important principles underlying all hernia operations: the obliteration of the hernial sac, and the closure of the channel along which the hernia protrudes.

Ante-operative Treatment.—The same ante-operative routine is employed as for all chronic cases (Chapter XIII). The lower abdomen and genitals are shaved and a sterile dressing is applied. Care must be taken that the external genitalia are not painted with iodine. In the operating room, the operative field is repainted with iodine, and the penis and scrotum are enclosed in a sterile, wet bichloride towel.

Operation.—An incision is made over the external ring upward along Poupart's ligament. The external ring is identified, and the surgeon calls for a grooved director on which he cuts the fascia of the external oblique. The sac is then identified, dissected free, its base transfixed and ligated with catgut on a curved needle. The repair of the hernia, "the closure of the channel" is then performed, the suturing being done with chromic catgut, kangaroo tendon, etc. A spica bandage (Fig. 143) in addition to adhesive plaster keeps the dressing in place. A plaster spica is often used in children where immobilization is absolutely essential. If the child is very young, the spica may be coated with shellac so as to render it impervious to urine and feces.

Post-operative Treatment.—As soon as the patient reaches the ward, a pillow is placed under the knees, and as soon as he is conscious, a Bellevue bridge is applied across the thighs to support the scrotum.

The cathartic is given on the second day and, as a rule, patients are kept in bed for two or more weeks. For the first twenty-four hours catheterization may be necessary.

In cases of incarcerated and strangulated hernias after the sac has been opened, the surgeon will cover the bowels with moist warm saline towels for about ten minutes, and if there is no evidence of real damage, and their color is good, the intestines are reduced into the peritoneal cavity. If the intestines are gangrenous, an intestinal resection will have to be done. These cases are then treated like any other case of intestinal resection.

In all cases of hernia it is very important to impress upon the mind of the recently operated that for a few months, at least, all physical exercise should be of the mildest kind, and that any sudden strain must be avoided.

CHAPTER V

THE SURGERY AND SURGICAL NURSING OF THE GLANDULAR SYSTEM

In no other system within recent years has the advance been greater and the research more extensive than in the field of the glands of internal secretion. It is true that we still know very little concerning most of them. But possibly within the next decade or so there will be great light shed upon the physiology of those organs which either alone or in combination control our physical and mental make-up. Glandular tissue has been described as that tissue which has for its function the secretion of certain substances. These may be of service to the body, as the digestive juices, or they may be purely excremental in nature, removing substances which are either poisonous or waste in character.

Classification of Glands.—It is convenient to divide glands into three groups: (1) those with ducts, (2) those without ducts (the glands of internal secretion), and (3) those which are a combination of (1) and (2). As examples of glands with a duct there may be mentioned the liver, the largest gland in the body, which secretes and excretes bile through the biliary duct; the submaxillary glands, the mammary glands, the prostate, sebaceous, sudoriferous, etc. Pure glands of internal secretion may be represented by the pineal, the pituitary, the thyroid, the parathyroid, and adrenal. Those glands which are both external and internal in secretion are represented by the pancreas, the ovary and the testis.

While the surgery of these glands is limited, probably those deserving most of our attention are the liver and the bile ducts which have been discussed under the gastrointestinal tract, Chapter IV, the ovary and testis which are reviewed in Chap-

mentality is practically nil. Thyroid extract given to these unfortunates often transforms them at least from an animal stage to a point where they can protect themselves sufficiently to exist.

Myxedema.—Very often patients in adult life begin to show signs of mental sluggishness with a slow reaction time, and their faces become coarse and mask-like. In other words, they are somewhat like a cretin. Thyroid extract or any preparation of the thyroid gland, given by mouth, helps these people markedly.

Goitre.—Any enlargement of the thyroid gland that is chronic in nature is spoken of as a goitre. There are certain regions of the earth where this disease is common; it is frequently seen in some mountainous places of Germany, Austria, France, Central Asia, Switzerland, and around the Great Lakes in Michigan. It is thought to be due to some peculiar agent found in the drinking water of these districts. The symptoms which come from the goitre are mechanical, and result from pressure of the enlarged gland upon those structures which it might compress. From pressing on the wind pipe (trachea) it may give rise to a cough, or it may cause difficulty in swallowing, by pressure on the gullet (esophagus).

Treatment of Goitre.—Goitre may be treated medically or surgically. Some cases respond to the internal administration of potassium iodide. X-ray, when given in graduated doses, sometimes reduces the size of the gland. But if the goitre is large and the symptoms are aggravating and persistent, surgery is practically the only measure which will afford relief.

Ante-operative Treatment.—On the morning of operation the neck should be shaven, cleansed with green soap and water, followed by alcohol and ether, and a sterile dressing applied.

Operation.—Gas and oxygen is the anesthetic of choice. The patient is placed upon the back with a sandbag beneath the shoulders so as to put the neck upon a slight stretch. (See Fig. 85, page 289). In addition to the ordinary "set-up" of instruments, in all operations upon the thyroid, it is essential to have a tracheotomy outfit in readiness. For very often in these operations, due to pressure upon the trachea, it collapses, and unless instant measures are instituted to relieve the strangulation due to the closure of the trachea, death will readily ensue because of asphyxiation. This horrible complication fortunately is rare, but adequate preparation must always be made to meet any emergency. Inasmuch as a few seconds will mean the life or the death of a patient, everything should always be in readiness for even this rarest of operative complications.

As there is bound to be a moderate amount of bleeding and oozing from the tissues, a small cigarette drain is employed for about 24 hours, and the ordinary sterile dressing is applied. Since the line of incision in a goitre operation is quite visible in the modern female, attempts are made to minimize the scar as much as possible. To ensure perfect healing after operation the neck is usually immobilized by means of starch bandages; these form a very light and efficient means of restraining the grosser motions of the neck.

Post-operative Care.—The patient should not be permitted to talk any more than is necessary for at least a week. Attention should be paid to the character and tone of the voice. The reason for this is obvious, when it is recalled that the nerves which partially control the vocal chords lie close to the gland and may have been injured or cut during the operation. This is indeed a serious complication, because if they are cut it will result in permanent alteration of the patient's voice.

It should also be remembered that occasionally patients run a high temperature, rapid pulse, and may even be delirious. The syndrome is often spoken of as acute thyroidism. This condition should be treated with ice packs, but this will be discussed at greater length in the treatment of exophthalmic goitre.

Exophthalmic Goitre.—As a splendid example of what attention to all details in an operation will do, nothing is more striking than the reduction in the mortality of exophthalmic goitre from sixteen per cent. to practically one per cent. This has been made possible by the energetic researches of Dr. George Crile. The factors which have caused this tremendous drop have been the use of gas and oxygen as an anesthetic, local anesthesia, multiple stage operation, coping with the mental attitude, bringing the operation to the patient, and the employment of the ice pack in cases of acute thyroidism.

Symptoms.—Patients with exophthalmic goitre as a rule are recognized immediately by the fact that their eyes are prominent and protrude, and that they are extremely nervous. Their pulse rates vary from 90 to 120, and sometimes even higher. In other words, they have what is called tachycardia. Their skin as a rule is moist, and they perspire freely. A very definite swelling of the thyroid gland is often visible. These symptoms all point to a poisoning from either an increased amount, or a perversion of the thyroid secretion. It does not take much imagination to realize that, above all else, these patients need peace and quiet. They are nervous to the extreme. Association with others, incessant talking, and noises tend greatly to aggravate them and increase their pulse rate. The keynote in the care of these patients is rest under ideal surroundings and treatment administered so tactfully and carefully that the shock to the nervous system will be of the minimum.

Treatment.—Medical.—All cases of exophthalmic goitre should, as a rule, be treated medically at first. The treatment consists of rest in bed, complete isolation from society, a diet of high caloric value with forced feeding, and the administration of sodium bromide to relieve the intense nervous excitement. Some physicians give iodine internally, and some use thyroid extract. Detailed accounts of the medical nursing in these cases may be found elsewhere.

Surgical.—It is in the surgical treatment of hyperthyroidism that tremendous strides have been made. The patient at present is not operated upon the day after she enters the hospital. These highly nervous women are no longer subjected to the terror of being ridden directly to the operating room and arriving there with a pulse of 140; then, in their weakened condition, subjected to ether anesthesia and a shocking operation, with the result that having little stamina left, they usually succumb within twenty-four hours after a partial thyroidectomy has been attempted.

Ante-operative Treatment.—In the treatment of these cases it cannot be emphasized too strongly that great tact and care

The anesthetic which is used is nitrous oxide and oxygen, and, in addition, the line of incision is usually first injected with novocain, ½%. The operation is usually done in stages; that is, the blood supply to the thyroid is first lessened by the ligation of the superior thyroid arteries, and then the inferior thyroid arteries. This may be done under local anesthesia, or under gas and oxygen. The reason for the preliminary ligation is to diminish the blood supply of the thyroid. This simple procedure is very often all that is necessary, and with it the symptoms of hyperthyroidism abate and the patient needs no further surgical treatment. If, on the other hand, the symptoms are not definitely improved, at least the blood supply of the gland is lessened, so that when the thyroid is removed, the hemorrhage will be materially decreased, the degree of shock less, and a speedy recovery of the patient assured.

Post-operative Treatment.—The patient should be kept especially quiet and given plenty of fluid by rectum. Very often these patients are subject to a sudden rise in temperature, sometimes as high as 106 degrees, and an increase in pulse rate that is rapid and thready. Their faces become pinched and covered with perspiration; they are apt to become delirious and die within a very short time. These symptoms are thought to be due to an acute hyperthyroidism. It has been found that as soon as these symptoms occur, they can be controlled by the use of the *ice pack.*

Occasionally, following the operation there may be a hemorrhage from the operative wound. The bandage should be reinforced and the operating surgeon immediately summoned. More rarely a condition of edema of the glottis may develop. This is evidenced by difficulty in breathing, cyanosis of the patient, and a bubbling respiration. This condition demands immediate attention, often tracheotomy (Chapter IX, page 122), and no time should be lost in summoning the medical officer in charge.

Following any operation upon the thyroid, especially of exophthalmic variety, the patient should be given a prolonged rest in some quiet mountainous resort The surroundings should be congenial, and the patient should not be permitted to return to her usual environment until the attending physician feels assured that she can stand the strain.

Tetany.—Occasionally after rather an extensive removal of the thyroid gland, a peculiar condition may result, namely that of tetany. This is presumably due to the fact that the parathyroid glands which are closely attached to the posterior surface of the thyroid have been partially removed.

The symptoms of tetany are intermittent, bilateral spasms confined to the extremities. These paroxysmal attacks may be controlled by the administration of calcium lactate, about fifteen grains every three hours.

CHAPTER VI

THE SURGERY AND SURGICAL NURSING OF THE NERVOUS SYSTEM

THE nervous system consists of the cerebrospinal and the sympathetic or autonomic systems. The cerebrospinal division is made up of the brain with the twelve pairs of cranial nerves and their peripheral modifications, and the spinal cord with its thirty-three pairs of spinal nerves and their peripheral modifications. The autonomic division comprises the sympathetic ganglia and their ramifications.

Fractures of the Skull.—While these injuries should really be included in the chapter on the Osseous System, they are so closely related to cerebral trauma that a brief discussion here might be deemed more advisable. Fractures of the skull may be divided into those of the vault and those of the base. Fractures of the vault may be simply fissures in the bone, or the bone may actually be depressed and splintered into several fragments. These cases are often accompanied by injuries to the blood vessels of the dura or pia mater, or by actual laceration of the brain substance. If it is a simple fracture, the treatment is that of elevating the depressed bone with forceps, or periosteal elevators, and should some of the fragments be splintered very badly they may be removed with rongeurs or punch forceps. Occasionally it may be necessary to trephine; this is described on page 82.

Fractures of the base are more serious because of the great danger of injuring the important brain structures in this location. As a rule, there is bleeding from the nose, sometimes the ears, and occasionally the pharynx. The treatment consists of absolute rest and quiet. The head should be slightly elevated and fixed between two pillows. If there is bleeding from the nose it is advisable to irrigate the nasal fossæ with warm boric solution to prevent the clot from becoming foul through infection

results from a rupture of one of the branches of the middle meningeal artery. Subdural hemorrhage is due to a rupture of one of the vessels of the pia mater, or a laceration of the brain with its vessels.

Ante-operative Treatment.—The head is shaved completely and iodinized. If the patient is unconscious, no anesthetic is required; if not, a little chloroform is sufficient. The head is supported on a sandbag, or small prop. (See Fig. 83.)

Operation.—A curved incision is made in the temporal region of the head, the temporal muscle turned down, and an opening made into the skull by means of an instrument called a trephine. This, by virtue of its circular serrated end, cuts out a button of bone. After the bone has been removed, the dura beneath is exposed. If better exposure is necessary, it may be obtained by enlarging this opening, by clipping away more bone with the bone-cutting forceps, or if the surgeon prefers to keep the bone intact, he may make two more trephine openings, and connect them with cuts made by a Gigli saw. This will remove one large plate of bone that may afterwards be replaced. The clot is then removed, and the bleeding vessels are found and ligated, or special Cushing clips (small metal clips) are placed upon the artery. If the bleeding is subdural, the dura is incised, and the source of the hemorrhage sought and controlled. The dura is then closed with interrupted sutures. The bone which had been kept in warm sterile saline is replaced into the skull, as a rule, and the wound closed with or without drainage. A good tight pressure bandage is applied over the entire head. (Figs. 122 and 123.)

After Treatment.—Patients should be kept in bed for about two weeks. During this period they should be allowed very few visitors, and absolutely no excitement. They should never be left alone. If unconscious, catheterization should be performed every eight hours, and the bowels moved by enema once a day, unless incontinence is present. In these pitiable cases great care must be taken to keep the patient exceptionally clean and free from feces and urine. Unconscious patients must be turned every four hours so as to prevent pressure necroses or bed sores, which are always a bad reflection on the nursing care, although often absolutely unavoidable. If the skin, especially around the bony prominences such as the sacrum, the heels, and elbows be carefully bathed with alcohol, gently massaged and powdered there is very little danger of this necrosis taking place, particularly if these regions are elevated for a few hours each day by inflated rubber rings. During convalescence, the patient's mind should not be subjected to any mental strain whatsoever, and the surroundings should be very quiet.

Brain Abscess.—Occasionally, septic complications, or intracranial suppuration may follow compound fractures of the skull, cerebral injuries, infections of the middle ear, and disease of the mastoid antrum. The diagnosis is sometimes very difficult, and the treatment is dependent upon the location of the focus. As for abscesses in other parts of the body, the immediate indication is drainage. In the brain abscess this presupposes a craniotomy (already outlined) with drainage of the abscess cavity.

If the abscess is due to a suppurating middle ear, the treatment is a little more involved. To begin with, if pus is present in the middle ear, it must be freely drained by incising the drum. This is often done under gas, and the tympanic membrane incised by a small, spear-like knife (myringotome). Some surgeons are not in favor of syringing the ear in the beginning, but keep the drainage free by wiping the meatus clean with cotton several times a day. Others prefer to have the ear syringed almost immediately with warm boric acid solution at least three times a day.

Mastoiditis and Sinus Thrombosis.—If the pus spreads from the middle ear it frequently causes an infection of the mastoid cells (mastoiditis); if it enters the region of the lateral sinus (really a vein running in a groove of the temporal bone) a sinus thrombosis may result. These conditions are treated by surgical intervention.

Ante-operative Treatment.—The hair in the region of the ear should be shaved for a considerable extent, and if the jugular vein is to be ligated, the neck should always be very carefully prepared.

Operation.—The operation consists in laying open and gouging out the mastoid cells, and if sinus thrombosis is present, an exposure of the lateral sinus. In case the sinus is involved before it is incised, the vein into which it drains (internal jugular) is ligated in the neck. The reason for this is to prevent the spread of infection down the jugular vein into the general circulation. After the vein has been ligated, the sinus is incised. the clot removed by careful flushings with warm saline solution, and the sinus packed.

After Treatment.—Patients suffering from a sinus thrombosis are very sick. As a rule, they are septic and, like all those cases, require plenty of fluid and sufficient calories to supply the energy their constitutions demand to fight the bacteria in the blood. Not only should they be given saline freely by rectum, but if necessary, also glucose infusions of from five to ten per cent. in strength. If patients are anemic, transfusions of blood are indicated, and should be given frequently until the blood cultures are negative, or the red blood cells and hemoglobin have increased to within normal limits. The wounds are dressed daily, cleaned carefully and packed anew; the dressings are held in place by bandages. (Described in Fig. 133.)

Tumors of the Brain.—The brain may be the seat of a tumor either benign or malignant in nature. As the mass within the cranial cavity grows, it crowds the brain and produces signs of compression with its resultant symptoms. In addition, there will be other physical signs dependent upon the area of the brain that is infiltrated by the new tissue, or compressed by the tumor mass. If the motor area is pressed upon, there may be paralysis; if the speech area is involved, there will be paralysis of those muscles which they innervate or loss of function of the nerves supplying the organs of special sense, as the eye, ear and nose.

Treatment.—If the tumor mass is localized, an operation is done similar to the one described under intracranial hemorrhage. In other words, an exploratory craniotomy is performed, and the trephine opening is made in that portion of the skull overlying the brain tumor area.

Occasionally, the tumor may be extirpated in toto, but if it is found to be inoperable, a plate of bone is removed in the tem-

that position in which the tension upon the recently sutured nerve will be minimum. A plaster splint is applied, and at the end of one week or ten days, active and passive motions are begun so as to keep up the nutrition of the muscles. Massage and electrical stimulation should also be begun around this period.

The splint may be removed in about six weeks to two months. It should not be forgotten that nerve regeneration is a very slow and tedious process, and very often as much as two years will elapse before the complete, or even partial restoration of function will ensue. The patient should be encouraged to massage the muscles involved so as to prevent atrophy and he should be taught how the faradic and galvanic electrical currents are applied, so that when attendants are no longer around, he may give himself those treatments which will mean a functioning extremity rather than a paralyzed one.

If the operation is done some time after the original injury the process is more difficult and the various plastic nerve operations will have to be performed. The after care is the same as that required for recent cases.

CHAPTER VII

THE SURGERY AND SURGICAL NURSING OF THE OSSEOUS SYSTEM

FRACTURES

A FRACTURE may be described as a break in the continuity of a bone. While this condition is treated in the main by the surgeon, it affords great opportunity for the nurse to exhibit her skill not only in preparing the necessary things for the treatment of the fracture itself, but even more by conscientiously attending to those details that bring comfort to the patient. A fracture may be *simple,* that is, only involving the bone, or it may be *compound,* in which case the skin and deeper tissues as well as the bone have been injured. Compound fractures are serious and dangerous because the broken skin affords excellent opportunity for the various pathogenic organisms to enter and cause bone infection. For the present, however, our attention will be confined to simple fractures, those in which the skin is not directly injured, although it may be swollen, black and blue, and very tender to the touch.

Simple Fractures.—It is obvious that as soon as any bone is broken there is ordinarily some deformity about the site of fracture. This may be due to the hemorrhage of the torn vessels of the periosteum, or the deep muscles; or it may be due to the fact that the fragments of the injured bone are displaced. In the normal bone, a balance exists between the muscles which are attached to it. When the bone is broken, this equilibrium is destroyed and the muscles attached to each fragment tend to pull it in their own direction, thereby causing displacement. This is not true, however, in all cases. Very often one fragment is telescoped or driven directly into the other. This is spoken of as an impacted fracture.

The aim in all fractures is to restore the bone fragments as near to their anatomical condition as possible, and after this has been accomplished, the next thing to do is to keep the fragments in their reduced position. The first process is usually spoken of as "reduction," and the second process as "immobilization."

Reduction of Fractures.—Fractures are reduced as a rule under general anesthesia, either gas, gas and oxygen, or ether. This is done because it is less painful, the patient is easier to control and the muscles are completely relaxed instead of being in a condition of spasm. Attempts at reductions are done by the surgeon as soon as possible after the injury.

There are, however, certain fractures which do not yield to manual reduction because of the following reasons: (1) Too much time has elapsed between the time of fracture and the period when the surgeon was called upon to treat it, (2) the muscular pull between fragments is so great that manual reduction is impossible, (3) the fragments although reduced are not able to be retained in their reduced position, (4) because of the imposition of bone fragments, muscle or torn periosteum, the fragments cannot be brought into apposition. These fractures are treated either by means of apparatuses designed for the gradual reduction of fractures, or by open operation.

Immobilization of Fractures.—Immobilization (the means of keeping fractures at absolute rest) has for its ultimate aim the healing of the divided bone ends by the growth of new tissue or "callus formation." There are many methods designed to hold fractures in apposition. They may be classified as follows: (1) bandages, (2) strappings, (3) splints (wood, wire and plaster), (4) extension and traction appliances, (5) mechanical means applied through open operation.

It is a general rule in all fractures that the limb affected should always be placed in a position to favor the complete relaxation of the muscles which would have a tendency to pull the fragments apart, and, since the longer fragment can always be more easily controlled, it should be made to follow the position attained by the shorter fragment.

Bandages and Strappings.—While bandages are employed more in sprains and dislocations, they are occasionally used in certain fractures. Fractures of the jaw are very often con-

tured ribs to heal. It should be emphasized that the adhesive plaster dressing should never be directly applied over the area of fracture, with the exception of fractured ribs, because, with the swelling of the limb and the pressure of the adhesive, an ulceration of the skin is apt to ensue. The result is that a clean fracture may be converted into a compound one. Another rule in the application of adhesive dressings is that the part over which the adhesive is to be applied should be shaven of all hair.

Splints.—"A splint is an apparatus for preventing movement of a joint, or between the ends of a broken bone." Since materials used for splints must of necessity be hard, firm and unyielding they should always be padded well. There is nothing more distressing than to see a patient with a simple fracture of the radius just above the wrist in which the splint was not only insufficiently padded but was applied too tightly. The result is a forearm which has become blistered, ulcerated and paralyzed from the pressure; the function of the wrist being irretrievably impaired, the stiff, smooth fingers are an ignominious monument to the carelessness of the surgeon and the attending nurse. Let it be an unfailing, unalterable rule that all fractures in splints of any description be regularly inspected so that the swelling of the part never becomes so great as to impair the circulation. The pulse at the wrist in fractures of the arm and forearm, and the pulse at the dorsum of the foot in fractures of the lower extremity should always be palpable after a splint has been applied. This is simple and safe assurance that the blood flow to the limb is not seriously impaired. Very often a patient will complain of pain in an area other than that of the fracture. The splint should always be carefully inspected to determine the source of the discomfort. Occasionally in circular casts, it is a good plan to cut a window in the plaster in the area of pain so as to relieve the pressure which is invariably causing the distress. By doing this, the incidence of ulcers from pressure will be reduced to the minimum.

Before any splint is applied it is of prime importance to cleanse the injured part. The nurse, always being mindful of the injury, should do this gently and carefully, causing as little pain as possible. This procedure should be completed by dusting the skin of the broken limb with talcum powder.

Splint Materials.—Any material which is light and strong is suitable for a splint. The following are some of the more widely used materials:

Wood.—Wood has been used for centuries to support broken limbs. Probably the best splints are the basswood. Basswood splints usually come in sizes of 18x4x¼ inches. When they are padded carefully with cotton, they make a good temporary splint, and because of the lightness of the wood, they can be cut to any desired size. The one great disadvantage is that it is impossible to mould them accurately.

Plaster of Paris.—This is perhaps the most widely used splinting material in civilian practice, and, beyond doubt, its widespread application is justifiable. It is easy to obtain, strong, moderately light, and when soft lends itself to accurate and easy moulding. Plaster of Paris is best handled in the form of plaster of Paris bandages. The manner in which they are made is given in Chapter XX. There are two ways in which these bandages may be applied. They may be used as bandages or "moulded splints."

Plaster of Paris Bandages.—These are applied as any other bandage, the limb having been previously padded with non-absorbent cotton. Extreme care should be taken to apply the bandages smoothly, without wrinkles and rather snugly. The number used is dependent upon the desired thickness of the cast. After this has been obtained, the cast may be further smoothed by applying an excess of plaster and polishing the same with long strips of cheese cloth moistened with peroxide of hydrogen. Plaster usually dries in from one to eight hours. For the first thirty minutes, the limb should be held until the plaster has partially dried, because the cast may become distorted by pressure of surrounding objects.

While it is not a universal practice, a great many surgeons deem it advisable to cut all circular casts in the direction of their longitudinal axis, in two parallel lines, diametrically opposed. The reason for this is obvious. Should the limb become swollen, the danger of any untoward complications, such as pressure necrosis, with a subsequent Volkmann's paralysis, is materially lessened. When the cast has been cut, a bandage is applied to hold the segments in place. Not only does cutting down a cast insure a "safety first" policy, but it becomes very convenient to do so when baking and massage are employed as the cast may be quickly removed and efficiently reapplied after each treatment.

If, for some reason, the surgeon should decide to leave the cast intact, and to have it cut at a subsequent date, it must not be forgotten that dried plaster is almost stone-like. The method of cutting casts is given on page 397.

Moulded Plaster of Paris Splints.—As the name implies, these are simply splints made up of plaster of Paris which, when soft, may be moulded. They are very extensively used because they are easily applied, safer than the circular cast, and save the labor of cutting through plaster. They may be used for all fractures of the extremities. Assume a fracture of the radius just above the wrist, a so-called Colles fracture. The manner of applying a moulded splint to this type of fracture is herewith briefly given: The length of the splint to be used is measured with a piece of gauze, in this case from the elbow to the metacarpo-phalangeal joint, and, in addition, the width of the arm is noted. This pattern of the splint in gauze is laid flat upon some smooth surface, either glass, marble, or board. A moistened plaster bandage is rolled back and forth over the gauze pattern, until the desired thickness of the splint has been attained. A piece of canton flannel usually lines the inner side of the splint. The soft plaster, lined with flannel and a thin layer of cotton, is applied to the anterior surface of the forearm, and bandaged snugly in place. The anterior splint in this way can readily be moulded to the shape of the arm. After the plaster has hardened the bandage is removed, all the rough edges of the splint smoothed and a muslin bandage reapplied. Some surgeons in addition to an anterior splint apply a posterior one. The technic is identical for all of the moulded variety. Very often a splint will be made double in length and be bent upon itself in the shape of a letter U, forming a joint anterior and posterior one. This type is known as a "sugar-tong" splint. It

out the aid of very much assistance. This, of course, is a wonderful advance over those methods which required a limb to be held in a certain position by a nurse or doctor until the plaster could be applied. The Hawley table may be used not only for the application of casts, spicas, and plaster jackets, but it is a convenient means to steady a limb and obtain traction if necessary, during the course of an open operation upon bone.

Plaster Jackets.—These are coats or jackets made of plaster that cover the patient from the neck well to the region of the thighs. It finds its application in dislocations of fractures of the vertebræ due to either accidental causes or to disease, such as tuberculosis of the spine. It may be applied with the patient resting either on the Hawley table, or with the patient lying across some supporting straps.

Methods to Obtain Traction.—In some cases, the fragments of the fracture are overriding to such a degree that were the limb permitted to heal in this position great deformity and shortening of the leg or arm would result. To overcome this, and to correct the overlapping of bones, traction may be applied. Nothing has developed the use of traction more than the Great War. For there, not only did the surgeon have to deal with fractured limbs but with fractured limbs plus injuries to the soft parts (compound fractures). To overcome these difficulties, which are practically impossible to handle if the limb is encased in plaster, an attempt is made to maintain reduction by traction often combined with suspension.

Traction.—Traction is used to correct overlapping or overriding bone fragments and lateral deformities. Through its agency, those muscles are relaxed which by their contraction might have resulted in malpositions of the fracture. In addition, if properly applied, it automatically secures the proper alignment of the bone ends and prevents the fragments from being displaced, thus avoiding injuries to muscles, blood vessels, or nerves.

In civilian practice, traction was practiced frequently for fractures of the femur either through a Buck's extension or a Hodgen's splint. Briefly, the Buck's extension is made by applying to the lateral aspects of the leg a piece of adhesive plaster about four inches wide, reaching from above the knee to below the sole (Fig. 10, B). Between the free ends of the

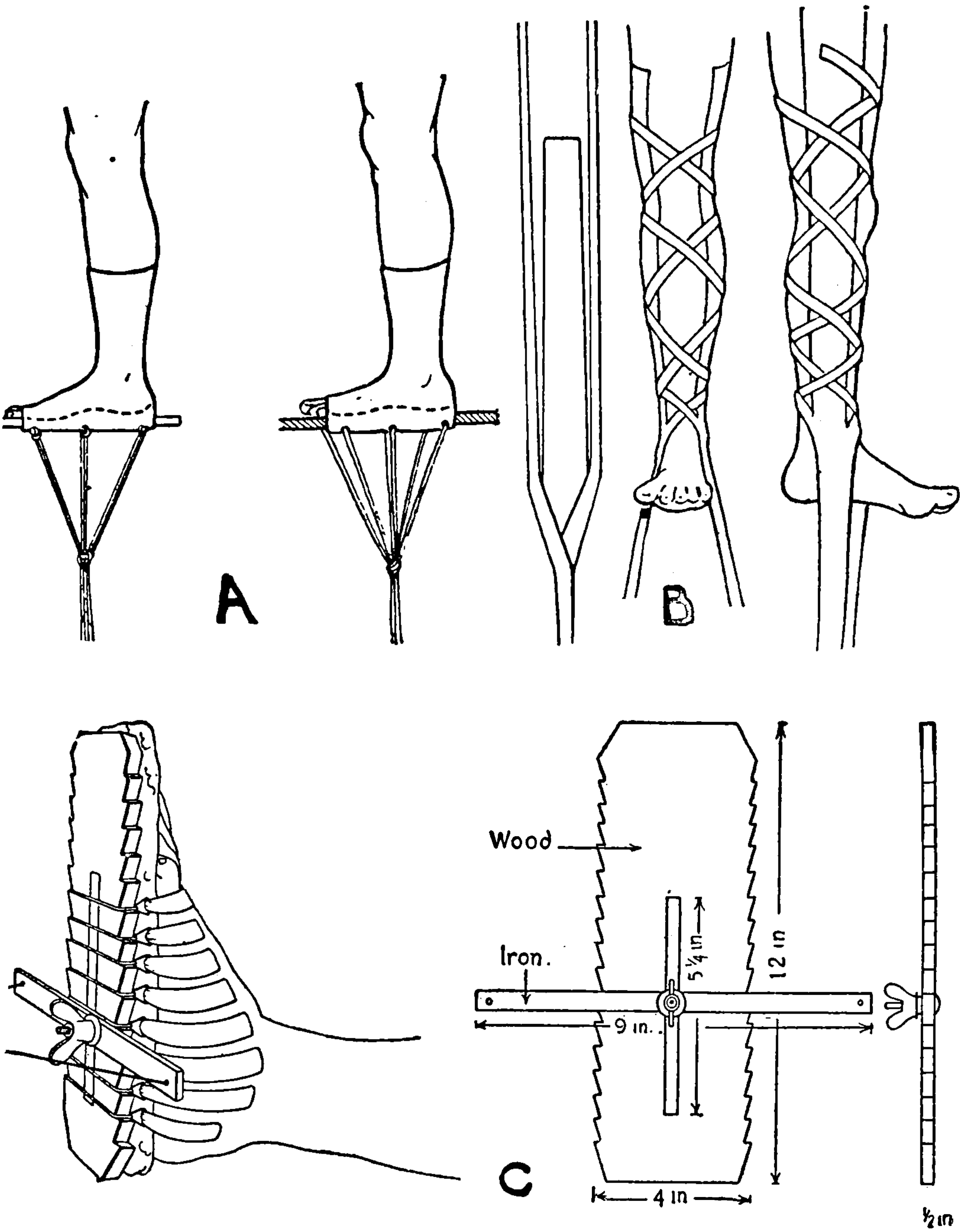


FIG. 10.—METHODS OF APPLYING TRACTION. *A*, stocking traction; *B*, adhesive plaster traction; *C*, Sinclair skate. From the Manual of Splints and Appliances, Medical Department, United States Army.

adhesive a piece of wood, five by three inches, is attached. This acts as a spreader, and a means by which weights may be attached and traction obtained.

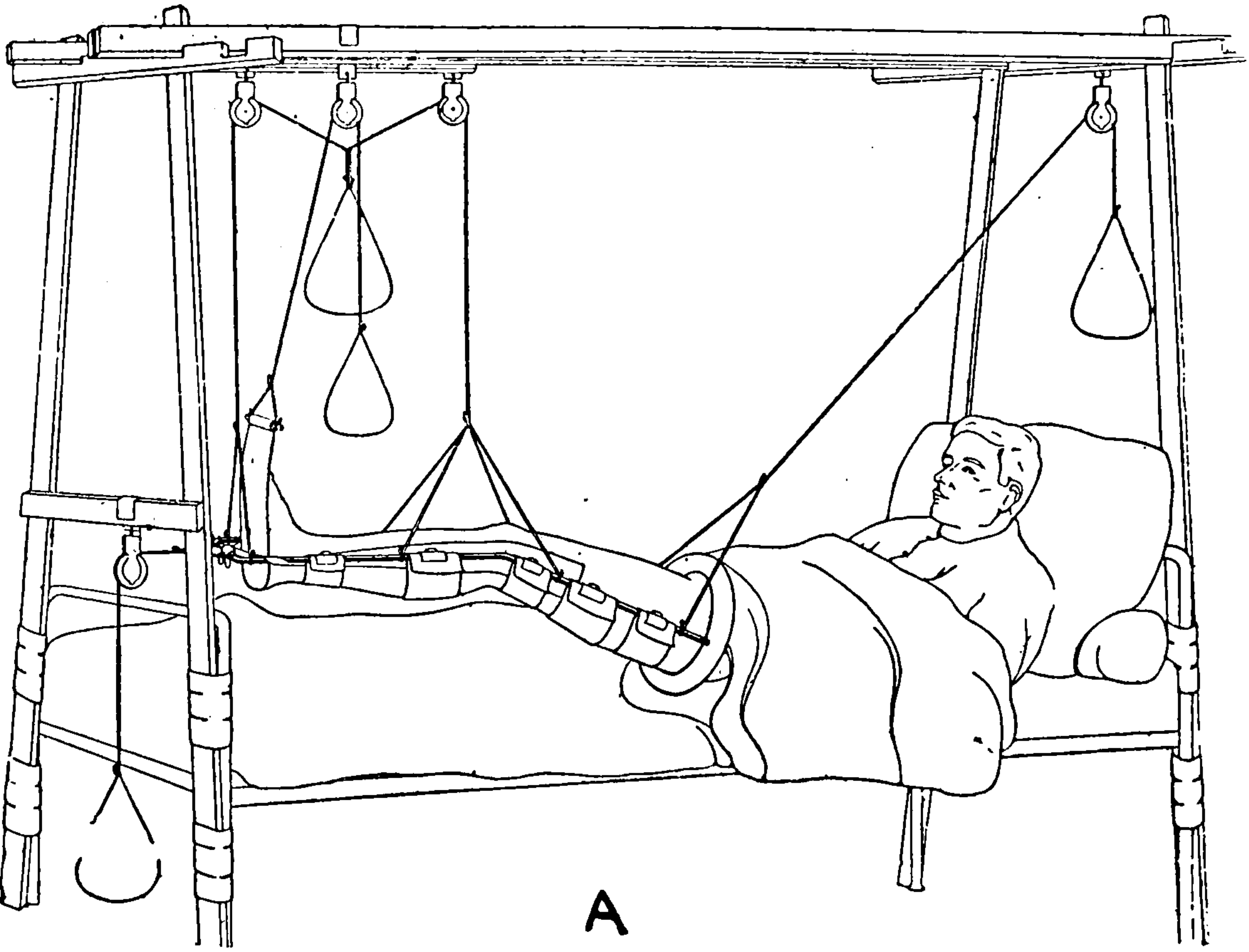


FIG. 11[1].—TRACTION LEG SPLINT. *A,* Thomas traction leg splint with suspension.

The Hodgen's suspension splint (Fig. 11[2]), which is really a forerunner of the various splints developed recently, is simply two parallel iron bars bent slightly in the region of the knee. The lower extremity is placed between these two bars, resting on several cross pieces. The limb is raised from the bed by cords attached to the splint and traction is obtained. Further traction may be obtained by combining this with a Buck's extension.

As the Buck's extension depends for its traction pull upon large areas of skin being covered by adhesive, it was found impractical during the war because extensive wounds of the skin and deeper tissues often complicated the fractures. So newer methods of traction were developed,—namely, the stocking traction (Fig. 10, A) and the Sinclair skate (Fig. 10, C). The former employs a light weight sock from which the toes have been removed. The sock is glued to the leg, ankle and foot except at its sole, and a piece of splint wood is introduced between the

obtained from the "Manual of Splints and Appliances" (Medical Department, United States Army).

SINCLAIR'S GLUE

Glue	50	parts
Water	50	"
Glycerine	2	"
Calcium chloride	1	part
Thymol	1	"

The glue is heated in a water bath to about 100° F. It is painted on the skin, the last coat given is painted in a direction against the growth of hair.

RESIN AND TURPENTINE GLUE

Resin	50	parts
Alcohol	50	"
Benzine (pure)	50	"
Turpentine	5	"

To the powdered resin, one-half the alcohol is added, then the turpentine and benzine. The measure is washed with the remaining alcohol and the contents poured into a bottle. The bottle is always kept tightly corked. The glue may be removed with alcohol or ether. No heat is necessary for its application and it should be applied as thinly as is possible.

Suspension.—While traction is an important element, suspension has enhanced its value by rendering greater comfort to the patient, and making much easier the surgical dressing of the wounds. The limb is usually suspended to an overhead wooden or metal frame (Fig. 11[2]) developed from the original Balkan frame. This consisted of two uprights with a cross piece at each foot of the bed supporting a horizontal bar. The frame now in use is a quadrilateral variety and is illustrated in Fig. 11[2].

To this frame may be attached various pulleys, or these pulleys may be run on trolleys as shown in Fig. 12, A, and Figs. 11[1] and 11[2].

There are several splints which have been recently developed, and although their application and suspension is the concern of the orthopedist and surgeon, the nurse should have a knowledge sufficiently great to secure the desired appliances at the

FIG. 12.—TRACTION ARM SPLINTS. *A*, Thomas traction arm splint; *B*, Thomas arm splint; *C*, Thomas traction arm splint. From the Manual of Splints and Appliances, Medical Department, United States Army.

splint room, and in the event of anything occurring to them in the absence of the attending doctor, she may apply "first aid." The ones most commonly used are those mentioned in the "Manual of Splints and Appliances" issued by the Medical Department, United States Army, and illustrated herewith.

Thomas Traction Arm Splint.—This is used for fractures of the shoulder joint, shaft of the humerus, elbow joint, and forearm (Fig. 12).

Jones "Cock Up" or "Crab" Wrist Splint.—This is intended for injuries to the wrist, or to maintain dorsal flexion of the hand in injuries to the wrist, and in injuries to nerve and muscle causing wrist drop (Fig. 13).

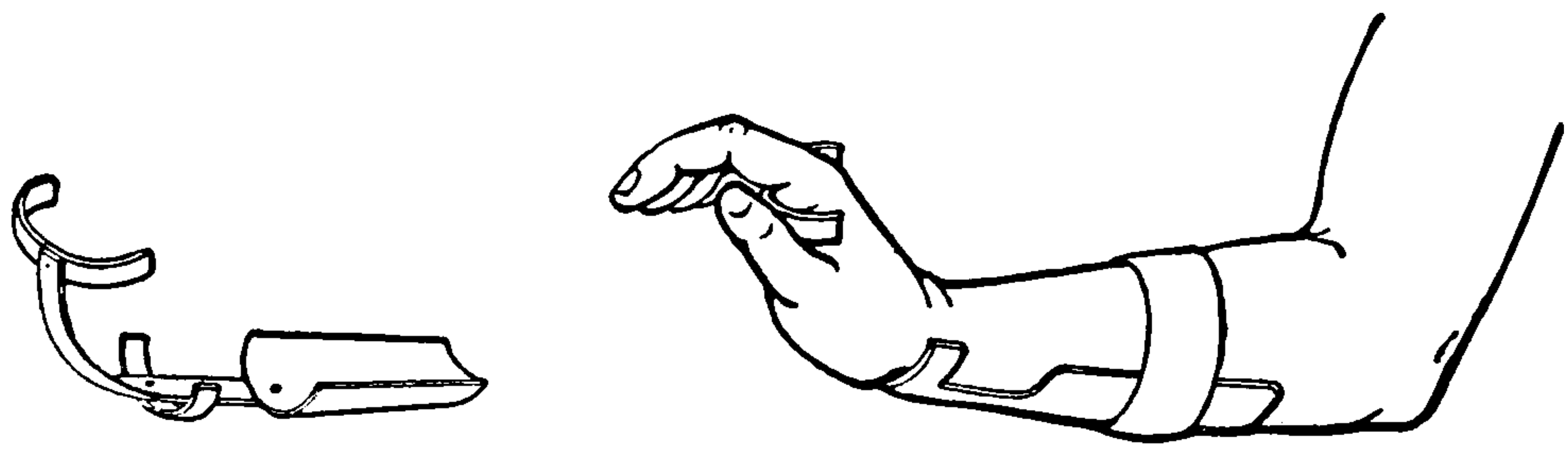


FIG. 13.—JONES "COCK UP," OR "CRAB" WRIST SPLINT. From the Manual of Splints and Appliances, Medical Department, United States Army.

Thomas Traction Leg Splint.—This is for injuries to the shaft of the femur, knee joint, and leg (Fig. 11[1]).

Hodgen Type Splint.—This is for injuries to the thigh (Fig. 11[2]).

Open Operation for Fractures.—In these fractures, which are not compound, when reduction has been impossible, it is often necessary to perform an open operation, reduce the fracture under the direct vision of the surgeon, and then hold the fragments in place by some mechanical measure. The means of accomplishing this are many. Some use wire, others, Lane plates; the latter are pieces of metal which bridge bones together, the plate being held fast to the bones by screws (Fig. 14).

Occasionally, although the bones are in good position, union by callus formation fails to take place. To stimulate bone growth a piece of bone may be taken from some other part of the body, as a graft from the tibia, and this is inserted into the fractured bone ends. Inasmuch as infection is very much

as much fresh air as possible, kept on a high caloric diet, and although confined to bed, the muscles of the affected limb should be given daily massage whenever possible. This will insure proper nourishment and maintain muscle tone, for it is well known that muscles not in active use are apt to undergo atrophy. The temperature should be carefully watched and any sudden rise might be indicative either of retention of pus somewhere in the wound, or the starting of a new focus in the same bone or another one.

Amputations.—Fortunately, today, amputations are but rarely performed, and limbs which years ago would have been sacrificed, are saved now by the newer advances of surgical treatment. Amputations are mutilations. They are employed as final measures and their indications are definitely defined and clearly cut.

Ante-operative Treatment.—The area, through which the amputation is to be done and the skin for a considerable distance above and below, should be shaven and cleansed very carefully. If there are any open sinuses they should be protected by packing and sterile dressings, so that their discharge will not contaminate the wound.

To prevent hemorrhage during amputation there are several methods devised which aim to compress the blood vessels supplying the limb in question.

Esmarch's Method.—This method attempts to squeeze all the blood out of the limb by applying an elastic bandage which is wound spirally from below upward, well above the region of amputation. At the upper limit, an ordinary rubber tubing tourniquet is applied and fastened. The elastic bandage is then removed. This is not applicable in septic conditions, nor in cases of tumors.

Lister's Method.—Here the limb is elevated for a few minutes and the ordinary tubing applied in a horizontal fashion as a simple tourniquet.

Tourniquets.—These should always be applied well above the region to be amputated, and should be sterilized. When the amputation is to be done near the hip or the shoulder, strips of sterile bandage should be applied around the tourniquets. These are held firmly by an assistant to prevent the tourniquet from slipping. Some surgeons prefer to use Wyeth's pins, elongated steel pins which are pierced through the muscles, and the tourniquet in pressing against these is prevented from sliding off (Fig. 15).

Amputation Operation.—The technic of the operation is variable. Some surgeons will inject all nerve trunks with novocain before cutting them. The bone stump is treated in various manners so that a full armamentarium of bone instruments should always be on hand. Amputation wounds are usually drained. The dressings applied should be large and pressure should be evenly exerted either by adhesive strips or bandage. As a rule the stump should be elevated. Sometimes a small splint is applied to the stump to immobolize it in a more efficient manner.

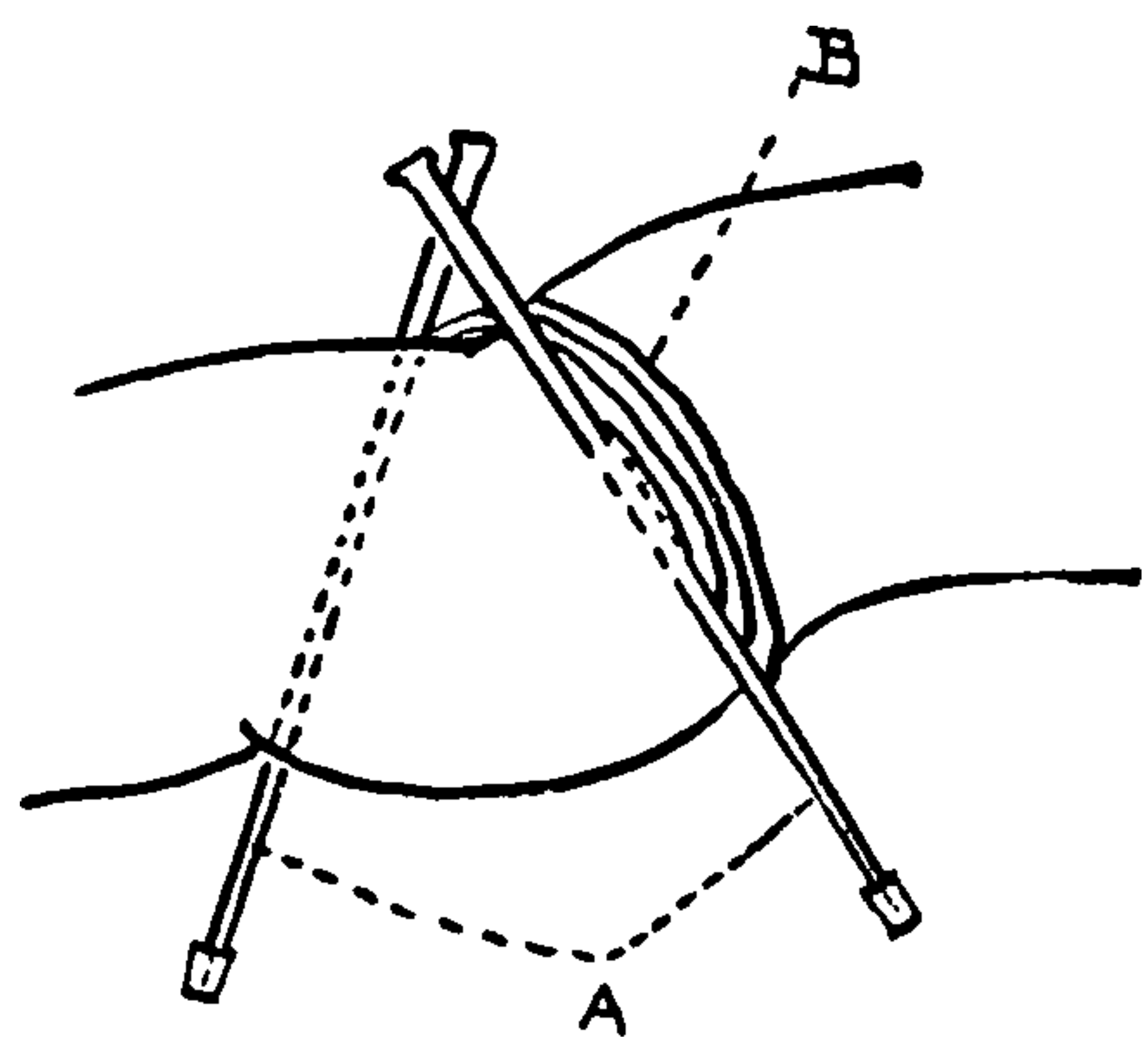


FIG. 15.—METHOD OF APPLYING WYETH'S PINS. *A*, Wyeth's pins; *B*, tourniquet.

After Treatment.—These patients are apt to suffer from considerable shock so not only must this condition be watched for, but also the danger of secondary hemorrhage. It should be routine practice to have an emergency tourniquet set very near the patient's bed so that should bleeding occur no time may be lost in arresting the hemorrhage. If the oozing is marked, the dressing may be reinforced or changed in twenty-four hours, although it is better to wait forty-eight hours.

Occasionally when the wound has almost healed it is often necessary to apply pressure to certain flaps or skin areas to relieve tension. This pressure can be obtained by thin bandaging or by adhesive strappings. In bandaging, it is always to be remembered that the turns which pass over the stump should be begun from above downward and on the side where the longer flap is. Sometimes when the flaps have been cut too short, it may be necessary to apply traction to pull the muscles over the stump.

While the stage of healing is in progress, gentle massage to the muscle groups will do much to maintain their tone and health.

If the amputation is one of the lower extremity, the patient should be taught carefully the proper use of crutches. Crutches should not press into the axilla but the weight of the body should be sustained by the hand resting on the cross piece of the crutch. Special instructions should be given as to how to descend and ascend a flight of stairs, cautioning the patient to hold the banister with one hand and using the other hand to hold the supporting crutch. To prevent the crutches from slipping they should always be equipped with rubber tips.

standard perineorrhaphy routines. The various methods are herewith outlined:

The routine which the nurse will follow in the after care of a perineorrhaphy will always be prescribed by the surgeon; it will vary considerably from time to time, depending upon the extent of the wound and the preferences of the particular surgeon. In any case it is extremely important to keep the wound surgically clean. At best, the task is not easy, nor very satisfactory because of the necessary, frequent exposure to the unsterile excretions of the body. Fortunately, however, nature has provided this part of the body with unusual resistance to infection, and therefore consistent and conscientious technic in the treatment of a perineorrhaphy wound will be rewarded with good results. Some surgeons will require that the part be kept immobilized for at least the first forty-eight hours. This is accomplished by means of a bandage passed about the thighs binding the legs together. This will be particularly desirable in the case of a restless patient. Other surgeons, however, will not prescribe this treatment and the nurse will, of course, not administer it as a routine practice because it is a rather trying ordeal for some patients. When applying this bandage the nurse should remember the rule forbidding the bandaging together of any two surfaces of skin and should see that the thighs are comfortably separated by means of a layer of non-absorbent cotton.

Sometimes catheterization will be prescribed to avoid contamination of the wound by the urine. This may be for only a period of forty-eight hours at stated intervals, or it may be for a longer time. In some cases treatment will be directed toward preventing evacuation of the bowels for a stated period, sometimes as long as nine days, particularly if the laceration has been a complete one—that is, one which has extended into the rectum. This treatment will consist of opium medication to suppress peristalsis, of fluid diet without milk, or of the two combined. Often, however, especially in cases of the slighter wounds, catharsis, oil enemas, etc., will be given in the course of a few days. Whatever the prescribed general treatment, however, the nurse must follow rigid aseptic technic throughout. Catheterization, of course, is always done with the most thorough asepsis, so no special lesson will be necessary here as to that, except to point out that in this case the asepsis must be in the interest of the wound as well as the bladder. As a rule, whether or not catheterization is done, after the bladder has been emptied the perineum will be douched with sterile water or some mild antiseptic solution such as 2 per cent. boric acid or 1-5000 bichloride, which will be allowed to flow over the wound from a pitcher or irrigator. The wound is then carefully patted dry with sterile gauze and the prescribed dressing applied. Sometimes the dressing will be only the plain dry gauze; but a dusting powder, such as aristol, or an ointment, such as boric acid, may also be applied. Keeping the wound dry is an important part of the nurse's duty in this case and it will require careful manipulation on her part because perineorrhaphy sutures are very frequently of silkworm gut which will mean that they will be likely to catch upon dressings and involve the risk of tearing the wound and also of causing considerable pain to the patient. The aseptic precautions will be necessary at least till after the sutures have been removed, which may be any period of from five to ten days.

The Uterus.—The uterus is a muscular, pear-shaped organ situated in the pelvic cavity between the bladder and the rectum. Its normal position is that of anteversion. The part of the uterus which projects into the cavity of the vagina is known as the cervix. The uterus is lined with mucous membrane; and entering the fundus or body of the uterus are the openings of the Fallopian tubes. The uterus may be the seat of acute inflammations, malpositions, or new growths, either benign or malignant.

Inflammations of the Uterus.—The mucous membrane of the cervix of the uterus may become acutely inflamed due to a variety of causes, especially from an infection by the gonococcus. This condition is known as endocervicitis, and if the inflammation extends further and attacks the mucous lining of the uterus, the process is known as endometritis. The treatment of this condition may be either medical or surgical.

Treatment of Acute Inflammatory Conditions.—In the acute infections, especially those due to a gonorrhea in which there is an associated urethritis (inflammation of the urethra) and a purulent vaginal discharge, it is of the greatest importance to warn the patient of the severe infectiousness of the disease, and the dire results which follow, if it is willfully neglected. It is imperative that the hands be kept away from the eyes, because a gonorrheal infection of the organs of sight may cause total and permanent blindness.

The patient should be placed in bed, given a bland non-irritating diet without condiments or spices, and all alcoholic beverages absolutely forbidden. Fluids should be forced to the utmost, and the attending nurse should give copious vaginal douches every four hours with any silver preparation, either protargol or argyrol, in dilutions of 1-10,000. In more chronic stages, these may be followed by silver nitrate irrigations.

Cervix.—The cervix, as a rule, is treated by the surgeon by direct applications of 10 to 20 per cent. silver nitrate, iodine, or 20 per cent. argyrol. The patient is appropriately draped, placed in the lithotomy position, a bivalve speculum is introduced, and the applications made directly to the cervix. However, in all these treatments, while the cervix itself may be benefited, it is difficult to reach the endometrium or lining mucous membrane of the uterus, and very often more radical surgical procedures have to be resorted to.

Operative Treatment.—One of the most common procedures is the operation known as dilatation of the cervix and curettage of the uterus. The purpose of the dilatation is to insure sufficient stretching of the cervical canal, so that instruments may be freely passed into the uterus, and secondly to insure drainage of the uterine cavity. The object of the curettage is to scrape away the diseased mucous membrane of the uterus so that a new and healthy lining will replace the diseased part. While this operation is done for chronic inflammations, it is also performed for the retained membranes of pregnancy, and for incomplete abortions. It is also a diagnostic measure, for in doubtful cases of cancer of the uterus, the curettings may be examined for microscopic evidences of malignancy.

There are cases in which there is a definite stenosis, or narrowing of the cervix, resulting in very painful menstruation

normal anatomical position and to hold it securely there. In the majority of operations this is accomplished by shortening the round ligaments. The operation may be performed through the inguinal canals, through the abdomen, and through the vagina.

The inguinal canal route:—As the round ligaments help to maintain the normal position of anteversion, they may be isolated in the inguinal canal, drawn out and sufficiently shortened so as to exert tension, and thus mechanically pull the uterus forward into place.

The abdominal route:—The uterus is lifted from its retroverted position and the fundus is sutured to the anterior abdominal wall directly (ventral fixation). Or the round ligaments are sutured to the recti muscles (the so-called Gilliam operation of ventral suspension).

The vaginal route:—The patient is placed in a lithotomy position, and the operation done through the vagina. The uterus is brought forward by suturing either to the anterior vaginal wall, or the lower part of the bladder, or it is pulled into place by shortening the round ligaments.

Prolapse of the Uterus.—This condition is often called "falling of the womb." Prolapse of the uterus is divided into three degrees. The first degree is that in which there is a relaxation of the pelvic floor with a protrusion of the vaginal walls; in the second degree, the cervix is found at the vulva; and in the third degree there is a mass of the uterus protruding from the vagina and lying between the thighs.

Treatment of Prolapse.—The palliative measures are the use of pessaries and tampons. A large circular rubber ring in the vagina is often very efficacious in maintaining the uterus in position. It is highly important that these pessaries be removed at least once a month and cleaned, and at the same time the vaginal canal be inspected to determine whether any irritation is present.

The curative measure is operation. The uterus is brought forward and upward by a ventral fixation and a perineorrhaphy gives support below. In some cases it is often advisable to remove the uterus (hysterectomy).

Tumors of the Uterus.—The uterus may give origin to benign and malignant growths. The most common benign tumor is a fibroid. These may cause bleeding (menorrhagia), vaginal discharge, pain, and quite often a mass may be felt within the abdomen. However, there are many women who have fibroids which never cause symptoms. Fibroids are treated by X-ray, radium, and operation.

Operative Treatment.—If the fibroids are single and do not involve the entire uterus, the tumor may be enucleated (myomectomy). If the tumors are multiple and involve most of the uterus, the entire organ may be removed (hysterectomy). This is an operation designed to remove the uterus. It may be performed through the abdomen (supravaginal hysterectomy), or it may be done through the vagina (vaginal hysterectomy).

Supravaginal Hysterectomy.—After the patient is anesthetized, she is placed in an exaggerated Trendelenburg position. (Fig. 63, page 271.) The abdomen is opened by a median incision and the intestines are carefully padded off with warm, moist saline pads. The fundus of the uterus is seized with a vulsellum. The broad ligaments on each side are clamped, and, if possible, one of the ovaries is left. The uterovesical fold of the peritoneum is incised and dissected toward the bladder. The uterine arteries are then clamped and the uterus is amputated through the cervix. The cervical stump is grasped with a second vulsellum, and the cervical canal is cauterized with carbolic acid or iodine. The cervix is then united in interrupted sutures, and the vessels usually tied with plain gut. The round ligaments are sutured to the cervical stump and the pelvic peritoneum approximated to the pelvic peritoneum. This, of course, leaves a little cervical tissue which may cause a persistent leukorrhea. To avoid this the entire cervix may be extirpated.

When the pelvic operation has been completed, the patient should be returned to the horizontal position and the abdominal wall closed. Occasionally vaginal drainage is required. This is done before the abdomen is closed by passing a curved clamp into the vagina and pressing against the posterior vaginal wall behind the cervix. The surgeon incises this area and introduces a cigarette drain into the clamp. When this is withdrawn, the drain is pulled down into the vagina.

There is no special nursing required post-operatively except that a careful watch should be kept for hemorrhage. Occasionally, although fortunately rarely, a ligature slips, and an uterine artery will start to bleed. This requires immediate surgical interference. Patients, as a rule, are kept in bed for about sixteen days.

Vaginal Hysterectomy.—This is performed through the vagina without an abdominal incision. It has no advantage over the other except that it does not leave a scar.

Malignant Diseases of the Uterus.—These may either affect the cervix or the body of the uterus. They are usually carcinomatous in character. The treatment is either complete hysterectomy, or the application of radium.

Diseases of Fallopian Tubes.—Any inflammation of the Fallopian tubes is spoken of as salpingitis. It may be acute or chronic.

Acute Salpingitis.—This may be due to an infection occurring during labor, from unclean instruments, much instrumentation, or a preëxisting gonorrheal infection. The history usually given is that of a vaginal discharge, abdominal pain of a colicky nature and, in addition, the history of a recent labor, instrumentation, or gonorrhea.

Treatment.—The treatment consists of absolute rest in bed in the Fowler's position (Chapter IV, page 59). Hot vaginal douches are given every six to twelve hours depending upon the severity of the inflammation. Applications are made to the lower abdomen, either in the form of heat or cold, and movements of the bowels should be assured by enemas. If the pain is very severe, sedatives may be given. Very often these cases of tubal infection are complicated by pelvic peritonitis resulting in the development of a pelvic abscess. Instead of draining this through the abdomen, the abscess may often be drained through the vagina by making an incision between the posterior part of the cervix and the posterior wall of the vagina. This is known as a *colpotomy.* A good sized drainage tube is introduced into the abscess cavity, but because of the dependent position, the

Post-operative Care.—As these patients are suffering, as a rule, from loss of fluid, saline is given intravenously, and, as soon as possible, a blood transfusion. They are kept warm like other shocked patients, but if it can be avoided, the shock position is not used. As soon as they have recovered sufficiently they are placed in the Fowler position. Means are taken, as soon as practical, to increase their red blood cells by the use of tonics, and the administration of iron in the form of Blaud's pills.

The Ovary.—The ovary besides secreting the ovum possesses an internal secretion which exercises a very important part in maintaining the normal nervous mechanism of the individual. Removal of both ovaries results in the complete cessation of menstruation and a train of nervous symptoms which make these patients objects of pity. They become very excitable, nervous, melancholy, and often so desperate that they have ended their existence by suicide. It is now the custom, whenever possible, to leave some part of the ovarian tissue, and should it be absolutely necessary to remove all of it, as in radical panhysterectomies for cancer of the uterus, the patient may be fed the ovarian extract of the animal. It is surprising what good results will follow.

Diseases of the Ovary.—Ovaritis is an inflammation of the ovary, rarely primarily diseased but usually secondary to tubal inflammation, which results in adhesions between both structures producing a condition spoken of as "diseased adnexa" or salpingo-oöphoritis. The symptoms are similar to those of salpingitis and the treatment employed is the same.

New Growths.—**Cysts.**—More than any other organ, the ovary is apt to give rise to cysts and cystic degeneration. The cysts may be of small size, or grow to enormous dimensions weighing more than twenty pounds. They may be filled with a clear viscid fluid or with other cellular materials. Types of the last named variety are occasionally called cystadenomas. Certain of these tumors, if their contents are spilled over the peritoneal cavity, will cause secondary tumors acting much like malignant growths.

Dermoid Cyst.—These are tumors which contain remnants of the epidermis, such as hair; in addition bone is often found as well as other tissues.

Carcinoma.—The ovary may be the seat of carcinomatous tissue and cancers of the ovary are frequently malignant, metastasizing early.

Treatment of Cysts.—In the case of simple cysts, only part of the ovary affected may have to be removed, or if the entire ovary is filled with many small cysts, a complete oöphorectomy may be performed. It is highly important that cysts of the ovary be delivered intact. Every effort should be made to preserve their integrity, for occasionally a cyst may be of the adenomatous variety, and if accidentally ruptured, the fluid escapes into the general peritoneal cavity and implantation growths take root.

In carcinoma of the ovary, the treatment, of course, is extirpation with subsequent X-ray or radium treatment. The general outlook of patients with ovarian carcinoma is indeed poor.

The Testicle.—This is the male organ of generation and corresponds to the ovary. It consists of the testes proper which manufacture the spermatozoa, and the epididymis which is really a series of canals collecting the sperm from the glandular substance of the testes. These tubules, or canals, unite to form a single duct, the vas deferens, which carries the testicular product to the seminal vesicles, small pouches situated behind the prostate which open into the floor of the prostatic urethra together with the openings of the prostate gland. The prostate gland lies in front of the bladder surrounding the prostatic urethra and secretes the fluid which nourishes the spermatozoa and gives the seminal fluid its characteristic qualities.

While the great majority of these cases will be handled by orderlies and trained attendants, circumstances may arise which will necessitate that they be cared for by skilled nurses.

Acute Inflammation of Testicle and Epididymis.—Probably the most common cause of the acute inflammation is gonorrhea affecting the epididymis mainly, although it may be secondary to certain chronic diseases such as gout, or trauma from urethral instrumentation.

Symptoms.—There are pain, swelling, tenderness of the epididymis, and systemic symptoms of anorexia, fever, and general malaise.

Treatment.—The patient is ordered to bed, and the testicle is elevated by placing beneath the scrotum broad strips of adhesive plaster which are fastened to the shaven thighs. Local applications to the scrotum may be made in the form of heat or cold. Probably the application bearing heat which is lightest in weight is the flaxseed poultice. If ice is used it should not be left on continuously, but on for two hours and off for one. An enema should be given daily, and the patient forced to drink water in large amounts. When the condition is due to gonorrhea, the patient should be placed upon individual precaution. After the acute symptoms have subsided, the patient may be allowed up, but the scrotum should be firmly supported by a suspensory for some time.

Chronic Inflammation of Testicle and Epididymis.—These are secondary to acute inflammations, or due to syphilis or tuberculosis. If syphilitic in nature the patient is given antisyphilitic treatment in the form of mercury and salvarsan. If tuberculous, the best procedure is operative.

Symptoms.—The pain is not so severe as in acute inflammations. In the cases of tuberculosis, there may be a sinus in the scrotum discharging pus from the diseased epididymis.

Treatment of Tuberculosis.—Tuberculous epididymitis, when only one side is involved, is treated by orchidectomy (excision of the affected testicle). These cases require no special nursing care except that they should be placed upon individual precautions and kept out in the open air as much as possible.

Hydrocele.—Lying in front of the testis and epididymis there is a small sac called the tunica vaginalis. This may become filled with fluid causing a hydrocele of the tunica vaginalis. As a rule it is not painful but uncomfortable because of its mere mechanical presence.

Palliative Treatment.—In this procedure a needle or a trocar and canula are inserted into the hydrocele sac and the fluid withdrawn. After most of the water has been tapped, some surgeons reinject an irritating fluid, such as a mild solution

suffering is quite severe, and the only measure affording permanent relief is the removal of the obstruction (prostatectomy).

Prostatectomy.—This operation is often preceded by a period of improving the patient's nutrition, and his urinary output by regular catheterizations. The operation resolves itself into a choice of perineal or suprapubic prostatectomy.

Perineal Prostatectomy.—The perineum is shaved and eight hours before operation the usual soapsuds enema is given. The patient is placed in a lithotomy position with the pelvis raised by sandbags and the prostate is enucleated through the perineum.

Post-operative Treatment.—The retained catheter is connected to bottle drainage and the urine collected. The gauze tampon which usually occupies the space of the removed prostate is taken out on the fifth day; the catheter is removed on the seventh, and from then on the urethra is treated with sounds of various sizes.

Suprapubic Prostatectomy.—In this procedure the prostate is removed through the bladder. It is done in two stages. The first operation is a suprapubic cystotomy, the second the actual removal of the gland through the previous bladder wound.

First Stage:—As a rule, catharsis is given forty-eight hours previous to the day of operation. Before operation the bladder is irrigated and often some novocain or alypin is injected. The bladder is kept distended and the cystotomy is done under local anesthesia. A button drainage tube is placed in the opening of the bladder and the tube clamped. When the patient arrives in his room the clamp should be removed from the tube and the bladder drained continuously, or intermittently. The diet should be very light and soft, fluids allowed in liberal amounts.

Second Stage:—While some surgeons proceed to enucleate the prostate immediately after cystotomy, the majority wait five or more days before completing the operation. Naturally there will be rather a profuse hemorrhage following the blunt dissection of the gland. This may be controlled by tampons, but a better result is obtained if a bag hemostat is used. This is made of rubber, is inflatable and when distended and placed within the bladder exerts pressure on the bleeding areas. One connection of the bag passes through the urethra, and is the means by which air is introduced. This is removed in twenty-four to forty-eight hours.

The suprapubic wound is freely drained, and at the end of forty-eight hours a button tube is inserted, connected to the bottle drainage and the patient allowed out of bed. At the end of a week the patient is encouraged to void, and as soon as he does so in sufficient amounts, the suprapubic tube is removed. Of course, the urine will leak in small amounts, but the sinus is healed in from the thirteenth to the twentieth day.

Cancer of Prostate.—In the early stages this is treated by prostatectomy. In the late periods, radium is tried as a palliative procedure.

CHAPTER IX

THE SURGERY AND SURGICAL NURSING OF THE RESPIRATORY SYSTEM

THE organs which constitute the respiratory system may be classified as the accessory and the main groups.

Accessory System:
1. Nose: nares, septum, sinuses
2. Mouth
3. Pharynx: nasopharynx, oropharynx

Main System:
1. Larynx
2. Trachea
3. Bronchi
4. Lungs and Pleura

The mouth and pharynx are discussed under the Alimentary System.

Nose.—The nose serves the very important function of filtering, warming, and moistening the air. In addition to aiding the sense of smell, it also gives the voice some of its qualities. The diseases which affect the nose are many and well known. The only pathological conditions of interest here are those resulting from obstruction from a deviated septum or hypertrophy of the turbinates (bones in the nares) and infections of the various sinuses.

Deviated Septum.—In this condition one or both sides of the nose are occluded by a deformity of the nasal septum, and an attempt is made to remove the obstructing cartilage by a submucous resection preserving the mucous membrane of the septum. After the operation has been completed, each nasal cavity is packed with strips of sterile gauze. The packing is removed after twenty-four hours.

pharynx and larynx may be cocainized, or the patient may be placed under deep anesthesia. The laryngoscope is passed through the mouth and pharynx into the larynx, the head and neck being bent backward, and the foreign body removed through the instrument.

Occasionally, the condition is so urgent that to relieve the asphyxia, an opening must be made into the trachea below the point of obstruction, so that air may enter the lungs. This opening of the trachea is spoken of as tracheotomy.

Tracheotomy.—A tracheotomy is an incision into the trachea in order that a tube may be introduced therein, thus providing for the entrance and exit of air. This may be done either as an emergency measure following a thyroid operation in which the trachea has collapsed, when a foreign body has become lodged in the larynx so that respiration is embarrassed, in acute edema of the glottis, or in obstruction asphyxia during the administration of an anesthetic. It may be employed as a preliminary measure to a removal of the larynx for cancer. The operation is either high or low, the high being preferable, because the trachea is more accessible; the low being done when the operator has to reach a foreign body which has fallen into one of the bronchi.

Operation.—The patient is placed upon the back with a sandbag underneath the neck so as to make the trachea as prominent as possible. An incision is made in the midline, the muscles separated, the trachea exposed, incised, and a tracheotomy tube introduced. These tracheotomy tubes are of various types, but the one generally used is similar to Fig. 16. It is very important, after the tube has been introduced, to see that it is patent, and that respiration is taking place freely. As a precaution, tape is usually threaded through the tube so that it will not slip down the larynx in any disorder which might ensue. Inasmuch as the outer tube comes into direct contact with the skin, it is a good plan to have a fine layer of gauze covered with boric ointment inserted between the tube and skin.

Post-operative Treatment.—The tracheotomy tube is a new passage through which air is drawn into the lungs, and since the air is no longer brought through the normal channels, it is important that above all the tube should be kept patent and clean. In order to ensure perfect cleanliness and free respiration through the tube, nurses must be on duty day and night ever alert to see that the patient has plenty of air. The inner tube should be removed about two or three times a day, cleansed, sterilized, and gently reinserted. It should never be cleaned in situ, i. e., as it rests in the patient's trachea. If at any time the tube should become suddenly plugged, the inner tube must be withdrawn immediately. At times the patient is apt to cough, and the mucus which makes its appearance at the orifice of the tube should be wiped away very gently. Occasionally from coughing violently both the inner and outer tubes may be expelled, and for this reason it is always important to keep a tracheotomy dilator on hand to meet this important emergency. This instrument will keep this passage open until another tube may be obtained and inserted.

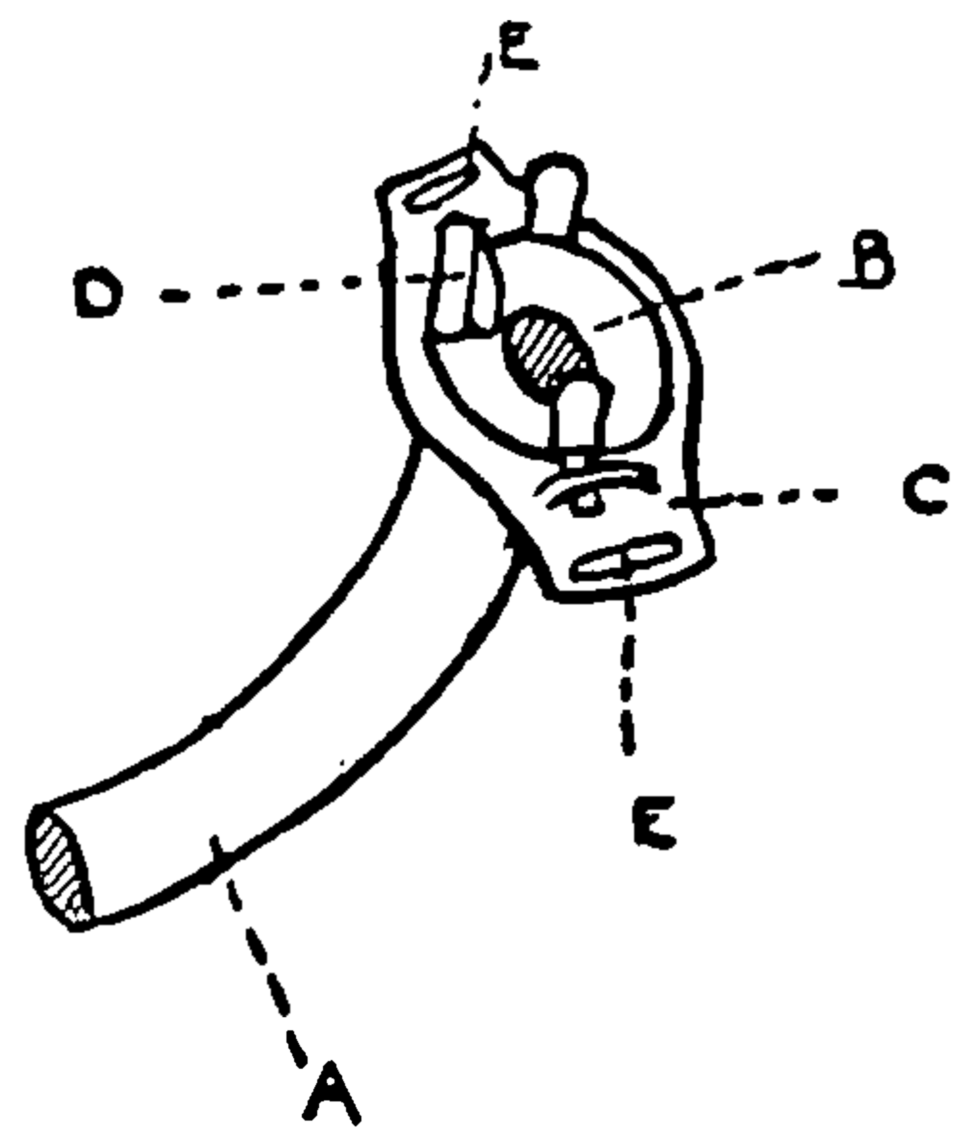


FIG. 16.—TRACHEOTOMY TUBE. *A*, outer tube; *B*, inner removable tube; *C*, safety guard; *D*, catch to hold inner tube in place; *E*, slot through which tape may be tied to hold safety guard in place.

Another important thing in these cases is to remember that the air which is now inspired no longer has the advantage of being warmed and freed from dust by the nasal passages. For this reason in the beginning, thin layers of gauze which have been wrung out in warm water should be placed over the tracheotomy orifice and changed every half hour. Some surgeons keep the patient under a croup tent so that the air may be warmed by the steam and the respiratory tract have the advantage of a warmed air. Compound tincture of benzoin may be added to the croup kettles.

There are very few conditions which require more conscientious nursing than do these patients, because their life is absolutely dependent upon the uninterrupted inflow and outflow of air through the tube. They should never be left alone, for one never knows at what moment the tube may become plugged and the patient become suddenly asphyxiated. Occasionally mucus may collect in the trachea and not be expelled through the tube. The reason for this is that the cough is insufficient in strength to expel the mucous plug. In these conditions a sterilized feather might be introduced through the tube and the trachea tickled, so as to incite coughing. The time for the permanent removal of the tube is purely at the discretion of the surgeon. Very often some surgeons will remove the double silver tube and replace it by a rubber one, then remove the rubber one when they see fit.

New Growths of the Larynx.—The larynx, like the other organs in the body, may be the seat of benign or malignant growths. Probably the most common of the benign growths is the papilloma. These growths may be removed in three ways: through the larynx with the aid of the laryngeal mirror; from without by performing a thyrotomy (an incision through the thyroid cartilage of the larynx), or through a Jackson or Killian laryngoscope. The instruments used for their removal may be the snare, curette, forceps or galvano-cautery.

Malignant Growths.—The symptoms of a cancer infiltrating the larynx may be very similar to those produced by the benign growths. Hoarseness, later loss of voice, respiratory difficulty, and pain are very common. Later when the growth extends and ulceration becomes evident, cough and pain on swallowing may be very evident. The only treatment is surgical. Either one-half or the entire larynx may be removed.

Laryngectomy.—As the name implies the operation is one in which the larynx is excised. The operation itself is preceded by a tracheotomy. This may be done as a preliminary operation one day, the remainder of the operation being performed at another time, or the entire operation may be done at once.

Operation.—The first part of the procedure is practically the same as a tracheotomy except that the trachea is blocked by the use of a Hahns canula. This is done to prevent the blood from the laryngectomy from leaking down the trachea into the lungs. The canula is simply a tracheotomy tube which has been previously boiled and to which is attached and securely fastened a sponge squeezed dry and dipped in a ten per cent. ether solution of iodoform. The sponge has been previously sterilized by soaking in a 25 per cent. alcohol solution for several days. The

monia, as a rule. After the pneumonia has resolved, or even before this period, a sudden rise in temperature may occur, accompanied by fever, chills, and the physical signs of fluid in the pleural cavity. This collection of fluid or pus may be general in nature, or localized (sacculated). As pus in other parts of the body usually requires drainage as soon as it is formed, here also an attempt should be made to remove it.

Treatment.—While it was customary before the war to resect a rib and insert a drainage tube into the pleural cavity as soon as a diagnosis of empyema was made, army experience has taught that such radical procedure is not always necessary. In fact, in the beginning, it is better to draw off the fluid which has accumulated with a needle and syringe, or Potain aspirator, thereby relieving the patient, and at the same time, reducing certain elements which might lessen the shock at the time of the future operation. It is also true that some of the patients recover with this simple aspiratory procedure, although the great majority must have a more radical operation performed sooner or later. The more radical procedure consists in the partial excision of one of the lower ribs so that better and more adequate drainage may be secured.

Operative Treatment.—Inasmuch as these patients are in a weakened physical condition from their pneumonia, or from the absorption of the poisons of the pus in the pleural cavity, it is advisable not to administer a general anesthetic, but to employ local anesthesia. This works with remarkable success.

Since the patients feel more comfortable when sitting almost upright, the operation is performed in this position. An aspirating needle with syringe locates the area of pus; its location is the determining factor as to which rib is to be partially resected. In general empyema or suppurative pleurisy, the incision is generally made along the eighth or ninth ribs. A part of the rib is removed subperiosteally, exposing the periosteum beneath which is the outer surface of the pleura. The pleura is then opened by incision and the pus allowed to gradually escape. A drainage tube is then placed into the pleural cavity.

There are many ways of draining the thoracic cavity. Some employ a Brewer tube (Fig. 17); others a simple rubber drainage tube. In empyema cases, great care should be taken that the number of drainage tubes used be carefully noted and recorded. The pleural cavity is a notorious hiding place for them, and very often a lost tube is the reason for a persistent sinus continually discharging large quantities of pus.

After Treatment.—Inasmuch as the discharge from the pleural cavity is moderately free, very often the drainage tubes are connected with bottle drainage. Occasionally, when a Brewer tube is employed, a piece of rubber dam is snugly fitted around the free end of the drainage tube, and the open end of the dam is placed in a bottle under a water level so that while the pleural fluid may escape from the chest no air can enter the pleural cavity. The result of this is that a negative pressure is soon established, the lungs expand earlier, and the patient's convalescence is shortened.

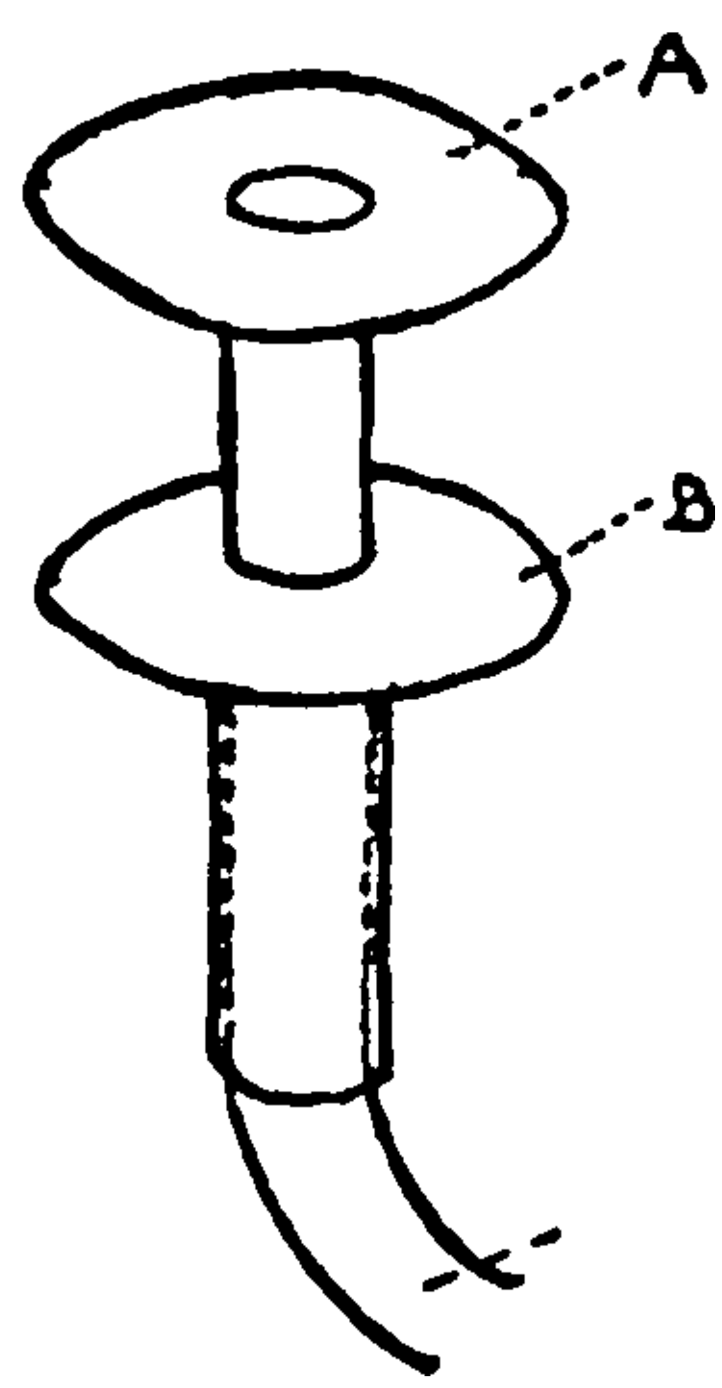


Fig. 17.—Brewer Empyema Tube. *A*, Rubber Disc resting tightly against parietal pleura; *B*, rubber disc resting tightly against skin; *C*, rubber tube connected to bottle drainage.

The discharge is rather copious for the first few days and superficial dressings must be changed and reinforced whenever necessary. After a few days the tubes within the chest are gradually shortened, and as soon as the discharge is very thin and the temperature is normal, the tubes may be withdrawn altogether. While the patients are in bed, they should be encouraged to breathe as deeply as possible so as to aid the expansion of the collapsed lung. With this end in view, they should blow fluids from one bottle into another, and children should be given those toys which encourage blowing, such as horns or balloons. If the temperature suddenly rises after the drainage has been removed, it simply means a reaccumulation of fluid in the pleural cavity, and necessitates an immediate reinsertion of the tube.

These patients should be allowed out of bed as soon as possible, and wheeled into the open air. If the weather is clear, their beds might even be moved into the open. The diet should be high in carbohydrates, and tonics should be given to restore their lost strength.

The Lungs.—The surgery of the lungs is still in its early stages of development, and the operations done upon these essential organs of respiration are but few in number. This is due to the mechanical difficulty of approach and exposure through the thoracic wall, and because of the difficulty of maintaining the potential negative pressure during an operation. The latter normally exists between the parietal pleura lining the interior of the thoracic wall and the visceral pleura which covers the lungs themselves. In the various phases of respiration, the parietal and visceral pleuræ are continually in contact; but should, for some reason, the air from the outer world enter this space, either by rupture of the lung tissue itself or through the thoracic wall, the negative pressure will be destroyed and the lung will collapse. A large space filled with air will thus be left between the parietal and visceral pleura. If this is remembered it will not seem strange that pleural and lung conditions take such long periods of time to return to normal after operation, for the infection of this large rigid cavity must be sterilized, the air within the chest absorbed, and the lung permitted to expand with the reëstablishment of the negative pressure.

Operations upon the Lungs.—There are several indications in surgery for operations upon the lungs themselves. Occasionally, it is advisable to remove a lobe of the lung because of some extensive infective condition, such as an abscess. As already mentioned, the normal thoracic cavity is under negative pressure, and when an opening is made communicating the pleural cavity with the external world, this negative pressure is destroyed, the lung collapses and expansion is impossible. There are two methods which aim to overcome the collapse of the lung. One is to do the operation in a chamber which is under negative pressure so that there is practically no difference between the negative pressure in the pleural cavity and the negative pressure in the room. By the other method, the air is under increased pressure and is introduced within the lung so that the lung is kept expanded even though the negative pressure within the thorax is destroyed.

CHAPTER X

THE SURGERY AND SURGICAL NURSING OF THE SKIN AND APPENDAGES

Surgical Conditions Involving the Skin.—A *wound* may be defined as a discontinuity of tissue. It may be superficial or deep, clean or contaminated, accidental or intentional. For purposes of classification, wounds may be divided into abrasions, contusions, punctures and lacerations. When the surface layers of the epithelium are scraped away, the wound is spoken of as an *abrasion;* when they have been destroyed by some pressure, but yet not actually removed, a *contusion* results; a *punctured wound* is the type left by a nail or awl; a *laceration* is caused by the deeper layers of the skin together with the epithelium being torn. All these wounds may be clean or infected. If they are clean they will heal in the manner described in Chapter II. If they are infected by bacteria, the various sequellæ which have been already outlined may ensue.

Treatment.—Hemorrhage should be arrested first; then any foreign material which may be present is removed, and the wound sterilized and protected from any further contamination by a dressing and bandage.

In most wounds, hemorrhage may be arrested by simple pressure, provided that no deep blood vessels are cut. This pressure should be applied directly over the bleeding surface, the material used being any sterile gauze, or in emergencies, a freshly laundered handkerchief. Should the bleeding still be profuse the measures outlined in Chapter III may be tried. After the bleeding has been controlled, the wound should be cleansed by simple irrigation with sterile water or a weak solution of iodine.

Antiseptics.—The application of iodine to a bleeding surface is of little avail, for it has been definitely proven that iodine here has little or no effect. Tincture of iodine on a dry surface is indeed efficacious and all lacerations, even though the infection be doubtful, should be thoroughly iodinized. In the application of iodine to abrasions, it must be remembered that if more than one coat is given, it is very apt to burn the skin. Thoughtless painting and repainting of small abrasions occurring in the tender skin of children or women may result in a burn which is much worse than the original injury. Some surgeons prefer to use peroxide of hydrogen. All wounds which have come into contact with manure and dirt should be cleansed first with peroxide of hydrogen and then iodinized. Of course, the number of antiseptics used are many, but experience has shown that while some antiseptics certainly kill bacteria, they may destroy the tissues themselves, and occasionally poison the individual. Because of this, bichloride of mercury and carbolic acid have fallen into disrepute. They possess extremely irritating properties and there is always danger entailed in their use. The popular antiseptic at present is one which has been developed during the war and which has had such wonderful success in the sterilization of wounds. It is the Dakin solution and a complete discussion of it will be found in Chapter XIX.

After the bleeding has been stopped, and sterilization has taken place, the wound should be protected from foreign materials such as dirt or bacteria. Sterile gauze is applied, either dry or greased with some sterile ointment (boric acid, vaseline, or liquid albolene), to prevent it from sticking to the wound. The dressing may be held in place by strips of adhesive plaster or a bandage, whichever suits the location of the injury the best. All dressings should be made as small and inconspicuous as possible both for cosmetic effect and reasons of economy.

Lacerated Wounds.—Wounds which gape considerably are sutured because the period of healing and the amount of scar tissue are thus lessened. The material used for the suture of wounds may be horsehair, silk, silkworm gut, plain, or chromic catgut described in detail in Chapter XV. For wounds of the face, horsehair is the material of choice on account of its fine texture. For deeper wounds, material possessing a greater strength, either silk or silkworm gut, is used. The needles employed are full curved, or straight, small Hagedorn type. Care should always be taken that the eye of the needle is patent and the cutting edge keen and sharp. Needle holders should always accompany needles. The type of holder depends upon the idiosyncrasy of the surgeon. To summarize then: The arrest of hemorrhage, the cleansing and sterilization of the wound and its protection from infection are the essentials in the minor surgical procedures involving the skin and deeper tissues. Nurses are always expected to have those things prepared which are necessary for the fulfillment of these essentials.

Infected Wounds.—If a wound is infected, the aim of the surgeon is to liberate the pus, establish its free drainage, sterilize the wound and convert an infected into a clean one. To obtain free drainage, an incision is made, or in a recently sutured wound, a few sutures are removed, and to aid the free escape of pus, a drain is inserted. In small infections the incision is done under local anesthesia with a knife (scalpel). Knives should always be sharp and keen as razors. Drains are the handiwork of a nurse and their manufacture should be clearly and thoroughly understood. The types of drains and their method of preparation are described in detail on pages 310-311, Chapter XVII. While the drainage secures the escape of pus, its freer exit is promoted by the use of wet dressings or dry heat.

Wet Dressings.—The means of keeping dressings wet are many. The dressing may be wetted and then covered with oil skin or rubber tissue to prevent evaporation; or a sterile solution may be poured upon the wound through the dressing every so often; or the dressing may be kept continually moistened by a warm saline drip or continuous immersion in a water bath. Infected wounds which are treated with Dakin's solution require special technic (see Chapter XIX). In all wet dressings the nurse should take particular care that the fluid is applied to the wound and the wound only, and that the surrounding skin does not become macerated or injured.

Suction Drainage.—Very often to secure better drainage, gentle suction may be applied to the end of the tube, using either the water siphon method or the suction machine.

Siphon Drainage.—One end of a Y-tube is attached to the drainage tube and another to the moving column of water from

or medicated with iodoform or bismuth is a question decided by the surgeon.

Treatment of Healing Wounds.—When the discharge and induration of an infected wound becomes less, the surgeon will begin reducing or removing the drainage, and will apply medications to stimulate granulation tissue. Granulation tissue may be stimulated chemically or physically. Weak solutions of silver nitrate or the actual caustic stick are sometimes used; balsam of Peru is very valuable. The size of the wound may be reduced by drawing the adjacent edges together with adhesive plaster; and, at times, strapping the granulating areas with sterile adhesive plaster will stimulate the granulations and also the surface epithelium to growth.

Secondary Suture.—Since the absolute sterilization of infected wounds by the Dakin method is possible, secondary suture of granulating wounds is done very often and has proven quite successful (see Chapter XIX). As soon as the wound has become filled with granulation tissue, the surface epithelium, or the skin itself begins to grow. If the area to be covered by skin is too great, and the resulting scar would be too big, a graft of skin may be resorted to.

Skin-Grafts.—Skin-grafts are of three varieties,—Thiersch, Reverdin, and Wolf.

Thiersch Graft.—The superficial layers of the epithelium are shaved off with a razor and planted over the wound, the grafts being rather large in size.

Reverdin Graft.—In this type small thin portions of the superficial layer of the skin are snipped off with scissors, and placed upon the granulating wound.

Wolf Graft.—In this variety, the entire thickness of the skin is utilized as a graft, or it remains connected by a pedicle to that part of the body from which it was taken, and after the graft is firmly attached the pedicle is severed.

In all skin-grafts, the nurse must not forget to keep the part quiet and warm. In removing dressings, the utmost care should be observed for fear of disturbing the graft itself, and as in all surgical procedures, the best aseptic technic should be maintained.

Burns.—While a French surgeon originally divided burns into six degrees or stages, according to the depth to which the injury penetrated, it will really suffice for nursing purposes to divide them into three. The agents which produce burns are many. Heat in the form of solids, liquids, or steam; chemicals, such as strong acids,—for example, carbolic, acetic, hydrochloric; powerful alkalis, such as sodium hydroxide, chloride of lime; special agents, such as X-ray, electrical currents and radium when not properly used may all cause very severe burns. Closely allied to those burns caused by heat are those due to the action of cold either from exposure to low temperatures, such as frostbite, or those resulting from actual contact with cold substances in the form of ice, snow, or liquid air.

The pathology and clinical appearance of all burns are essentially the same regardless of the agent inflicting the injury, but the degree varies. First degree burns are recognized as those in which there is redness, with some pain and swelling, followed by a scaling of the skin. If the redness is of a greater degree, blisters appear; this is a second degree burn. All other burns might be classified as third degree. They vary from definite charred areas to those cases in which an entire limb or more is involved. The symptoms which result may be classified as local and constitutional.

Local Symptoms.—There is a marked inflammatory reaction of the parts adjacent to the burn followed soon by sloughing of the charred or injured tissues and, finally, after the wound has been cleansed and the granulations are vigorous, healing ensues.

During the first and second periods, there is considerable absorption from the products of destroyed tissue and the patient may suffer from certain constitutional complications; these may be very mild or so severe as to cause death. The causes of death following burns may be shock, poisoning from the charred tissues, or complications arising from infections such as erysipelas or sepsis. It should be remembered that extensive burns rather than limited deep ones are the more serious, and that children with skin burns averaging more than one-third of their body are apt to die from the effects.

Treatment.—The treatment of burns may be grouped under two heads,—local and general.

General Treatment.—In extensive burns there is often deep shock which should be treated immediately. The patient should be placed in the shock position. The body must be kept warm with hot water bottles and blankets. Fluid should be given either by rectum in the form of a Murphy drip, or in very severe depressed conditions, a saline infusion. If the pain is intense, morphia may be required. It occasionally happens that, together with the burns, the patient suffers from poisoning of carbon monoxide gas.

Carbon Monoxide Poisoning.—This is recognized by the great difficulty with which these patients breathe, the fact that their lips are a very deep red and their skin a bluish hue. The condition requires urgent interference.

Treatment.—The blood must be rid of the excess carbon monoxide and its oxygen content increased. The patient may be given oxygen from a commercial oxygen tank by means of a funnel held directly over the nose and mouth. To prevent further loss of oxygen, a paper cornucopia may be fastened to the funnel. If the congestion of the patient is very extreme, blood may be removed from a vein in the arm. This reduces the actual blood content of carbon monoxide, and then the patient may be given an infusion of saline or a transfusion of blood which will still further decrease the amount of poisonous gas.

Local Treatment.—First Degree:—If there is much smarting and pain, a paste of bicarbonate of soda, or cold cream, may be applied, and the burned area protected from the air.

Second Degree:—When blisters or blebs are present, they should be opened by puncture with a sterile needle and the serum removed. After this, sterile vaseline or boric ointment may be applied.

Third Degree:—If the patient has rather extensive burns, and the clothes covering the skin have been destroyed by fire, to prevent greater shock, it is better to give the patient anesthesia, remove the clothes, cleanse the burned areas very thoroughly with either copious washings of sterile saline, or bichloride in

atomizing arrangement is screwed over both. Then by air pressure the liquefied wax is sprayed over the part in a delicate, thin, even film, and the part covered with a fine cotton batting, and a bandage applied. The advantages of this method are painlessness of application, absolute sterility, formation of a soft splint-like dressing over the wounded area rendering it immobile and thereby diminishing pain. At the end of twenty-four hours due to the exuding serum, the wax layer with the thin cotton batting attached separates rather easily and painlessly. While this method requires much time and patience, the end results easily compensate for the trouble involved.

It should always be remembered that the burned areas are portals of entry for the various pathological bacteria. Excessive care should therefore be taken to guard against infection. The application of unsterile home remedies, such as flour and water, olive oil, etc., is to be condemned. If a first aid dressing must be applied and there are no sterile supplies at hand it is better to cover the part with a freshly laundered, clean, dry towel until the proper material may be obtained.

The Breast.—Diseases of the breast form a relatively important chapter in surgery. In the main they are of two great varieties,—those due to inflammation and those due to new growth. Inflammation may involve either the nipples or the breast and may be acute or chronic.

The Nipples.—Cracked or fissured nipples, often seen during lactation, are especially painful because the skin has become broken. They may form a portal of entry for the various microörganisms and thus give rise to infections of the breast itself, or, when the child suckles, it may swallow some of the diseased tissues about the cracked nipples.

Treatment.—All nipples after nursing should be thoroughly but gently washed with boric acid, then dried and powdered with borated talcum. If fissures are present the child may nurse through a nipple shield, and in the interval the nipples may be treated with boroglyceride, touched with silver nitrate (solid) or painted gently with tannic acid. These measures suffice, as a rule, to bring the nipple back to its normal healthy status.

Acute Mastitis.—Acute inflammations of the breast, known as acute mastitis, usually occur in women during the close of the lactating period. It is the result of improper hygiene of the nipples, although this may not always be the case.

Symptoms.—The patient may complain of pain and heavy feeling in the breast, and, at the same time, redness, swelling, and areas of hardness may appear in certain parts of the breast. There are a rise in temperature, an increase in the pulse rate, loss of appetite, slight headache, and a feeling of general malaise.

Treatment.—If pus has not yet formed, the breast is elevated with the bandage in such a way that it is firmly supported upward. (See Figs. 141 and 142, page 386.) This will do much to relieve the pain, but care should be taken that the binder is not applied too tightly. Nursing, as a rule, is discontinued, and if the breast throbs and feels distended, the milk may be expressed regularly either by gentle massage, the direction of the massage being a stroking motion from the circumference of the breast towards the nipple; or the milk may be aspirated by a breast pump. During the interval, either hot applications such as flaxseed poultices may be applied to the breast, or cold applications in the form of a magnesium sulphate solution of 50 per cent. strength. When pus is formed the abscess is opened by the attending surgeon and freely drained. After the acute suppurative process has subsided the drainage tubes are shortened gradually and the granulation tissue stimulated by silver nitrate.

Chronic Mastitis.—This condition is not uncommon, and presumably is due to a chronic inflammation of the breast. The patient complains of vague and indefinite pains localized in the breast itself, and, on examination, there may be found here and there some very small nodules which may be tender. At times the lymph glands in the axilla (arm-pit) show enlargement; as a matter of fact this condition is frequently difficult to distinguish from cancer of the breast.

Treatment.—Sometimes a well fitting breast binder will relieve much of the pain. If there is considerable induration or hardness of the tissue, warm fomentations may bring relief. Should these measures fail, most surgeons will remove that portion of the breast which is pathological. If at the time of operation it is thought that the condition might be cancerous, the entire breast and deeper tissues are removed.

New Growths of the Breast.—As in other locations those tumors which invade breast tissue may be either benign or malignant. Of benign tumors of the breast, the most common are fibroadenomata; these occur mainly in young women; they are definitely encapsulated, freely movable, do not grow beyond a certain size, and cause no enlargement of the lymph glands of the axilla.

Treatment.—The treatment is the excision of the growth, with occasional drainage of the space left by its removal for twenty-four hours.

Carcinoma.—Carcinoma of the female mammary gland is relatively common. The rate of growth of the tumor cells will vary greatly. Any mass in the breast is strongly suspicious of carcinoma if it occurs after the age of forty, and is hard, not definitely encapsulated, and attached to the skin or deeper muscular layers. The glands in the axilla may be enlarged at a very early period. If the disease has lasted for some time the patient may be emaciated, pale, anemic and weak.

Treatment.—The treatment is radical excision of the entire breast and the lymph glands which drain it. Inasmuch as some surgeons perform a rather wide excision, the skin of the patient should be prepared from beneath the angle of the jaw to the umbilicus, from well beyond the midline of the affected side to the region beyond the axillary border of the scapula (shoulder blade). This preparation, in the main, will consist of shaving the hair. Some surgeons prefer no pre-operative preparation of the skin other than that of cleansing it with green soap and water, leaving the iodine to be painted on in the operating room; others will have the skin cleansed with green soap and water, followed by alcohol, then ether, finally applying sterile dressings.

Operation.—The anesthesia may be given either by the Bennet method or intranasally. A sandbag is placed beneath the shoulder blade of the affected side. (See Fig. 75, page 280.) The arm may be put out either at right angles to the body, straight, or at right angles and bent at the elbow to an angle

CHAPTER XI

THE SURGERY AND SURGICAL NURSING OF THE URINARY SYSTEM

Anatomy.—The urinary system is composed in a normal individual, of the kidneys, the ureters, the bladder and the urethra. The kidneys, usually two in number, are compound tubular glands. They are situated on either side of the spinal column in the region corresponding to the last two thoracic and upper two lumbar vertebræ. The right kidney is at a lower level than the left owing to the presence of the liver on that side. As a rule they are about four inches long, two and one-half inches wide, and one and one-half inches thick. Each kidney is covered by a capsule. There are cases in which the kidneys are fused into one, the horseshoe kidney; or there may be only one kidney present.

The ureters which connect the kidneys to the bladder vary from twelve to eighteen inches in length. The bladder, which is the reservoir for the urine, is situated in the pelvis behind the pubis. It is in front of the vagina in the female and in front of the rectum in the male. It is a muscular sac, and at its neck gives origin to the urethra. The urethra is about one and one-half inches long in the female, and eight to nine inches in the male. It courses beneath the symphysis pubis in a downward and forward direction; its external orifice in the female is situated between the clitoris and the vaginal opening. In the male it normally runs through the length of the penis.

Diseases of the Kidney.—The inflammatory affections of the kidney may be either of the acute or chronic variety. The acute variety may involve the pelvis of the kidney (pyelitis), or there may be pus formation in the kidney itself (suppurative nephritis). If the pus is retained in the pelvis with a resultant dilatation, the condition is spoken of as a pyonephrosis.

Of the chronic inflammations, the one which interests the surgeon most is tuberculosis.

Treatment of Acute Infections.—In *pyelitis*, the treatment is primarily medical. The patient is placed in bed; fluids are forced to about 2000 c.c. a day, and urotropin gr. 10, or more is given by mouth three times a day. If it is thought that the pyelitis is in some way due to a chronic constipation with a dilated caput coli, colon irrigations are especially indicated. Occasionally the pelvis of the kidney is irrigated directly through a ureteral catheter which has been introduced into the ureter by means of a *cystoscope.* This is an instrument designed to give a view of the interior of the bladder. It has the general shape of a sound, has a telescopic lens and carries an electric light to illuminate the interior of the bladder which has been previously distended with warm boric acid. It has several modifications and attachments so that small catheters may be passed into the ureteral orifices. By this means the urine from both kidneys may be collected separately, and the condition and functional activity of each kidney may be judged.

In pyonephrosis, the kidney is incised in the region of the pelvis and the pus removed. This operation is spoken of as a nephrotomy. But if the kidney shows many areas of infection, the so-called acute surgical kidney, it may be completely removed (nephrectomy).

Operation of Nephrotomy.—The patient is placed in the kidney position. This is described in Chapter XVI—see Fig. 67.

Post-operative Treatment of Nephrotomy.—Inasmuch as urine as well as pus will escape from the kidney through the wound, the dressings should be frequently removed and changed to prevent maceration of the skin. The patient is placed upon forced fluids, their amount carefully measured, and the urinary output approximately estimated. These cases are rather protracted, lasting from six to eight weeks. The nutrition should be particularly watched and every effort taken to maintain or increase the patient's weight by a liberal diet, high in carbohydrates. When they are allowed up, there is often a leakage of urine through the wound, and to prevent the embarrassment of a constant urinous odor, a lumbar urinal may be worn.

Nephrectomy.—When it is evident that the kidney has been destroyed to such a degree that it is of little use to the organism, it is much better to remove it completely. A nephrectomy is always done for the acute septic kidney, diffuse pyonephrosis, tuberculosis, or new growths, provided the physical condition of the patient will permit such an operation, and the other kidney is present and not markedly diseased. If the ureter is definitely pathological, it is dissected down until a healthy portion is found, or if the entire length is affected, it might be totally excised together with the kidney.

Post-operative Treatment.—The treatment is similar to that of a nephrotomy. The drainage tubes are removed at the end of three or four days, and the patient is kept in bed for three to four weeks, until the wound has firmly and completely healed.

Renal Calculus.—Renal calculi or kidney stones may be found in the substance of the kidney, in the pelvis, or in the ureter. The stones may be single or multiple, rough or smooth, and may be present in one or both kidneys. The symptoms which they cause are those of renal colic. This is a severe colicky pain in the loin radiating downward to the testicle or vulva. Blood is found in the urine (hematuria) and there is occasionally frequency and urgency with burning micturition.

Treatment of Renal Calculus.—Patients who have a tendency to renal colic, as evidenced by a previous history of attacks, or the passage of small calculi, and whose urine contains an excess of urates, should be placed upon a diet which is poor in protein. Alcohol is absolutely prohibited, also tea and coffee. Alkaline drinks should be administered, and the alkaline diuretics, such as acetate, bicarbonate, and citrate of potassium should be given freely and often.

Operative Treatment.—When there is definite evidence of a stone from the clinical history augmented by positive radiographic and cystoscopic findings, operation is indicated, for it is the only measure which will insure permanent relief. The operations performed for kidney stones are two in number:—nephrolithotomy and nephrectomy.

Nephrolithotomy.—In this operation the procedure is similar to a nephrotomy. The usual lumbar incision is made with the

liberally, and during the first week, urotropin gr. 10, or more is given. The patient is kept in bed for at least three weeks.

Inflammations of the **Urinary Bladder.**—*Acute Cystitis.*—Cystitis may originate in the bladder itself, or it may be secondary to inflammations of the kidney, urethra, or other organs. The symptoms are frequency and urgency of micturition, and a burning sensation when the urine is voided.

Treatment of Acute Cystitis.—Patients should be kept in bed. The pressure about the bladder is relieved by elevating the pelvis so that the intestines will fall away from it, and flexing the knees so as to relax the spasm of the rectus muscles of the abdomen. Hot applications applied over the bladder region are very agreeable, and Sitz baths given about three times daily afford great relief. If the pain is very severe, morphine is given.

If there is great difficulty in voiding because of excruciating pain, a little novocain instilled in the posterior urethra affords great relief. Urine is less irritating when alkaline, and an acid condition may be alkalinized by the giving of sodium bicarbonate or sodium citrate, 20 gr. three times a day. The diet should be bland, non-irritating, and mainly fluid in nature. Irrigations of the bladder may or may not be done according to the judgment of the surgeon in charge. Irrigating solutions may be of boric acid, and later, when the disease becomes less acute, irrigations of silver nitrate in distilled water may be employed 1-5000, potassium permanganate 1-5000, or protargol 1-10,000. They are more effective and comforting when given warm.

Chronic Cystitis.—Chronic inflammations of the bladder may be the result of an acute attack, or secondary to some condition in the bladder itself, as a papilloma or a stone.

Treatment.—The treatment is that employed in the late stages of acute inflammation, namely, irrigations. These should be given daily, after a diagnosis of its etiology has been made. Sometimes, because of stricture of the urethra or inflammation of the testes, irrigations are not practical. These cases are treated by cystotomy (a suprapubic incision into the bladder with the establishment of free continual drainage).

Primary tuberculosis of the urinary bladder is extremely rare; it is ordinarily infected secondary to the kidney, prostate, or testis. The complaints given are usually of frequency, urgency, and often bloody urine.

Treatment of Tuberculosis of Urinary Bladder.—The treatment, of course, should be directed to the primary focus of the tubercle bacillus, and, if the kidney is responsible, it should be extirpated. While this is of prime importance, the patient meanwhile must receive some treatment to relieve the very distressing symptoms of a diseased bladder. In the first place the patient should be kept in good hygienic surroundings. Food should be plentiful, appetizing, and highly nutritious, and every measure available should be taken to insure the strengthening of a weakened, debilitated constitution. The bladder should be irrigated with very hot solutions of boric acid. These are always pleasing, and will relieve much of the pain. If the pain is very severe, some novocain (but never cocaine) might be instilled into the bladder. Tuberculous bladders are ulcerated, and great care must be taken that too much medication is not instilled, because free absorption is apt to take place and poisoning result. Rectal suppositories containing opium and extract of belladonna do much to relieve pain.

Operative Treatment.—This consists in a suprapubic cystotomy and the direct treatment of the ulcerated bladder mucosa, either with the actual cautery or chemical caustics. The after treatment is very important. The foot of the bed is raised, the bladder drained by continuous drainage, and washed out daily with a bland non-irritating solution through the suprapubic tube. Drainage of the bladder is kept up for about six weeks. It is important to maintain all the rules of strict asepsis in these cases, for nothing is more discouraging than to add secondary infection.

Bladder Stone.—When a stone is present in the bladder, there are generally pain, frequency of urination, and the occasional passage of blood at the end of micturition. The diagnosis of bladder calculi is not so difficult since the use of the X-ray and cystoscope, although formerly its presence was detected by the metal sound stone searcher of Thompson.

Treatment.—The stone is either removed by lithotomy or litholapaxy.

Litholapaxy.—The patient is placed in the lithotomy position (Fig. 72) and the urethra locally anesthetized. Some employ spinal anesthesia, and others, general. In this procedure an attempt is made to crush the stone within the bladder by means of a lithotrite. This is an instrument introduced through the urethra, and then opened when in the bladder, grasping the stone between its two powerful jaws, and crushing it into smaller pieces. The stony fragments are later evacuated by means of a Bigelow evacuator, which is an instrument designed to suck from the bladder the stone fragments in a water current.

Post-operatively, water should be given in large amounts; the urine should be kept acid, and drainage from the bladder should be free, through an inlying catheter. As a rule this can be removed at the end of forty-eight hours.

Suprapubic Lithotomy.—In this operation the bladder is opened above the pubis; the stone is removed, and the bladder sutured.

Ante-operative Treatment and Operation.—This consists of the ordinary preparation for any abdominal operation. The patient is anesthetized, the bladder is distended fully with either warm boric acid solution or air, and the patient is placed in the Trendelenburg position (Fig. 63). A suprapubic median incision is made, the bladder exposed, incised, and the stone removed with special forceps. The bladder is sutured with a double row of sutures, and the abdominal wound closed.

Post-operative Treatment.—If the wound is sutured tightly, the patient may be permitted up in from ten to fourteen days. If there is suprapubic drainage because of a concomitant cystitis, the tube should be left in for about ten days, and then removed; the patient is allowed up as soon as the suprapubic wound has healed. With very old people, attempts should be made to get them out of bed as soon as possible, for experience has shown that a weakly healed abdominal wound is better than broncho-pneumonia and death which may result if these cases are confined to bed.

New Growths of the Urinary Bladder.—Tumors of the blad-

ing in difficult micturition, and often complete retention of urine. To relieve this, if catheterization is impossible, a urethrotomy is performed. If the constriction is in the penile portion an internal urethrotomy is performed; if in the deep urethra, an external urethrotomy.

Internal Urethrotomy.—An internal urethrotomy consists of cutting the stricture with an urethrotome (an instrument shaped like a sound containing a hidden knife). The urethrotome is introduced into the region of the stricture, the knife drawn, and the stricture cut. Sounds are then passed and the strictured area dilated to the calibre desired.

External Urethrotomy.—The patient is placed in a lithotomy position, a filiform bougie is passed into the penis, and an attempt made to pass it through the strictured area. A tunnel sound is threaded along the filiform bougie down to the strictured area, the perineum is incised over the sound, and the stricture, identified by means of the filiform, is cut with a special urethrotomy knife. A tube is passed into the bladder through the perineal incision.

Post-operatively this tube is connected with bottle drainage. Fluids are forced and in about one week the tube is withdrawn and the patient is encouraged to void through the urethra. Sounds are passed about twice a week.

Circumcision.—This operation is performed to relieve a tight prepuce (phimosis), and consists in trimming off the redundant skin and mucous membrane of the penis. In young children the nurse should change the dressing after urination.

CHAPTER XII

SURGICAL DIETETICS

DIET is indeed a most important post-operative consideration. No two patients can be nourished alike, and it is a grave mistake to feed them in a routine manner as is so often done. The type of operation performed, the physical condition, the age, and the general post-operative behavior are all important factors in determining the kind of food, the amount and the frequency of the feedings. Patients who have had a colostomy performed certainly must be dieted differently from those who have had a gastroenterostomy. A woman of sixty will not be able to digest the regular hospital diet with the ease of a young boy. Then again, while the diet may be perfect when under supervision of the nurse, obliging relatives and kind friends may bring food and delicacies which may prove detrimental to the health of the patient. It is not unusual to see gastric disturbances after visiting days, due to candy and fruit which have been smuggled in by visitors. This evil should be tactfully and carefully controlled.

In the discussion of surgical dietetics, to facilitate matters, it will be best to first consider the diet following a simple operation, such as hernia, appendicectomy, ventral suspension of the uterus, and simple plastic gynecological operations.

Liquid Diet.—After a patient has recovered from the anesthetic, he asks for water, and inasmuch as there is bound to be nausea and vomiting following most operations, water is not permitted until two hours after the last vomiting. Of course, it is rather difficult to judge which is the last vomiting, but this can be learned by experience. As a rule, water is given in teaspoonful doses, moderately warm, although some surgeons will order it ice cold. If the patient tolerates this well, more may be given if desired. but he should never be allowed to drink promiscuously and freely. It is not advisable to allow fluids or "liquid diet" until the day following operation. The liquids commonly used are broths, gruels, tea, egg albumen, and lemon juice. About five ounces of these are given at a time. The second day after operation, milk may be added.

Milk is almost a perfect food; it is quickly delivered to the stomach, is entirely absorbed, has a high caloric value and provides considerable nourishment. There are some people who cannot tolerate plain whole milk. This may be remedied occasionally by adding barley water, lime water, plain water, seltzer, vichy, or a little brandy.

While it is not good policy to use alcoholic beverages, such as brandy or whisky, sudden withdrawal of these from patients who have been accustomed to alcohol for years might bring on delirium tremens. For these chronically alcoholic individuals it is sometimes advisable to give one-half to one ounce of whisky three times a day. On the other hand, some surgeons use it as a stimulant, prescribing it for weak and debilitated patients the first few days after operation.

The fluids should be served at frequent intervals according to the desire of the patient; whenever possible they should be served warm and always attractively. If they do not agree with the patient, and cause vomiting, their administration should cease. On the third day, as a rule, after the patient's bowels have been moved either by a cathartic or by an enema, a selected soft diet is allowed.

Soft Diet.—The following foods are appropriate for a soft diet. It may be varied and grouped according to the taste of the patient:

Cereals:—Wheatena, hominy, oatmeal, cornmeal, farnia, cream of wheat.
Eggs:—Soft boiled.
Vegetables:—Baked, mashed, or boiled potatoes.
Macaroni.
Desserts:—Ice cream, baked custard, rice, tapioca, or cornstarch pudding.

If this is well borne, within another day the patient may be shifted to a convalescent diet.

Wednesday

Breakfast	Dinner	Supper
Wheatena	Chicken, baked potato	Egg
Fresh fish	Macaroni	Rhubarb or prunes
	Tapioca pudding	

Thursday

Breakfast	Dinner	Supper
Hominy	Boiled beef, rice	Egg
Egg	Mashed potato	Baked apple
	Baked custard	

Friday

Breakfast	Dinner	Supper
Oatmeal	Fresh fish	Eggs
Egg	Boiled potato	Prunes
	Macaroni	
	Ice cream	

Saturday

Breakfast	Dinner	Supper
Cornmeal	Chicken	Egg
Stew	Mashed potato	Apricots or pears
	Hominy	
	Cornstarch pudding	

Approximate values to be given.

	Protein	Carbohydrates	Fat	Total Calories
Men	100 gm.	300 gm.	90 gm.	2500
Women	80 gm.	300 gm.	80 gm.	2200

Regular Diet.—This should be composed of the food to which the patient is normally accustomed, and should consist of a good mixed diet. It is not necessary to outline it in detail. Those foods should be selected which the patient enjoys, which are easily digestible and which need not be fried in fat. An example of such a diet is the following one:

Total quantity of milk allowed must not exceed 750 c.c. or 1½ pints.

Breakfast

Coffee or tea with milk and sugar, or milk.
Bread and butter.
Two eggs to each patient in male wards.
One egg to each patient in female wards.
Cereal with milk and sugar.
Fresh fish. Hash.

Dinner

Soup
Meat or fish
Potatoes, baked, boiled, or mashed. Bread and butter.
Spinach, squash, boiled onions, beets, sweet potatoes, macaroni, tomatoes, corn.
Pudding, or fruit. Milk, 180 c.c. or 6 ounces.

Supper

Tea or milk. Bread and butter.
Cooked fruit (prunes, apples, rhubarb, apricots, pears).
Cold meat. Eggs.
Cereal with milk and sugar. Milk toast.

Diet for Diabetes.—When certain diseases, such as diabetes or nephritis, complicate surgical conditions, the patient often undergoes a pre-operative dietetic preparation, so that the best possible physical state is attained before the operation is performed. It is a well-known fact that patients who suffer from diabetes mellitus, a disease in which the sugar content of the blood is high, and sugar appears in the urine, are extremely poor operative risks. To begin with, they take their anesthetic poorly, their tissues are rather low in vitality, become infected very easily, and are slow in healing. Then after operation, they are apt to pass into a diabetic coma, a very serious complication, usually resulting in death. In order to give these patients the best post-operative chance by rendering them less liable to coma, infection, and slow wound healing, every attempt should be made to reduce their diabetes to the minimum, or to render them sugar free. The following list of diets are those which are usually prescribed or ordered by surgeons to accomplish these ends.

Standard Strict Diet.

Breakfast

2 eggs. Coffee with 45 gm. cream.
Ham, 90 gm.
Butter, 15 gm. on biscuit during the test period; cooked with the eggs if no biscuit or bread is taken.

Luncheon

Meat, steak or chops, 120 gms.
Green vegetables (from list), 2 tablespoonfuls.
Butter, 15 gm. with green vegetable if no biscuit or bread is taken.
White wine, 2 claret glasses, or whisky or brandy, 2 tablespoonfuls.

Afternoon tea with 15 gm. of cream.

Dinner

Clear soup.
Fish, 90 gm.
Meat, beef, mutton, turkey, or chicken, 120 gm.
Green vegetable, 2 tablespoonfuls.
Salad with 15 gm. of oil in the dressing. Cream cheese, 30 gm.
Butter, 30 gm. on fish, meat, or vegetables if no bread or biscuit taken.
White wine, 2 claret glasses, or whisky or brandy, 2 tablespoonfuls.
Demi-tasse.

Bedtime

Bouillon with one raw egg.
Protein, 112 gm.; nitrogen, 18 gm.; fats, 160 gm.; calories, 2200; omitting ham, protein, 94 gm.; nitrogen, 15 gm.
For convenience in determining the carbohydrate tolerance, the following biscuits may be used, as the percentage of carbohydrates is practically constant:—Huntley and Palmer breakfast biscuit which contains 5 gm. carbohydrate; Uneeda Biscuit, which contains 4.6 gm. carbohydrate.

Standard Diet with Restricted Protein.

Breakfast

2 eggs. Bacon, 15 gm. Butter, 20 gm.
Coffee with 45 gm. of cream.
Luncheon
1 egg. Bacon, 15 gm.
Lamb chops, ham, or beefsteak, 60 gm. Butter, 40 gm.
Salad with 15 gm. of oil in dressing.
White wine, 2 claret glasses, or whisky or brandy, 2 tablespoonfuls.

Eggs.	Prepared in any way without flour.
Fats.	Butter, lard, suet, olive oil, or other fats.
Cheese.	All kinds, especially cream, Swiss, English and pineapple.
Salads and Vegetables.	Beet greens, Brussels sprouts, cabbage, cauliflower, celery, chicory, cresses, cucumbers, egg-plant, endive, kohlrabi, leeks, lettuce, okra, pumpkin, radishes, rhubarb, salsify, sauerkraut, spinach, string-beans, tomatoes, and vegetable marrow. Pickles made from these vegetables unsweetened; ripe olives.
Fungi.	Mushrooms and truffles
Condiments.	Salt, pepper, cayenne, paprika, curry, cinnamon, cloves, English mustard, nutmeg, caraway, capers, vinegar, and piquant sauces in small quantities.
Dessert.	Jellies made from gelatin, custards and ice cream made with eggs and cream; all sweetened with saccharin and flavored with vanilla, coffee or brandy.
Nuts.	Butternuts.
Cream.	Not over 90 c.c. a day.
Beverages.	Tea or coffee, sweetened with saccharin and with portion of cream allowed. Whisky, brandy, rum, and other distilled liquors up to 3 ounces a day. Light wine or Moselle wine, claret or Burgundy up to 16 ounces a day. Mineral waters of all kinds. Lemonade in small quantity sweetened with saccharin.

Articles Prohibited. (Except as prescribed in the Accessory Diet.)

Sugars and sweets of every kind.

Pastry, puddings, preserves, cake and ice cream.

Bread, biscuits, toast, crackers, and griddle cakes.

Cereals such as rice, oatmeal, sago, hominy, tapioca, barley and macaroni.

Vegetables such as potatoes, carrots, parsnips, beans, peas, beets, green corn, and turnips.

Fruit. Neither fresh nor dried.

Soups, sauces or gravies thickened with flour or meal, or made with milk.

Beer, ale, porter, all sweet wines, sherry or port wine, sparkling wines, cider and liquors.

Milk, chocolate or cocoa.

Soda water and all sweet drinks.

Oatmeal Days.

Porridge made from oatmeal, 250 gm. with butter, 250 gm., salt and pepper.
Black coffee, light wine ¼ liter, or cognac, 60 c.c.
The whites of 6 eggs may be added to the porridge if desired.

	Nitrogen gm.	Carbohydrate gm.	Calories
Oatmeal	6.2	170	1025
Butter	0.4		1975
	—		——
	6.6 or 42 gm. protein		3000
Alcohol (40 gm.) ...			210
6 whites of eggs	3.6		90
	—		——
	10.2 or 63 gm. protein		3300

The entire diet consists of:—Protein, 63 gm.; nitrogen, 16.8 gm.; carbohydrate, 170 gm.; fat, 212 gm.; calories, 3300.

Diet for Patients with Nephritis.

Occasionally patients with severe nephritis have to undergo operations; or, if they are operated on in an emergency, their post-operative care is partially one of diet. It is a known fact that salt or sodium chloride is retained in the body in cases of kidney disease, and that its retention causes edema. Occasionally if there is a sodium chloride retention it is necessary to put the patient upon a salt poor diet. These may be of three general varieties. The important factor in all is that the food should be prepared without any salt and that the butter and bread are to be salt free and that no extra salt should be allowed.

Salt Poor Diet. 1.

Breakfast

Bread, 30 gm. or 1 oz. Sugar, 10 gm. or $^1/_3$ oz. Farina, 60 gm. or 2 oz.
Butter, 30 gm. or 1 oz. 1 egg or 40 gm. or $1^1/_3$ oz. Coffee, 150 c.c. or 5 oz.
Total, 320 gm. or $10^2/_3$ oz.

Dinner

Bread, 30 gm. or 1 oz. Butter, 20 gm. or $^2/_3$ oz. Sugar, 10 gm. or $^1/_3$ oz.
Rice, 60 gm. or 2 oz. Farina, 100 gm. or $3^1/_3$ oz. Tea, 150 c.c. or 5 oz.
Total, 370 gm. or $12^1/_3$ oz.

Supper

1 egg or 40 gm. or $1^1/_3$ oz. Toast, 15 gm. or ½ oz. Bread, 30 gm or 1 oz.

Butter, 15 gm. or 1½ oz. Custard, 100 gm. or $3^1/_3$ oz. Prunes 60 gm. or 2 oz.

Tea, 180 c.c. or 6 oz.

Total, 440 gm. or $14^2/_3$ oz.

This contains chlorides, 1 gm., protein, 35 gm. or $1^1/_6$ oz. Fat, 65 gm. or $2^1/_6$ oz. Carbohydrate, 140 gm. or $4^2/_3$ oz. Calories, 1300.

Salt Poor Diet. 2.

Breakfast

Bread, 60 gm. or 2 oz. Sugar, 40 gm. or $1^1/_3$ oz. Farina, 60 gm. or 2 oz.

Butter, 35 gm. or $1^1/_6$ oz. 1 egg, 40 gm. or $1^1/_3$ oz. Coffee, 150 c.c. or 5 oz.

Total, 385 gm. or $12^5/_6$ oz.

Dinner

One egg, 40 gm. or $1^1/_3$ oz. Bread, 60 gm. or 2 oz. Butter, 30 gm. or 1 oz.

Rice, 70 gm. or $2^1/_3$ oz. Farina, 100 gm. or $3^1/_3$ oz. Tea, 150 c.c. or 5 oz.

Total, 450 gm. or 15 oz.

Supper

One egg or 40 gm. or $1^1/_3$ oz. Bread, 60 gm. or 2 oz. Butter, 30 gm. or 1 oz.

Custard, 100 gm. or $3^1/_3$ oz. Prunes, 60 gm. or 2 oz. Tea, 180 c.c. or 6 oz.

Total, 485 gm. or $15^5/_6$ oz.

This contains chlorides, 3 gm.; protein, 50 gm. or $1^2/_3$ oz.; fat, 100 gm. or $3^1/_3$ oz.; carbohydrate, 240 gm. or 8 oz.; calories, 2100

Salt Poor Diet. 3.

This is the same as the convalescent diet without broths or soups. The fish, meat and green vegetables must be boiled in two waters to remove most of the salt. Milk, 250 c.c. or 8 oz. only allowed.

Diet in Gastric Cases.—The diet following stomach operations is dependent upon what has been done surgically. If the ulcer-bearing area has been removed, it is not essential to place

patient is asthenic. After a few days, peptonized milk ℥ ii alternating with vichy ℥ ii may be given every two hours. If this is well borne, the milk is increased one ounce daily until eight ounces are taken. If the administration of the milk is followed by no pain, the amount of vichy may be increased to four ounces. In about ten days, thickened soups, such as purée of pea, sago, tapioca and junket are allowed. In the third week, scraped raw beef, very soft boiled eggs, macaroni, purée of vegetables, and zwieback may be given. The patient is gradually returned to a selected soft diet during the fourth week. If pain appears a return is made to the simpler milk diet.

Lenhartz Diet.—The food of a Lenhartz diet is administered at hourly intervals; it must be thoroughly masticated and eaten very slowly, and, during the treatment, the patient must be kept in bed. For the first week, the raw eggs which are used, are beaten up whole and iced; the milk is also iced; granulated sugar is added to the eggs on the third day. Boiled rice, zwieback and scraped beef are prepared in the usual manner. The Lenhartz diet for fourteen days is as follows:

As eggs differ in size and weight, take the total of eggs for the day of diet, beat, measure, and divide into seven feedings and put into medicine glasses. Keep on ice and use as directed, alternating with milk. The milk is kept in a bowl of cracked ice, and the eggs are beaten up raw and iced. The spoon is kept in a bowl of ice. The feedings should be given very slowly and the patients are never allowed to help themselves.

The patient should be given small feedings frequently and fed by spoon. Salt the eggs to taste on the first and second days; sugar is started on third day.

First Day

7 a.m.	Egg
8	Milk, 20 c.c. or $^2/_3$ oz.
9	Egg
10	Milk, 20 c.c. or $^2/_3$ oz.
11	Egg
12 noon	Milk, 15 c.c. or ½ oz.
1 p.m.	Egg
2	Milk, 15 c.c. or ½ oz.

First Day—Continued.

3 p.m.	Egg
4	Milk, 15 c.c. or ½ oz.
5	Egg
6	Milk, 15 c.c. or ½ oz.
7	Egg

Total, eggs (raw), 2; milk, 100 c.c. or $3^1/_3$ oz.

Second Day

7 a.m.	Egg
8	Milk, 35 c.c. or 1 oz.
9	Egg
10	Milk, 35 c.c. or 1 oz.
11	Egg
12 noon	Milk, 35 c.c. or 1 oz.
1 p.m.	Egg
2	Milk, 35 c.c. or 1 oz.
3	Egg
4	Milk, 35 c.c. or 1 oz.
5	Egg
6	Milk, 35 c.c. or 1 oz.
7	Egg

Total, eggs (raw), 3; milk, 200 c.c. or $6^2/_3$ oz

Third Day

7 a.m.	Egg. Sugar, 2 gm. or ½ oz.
8	Milk, 50 c.c. or $1^2/_3$ oz.
9	Egg. Sugar, 3 gm. or ¾ dr.
10	Milk, 50 c.c. or $1^2/_3$ oz.
11	Egg. Sugar, 3 gm. or ¾ dr.
12 noon	Milk, 50 c.c. or $1^2/_3$ oz.
1 p.m.	Egg. Sugar, 3 gm. or ¾ dr.
2	Milk, 50 c.c. or $1^2/_3$ oz.
3	Egg. Sugar, 3 gm. or ¾ dr.
4	Milk, 50 c.c. or $1^2/_3$ oz.
5	Egg. Sugar, 3 gm. or ¾ dr.
6	Milk, 50 c.c. or $1^2/_3$ oz.
7	Egg. Sugar, 3 gm. or ¾ dr.

Total, eggs (raw), 4; milk, 300 c.c. or 10 oz.; sugar, 20 gm. or 5 dr.

Fourth Day

7 a.m.	Egg. Sugar, 2 gm. or ½ dr.
8	Milk, 70 c.c. or $2^1/_3$ oz.
9	Egg. Sugar, 3 gm. or ¾ dr.

Fourth Day—Continued.

10 a.m.	Milk, 70 c.c. or $2^1/_3$ oz.
11	Egg. Sugar, 3 gm. or ¾ dr.
12 noon	Milk, 65 c.c. or 2 oz.
1 p.m.	Egg. Sugar, 3 gm. or ¾ dr.
2	Milk, 65 c.c. or 2 oz.
3	Egg. Sugar, 3 gm. or ¾ dr.
4	Milk, 65 c.c. or 2 oz.
5	Egg. Sugar, 3 gm. or ¾ dr.
6	Milk, 65 c.c. or 2 oz.
7	Egg. Sugar, 3 gm. or ¾ dr.

Total, eggs (raw), 5; milk, 400 c.c. or $13^1/_3$ oz.; sugar, 20 gm. or 5 dr.

Fifth Day

7 a.m.	Egg. Sugar, 4 gm. or 1 dr.
8	Milk, 80 c.c. or $2^2/_3$ oz.
9	Egg. Sugar, 4 gm. or 1 dr.
10	Milk, 80 c.c. or $2^2/_3$ oz.
11	Egg. Sugar, 4 gm. or 1 dr.
12 noon	Milk, 80 c.c. or $2^2/_3$ oz.
1 p.m.	Egg. Sugar, 4 gm. or 1 dr.
2	Milk, 80 c.c. or $2^2/_3$ oz.
3	Egg. Sugar, 4 gm. or 1 dr.
4	Milk, 80 c.c. or $2^2/_3$ oz.
5	Egg. Sugar, 4 gm. or 1 dr.
6	Milk, 90 c.c. or 3 oz.
7	Egg. Sugar, 4 gm. or 1 dr.

Total, eggs (raw), 6; milk, 500 c.c. or $16^2/_3$ oz.; sugar, 30 gm. or 1 oz.

Sixth Day

7 a.m.	Egg. Sugar, 4 gm. or 1 dr.
8	Milk, 100 c.c. or $3^1/_3$ oz.
9	Egg. Sugar, 4 gm. or 1 dr. Scraped beef, 12 gm. or 3 dr.
10	Milk, 100 c.c. or $3^1/_3$ oz.
11	Egg. Sugar, 4 gm. or 1 dr.
12 noon	Milk, 100 c.c. or $3^1/_3$ oz.
1 p.m.	Egg. Sugar, 4 gm. or 1 dr. Scraped beef, 12 gm. or 3 dr.
2	Milk, 100 c.c. or $3^1/_3$ oz.
3	Egg. Sugar, 4 gm. or 1 dr.
4	Milk, 100 c.c. or $3^1/_3$ oz.

Eighth Day—Continued.

3 p.m.	One soft boiled egg.
4	Milk, 133 c.c. or $4\frac{1}{2}$ oz.
5	Egg. Sugar, 14 gm. or $3\frac{1}{2}$ dr. Zwieback, 10 gm. or $2\frac{1}{2}$ oz.
6	Milk, 133 c.c. or $4\frac{1}{2}$ oz. Scraped beef, 24 gm. or 6 dr. Boiled rice, 33 gm. or 1 oz.
7	One soft boiled egg.

Total, 4 raw eggs; 4 soft boiled eggs; milk, 800 c.c. or $26^2/_3$ oz.; scraped beef, 70 gm. or $2^1/_3$ oz.; boiled rice, 100 gm. or $3^1/_3$ oz.; zwieback, 20 gm. or 5 dr.; sugar, 40 gm. or $1^1/_3$ oz.

Ninth Day

7 a.m.	One soft boiled egg.
8	Milk, 150 c.c. or 5 oz.
9	Egg. Sugar, 13 gm. or 3 dr.
10	Milk, 150 c.c. or 5 oz. Scraped beef, 23 gm. or 6 dr. Boiled rice, 66 gm. or 2 oz.
11	One soft boiled egg. Zwieback, 20 gm. or 5 dr.
12 noon	Milk, 150 c.c. or 5 oz.
1 p.m.	Egg. Sugar, 13 gm. or 3 dr.
2	Milk, 150 c.c. or 5 oz. Scraped beef, 23 gm. or 6 dr. Boiled rice, 66 gm. or 2 oz.
3	One soft boiled egg. Zwieback, 20 gm. or 5 dr.
4	Milk, 150 c.c. or 5 oz.
5	Egg. Sugar, 14 gm. or $3\frac{1}{2}$ dr.
6	Milk, 150 c.c. or 5 oz. Scraped beef, 24 gm. or 6 dr. Boiled rice, 66 gm. or 2 oz.
7	One soft boiled egg.

Total, 4 raw eggs; 4 cooked eggs; milk, 900 c.c. or 30 oz.; sugar, 40 gm. or $1^1/_3$ oz.; scraped beef, 70 gm. or $2^1/_3$ oz.; rice, 200 gm. or $6^2/_3$ oz.; zwieback, 40 gm. or $1^1/_3$ oz., or toast, 20 gm. or 5 dr.

Tenth Day

7 a.m.	One soft boiled egg.
8	Milk, 166 c.c. or $5\frac{1}{2}$ oz.
9	Egg. Sugar, 13 gm. or 3 dr.
10	Milk, 166 c.c. or $5\frac{1}{2}$ oz. Scraped beef, 23 gm. or 6 dr. Boiled rice, 66 gm. or 2 oz.
11	One soft boiled egg. Zwieback, 20 gm. or 5 dr. Butter, 4 gm. or 1 dr.
12 noon	Cooked chopped chicken, 25 gm. or 6 dr. Milk, 166 c.c. or $5\frac{1}{2}$ oz.

Tenth Day—Continued.

1 p.m.	Egg. Sugar, 13 gm. or 3 dr.
2	Milk, 166 c.c. or $5\frac{1}{2}$ oz. Scraped beef, 23 gm. or 6 dr. Boiled rice, 66 gm. or 2 oz. Butter, 4 gm. or 1 dr.
3	One soft boiled egg. Zwieback, 20 gm. or 5 dr. Butter, 4 gm. or 1 dr.
4	Cooked chopped chicken, 25 gm. or 6 dr.
5	Egg. Sugar, 14 gm. or $3\frac{1}{2}$ dr.
6	Milk, 166 c.c. or $5\frac{1}{2}$ oz. Scraped beef, 24 gm. or 6 dr. Boiled rice, 67 gm. or 2 oz. Butter, 4 gm. or 1 dr.
7	One soft boiled egg.

Total, 4 raw eggs; 4 cooked eggs; milk, 1000 c.c. or $33^1/_3$ oz.; sugar, 40 gm. or $1^1/_3$ oz.; scraped beef, 70 gm. or $2^1/_3$ oz., boiled rice, 200 gm. or $6^2/_3$ oz.; zwieback, 40 gm. or $1^1/_3$ oz.; or toast, 20 gm. or 5 dr.; chicken, 50 gm. or $1^2/_3$ oz.; butter, 20 gm. or 5 dr.

Eleventh Day

7 a.m.	One soft boiled egg. Milk, 250 c.c. or $8^1/_3$ oz.; zwieback, 10 gm. or $2\frac{1}{2}$ dr. Butter, 4 gm. or 1 dr.
9	Egg. Sugar, 13 gm. or 3 dr. Scraped beef, 20 gm. or 5 dr. Boiled rice, 75 gm. or $2\frac{1}{2}$ oz. Zwieback, 10 gm. or $2\frac{1}{2}$ dr. Butter, 6 gm. or $1\frac{1}{2}$ dr.
11	One soft boiled egg. Milk, 250 c.c. or $8^1/_3$ oz. Butter, 6 gm. or $1\frac{1}{2}$ dr. Zwieback, 10 gm. or $2\frac{1}{2}$ dr.
1 p.m.	Egg. Sugar, 15 gm. or 3 dr. Cooked chopped chicken, 25 gm. or 6 dr. Boiled rice, 75 gm. or $2\frac{1}{2}$ oz.
3	One soft boiled egg. Milk, 250 c.c. or $8^1/_3$ oz. Scraped beef, 20 gm. or 5 dr. Boiled rice, 75 gm. or $2\frac{1}{2}$ oz. Zwieback, 10 gm. or $2\frac{1}{2}$ dr. Butter, 6 gm. or $1\frac{1}{2}$ dr.
5	Egg. Sugar, 14 gm. or $3\frac{1}{2}$ dr. Cooked chopped chicken, 25 gm. or 6 dr. Boiled rice, 75 gm. or $2\frac{1}{2}$ oz. Butter, 6 gm. or $1\frac{1}{2}$ dr.
7	One soft boiled egg. Milk, 250 c.c. or $8^1/_3$ oz. Zwieback, 10 gm. or $2\frac{1}{2}$ dr. Butter, 6 gm. or $1\frac{1}{2}$ dr. Scraped beef, 30 gm. or 1 oz.

Total, 4 raw eggs; 4 cooked eggs; milk, 1000 c.c. or $33^1/_3$ oz.; butter, 40 gm. or $1^1/_3$ oz.; sugar, 40 gm. or $1^1/_3$ oz.; scraped beef, 70 gm. or $2^1/_3$ oz.; boiled rice, 300 gm. or 30 oz.; zwieback, 60 gm. or 2 oz.; chicken, 50 gm. or $1^2/_3$ oz.

Twelfth Day

7 a.m. One soft boiled egg. Milk, 250 c.c. or $8^1/_3$ oz. Zwieback, 10 gm. or 2½ dr. Butter, 4 gm. or 1 dr.

9 Egg. Sugar, 13 gm. or 3 dr. Scraped beef, 35 gm. or 1 oz. Boiled rice, 75 gm. or 2½ oz. Zwieback, 10 gm. or 2½ dr. Butter, 6 gm. or 1½ dr.

11 One soft boiled egg. Milk, 250 c.c. or $8^1/_3$ oz. Zwieback, 20 gm. or 5 dr. Butter, 6 gm. or 1½ dr.

1 p.m. Egg. Sugar, 13 gm. or 3 dr. Cooked chopped chicken, 25 gm. or 6 dr. Boiled rice, 75 gm. or 2½ oz. Zwieback, 10 gm. or 2½ dr. Butter, 6 gm. or 1½ dr.

3 One soft boiled egg. Milk, 250 c.c. or $8^1/_3$ oz. Scraped beef, 35 gm. or 1 oz. Boiled rice, 50 gm. or $1^2/_3$ oz. Zwieback, 10 gm. or 2½ dr. Butter, 6 gm. or 1½ dr.

5 Egg. Sugar, 14 gm. or 3½ dr. Chopped cooked chicken, 25 gm. or 6 dr. Boiled rice, 75 gm. or 2½ oz. Zwieback, 10 gm. or 2½ dr. Butter, 6 gm. or 1½ dr.

7 One soft boiled egg. Milk, 250 c.c. or $8^1/_3$ oz. Zwieback, 10 gm. or 2½ dr.

Total, 4 raw eggs; 4 cooked eggs; milk, 1000 c.c. or $33^1/_3$ oz.; sugar, 40 gm. or $1^1/_3$ oz.; scraped beef, 70 gm. or $2^1/_3$ oz.; boiled rice, 300 gm. or 10 oz.; zwieback, 80 gm. or $2^2/_3$ oz.; chicken, 50 gm. or $1^2/_3$ oz.; butter, 40 gm. or 1½ oz.

Thirteenth Day

7 a.m. One soft boiled egg. Milk, 142 c.c. or $4^2/_3$ oz. Zwieback, 10 gm. or 2½ dr. Butter, 4 gm. or 1 dr.

9 Egg. Sugar, 13 gm. or 3 dr. Milk, 142 c.c. or $4^2/_3$ oz. Scraped beef, 20 gm. or 5 dr. Boiled rice, 75 gm. or 2½ oz. Zwieback, 20 gm. or 5 dr. Butter, 6 gm. or 1½ dr.

11 One soft boiled egg. Milk, 144 c.c. or 5 oz. Zwieback, 10 gm. or 2½ dr. Butter, 6 gm. or 1½ dr.

1 p.m. Egg. Sugar, 13 gm. or 3 dr. Milk, 142 c.c. or $4^2/_3$ oz. Cooked chopped chicken, 25 gm. or 6 dr. Boiled rice, 75 gm. or 2½ oz. Zwieback, 10 gm. or 2½ dr. Butter, 6 gm. or ½ dr.

3 One soft boiled egg. Milk, 144 c.c. or 5 oz. Scraped beef, 20 gm. or 5 dr. Boiled rice, 75 gm. or 2½ oz. Zwieback, 10 gm. or 2½ dr. Butter, 6 gm. or 1½ dr.

5 Egg. Sugar, 14 gm. or 3¼ dr. Milk, 142 c.c. or $4^2/_3$ oz. Cooked chopped chicken, 25 gm. or 6 dr. Boiled rice, 75 gm. or 2½ oz. Zwieback, 10 gm. or 2½ dr. Butter, 6 gm. or 1½ dr.

Diet for Anti-Constipation.

Breakfast

Any fruit, fresh, cooked, preserved, or dried.

Shredded wheat, Thomas uncooked wheat biscuit, or oatmeal, or toasted corn flakes with cream if possible, otherwise a small amount of milk and sugar or molasses.

Bread.—Use only graham, rye, bran, whole wheat or corn bread.

Butter, jam, jelly, or honey. Coffee with cream and sugar.

Luncheon and Dinner

Soup.—Any kind except those thickened with flour, or containing milk.

Fish, meat, or eggs in moderation. Eat as much of the fat as possible.

Vegetables.—Fresh or canned in any quantities. Green salads with olive oil.

Desserts.—Fresh fruit or fruit cooked or preserved is best; also jellies prepared with coffee, wine and lemon, etc. Water ices may be eaten freely but only small amounts of ice cream may be taken. The undercrusts of pies may not be eaten.

General Directions.—Take at least a glass of water before breakfast, one in the middle of the day, and one at night. In addition take as much water as may be desired. This may be plain water, vichy or any carbonated water. Buttermilk, sour milk, cider, beer, and white wine are allowed. Butter in any quantity is permitted.

Avoid tea, red wine, milk and whisky, white bread, noodles, vermicelli, macaroni, cake, rice, barley, potatoes, and cheese.

General Rules.—Have a regular time for going to the toilet. Take a daily walk in the open air. Practice the setting-up exercises daily.

Setting-up Exercises.—

1. Knees stiff; bend forward and try to touch floor with fingers.
2. Bend body backward from hips.
3. Bend body to the right and left from hips.
4. Rotate to the right and to the left on hips.

Anti-Obesity Routine.—Very often it is necessary to reduce extremely stout individuals before any operation is undertaken. Of course, this is difficult to accomplish and great care and judgment should be exercised because the patient must not be weakened unnecessarily. The general routine is as follows:

1. A hot bath on Monday, Wednesday, and Friday for ten minutes before retiring.
2. Epsom salts, one tablespoonful in cold water on Tuesday morning.
3. Walk at least one mile daily.
4. Setting-up exercises for ten minutes each morning before breakfast.

Anti-Obesity Diet.

Breakfast	Calories	Proteins
One orange or one apple	70	1
Coffee with 4 tablespoonfuls milk	20	2
1 teaspoonful sugar	20	0
2 eggs or lean meat (about 5 x 3½ inches)	150	13
Luncheon		
Cup of beef tea or clear soup	25	3
Tea with 2 tablespoonfuls milk	20	1
1 level teaspoonful sugar	15	0
2 slices of bread about 4 x 4 x ½ inches	146	4½
1 pat of butter about 1 x 1 x ½ inches	80	
1 saucerful spinach, celery, or green vegetable	5	
Lean meat about 5 x 3½ inches	300	24
Dinner		
One cup of beef tea or clear soup	25	3
Tea with 2 tablespoonfuls of milk	20	1
1 teaspoonful sugar	15	2¼
1 slice of bread	70	2¼
Butter, one-half pat	40	
Meat about 5 x 3 x ½ inches	300	24
Entire potato or 2 tablespoonfuls of any starchy vegetable without grease	90	2
Total	1405	80¾

Additional Diet if prescribed:

One quart of buttermilk	640	60
American cheese, one inch cube	70	40

Nutrient Enemata.—As a rule these enemata are not very successful, but when food is constantly vomited from the stomach, or when there is a stenosis of the cardia of the stomach or esophagus, at least some little nourishment is received in this way. Preceding it a cleansing enema of about one pint of normal saline solution should be given. It is advisable to use a small soft tube and to insert it about 25 cm. from the rectum, for the higher it is introduced the greater is the absorption.

The food used in the enema is thoroughly mixed, then strained through cheese cloth, and poured into the funnel, five ounces at a time, at a temperature of 110° F. Great care should be taken that no air is introduced. The patient must lie quietly in bed for at least twenty minutes after the enema. Following are several formulæ which may be used:

1. The whites of two eggs and peptonized milk, 90 c.c.
2. One whole egg, 1 gm. of salt, 10 c.c. of brandy, 90 c.c. of peptonized milk.
3. Boas's formula:—250 c.c. milk, yolks of two eggs, 3 gm. table salt, 1 tablespoonful red wine, 1 teaspoonful wheat starch.

Feeding through Fistula.—This is employed when an opening has been made in the stomach because of some benign or malignant disease of the esophagus or cardia of the stomach. The food which is passed through the fistula must be either fluid or semi-solid and properly warmed.

unconscious struggling as the anesthesia develops, and will prolong and complicate it in numerous ways. And finally, all these irregularities will use up valuable vitality and preclude the best anesthesia and recovery. This state of affairs the nurse can prevent entirely in some cases and to a great degree in most cases by judicious word and deed as she goes about the preparation. This merely means that her general attitude will be reassuring and encouraging, and that she will avoid as far as possible all reminders of the event for which she is preparing. Such conduct has, of course, been dinned into every nurse's ears continuously ever since she entered the hospital as the only kind which ever befits a nurse, but she must practice it in this case with the utmost degree of refinement.

With this lesson well in hand *the bodily preparation* of the patient may be taken up. There will be specific orders by the surgeon, and these will vary in detail; and there will also be variations depending upon the anesthetic to be given and the nature of the operation. Nevertheless, though we can cover this ground in only a somewhat general way we shall enumerate the probable steps as follows:

1. *A cathartic will be administered* twelve or more hours before the operation.

2. Six hours or more in advance *food will be prohibited* or perhaps restricted to fluids till two or three hours before the appointed time for the operation, and then nothing will be administered by mouth. It is obligatory that several hours of starvation immediately precede an anesthetic because anything in the stomach, even water, is likely to cause vomiting when the anesthetic begins to take effect, and this, besides being annoying, may have serious asphyxial results. In some cases the question of harmful prostration from lack of food may override the danger of its presence in the stomach, but care must be exercised in this event to give foods which the stomach will dispose of most rapidly such as broths, tea or coffee, etc.; and milk should be especially avoided for this reason, even in the tea and coffee.

3. The operative field may be prepared at any time, but this will usually be determined by order and by circumstances, and

suggestions pertaining to specific cases have been pointed out in their proper connections in Chapters IV to XI.

4. Several hours in advance one or more *cleansing enemas* will be given. This part of the preparation must be done with considerable caution because it must be remembered that the patient has probably been subjected to vigorous catharsis which may have been exhausting, that the tonic effect of food has been denied, and that in any case an enema is liable to be prostrating. Nervous patients, and those in a state of reduced general vitality may entirely collapse under the administration of the enema at this time if care is not exercised. Plenty of time should be reserved for this treatment and all suggestion of haste should be avoided.

5. In cases of intestinal obstruction, other cases where the stomach is probably not empty, or where an operation is to be performed upon the stomach *a lavage* may be given. This is another treatment which calls for extreme calmness because it is always a trying and exhausting ordeal for the patient and those needing it will usually be in poor condition.

6. Immediately before the anesthetic is administered *the bladder must be emptied* and by catheterization if necessary.

7. The patient is clad in *loose, simple clothing* and plenty of it, according to the season. As a rule, a nightgown reinforced over the chest with a piece of flannel, loosely-fitting stockings, and a suitable number of blankets will comprise the wearing apparel.

8. *False teeth,* including detachable bridgework, will be removed and carefully laid away.

9. *All jewelry is removed* and safely cared for also. In cases where there may be prejudice on the part of the patient against removing some article of jewelry, such as a ring, it should be secured against loss by anchoring in place with a piece of tape or bandage.

CARE OF PATIENT DURING ANESTHESIA

The policy of calmness and reassurance which you adopted before beginning the preparation must be observed with redoubled effort when the administration of the anesthetic is begun, because, as pointed out above, *the mental attitude* of the patient will determine his behavior in general throughout his anesthesia. Absolute quiet in the room will be necessary for the best results, and talking or whispering, especially after the administration of the anesthetic has been begun, are particularly objectionable because the sense of hearing is one of the last to be anesthetized and as it often functions capriciously at this time patients may get undesirable impressions from what is said. Furthermore, conversation often leads partially anesthetized patients to make efforts to participate in it and this will delay the anesthesia and aggravate the excitement. Also, too great caution cannot be taken in deciding when the sense of hearing has been entirely overcome and when it will be safe to indulge in professional discussion of the patient's condition which it might not be wise for him to hear.

There will always be some degree of *struggling,* sometimes voluntary and nearly always involuntary, during the induction of the anesthesia, particularly in the case of ether, and the nurse will usually be expected to do guard duty against this. The arms and legs will be her chief concern, for though sometimes a strong patient will endeavor to sit up and even thrust himself from the table, if the arms and legs are kept in place he is helpless further. It is sometimes the custom to restrain the legs by binding them to the table with a strong strap passed just above the knees. With a strong, healthy patient, which is the type most likely to cause trouble, this precaution may be necessary, especially if there are not enough assistants available to control him, for one assistant cannot manage such a subject; but this practice will be very exciting to some patients and should not be adopted unless absolutely necessary. For these excitable patients a good plan will be to have this strap ready and to defer the adjustment of it till a degree of unconsciousness has been attained; or, some subjects will not be alarmed by this restraint if it is explained that you are applying it to prevent them from rolling from the narrow table after they have gone to sleep. In fact, this apology for the strap, if sincerely made, will sometimes comfort a nervous patient and

entirely overcome a nurse in this way when in the stage of excitement and he may even injure her.

The foregoing comments will apply in a general way to subjects of all anesthesia, but as your specific troubles and duties will depend somewhat upon which of the several anesthetics is used we shall take up separately each one of the four more common ones: nitrous oxide, ether, chloroform, and ethyl chloride, and point out briefly the usual behavior of patients under them and the corresponding nursing care.

Nitrous Oxide.—The induction period of this anesthetic is very short, lasting only a few seconds and there will be little or no struggling, so the nurse's duties will not extend much beyond assisting the anesthetist in *keeping the patient composed* so that he will breathe deeply and regularly. The general precautions against excitability outlined above, however, should always be taken as occasionally they will be helpful.

With nitrous oxide *the pulse* should not show much change, but should be regular, full and quiet.

Ether.—This anesthetic calls for all the precautions mentioned above because its induction period is relatively long, the anesthetic is comparatively disagreeable to take, there is almost always *a period of excitement* of greater or less duration and severity, and there are numerous respiratory and other irregularities which may arise and call for a helping hand from the nurse.

The anesthetist will, of course, guide the nurse's general course of action, but unless otherwise instructed she will make no mistake by following the more moderate course we have already advised. On the subject of *restraint* during the stage of excitement in the induction of ether anesthesia anesthetists will disagree. Some will prefer absolute resistance from the beginning to all efforts on the part of the patient, especially with his hands, and others will act upon the belief that early resistance to these efforts only aggravates them and will therefore advise permitting any activity that does not displace the inhaler or allow the patient to harm himself or the attendants. Personally, we have been entirely converted to this practice and are therefore inclined to advise the nurse to adopt it where she is not otherwise directed by the anesthetist, but she must be very sure beforehand that she is prepared to carry it out successfully, and must remember that even though the plan may succeed at first, some cases will later compel her to abandon it for the sterner measures.

With ether one expects *the pulse* to increase more or less in force and frequency, but extreme or sudden increase in frequency and other abnormal developments in the pulse will be matters of concern.

Chloroform.—The induction of chloroform anesthesia is usually less eventful from the nurse's standpoint than that of ether, that is, cases of extreme *excitement* will not be so numerous; but they will occur and must therefore be kept in mind. There is one important difference between the two anesthetics which the nurse should note, and that is that ether is, in general, stimulating to the action of the heart in the early period of its administration while chloroform is depressing. For this reason patients to whom chloroform is being administered should not be allowed the extreme activity during the stage of excitement which we have advised for those receiving ether. The anesthetist will control this, but we owe it to the nurse here to emphasize the fact that the method we recommended so highly for ether patients must be confined to them.

The pulse of the chloroform patient is of comparative importance. We have just remarked that chloroform depresses the heart, and so it does, but the nurse watching the pulse will notice that in the very beginning of the administration there may be a slight quickening of the pulse and a noticeable increase in its force. Very soon, however, there will be a gradual decrease of both which will probably extend below the level you noticed before the anesthetic was started. Extremes in either direction are, of course, danger signals.

Ethyl Chloride.—Ethyl chloride is not in general use for prolonged anesthesia, but it is popular in some communities for *short operations and dressings* which require only a few moments. We mention it here since its administration will usually require the attendance of a nurse throughout because entire relaxation is rarely attained and restraint of hands or the part operated upon will usually be necessary. Induction, entire anesthesia, and recovery will all take place within a few moments, and as *vomiting* often occurs very soon after the withdrawal of the inhaler, the nurse should be prepared for this from the beginning.

With ethyl chloride *the pulse* should not show much change, as a rule, except perhaps a slight decrease of frequency and force.

During the operation the anesthetist will be responsible for observing the general condition of the patient, but the operating room nurse also should make it a rule to remember the patient's condition and to be prepared to supply warm blankets, hot water bottles, hypodermics, etc., at any time. The temperature of the room is also the nurse's responsibility, and she should remember that maintenance of the standard temperature (75°-76° F.) and the exclusion of draughts have a direct influence in conserving the patient's well-being.

AFTER CARE

After the operation the nurse will usually be left entirely responsible for the preparation of the patient for the journey to his bed, and she will see that he is *well wrapped in blankets.* During anesthesia, especially with ether, there may be considerable perspiration, and as the outer hallways through which the patient is carried will doubtless be cooler than the operating room and well supplied with draughts it will be very easy for him to become suddenly chilled and thus to contract bronchitis or pneumonia. Also, ether patients have been given a predisposition to these two complications by the irritant effect of ether upon the air passages. In any other case, no matter what the anesthetic has been, it must be remembered that the patient's vitality has been lowered by both it and the operation itself and that he must be as well fortified as possible against the effects of sudden change of temperature.

Special care must be taken also in *handling an anesthetized patient,* for violent or sudden change of position may seriously

the hands and feet, observed from time to time by feeling them. In warm weather, or when the patient is in good general health and the anesthesia has been slight or short (as in short administrations of nitrous oxide or ethyl chloride) the blankets and some of the other precautionary measures may not be necessary, but the patient should, of course, be given the benefit of any doubt.

Though events of recovery will depend somewhat upon the temperament and physical condition of the patient, there is a general course which may be expected for each of the anesthetics and certain accidents and complications which are peculiar to each. We shall, therefore, discuss separately the recovery to be expected from each of the four anesthetics. It must be remembered, however, in all cases that the nature of the operation modifies recovery to a greater or lesser degree, but your study of shock, hemorrhage, and other operative and post-operative complications will teach you to make the necessary differentiations.

Nitrous Oxide.—Patients who have had this gas will recover within a very few minutes, as a rule, though the time will often be prolonged by *hysterical outbursts* of laughing, crying, etc. *Nausea and vomiting* sometimes occur, but they are infrequent. Oftenest a patient will shows signs of lassitude and may sleep for a considerable time. *Headache* is not uncommon and may sometimes be very persistent. *The pulse and respirations* of these patients should always be watched closely for some time, but as a rule recovery will be uneventful in these respects.

Nitrous oxide subjects will usually be able to take *nourishment* comparatively soon after recovery, but the surgeon's orders will determine the nurse's course in this respect, as there will often be surgical reasons of which the nurse may not know which will control administrations by mouth. Comments on page 188 on the administration of water to ether patients will apply in general to nitrous oxide subjects, and detailed instructions as to diets in all cases are given under the subject of surgical diets in Chapter XII, and in the discussions of the various operative conditions in Chapters IV-XI.

Ether.—Recovery from this anesthetic calls for careful nursing, and patients should not be left alone for one moment until consciousness is entirely established, for whatever aid they may need during this time must be given promptly.

Provision should be made early for the *restraint* of violence during recovery, for all the efforts incident to the stage of excitability in the induction of the anesthesia may be repeated during recovery. The favorite attempt of these patients is to

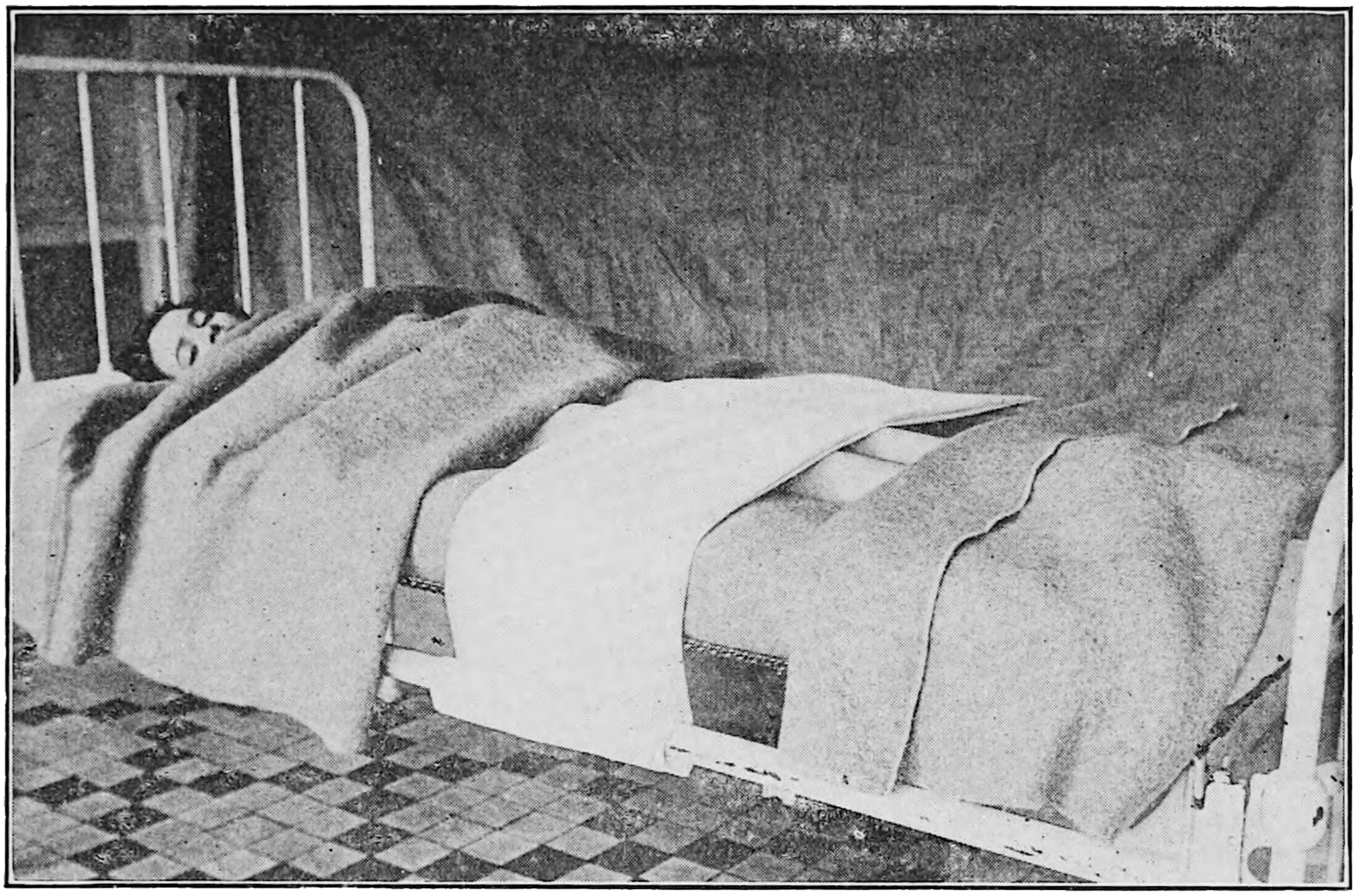


FIG. 19.—RESTRAINING SHEET FOR PATIENTS RECOVERING FROM AN ANESTHETIC. Strong safety pins may keep this in place on the bed frame; if the bar to which it is attached is not cylindrical, friction will hold a tightly drawn and well tucked in sheet; or, the sheet may be passed entirely around the bed springs and the ends fastened together underneath.

get out of bed, and if there are not enough assistants to control them throughout the period of this tendency a restraining sheet should be fastened across the bed just over the knees (Fig. 19). This will be of enough assistance, as a rule, so that one nurse can master the situation.

The respirations should be watched closely, for there are many respiratory complications which may arise before consciousness is regained. Regularly, the patient recovering from ether will breathe less deeply and vigorously than normally because, though ether acts as a stimulant early in its administration, it eventually tends to depress the respiratory nerve center. The color of the face, particularly of the ears and lips, will be a good guide as to whether or not he is inhaling sufficient oxygen if it is not convenient to observe his chest motion. In this connection the nurse should remember that sedatives, especially morphine, if given recently, will probably have contributed to the depression and she will make allowance on that basis for abnormally slow or shallow respirations, but she should not be too slow to be alarmed by respiratory depression after an anesthetic. In cases of extreme or sudden depression, while waiting for help, vigorous rubbing of the lips and face with a coarse towel may revive the patient somewhat, and of course the nurse is always prepared to give artificial respiration in cases of emergency. However, if the color and pulse are good and the patient is breathing unobstructedly the best treatment is to leave him alone, for many will pass unconsciously from their anesthesia into a sound sleep from which they will awaken in an hour or two fully recovered and more comfortable for thus having passed away time which would otherwise have been very unpleasant. This last remark has been inspired by observation of occasional instances in which concern has been felt for the patient who quietly "slept off" his anesthetic, and he has been aroused with no other effect than to bring him into earlier consciousness of his troubles than necessary.

Other respiratory complications may arise early through *occlusion of the pharynx* by a swollen or flabby tongue or by accumulation of mucus or vomitus. This can usually be avoided by keeping the patient's head turned to one side during recovery, or, if possible, by turning his entire body toward one side, both of which measures allow any fluid to run out of the mouth and also tend to throw the tongue and jaw forward and away from the posterior wall of the pharynx. In cases of persistent tendency of the tongue to occlude the throat the simple pushing forward of the jaw may overcome the difficulty as this carries the tongue forward also. This is often hard for the young nurse to learn to do properly, but if she will first make sure that the teeth are not locked together and will then thrust the lower teeth in front of the upper ones, or as nearly so as

the vomitus and becoming asphyxiated by it; and it is also possible that inhaled vomitus is responsible for some cases of "ether pneumonia." Also, his eyes must be shielded from the vomitus as they may be considerably irritated by it and develop a troublesome and painful case of conjunctivitis. When consciousness has been recovered to some degree the coughing reflex will function and the patient will be able to save himself from the asphyxial danger by coughing, but in any case his head should be held to one side while vomiting and the mouth

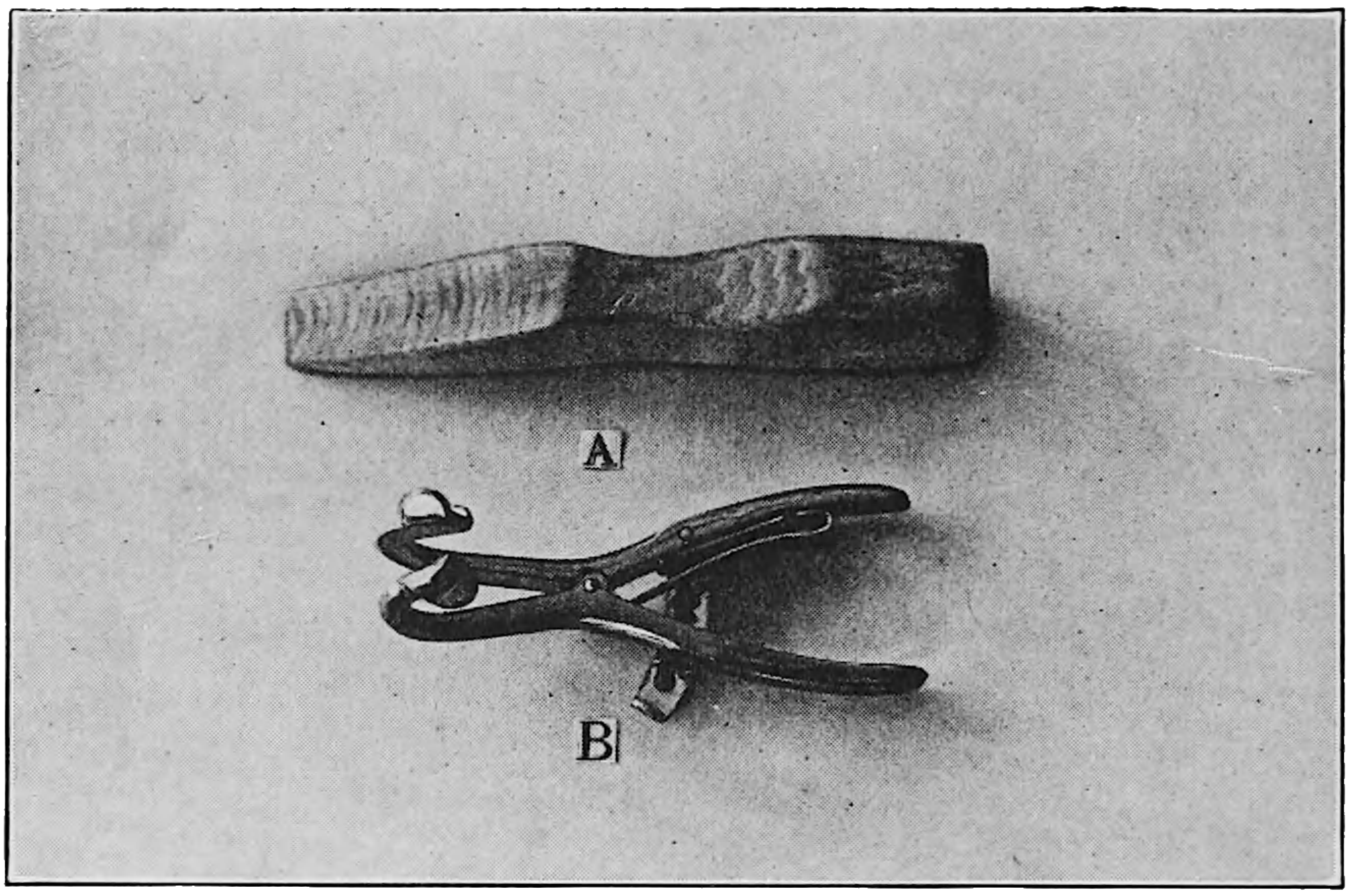


FIG. 21.—MOUTH GAGS. *A*, a simple wooden wedge which is very safe and very serviceable for prying the teeth apart, as well as for holding the mouth open temporarily for swabbing, pulling the tongue forward, etc.; *B*, metal gag which can be inserted only after the teeth have been well parted, but which is self-retaining when well placed.

swabbed clean if necessary. The character of the vomitus should always be noted. In ether cases there is likely to be much mucus, as ether stimulates all secretions more than the other anesthetics; and there will be indications of bile sometimes, and of stomach secretions. If blood is present it will be a matter of special concern. However, if the operation has been upon some part of the mouth, nose, throat, or stomach, it must be expected that old blood ("coffee grounds") which has been spilled or swallowed will be vomited. Bright red blood is alarming also, but a bitten tongue or a loosened tooth may be the contributing agent of this. Any case of unusual vomitus, however, should be reported to the surgeon as it will usually call for investigation by him.

The pulse, of course, is watched closely. That, too, will be somewhat depressed, at least for a short time after the patient's return to bed, but within an hour or so it should show signs of recuperation.

There are several odd manifestations which may accompany recovery from ether, such as *tremor, hiccough,* etc., but they are usually transitory and are not seriously significant unless they persist unduly. It is very likely that the patient who has manifested the tremor during the induction of his anesthesia will do so again when he recovers, but the nurse must not make the mistake of overlooking a real chill in these patients because the two conditions are easily confounded and a chill, as every nurse knows, is not to be taken lightly. Likewise, persistent hiccough should be regarded seriously because, aside from being very distressing to the patient, it may signify something deeper than a mere irregularity of recovery of consciousness.

Pulmonary edema is another complication of ether anesthesia, though it is an infrequent one. The nurse has doubtless learned elsewhere the symptoms of edema of the lungs and will at once recognize the unmistakable sound caused by the great quantity of mucus which has accumulated in the lungs and is being "washed" back and forth with respirations. A collection of thick mucus in the throat will sometimes cause a similar sound and even a degree of the cyanosis so prominent in edema, but swabbing of the throat and observations of the patient's general condition will quickly tell the nurse whether or not to be alarmed.

Another complication to be feared and guarded against is "*ether pneumonia.*" It is not frequent, but the nurse must always bear it in mind. General nursing training will have taught the nurse the warning signs and symptoms of pneumonia, so we shall not take space for them here.

Some authorities attribute one or two *kidney disorders* to ether, chiefly that of albuminuria and sometimes suppression. Urinalysis will show that albuminuria often does arise after anesthesia; but whether it is caused by the anesthetic or by something else will not concern us here as its treatment, if there is any, will be by prescription only. Suppression, of course, would be a serious condition but it is a nursing problem here only in so far as the nurse will be responsible for reporting as to whether or not evacuations of the bladder occur normally. This subject is entered into more fully in Chapter III, page 32, under post-operative complications.

The voiding of urine is always a matter of attention after anesthesia and if it does not occur normally, or nearly so, it must be regarded with concern. This may be due to suppression, which may or may not have reference to the anesthetic; but it will be very much more likely to be due to some deranging effect of the anesthetic or the operation upon the nerve-control of micturition which causes retention. The early training of the nurse will have prepared her for overcoming mild cases of retention, and the subject is discussed more fully in Chapter III, page 31; but she should seek guidance in all cases of failure to void urine within a few hours after recovery because this is a very important avenue of elimination of the anesthetic and any obstruction of it must be promptly removed.

The nurse will be guided by the surgeon's orders as to the *administration of nourishment,* because this will depend largely upon the surgical condition of the patient as well as upon the individual customs of the surgeon. Patients will be very thirsty from the earliest moment of recovery and will desire large quantities of water. Some surgeons will advise satisfying this longing generously, except, of course, in stomach or other cases where it will be harmful to the wound itself; and other surgeons will prescribe extreme moderation, even to the extent of allowing only small pieces of cracked ice. Every nurse knows that more than the most meager quantity of water aggravates nausea and vomiting in the vast majority of cases, but it is also a fact that plenty of water and the usual prompt vomiting of it will often have a sedative effect upon a turbulent stomach by cleansing it thoroughly of the disturbing contents. This treatment, however, is so heroic that the average nurse shrinks from it and she should not administer it except under definite order because there are many cases in which vigorous

than after ether. The precautions mentioned for cases of vomiting after ether apply equally to chloroform subjects, with the addition of the one discussed in the following paragraph.

Chloroform subjects very frequently exhibit considerable *pallor* and this will usually be accompanied by marked *depression of the pulse.* These two symptoms are especially likely to occur just before or during vomiting, and as their severity will usually depend upon the severity of the *vomiting* and the excitement accompanying it the nurse can often prevent considerable exhaustion and even collapse by judicious management of such cases.

The pulse is likely to be comparatively feeble throughout recovery from chloroform, and, as pointed out in the preceding paragraph, is subject to periods of great depression. This makes it advisable to exercise special care to keep these patients quiet though, as we have said, quiet recovery is provided by nature in the great majority of chloroform subjects.

Hiccough will occur occasionally, but as in the case of ether it will not often be of great consequence.

Bronchial and pulmonary complications are not frequent after chloroform because the anesthetic is not so irritating to these parts and does not cause the severe congestion of them that ether so often does. However, they are not entirely unknown and the nurse should not forget their possibility.

Though *kidney complications,* beyond albuminuria, are not attributed to chloroform, *the voiding of urine* is an important matter of nursing attention, as in the case of ether.

The discussion of *nourishment* in the case of ether will apply in general to chloroform.

Ethyl Chloride.—Complete recovery of consciousness after ethyl chloride usually takes place within a very few minutes. Occasionally there will be a case of *collapse,* but this will usually occur before the responsibility for the patient has been transferred from the anesthetist to the nurse. However, when collapse does occur it is so sudden and so profound that the nurse should keep its possibility in mind.

Headache, nausea, and vomiting occur frequently, and they may be severe.

The pulse, respirations, and general condition will, of course, be carefully watched for some time, as in all cases of anesthesia.

Subsequent treatment as to *nourishment,* etc., will correspond in general to that for nitrous oxide cases.

For lack of a more opportune moment we must mention now the matter of *the removal of the extra blankets* with which the anesthetic subject has been safeguarded. There can be no rigid rule laid down as to when this should be done, as there are too many varying factors to be considered. Some of the determining factors, excepting the self-evident one of recovery from the anesthetic, are these: The particular anesthetic given; length of the anesthesia; condition of the patient; season of the year; temperature of the room; and, of course, always the subjective comfort of the patient. For the same reason that the blankets were put on, care must be exercised as to their removal; that is, there must be no chance of exposure taken. In this respect error may be made in both directions, for it is as much a mistake to leave these blankets on so long after recovery that the patient becomes unduly warm as it is to take them off before nature's "heating plant" is in working order. In hospitals there will usually be an established routine, and elsewhere the nurse will need to draw upon her professional good judgment. Entire recovery from the anesthetic is the first requisite. This will mean that nitrous oxide and ethyl chloride patients, if they have blankets at all, will not need them as long as ether and chloroform subjects. A vigorous, generally healthy subject will recover all his functions much sooner after any anesthetic than a weak, devitalized one. After recovery the patient in poor condition may need protection further, while the stronger one may not. In winter longer protection will be needed than in summer. In a warm room more freedom can be taken than in a cold one. In the daytime patients have better resistance, on the whole, than at night. And last but not least, the patient's feelings, which always have an influence upon his condition will enter into the case to some degree.

Naturally, this transition is accomplished gradually, that is, these special blankets are not all withdrawn at one time. This much having been said, common sense will do the rest.

All nursing care following an anesthetic must be a fusion of that which pertains particularly to the anesthesia and of that demanded by the surgical condition of the patient. We have necessarily disregarded surgical conditions here, but their important nursing care is pointed out under the discussions of the various operative procedures in Chapters IV to XI; under shock and hemorrhage, in Chapter II; under post-operative complications, in Chapter III; and under surgical dietetics in Chapter XII. By combining the discussions of the subject from these several standpoints the nurse can formulate for herself the befitting twofold course of action demanded of her for each individual case.

or self-evident to you, or which seem very foreign to your case, and ask you to believe with us that they will meet the needs of someone else.

Much that must be said here to make the discussion complete will be of more value if studied in combination with the practical experience in the operating room itself; but the practice of plunging a pupil directly into the actual work from which she is expected to gather her knowledge as occasion chances to present itself is to leave her education too much to the mercy of her own enthusiasm and the uncontrollable irregularities of the work. A few preliminary classroom lessons before she is rushed into the confusion and excitement of the operating room will conserve much of the pupil's nervous energy, will save much valuable time for both herself and the other members of the staff, and she will have a sounder education for having acquired it in an orderly, logical way.

We strongly advocate the doctrine that every nurse should be given a thorough course in operating room technic, not only because of the countless number of additional facts she learns thereby which are essential to the highest efficiency in whatever specialty she may adopt after she has graduated, but also because of the general educational value of the discipline it gives her in alertness, accurateness, and promptness of response. However, there are relatively few nurses who should aspire to become operating room "specialists," because the work is a highly specialized type of nursing, and certain natural as well as cultivated qualifications are necessary for more than mediocre efficiency in it. We do not know any more about the universally model operating room nurse than we knew a few moments ago about the universally model operating room itself, but a few pages hence we shall attempt to set up a few standards which will apply universally.

A thoroughly logical sequence in the presentation of the almost innumerable phases of this subject is very difficult to arrange, but as a nurse knows in a general way, before taking up this course, what an operating room is for, she will perhaps do best by beginning here with a picture of its general arrangement and equipment.

THE ROOMS AND THEIR FURNISHINGS

Ideally the operating theater comprises these rooms:

1. Operating room proper
2. Anesthetizing room
3. Dressing room for surgeons
4. Dressing room for nurses
5. Recovery room
6. Work room for nurses
7. Sterile supply room
8. Sterilizing room
9. Storage room

Of course, this exact number of rooms may never be available, but they do represent departments, and whatever space is provided should be subdivided and arranged with these separate features in mind. By the time you have finished this chapter we shall hope to have assisted you to enough ideas to enable you to make the best combination of these departments which your space permits.

When practicable *the operating theater is on one of the higher floors* of the building because in this location it is most likely to be isolated from miscellaneous traffic and undue noise and dust, all of which are menaces and nuisances to an operating room.

1. **The Operating Room Proper.**—*a. Construction.*—This is, of course, *a light room* and it has a northern exposure if possible because of the better diffusion of light it will furnish than one into which strong rays of sunlight stream in some parts, causing deep shadows in others; and a skylight will be an additional advantage. The size of the room is best *no larger than is necessary* for holding the equipment and allowing the minimum space for comfort in moving about. Too large a room is wasteful of time and steps, and too small an one, of course, will be too congested for the easy maintenance of asepsis, because there are always the sterile and the unsterile equipment

in more or less close association. Unless one has the pleasure of planning the construction of her own operating room, however, she will not be able to control this feature of the matter beyond exercising good judgment as to arrangement of contents and organization of routine practices.

It ought not to be necessary to remind you that the walls, floors, and all other structural parts of the room should be *finished in the most hygienic way* possible; that is, they should be of some material that can be easily washed and that will not catch or hold dust readily, for example, tiling, enamel paint, etc. Those of you who have had the advantages of training in a hospital built on modern architectural principles will have observed the curve, for instance, in which the wall and the floor meet instead of the old-fashioned right-angle which is such a safe harbor for dust and such a good incubator for germs; you will probably have noticed also that the corners of the walls are fashioned similarly; also, the window ledges were probably slanting or curved, and all window casings, door casings, and other finishings were as free as possible from nooks and corners. This has all been provided for you and you have taken it for granted, but you should appreciate the principles involved so that if it falls to your lot at some time to control the adaptation or construction of some room for operating purposes you may be able to be of the best service.

On this same principle, a good technician does not provide wall hooks in her operating room upon which careless persons may hang various articles which lumber up the room and encourage contamination. The storage and supply rooms are the proper places for all articles which are not needed for the operation, and between operations the storage and supply rooms are the places for everything except the more non-transportable furniture. Under some conditions of room arrangement where space is limited the operating room may have to bear a part of the burden of storage, but in any case one must always follow the principle of keeping all supplies protected as far as possible. This practice is not only refined technic but it is also simple common sense in that it saves the time and labor of unnecessary renovation.

Many of the more expensive tables are very complex in their mechanism, and as the average nurse is not mechanically inclined she finds it difficult to learn how to manipulate them; but as it usually falls to her lot to see that the patient is placed in the proper position for the operation, she should consider it her business to master the mysteries of her table, as all the attachments and adjustments serve some helpful purpose if the responsible person knows how to put them to their intended use expertly. This may seem a minor detail but operating room work is made up of detail, and, like a delicately adjusted machine, if one part functions poorly it is very likely to cause embarrassment to the whole machine. For instance, in the case of operations upon the kidney we have seen it necessary for the surgeon, after struggling many precious minutes against the handicap of an improper position of the patient, to stop operating, dress the wound temporarily, unsterilize his gloves and gown, and adjust the patient's position himself. This is an extreme illustration because of the fact that, for anatomical reasons, the kidney is difficult of access in the best of positions, but corresponding annoyances in many other cases may arise from lack of intimate acquaintance with this very essential article of equipment.

One or two *instrument tables* are the next essentials. If there is but one operation to be done one table is enough, but where there is to be a session of several cases it will be necessary to have a second table for the reserve supplies. Many varieties are in use (Fig. 23) and there is no importance in the design of any one except when one is desired which can be placed across the operating table near enough to the wound so that the surgeon can pick up the instruments from it himself. For this purpose a type similar to the one illustrated in Fig. 24 will be needed. This is a very serviceable table, as it is adjustable in height, is on rollers, and can thus be easily adapted and moved as convenience requires.

A *table for dressings* and other miscellaneous supplies will be needed in nearly every case. This should be no larger than necessary.

One or more *stretchers* are necessary. In a large hospital where space permits and elevators are used, the wheel stretcher (Fig. 25) will be the one to provide, but in many smaller in-

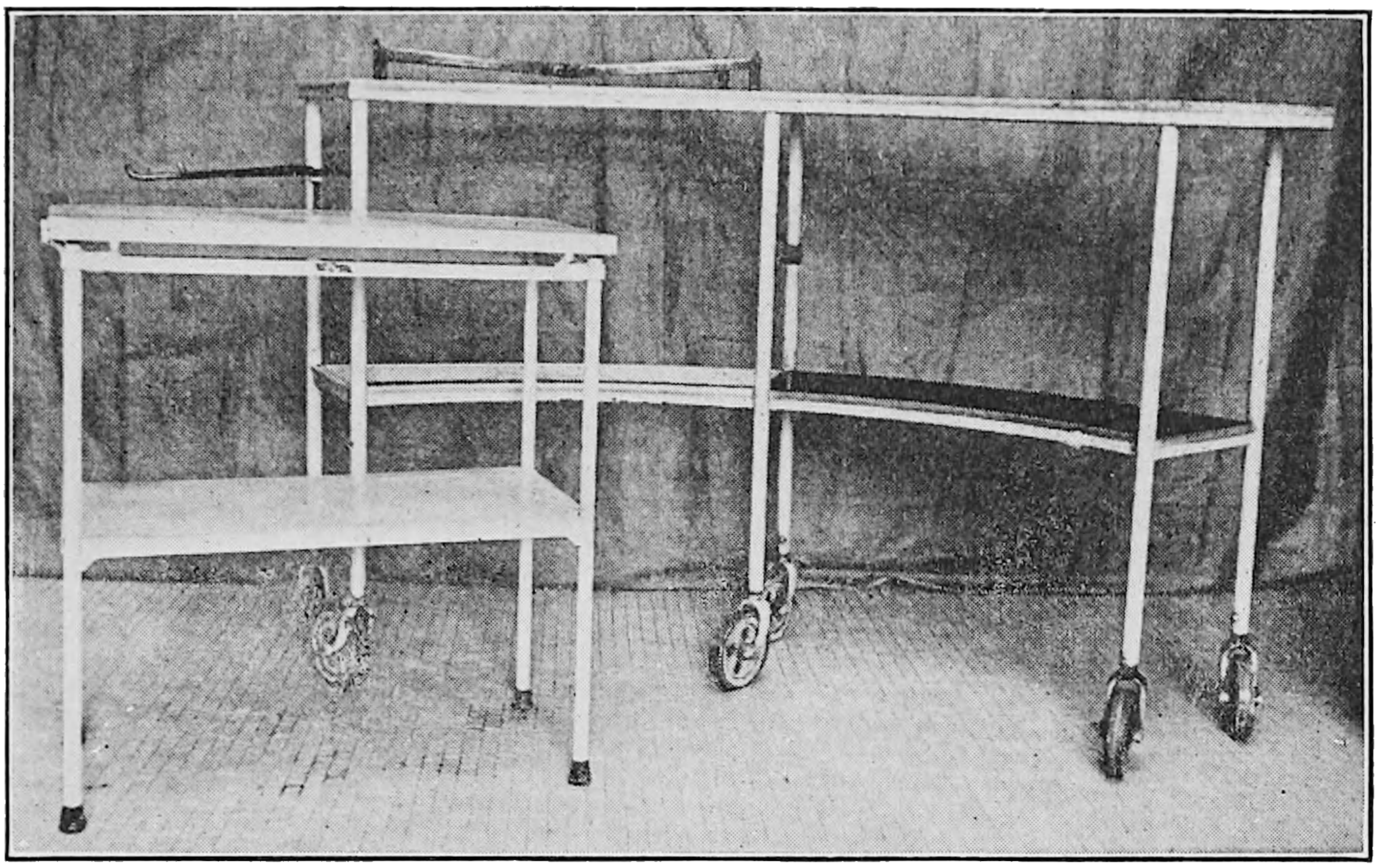


Fig. 23.—Two Varieties of Instrument Table.

stitutions the carrying variety (Fig. 26) can be made to an- swer all purposes; but where there is much carrying up and

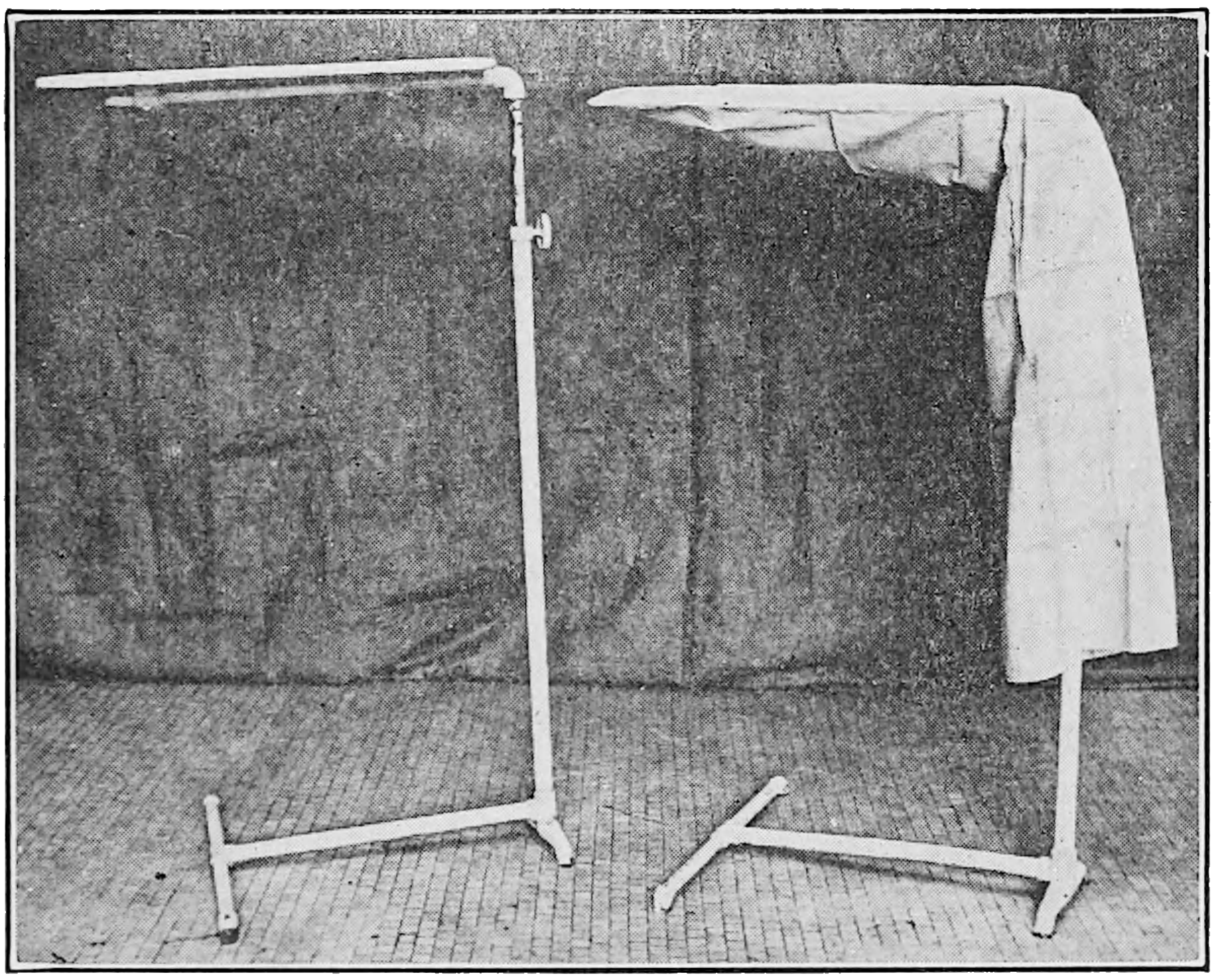


Fig. 24.—Adjustable Instrument Table Which May be Extended Across the Operating Table in Any Location Desired. The cover shown is the one described on page 216, paragraph No. 13.

down stairs to be done the special design shown in Fig. 27 is very serviceable.

A *tub or large basin* holding 6 or 8 gallons will be needed in large operating rooms for a 1-1000 solution of bichloride which will serve many useful purposes from time to time.

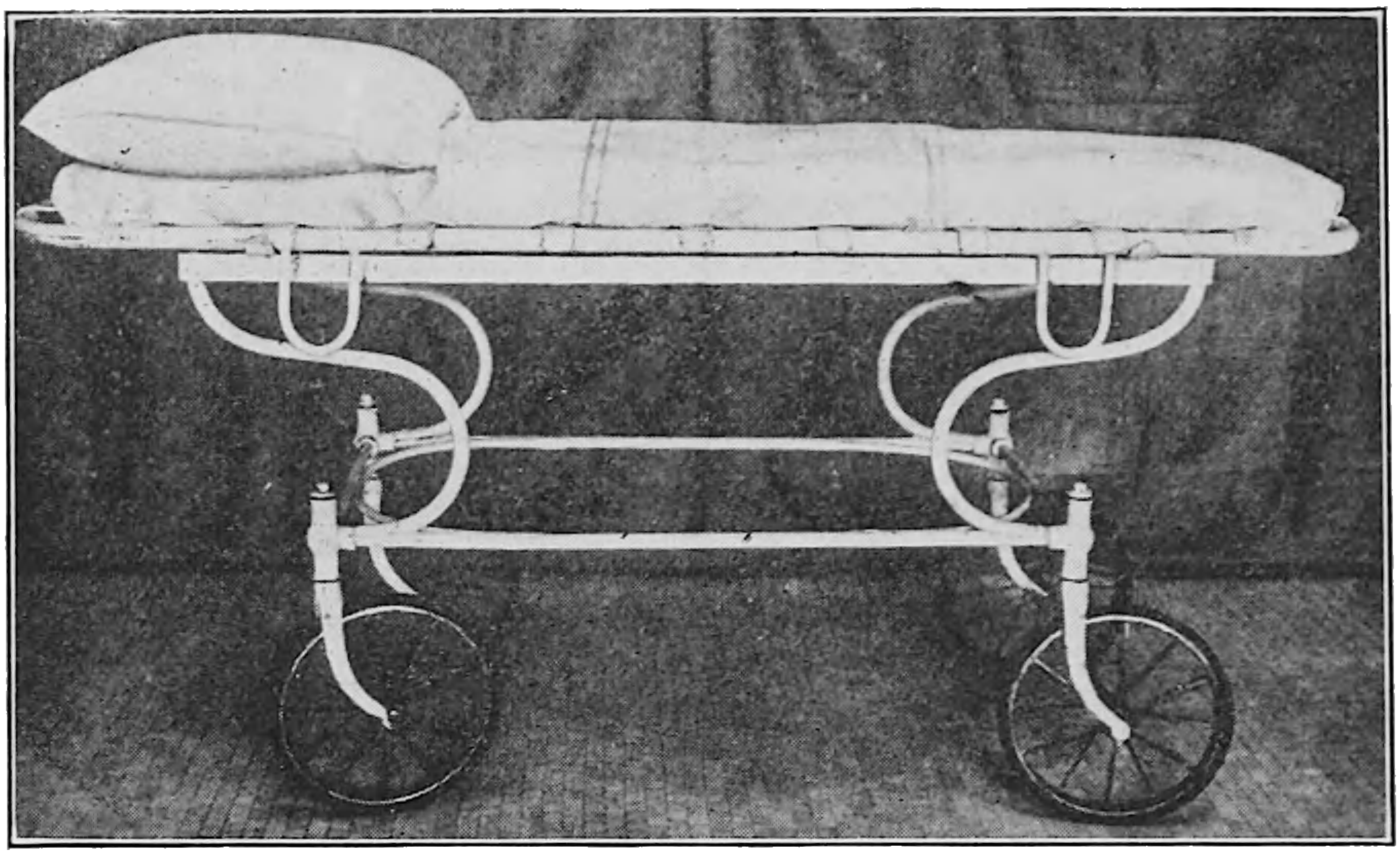


FIG. 25.—WHEEL STRETCHER.

Other minor articles for this room are, *a seat for the anesthetist or surgeon* (Fig. 28) ; possibly *a small table* for unsterile

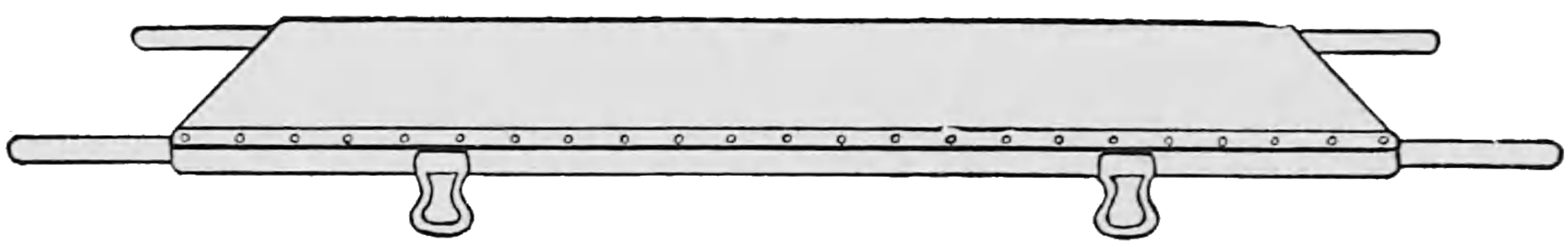


FIG. 26.—CARRYING STRETCHER. This is, in general outline, the U. S. Army type.

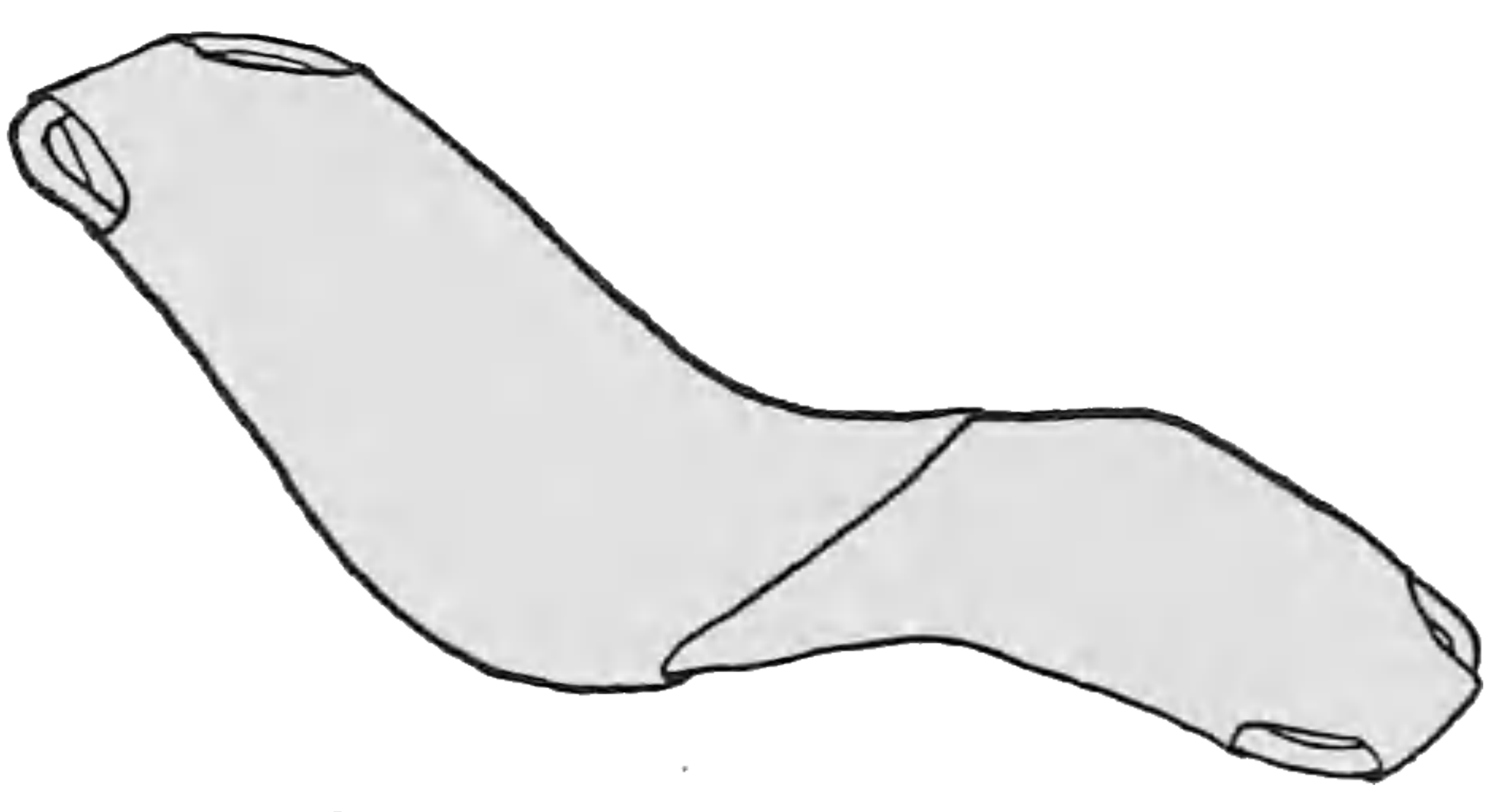


FIG. 27.—STRETCHER SUITABLE FOR CARRYING PATIENTS UP AND DOWN STAIRWAYS. It is merely a bent iron tube covered with canvas slip covers. Some models have a single piece of canvas shaped like the frame and laced to it with a strong cord passed through eyelets in the border of the canvas.

supplies such as adhesive plaster, bandages, etc.; and a set of *low benches* (Fig. 29) of differing heights for the surgeon to stand upon for some operations. These should range in height

general favorite. It is *the "drum"* (Fig. 31), or metal container in which the dressings and other fabrics are sterilized and from which they are used directly while the operation is in

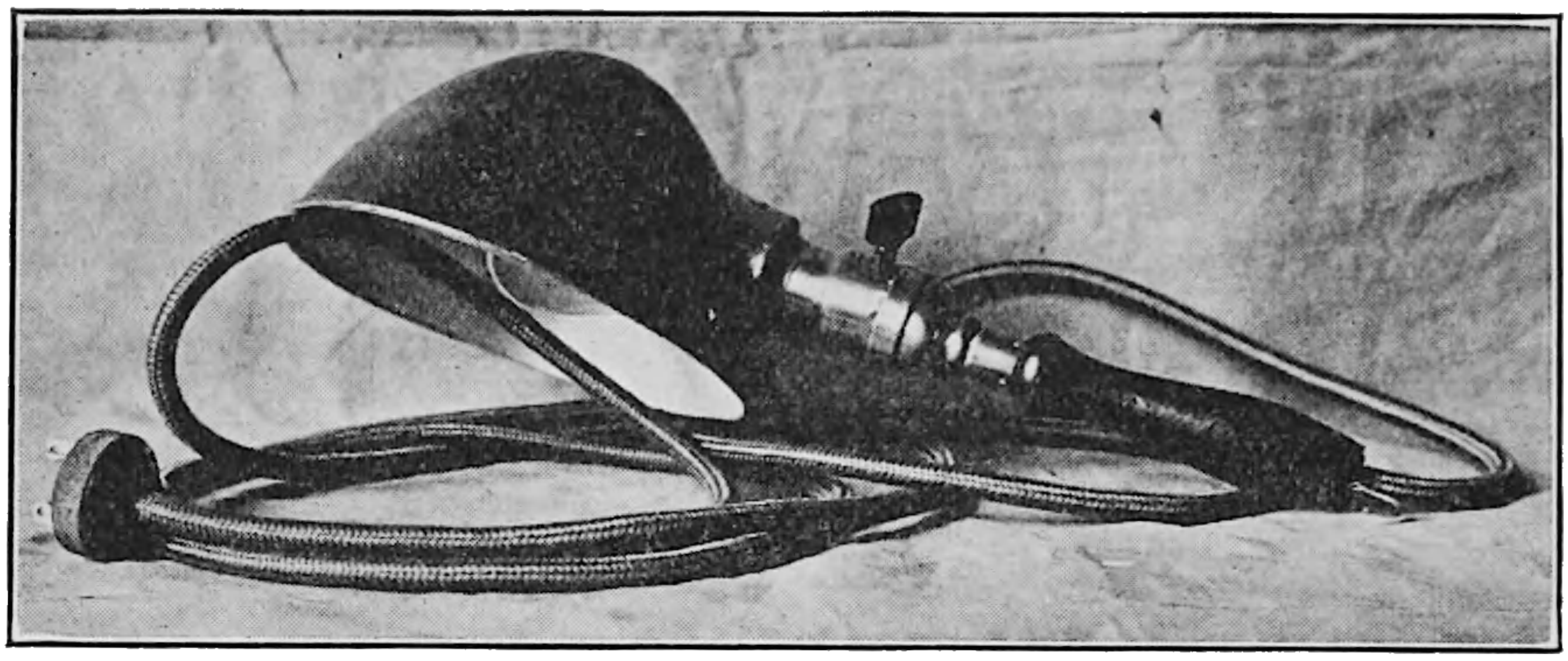


FIG. 30.—HAND LIGHT.

progress. It is made with perforations which are opened to admit the steam while in the sterilizer, and closed afterward, making the drum very safe and dust-tight. The lids of these drums, when in use, are opened and closed by means of a foot lever on a specially fitted stand, and they thus provide a very convenient storage medium. For a complete system several drums will be needed; for example, the gloves cannot be kept with the wound dressings because they are covered with talcum powder and this sifts from them when they are handled; also, for reasons which you will learn later, it is not good technic to store the sterile gowns with the wound dressings; and it may not be convenient to have the draping sheets and towels in the same part of the room, or even in the same room, with any of the other supplies. Thus, you will need at least four drums if you have any, and when this system is used there is usually included a fifth *drum for hot wet towels and pads* (Fig. 32). Here we must digress somewhat to say that this hot towel drum is similar to the others except that it is perforated in the bottom and is fitted over a

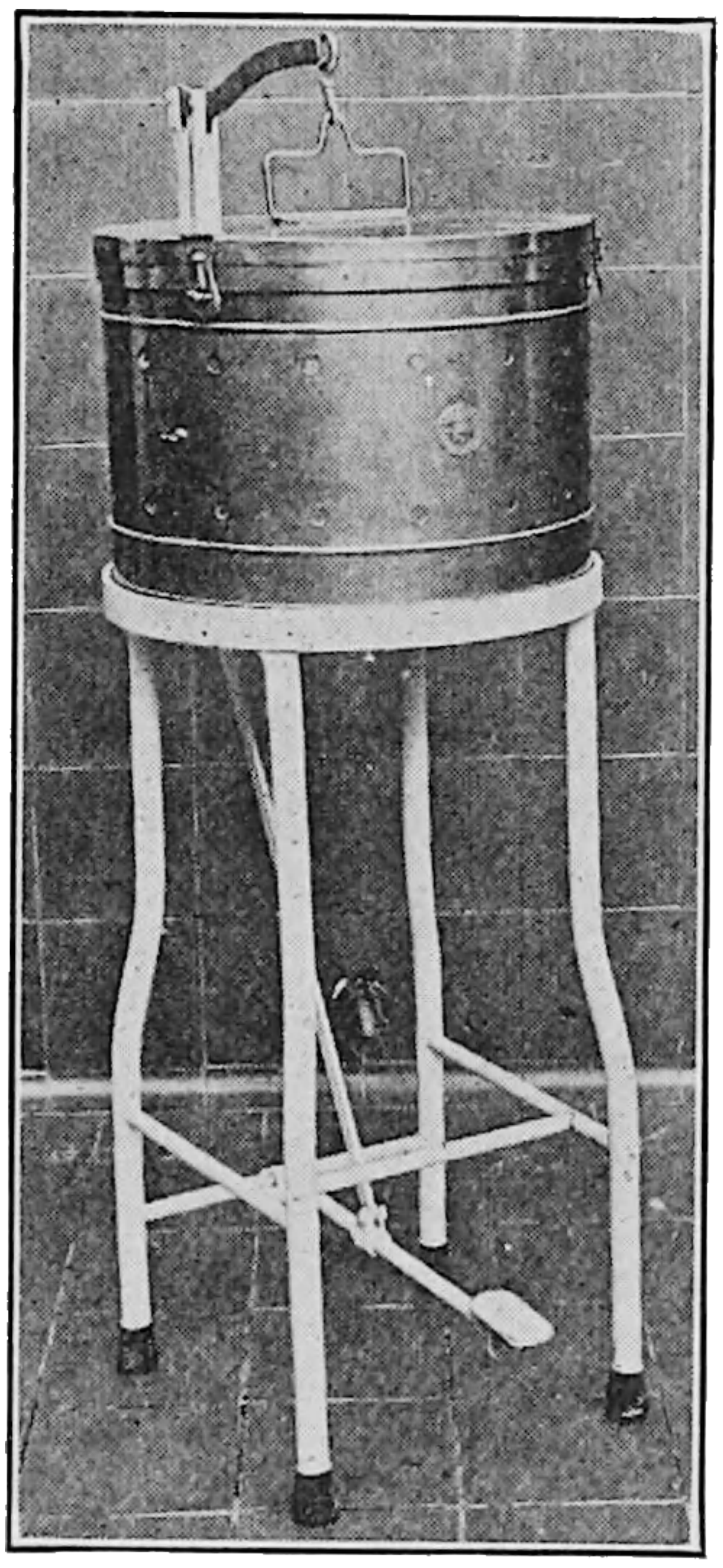


FIG. 31.—DRESSING DRUM WITH PEDAL OPENING STANDARD.

small water tank which is heated electrically or otherwise, thus allowing the towels to become wet and heated by the steam. Besides the set of drums in use, as outlined, there will be needed reserve ones, so this involves a considerable equipment which will be too expensive in some instances; and besides there will sometimes be the consideration of storage space because these stands and drums require more space for a given amount of contents than do the simple muslin-covered parcels which you would otherwise use.

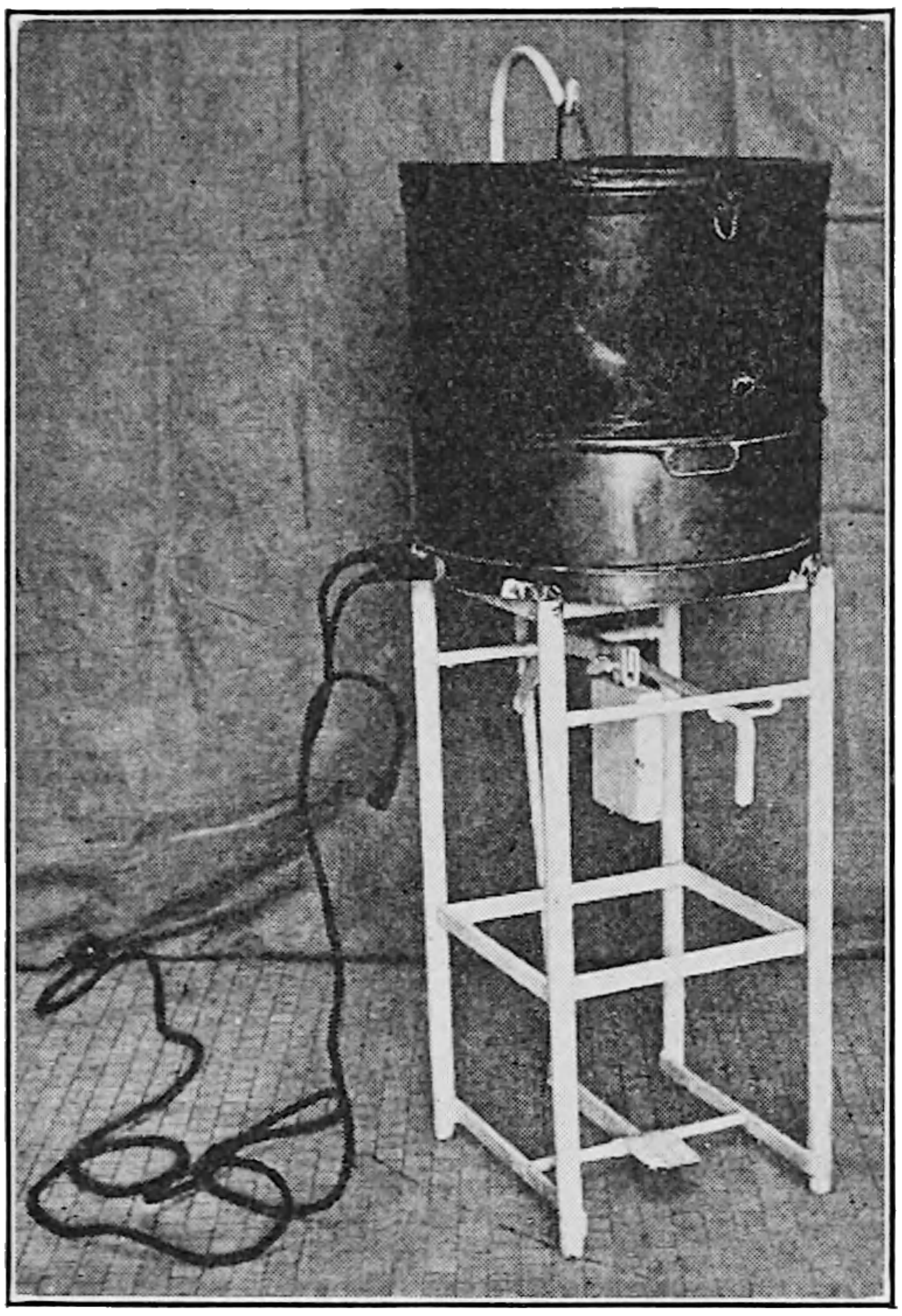


FIG. 32.—HOT TOWEL DRUM WITH PEDAL OPENING STANDARD AND ELECTRICALLY EQUIPPED STEAMING DEVICE.

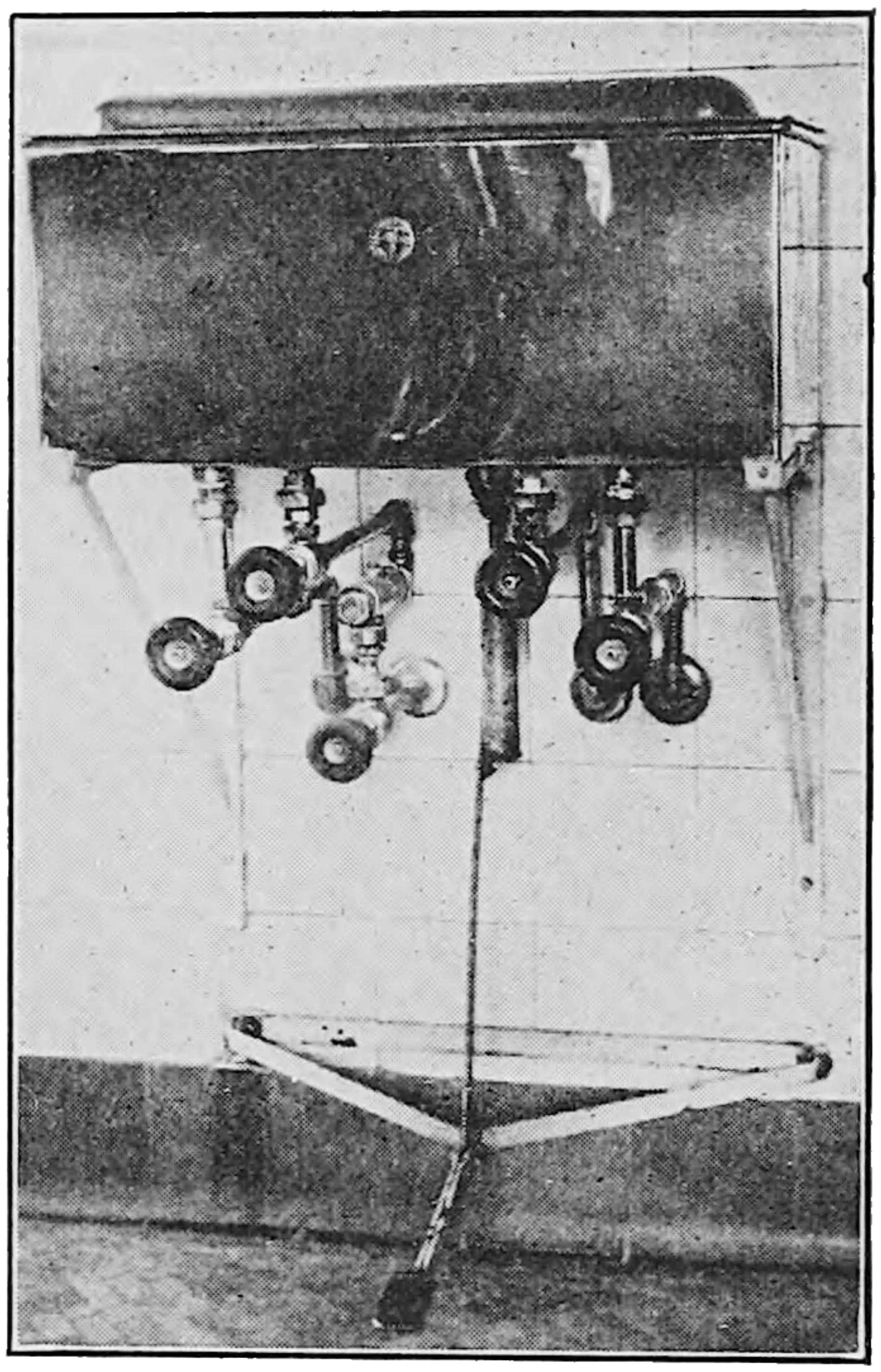


FIG. 33.—INSTRUMENT STERILIZER.

c. Sterilizers.—Where space permits *the instrument sterilizer* (Fig. 33) should be within the operating room and as near the instrument table as is practicable and safe, because frequent reboiling of instruments is usually necessary during an operation and it saves time and handling if the person responsible for the instruments has direct, easy access to this boiler. When this sterilizer is heated by gas or any other *open flame* it must be stationed a safe distance from the anesthetist because ether, chloroform, and ethyl chloride are highly inflammable. Furthermore, extreme heat, and particularly an open flame, will decompose chloroform vapor and produce phosgene and hydrochloric acid gases which, in a small or poorly ventilated room, may cause serious trouble by their irritant effect upon the eyes and the respiratory tract.

In some cases one sterilizer may have to suffice for all other supplies as well as the instruments; but where possible there should be another large *utensil sterilizer* (Fig. 34) for large basins, etc. This should be in the operating room also when possible.

Besides the reason of convenience for having these boilers within the room, there is the technical reason that *the steam which they give off renders the air moist* and thereby keeps down dust which might sometimes be a real menace in a dry atmosphere.

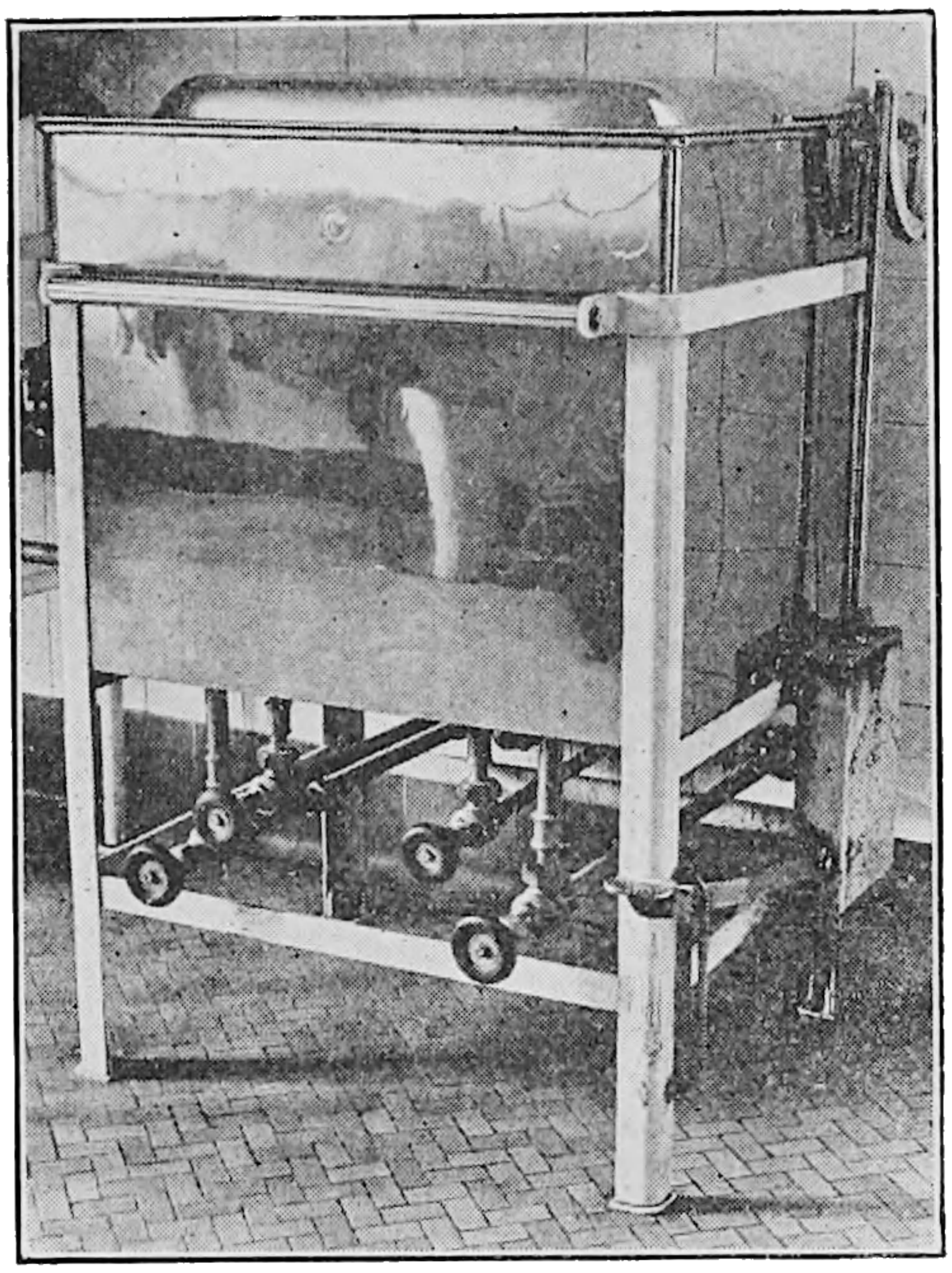


FIG. 34.—UTENSIL STERILIZER.

Water Sterilizers (Fig. 35), one for hot sterile water and one for cold, and equipped with a filter, will also be necessary. These are perhaps best placed outside of the operating room, but their outlets should be extended into the room at some easily accessible point.

d. Miscellaneous Equipment.—There are a great many other devices which are in more or less general use and which, if properly fitted into a corresponding general system, simplify the work. In fact, those who have become accustomed to the more elaborately outfitted operating rooms and who have never been compelled to work more primitively will consider indispensable many of these items; but as they are more or less luxuries we shall not take space here to enumerate them.

2. **The Anesthetizing Room.**—*a. Construction.*—The finishing of the walls, floors, etc., should be similar to that described for the operating room, because where there is a separate room

stretcher for the patient. In generously equipped operating rooms where several operations are done in immediate succession there will doubtless be an extra operating table for this purpose and the patient will be anesthetized upon the table upon which the operation is to be performed. Otherwise, a wheel stretcher or some other type of table will be needed.

There will also be needed a small *table for the anesthetist's supplies.* This may be one that is fitted with wheels so that it may be taken into the operating room during the operation, but the articles needed by the average anesthetist after the anesthesia is established are so few that it is perhaps not advisable to have more than a simple stationary stand in the anesthetizing room.

A *table for miscellaneous articles* will be necessary and this one should be spacious because when the preparation and sterile draping of the patient are done in this room expediency will require that many odds and ends, such as sandbags, pillows, rubber sheets, operating table attachments, etc., be within easy reach.

When there is enough space to make it technically safe the sterile draping supplies may be kept in this room during operations and for this purpose there will be needed *another table,* except when the "drums" are used, in which case one packed exclusively with draping sheets and towels will take the place of this table. The drum is so securely closed that there can never be any objection to having it in the anesthetizing room.

A chair or two may be useful in this room.

When limited space makes a separate anesthetizing room impossible, the anesthetic will be administered in the operating room itself, and this will require great caution as to the sterile drapings and supplies, for there is always more or less commotion attendant upon the induction of the anesthesia and the preparation of the patient in the form of struggling of the patient and the necessary handling of blankets, etc.

3. **Dressing Room for Surgeons.**—*a. Construction.*—The walls and floors of this room should be similar to those of the operating room.

b. Furniture.—Wash basins with hot and cold running water are the important essentials of this room, and if possible pedal faucets (Fig. 36) should be installed with them. The number of basins will depend upon circumstances and the number of surgeons operating at one time.

One or more *"arm basins"* should be provided for the antiseptic solution in which the hands and arms are sterilized after scrubbing. Standard ones (Fig. 37), holding enough solution so that the whole arm up to the elbow may be immersed are best, but large ones of other design will serve.

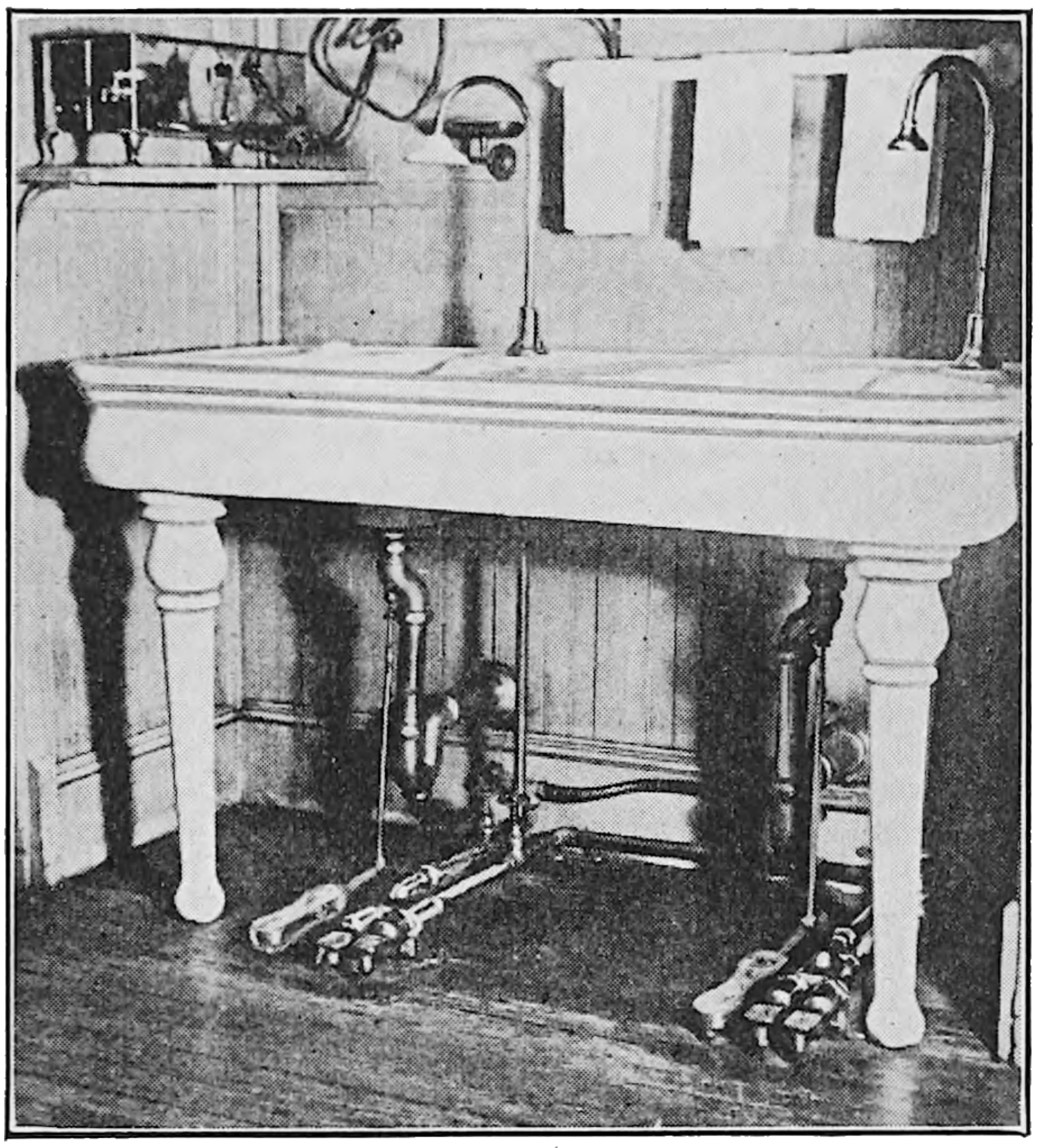


Fig. 36.—Wash Basins Equipped with a Pedal Device for Turning the Water On and Off, and with a "Goose-Neck" Faucet, Which Permit Scrubbing of the Hands and Arms Without Contaminating Them During the Process.

Where possible *individual lockers* should be provided in this room for the surgeons.

Some provision must be made for the surgeons' sterile suits or gowns. *The drum* answers this purpose admirably, but in lieu of this *a table* will be needed for these sterile supplies which will be packed in individual parcels or stored immediately in advance on the sterilly draped table.

A few chairs will be appreciated in the dressing room.

4. **Dressing Room for Nurses.**—This room should be essentially the same in equipment as the one for the surgeons, but

it may not need to be as large, though this will depend upon the relative number of nurses using it.

5. **Recovery Room.**—Where space and nurses are plentiful one room may be equipped with one or more beds and with paraphernalia for the resuscitation of the occasional patient who may need immediate treatment. In other cases this room will be convenient for use in transferring the patient from the operating table to the stretcher, and for the application of bandages, plaster casts, splints, etc.

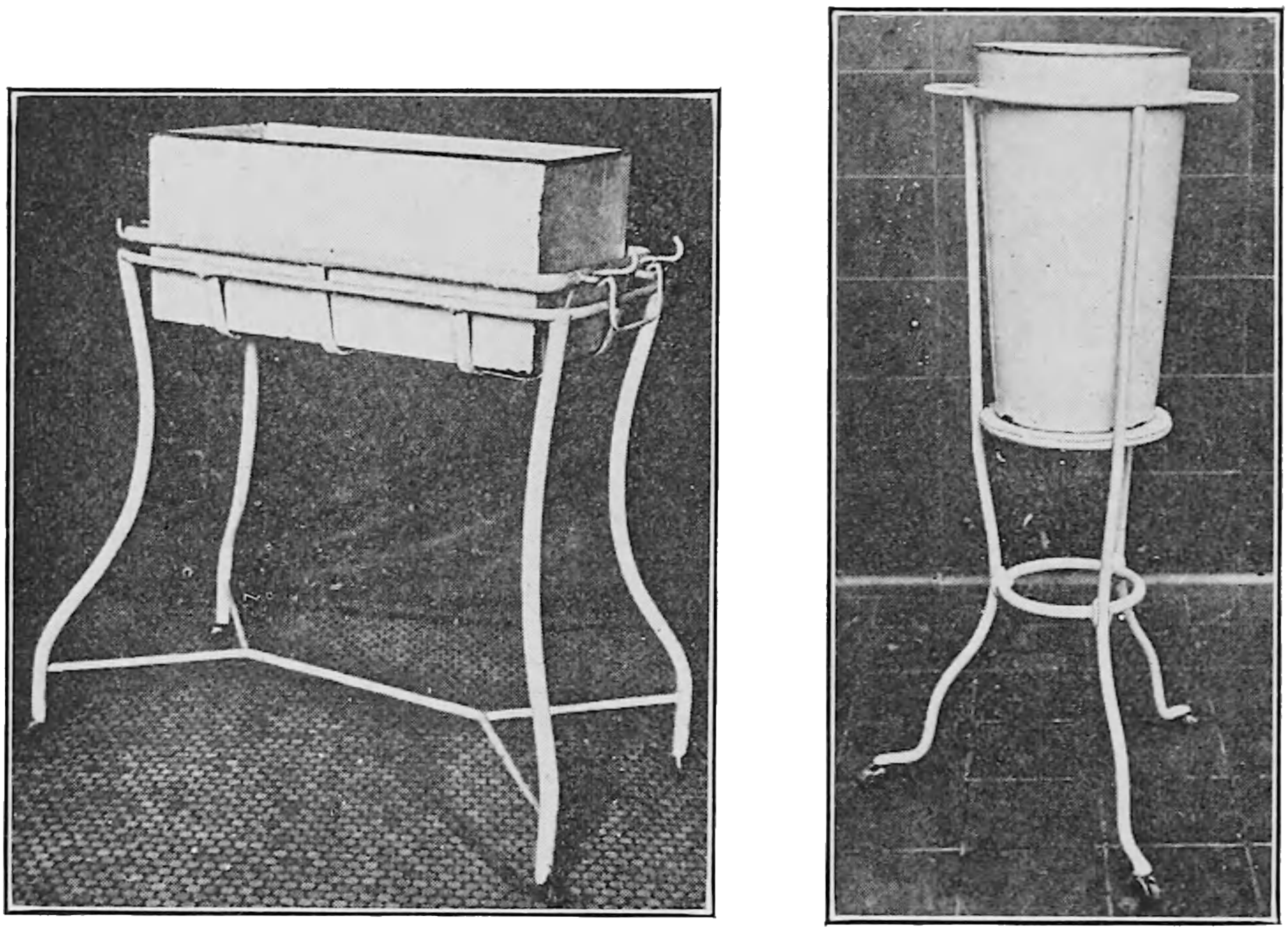


Fig. 37.—Two Types of Arm Basin.

6. **Work Room for Nurses.**—*a. Construction.*—This is a department of the operating theater which is often neglected in hospital architecture, for the fact is probably overlooked that it is in this room that the nurse spends the major part of her time and does the bulk of her work. For this reason the work room should, first of all, be *well lighted* both naturally and artificially, and of course *well ventilated* and *comfortably heated.* While it is advisable that this room should be sanitarily finished on the general principles of the operating room, it is not so important.

b. Furniture.—Ample work tables, chairs, dust-proof storage

above, have some corner devoted to this class of supplies and form the habit of leaving nothing portable in the operating room which has no useful immediate function to perform there.

THE PERSONNEL

The scene is now laid and we have a roughly furnished operating theater. Before we go further we shall put some people into it to do the hundreds of things which remain to be done before we are ready for our patient.

1. **Personal Qualifications.**—In the first place, one must be very *strong physically* to endure the strain and severity of operating room work. Hours of application are likely to be longer, and at all times the work is more intense than in any other type of nursing, and a strong body is the only one that will hold out to the bitter end.

Patience and forbearance are also more in demand, and for longer periods than elsewhere. The nature of the work requires that no time be lost and no mistakes made, and consequently everybody is more or less under nervous tension, which means that the nurse will not always receive the consideration from her superior officers which she has been accustomed to receiving in other lines of her work. Orders are more numerous, and often conflicting, and if the nurse has not the maximum amount of the proverbial patience and self-effacement which are always urged upon her profession she will often fare rather uncomfortably in the operating room.

Alertness of mind, self-control, and promptness of conversion of thought into action are other indispensable qualifications for real efficiency. A patient is under an anesthetic and undergoing interference with his life mechanism, which means that emergencies are always arising, and the nurse who "loses her head" is not popular, to say the least, on an operating room staff.

Conscientiousness, though essential and presupposed throughout the professional activities, is obligatory here. When an operating room nurse reflects that a single chance taken under pressure of orders or time may cost the health or even the life of another person she will never yield to any circumstance on this point.

While all the foregoing qualifications are important, perhaps the one which distinguishes the operating room "genius," so to speak, from the others is the *power to think, plan, and work logically, consistently, and methodically.* You will say that this power is an asset in any walk of life, and so it is, but it is useful here to the utmost degree, and its lack is nowhere of more hindrance than in the operating room. This not only applies while the operations are going on but also in the daily routine of the department; for there is a multiplicity of detail in this work which, if muddled by cloudy thought, can become more of a squanderer of time, energy, and service than any other thing we can think of.

These are all desirable qualifications. You have some of them, and perhaps you are particularly fortunate and have all of them; but at any rate you can acquire at least a degree of each of them, and you must do so if you wish to succeed in the operating room and enjoy the work there as you should.

2. **Division of Duties.**—This is a subject upon which it is useless to say much because the number of persons on a staff is determined by varying and numerous circumstances, and therefore the apportionment of the work will be different in all cases. However, the principle of "*division of labor*" should be applied as minutely as possible, particularly in a large operating room where a great number of cases are done in one session. By "division of labor" we mean, of course, the practice whereby each person's work is clearly defined for her so that she is held responsible for the same thing at all times, and so that her activities do not overlap those of the others on the staff. How this is done will depend upon the number of persons on the staff, the arrangement of the operating theater, the number and nature of the operations, etc.; but the principle should be to aim to have as many persons as are necessary to permit division of the work logically up to the point where each one has only the amount of work to do which she can get done with reasonable ease. More work than this for each person causes confusion,

delay, and general inefficiency; and less than this amount is extravagance. Variations in the qualifications and capacities of the individuals for hard work, whether they are graduate or pupil nurses, orderlies, etc., will also modify this division of labor, but it will not affect the above guiding principle.

3. **Discipline.**—In general, the organization of an efficient operating room staff as to authority, system, division of duties, thoroughness, attention to detail, promptness, despatch, and team work may be likened to that of the Army. There must be the commanding general with supreme authority, and her staff must be educated to corresponding obedience. Hospital discipline in general is often likened to that of the Army, and the operating room organization should embody this same *discipline in concentrated form.* Emergencies involving life and health are always arising, and there is usually no time for "reasoning why" when orders are received. If each one knows her duties, has been given the proper instructions as to how to perform them, and has caught the spirit of "each for all," the system will do the rest.

SUPPLIES

(*For Sterilization see Chapter XV*)

Our next step is to *provide and prepare the various supplies* and odds and ends which it will be necessary to keep on hand in the operating room. The nurse will have learned about and used many of the things we shall need, but for reference purposes we shall record here a list of standard supplies and then go into detail as to those which are likely to be new to her when she begins her operating room training.

1. Adhesive plaster
2. Amputation retractor
3. Aprons, muslin and rubber
4. Bandages, Esmarch
   " flannel
   " gauze
   " muslin
   " plaster of Paris
   " starch
5. Basins
6. Blankets
7. Brushes, nail
8. Caps, surgeon's and nurse's
9. Carrel-Dakin outfit
10. Catheters
11. Cautery
12. Cotton
13. Cover for instrument stand

in thirds half way up the long way, and stitch in all edges (B of Fig. 38).

3. **Aprons.**—(*a*) *Muslin.*—These will be made after the pattern of the ordinary "butcher's" apron, and may be used over the gown or suit and changed for each operation. (Fig. 39.)

(*b*) *Rubber.*—These may be purchased ready-made, or they are very easily fashioned from a piece of rubber sheeting by the same pattern as the muslin ones. They may not be used in routine practice but there should be several on hand in every operating room as occasions will arise when the surgeon or the nurse will need their protection.

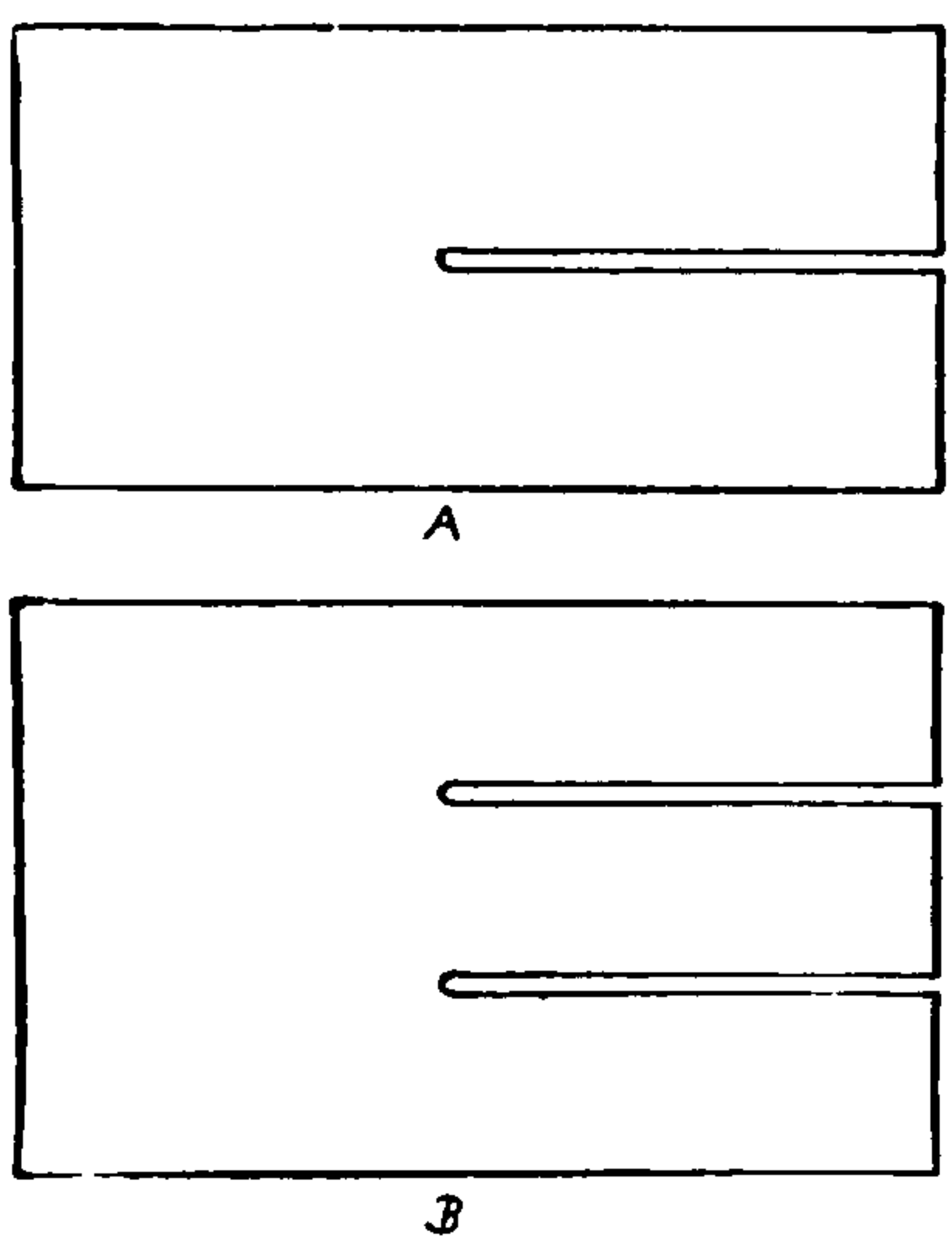


Fig. 38.—Amputation Retractors. *A*, the two-tailed one for use in the amputation of one bone; *B*, the three-tailed one for use in the case of two bones.

4. **Bandages.**—This supply will not differ from that which the nurse will have learned about on the wards.

5. **Basins.**—A good assortment of white enameled basins should be on hand for both sterile and unsterile usage. The familiar kidney-shaped one is always useful, and for a great variety of purposes; large round ones holding a gallon will be needed for rinsing hands in salt solution, etc., during operations; smaller ones holding a pint, perhaps, will be serviceable for wound or dressing solutions; long narrow, shallow ones will serve for sterilizing in antiseptic solutions instruments which cannot be boiled. The exact number and variety of each cannot be prescribed but the supply should be generous.

Basins for use upon the floor about an operating table will also be needed. Any kind will do but a great deal of noise will be saved if the light-weight "composition" one is used, especially in the case of tile or cement floor.

6. **Blankets.**—Plenty of blankets will be needed, and there should be several warm ones in readiness in a blanket warmer, the sterilizer, or upon a radiator for emergency use in shock cases.

7. **Brushes, Nail.**—As these will have to be boiled repeatedly a very plain kind should be used, that is, the backs should be unvarnished, and the coarse bristles will last better than fine ones.

8. **Caps.**—(*a*) *Surgeon's.*—These are best made of muslin and may be merely a skull cap (A of Fig. 40) or they may be a combination of cap and face mask (C of Fig. 40), in which case it is better to use a thinner material as the heavier one may

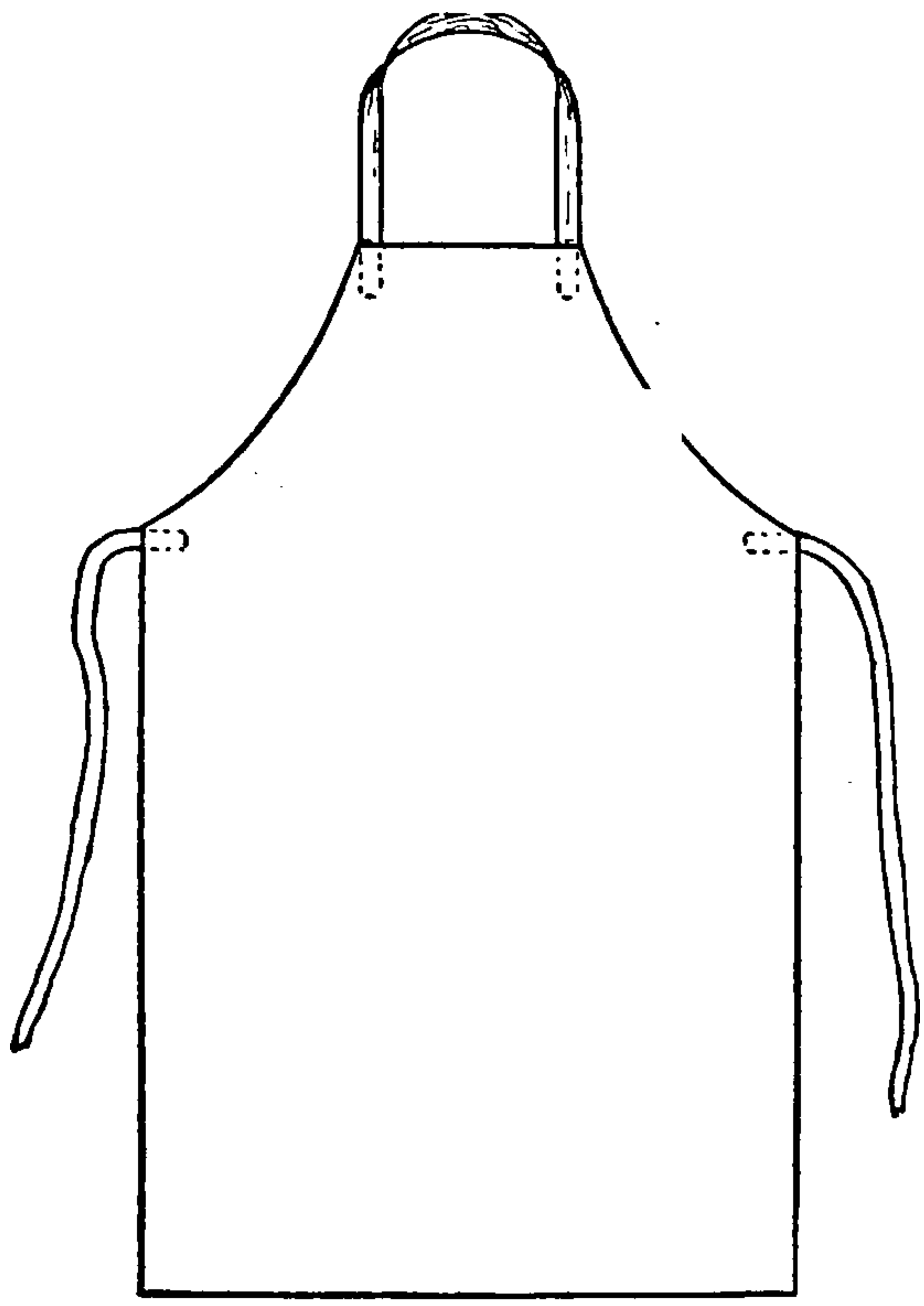


FIG. 39.—MUSLIN APRON.

be too warm and cumbersome. The surgeon will, as a rule, make his own selection of design. (*b*) *Nurse's.*—These are best made of muslin also, and any design that will cover the hair well will be a good one (B of Fig. 40) and the combination of face mask and cap described for the surgeon (C of Fig. 40) may also be used by the nurse.

9. **Carrel-Dakin Outfit.**—The nurse will have learned all about this on the wards, and Chapter XIX gives detailed instructions. The only equipment that need be kept on hand in the operating room will be the wound tubes, the vaseline gauze, and a small quantity of Dakin's solution.

10. **Catheters.**—These will not often be used in the operating room but a few of both the rubber and the glass ones used on the wards should be kept on hand.

11. **Cautery.**—There are several kinds of cautery which

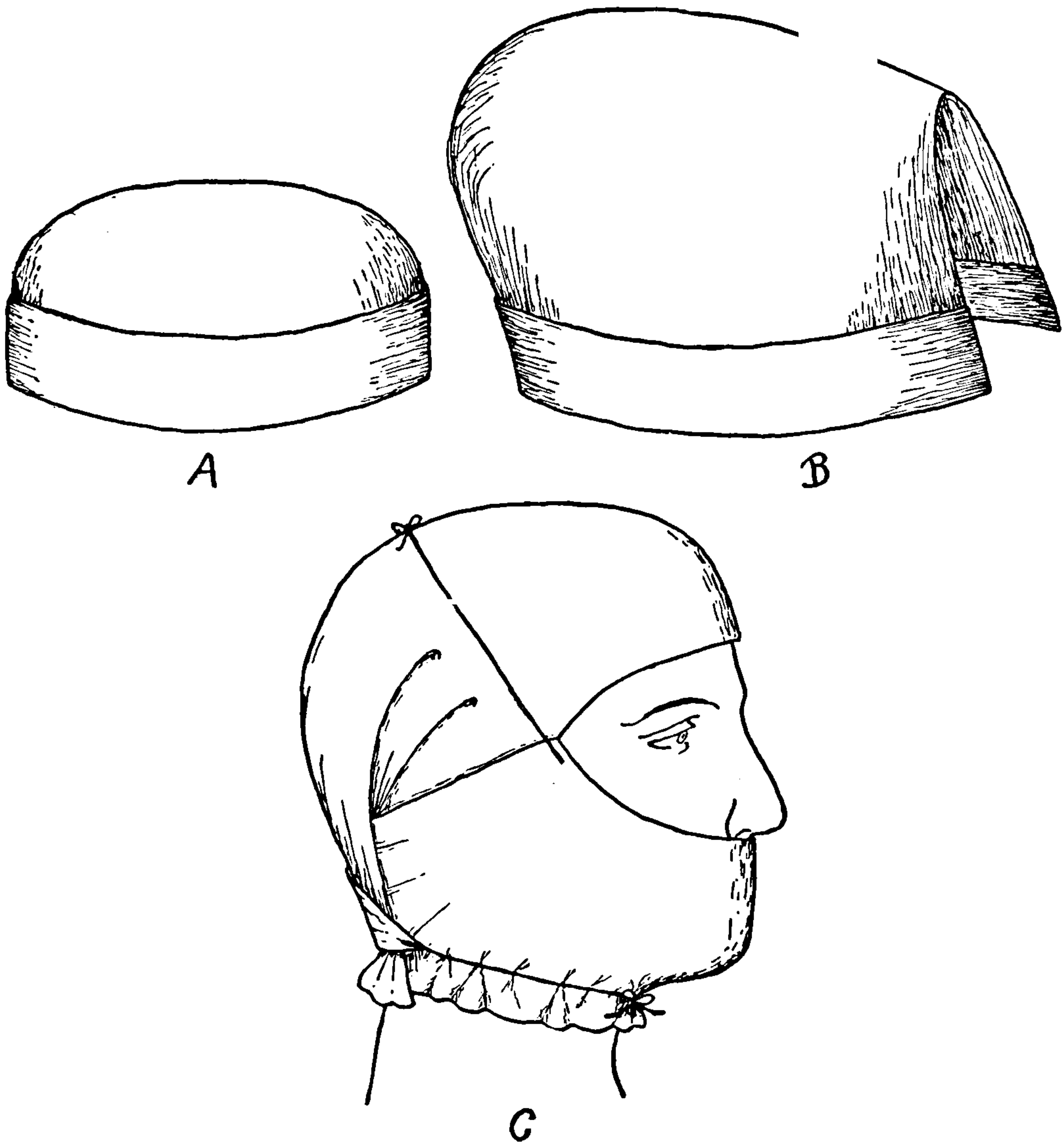


FIG. 40.—OPERATING CAPS. *A*, simple skull cap for the surgeon; *B*, nurse's cap; *C*, combination cap and mask suitable for either surgeon or nurse (see directions for making cap *C* on page 222).

are described in Chapter XV, pages 242-245, under "Sterilization," as the cautery is, of course, a sterilizing agent.

12. **Cotton.**—Both the absorbent and the non-absorbent cotton used on the wards should be on hand.

13. **Cover for Instrument Stand.**—This will be a slip cover, simply a long narrow bag (see Fig. 24, page 199), which is de-

Aristol powder
Aromatic spirit of ammonia
Atropine (hypodermic)
Benzine
Bichloride of mercury
Boric acid, powder and crystals
Caffeine (hypodermic)
Camphor in oil or ether (hypodermic)
Carbolic acid
Carbonate of soda (washing soda)
Chloroform
Cocaine
Codeine (hypodermic)
Collodion
Dakin's solution
Ether
Ethyl chloride
Formalin
Glycerine
Green soap
Hyoscine (hypodermic)
Iodine, tincture
Lime, chloride
Lubricant (vaseline, K-Y, etc.)
Morphine (hypodermic)
Nitrous oxide
Novocain
Olive oil
Oxygen
Peroxide of hydrogen
Silver nitrate, solution and "stick"
Sodium chloride
Strychnine (hypodermic)
Talcum powder
Vaseline
Water, distilled

17. **Gauntlets.**—These will simply be loose muslin sleevelets which will reach from well above the elbow to the hand. They will be used with the short-sleeved suits and gowns in combination with the muslin apron (Paragraph No. 3) and will be kept in place either with a rubber band or a safety pin.

18. **Gauze.**—See "Dressings" (Paragraph No. 15).

19. **Glove Covers.**—Though not necessary, these covers will be a great convenience and they are very simple to make. Cut a piece of muslin about 12 x 31 inches, hem the ends, fold each end to the middle of the piece, and stitch the sides so as to make a double envelope (Fig. 42) into which the gloves may be slipped separately; then fold through the middle into a compact parcel.

20. **Gloves.**—(*a*) *Rubber.*—There are numerous kinds of rubber gloves on the market and the one you provide will depend upon the choice of the surgeon. They are made in many sizes, so everyone can be well fitted, and it is important that this be done for too tight a glove will be very uncomfortable and too large a one will be a hindrance. Many gloves should

be kept in reserve as they do not last long and they should not be used except when in good condition.

(*b*) *Cotton.*—These are not often used but occasionally they are slipped over the rubber ones when it is difficult to handle

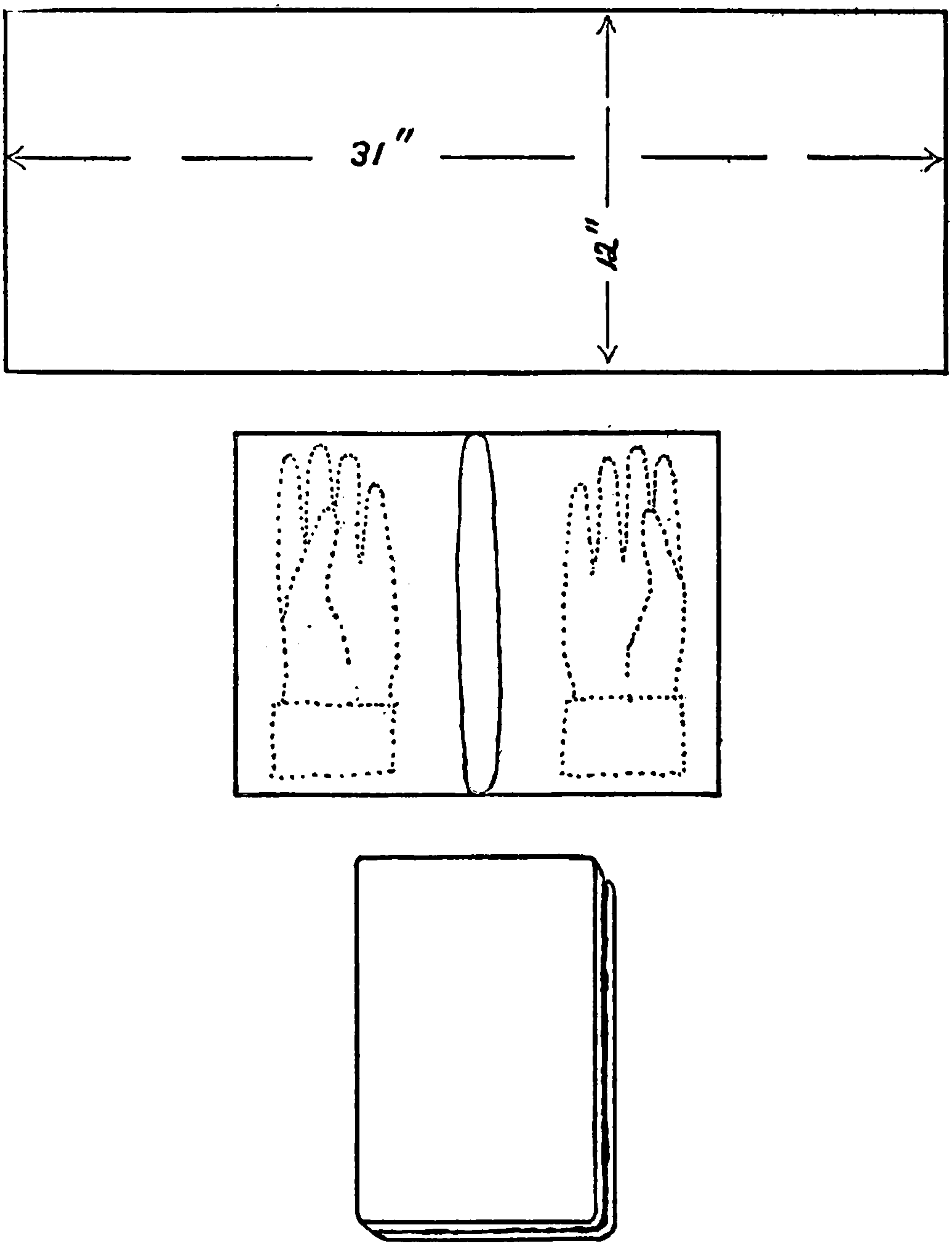


FIG. 42.—GLOVE COVER.

such parts as the intestines, the breast, etc., as the rubber gloves are likely to slip awkwardly on these parts. Any good cotton glove will answer the purpose, but relatively large ones must be provided as they shrink considerably in sterilization.

21. **Gowns.**—These should be made of heavy "twilled" muslin and several sizes should be provided. They must be made to close in the back, and tape strings that may be tied are better than buttons for closing them as they withstand the wear and tear of the laundry better. They will have either long or short sleeves, the long ones being used when the gown is changed between operations and the short ones when the gauntlets (Paragraph No. 17) and aprons (Paragraph No. 3) are used. The chief point to notice about the gowns is that the long sleeves are long enough to reach well down to the hand so that they may be securely tucked under the rubber gloves, and

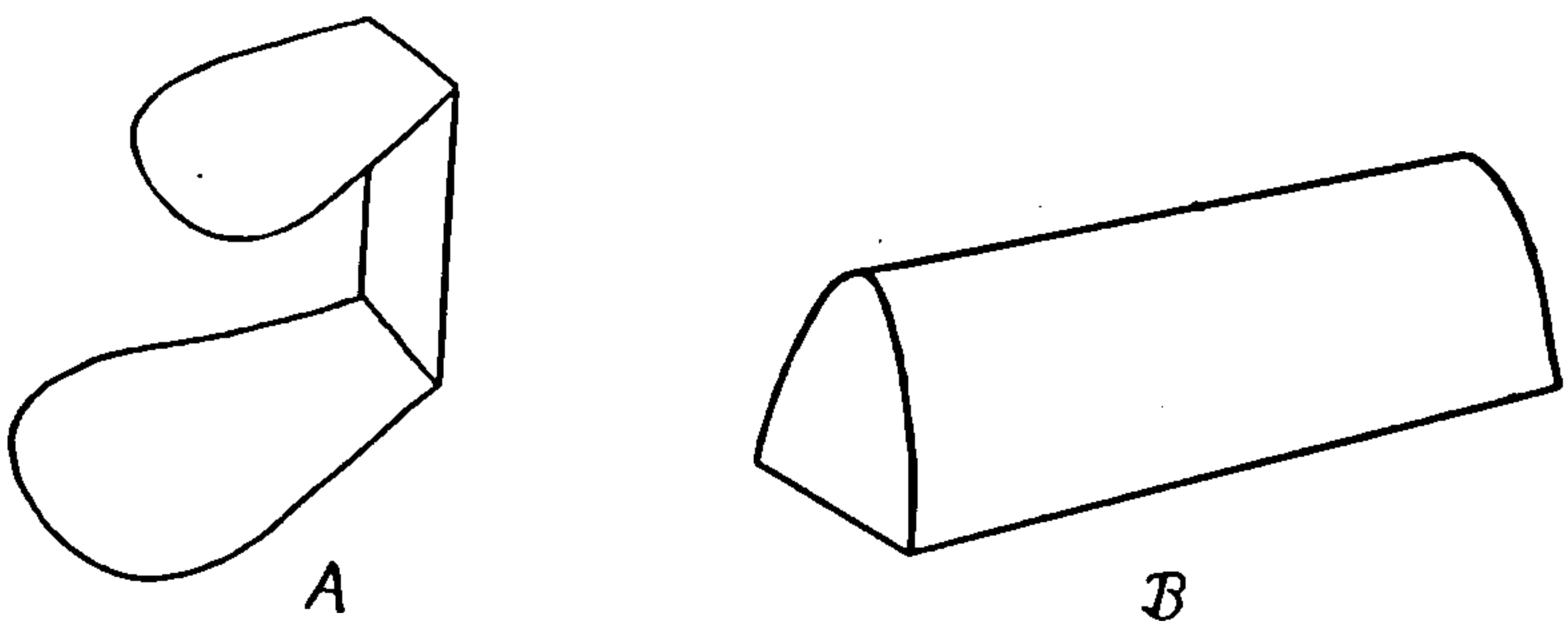


FIG. 43.—TWO TYPES OF HIP OR PELVIC REST. *A*, metal design which is especially suitable in the application of a plaster of Paris hip spica; *B*, a simple wooden block which will be better suited than *A* for use in applying a hip spica bandage to a conscious patient, as it will be long enough to reach across the patient's body and thus to balance him comfortably, whereas the metal one is narrow, is too uncomfortable for a conscious patient, and usually requires an assistant to keep the patient balanced upon it.

that the short ones reach well to the elbow so that they may be kept securely within the gauntlet.

22. **Hip Rest.**—The nurse will have learned about the uses of the hip rest (Fig. 43) on the ward and they will be the same in the operating room, namely, for convenience in applying hip-spica bandages.

23. **Hot Water Bottles.**—These will sometimes be needed for patients in shock.

24. **Hypodermoclysis Outfit.**—This will be the same as the one used on the ward.

25. **Infusion Outfit.**—This also will have been learned about on the ward.

26. **Inhaler.**—The surgeon or the anesthetist will usually decide upon the particular variety to be provided.

27. **Instruments.**—This subject will be best learned by the

the head and neck. Design C is merely a piece of gauze cut 30 inches square, folded diagonally by turning two diagonally opposite corners to the center of the piece and continuing to fold in this direction till the strip is 5 or 6 inches in width. It is

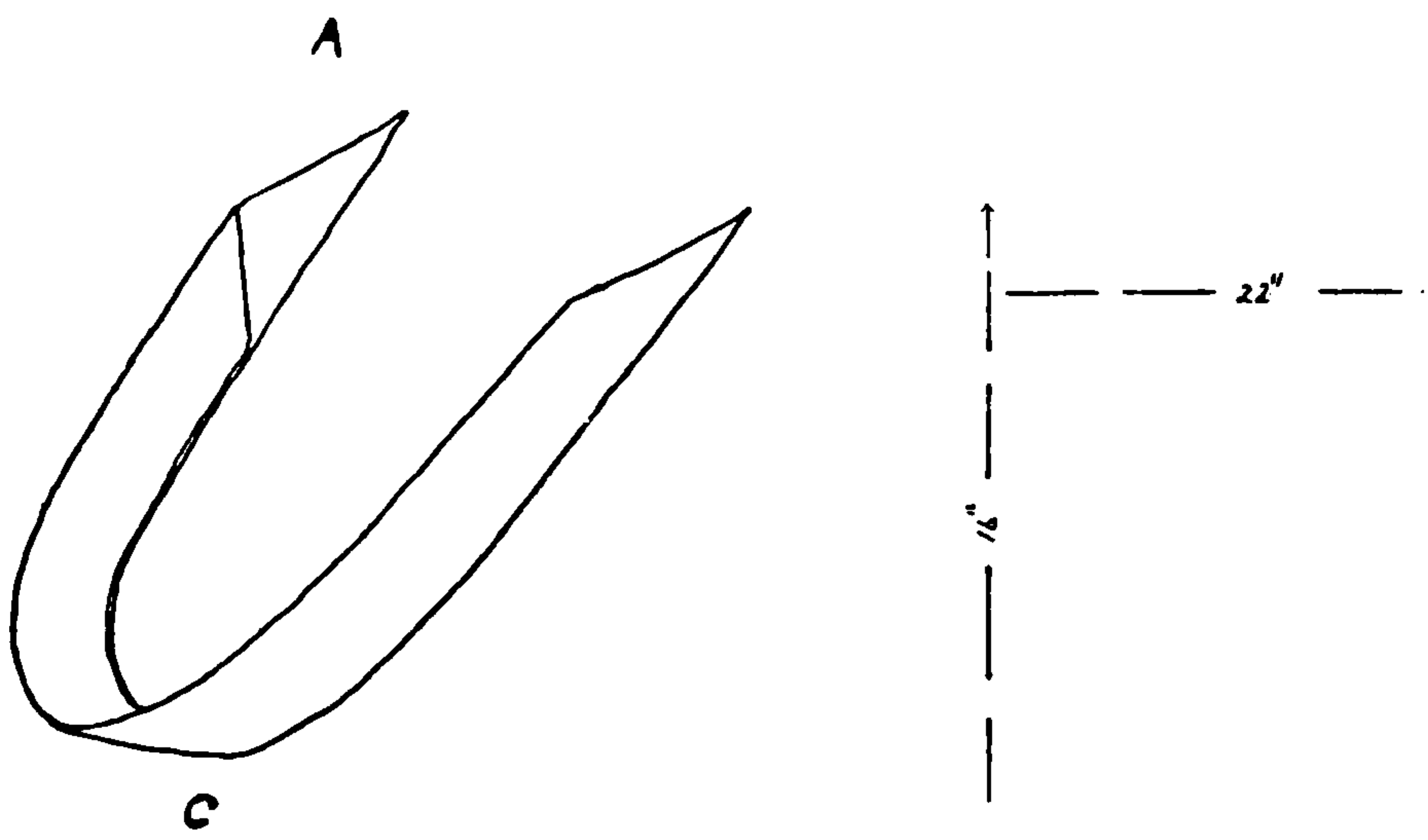


FIG. 45.—FACE MASKS. A, several layers of gauze stitched together, and having tape strings attached to each corner for tying around the head and neck; *B,* made similarly to *A; C,* piece of gauze folded as described in Paragraph No. 32; *D,* made either of one layer of heavy gauze or of several layers of thinner gauze, with tapes attached for tying in place as illustrated in *C* of Fig. 40, page 216.

adjusted by placing the middle of it over the face, twisting the ends till it fits neatly, and then tying over the crown of the head. Mask D of the illustration is the outline of the one which is shown adjusted to the wearer in C of Fig. 40.

33. **Mouth Gag.**—There are many designs from which to

select, and two representative types are illustrated in Fig. 21, page 186.

34. **Nail Cleaners.**—Any kind that can be boiled will do, but there is probably nothing better than the simple orange stick.

35. **Needles.**—A plentiful supply of hypodermic and exploring needles will be needed, including the long, slender, hypodermic needles which will be considerably in demand for local anesthesia.

36. **Needles, Suture.**—These are properly classified as instruments and it will be assumed that the nurse has learned the varieties during the course of her practical training.

37. **Packing.**—Plenty of gauze packing of assorted widths from 1/8 inch, or even less, up to 2 inches should be in readiness at all times. The nurse will have learned how to make this on the wards. The larger sizes should be made in lengths of 5 yards or more, as when packing of this width is used in the operating room a large quantity will be needed and in most cases it will be very important that it be in one uncut piece.

38. **Pads, Abdominal.**—These pads are used for blocking off the operative field in abdominal operations, and several sizes and shapes will be needed (Fig. 46). Pads A, B, and C of the illustration are made of from 6 to 10 layers of gauze carefully turned in and sewed at the edges, and with a piece of strong tape firmly sewed to one corner so that they may be secured in some way on the outside of the wound to prevent their being lost in the abdominal cavity. In some cases it may be the custom to sew a heavy iron ring to the end of the tape. This ring is conveniently pinned to the draping sheet or, because of its weight and the report it gives if the pad accidentally falls to the floor, it is a very satisfactory means of keeping track of the otherwise somewhat elusive pad. In other cases the tape will be fastened to the sheet with a safety pin or clamp, or it will simply be marked by the attachment of an artery clamp to it. Pad D is about 1 yard long, 5 inches wide, and 8 or 10 layers thick. It, also, will have a tape attached, and it should be rolled into the shape of a roller bandage because it will be more convenient to handle in this form. Pad E of the illustration is

especially designed for use in the removal of the appendix. It will be made about 6 inches long, 4 inches wide, and 6 layers thick; it will be split half the way up from the middle of one

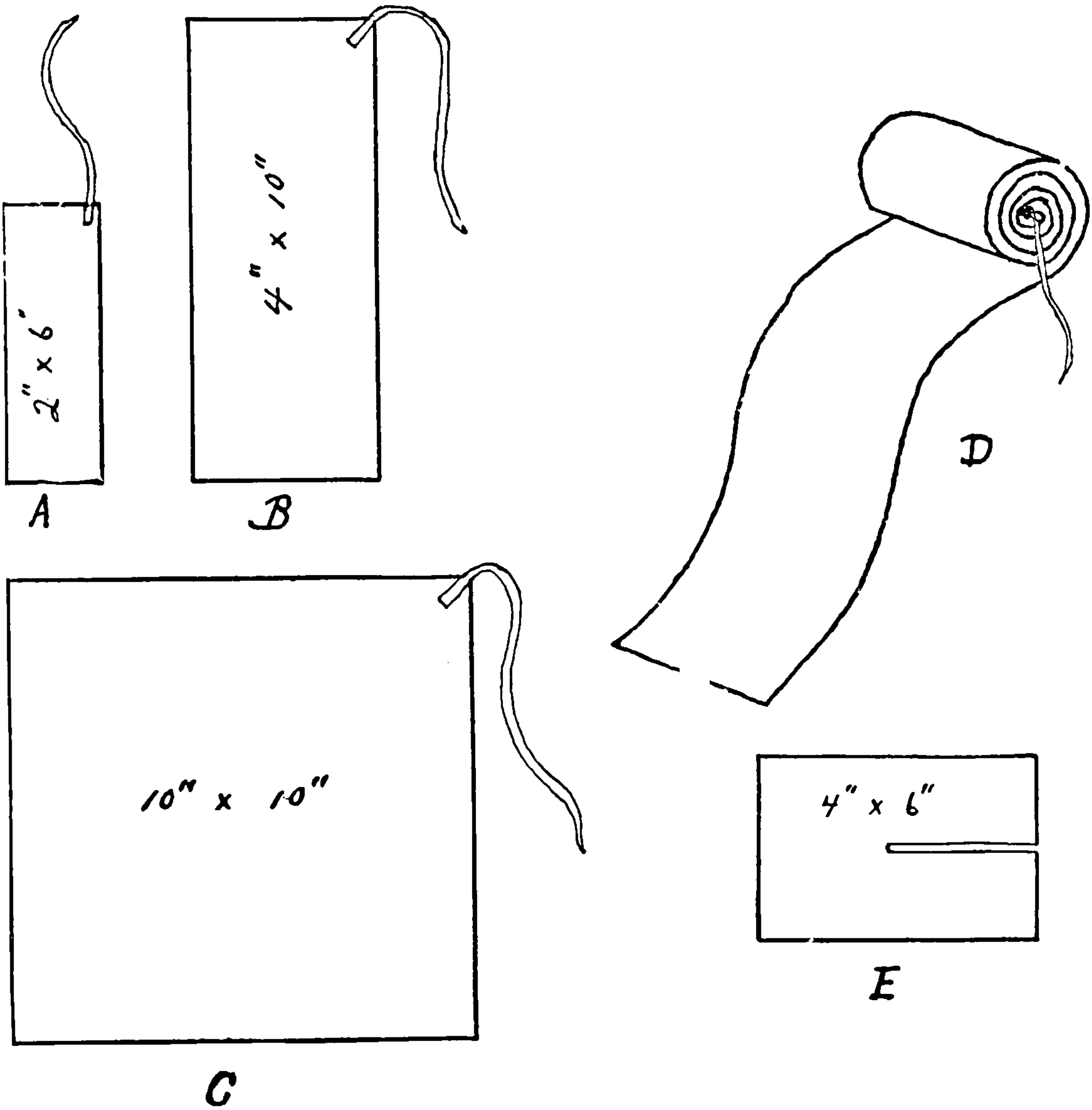


FIG. 46.—ABDOMINAL PADS. *A, B,* and *C,* are made of gauze in dimensions of 2 x 6 inches, 4 x 10 inches, and 10 x 10 inches respectively, and should be from 6 to 10 layers thick; *D,* is 1 yard long, 5 inches wide, and 10 layers thick; *E,* is 6 inches long, 4 inches wide, and 6 layers thick, and is split into two tails at one end for use in folding about the appendix during its removal.

end and will be finished about the edges like the others. This pad will not need a tape because it will be used only on the surface of the wound.

39. **Pads for the Operating Table.**—The table must always be covered with a soft pad. Often this will be supplied with

a good supply of all sizes of rubber tubing for it is used for many different purposes.

47. **Safety Pins.**—Many of these, of course, are always needed.

48. **Salt Solution.**—(*a*) *Concentrated.*—For purposes of irrigation or of rinsing gloves during the operation the normal salt solution (0.9%) made from ordinary salt and the filtered water from the water sterilizer will answer. A convenient way to provide this is to sterilize the salt in concentrated solution, 10% for instance, in flasks holding enough for one day's use. The proper amount of this solution is easily added to water when needed, 2½ ounces of the 10% solution in a quart of water making the normal solution nearly enough for purposes of irrigation or rinsing. (*b*) *For Infusions.*—For intravenous infusions a more refined solution must be made because this is injected directly into the blood stream where any but the accurately normal solution can cause serious damage. Distilled water may be used, but clean tap water is not objectionable; chemically pure sodium chloride is advisable, though good common table salt will do; and the 0.9% solution must be accurately mixed.

The drug market supplies salt specially prepared for the infusion solution, and in some cases the potassium chloride and the calcium chloride will be included, but the chemically pure sodium chloride is extensively used alone and, as stated above, common table salt answers very well. The manufacturer will enclose directions for mixing his particular product, but where the sodium chloride alone is used the proper proportion will be 124 grains of salt to one quart of solution. The nurse should remember that the amount of salt is prescribed by weight and she will not attempt, therefore, to measure it with a spoon or any other such inexact measure, because it would be a rare case indeed in which a pharmacist could not be found to weigh it for her. After the salt has been dissolved in the water the solution must be filtered through fine filter paper a sufficient number of times to make it perfectly clear, and then it should be put into quart-size glass flasks for sterilization, the flasks being very securely stopped with plugs of non-absorbent cotton covered with gauze and tied well down over the mouth of the flask. The cleanest and easiest practice in making this solution is to filter it directly from one flask to another each time.

49. **Sandbags.**—For the adjustment of the patient's position upon the table it will often be necessary to have sandbags of various sizes. The sand for these bags should be fine and clean, sea sand being the best; the bags should be made of heavy canvas or "ticking"; and this should be covered with strong rubber sheeting. Care should be taken not to fill them too full, as a slightly flexible bag is more adaptable than a solid one.

50. **Sheets.**—(*a*) *Plain Muslin.*—A generous supply of large heavy muslin sheets must be on hand for both sterile

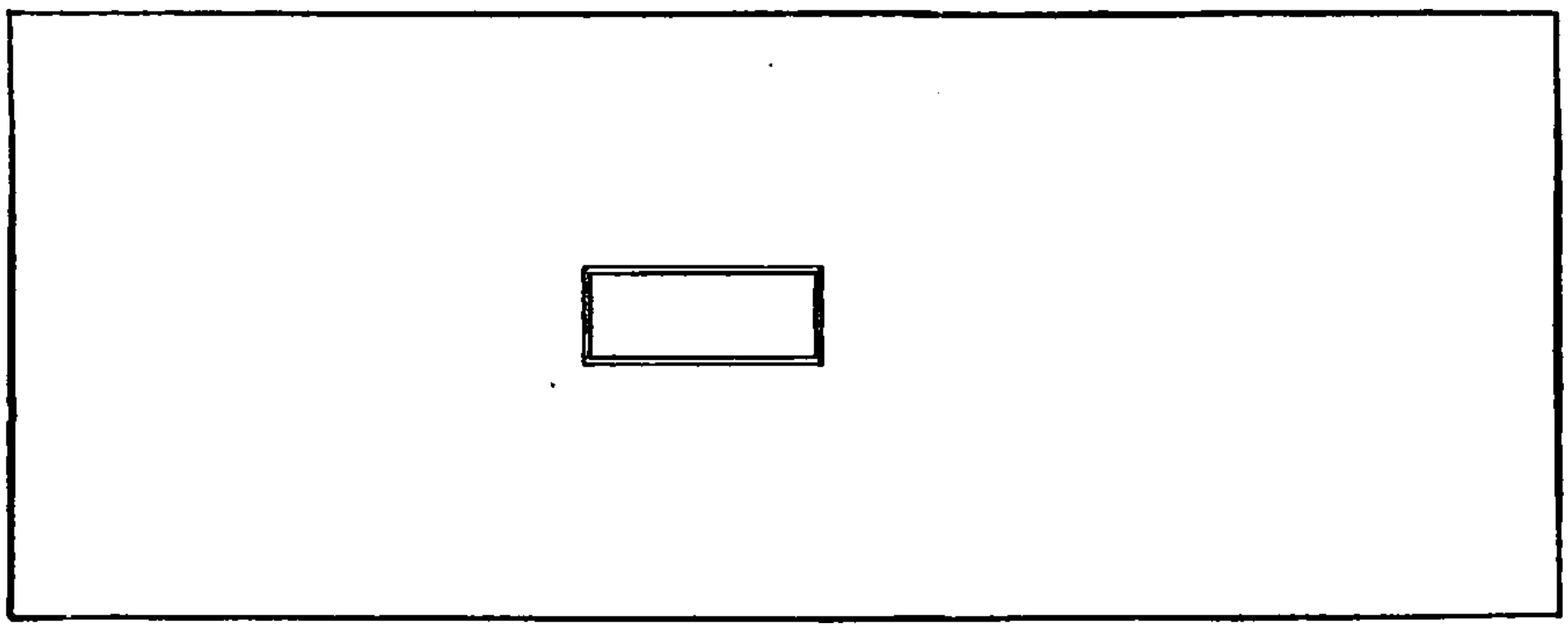


FIG. 47.—LAPAROTOMY SHEET. This is simply a large muslin sheet with an oblong opening cut in the center. The size of this opening should not be less than 4 x 8 inches, and much larger openings are often preferred.

and unsterile purposes. (*b*) *Laparotomy.*—Another type of sheet which is very easily made and which is a very convenient article is the "laparotomy" sheet (Fig. 47). This is merely a muslin sheet which is long enough to cover the entire table and which has an opening about 4 x 8 inches or larger cut in the center of it—this must, of course, be durably bound with tape. This sheet will be useful for a great many operations, and we shall point out its uses under "Operative Positions and Draping" in Chapter XVI.

51. **Splints.**—See suggested varieties in Chapter VII, under the discussion of "Fractures."

52. **Stockings, Lithotomy.**—For operations in the lithotomy position (Fig. 74, page 279) it is desirable to have large muslin stockings which will slip over the patient's feet and the table fixture loosely and extend well over the patient's abdomen and

down over the side of the table. Any nurse can design a stocking suitable for this purpose, as the chief requisite is that it be of generous size.

53. **Stomach Tube.**—This will be needed for an occasional lavage.

54. **Suits.**—Hospital furnishing houses will supply these operating suits which are made of a heavy "twilled" muslin. They will have short sleeves, and the apron (Paragraph No. 3) and gauntlets (Paragraph No. 17), or the gown (Paragraph 21) will be used with them.

55. **Suture Material.**—We shall give here only general information about suture materials, for it will be the exception rather than the rule that the nurse will be called upon to prepare them because factories supply them so conveniently that most hospitals purchase them ready for use. In Chapter XV, however, under "Sterilization," we record various processes in detail for the benefit of those who may at some time need to refer to them.

Likewise, and for a corresponding reason, we shall speak only in a general way here of the uses of suture material and leave the details for the discussion of "Instrument Passing" in Chapter XVII.

Substances used for sewing wounds are of two classes: *Those which are absorbable* by the tissues, and *those which are non-absorbable* and which must, with a few exceptions, be removed as soon as the wound is nearly enough healed to hold together without them.

The absorbable suture materials are *catgut* and *kangaroo tendon.*

Catgut is made from the intestines of animals, usually the sheep, and consists of a strip of the submucous coat which has been twisted, rope fashion, into a fairly smooth thread, and then dried, cut into standard lengths, and sterilized. This is ordinarily called "plain catgut." It is usually absorbed by the tissues within 5 to 10 days. To make it more resistant to absorption this plain catgut is treated with chromic acid which hardens it, and then we get a suture that will hold fast as long as 20 days or more, depending upon the length of time it is

above as non-absorbable materials, and may wonder how these "foreign bodies" can sometimes be left permanently in such parts as the intestines, for instance; but it so happens that nature is capable of accommodating herself to a few such invasions by either encapsulating the invader so as to shield the more sensitive tissues from its irritating effect, by eventually disintegrating it, or by sloughing it out.

Silkworm gut is made by drawing out into a thread the ductile sac which the silkworm has just prepared from which to spin his cocoon. This is naturally white, but it is usually dyed black before it is prepared for use. Silkworm gut is a relatively strong suture material and is therefore used as a "through-and-through" suture to hold together large abdom-

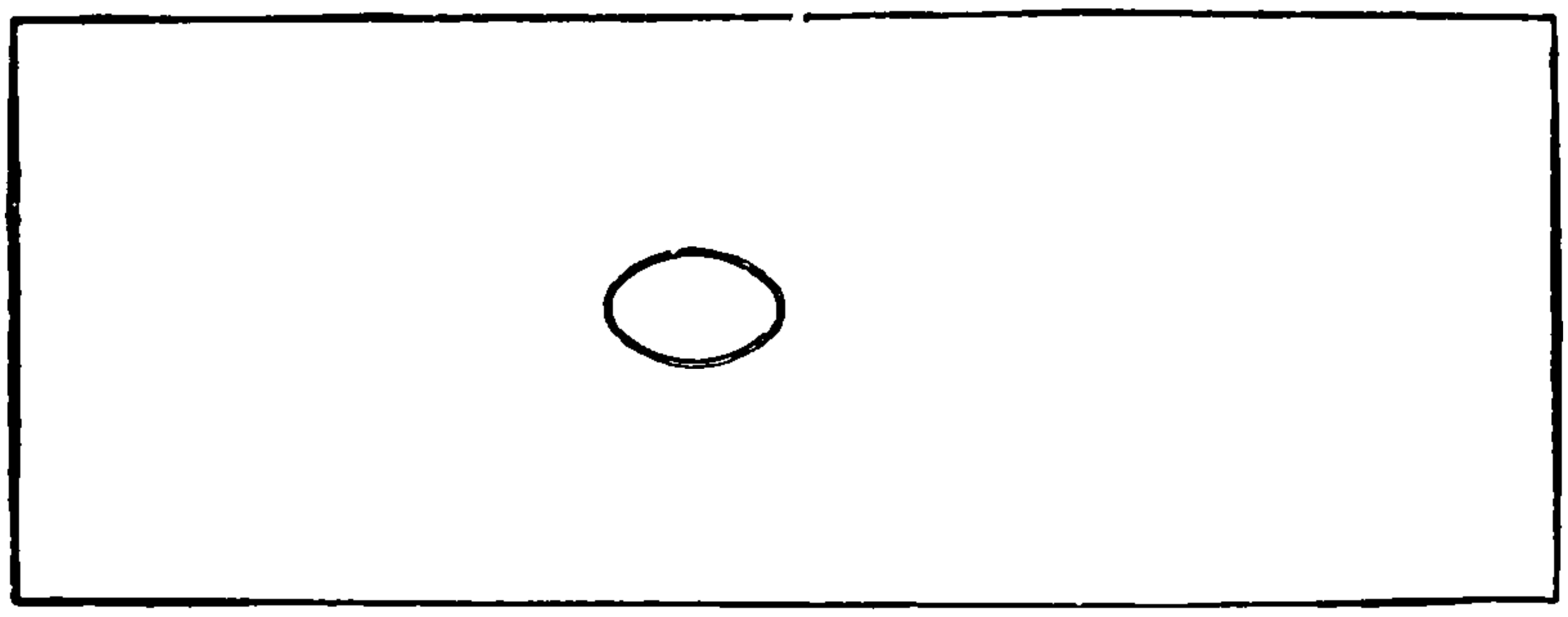


FIG. 48.—LITHOTOMY TOWEL. Made of heavy muslin about 2 yards long and 28 inches wide. The opening in the center is about 3 or 4 inches in diameter. See use of this towel in Fig. 74, page 279.

inal wounds or any wound in which there is likely to be much tension during the healing period. It is supplied in several weights.

Silver and aluminum-bronze wire are used to suture together the fragments or ends of broken bones chiefly.

Metal clips are made of silver or some other non-corroding soft metal, and they are used for skin wounds and occasionally for ligating blood vessels. The clip which the nurse will be most likely to see in hospitals is the one called the "Michel" skin clip.

56. **Syringes.**—There are innumerable types of syringe, and the nurse will have learned on the wards the kinds which are in common use for hypodermics, aspirations, irrigations, etc., and these three classes will cover the usual needs for the operating room.

57. **Thermometers.**—The clinical thermometer will be rarely used, but the bath thermometer should always be ready to use for all irrigations, infusions, etc.

58. **Tongue Forceps.**—The surgeon or anesthetist will decide upon the variety to be provided, but three kinds are illustrated in Fig. 20, page 185.

59. **Tourniquets.**—There are numerous varieties but a very simple and extensively used one consists of a piece of heavy rubber tubing which is long enough to be tied about the limb, or, it is often secured by means of a strong clamp.

60. **Towels.**—(*a*) *Plain.*—The only point to mention about these towels is that they be of some soft, absorbent material which launders well. Perhaps the best material is that which is known commercially as "bird's-eye cotton." A linen or other smooth-surface towel will be found unsatisfactory because it will not stay in place well; instruments slide upon it; and stains of blood, iodine, etc., are not easily removed from it. (*b*) *Lithotomy.*—This is not a necessity, as a sheet or the wound towels may be used instead, but it is a great convenience and it is so easily made that we recommend its inclusion in the equipment. It consists merely of a piece of muslin about two yards long and 28 inches wide in the center of which an opening 3 or 4 inches in diameter is made (Fig. 48). This is used for draping patients in the lithotomy position, as illustrated in Fig. 74, page 279.

CHAPTER XV

OPERATING ROOM STERILIZATION

THE subject of bacteriology is of tremendous concern in relation to operating room sterilization and, as we have said previously, the pupil should have studied it before taking up the operating room course. However, those students who have not yet covered the subject will find material upon it in Chapter I, and we shall review briefly here a few of the more important terms which have a bearing upon the contents of this chapter.

DEFINITIONS

Septic.—When we say that a wound is septic we are using a general term which means that it is under the actively destructive influence of bacteria of some kind, and the word carries with it a special emphasis upon the decomposition caused by the bacteria and its effects. The noun, sepsis, then, would mean the state or condition of being septic.

Infection.—This is a term that is hard to differentiate from sepsis, for when we say that a wound is infected we mean, as we would if we called it septic, that it is inhabited by bacteria which are multiplying within it, are feeding upon it, and are, therefore, destroying its health. In common parlance we use the terms interchangeably, however, and there is perhaps no important difference between them except, as mentioned above, sepsis does bear more of a reference to the products of infection and also to their effects. The term infection is also used in the sense of its being the act or process by which the wound is contaminated with bacteria, and in the sense of its being the bacteria themselves at work in the wound. The use of bacteria-laden hands or instruments, for instance, in a wound would be the act of infection, and the resultant growth of the bacteria in the wound would be the infection itself.

which can destroy germs, or bacteria. In the surgical sense the terms bacteria and germs are used interchangeably, so it does not materially matter which we use here.

Sterilization.—This is really our major term, for it is larger than all the rest in that it signifies the absolute destruction of all forms of bacteria.

Technic.—This is a word which we use a great deal and which often seems to be regarded as the name of something very formidable. It is the name of something very important as it is applied in the operating room, but as is so often the case, this very important thing is, in actuality, a very simple one. Technic is nothing more nor less than the way of doing a thing, and in the operating room it is merely the way in which we make and keep things sterile. Even in this sense, however, there is a danger of its becoming something of a bugbear and of its developing into a hindrance rather than the help it is designed to be and always should be. Simplicity is the keynote of good technic, as it is the keynote of all good human endeavor, and the less complex we make it the fewer will be our points of contact with those things which have the power to make it fail.

In the operating room, then, we have all the terms we have just defined as startling watchwords, but the greatest of them are *septic,* or *infected,* and *sterilization;* for we must treat everything that is to come into contact with a wound, either directly or the most remotely indirectly, as though it were septic or infected and must sterilize it before it is used; and, of course, it goes without saying that we must keep it so. Words and their definitions are important, but they will not keep a wound free from infection unless they are put into practice with an intelligence and a conscience, and with a skill that can be acquired only by diligent application.

Much will have been learned in the classroom and on the wards about sterilization, antisepsis, asepsis, and all the rest, and the nurse will know in a general way how to sterilize many things and how to keep them sterile; but *in the operating room she will find a rigidity and a minuteness of technic* which at first will seem to have no relation to what she has previously practiced. On the wards she had to deal only with wounds which were partially healed and which were not, therefore, so susceptible to infection as fresh ones, and for this reason she was permitted many practices which would be very dangerous in the operating room where the wound is fresh and in its most infectible state. Also, in the wards the supplies which she handled were used only on the surface of a wound or within an infected one which is very largely protected from new infection by its own excretions, while in the operating room she deals with the things that are to come into closest contact with the entire area of a freshly made wound and even with the blood stream itself. Her problem, therefore, is a much more serious one, and her methods must be in accordance.

THE AGENTS

The subject of practical sterilization is a rather troublesome one to master because of the fact that the various articles needed in surgery differ so widely in composition and therefore in the amount and means of sterilization to which they may be subjected without injury. By long experience and practice, however, during the period of time since Lister gave the world the discovery of aseptic surgery (see "Introduction and History"), one or more good methods have been evolved for the sterilization of every substance with which we have to deal, and so our present task is simply to learn, article by article, the special recognized method which is adapted to each individual case. The numerous and somewhat tedious methods may be clarified to some degree for the student if she will learn, and then remember, as she plods through the details of the following pages, that, after all, *each one may be classified under one of two great classes,* and that whatever particular process she is carrying out is simply an adaptation of one of these two major methods, and that the special variation is dictated by some material peculiarity for which nature is responsible.

These two major classes of sterilizing agencies are: THERMAL and CHEMICAL.

You will be taught one or two *other classes* by many authorities. For instance, you will be given the class "mechanical," and the example for it will be the cleansing of the hands, etc., with soap, water, and brush; but it is a fact that, in the last analysis it is the soap and water which constitute the sterilizing agency in the case, and as they are chemicals "scrubbing" may very consistently be called a chemical sterilizing agent, with the brush thrown in. In fact, if the brush is given too much prominence in the process it can do more harm than good by scratching the skin and making harbors for infection. You will also see the term "light" used for another class, and in your experience you may have seen wounds treated by exposure to the sunlight, and you know that sun does kill some germs easily, but this may be regarded as another case of chemical action for there is considerable evidence for the belief that it is the "actinic" or chemical element in the rays of the sun that does this work.

All of the sterilizing agents in common use, then, may be classified under the two main heads which, for a little more simplicity, may be subdivided as follows:

I. THERMAL
  1. *Moist Heat*
    a. *Boiling water*
    b. *Steam*
  2. *Dry Heat*
    a. *Hot air*
    b. *Flame*
    c. *Actual cautery*

II. CHEMICAL—All solutions of chemicals which have the power to kill germs.

I. THERMAL STERILIZATION

Of the two forms of thermal sterilization, the moist and the dry, *the moist form is the more effective* at a given temperature and period of exposure, experiment showing that the very hardy anthrax spores, for example, are killed by boiling water (212° F.) in about 12 minutes, whereas dry air at a temperature of 300° F. requires almost 3 hours. The moist form is, therefore, more practical and it is fortunate that by far the

of the "steam pressure sterilizer" so that we shall be able to understand more clearly the explanation further on as to why we use it.

There are many designs of steam sterilizers on the market and no two of them are exactly alike in detail of structure, but they are alike in essential principles and if we have a clear idea of these general principles we shall have no serious difficulty in learning to operate any particular type that we may

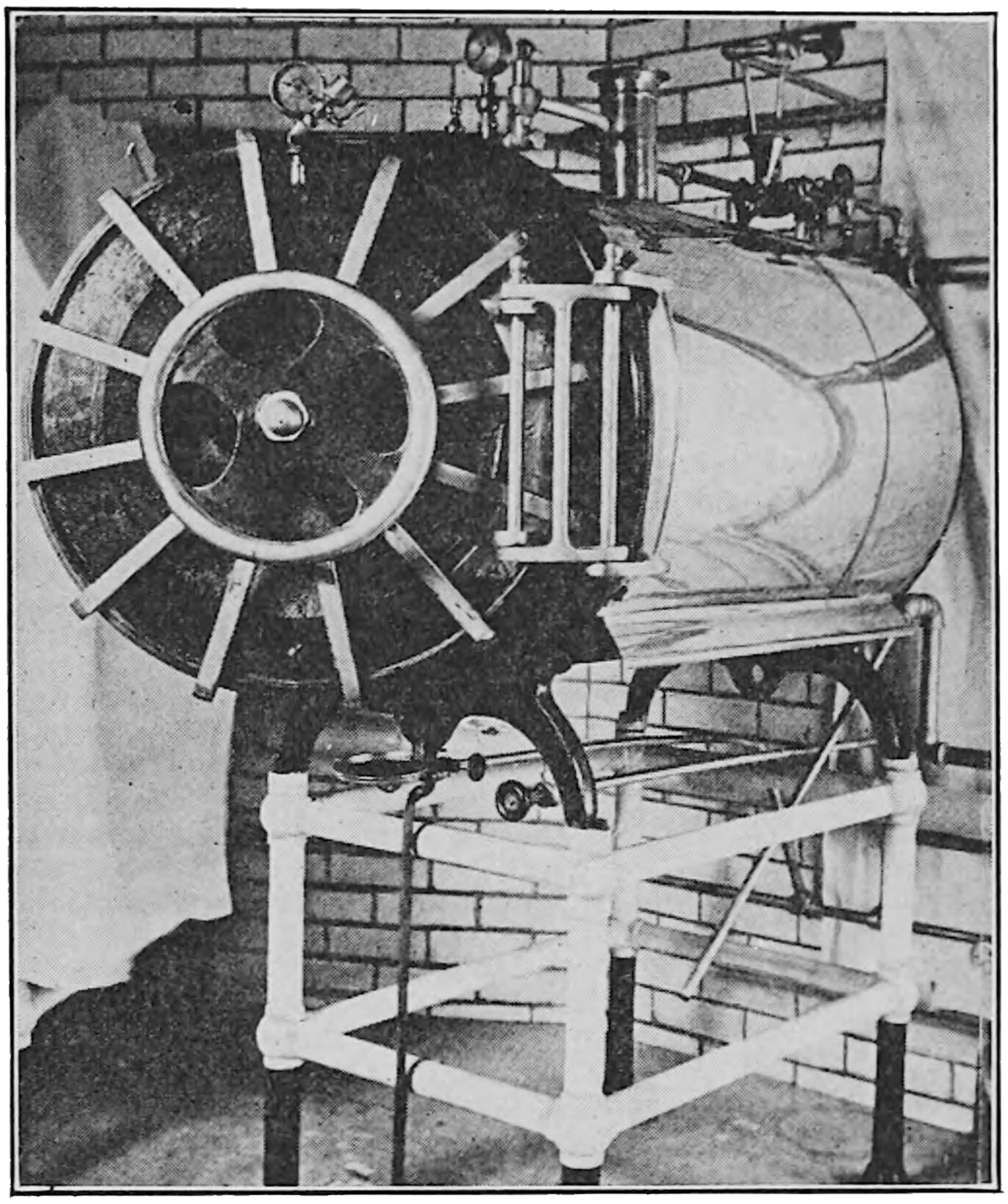


FIG. 49.—STEAM PRESSURE DRESSING STERILIZER. The construction and operation of this sterilizer are explained on page 239.

encounter in practice. It is a fact that the average nurse is greatly puzzled by these sterilizers when she first undertakes to operate them, she is afraid of them, and when she does finally learn to control them she performs the duty in a rather perfunctory way and takes little interest in her instrument beyond knowing the serial order in which the valves are turned on and off. Perhaps this common attitude among pupil nurses is due to the fact that they are women and therefore not interested in things mechanical, but whether or not that is the reason, the attitude is a bad one and an unnecessary one because a few moments of study will make any one of these sterilizers very intelligible and even simple to any pupil and will prevent its becoming the bugaboo it too often does.

In a few words, using Figure 49 as our guide, the *secrets of this instrument* are these: The large cylindrical part is a strong, hollow, steel shell which contains water, and is called the *"jacket"*; underneath this is the gas burner, steam pipe or other *heater* which boils the water and converts it into steam. This "jacket" is, of course, steam-tight, and as the steam increases in quantity it necessarily becomes more and more compressed and correspondingly hotter. The two clock-like dials on the top of the cylinder in front are *"steam gauges,"* which indicate in pounds the pressure of the steam; one of these is connected with the "jacket" and the other we shall speak of presently. On the top of the cylinder at the rear are several *valves*; one of these connects the "jacket" with the interior of the sterilizer, the *"chamber,"* into which we put our supplies for sterilization. The *door* to the "chamber" is fitted with heavy bolts which enable us to fasten it so as to make the "chamber" as steam-tight as the "jacket." When we have the desired amount of steam pressure in the "jacket" we then open the valve we have just mentioned and allow the steam to enter the "chamber" where it permeates our supplies. The water is still boiling and giving off steam to fill this new space and in a few moments we have the same pressure in the "chamber" as in the "jacket," as we can tell by the second "steam gauge," which is connected with the "chamber." The "jacket" and "chamber" are now in direct communication through the steam valve and we leave them so till we have finished our sterilization. The standard *amount of steam pressure* which is used in these sterilizers is 15 pounds, and at this pressure the temperature of the steam is about 250° Fahrenheit, or 38° F. higher than boiling water. The sterilizer is fitted with a "safety valve" which is regulated so as to open automatically when more than this amount of steam accumulates and allow it to escape. The details as to time of sterilization, etc., will be given when we describe, later on, the sterilization of individual articles.

This is the A, B, C of sterilization by means of the steam pressure sterilizer, but when you come to actually operate one of the more complex sterilizers you will find a few more valves and other attachments; these, however, will be clearly explained by the manufacturer who always supplies printed instructions, and it is important that the nurse should have before her these instructions at all times until she thoroughly masters the mechanism of any sterilizer she may need to operate, for the various designs differ in essential details.

A very important feature which will be encountered in all the better ones is an arrangement for *creating a "vacuum";* and this brings us to a subject which we have not yet mentioned, namely, sterilization by steam pressure in a vacuum. Those of you who have studied physics will know that a vacuum is a space which has nothing in it, not even air, and when we use the term in connection with the sterilizer we simply mean the "chamber" which has had the air sucked from it; and the "vacuum valve" which you will find on your sterilizer means simply a valve which is so made that it may be turned to allow the steam in the "jacket" to suck all the air out of the "chamber." This creation of the vacuum is, of course, done before the steam is allowed to enter the "chamber," and so we are then able to sterilize in a vacuum.

The nurse will now reasonably ask two questions: *"Why do we sterilize in a vacuum?"* and more insistently, *"Why, if boiling water is hot enough to sterilize, do we need to heat steam—practically the same thing—to a so much higher degree?"* The answer to the first question is simply that, since by a law of physics no two substances can occupy atomically the same place at the same time, therefore, speaking atomically, where there is air there can be no steam, and as air serves no useful purpose we remove it so that the useful steam may have its place. The answer to the second question is that we do not compress the steam so much to raise its temperature as we do to make it penetrate to the interior of the more or less compact parcels

service. A thermometer is always an important attachment for this sterilizer, of course.

b. Flame.—Some articles may be sterilized by passing them through the flame of an alcohol lamp or a gas burner. Also, an emergency means of sterilizing the inside of metal or other fire-proof basins or dishes is to pour a very small amount of alcohol (methyl alcohol is best) into them, light it with a match, and allow it to burn out. This is a rather dangerous method, and when it is practiced great care must be taken to use only enough

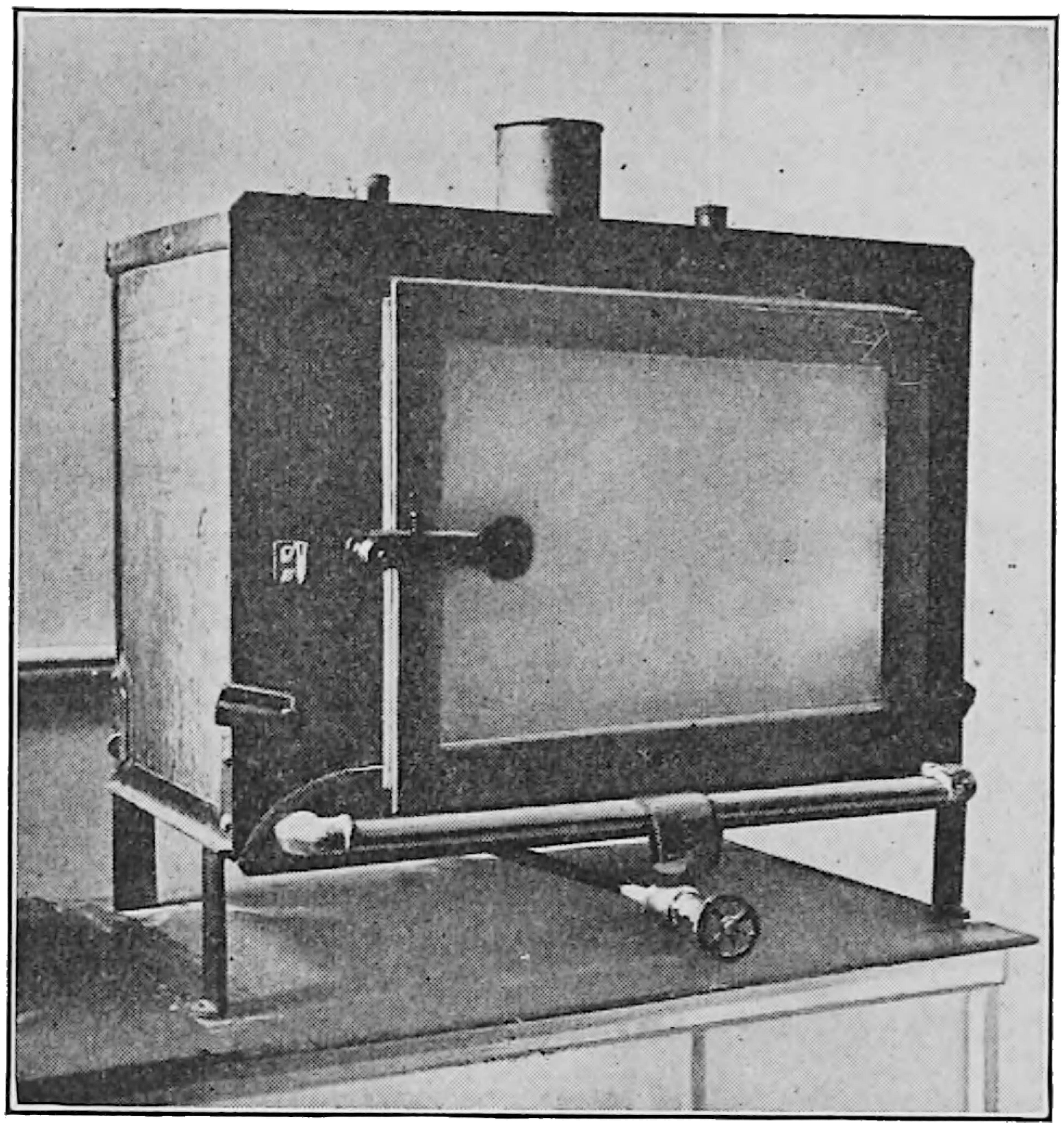


FIG. 50.—HOT AIR STERILIZER.

alcohol to barely wet the surface of the article, for it burns slowly and with a high degree of heat; pains must be taken not to spill the alcohol anywhere in the neighborhood; and the bottle must be removed to a safe distance before the match is lighted.

c. Actual Cautery.—The nurse will probably never be called upon actually to use this instrument herself, as its chief applications are for the sterilization of the appendix stump after the appendix has been removed, for the removal of hemorrhoids, or for the cauterization of tumors, ulcers, etc. Its care and preparation for use, however, will be her duty and she should become familiar with it.

The actual cautery may be of one of these three varieties: (*a*) A simple iron (Fig. 51) similar to *the soldering iron* used by a plumber, and modifications of this for special uses. These

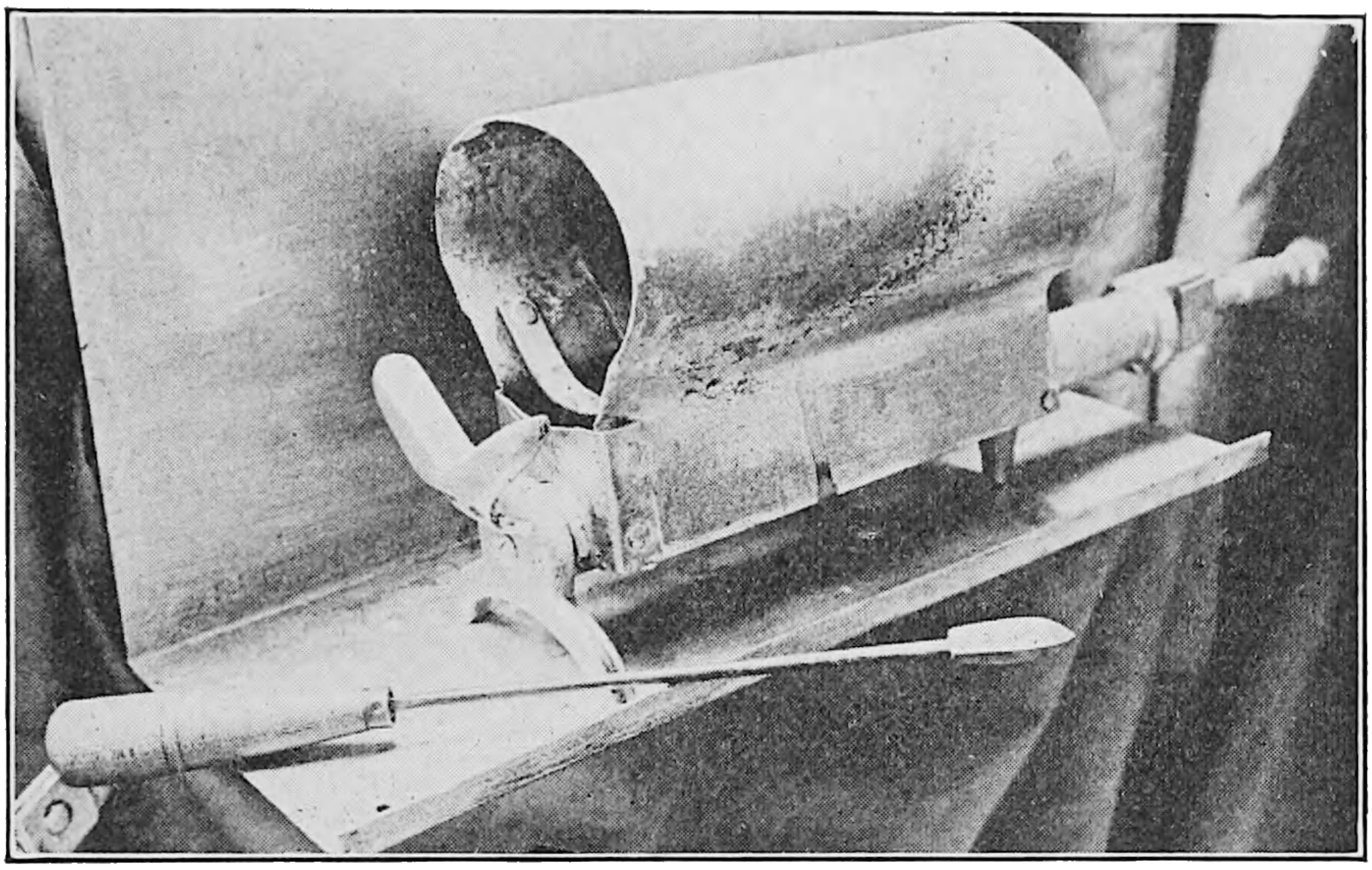


Fig. 51.—The Mayo Soldering Iron Cautery with Special Gas Burner for Heating It. The irons are made in several shapes and sizes.

may be heated in any flame, but a special burner shown in the illustration accompanies the particular type called the Mayo cautery. The only attention these irons will need to keep them

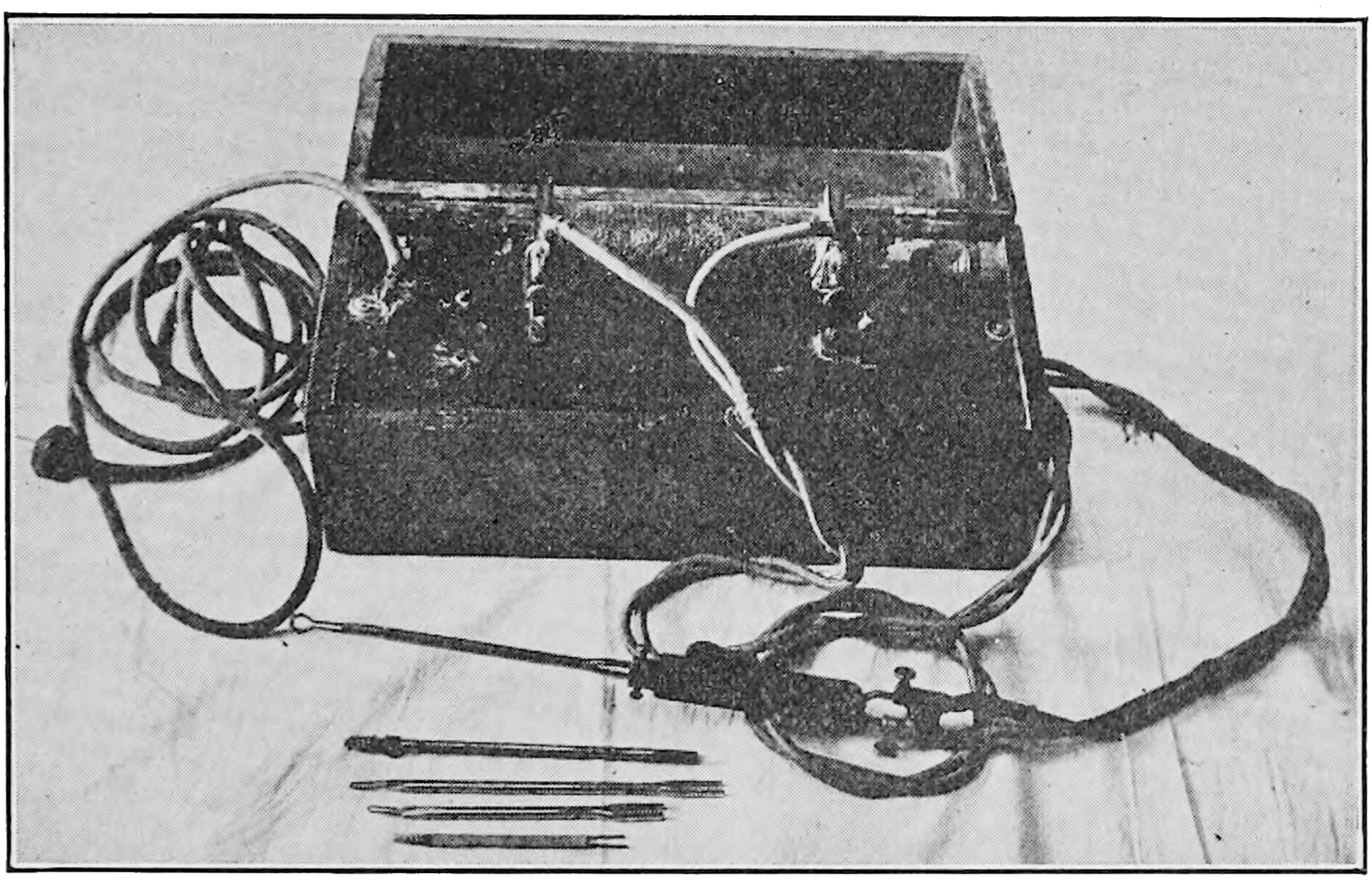


Fig. 52.—Electric Cautery.

in good condition is to scour them after use with a hard scouring powder (emery, for example) or with a piece of fine sandpaper. (*b*) *The electric cautery* (Fig. 52), for which also there are points of a variety of sizes and designs. (*c*) *The Paquelin cautery* (Fig. 53), or one constructed on its general principles. This is a complex instrument which *requires careful handling* to keep it in working order; and as it will usually be the nurse's duty to hand it to the surgeon ready for application every nurse should make sure that she understands it and that she can properly heat it. This cautery consists of a hollow platinum point which is kept hot by the burning of benzine vapor pumped through it from a small reservoir by means of a rubber bulb. In practice this cautery is often very unsatisfactory because it fails to become or remain hot; but if the hollow platinum point is not punctured, and if its cavity is not obstructed by a dent, its failure is nearly always due to the fact that the person

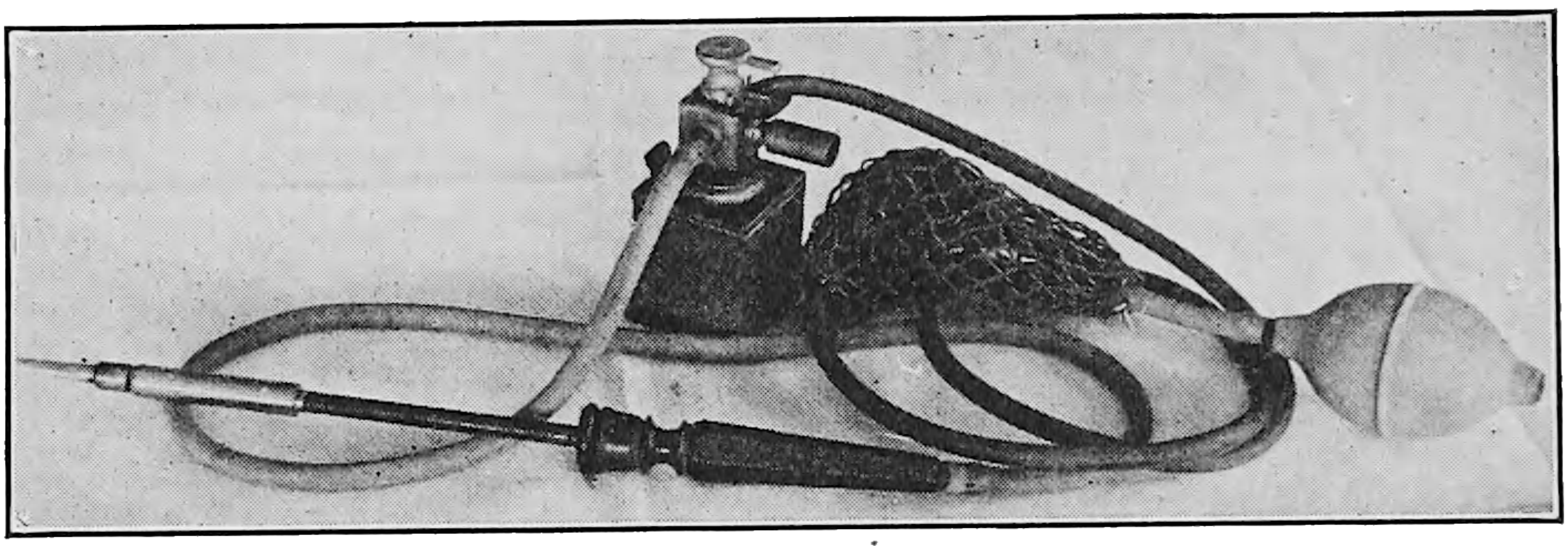


FIG. 53.—THE PAQUELIN CAUTERY.

manipulating it does not quite understand how it must be treated. In the first place, the platinum points are very soft and therefore easily bent or dented, and they must always be handled gently and protected from accident. But given a point in good condition, practically all failures with this cautery are due to the fact that the proper procedure has not been followed in heating it. The benzine reservoir contains a sponge, and in filling it only enough benzine should be put into it to saturate the sponge, for it is only the vapor that will serve our purpose, and if there is more benzine than the sponge will absorb the fluid itself will be pumped into the point and clog it. A good practice is to invert the tank after filling it to allow the excess to escape. The next, and perhaps the most important precaution to be taken is that the platinum point must be heated red hot (in a gas or alcohol flame) before the benzine vapor is

of general application in modern surgery: *Bichloride of mercury, iodine, alcohol, carbolic acid, Dakin's solution, formalin, lysol, ether.*

PRACTICAL METHODS

(*For Initial Preparation of Supplies see Chapter XIV*)

One of the first principles to be learned by the operating room beginner is to *reduce the handling of sterile supplies to the very lowest point.* The methods we shall give you in the following pages we believe to be perfectly safe and if you follow them conscientiously we believe your supplies will be sterile, but we must always remember that the human element in all our acts perpetuates the possibility of mistakes and, therefore, every time one avoids handling a sterile thing one escapes a possibility of contaminating it. This applies particularly after the thing is sterile, of course, but one must begin the application of the principles with the packing of the supplies for sterilization because the way in which this is done will determine to no small degree the amount of necessary subsequent handling. The element of time saving also enters here, for, on the whole, the more quickly, or, rather, the more directly a sterile thing reaches the wound from the sterilizer the more certain one can be of its asepsis; and so, while we are aiming to avoid frequency of handling we must also aim to reduce as much as possible the duration of each particular act of handling. We shall try, then, to pack our supplies in the most convenient and accessible form possible; and as we take up each type of supplies we shall carry it through its particular process of sterilization.

There are certain supplies, such as *basins, irrigators, etc.,* which will be awkward to store sterilly; and there are others, *the instruments* for example, for which there is no suitable method by which they may be thus stored and at the same time kept in good condition. In such cases sterilization, by boiling chiefly, immediately before use will have to be the practice.

Gauze and Muslin Supplies.—We shall presume first that you are equipped with the *drums* for these supplies and that you are packing for a session of two or more operations. In this case you will do best to use a set of four drums, and to devote one entirely to each of the following groups: (1) *Gauze sponges, all wound dressings, and a few towels;* (2) *Draping sheets and towels;* (3) *Gowns, or aprons and gauntlets;* (4) *Abdominal pads and towels* (the hot towel drum). Such things as packing, the lithotomy towel and stockings, sterile bandages, cotton, etc., which are only occasionally used, are best packed in individual muslin-covered parcels. Or, for the packing, a convenient plan is to pack it in long glass tubes which are well plugged with cotton and wrapped in a muslin cover. One doctor's suit or gown, a cap, and a mask are best packed together in a parcel for each individual according to size; likewise, there should be a similar set of cap, gown, and mask for each nurse, as these articles will be needed in the dressing room, and but once for a session. When the gauntlets are used a supply of rubber bands or safety pins for holding them in place should be packed with them.

If drums are not used about the only substitute will be *the muslin-covered parcels,* and when preparation is made for several operations to be done at one time the general plan given above for the drums will work well. However, with the muslin-covered parcels there will always be more handling required in opening and disposing the contents upon tables, and for this reason it may be better to combine them into fewer individual parcels. How this is done must be left to the ingenuity of the nurse who will be guided by her equipment and the nature of her work; but she must always keep in mind her goal of simplicity and minimum amount of handling and exposure.

In small operating rooms, where only one operation need be prepared for, one drum or one parcel may be used for all these supplies except, of course, the individual wearing apparel, which should be arranged as in the other cases.

All of these supplies are *sterilized in the steam pressure sterilizer,* and they should be exposed to the steam at 15 pounds pressure (250° F.) for 45 minutes, and to the drying process for from 20 to 30 minutes or more, according to the load.

Rubber Gloves.—The gloves should, first of all, be most *carefully tested* to eliminate those with the slightest perforation (see page 294). They are then *powdered* well and evenly on both sides with talcum powder; *the cuff turned up* over the outside for about 2 inches; and placed in the *muslin covers,* if these have been provided, and otherwise folded in a towel. If the towel is used it should be so folded about the gloves that a layer of it comes between them for this will aid in permitting the steam to reach all parts. It is best technic to provide a separate glove cover or towel for each pair of gloves; and with each pair should be included a small *packet of talcum powder,* as the hands will always need to be well powdered before attempting to put on the gloves. This powder is best wrapped loosely in a piece of thin paper.

These parcels of one pair each are then packed together in a drum or muslin cover, enough pairs being provided for accidents such as tearing or unsterilizing. A few towels should be included in this parcel for use in drying the hands.

It is a good practice, before sterilizing new gloves for the first time, to *scrub them well and boil them* for a few minutes, as some brands will come out of the first sterilization covered with a more or less gummy substance. The scrubbing and boiling will prevent this, and in any case it is advisable to be sure that anything one sterilizes has had the cleanest start possible.

Gloves are sterilized in the steam sterilizer at 15 pounds pressure, and they can never be subjected to the steam for more than 20 minutes without greatly injuring them. If they are not packed too tightly 10 minutes will be enough. Drying should be accomplished inside of 20 minutes also, and if loosely packed 10 or 15 minutes will suffice. Rubber does not withstand high temperatures well, and if damaged in sterilization gloves are easily torn and may then be as much of a menace as when imperfectly sterilized; for it must be remembered that the hands are never considered absolutely sterile. This is *the "dry method"* of glove sterilization.

Some surgeons will prefer *"wet-sterilized" gloves,* and in that case the gloves are boiled for 10 minutes and then stored in a basin of some antiseptic solution from which they are used directly. The particular solution used will be a matter of individual preference but will probably be either a 1-1000 solution of bichloride of mercury, 1-60 carbolic acid, or lysol ½% or 1%.

fashion of a cigarette. It is the better practice not to make up this drain till immediately before use as the length and thickness will need to be adjusted to each individual wound; and as any of the gauze you have for other purposes will do for this one you will simply need to have the rubber dam in readiness in a variety of sizes varying from 3 or 4 to 6 or 8 inches square. The pieces should be well washed in soap and warm water, and then *sterilized by boiling* in plain water for 10 minutes. This rubber will be in better condition for use if boiled freshly at the time, but when it is used frequently it is a good practice to boil a supply in advance and store it in a well-covered glass jar in a 1-60 carbolic solution. This solution softens the rubber in time, so no more should be prepared than will be used within a week or two.

Rubber Tissue.—This should be cut in sizes similar to those of the rubber dam, and it too should be washed in soap and water, but as hot water dissolves it care must be taken to use cool water. The only method which can be used for *sterilization* of rubber tissue is the *chemical* one and the best solution is bichloride 1-1000. Naturally, you will feel that by this method you may not be able to sterilize the tissue beneath the surface since it is made of rubber and is therefore impervious to any solution, but when you soak it over night, or for 12 hours, you may feel that your germicidal solution has reached any part of it that any of the wound fluids will be able to do and that, therefore, it is fit for aseptic surgical use. Necessarily this tissue must be prepared in advance, and after it has been subjected to the 1-1000 solution of bichloride for 12 hours it should be stored in a glass jar in a 1-5000 solution of bichloride. Do not use a stronger solution than the 1-5000 for storage because the tissue is used directly from this solution and a stronger one will be irritating to some wounds. Also, do not use a carbolic acid solution, because rubber tissue deteriorates rapidly in it.

Rubber Tubing.—Whether or not you provide a sterile supply of rubber tubing will depend upon how much demand you have for it. Some surgeons use it considerably for drainage, and in that case it is well to have a sterile supply prepared in advance. Tubes of a variety of diameters will be needed, and a serviceable length for each piece will be about 12 or 14 inches. After being well washed this rubber may be prepared for use in one of several ways: It may simply be *boiled* for 10 minutes and then stored in a jar of 1-60 carbolic solution; or, after washing it may be boiled, dried, powdered, and *sterilized in muslin covers or long glass tubes in the steam sterilizer.* The reason for boiling this tubing before steam sterilization is the same as that given above for rubber gloves, namely, to remove the surface finish which the manufacturer has put upon it and which becomes soft and somewhat sticky under the steam. The powder serves the same purpose as in the case of the gloves, namely, to absorb the small amount of this gum which oozes to the surface during a sterilization—before use this powder must be rinsed off in sterile water. Perhaps the most practical plan for storing this tubing is in the long glass tubes which are sold as "catheter" tubes. One piece in a tube will be best, and a gauze-covered absorbent cotton stopper fastened well down over the mouth of the tube will be necessary so as freely to admit the steam to the interior.

Rubber Aprons.—These are best *sterilized as advised for the rubber gloves,* that is, they are well powdered, wrapped in a muslin cover and sterilized in the steam sterilizer as directed for the gloves.

Syringes.—Many syringes are boilable and *boiling is the best method where permissible,* but there are so many types of syringe that one must make sure of the construction of each one before attempting to sterilize it because the wrong method will quickly put this delicate instrument out of order. An all-metal one which has perhaps a leather or rubber plunger or packing, a hard rubber one or one with hard rubber mountings, and some of the combination glass and metal ones cannot be boiled and must be sterilized by soaking in some solution. A 1-20 carbolic acid solution is perhaps a good all-round one for such syringes, as bichloride will rust the metal parts and alcohol will injure the rubber and leather parts. A plan which may be applied to the all-glass one, where it will be an advantage to have it ready-sterilized, is to put it (with the plunger separated) into a cotton-plugged glass tube and sterilize it in the steam sterilizer. A piece of cotton will be needed in the bottom of this tube to avoid breakage.

Thermometers.—*The chemical method* will always be necessary for the sterilization of thermometers and any solution will answer, though bichloride should be first choice.

Needles.—As any moist method of sterilization will soon rust *syringe needles* interiorly a good plan is to put each one into a small glass tube plugged with cotton and *sterilize in the dry air sterilizer* for 1 hour at 300° F. The "temper" is of course somewhat altered by this process but it is not enough to be seriously noticed, and the needles will always be free from rust and will last much longer.

The suture needles may be boiled with the instruments, for although they come under the classification of "cutting" instruments, which we shall tell you a few paragraphs hence should not be boiled, the harm done to them is so little as to be negligible. In some large institutions where many varieties are needed during a session, it is the practice to arrange a complete set in a muslin or folded towel case (Fig. 54) and *sterilize them in a cloth cover in the hot air sterilizer* for 1 hour at 300° F. This high temperature and the subsequent slow cooling somewhat soften them, however, but the entire avoidance of rust and the convenience compensate for this slight objection.

Tourniquet and Esmarch Bandage.—*Boil* 15 minutes in normal salt solution.

Vaseline, Olive Oil, Glycerine.—These may all be *sterilized in the steam sterilizer* if care is taken to put them into containers that will withstand the temperature. Or, a method of second choice is to boil them in a water bath.

Novocain.—This will withstand a moderate amount of *boiling* in a water bath.

Instruments.—All instruments except the "cutting" ones, such as knives, are *sterilized by boiling* in the 1% washing soda solution for not less than 10 minutes. The sharp-edged ones are somewhat dulled by the boiling and will therefore need to be sterilized chemically. Alcohol is much used for this purpose, but the objection to it is that the instruments must remain in it an hour or two, and in that time the water which all alcohol contains

rusts them more or less. Another method frequently practiced is to soak these instruments in pure carbolic acid for 5 minutes, rinse off the carbolic in alcohol, and then dry them. Rust is avoided in this way, and when the instruments are free from intricate joints or crevices from which the carbolic might chance not to be removed thoroughly by the alcohol, there is no objection to this method. Carbolic solution, 1-20, is often used also, but it is a slow germicide and involves the complication of rust. In any of the solutions, however, the disadvantage of rust may be greatly reduced by the addition of a few grains of borax.

The hot air method is sometimes used for the sterilization of instruments, and for the heavier and plainer ones there seems to be no harmful result, but the practice will play havoc with the delicately constructed and the cutting ones, as the high degree of temperature necessary and the subsequent cooling alter the "temper" of them and thereby their adjustment.

Suture Material.—In most cases the suture material will be purchased ready-prepared, but as the nurse may wish to know the various processes for her own satisfaction, and as she may sometimes be called upon to sterilize the various materials herself, we shall give here a few of the more frequently employed methods.

When the nurse undertakes the sterilization of suture material she must remember that she is dealing with the most *serious piece of sterilization* which she will ever be called upon to do because the sutures, especially the catgut ones, are imbedded in tissues which have been more or less injured by the operation and thereby made more susceptible to infection and they will hold there in this very good culture medium any germs which may have escaped destruction, and thus bring about the most serious kind of infection. Catgut is difficult to sterilize by any process because it is very easily ruined by even slight departure from the tried and true methods which have been established by very exact experimentation, a few degrees more of heat, for instance, making it so brittle that it will crack in the process of tying or tear under any slight strain; so, before attempting the sterilization of catgut the nurse must make sure that she understands and can control her sterilizer and all the other apparatus, and that she has an intelligent knowledge of the formula she is using, of the ends at which she is aiming in each step, and of the final result she must get. A very important point which she must settle before each sterilization is that she is using a thermometer which is absolutely accurate, because faulty and inaccurate thermometers are responsible for more failures than any other defect of the process. The person who does this work must give her undivided attention to it throughout the process or she will not escape at least one, or more, of the many pitfalls which lie in her pathway.

Plain Catgut

The raw catgut is manufactured in seven and sometimes nine weights and is usually sold in bundles of ten strands, each strand being 10 feet in length. There are many ways advised for arranging it before sterilization and most of them are convenient and technically good, but the one which will apply to all methods is that of cutting it into the proper size for use, which will mean about 30 inches for the suture and 15 inches for the ligature, the strand of 10 feet thus making 4 sutures or 8 ligatures. These should then be rolled around the fingers into coils of about 1½ inches in diameter, the end of the strand being wrapped around the finished coil to prevent its unrolling (Fig. 55).

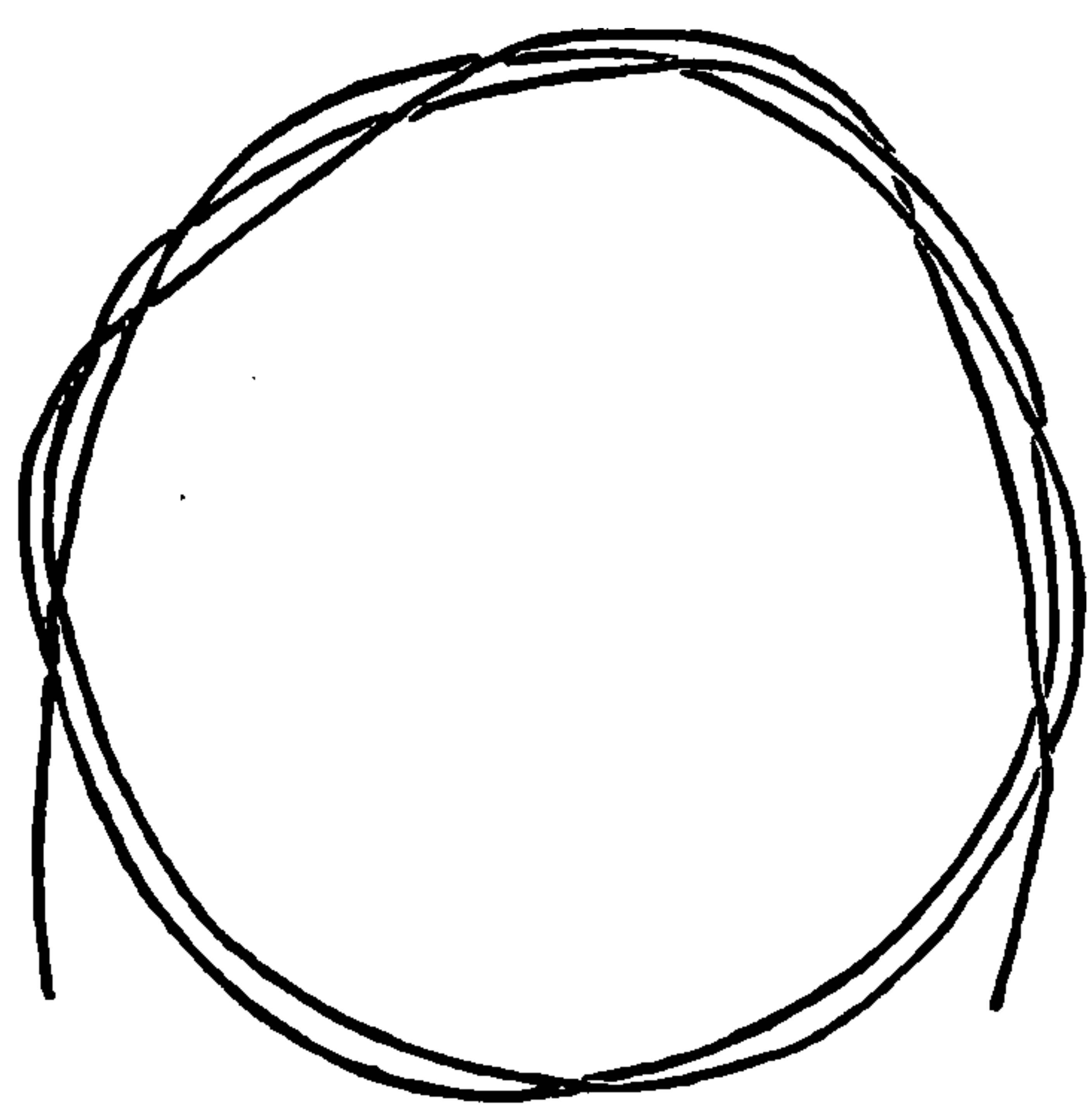


FIG. 55.—METHOD OF ROLLING A CATGUT SUTURE OR LIGATURE FOR CONVENIENT HANDLING IN STERILIZATION AND IN DISPENSING AT THE OPERATING TABLE. The ends should be coiled about the roll only once or twice, as more turns will permanently kink it.

The most economical way is to roll each suture or ligature separately, but of course any number which is found convenient may be combined into one coil. This plan involves so much less handling after sterilization than those in which it is necessary to cut the desired piece from a large reel, and this is perhaps the best reason one can advance in favor of any method of sterilization.

There is an almost uncountable number of formulæ for the preparation of catgut, and it does not seem to matter much which one is used for they all arrive at the same destination, namely, sterile catgut. There is a little difference, however, in some cases in the texture of the suture, the iodine methods, for instance, having a tendency to make it a little less flexible, but aside from this there seems to be no reason except individual taste for preferring any one of the following to any other one of them.

Lee Method (Modified).—

1. Line metal or glass beakers loosely with heavy filter paper, so as to insulate the catgut from the walls of the beaker which gets hotter during the process than the contents and will burn the catgut at any point of contact.
2. Throw coils of catgut into beaker loosely.
3. Place in hot air sterilizer.
4. Raise the temperature of the oven slowly to 212° F. and keep it there for 40 minutes. This is to dry out the catgut, and it should therefore be done on a dry day and in a room free from abnormal moisture.
5. Immediately at the end of the 40 minutes barely cover the catgut with liquid albolene which has been heated to about 120° F.
6. Raise the temperature of the sterilizer slowly and gradually to 300° F. and keep it at exactly this temperature for 30 minutes.
7. Leave the beakers in the sterilizer to cool slowly.
8. After 24 hours heat the sterilizer slowly again to 300° F. and keep it there for one hour.
9. Allow to cool as before.
10. When cold drain off the albolene and store the catgut in sterile jars in a 1/16% alcoholic solution of iodine.
11. The catgut will be ready for use in 24 hours.

It will be better not to cover the beakers during the process,

2. Cover the jar tightly and let it stand for 8 days.
3. After the eight days the catgut may either be left in the above solution or stored in alcohol.
4. Rinse the catgut in sterile water before use.

BURMEISTER METHOD.—Soak the catgut for one week in this solution:

Chloroform	1 gram
Metallic iodine	15 c. c.

BOECKMANN METHOD.—

1. Soak catgut in ether for 1 week.
2. Wrap in paraffine paper and seal in a paper envelope.
3. Sterilize in dry air sterilizer at 300° F. for 3 hours.
4. Repeat sterilization after 24 hours.

NEW YORK HOSPITAL METHOD.—

1. Soak in benzine 24 hours.
2. Allow benzine to dry off.
3. Boil in alcohol for from 1 to 1½ hours, according to the weight of the catgut.
4. Leave catgut in the alcohol.
5. After 24 hours boil again for ½ hour.
6. Store in alcohol.

Great care must be taken when boiling alcohol to do it always in a double boiler or sand bath, as alcohol is easily ignited, especially when an open flame is used.

Chromic Catgut

As stated above, chromic catgut is plain catgut which has been *hardened* in a solution of chromic acid to make it resist absorption in the tissues longer.

The chromicizing must be done before the catgut is sterilized and before the long strands are cut. The reasons for this will be found in the following facts: (*a*) The chromic acid is made up with water which renders the catgut spongy and which must be dried out of it before anything further can be done; (*b*) In the process of drying there is a certain amount of shrinkage which takes place very unevenly unless the strands are kept stretched during the process; (*c*) Consequently, the strands must be stretched out at full length across a large frame or between two wall pegs, and securely fastened at both ends under moderate tension for drying; (*d*) It is easier and simpler to handle the long strands than the short ones for this part of the process.

Therefore, to chromicize the catgut we lay the rolls as they come from the factory in a dish which will allow them to lie loosely on the bottom without cramping, and then pour over them a 1-2000 chromic acid solution, and leave them undisturbed in this solution for 24 hours. At the end of this time we remove one strand at a time and stretch it carefully and at an even and quite moderate tension across the frame or between the pegs, fastening both ends securely because there is considerable shrinkage in drying and therefore a strong pull on the ends. The strands may be separated without difficulty if the precaution is taken before putting them to soak to examine the roll, as one would a skein of yarn, to see in which direction it may be unwound, and then to place it in the jar accordingly. It is left on the frame until "bone-dry" and is then *sterilized like the plain catgut.*

Kangaroo Tendon

This is prepared like the catgut.

Horsehair

This must be *thoroughly cleansed* in soap and water, and it should be allowed to soak in this for a few hours in order to be sure that it is perfectly clean. It is then rolled into coils like the catgut, *sterilized by boiling* in clear water, and is then best stored in a 1-60 solution of carbolic acid. Because of the special danger of tetanus and anthrax spores in the case of horsehair, sterilization of fresh supplies must be very thorough, an hour or more being required for safety. The horsehair will withstand this amount of exposure to boiling and we therefore have no excuse for giving it less. Alcohol is sometimes used instead of carbolic for storage but this is likely to make it too stiff and somewhat brittle.

Silk and Linen Thread

These must be wound on small reels, preferably glass ones, and it will be more practical for future use to leave them in one long piece rather than to cut them into suture lengths. If they are white and it is desired to dye them black any standard fast dye may be used if the nurse first familiarizes herself with the correct process for doing this.

Silk and linen thread are *sterilized by boiling* in plain water and should not be subjected to the process for more than 30 minutes, as they deteriorate somewhat in boiling water.

Sometimes the silk thread may be impregnated with paraffine or with liquid albolene. When paraffine is used it should either be first melted and the silk then boiled in it, or a jar containing the silk and enough of the paraffine to cover it when melted may be placed in the autoclave and sterilized like the gauze dressings. When boiling paraffine over a flame or a stove it must be closely watched as it will burn if allowed to become too hot. Albolene, also, may either be boiled or sterilized in the autoclave, and it will need the same care as the paraffine when boiled on a stove or open flame.

Silkworm Gut

The raw silkworm gut will usually be supplied by the market in bundles of 100 strands each about 14 or 15 inches long. These may be wound in coils of one or more strands each like the catgut. It is usually sold in the natural color, white, and if it is preferred black it may be dyed as suggested for the silk and linen. This is best done after it has been rolled into the coils. It is then *sterilized by boiling* in clear water, and unlike the silk and linen, it does not deteriorate in boiling, so a generous amount of time may be given it. It should then be stored in a 1-60 carbolic acid solution. Alcohol should not be used for this storage, as silkworm gut has a tendency on its own account to be brittle and alcohol will encourage this tendency too much.

probability of their being cracked by being knocked about in vigorously-boiling water, which is probably about the only cause of the explosion.

A perfectly safe way to sterilize these tubes is, of course, the chemical one. It does not matter much which particular chemical is selected as long as perfect sterilization is secured.

CHAPTER XVI

THE OPERATING ROOM IN ACTION

PREPARATION OF THE ROOM FOR THE OPERATION

You now know in a general way how to provide what you are likely to need for the average operation, and we can proceed to the detailed preparation of a room.

First of all, absolute *cleanliness* of the room in every respect must be attended to. Doors and windows must be so adjusted as to prevent draughts and the entrance of dust, and the temperature regulated at about 75° or 76° F.

The glass and other articles which must be sterilized chemically are "put to soak" (the bichloride tub which we advised above will serve well here); the various odds and ends and *the parcels of sterile supplies* which will be needed for the particular case are placed in convenient readiness; *boilers* are filled with the articles which belong in them and are started boiling; and you then proceed to the sterilization of your hands.

This, of course, you will do in the dressing room. First, you will *put on your cap and mask,* as you cannot do it safely after your hands are sterile, and no one else can do it satisfactorily for you. Next, you *scrub your hands and arms* by means of a brush, green soap, and warm running water, scrubbing from the elbows downward and continuing the process carefully and painstakingly for at least 5 minutes, taking special care to clean thoroughly about the nails with the nail cleaner. The brush and nail file you have previously boiled and brought to the dressing room in a small sterile basin of alcohol, a 1-60 carbolic solution, or any other suitable solution. The scrubbing completed, you will *continue the sterilization* of your hands by some such method as these: (*a*) Rinse off the soap thoroughly, allowing the water to run from the hands toward the elbows rather than in the opposite direction so as to avoid the possibility of rinsing contamination from the unwashed upper arm downward over the hands; rinse in alcohol; and then immerse the arms and hands in a 1-1000 solution of bichloride for 3 minutes. When bichloride is used the greatest care must always be taken to have absolutely all the soap removed as bichloride cannot penetrate it and therefore will never reach the skin. (*b*) After rinsing put a small quantity of chloride of lime and the same amount of powdered washing soda into the palm of your hand, make a lather of this with a little water and rub the arms and hands with it for a minute or two; then rinse this off in a basin of sterile water and immerse the arms and hands in the bichloride for 3 minutes.

There are many other methods which you may learn from time to time, but these two are as thoroughgoing and as convenient as any.

You now *put on the sterile gown,* having some unsterile person fasten it for you, and you are ready to go into the operating room.

All of the tables which are to be used for sterile supplies have been "*dusted*" with a towel wrung out of bichloride solution. If you have an unsterile assistant she may do this for you, or you may have done it previously yourself. The practice of doing this after the sterile gown has been put on is not technically good as there are too many chances of its being unsterilized in the process.

Your next step is to *drape the tables* with the sterile towels, and to *put upon them the sterile supplies* which you have boiled or otherwise sterilized. In draping tables it is a good practice to cover them first with towels wrung out of the bichloride solution, as the wet towels stay in place better than the dry ones, and more than one layer of cover should always be used on a sterile table because there may often be unnoticed holes in the towels. The supplies should, of course, be kept well covered with towels or a suitable sheet.

There are innumerable details in connection with the arrangement of the various supplies such as suture material, instruments, etc., but a large volume would be required to record them all, and then it would be impossible to provide for all the variations that will be dictated from time to time by the arrangement

iodine, sometimes preceding the iodine with a sponging with ether. As a rule the shaving will have to be done before the patient comes to the operating room, and this is the better technic. The point that all parts which are to be painted with iodine should be perfectly dry must not be overlooked, because it is a fact that the iodine does not penetrate as deeply into skin that has been recently wet as it does into the normally dry skin, and furthermore, it is believed that the presence of an abnormal amount of water in the skin renders it more susceptible to the somewhat irritating power of the iodine. This means that all operating room shaving will be done dry, because it is perhaps not overcautious to make the rule that the lather should not be used within the 12 hours preceding the iodine application.

Some parts of the body, the face for instance, as a rule are *not subjected to the iodine,* but instead are scrubbed with green soap and rinsed with alcohol and perhaps also with bichloride. For *children, old people,* or others whose skin might be too much irritated by the full-strength tincture of iodine, it is diluted to half strength, and sometimes less, by the addition of alcohol.

A simple way to apply the iodine is by means of a small gauze sponge held in a pair of forceps, preferably sponge forceps, but care must always be taken not to use so much iodine that it will trickle down under the patient's body or into the axilla or any other part where it may be confined in the presence of moisture and cause troublesome burns. Sometimes the iodine will be sponged off with alcohol immediately after it has thoroughly dried.

OPERATIVE POSITIONS AND DRAPING

It is something of an art to arrange the patient in a good and stable position and to place the sterile draping so that it will be unobtrusive and at the same time serviceable and durable. Anyone can lay towels and sheets around an operative field, but it takes study and ingenuity to do it well. Likewise, there are many points about the various positions of the patient, which, to be appreciated, must be studied and practiced carefully.

We shall now take up the representative operative positions and the sterile draping suitable for them. When not definitely mentioned it will, of course, be understood that *the operative field has been sterilized* immediately after the position has been arranged and before the sterile draping is adjusted.

Also, as it will be monotonous to mention it each time, we shall here lay down the rule that *a rubber sheet will be thrown over the patient, table, sandbag, etc.,* in any place where there is likely to be much drainage from the operative field.

Dorsal Position.—This is the most frequently employed position (Fig. 57), and it will be *used for most operations upon the intestines, stomach, pancreas, spleen, and bladder.* In some

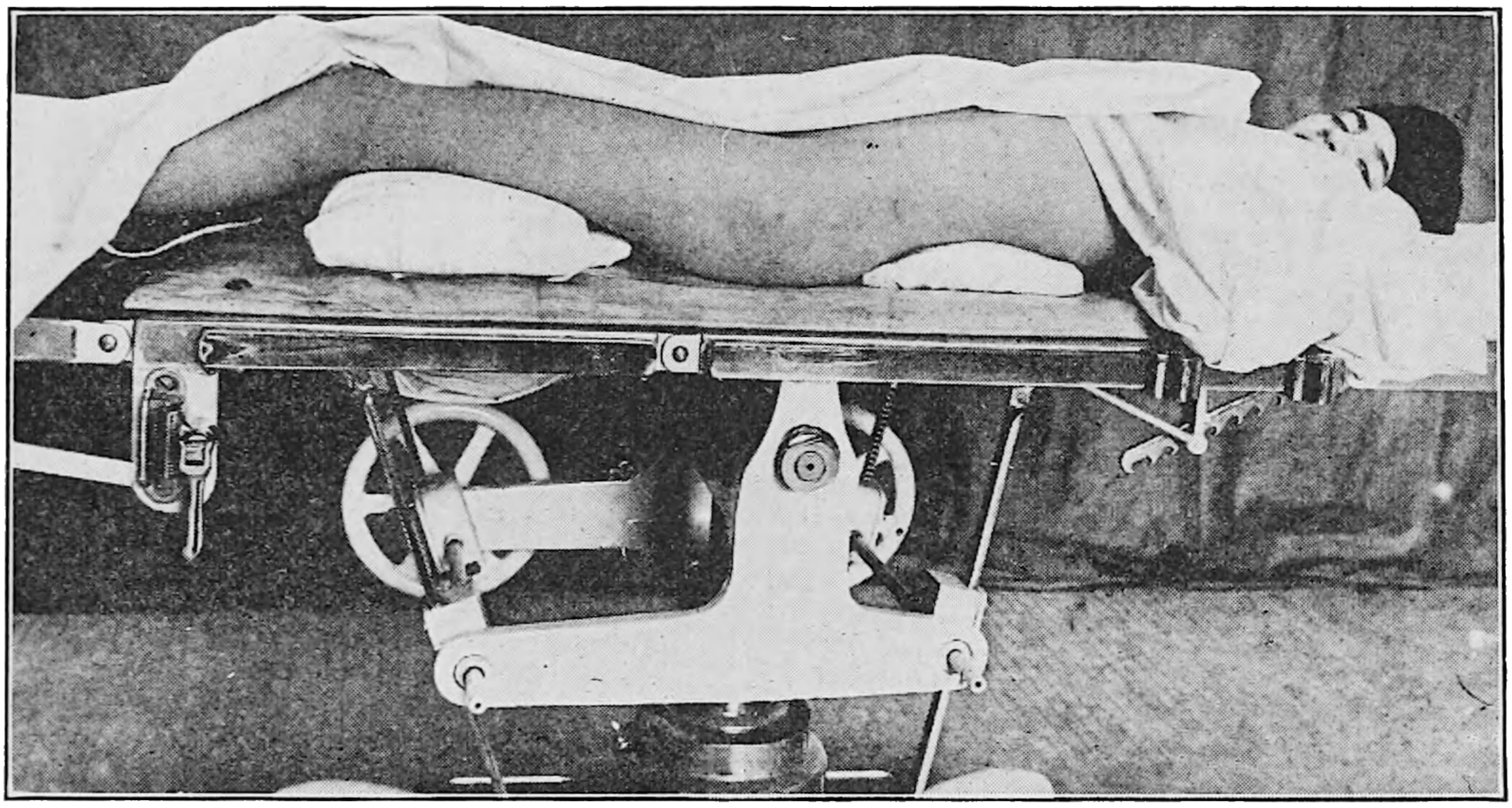


FIG. 57.—DORSAL POSITION. The pillows under the back and thighs are for the greater comfort of the patient and for the relaxation of the abdominal muscles.

cases the patient is simply placed flat upon the back, but in others there will be a small pillow under the "small" of the back and a larger one or a small sandbag under the thighs as shown in the illustration. *The pillow under the back* will be especially desirable for women, whose backs naturally curve more than men's, and it *will serve the purpose of preventing the severe backache* which so frequently complicates convalescence from a long abdominal operation, because it keeps the muscles of the back in their natural position and prevents the abnormal strain which would otherwise occur. *The pillow under the knees causes relaxation of the abdominal muscles* which results in much less strain upon them and thus enables the surgeon to retract them out of his way more easily and with less injury to them when doing an abdominal operation. The arms may be arranged in various ways but these two will answer all purposes for this position: (*a*) They may be fastened at the patient's side by means of a folded towel (Fig. 58), which is passed across the table under the patient's back and an end pinned about each forearm, or an end turned over each arm and then tucked under the patient's body. (*b*) They may be laid against the chest with the hands well outward on the shoulders

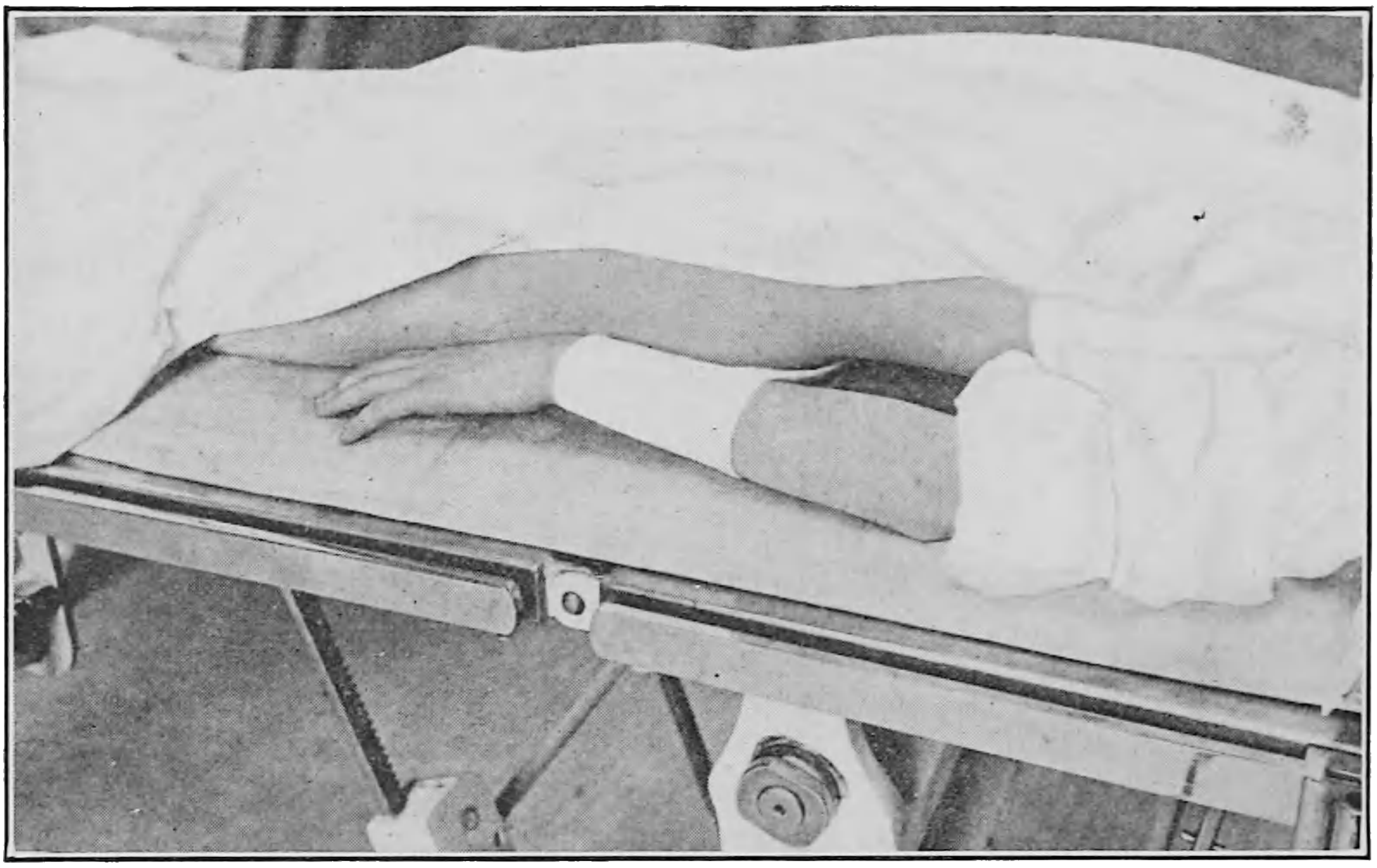


FIG. 58.—METHOD OF FASTENING THE ARMS AT THE PATIENT'S SIDE. The towel is passed under the patient's body crosswise of the table, and the end is carried around the wrist and then tucked under the body.

(Fig. 59), the sleeve pinned to the shoulder of the gown, and the tail of the gown tucked about them to hold them in place. The arms are less obtrusive, as a rule, when lying at the patient's side, but there are many operations in which this practice is technically quite unrefined, for instance, abdominal or other trunk cases in which pus, irrigating solutions, etc., may run down over the arms and hands thus placed.

The sterile draping for this position is relatively simple and is done in one of two ways: (*a*) *The laparotomy sheet* described on page 227 is laid over the patient very carefully (Fig. 60), two people being almost necessary for this act in order not to

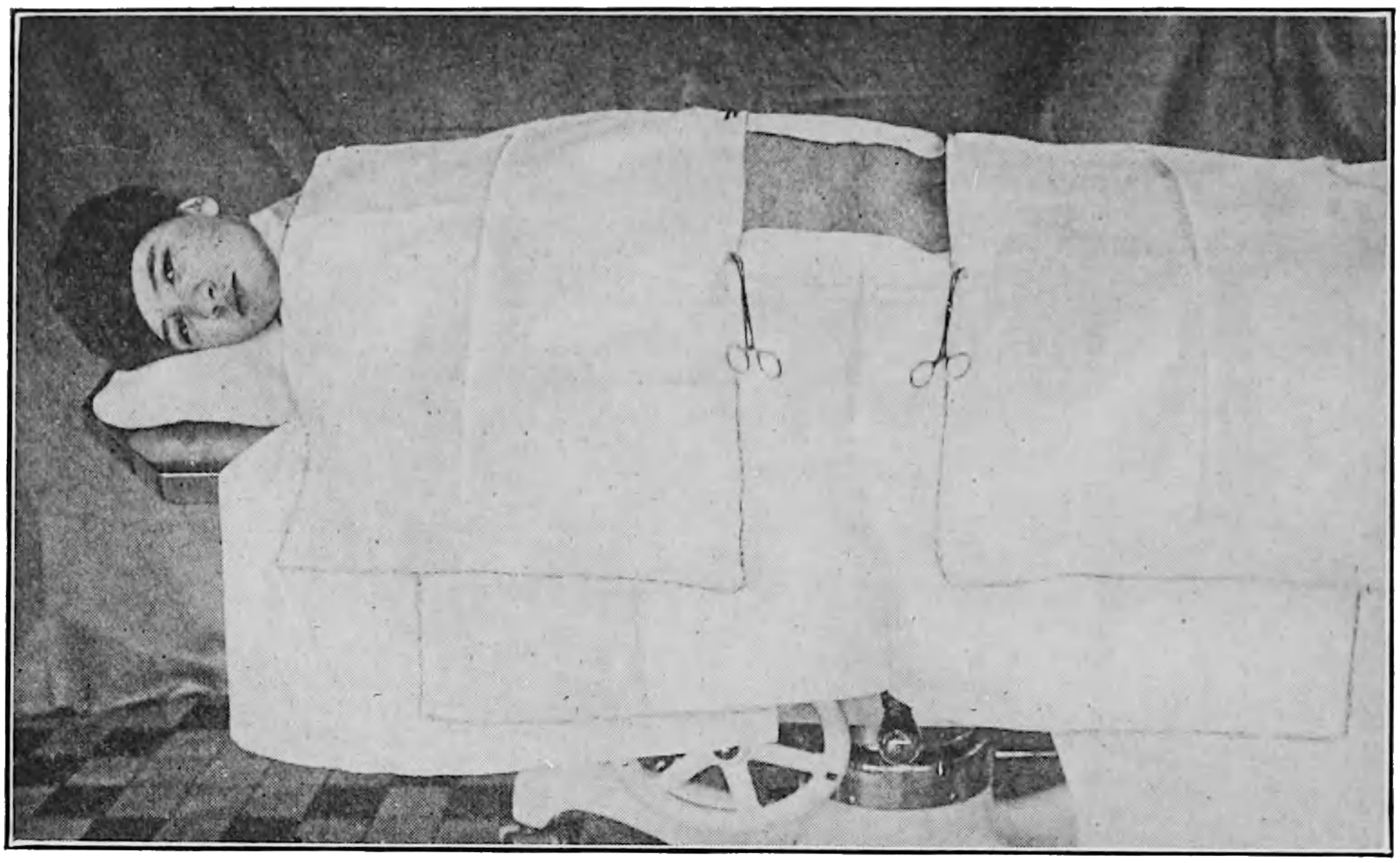


Fig. 61.—Draping for the Dorsal Position with Two Sheets and Four Towels. One sheet is laid across the lower part of the table and the edge brought up to the lower border of the operative field, and the other over the chest similarly. The towels are then disposed over these as illustrated, the crosswise towels lying on top of the lengthwise ones for greater security. One of the towel clamps shown in Fig. 62 binds these towels and the underlying sheets securely together at each corner of the operative field.

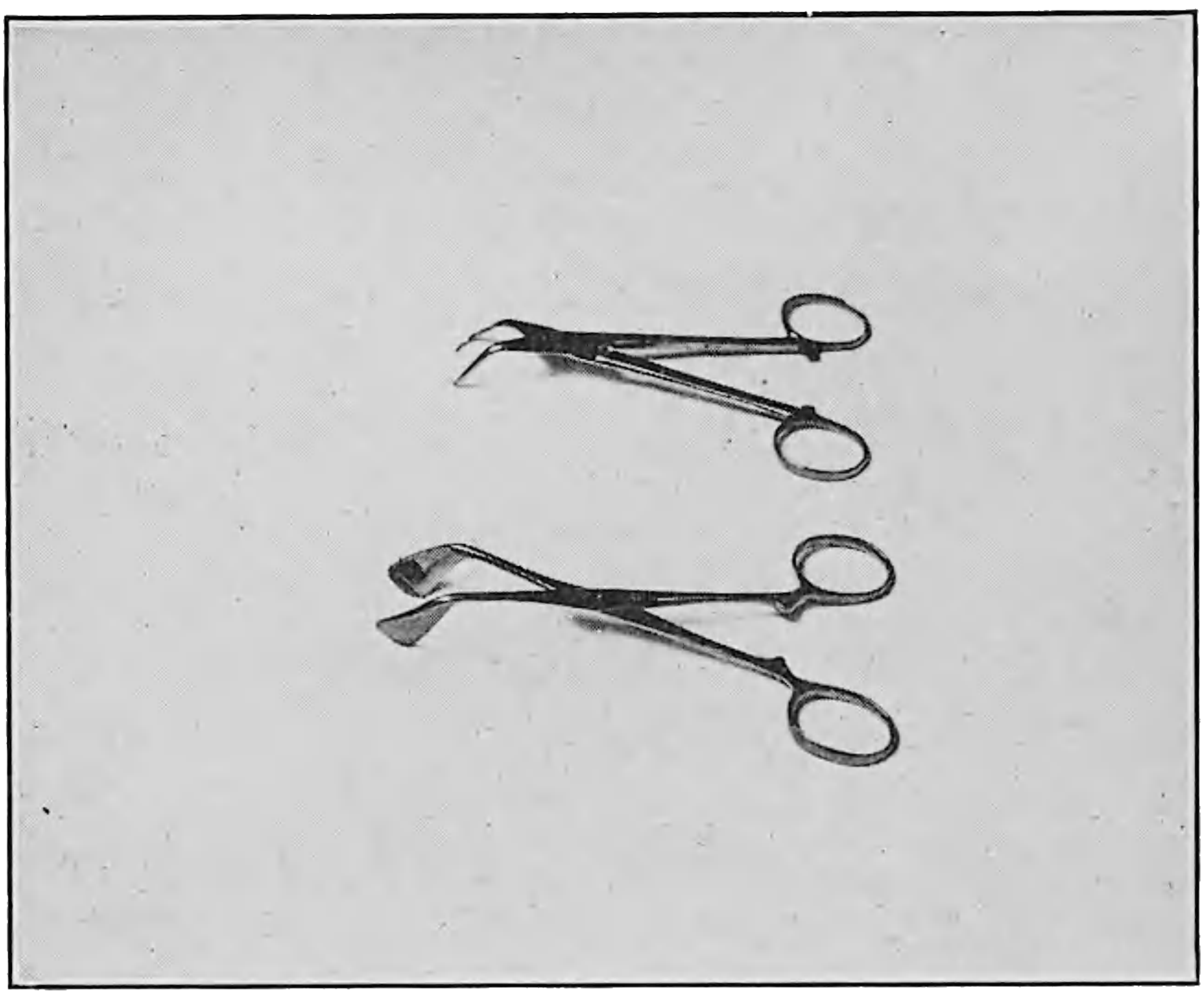


Fig. 62.—Two Types of Towel Clamps, Used for Holding the Draping Sheets and Towels Together. The sharp-pointed clamp is usually passed through the patient's skin as well as the draping.

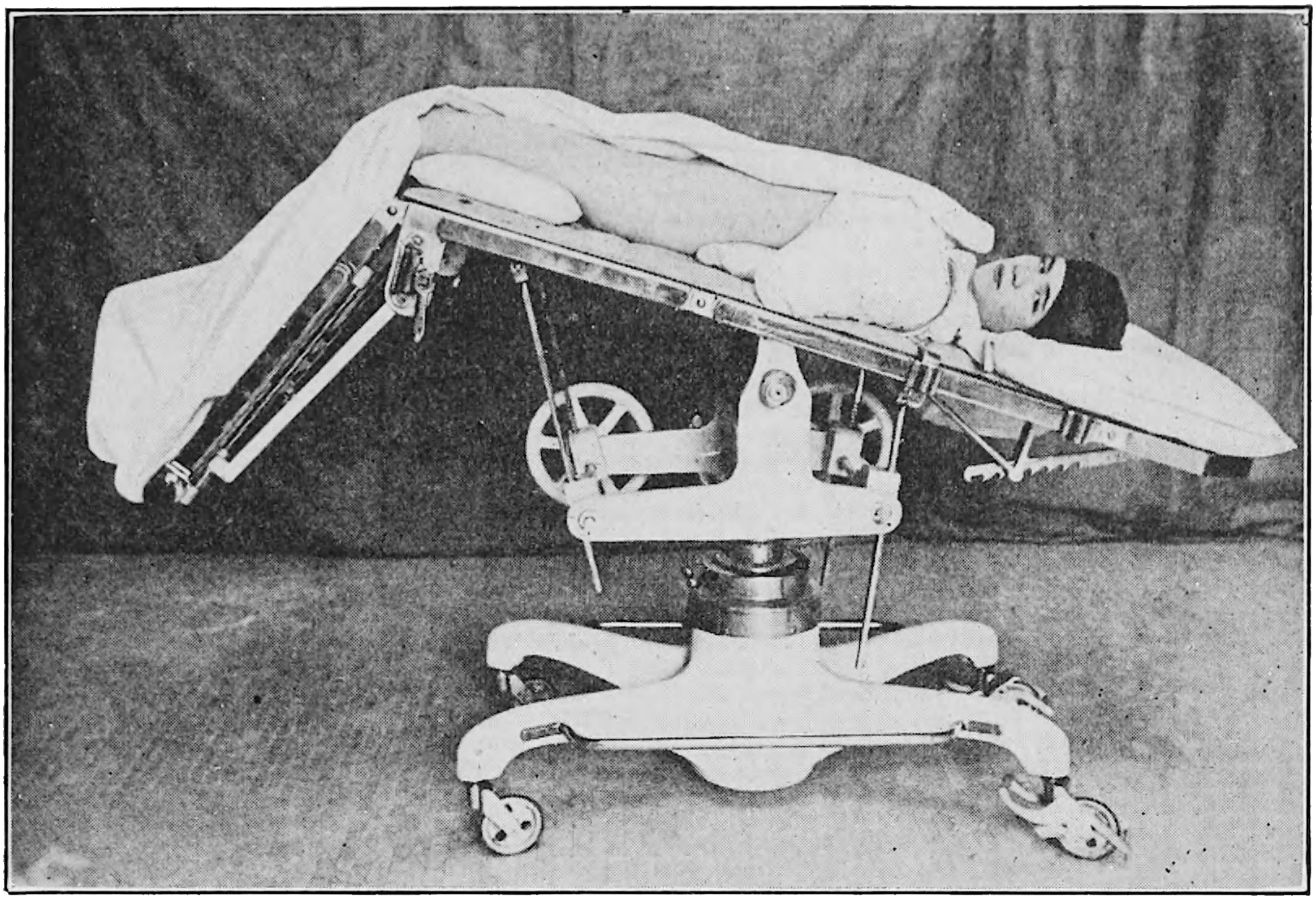
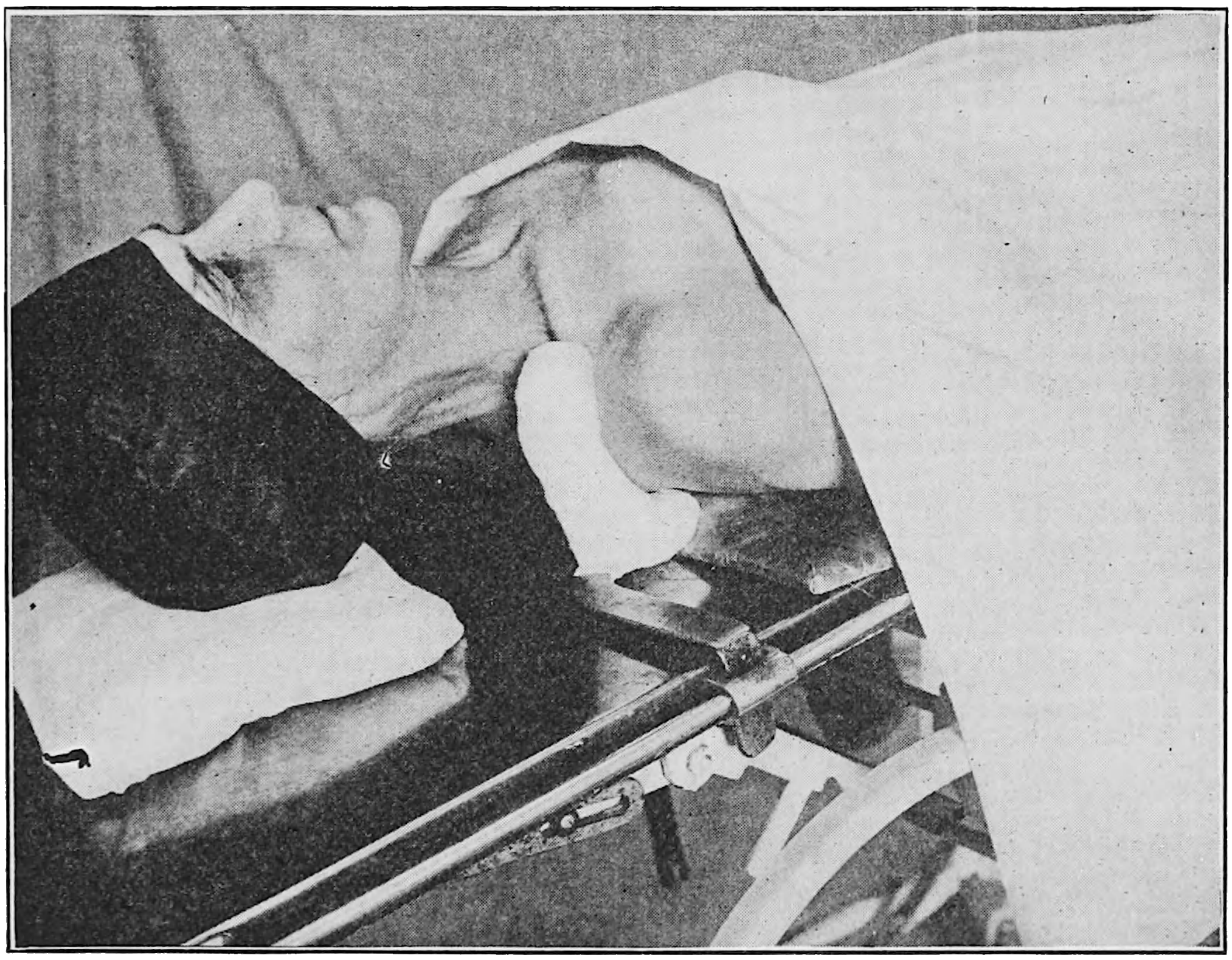


FIG. 63.—TRENDELENBURG POSITION. The pillows under the patient's back and thighs serve the same purpose as in the dorsal position (Fig. 57). The shoulder guard, shown more clearly in Fig. 64, keeps the patient from sliding.



operation where this sheet will be appropriate an assistant can always be found; or, if carefully done there can be no objection to an unsterile person handling the end which is placed under the patient's chin because this is unsterilized immediately in any case. (*b*) *Two sheets and 4 towels* may be arranged as in Fig. 61. It should be noticed that the towels which run lengthwise of the patient are put on first and the crosswise ones laid over them, because this is the much more secure way and it brings the towel edges into positions where they will be less

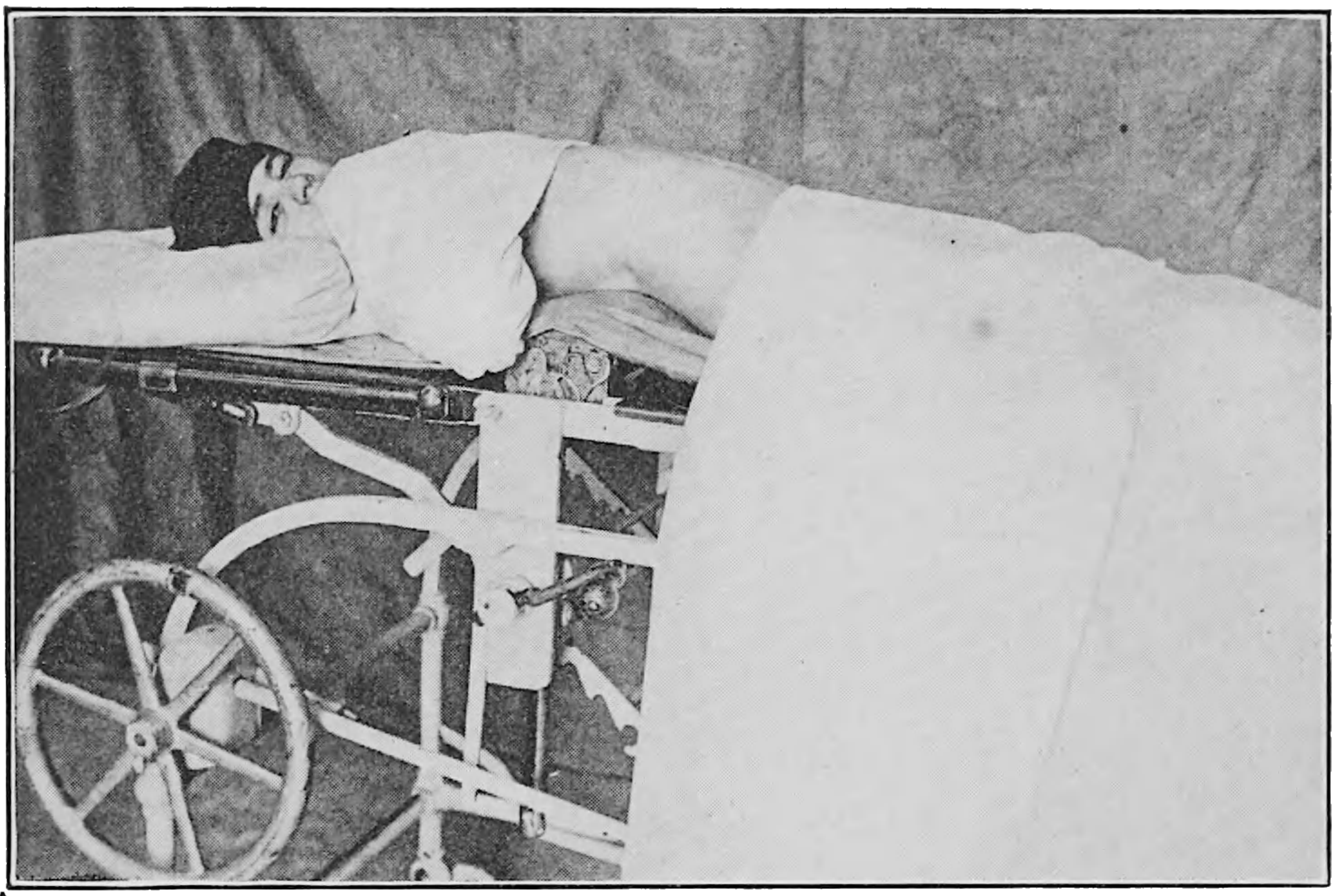
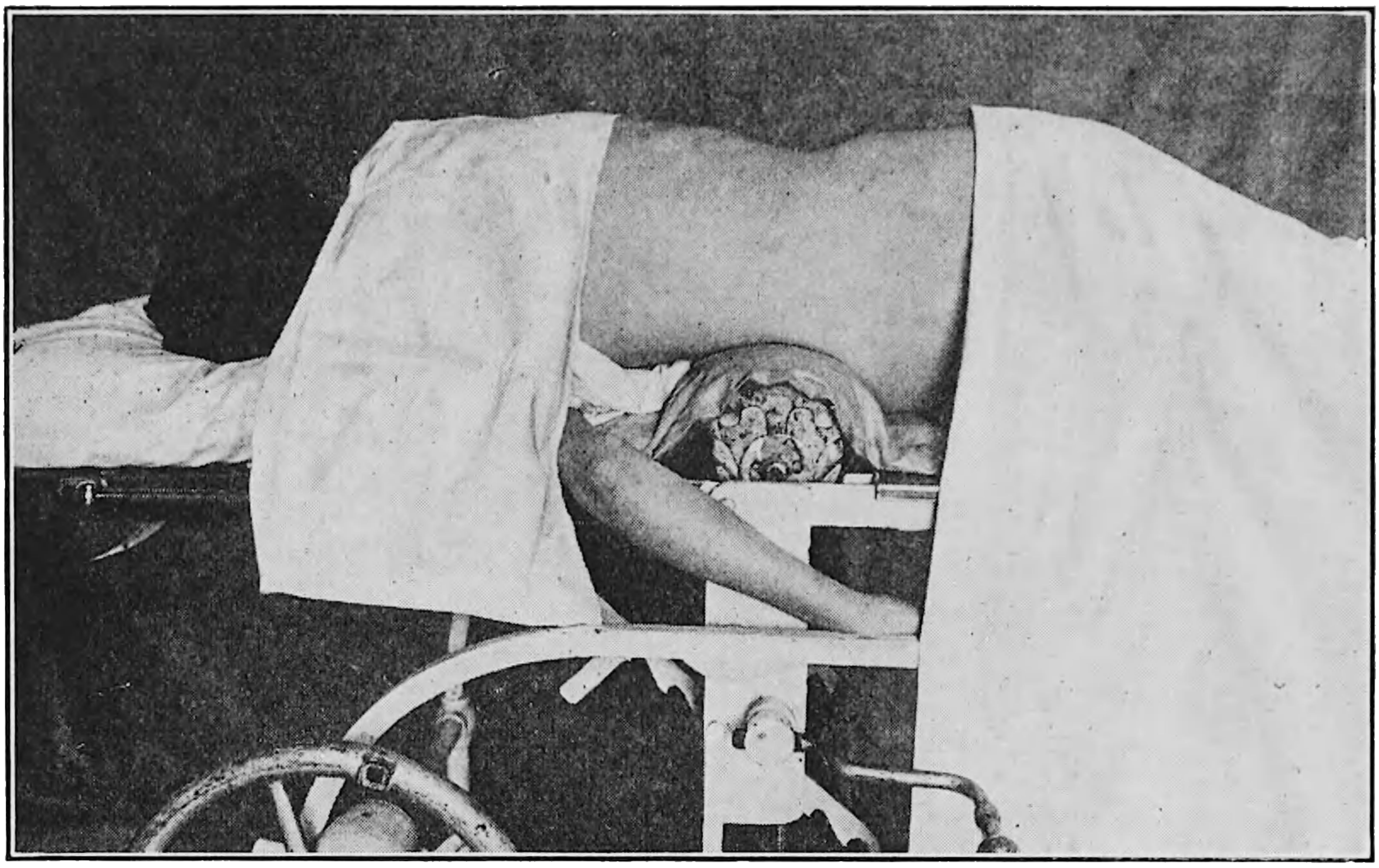


Fig. 65.—Gall Bladder Position. This table has a crosswise rest which may be screwed up under the gall bladder region so as to throw it well upward. In lieu of this a small sandbag will serve the purpose. See also Fig. 66.

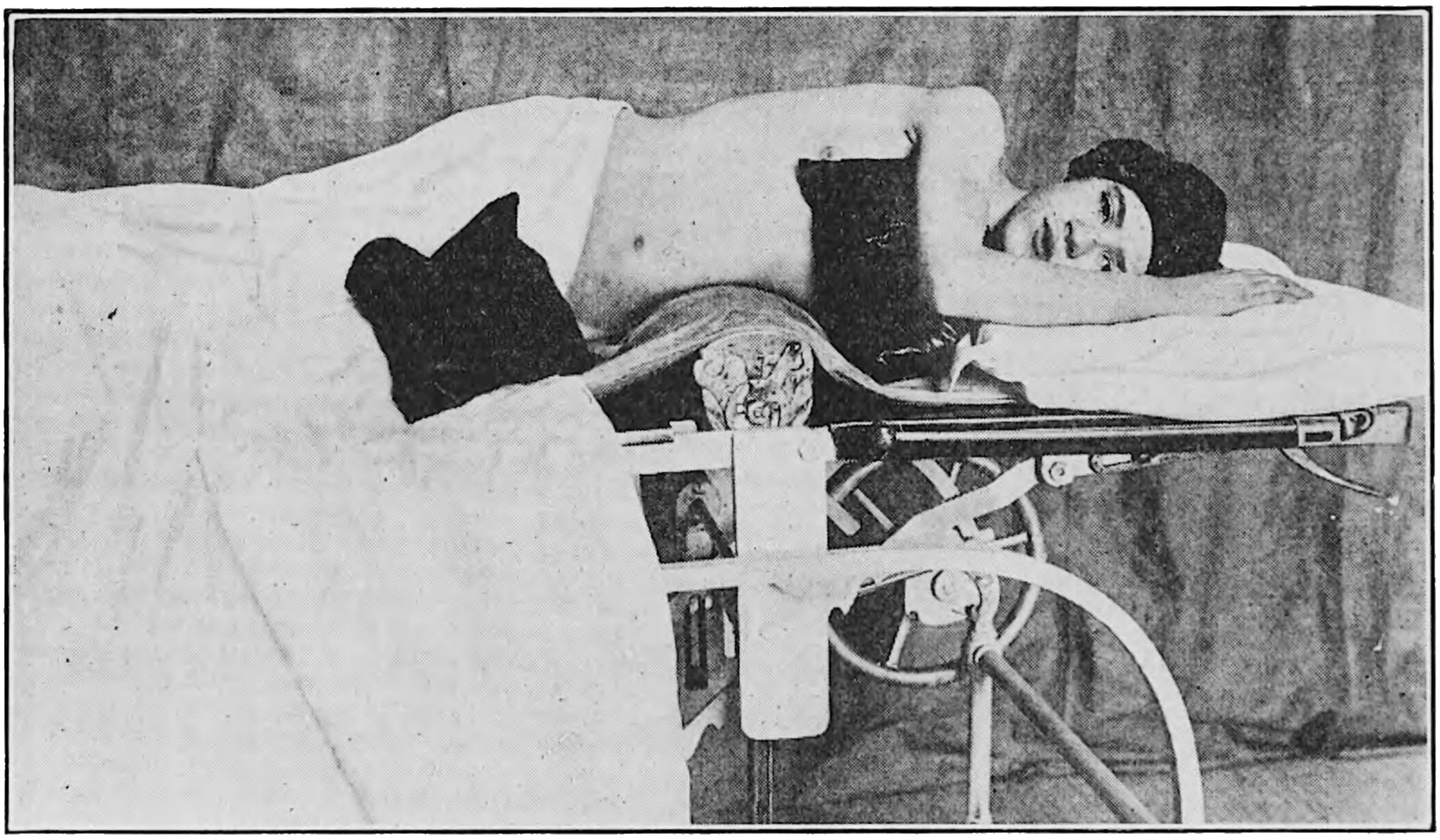
likely to cause annoyance by catching upon instruments or by being brushed out of place by the arms of the surgeon and assistants. The two crosswise towels will keep the draping in place much better if they are wet, but if the operative field has been painted with iodine there may be objections raised to the use of wet towels here. A towel clamp (Fig. 62) or some substitute, such as an ordinary artery clamp, will be needed at each of the four corners of the field to keep the draping in place.

Trendelenburg Position.—For this position (Fig. 63), the patient is first placed in the dorsal position, the foot section of the table is dropped, and the whole table top is then inclined,

the organ out from under the ribs. If your table is not supplied with the "rest" shown in the illustration a pillow or small sand-



A



B

Fig. 67.—Kidney Position. *A*, rear view showing the disposal of the one arm and the elevation of the patient's waist line to about the level of the hips; *B*, front view showing where the other arm rests and how the sandbags are best placed for stabilizing the patient in the proper position, which is slightly forward of the true lateral position.

bag will answer the purpose; or, you may have a table which can be broken in the middle directly under the gall bladder region (Fig. 66) which will accomplish the same purpose.

The draping will be the same as for the dorsal position.

Kidney Position.—The patient is turned on his side (Fig. 67) with the lower arm at his back, the other up toward his face, the uppermost knee and hip joints flexed so as to bring the knee down upon the table in the capacity of a brace to keep the body from falling forward, the chest is braced anteriorly with a large sandbag, and sometimes the pelvis also will need the support anteriorly of a heavy sandbag. The crosswise rest is now screwed upward directly under the location of the kidney so

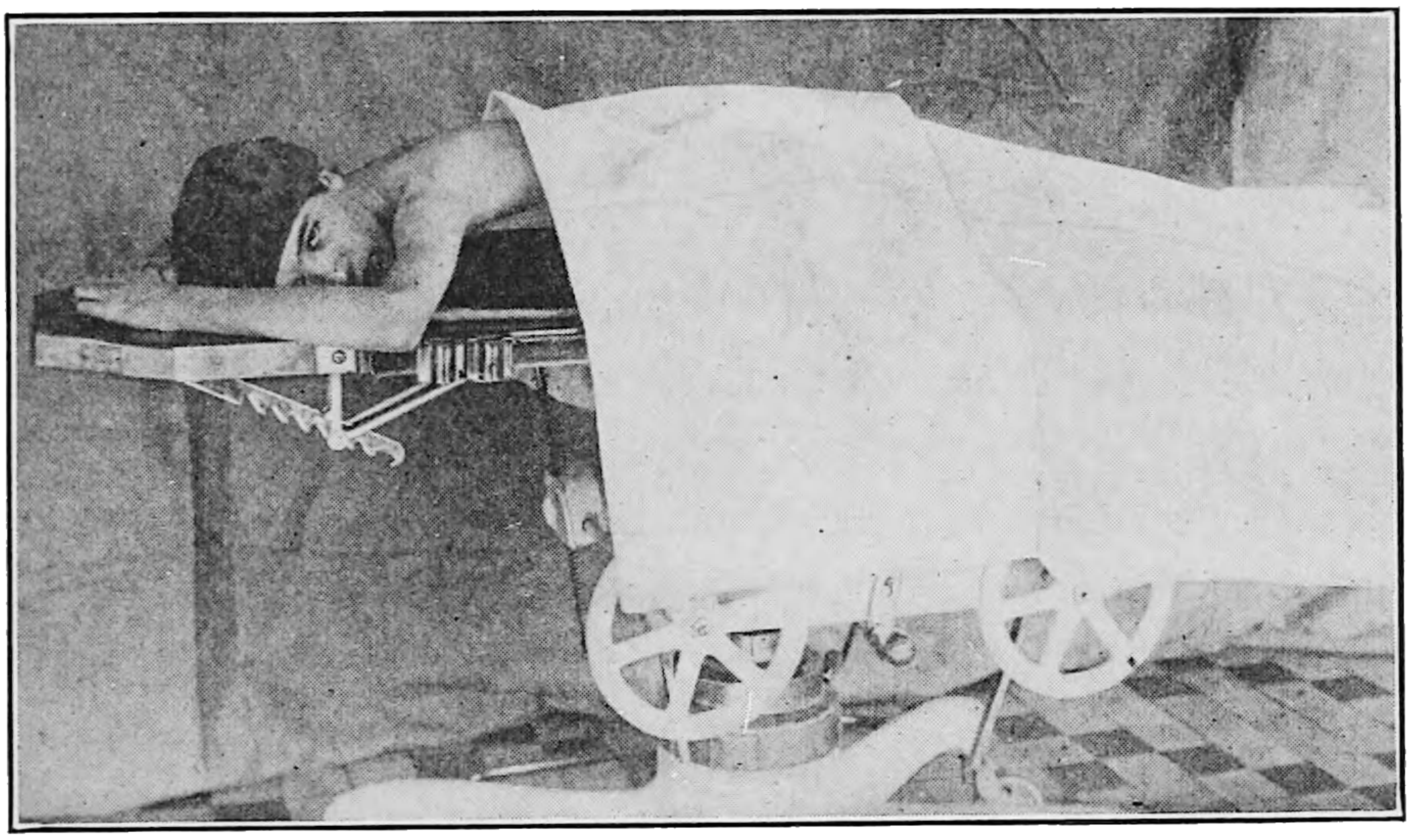


FIG. 68.—PRONE POSITION. The patient lies flat upon his face except for one shoulder which is elevated slightly upon a small sandbag so as to turn his face away from the table sufficiently for the administration of the anesthetic. Some tables may be broken at the head so as to accomplish this purpose without the sandbag, or, the arrangement shown in Fig. 83 may be used.

as to throw the organ as well outward and upward as necessary from under the ribs. Foresight should be used in seeing that the patient is properly placed in relation to this rest before any of the preceding adjustments are made so that the raising of it will not disarrange the position. When properly arranged *the patient will incline very slightly toward his face from the true lateral position.*

This is the most *difficult position to arrange* and a great deal of practice should be devoted to it by the beginner.

The draping corresponds to that for the dorsal position.

Prone Position.—The patient lies flat upon the table with the face downward and the arms above the head (Fig. 68). Spe cial care of the head must be taken in arranging this position; some tables will be so constructed that a section at the head may be lowered somewhat to allow the patient's head the required

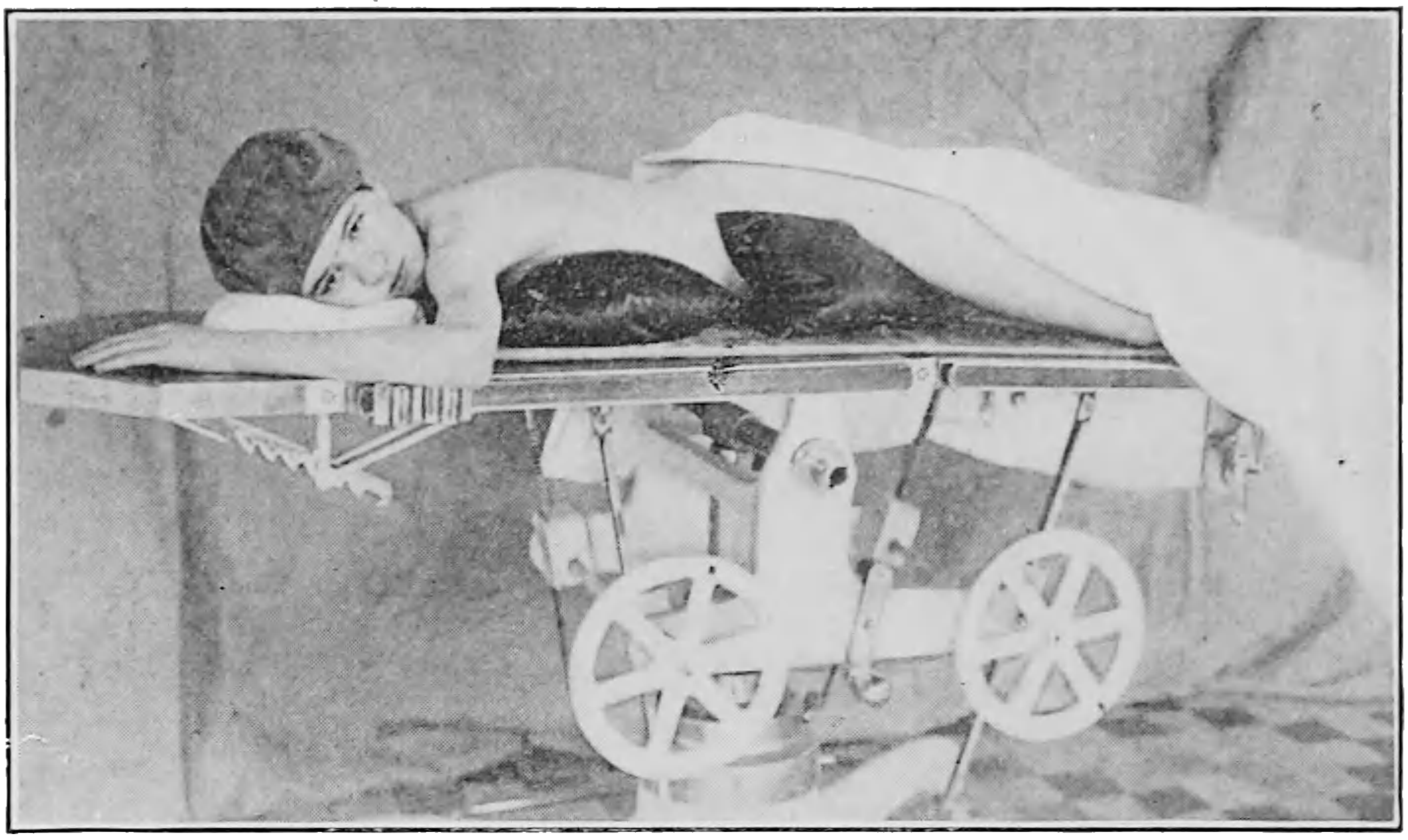


FIG. 69.—LATERO-PRONE POSITION. The patient is inclined about half way between the lateral and the prone positions, and the sandbags under the chest and the hips, and his flexed knees, stabilize him.

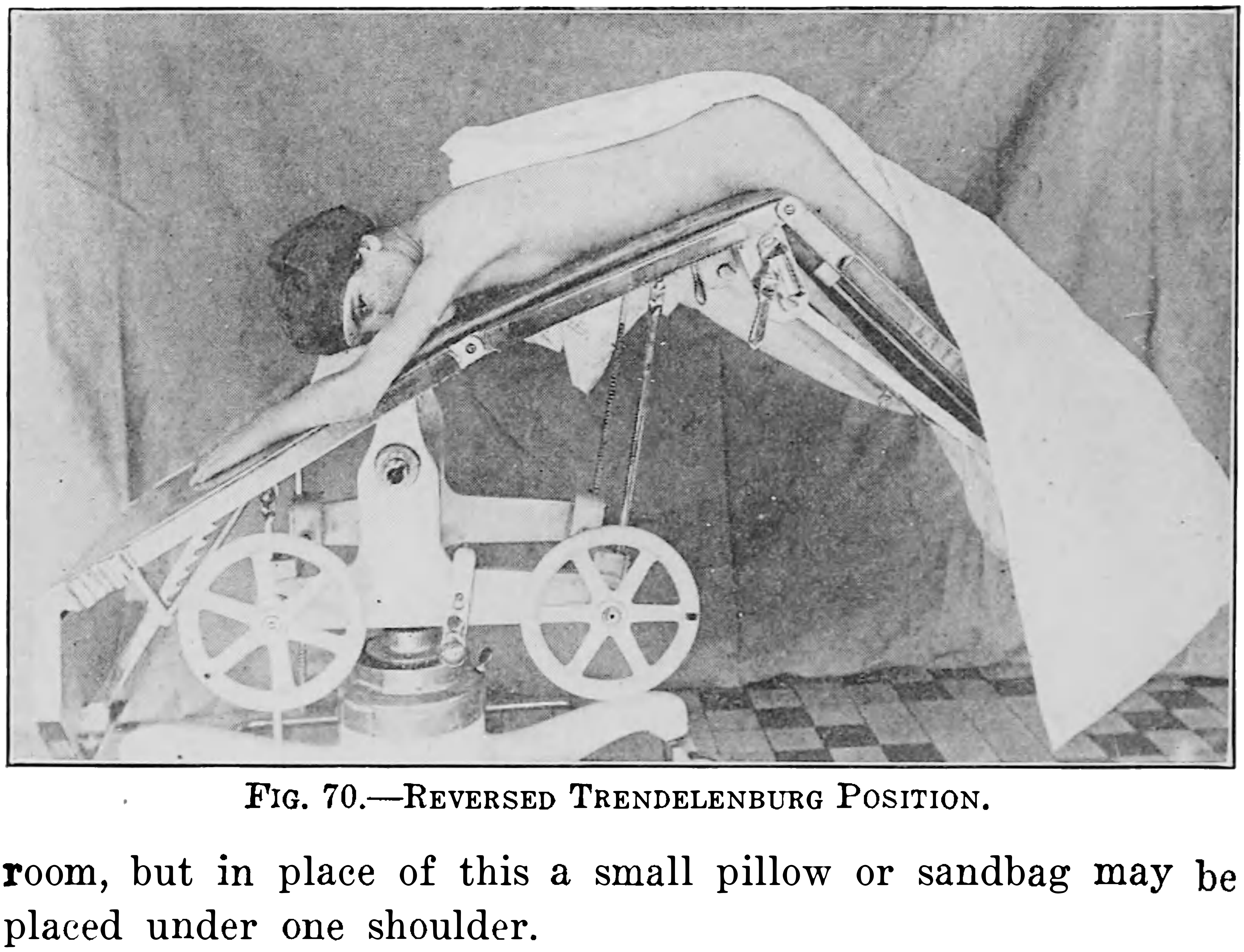


FIG. 70.—REVERSED TRENDELENBURG POSITION.

room, but in place of this a small pillow or sandbag may be placed under one shoulder.

This position will be *used for operations upon the spine* or other parts of the back.

The dorsal draping may be adapted to this position.

Latero-Prone Position.—This will be *used for operations upon the chest* (Fig. 69). The body is turned about half way between the lateral and the prone positions, and the chest and hips rest against sandbags, the lower arm lying at the back and the other upward toward the face.

The dorsal draping is adaptable to this position.

Reversed Trendelenburg.—In this position the patient is

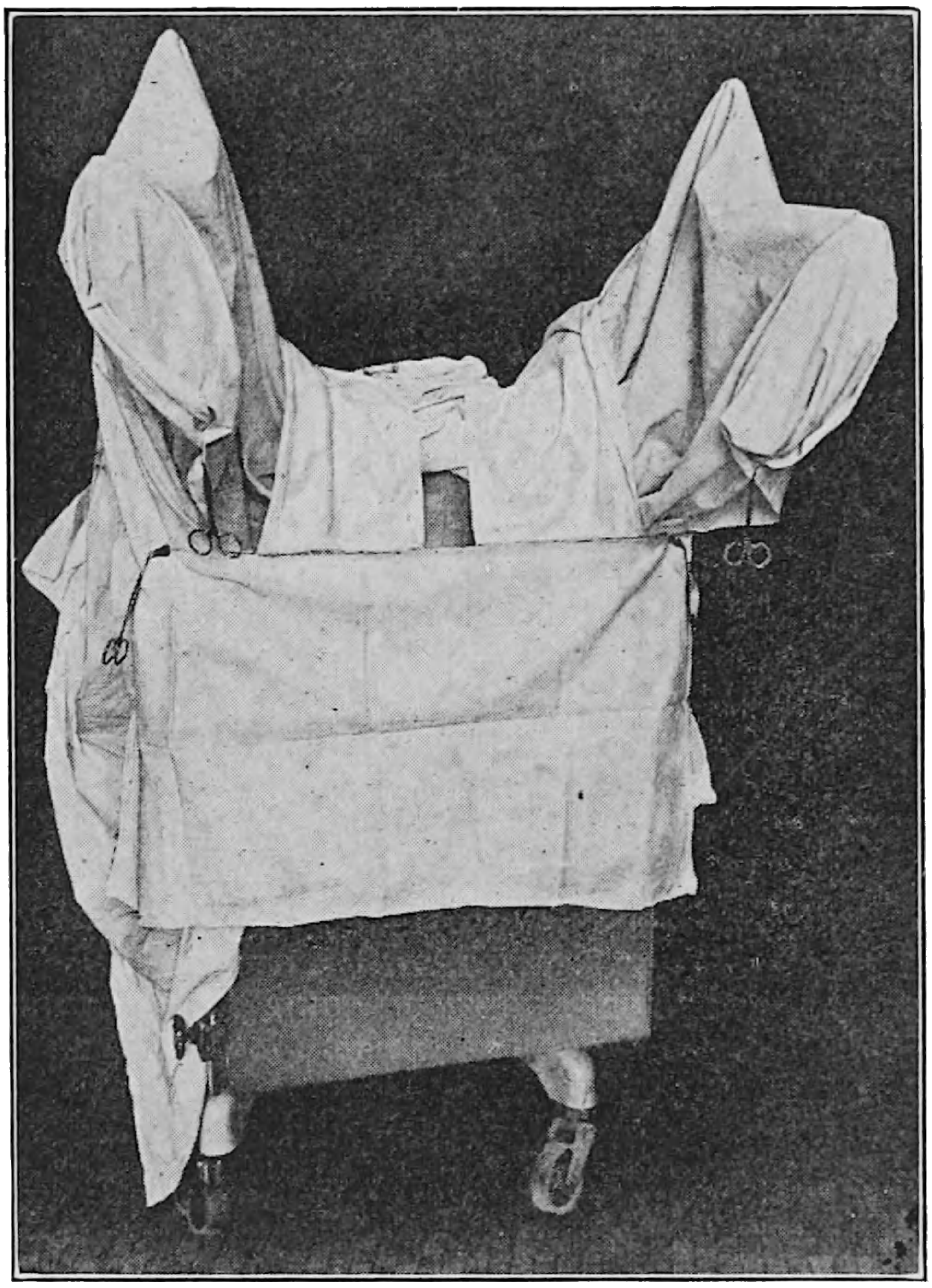


FIG. 73.—DRAPING WITH A SHEET AND TOWELS IN THE LITHOTOMY POSITION. The blunt towel clamp shown in Fig. 62 will be needed to keep the sheet in place at each heel and to bind the sheet and towels together about the stirrups.

placed upon the table face downward with the hip joints directly over the line at which the foot section of the table breaks, with the arms over the head. Screw the table upward as in the Trendelenburg position, allowing the foot to drop at the same time (Fig. 70). The patient will be so well balanced in this position as a rule that the shoulder guards will not be needed

This position will be *used for some operations upon the rectum.* The principles of *the dorsal draping* will apply here.

Sims Position.—This will be used occasionally for *examinations of the rectum.* There is no essential difference in the arrangement of the patient's body between this position and the

Fig. 74.—Draping with the Lithotomy Towel and Stockings for the Lithotomy Position. A blunt towel clamp will be needed at either edge of the towel near the top to keep it in place. If this towel is wet it will stay in place better.

latero-prone one, except that the patient will lie on the left side.

As *the draping* will rarely ever need to be sterile the way in which it is done is not important, but Fig. 71 will show how it may be done with one sheet.

Lithotomy Position.—For this position (Fig. 72) some kind of leg supports will be needed. Metal ones called stirrups (see illustration) will doubtless be supplied with your table, but if not, one of the devices which we describe in Chapter XXI, page 412, under improvised positions for operations in the home may be used. The stirrups are put into place, the foot of the table is dropped, the patient's feet being held meantime, the patient is drawn down so that the buttocks project slightly over the end of the table, and the legs are then fastened upward and backward so as to throw the knees well backward toward the abdomen. Sometimes a sandbag may be placed under the buttocks to adjust the position of the pelvic organs,

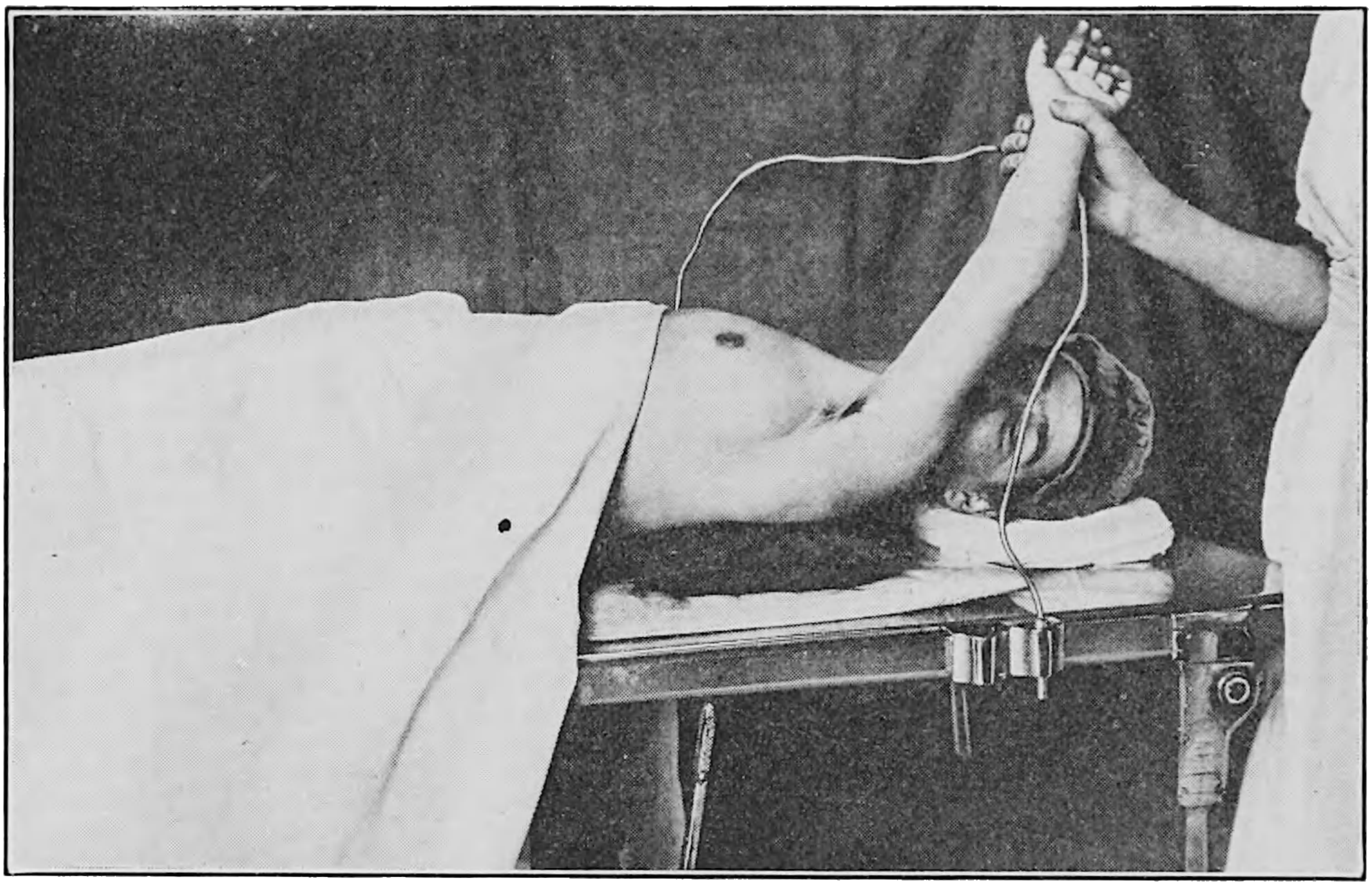


FIG. 75.—BREAST POSITION. A small sandbag will be necessary under the shoulder, if the axilla is involved, to throw the part away from the table. Note the wire arch, the Kocher guard, which extends across the table in the plane of the patient's shoulders. A draping sheet thrown across this isolates the anesthetist from the operative field. (See Fig. 77.)

or, for the same reason, the foot of the table may be slightly elevated as in the Trendelenburg position. A Kelly pad or a rubber sheet must always be used over the end of the table. In this position *the arms* will have to be arranged at the chest.

The lithotomy position will be *used for some gynecological, genitourinary and rectal operations.*

The draping may be done with a sheet and towels (Fig. 73), or, better, with the lithotomy stockings and towel (Fig. 74) described on page 231.

Breast Position.—For operations upon the breast the patient will lie upon her back. If the disease is malignant the axillary

glands will be removed as well as the breast, and in this case the arm on the affected side must be free. Usually a small pillow or sandbag will be placed under the shoulder on this side to throw the axilla well up from the table (Fig. 75). *The uninvolved arm* may be placed either at the side or on the chest.

For a simple breast operation *the dorsal draping* will apply. When the axilla is involved, however, the draping is more complex and may be done as follows: After the operative field has been sterilized the patient's head and shoulders are lifted, a

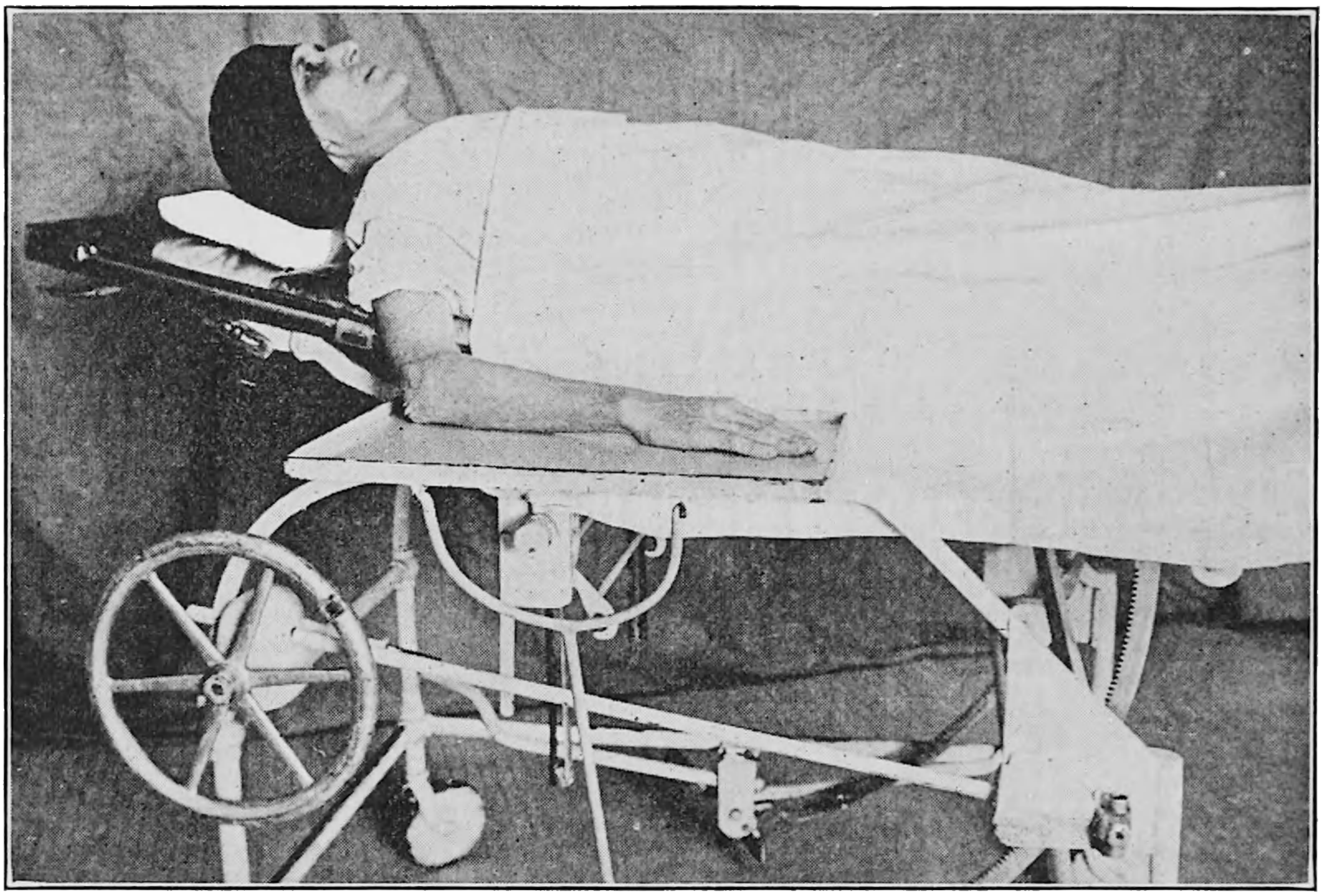


FIG. 78.—DETACHABLE ARM BOARD SUPPLIED WITH THE TABLE.

rubber sheet is spread under the shoulders and over the side of the table by an assistant, and a sterile sheet is then passed under the shoulders so that the table is well covered in the region of the axilla; the hand and forearm, which have been held by an unsterile assistant, are then covered with sterile towels, beginning at the hand with one which is folded once crosswise, making a nearly square cover which is allowed to fall in folds about the wrist, and continuing from the wrist to the operative field with towels folded lengthwise, bandage fashion (Fig. 76). Wet towels are better for this purpose as they stay in place better. The general principles of the dorsal draping may then be applied, the arm and the axilla being, of course, a part of the operative field (Fig. 77).

There is an attachment supplied with the more complete tables which will be very useful in the breast case—it is *the Kocher guard,* and it is simply a semicircular piece of soft metal which is fitted vertically across the table in about the plane of the patient's chin (see Figs. 75, 76 and 77), and serves the purpose of holding the upper sterile sheet well up between the operative field and the anesthetist. This is a very service-

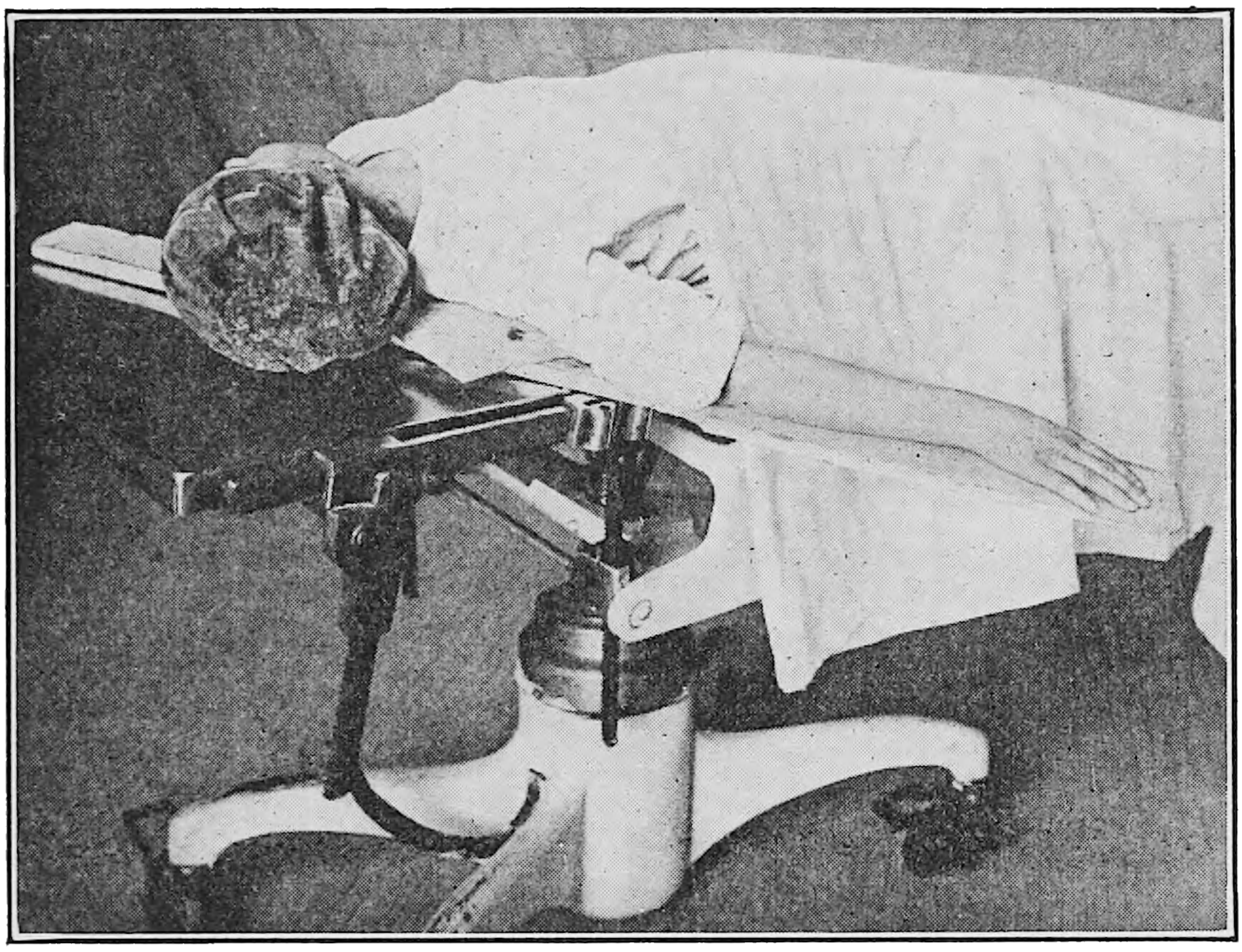


FIG. 79.—SIMPLE LONG, NARROW BOARD WHICH MAY BE FITTED TO ANY TABLE AS AN ARM BOARD.

able attachment, and if not supplied with the table may be very easily improvised. There are other devices designed to serve the same purpose but the Kocher guard is adaptable to a greater variety of positions as it is made of soft metal and can be bent into any desired shape (see adaptation of it for neck cases in Fig. 85, page 289).

Arm Position.—Many hand and arm operations can be done with the part simply laid upon the patient's body, but often a small table will be needed, an arm board which is supplied with some tables may be attached (Fig. 78), or a simple long, narrow board may be used as illustrated in Fig. 79.

The laparotomy sheet will serve well in some cases for *draping,* the arm being simply slipped through the opening and unsterile parts of the arm wrapped with towels as described for the breast case (Fig. 76), or two sheets may be arranged as for the leg (see Fig. 80), any uninvolved part of the arm or hand being wrapped with towels, as just described.

Leg Positions.—A great variety of positions will be employed from time to time for operations upon the various parts of the feet and legs, depending upon whether the anterior or the posterior aspect or both must be accessible. The simple

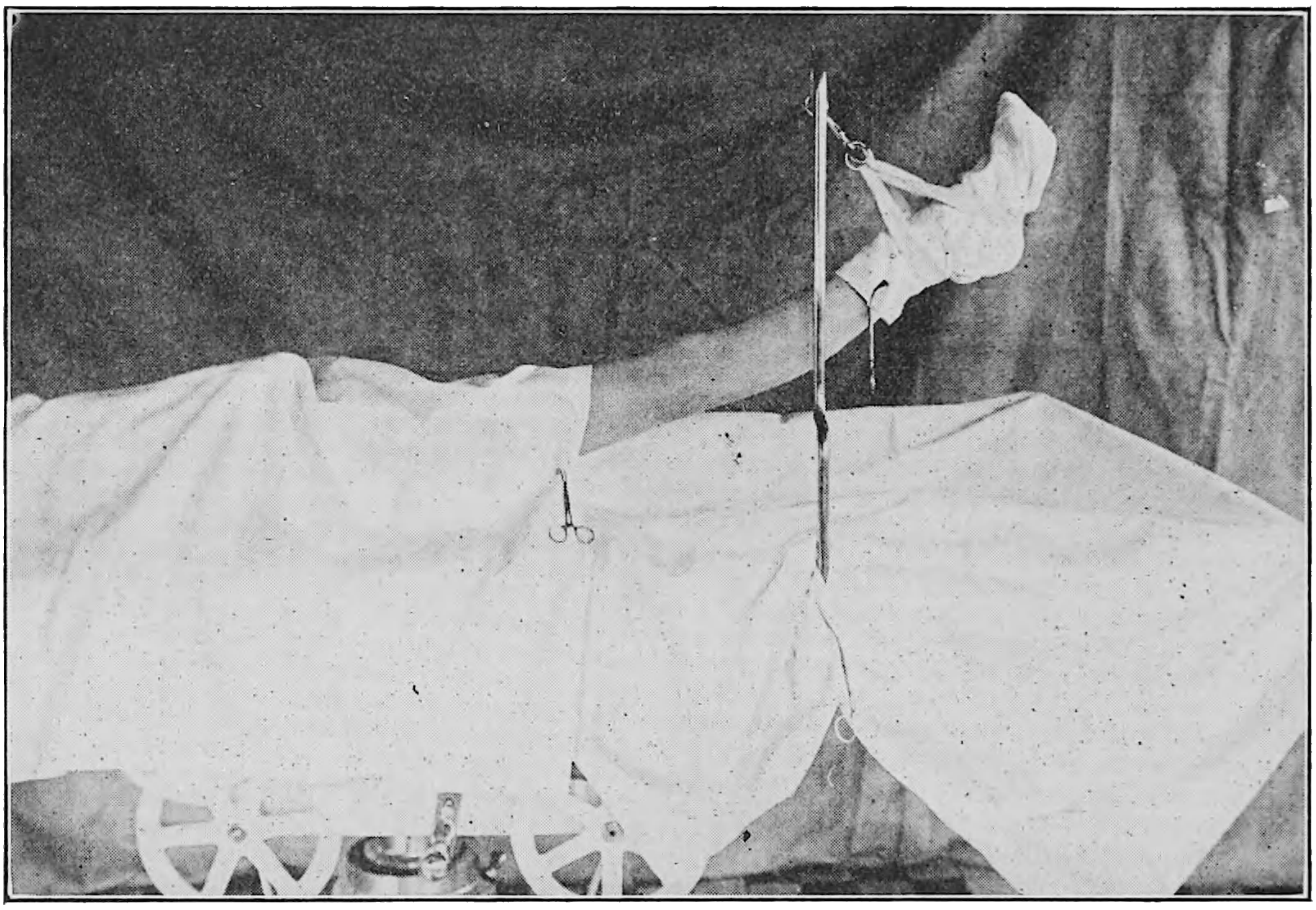


FIG. 80.—USE OF STIRRUPS FOR OPERATIONS UPON THE LEG.

dorsal position with a sandbag under the heel will answer for the anterior aspect of the leg and for the foot except when the heel is involved, in which case it may be necessary to turn the patient either upon his side or his face, and in this latter position, of course, the posterior aspects of the legs are also accessible.

Another plan which gives access to all parts of the feet and legs is to suspend them from the *table stirrups* which are used for the lithotomy position (Fig. 80). This position applies especially well in the case of operations for the removal of numerous and scattered varicose veins.

81). Extra towels may, of course, be placed upon the sheet underneath the parts if thought necessary for safety.

When the feet are not included in the operative field they must be well wrapped in towels after the fashion advised for the hand (Fig. 76), or, a very convenient plan is to use a heavy white cotton sock or stocking which can be securely clamped at the edge the same as the towel. Any uninvolved part of the leg should also be covered. When only one leg is involved

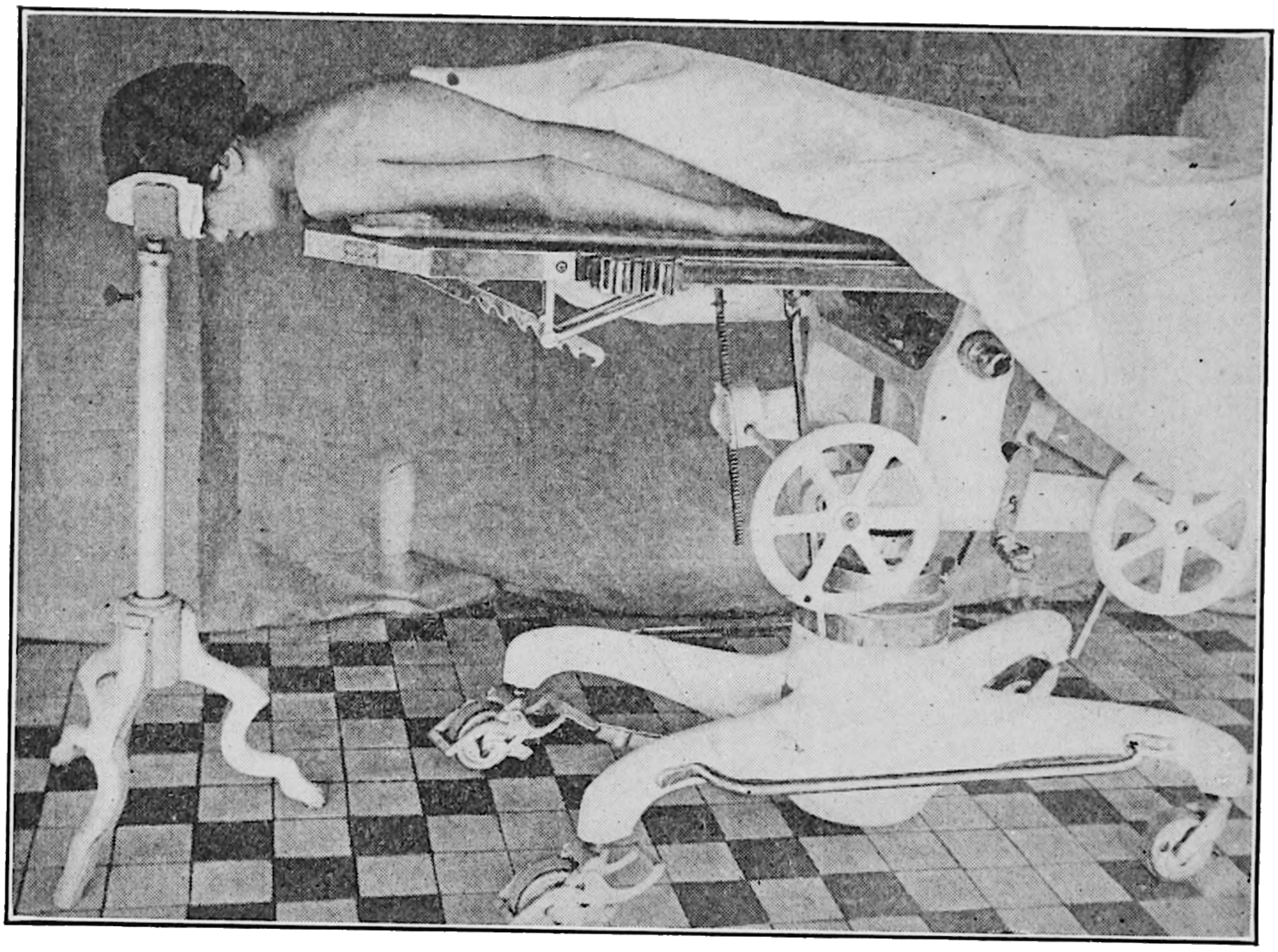


FIG. 83.—ARRANGEMENT OF PATIENT IN THE PRONE POSITION ON A SPECIAL HEAD REST FOR OPERATIONS UPON THE BACK OF THE HEAD OR NECK. Some such method is necessary when it is essential to the surgeon that the head be not turned as it would need to be were it lying upon the table.

the only variation will be that the other will simply be covered with the lower sheet.

When the stirrups are used they may be sterilized by boiling if a sterilizer large enough for them is available, and otherwise they may be wrapped in sterile towels.

Head Positions.—In practically all head cases a small sandbag will be needed under the head, because otherwise it will not be stable. This will simply be so adjusted as to make the operative field most accessible.

For the face and mouth (tonsils, etc.) and the front and top of the skull the patient's body will be in the dorsal position and the head turned as necessary.

For operations upon the face *the draping* will be done as follows: The patient's head and shoulders are held up and a sheet with a wet towel laid upon it is passed underneath so that the sheet will extend well up under the shoulders and the towel will come into position directly under the head which is

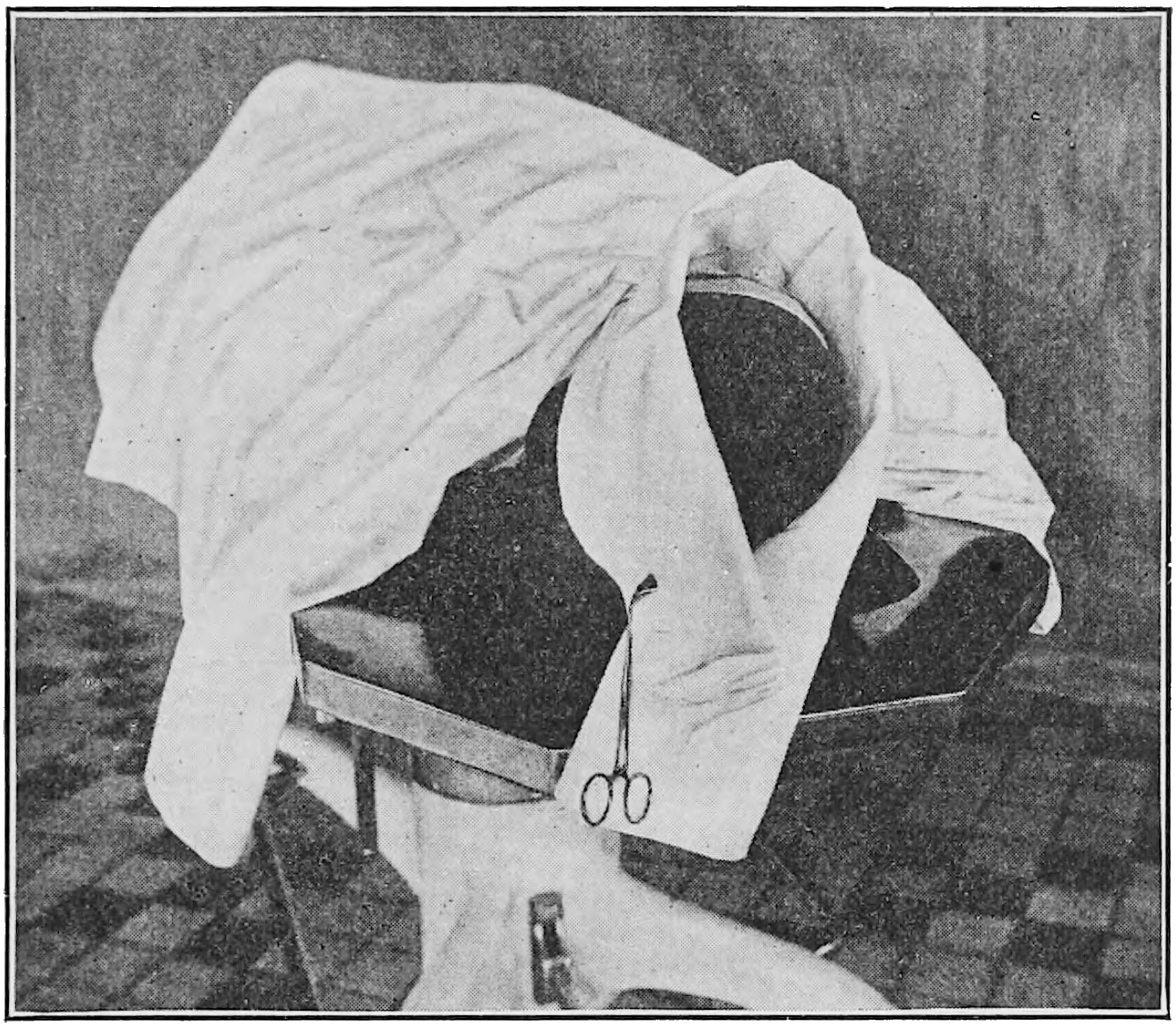


FIG. 84.—FOLDED TOWEL CLAMPED ABOUT THE FACE TO PROTECT THE OPERATIVE FIELD FROM THE INHALER IN FACE, NECK, OR SKULL OPERATIONS.

now laid upon the towel. This wet towel is then wrapped and clamped securely around the head and hair (Fig. 82), a sheet is thrown over the patient's body and clamped about the neck to the lower sheet.

In all operations about the head it is advisable that the anesthetist be supplied with a sterile ether mask, sterile gloves, and a sterile cover for his ether can, unless, of course, the vapor method of administering the anesthetic is used, in which case the unsterile apparatus may be carried out of the way by means of its rubber tubing.

For the back of the head the position just described may answer, the simple prone position may be used, or the patient may have to be placed in the prone position and some such device as is shown in Fig. 83 added for the convenience of the anesthetist. This last position, of course, involves the special equipment of the head rest, but a small table or some other article of furniture may be adapted.

For all head cases the arms should be arranged at the patient's side. This is a somewhat strained position for them when the prone position is used but they will be too much in the way over the head.

The draping for an operation upon the skull when the patient lies upon his back or in the simple prone position will be done thus: The usual sandbag and rubber sheet are first adjusted, the patient's head is held from the table and sterilized, a sterile sheet is passed well under it, and the head may then be laid upon this, after which the top sheet is applied and a folded towel clamped about the face as shown in Fig. 84 to isolate the anesthetist. When the special head rest is used one sheet thrown over the patient and clamped about the neck and the folded towel about the face will be about all the draping necessary.

One or two metal face guards are made specially for separating the operative field and the inhaler in such cases, but draping with them will be easy if one can do it as just described.

For nose and throat operations done under local anesthesia, with the patient sitting in a chair, a towel about the head and one sheet thrown about the patient and clamped together at the back of the neck will usually suffice.

Neck Positions.—The sandbag and the rubber sheet will always be used as for the head cases, but the head will usually be thrown further back, particularly when the operation is for goiter; and, of course, well to one side for cervical gland cases.

As in all operations about the head, the problem of isolating the anesthetist is an awkward one to solve, but where *the Kocher guard* is available it may be so bent and draped as to make a technically perfect arrangement and a reasonably convenient one for all concerned (Fig. 85). In this case, after the neck has been sterilized a sterile sheet is passed under it and the shoulders; another sheet is then thrown over the patient's body and

the edge passed about the neck and clamped at the back. A third sheet is then thrown over the Kocher guard and clamped about the neck also. This latter clamp is best adjusted by an unsterile person on the anesthetist's side of the guard. There are other designs of guard which are very suitable for this purpose of isolating the anesthetist, but it is not necessary to enumerate them, for if one can adjust the Kocher guard satisfactorily the others will not be puzzling.

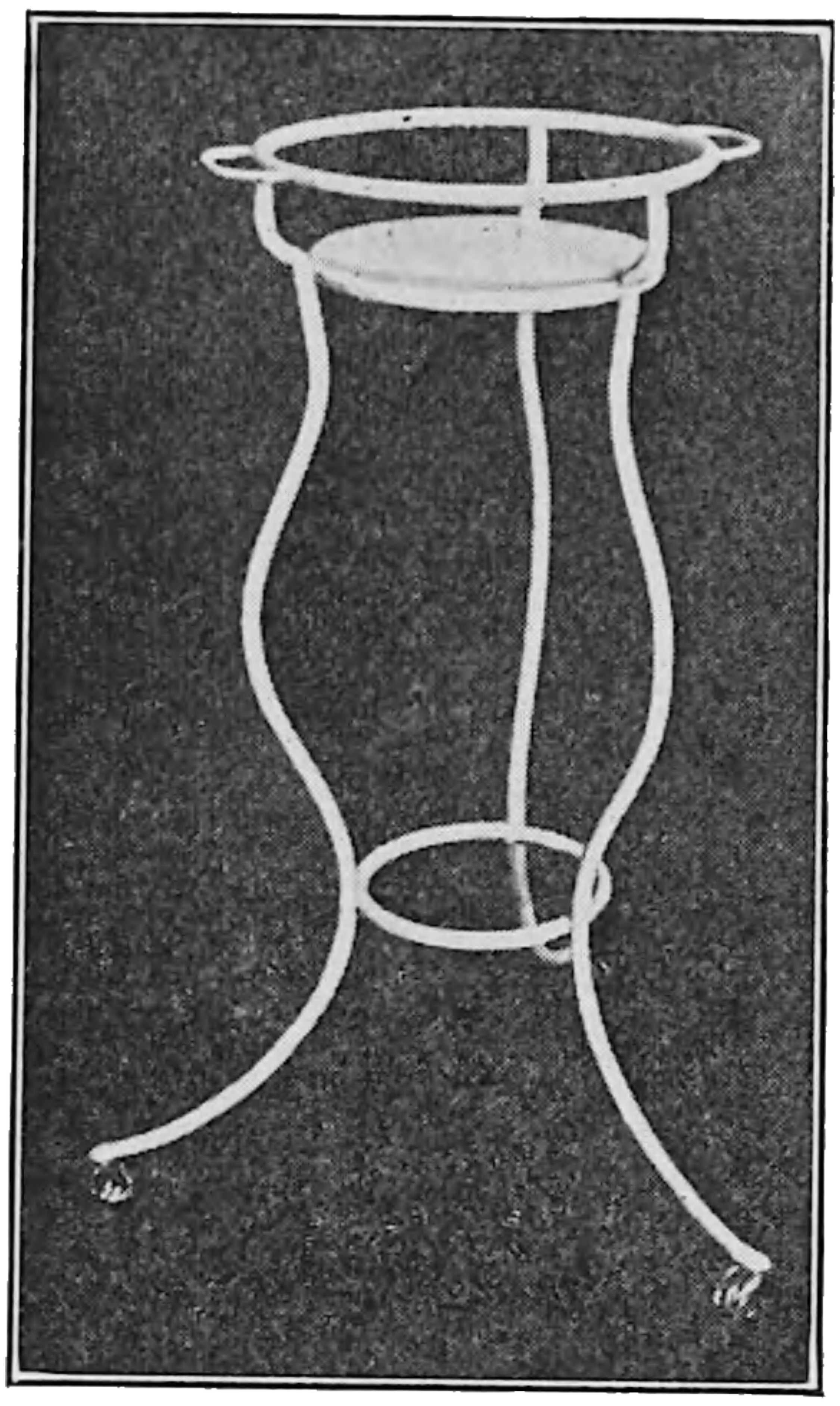


FIG. 86.—PORTABLE DRESSING STAND.

When a guard is not used the procedure should be in general as described for face cases, including careful isolation of the anesthetist.

When there is a separate anesthetizing room the preparation and draping are best done there and the table rolled into the operating room fully prepared for the surgeon. It will thus be seen that convenience will require that the sterile preparation and draping supplies be stationed in the anesthetizing room. With the drum system this will be easy, but otherwise it will be necessary to have a sterilly draped table for the purpose; or, if conditions do not make this possible or safe a small stand (Fig. 86), which is easily carried may be prepared for each individual case and carried into the preparation room each time.

THE OPERATION

It will not be possible to do more than barely outline the procedure of the nursing staff during an operation, because there are so many minor details which will differentiate almost every operation from every other.

In general, however, especially where a number of operations are done in immediate succession, there should be a recognized *head nurse* who will be responsible for the general management of the nurses' end of the work, and for the dispensation of the sterile supplies as needed. As the sterile supply drums or tables must serve for all the cases it is evident that no person but an absolutely sterile one can draw supplies from them, and this makes it obligatory that one nurse, preferably the head nurse, do nothing but *serve as the connecting link* between these supplies and those who use them. This means that she never touches anything that has been in contact with any case, because, of course, no matter how "clean" a given operation may be it is not considered clean in relation to any other, and this nurse must serve as the guardian of every patient's right to the benefit of every doubt. This may seem like overdoing the matter, and if every nurse on the staff were highly experienced perhaps it would be, but it must be remembered that the operating room, like the wards and every other nursing department of the hospital, is a training school, that inexperience is rampant, and that, therefore, *many sacrifices must be made to the cause of education,* and many otherwise unnecessary precautions taken against the dangers of inexperience.

We have already pointed out, but it needs repetition, that *handling of sterile supplies must be kept at the absolute minimum;* and furthermore, nothing that can be handled with forceps should be touched with the gloves, for the very good reason that an instrument can be made sterile and kept so with much greater certainty than a pair of gloves on the two hands of any given, and very busy, human being.

The number of assistant sterile nurses will be determined by circumstances, but as a rule, in large institutions especially, one or two others may be present to help about the wound in the way of holding retractors, etc. An unsterile nurse to do errands will be useful; and this is logically the lesson with which a beginner should be initiated into the mysteries of the operating room in action.

One or more orderlies will be necessary about an operating room to do the heavy lifting and other heavy work which nurses cannot do. Other duties for orderlies will vary with local conditions.

Management between operations should be well thought out, and the ease and despatch with which the work of this period is done will depend almost entirely upon the number of assistants. It may not be possible for the head nurse to remain sterile at this time because it is likely that her staff will be divided between the patient just finished and the one to follow and she will, therefore, need to do some of the unsterile work between operations.

Too much haste must be avoided during the period of resterilization between operations, and special precautions must be taken, of course, after an infected case. Everything that has been used or subjected to contamination in any way must be *reboiled or discarded,* all soiled linen removed, the floor basins emptied, and the floor mopped. Where possible the patient should have been taken to another room (the recovery room), or at least a distant corner of the operating room, before blankets are applied or other preparations made for the transference of the patient to his bed, as a great deal of dust may be raised in this process and other unsterile things scattered about. Gown, or apron, and gloves are of course changed, and before the fresh ones are put on the hands should be rinsed in the bichloride or other solution again, because it is rarely possible that one has avoided contact with the soiled gloves or gown in the act of their removal.

Attention should be called here to an item which is often overlooked, namely, that if *the operating table* has been subjected to contamination in an operation it must not be used again till it has been thoroughly cleansed. In cases of known infection it may be protected in advance by putting rubber sheets in strategic places, but contaminating drainage cannot always be foreseen, and the operating table, because of its many corners and crevices, may become through such cases a very active carrier of infection.

AFTER THE OPERATION

It will be the practice to operate upon the patients of any given group in such order that the cleanest one is done first and the least clean one last, and so, at the end of a session the operating room will be in more need of resterilization than at

pearance, it materially shortens the span of life of the nickel plating. Delicately-jointed instruments should be oiled immediately, and all should be provided with a dry storage place.

The gloves are well scrubbed on both sides with soap and warm water, hot water being precluded for the same reason as for the instruments. It is even more important that blood should be thoroughly removed from gloves as the sterilization will render absolutely irremovable any that may have been left upon them. Before further handling they should then be boiled for about 5 minutes, not being put into the water, of course, till it has reached the boiling point; and then they are dried and tested for holes. The test for defects is an important one, and a great deal of practice will be necessary to learn to do it without oversights. It must be remembered that the smallest pinhole may allow the passage of infection to the wound from the hand, and that all tests must be made with these in mind. A good method is to hold the cuff open, the fingers of the glove being downward, in which position they will be well inflated with air; then quickly grasp the edges of the cuff together, confining the air which, under a little pressure, can be felt by the cheek, for instance, escaping from the smallest perforation. If the glove is in good condition generally, the holes should be patched, as nurses and junior staff assistants can wear patched gloves without inconvenience. Too great economy must not be exercised, however, in the salvaging of torn gloves because when a glove becomes so old and lifeless that it tears easily it is a menace and should be thrown away. Cuffs and other strong parts of badly torn gloves can be utilized for the patches which should not be cut any larger than is necessary to make a durable repair.

Patching is something of an art, too, but if done skillfully a patch will usually outlast the remainder of the glove. It is done thus: Turn the glove wrong side out—this is important because the wrong side of the rubber is usually rougher than the right side and the cement will therefore adhere better; locate the hole accurately; cut a patch to fit; sponge both the patch and the region of the hole rather vigorously with benzine —this will cleanse the surfaces and at the same time somewhat roughen them; apply a thin coat of rubber cement to the patch, quickly put the patch into place, and press firmly for a few moments until the cement has dried well. Note that the cement is better applied to the patch than to the glove, because it will not be possible to estimate the exact space required on the glove. A light sponging with benzine over the region will complete the process neatly. Do not sterilize these gloves until the cement has had several hours in which to dry completely.

All unused sterile supplies which have been opened must be resterilized, including all drums. This may seem like another case of overprecaution, when little has been used from a parcel, but if this were not made the rule such a parcel might remain in reserve too long; for it ought to be the practice to resterilize all supplies at least as often as once a week. For this reason it is not good technic to keep more than one week's stock sterilized ahead, and some system ought to be in operation whereby the parcel longest in reserve should always be used first. In a large establishment where it is hard to follow every detail regularly, it is wise to mark each parcel with the date of sterilization so that too old ones may be detected.

All the miscellaneous utensils used must, of course, be resterilized before they are stored away.

CONCLUDING SUGGESTIONS

Aim to have only *standard equipment,* and no more of that than you use.

Try to keep your methods and your entire *system as simple as possible.* The natural tendency of operating room technic is to become complex and involved and constant good management is required to prevent nonessentials from superseding and supplanting essentials.

Do not overstock in *sterile supplies,* and keep what you have in circulation.

If your operating room is a training ground for pupil nurses do not forget *the educational phase* of the work in the press of routine requirements. The two can prosper hand in hand but all concerned must recognize them both and someone must study the system and guide it wisely.

CHAPTER XVII

INSTRUMENT PASSING

As a rule there will not be time enough during the routine course of training in the operating room for the nurse to gain an intimate knowledge of the uses of instruments and suture materials, but as she will very often be called upon after graduation to assume the responsibility for providing the proper ones and for officiating at the operating table as "instrument passer," we shall record here a few principles which should guide her in this duty, and as many details as it will seem worth while for her to learn in the abstract.

The subject is a very difficult one to present on paper in any other than a general way because in practice there will repeatedly arise, through preferences of surgeons and the diversities and irregularities of cases, variations in detail of both instruments and technic which cannot possibly be foreseen. Moreover, we have not the space here to cover, even in a general way, every one of the hundreds of operations that may be performed upon the human body; but we advise every prospective instrument passer who wishes to work intelligently and resourcefully to *secure access to one of the good books which surgeons have written on operative surgery* and familiarize herself with the probabilities, at least, in any given case, and thus endeavor to make of herself an intelligent and co-operative assistant rather than a mere mechanical adjunct which she will otherwise be, at least until she has had the opportunities of a long period of observation.

However, though by actual count the number of recognized surgical operations would run well up into the hundreds, the instrument nurse will find in her study of them that, after all, from her standpoint they differ in relatively few important respects. Her chief problem, therefore, will be to *master her*

Silk thread, horsehair, or skin "clips" and the special forceps for applying them

Everything being sterile and conveniently placed, you may now *arrange the instrument stand* (Fig. 24, page 199) in some such orderly way as that suggested in Fig. 87, laying aside the pair of straight scissors and one pair of the plain anatomical forceps for your own use in handling the sutures.

Next it will be wise to *make a "suture book"* from a towel folded as shown for the needle book in Fig. 54, page 253, namely, by these steps: (1) Lengthwise, bringing each edge to the middle; (2) Crosswise, bringing each end to the middle; (3) Crosswise, through the middle again, bringing the ends together; (4) Crosswise, through the middle again. This will give you, as shown in the illustration, a compact, book-like arrangement of the towel in which you have two separate compartments in which to store your sutures and needles conveniently. This is, of course, not a necessity but one of those conveniences which will never be discarded when once tested out, for if one assigns a place to each kind of suture material a great deal of time and trouble will be saved in finding what one wants when pressed for time.

Now, *arrange in this book the suture material* and accompanying needles. You will probably first be asked for a ligature for the vessels about the base of the appendix. This will be the No. 1 or 2 plain catgut in the aneurism needle, or one of the heavy round needles in the needle holder, and you may need several of them. Next will be the linen suture, the "purse string," for the appendix, on a straight intestinal needle. The next will be the second purse string—the No. 0 plain or chromic catgut, also on a straight intestinal needle. Next will probably be the ligatures, which should be of No. 1 plain catgut—these you can lay out straight within one of the folds of the suture book with the ends projecting so that you can easily grasp them. Then you will probably be asked for the sutures for closing the wound, which will come in the following order: No. 1 plain catgut on either a surgeon's needle, or the heavier curved round one, for the peritoneum; No. 2 plain catgut for

Fig. 87.—Diagram of the Arrangement of the Instrument Stand when the Type Shown in Fig. 24, Page 199, Is Used.

the muscle; the same, or the No. 2 chromic for the fascia; next you may need the No. 2 plain catgut for the fat layer, or perhaps some fine silkworm gut on a larger sharp needle for the fat and skin layers together; then will follow the skin suture —the silk or horsehair—on a sharp straight needle, or perhaps the skin clips. The suture material is now in convenient order and you are ready for the operation to begin.

The first instrument used will be the knife, which you will have within easy reach, as you will also have the forceps, scissors, clamps, etc., which will be used next. You will *watch all steps* of the operation closely, replacing artery clamps on the stand as they are used, and endeavoring to *keep one step ahead* of the surgeon in your preparation. When the appendix has been drawn up into the wound you will have the aneurism needle, or the heavy round needle threaded with the mesoappendix ligature ready to hand to the surgeon, and keep yourself in readiness to hand him another until this part of the operation is finished. Then will come the linen purse string on the straight and fine round needle. At this point you will probably be asked for the "crushing" clamp. The appendix will then be cut away and the stump sterilized, probably with the cautery. Then the fine-pointed pair of thumb forceps will be used for inverting the appendix stump.

At this point the instrument nurse must learn *a special lesson in technic:* The appendix stump exposes the interior of the intestine which, of course, is not sterile, and although it has been cauterized, the crushing forceps, the inversion forceps, and the knife or scissors which were used for cutting it away are not considered clean, and it is the instrument nurse's duty to see that these instruments are discarded—a small basin or a folded towel may be used to receive both these and the appendix and immediately handed to an unsterile attendant. This lesson should be well learned and the technic of carrying it out well planned because it will apply in most operations where a part is removed, and in others where an unclean step intervenes.

After the appendix stump has been inverted the second purse

you provided for the appendix operation will be assumed for all others, and that the sets mentioned under the following individual headings will merely be *additions.* *The suture material supply,* on the other hand, was perhaps as complex and elaborate as it will be in any other case, and much more so than in most of them. *Ligatures,* however, apply universally, and they will be assumed in addition to the suture material we shall mention.

It will also be taken for granted that the nurse is familiar with *the special designs of instruments* suitable for different structures and parts of the body and will know the difference, for instance, between the "bone-cutting forceps" meant in the list for skull operations and the one meant for operations upon the extremities. The easiest road to this specific knowledge will be a few hours devoted to the study of some complete illustrated instrument catalog. This may seem like learning the English language by studying the International Dictionary, but a trial of the suggestion will prove its worth.

REPRESENTATIVE OPERATIONS

We shall aim to discuss one or more operations from *each anatomical group,* and as we shall select the more complex ones the nurse will have no difficulty in deducting from them whatever help she may need for the other simpler ones of the group which we do not mention.

In Chapters IV to XI operations have been presented in essential details and in the same anatomical order which will be followed here, and since many special instruments have been pointed out there the student should study the corresponding subject in those chapters at the same time that she takes them up here.

Intestines.—For operations upon the intestines these special instruments should be provided: 2 pairs of intestinal clamps with rubber tubing covers for the blades (A and B or C of Fig. 88), large abdominal retractors, 6 pairs of fine tenacula (Allis's, for example), 1 or 2 extra pairs of scissors and thumb forceps, and sometimes a Murphy button.

The suture material will usually be linen thread or the Pagenstecher, and No. 00 or 0 chromic catgut; and the needle will be the fine, straight, round intestinal one usually, though occasionally a curved one will be called for instead.

When the interior of the intestine is exposed during the operation the instrument nurse must apply *the special technic* described in the case of the removal of the appendix (page 300).

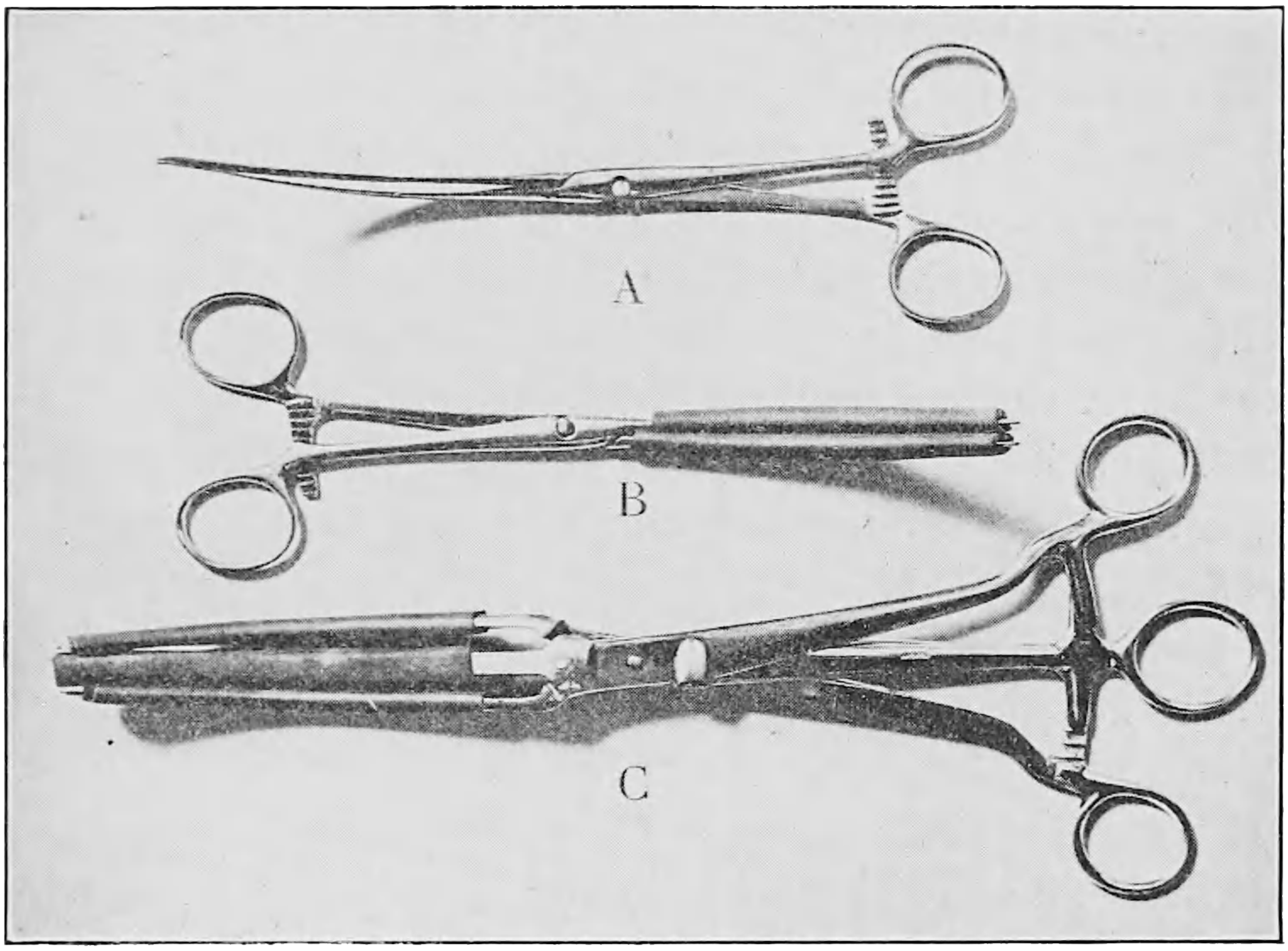


FIG. 88.—INTESTINAL AND STOMACH CLAMPS. *A*, plain, flexible intestinal clamp; *B*, the same clamp with the rubber tubing covers which must always be used and which should be slightly smaller in diameter than the clamp so that they will fit snugly; *C*, larger double intestinal or stomach clamp with the rubber tubes in place.

As in the case of the appendix, a special towel or basin should be provided for the reception of all the instruments used during the unclean stage of the operation, and the instrument passer can then manage to avoid contaminating either her own gloves or her instrument table—the special forceps and scissors advised above were for use at this stage so as to avoid the trouble of resterilization for the remainder of the operation.

When the Murphy button is used the two sections should be screwed apart and each clamped in an artery clamp for convenience in handling. Purse strings of heavy linen or silk thread on an intestinal needle will be used for fastening them in place.

The closure of the abdominal wall will correspond to that of the appendix wound.

Hernia.—There are no *special instruments* required for any of the operations for the repair of a hernia, except in those cases which involve strangulation of the intestine. Then, of course, you will need to provide for an operation upon the intestines as described above.

The sutures for hernia repair will be in general as follows: No. 1 or 2 plain catgut on the heavier round needle for the "sac"; No. 2 chromic catgut, kangaroo tendon, or sometimes silkworm gut on the same needle for the muscle; the chromic or No. 2 plain catgut for the fascia; and for the fat and skin the same as for the appendix case.

Gall Bladder.—The two more *common operations* involving the gall bladder are the excision of the part and the removal of stones from it. The instrument passer should always provide for both, and the only *special instruments* will be: gallstone forceps, gallstone scoops, bile duct probe, and perhaps a small trocar with rubber tube attached.

If the gall bladder is removed *a strong ligature* of No. 2 plain or chromic catgut on the heavier round needle should be prepared. When it is not removed you may need to supply a medium-sized rubber *drainage tube,* an ordinary rubber catheter sometimes being used; and for closing the gall bladder around this you may need a No. 1 chromic suture on a small round needle.

There may sometimes be *an anastomosis* performed between the intestine and the gall bladder or gall duct. In this case the preparation described for intestinal operations will apply in general.

There will probably be no new feature about *the closure* of the wound.

Tonsils and Adenoids.—For the removal of tonsils there are many methods, but you will always provide a mouth gag, a tongue depressor, a tonsil-seizing forceps, an eneucleator or dissector, a tonsil punch, a pair of long scissors, and either a snare or one of the many designs of tonsillotomes.

the deeper structures, and horsehair or silk for the skin will be the likely *suture material.*

Spleen.—Operations upon the spleen will be infrequent. *For removal of the organ* your chief concern will be to provide plenty of large hemostatic forceps and strong ligatures. *Suturing of the spleen* will probably be done with plain catgut on a round needle.

Thyroid Gland.—*For the removal of the gland* the special thyroid grasping forceps or a suitable tenaculum will be the only special preparation, aside from plenty of artery clamps and ligatures. Plain catgut No. 1 or 2 for the deeper structures and horsehair or silk for the skin will be the likely *suture material.*

Tendons.—Your only special concern will be in cases of *suture of the tendon,* when you will probably need chromic catgut or silk sutures on a round needle.

Brain.—Naturally, *the special instruments* needed for reaching the brain will belong to the "bone instrument" group, and they will be these:

Periosteal elevator	Bone-cutting forceps
Bone drill, or trephine	Bone-gouging forceps
Chisels	Bone curettes
Gouges	Small sharp retractors (toothed)
Mallet	Special brain retractors

When the dura is to be sutured fine catgut on a small round needle will probably be used. The scalp will usually be closed with silkworm gut on a surgeon's needle.

Nerves.—*For the suture of nerves* fine chromic catgut or silk should be provided on a fine round needle.

Spine.—For operations upon the spine, which will be assumed to include the spinal cord, you should provide the special bone-cutting forceps designed for the purpose, and in addition to that, chisels, gouges, mallet, periosteal elevator, exsection saw, and a small blunt hook.

For closing the wound you will need fine catgut on a round needle for the dura, No. 2 plain catgut for the deep structures, and perhaps silkworm gut for the skin.

Bones.—For all bone work, such as the open repair of fractures, the removal of the whole or parts of bones, etc., you should be equipped with *general bone instruments* as follows:

Periosteal elevators	Bone curettes
Chisels	Bone-holding forceps (sequestrum forceps)
Gouges	Saws (Gigli's, and other suitable ones)
Mallet	Bone drill
Bone-cutting forceps	
Bone-gouging forceps	

In the case of fracture the silver or aluminum-bronze wire may be used for *suturing the bone fragments;* sometimes, as in the case of the patella, chromic catgut may be needed; or, you may need to provide bone plates, such as the "Lane" plates (Fig. 14, page 101), and then you will also need screws, screw driver, and screw-holding forceps.

When the "Lane" plating is done you may be expected to carry out the special *Lane technic* for the operation, which means a method by which the hands are never put into the wound, everything being done with instruments, and all supplies handled entirely with forceps. Considerable practice will be necessary before one can carry out this technic well and without great fatigue from the close application it will require. Its principle is so excellent, however, that you will do well to acquire the habit of applying it as far as you can in all your instrument and suture work, and with practice you will find that many of the things you usually fumbled with your fingers—needles, for example—can be handled much more easily and quickly with forceps.

For the closure of fracture wounds No. 2 plain catgut and silkworm gut will be your likely suture material.

Reproductive Organs.—For the various operations upon the pelvic organs through an *abdominal incision* you should provide these special instruments: Deep abdominal retractors, 2 large aneurism needles, plenty of large hemostatic (hysterectomy) forceps, sponge forceps, one or two tenacula or "elevating" forceps.

In the case of hysterectomy you will need ligatures of No. 3 or 4 plain catgut on the aneurism needle, or on the heavy round needle in the needle holder. These ligatures should be long—the full suture length—as it will not be convenient to tie shorter ones in the depths of the pelvic cavity. After the uterus is removed you will need the No. 3 or 4 plain catgut and sometimes also the No. 2 on a heavy sharp needle for sewing over the stump.

Salpingectomy and oöphorectomy will require no further preparation.

In the case of removal of a large ovarian cyst you should provide a large trocar with a long rubber tube attached.

For suspension of the uterus there are a number of possibilities in the way of sutures, but you will probably guess well if you provide plenty of No. 2 chromic catgut on a medium-sized surgeon's needle.

Occasionally some of these operations may be done through a *vaginal incision* instead of the abdominal one. This will not modify your preparation materially except that you will need vaginal retractors instead of abdominal ones.

For a curettage these instruments will be needed: Vaginal speculum, tenaculum, cervical dilator, several sizes of uterine curettes, uterine sound, uterine dressing forceps, and an intra-uterine irrigating tip.

For operations upon the cervix the special instruments will be a vaginal speculum and a tenaculum. The sutures will probably be No. 2 chromic catgut or silkworm gut on a heavy sharp needle.

This same preparation will apply for the several *plastic operations* that may be done upon the vaginal wall.

For suturing the perineum you will probably need No. 2 plain or chromic catgut on a medium-sized round needle, and silk-worm gut on a heavy surgeon's needle.

Breast.—For the removal of the breast the instrument passer's chief concern will be to provide plenty of artery forceps and ligatures. The sutures will usually include No. 2 plain catgut on a surgeon's needle for the deeper parts, and silkworm gut on a large surgeon's needle for the skin, and sometimes silk or horsehair also.

forceps, and an amputation retractor. *Ligatures* will, of course, correspond in weight to the size of the stump. *Sutures* will probably be of No. 2 plain catgut and silkworm gut.

DRAINS

We have said nothing as we have gone along about *the preparation of drains* because the question of where they will be used, and what kind, if any at all, will depend entirely upon circumstances. However, as it will be the instrument passer's duty, as a rule, to provide and fashion the drain we shall append a few comments here about the various kinds. (Fig. 89.) A special drainage tube for empyema cases has been illustrated in Fig. 17, page 127, and the student will find information about it there.

A. **Cigarette Drain.**—For this a piece of rubber dam or rubber tissue of suitable size will be used, and within it will be rolled, lengthwise, cigarette fashion, a piece of gauze of a size to fit the wound, the ends of the gauze being allowed to project slightly beyond the rubber (A of Fig. 89).

B. **Mikulicz Drain.**—A square piece of gauze or rubber dam large enough to line the entire wound is folded as indicated in B^1 of Fig. 89—that is, diagonally several times. With a pair of sharp, curved scissors small notches are cut in this folded piece of material as shown in B^2 of the illustration. For insertion the drain will be unfolded, and after it has been perforated it should appear as shown in B^3 of the illustration. When this is in place in the wound it will be packed full of gauze packing.

C. **Rubber Tissue and Rubber Dam.**—Pieces of either of these materials may be folded flat or rolled into tubes of suitable size (C of Fig. 89).

D. **Rubber Tubing.**—Pieces of rubber tubing may be fashioned in various ways (D of Fig. 89). The gauze packing may or may not be used in these drains. The large drain of group D has the rubber tube inside of the gauze, and the whole is encased within a few layers of rubber dam.

E. **Horsehair and Silkworm Gut.**—A strand may be rolled into a suitable shape for small wounds (E of Fig. 89).

F. **Rubber Bands.**—For small drains an ordinary rubber band, either whole or in part, may be used (F of Fig. 89).

G. **Gauze Packing.**—This will need no special preparation.

A safety pin should accompany every drain, either to pin it

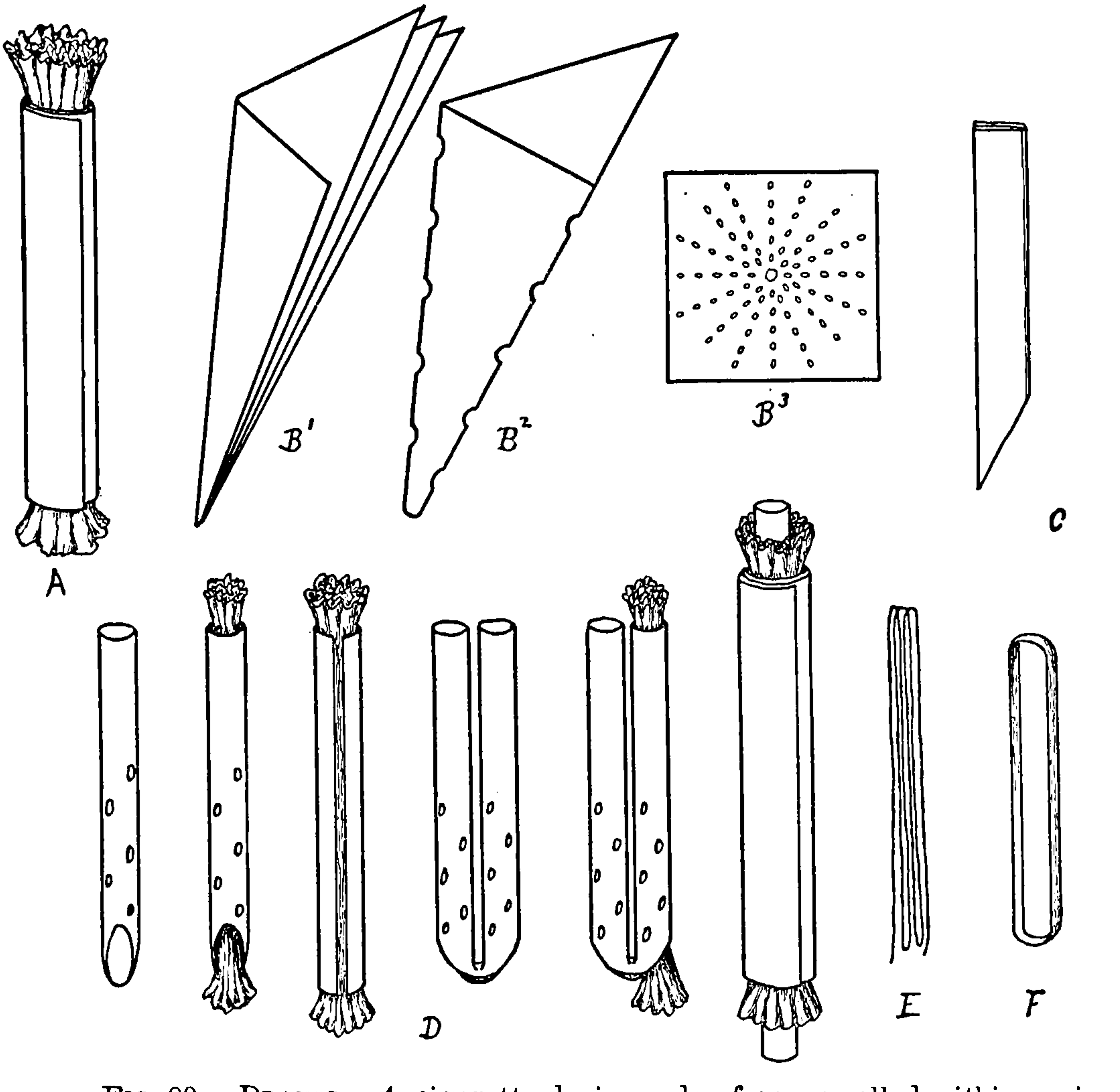


FIG. 89.—DRAINS. *A,* cigarette drain made of gauze rolled within a piece of rubber tissue or rubber dam; *B^1, B^2, B^3,* three stages in the evolution of the Mikulicz drain which is made from a piece of gauze or rubber dam; *C,* rubber tissue or rubber dam drains made by folding the piece flat or by rolling it into a tube; *D,* various designs of rubber tubing drains; *E,* horse-hair or silkworm gut drain; *F,* ordinary rubber band.

fast to the dressing or to serve as a guard against its slipping into the wound and becoming lost.

A pair of dressing forceps is, of course, always among the general instruments, and this should always be in readiness for the insertion of the drain.

As we have warned all the way along, what we have given here is only the probable and the possible. It will now be the instrument passer's duty to learn the special methods of her surgeon and to familiarize herself as widely as possible with surgical procedures, and then she will be equipped to supplement knowledge with the good guessing which every instrument passer should always know how to practice.

separately and which have dust-tight covers. The best technic, however, is to *use the supplies directly from the container in which they were sterilized* provided it can be safely opened and closed repeatedly. This will save much time and work and, of course, is better technic in that it eliminates the exposure incident to the transferral from one container to the other.

There is a special *metal dressing box or drum* (Fig. 90) which is ideal both as to convenience and as to safety. It is made with a catch which serves to prop the lid open during sterilization and to close it securely afterward. A simple mechanism on the top of this box answers the double purpose of a handle for carrying it and of a lever for opening the lid easily and safely. This constitutes a very compact and thoroughly satisfactory container in which can be stored all the gauze and cotton supplies, including the draping towels, and when it can be procured it should be used in preference to any other device.

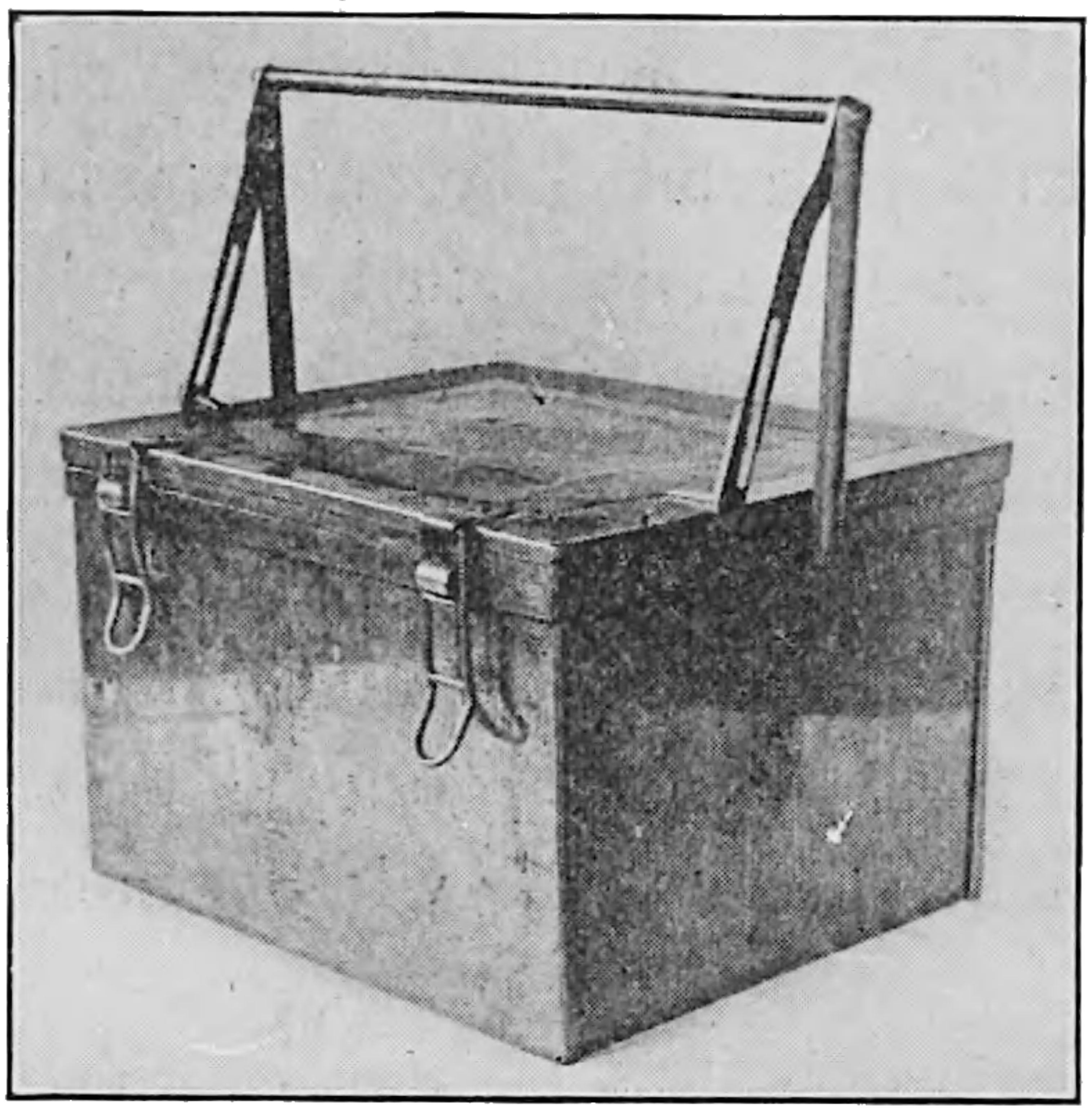


FIG. 90. — PORTABLE METAL DRESSING BOX. The bar across the top serves as a handle for carrying and also as a lever for opening the lid, and it is so attached that it may be turned down over the side of the box out of the way.

While this dressing box is very safe and can be kept cleaner than any other container, it must be remembered that *no container which is opened and closed frequently can be considered sterile indefinitely.* When a number of dressings are to be done at a time, those believed to be "clean" should, of course, be done first and the infected ones last; and the dressing box thus frequently exposed during a considerable period of time would not be safe to use further until resterilized. The plan advised for the operating room dressing supplies in Chapter XVI, page 295, will apply here also, especially where inexperienced nurses are concerned; that is, do not hold over from one session to another a used dressing box, even though you are reasonably certain of its sterility.

The dressing instruments will, of course, be boiled freshly for each dressing. The practice, sometimes seen, of boiling them in advance, drying them with a sterile towel, and wrapping them in a sterile muslin cover for the next day's use, is one that should not be adopted except in those instances where one has not easy and prompt access to a boiler. As in the case of the operating room, it is well to have the instrument boiler near at hand when doing dressings, especially when several are to be done in close succession. There are many *portable electric instrument sterilizers* on the market (Fig. 91), and if one of these can be procured and the suitable connection for it provided near the patient it makes an admirable dressing equipment. Most of these sterilizers have an attachment which automatically dis-

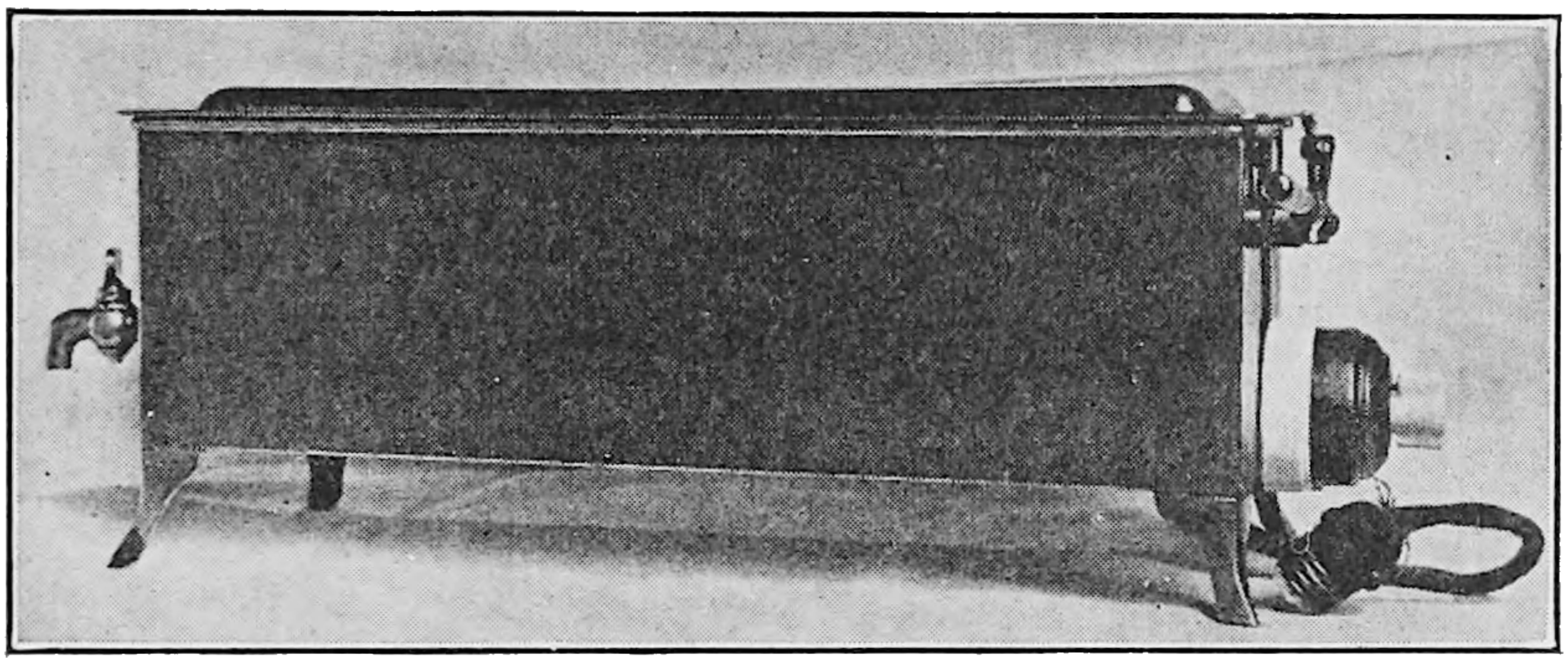


FIG. 91.—PORTABLE ELECTRIC INSTRUMENT STERILIZER.

connects the current in case they boil dry, and some of the more recent designs have a thermostatic mechanism which assumes entire responsibility for keeping the water at the boiling point and of turning off the current if the water supply becomes exhausted.

The other supplies and equipment for a dressing need not be taken up here because that phase of the subject belongs more particularly to general practical nursing and the pupil will have learned it in her practical course.

To have all these necessities conveniently at hand, especially when more than one dressing is to be done at a time, will call for *some means of compact and easy portability.* There is always the tray, of course, which can be very conveniently arranged and stocked, but when a variety of dressings are to be done the items it must accommodate will be so numerous and so heavy that it will be cumbersome and not very satisfactory generally. In spacious hospital wards the most convenient and technically the best device for storing and transporting supplies from one patient to another is one of the *dressing carriages* (Fig. 92) which are made in many designs and sizes. These carriages have several shelves, are mounted on rubber-tired wheels, sometimes have an attachment for elevating an irrigator

FIG. 92.—DRESSING CARRIAGE FOR USE IN THE HOSPITAL WARD.

which is useful in Carrel-Dakin dressings and other irrigations, and are very simple to wheel about from bed to bed. If one has the electric instrument sterilizer and accessible wall outlets for its attachment it may be kept on this carriage also and will thus furnish an ideal means of keeping the instruments perfectly clean and ready for instant use. If wisely stocked with supplies and kept in good order this dressing carriage will save many precious steps and will enable one nurse to do all the assisting for a series of dressings without the expenditure of the valuable time of a second errand nurse.

As remarked above, most of the other nursing details of dress-

more time than the direct method of pulling it off, but in cases of sensitive, nervous, or very ill patients, and often with children, it will be necessary to adopt one of these gentler methods. Any oil—albolene, or olive oil, for examples—will soften the plaster in a few minutes and will have no unpleasant effect upon even a broken skin. Benzine will dissolve the plaster more quickly but it will be painful if the skin is broken.

The general principles of handling sterile supplies for dressings will have been taught the nurse in her practical course of instruction and if she has had her operating room training she will know them well, but *the important principle of arranging equipment and general technic so as to reduce the amount of handling* necessary cannot be urged too often. This point is not only important in the interest of asepsis, but it also saves much time, labor, and confusion. A good standard practice is to keep a pair of long sterile forceps and a pair of scissors for use in handling the sterile supplies in a tall jar containing a solution of 1-40 or 1-60 carbolic acid to which a few grains of borax have been added for the purpose of preventing rust. These can be kept on the dressing tray or carriage at all times, and as long as they are used for nothing but the perfectly sterile dressings they need not be reboiled oftener than once a day. The point that these forceps and scissors should be long ones is emphasized because their length will enable the nurse to keep her unsterile hand well out of the region of the opening of the sterile container and thus avoid the possibility of unsterile dust dropping from it onto the sterile supplies.

In this connection it should be urged upon the nurse who dispenses the sterile supplies to *keep her hands as free from contamination as possible.* It will not be necessary for her to sterilize them but she should avoid, as far as she can, the removal of dressings, and the application of adhesive plaster, bandages, etc., after the dressing is done, especially in an infected case, if she is obliged to go directly to another wound. If an assistant is available this part of the dressing should be left entirely to her. In any case the soiled dressings should always be removed and otherwise handled with forceps. These forceps need not be sterile but it will be just as well to keep them in a jar of the weak carbolic solution on the dressing tray or carriage. The precaution should be taken to use for this purpose a different kind of forceps and jar from those provided for the sterile work.

In this connection the nurse usually needs to be cautioned about her *technic as it pertains to the ubiquitous bandage scissors.* The usual abiding place of these indispensable instruments, when they are not in use, is the nurse's apron belt or pocket, and it becomes automatic for her always to put them back there after use. In the ordinary everyday work this is a perfectly legitimate practice, but in the case of cutting off infected dressings the nurse should remember that her bandage scissors and her apron belt or pocket are entitled to the same technical attention as her hands or anything else she uses, and she will, therefore, sterilize her bandage scissors whenever she has been obliged to contaminate them.

Another point which is often overlooked is that *solutions used for washing or irrigating wounds should not be thrown into the receptacle containing the gauze dressings.* These two articles are eventually disposed of by entirely different means, the dressings by way of the furnace and the solutions by way of the sewer. Thus, if thrown together they must be separated later, which entails avoidable labor and very bad technic in that much wider contamination than is necessary is caused by this solution. Two waste dressing receptacles (preferably pails with handles) are necessary if solutions are used for a dressing.

As remarked in the beginning of this chapter, if the nurse dresses the wound herself she will have the guidance of the surgeon as to specific treatment, but she will need to exercise her best knowledge of asepsis and general surgical technic on her own account.

The person who does a dressing must, of course, have sterile hands. The bare hands may be sterilized as directed in Chapter XVI, page 263, or if sterile rubber gloves are available they should be used instead. If sterile gloves are used it will not be necessary to put the hands through the rigid sterilizing process required in the operating room but, of course, they should be very thoroughly cleansed.

All sponging of the wound, the handling of drains, dressings, *etc., should be done with forceps,* and to do this it will be necessary to provide two pairs of dressing or anatomical forceps—one for each hand. With a little practice one can thus keep her gloves entirely clean throughout a dressing, and can do a number of dressings without changing gloves. However, as a safeguard against unconscious error, *the gloves should be given a thorough rinsing after each case in some antiseptic solution,* such as 1-1000 bichloride.

Some of the foregoing advice may seem a little overdrawn, but when a nurse has become a finished technician she knows that *good technic is as easy as bad technic,* and where life and health are dependent upon us we have no right to do less than our best.

Secondly, the tissues of a wound are a literal culture medium for the germs, and this means that there is present in the wound, besides the germs themselves, the dead tissue which they have destroyed in the process of their feeding upon it, and all the other waste, which you have learned about in Chapter I, that accompanies inflammation and infection.

Furthermore, a great deal of this material is not on the surface of the wound but permeates its walls to a greater or lesser depth. Thus, you see, even though we were able, as we sometimes are, to wash the wounds as you do your hands, we could not reach the "soiled" parts that are within the tissues themselves, and could not, therefore, expect our bichloride to accomplish much in these parts.

More than this, bichloride, as is true of all the other powerful antiseptics which you have used, is very irritating to the tissues and while it was destroying the germs it would also destroy, or at least devitalize, the good tissue which it reached. You have doubtless learned this in the case of your own hands which have become sore or have developed a rash when you have had to use it frequently. Bichloride has been used only as an example and you would find that carbolic acid, formalin, or any other known antiseptic that is at all powerful would act similarly. Also, your hands have been only an example with which can be compared all the various articles which you are in the habit of sterilizing with an antiseptic solution.

Another more complex and abstruse problem which enters into this subject is that of actually *getting a solution of any kind into the tissues themselves,* even "clean" ones. Those of you who have studied physics and chemistry will know from what you have learned about "osmotic pressure" that there is a great difference among the powers of solutions to permeate any given material. This may be demonstrated by taking a jar with a partition of some permeable membrane, parchment paper, for instance, through the middle of it, and pouring into one side a colored solution of salt in water and into the other side plain water, and then watching them mix. Each solution permeates through the membrane into the other compartment, and in this case the water permeates more rapidly than the colored salt solution because the water is the less dense solution, or, as we say, has less "osmotic pressure." If we put the same solution into the two compartments they will mix equally because, of course, their "osmotic pressures" are equal. Similarly, if we put two different solutions having the same density into the two compartments they, too, would mix equally because they had the same "osmotic pressure." In the study of physiology the blood serum is taken as the standard fluid for all comparisons of this kind and any fluid which has the same "osmotic pressure" as the blood serum is said to be "*isotonic*" with the blood. This term "isotonic" is one which nurses often hear and they should know its meaning, especially if they wish to understand one of the great hidden secrets of the efficacy of the Dakin solution.

The fact, then, which we have just tried to prepare you to understand is that another great reason why bichloride, carbolic acid, formalin, etc., will not sterilize an infected wound is because they are not "isotonic" with the blood serum and will not, therefore, mix well with it through the permeable "membrane" we have in the case of wounds—the body tissues.

Consequently, in order to sterilize an infected wound we have to devise some means, first, of "washing" it as best we can, and then of applying to it a solution which has the power of killing its germs whether they are on its surface or more or less entrenched within its tissues. This Drs. Carrel and Dakin have done for us in great detail in the Carrel-Dakin system of wound disinfection.

HISTORY

The method, as a whole, is the invention of Dr. Alexis Carrel, the distinguished American biologist who, since his emigration to this country in 1905 from his native land, France, has repeatedly commanded the attention and admiration of scientists the world over by his brilliant and serviceable experiments and discoveries in the art of surgery, carried on, for the most part, at *The Rockefeller Institute for Medical Research,* in New York.

The Carrel-Dakin treatment was introduced, however, on the battlefield, in the beginning of the European war, by Dr. Carrel at his French Army hospital, founded by the Rockefeller Institute at Compiègne, France. In this work he had the collaboration of Dr. Dakin who did much of the laboratory experimentation necessary to perfect the remarkable solution which Dr. Dakin had given to the profession some time previously and which bore his name. In time the treatment was adopted by several other French Army surgeons and became an established treatment in their war hospitals. Because of its exacting and somewhat tedious technic, however, and through hesitancy to institute radical changes in procedure, the method was rather slow of adoption by surgeons in general, but its beneficence has become such an established fact that it is now in fairly general use.

Before taking up the study of the system as a whole we shall take time to gather together and learn about *the tools we shall need,* for when we have all this in mind the remainder of the text will be more intelligible; and as this is the part of the Carrel-Dakin method with which the nurse is most concerned in practice, special emphasis put upon these details before thinking of anything further will be a good initial investment.

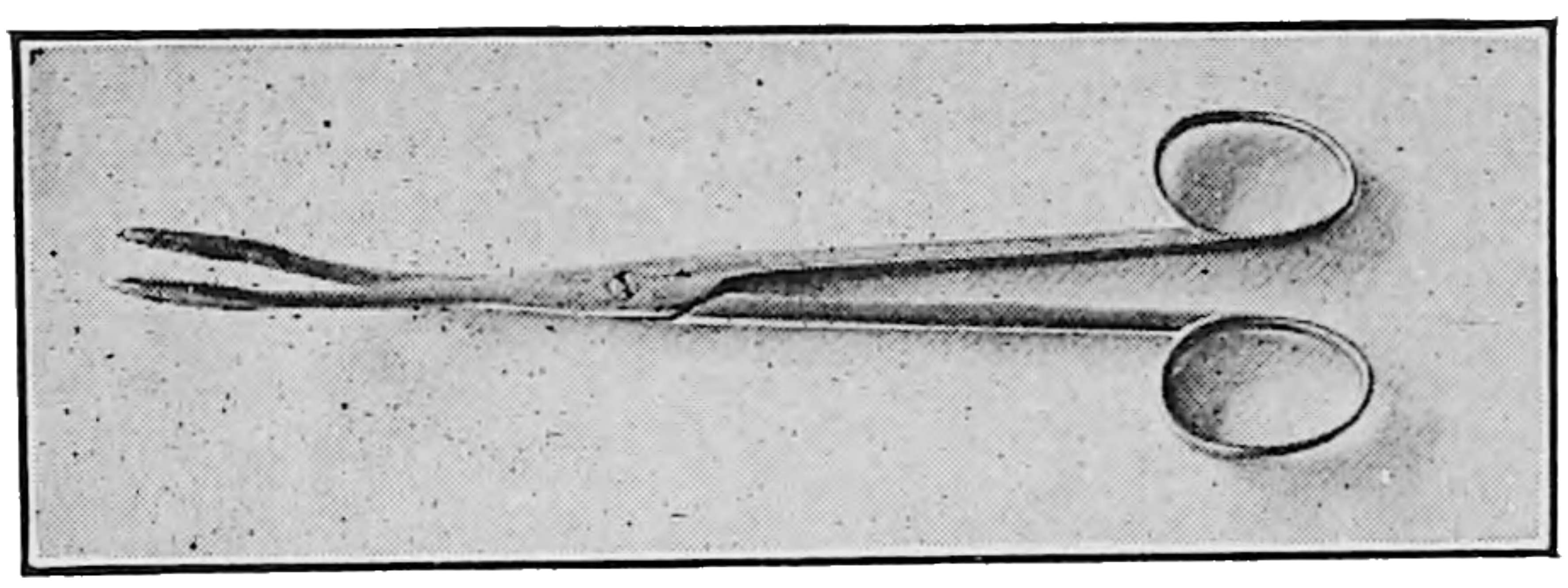


FIG. 94.—DRESSING FORCEPS FOR USE IN DRESSING THE CARREL-DAKIN WOUND.

EQUIPMENT

For the administration of this treatment a considerable number of articles are needed, and experience will teach that none of them can be omitted without serious handicap following.

The necessary items are these:

1. Instruments: 4 pairs of long dressing forceps (Fig. 94) and 2 pairs of long scissors; all sterile, of course.

6. Large sterile gauze dressings.
7. Sterile cotton pads.
8. Sterile safety pins.

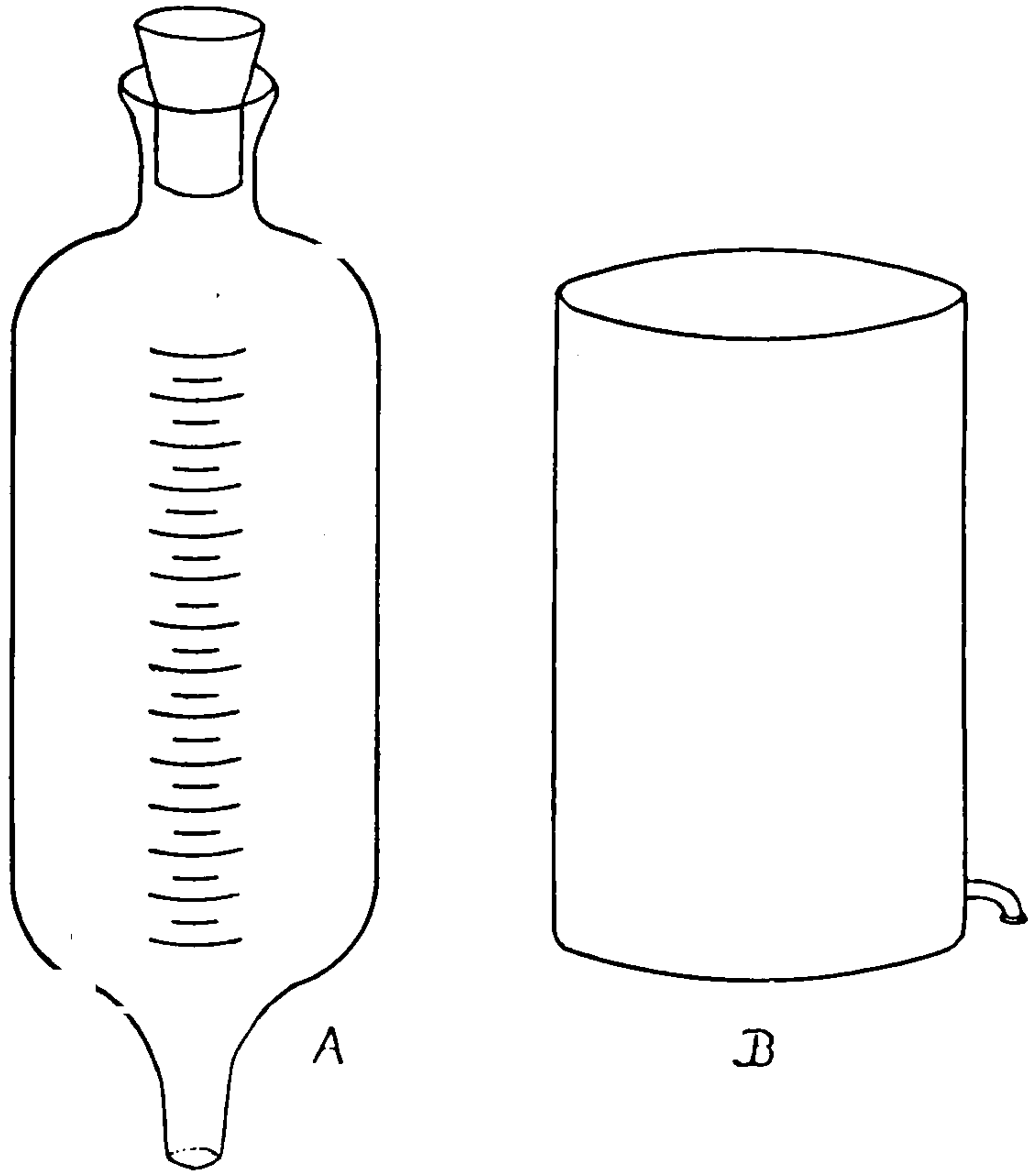


FIG. 96.—RESERVOIRS FOR THE DAKIN SOLUTION. *A*, a glass graduated one which may be securely stopped with a cork; *B*, a flat-bottomed one made of enameled metal.

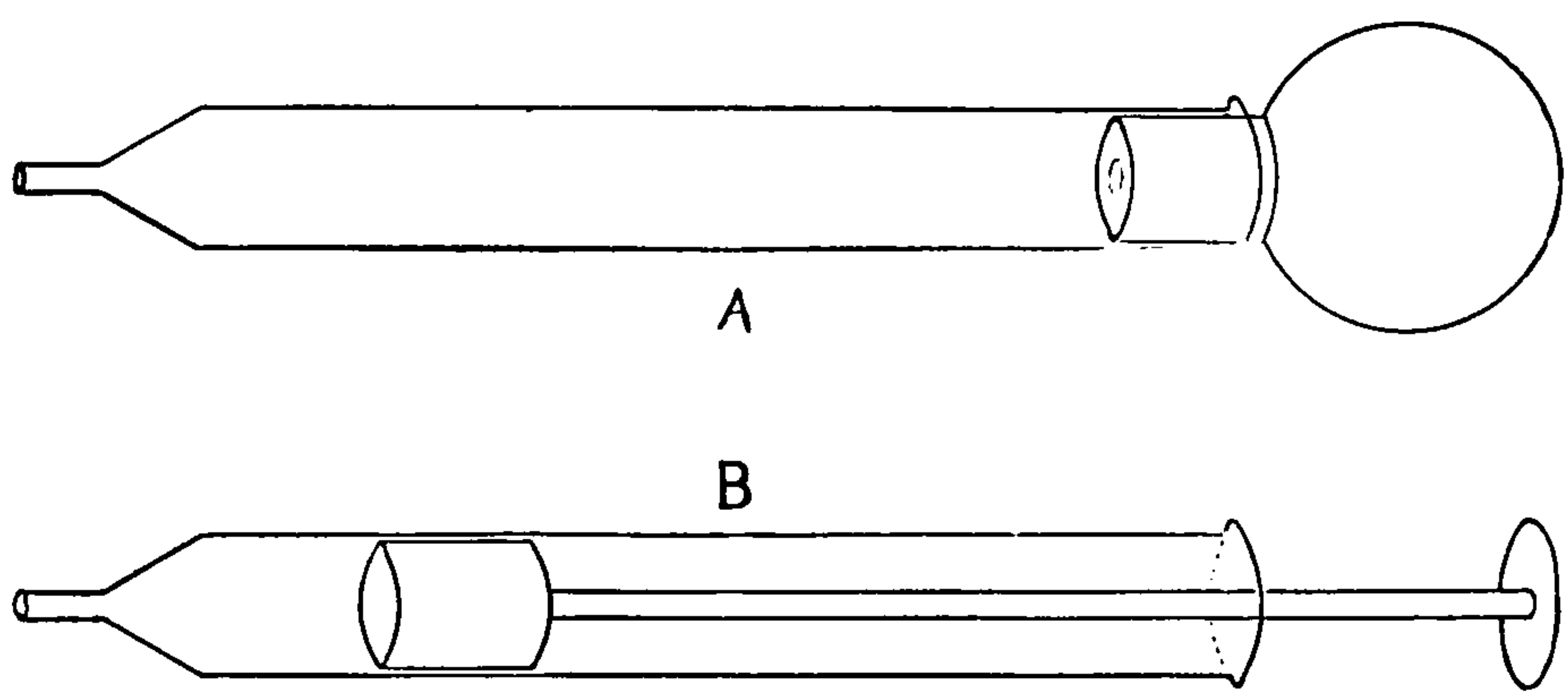


FIG. 97.—GLASS SYRINGES FOR ADMINISTERING THE DAKIN SOLUTION. *A*, rubber bulb type which may be operated with one hand—the most convenient one for the purpose; *B*, the more common plunger type.

9. Bandages.
10. Irrigator stand (Fig. 44, page 221).
11. Reservoir for Dakin's solution (Fig. 96).
12. Glass syringe (1-ounce size) (Fig. 97).

13. Rubber tubing—enough to reach generously from the reservoir to the wound.

14. Stopcock (spring or screw) (Fig. 98).

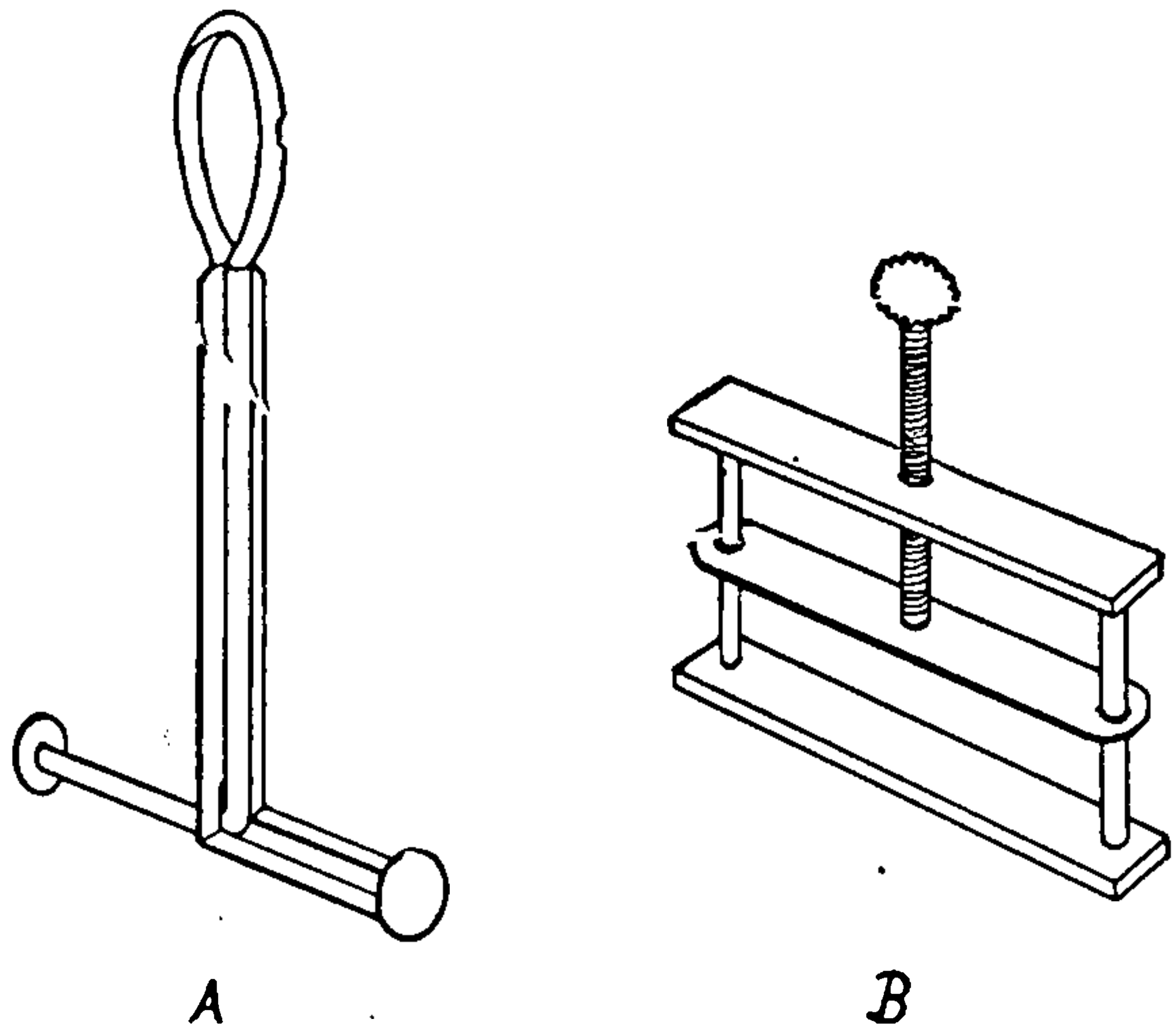


FIG. 98.—STOPCOCKS FOR USE ON THE SUPPLY TUBING IN THE RESERVOIR METHOD OF ADMINISTERING THE DAKIN SOLUTION. *A*, metal spring variety, suitable for the intermittent method as it always entirely closes off the tube; *B*, screw variety, suitable for the continuous method of instillation, as the rate of flow of the solution can be very exactly controlled with it.

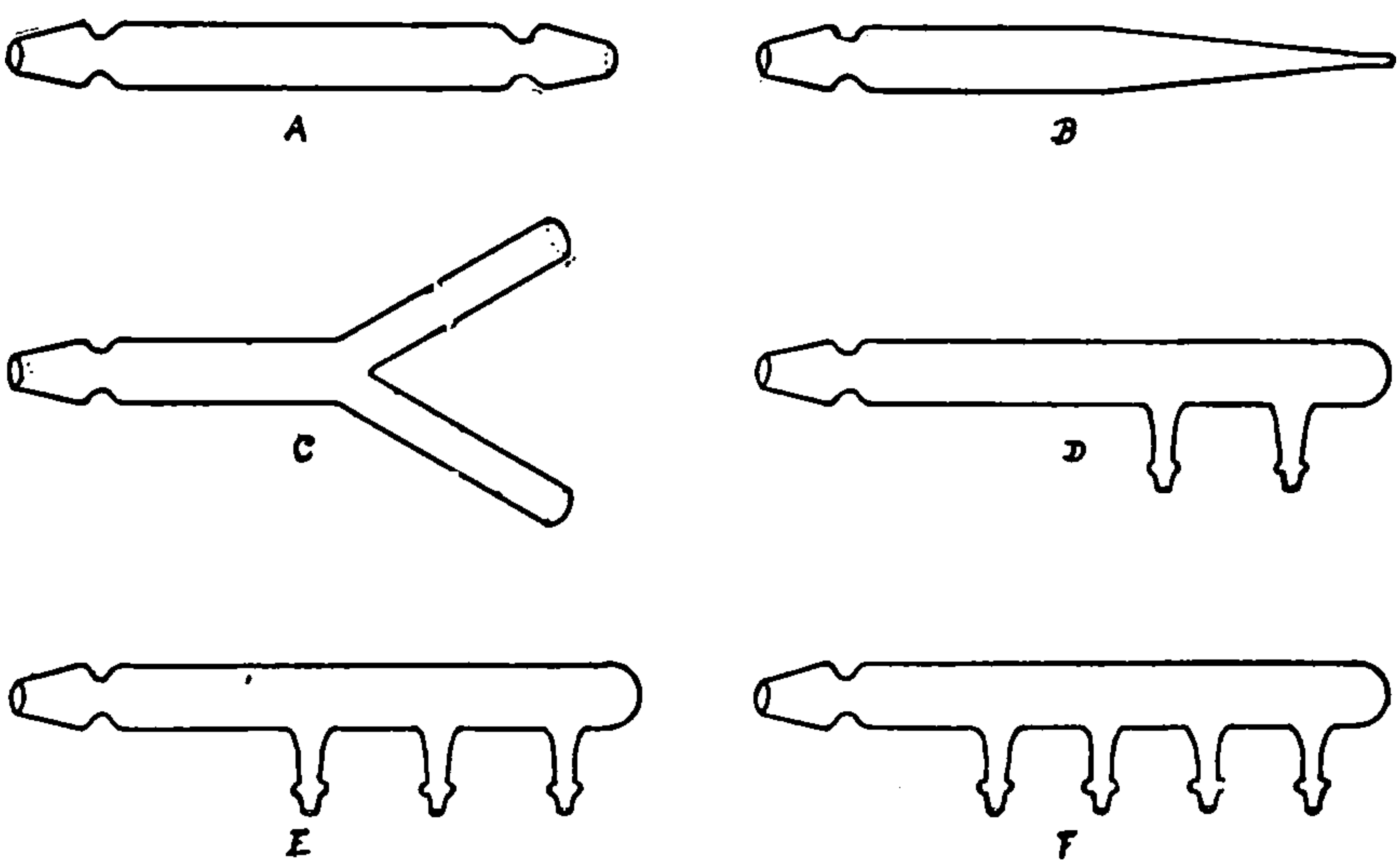


FIG. 99.—GLASS CONNECTING AND DISTRIBUTING TUBES. *A*, ordinary straight splicing tube; *B*, suitable for connecting rubber tubes of different calibers, as in the case of uniting one of the small wound tubes directly to the main supply tube. This tube also answers as a dropper tube in place of the special one illustrated in Fig. 100; *C*, Y-tube for making various bifurcations in the main supply tube; *D*, *E*, and *F*, 2-, 3-, and 4-way tubes for connecting the wound tubes with the supply tube.

15. Glass connecting and distributing tubes (straight, Y-shaped, 2-, 3-, and 4-way) (Fig. 99).

16. Glass dropper tube (Fig. 100).

1. **Instruments.**—For the dressing the *forceps and scissors* should be long ones so as to make it possible to keep the hands well away from the wound and dressings. The best type of dressing forceps is the one illustrated in Fig. 94. Four pairs are provided, as both the person who dresses the wound and the assistant will use a pair in each hand.

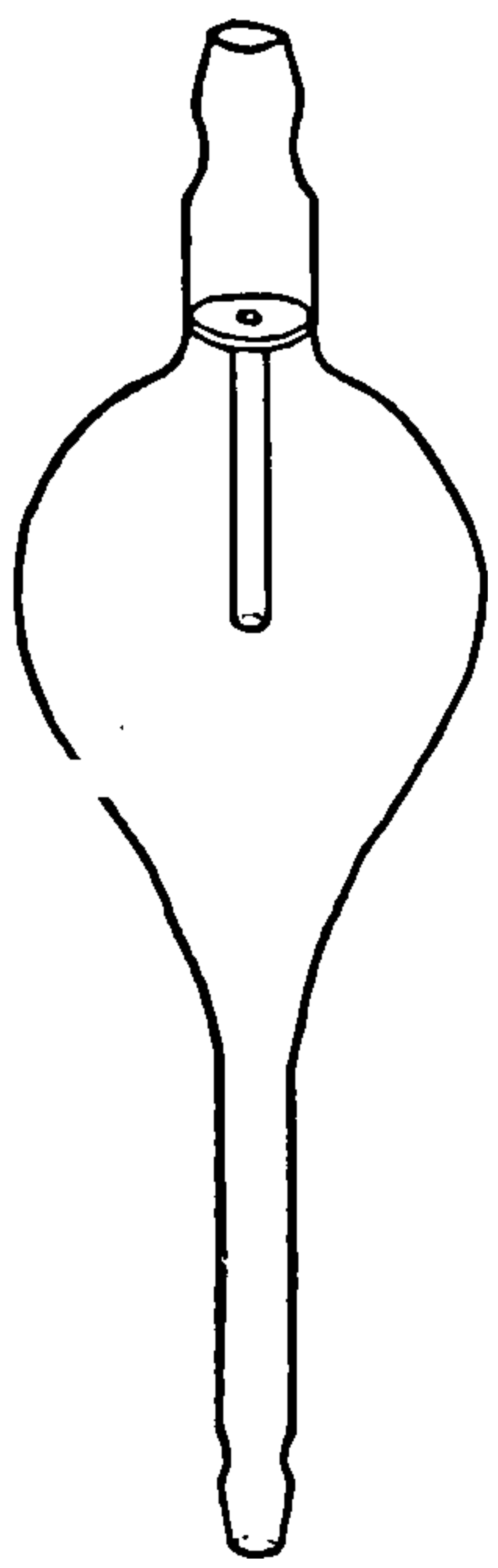


FIG. 100.—GLASS DROPPER TUBE FOR USE ON THE MAIN SUPPLY TUBE IN THE RESERVOIR CONTINUOUS METHOD. The solution can not pass through this tube faster than drop by drop, and the rate at which it is dropping can be readily observed at all times.

2. **Solution Basin.**—This may be of any material that is *easily sterilizable,* but as Dakin's solution deteriorates upon exposure to light it is advisable to select a dish made of an opaque material and one having a cover. An enamel-ware covered dish which holds a pint will be a good one for the average purpose. This should be sterilized by boiling.

3. **Vaseline Gauze.**—Probably the best gauze for this purpose is *bandage gauze,* as the material used must have more body than the average dressing gauze has. The size of the pieces will doubtless be prescribed by the individual surgeon, as preferences vary, but an average suggestion would be to cut a 2-inch bandage into 6-inch lengths. Turn back one end of each strip a half inch or more; the reason for this is that it can be picked up more easily after it has been impregnated with the vaseline. Lay these in a neat rank, the piece you have turned back lying on top each time, in a shallow dish; this dish may be of any material that will withstand the steam pressure of the autoclave, it must have a cover, and it will be found more satisfactory to have it of a length and breadth only slightly larger than the gauze strips. Melt the vaseline (preferably the white vaseline) and pour it over the gauze, using only enough to cover it. It might be mentioned that the dish containing the gauze should be warm when the melted vaseline is poured into it so that a good permeation of the gauze will take place then, when the proper amount needed must be judged. This is then *sterilized in the autoclave* for the

evenly as possible over the surface of the tube, and making about 4 holes to each inch of tubing. Do not attempt to make these holes with a hot needle, as this may leave loose pieces of burnt rubber in the tube which would later become foreign bodies in the wound. There is no substitute for the punch which removes entirely a small piece of the rubber. This tube is used as you now see it, but for some purposes it needs a further modification thus:

Tube B. Over the perforations of the tube described above wind, bandage fashion (B of Fig. 95) a strip of soft gauze, or, as Dr. Carrel originally prescribed, a piece of Turkish toweling. The toweling is not always at hand, and soft gauze makes a good substitute. The amount applied will necessarily vary with the wound, but a good average amount would be 6 or 8 layers. It will be a wise precaution to stitch this gauze at one end to the tube to prevent its being lost in the wound. This tube will be used in cases where the solution has to be carried uphill, the gauze serving the purpose of holding the solution in contact with the wound surface.

Tube C. Leave both ends open, cut one end at an angle, and about ⅛ inch from this end cut a small hole (C of Fig. 95) with a pair of scissors, making the tube resemble an open-end rectal tube. This tube will be used in deep, narrow wounds where all one needs to do is to fill the cavity with the solution. Or, if the continuous method of administration is used, this will be the most serviceable tube.

Tube D. This tube should be about twice as long as the others, and it is perforated in the middle (D of Fig. 95) instead of at one end. The solution is carried into this tube at both ends by means of a glass Y-tube (C of Fig. 99) and the loop thus formed is used for surface wounds.

These tubes are best *sterilized in clear boiling water,* and 15 minutes is enough time to give them; for every nurse knows that rubber articles deteriorate soon under any method of steriliza tion.

5. **Small Gauze Dressings.**—For this dressing the small gauze sponge or "wipe" which is provided for general sponging

will serve. This will be used as Dakin packing in many wounds in coöperation with the tubes.

6. **Large Gauze Dressings.**—These will simply be large folded gauze dressings of a size and shape to generously cover the wound.

7. **Cotton Pads.**—These pads are very important adjuncts and should be made with care and foresight as to size, shape, and thickness. There should be a generous layer of absorbent cotton, a thinner one of non-absorbent cotton, and these should be securely covered with a layer of gauze. Their size and proportions will vary with the size, nature, and location of the wound, but they should always be large enough to extend well beyond the gauze dressings on all sides, and if the wound is so situated that there may be drainage downward, as in the case of the extremities, this pad should be large enough to envelop the part entirely.

All gauze and cotton dressings will, of course, be *sterilized in the steam autoclave.*

8. **Safety Pins.**—It is important that these should be sterilized either by dry heat, or by boiling immediately before use so as to be sure that they are free from rust.

9. **Bandages.**—There should be a supply of sterile bandages on hand, as in some cases it is necessary to use them where sterility is obligatory.

10. **Irrigator Stand.**—In the hospital the provision of a suitable stand presents no problem (see Fig. 44, page 221), but in the home and other places one can always find a costumer, a chandelier, a bed post, chiffonier, or any number of other supports which can be utilized for raising the solution the required height above the patient.

11. **Reservoir for Solution.**—Many authorities advise a glass irrigating jar (A of Fig. 96) for this purpose, and if it is small and graduated in ounces or cubic centimeters it is a good one; but if it is large it seems a little inconsistent, inasmuch as the Dakin solution is known to deteriorate when exposed to light, and if one puts as much as a quart in this jar it is evident that the last portions of this quantity used will have been exposed for many hours. Another objection to the glass containers is

that most of them are not flat-bottomed and cannot, therefore, be elevated by any means but suspension which might not always be convenient. The graduated glass jar, however, is an advantage in that it enables one to see the amount of the solution that is being injected at each instillation; but in the average case perhaps the article most easily obtained will be the simple enameled metal irrigator with a flat bottom and an outlet in the form of a tube projecting from the side (B of Fig. 96). This is easily *sterilized by boiling,* and if not provided with a ready-made cover a heavy cloth cover can be fitted. The most serviceable size in this type of irrigator will be one that *holds a quart.* This irrigator, as well as the glass ones, may, of course, be *sterilized by steam,* or *by soaking in some antiseptic solution,* such as bichloride.

We would caution the nurse against the temptation which may come to her in a private house to use a rubber douche bag for the reservoir. All concerned, including the bag, would come to grief within a very short time as the Dakin solution finds weak places in rubber sooner than any other solution.

12. **Glass Syringe.**—This will be needed only when the solution is administered by the syringe method instead of by reservoir. It is, of course, necessary to provide an individual syringe for each wound. The capacity should be from 1 to 2 ounces; a smaller one is too trifling, and a larger one may be too forceful (Fig. 97). Of these two syringes A of the illustration is the better model because it can be manipulated with one hand, which will always be a great advantage as the other hand will be free to control and steady the wound tube. These are sterilized by boiling.

13. **Rubber Tubing.**—The red rubber tubing seems to be the best quality for this purpose. One piece, long enough to allow considerable slack between the reservoir and the delivery tubes, should be provided, and there should also be on hand several shorter pieces. This rubber should be in perfect condition, as, at its best, it does not withstand the Dakin solution well, and a small defect will soon play havoc with the patient's comfort, the bed, and the nurse's time. The caliber of this supply tubing should be a few sizes larger than that of the wound tubes, or, a

important part of the technic, but it could not succeed out of coöperation with the three other procedures which go with it to make the whole. The *four processes,* then, which make up the complete system are:

I. *Débridement.* II. *Administration of the Dakin Solution to the Infected Wound.* III. *The Periodical Bacteriological Examination of the Wound.* IV. *The Suturing of the Wound When Sterile.*

I. DÉBRIDEMENT

As outlined above, the Carrel-Dakin technic proper begins with the surgical operation called "*débridement,*" which is a French word meaning, in the words of the International Dictionary, "Operation of removing by an incision any part which causes obstruction or prevents escape of pus." This operation, however, as applied here by Dr. Carrel, involves a little more than the above definition implies, for by "*débridement*" Dr. Carrel means a very thorough, delicate, and rigidly aseptic removal from the wound at the very earliest possible moment of all foreign material, infected tissue, injured tissue which might easily become infected, and also as much good tissue as might stand in the way of the thorough application of the Dakin solution to absolutely every part of the wound. In other words, when the surgeon "debrides" a wound he operates as soon as he can, uses and exacts the most rigid aseptic technic possible, and under these conditions lays the wound widely open, takes out all foreign bodies, dirt, etc., and then cuts away all dead and injured tissue and whatever good tissue may be necessary to give him reasonably good access to every remote part of the wound, using great care throughout not to cause any more injury to the good tissue than is absolutely necessary to gain his end; and when he is through he has a wound that contains nothing but living, and, so far as the eye can see, healthy tissue.

The first step in the treatment has now been taken—the wound has been "debrided" and as much of the *infection has been removed* as is possible by means of pure surgery.

II. ADMINISTRATION OF THE DAKIN SOLUTION

This subdivision of the method involves a *group of procedures* which we shall classify as follows:

1. **Dressing of the Wound.**—*a. Vaseline Gauze. b.* The *Delivery Tubes. c.* The *Gauze and Cotton Dressings.*

2. **Adjustment of Instillation Appliances.**—*a.* For the *Reservoir Intermittent Method. b.* For the *Reservoir Continuous Method. c.* For the *Syringe Method.*

3. **Instillation of the Dakin Solution.**—*a.* The *Reservoir Intermittent Method. b.* The *Reservoir Continuous Method. c.* The *Syringe Method.*

1. **Dressing of the Wound.**—It may seem to you, after learning of the thoroughness with which the *débridement* was done, that the wound should now be free from germs and that healing would take place in the natural course of events. Or, if you accepted doubt on this point you might hold that we could determine whether or not there still remained infection by taking a culture of this clean and healthy-looking wound. This contention would not be quite sound, however, because of the fact that infection does not develop and become active for a day or two, and so, in order to play safe, the stage is set immediately for the instillation of the antiseptic solution.

a. The Vaseline Gauze.—The first step is to apply the vaseline gauze strips to the skin *immediately surrounding the wound.* The skin becomes irritated in a short time if subjected to a constant bath of the combination of Dakin's solution and the wound excretions, and for this reason all parts likely to be exposed to drainage must be carefully covered with the vaseline gauze which is impervious to it (Fig. 102).

The assistant, a pair of dressing forceps in each hand, picks up the end of the vaseline gauze strip which she turned back when she packed it, pulls the piece loose from the others and immediately grasps the other end with the pair of forceps in the other hand. She passes it thus to the person dressing the wound; he, also, has a pair of dressing forceps in each hand.

These strips are then pressed smoothly and closely upon the needful parts as pointed out above.

b. The Delivery Tubes.—Next, the rubber wound tubes are put into place. The size, shape, location, and general character of the wound will determine which of the four kinds of delivery tubes you have provided will be used (Fig. 103). In some cases you may be called upon for more than one kind for the same wound.

Tube A (Fig. 95) is the most frequently used one because it can be adapted to the *greatest variety of wounds* and can be best fitted into the more shapeless ones (see A of Fig. 103).

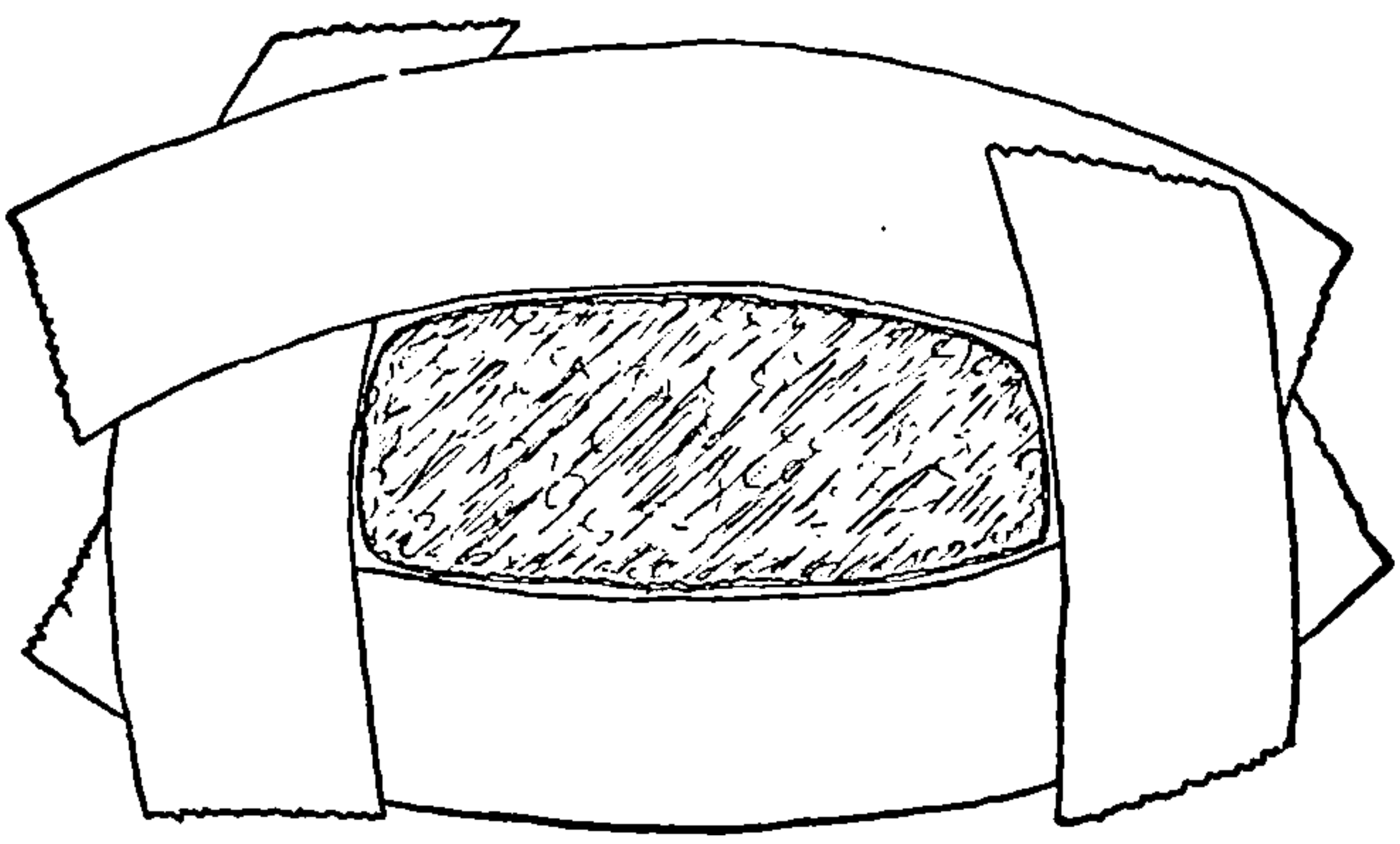


FIG. 102.—THE WAY TO LAY THE VASELINE GAUZE STRIPS AROUND THE MARGIN OF THE WOUND.

However, if the wound is in such a position that it will not hold the solution until it is absorbed—in other words, if it is not right-side-up, as one on the lower part of the leg or arm, or on the back—*tube B* (Fig. 95) will have to be used (see B of Fig. 103), and the gauze which you have wrapped around it will serve as a storehouse which will supply the solution to the tissues as fast as they can absorb it. Some of the small gauze dressings which you have provided may also be used in this case to fill in the wound or to keep the tubes in place. It should be remembered that when this gauze is used it should be saturated with the Dakin solution before it is inserted. Also, when tube B is used the gauze-wound end should be dipped into the solution before insertion. The solution basin mentioned above is, of course, used for this purpose.

If the wound is a relatively *smooth-walled* one, and will hold

the solution, *tube C* (Fig. 95) is used (see C of Fig. 103), and some of the small gauze dressings may be tucked around it to keep muscles or other structures from closing in upon it and obstructing it, though when this is done the gauze should be so placed that it does not come between the tube openings and the wound surface, as it is likely to become clogged with wound excretions and will then be impervious to the solution.

In the case of a *shallow wound* on the surface, especially if it is extensive, one or more of *tube D* (Fig. 95) will be used (see D of Fig. 103), a thin layer of gauze being first spread over the wound to prevent the tube from adhering to it. Not more than one or two thicknesses of gauze should be used because it will become clogged with the wound excretions and prevent the solution from reaching the wound. A number of tube A may also be used on this type of wound.

In all cases tubes must be selected in which the *perforations will not extend beyond the edges of the wound.*

When tube D is used the glass Y-connecting tube must be affixed before it is put into place, but with the others it will be found more satisfactory, and just as good technic, to adjust their connecting tubes after the patient has been put to bed.

c. The Gauze and Cotton Dressings.—The sterile gauze dressings are next applied, and over them the cotton pad, non-absorbent side outward, of course. In nearly all cases these pads will have to be split so as to allow the rubber delivery tubes to pass outward through them (Fig. 104) rather than under them, one reason for this being that by this means the tubes can be kept in place better, and another being that the patient is thus protected from any leakage from the ends of the tubes and also from the unpleasantness of contact with rubber. The safety pins you have provided will come into service at this point.

The cotton pads must never be omitted because they serve two important purposes: They protect the bed and the patient's clothing, and the non-absorbent layer of cotton prevents undue evaporation of the solution. In this connection it may be well

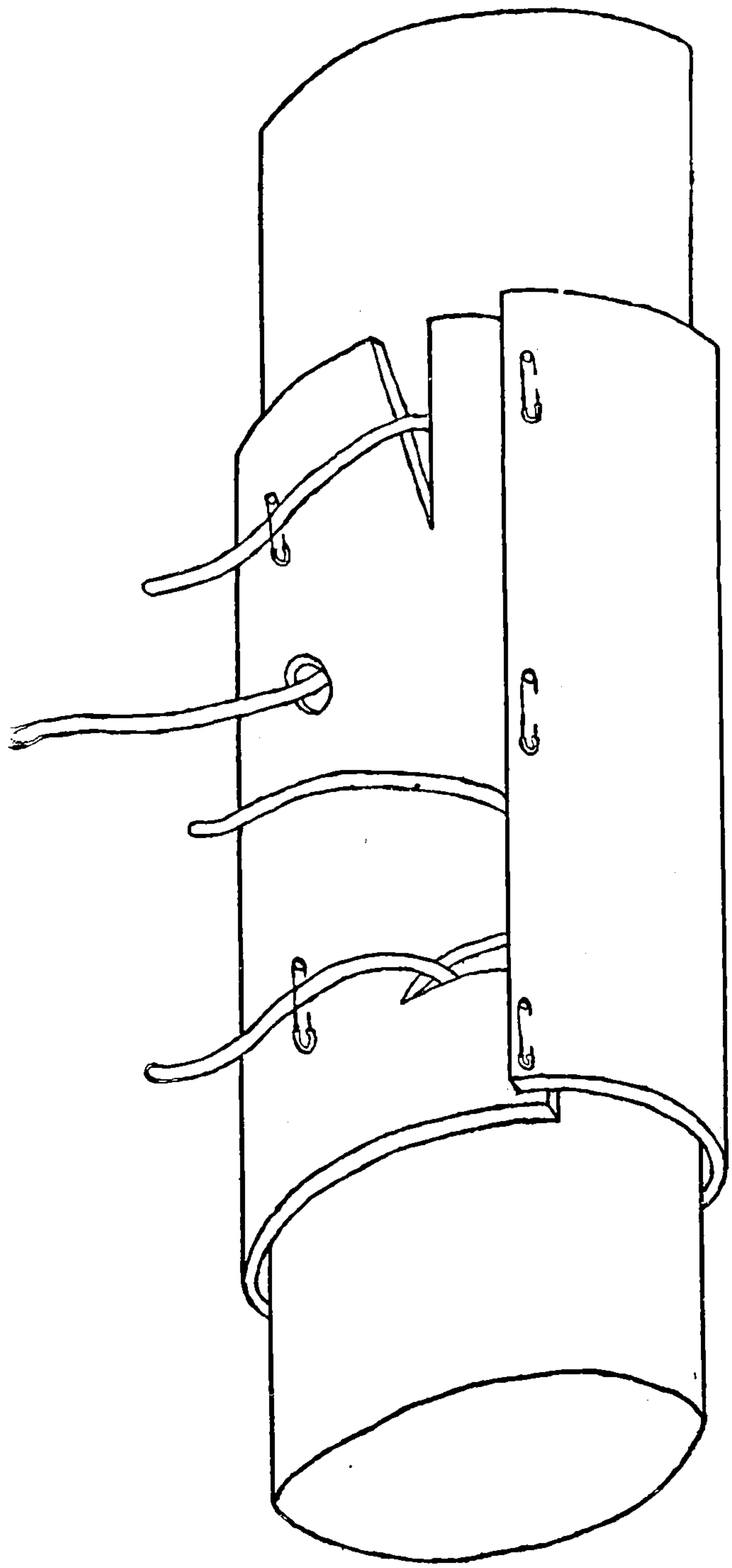


Fig. 104.—Diagram of Possible Ways of Making Exits Through the Gauze and Cotton Pad for the Wound Tubes so that They Need not Lie on the Skin Surface, and Will Remain Where They Were Placed When the Wound Was Dressed.

to warn the nurse against covering any part of a Carrel-Dakin dressing with rubber sheeting of any kind, as a certain amount of evaporation is inevitable and the re-condensation that would take place under the rubber sheet would be as unwholesome and uncomfortable in this case as every nurse knows it is in all others.

The dressings are then, of course, secured by bandages, or in some cases by tape or webbing straps which can be tied in place. *Dressings for Carrel-Dakin cases should not be fastened quite so tightly* as is permissible with most other dressings, because they will administer the solution better when loose, and furthermore, the bandages sometimes shrink a little when they become wet.

2. **Adjustment of Instillation Appliances.**—Before the arrangement of the instillation outfit is carried further, whichever method of administration is to be used, *the patient must be made comfortable* and the bedding adjusted as far as possible.

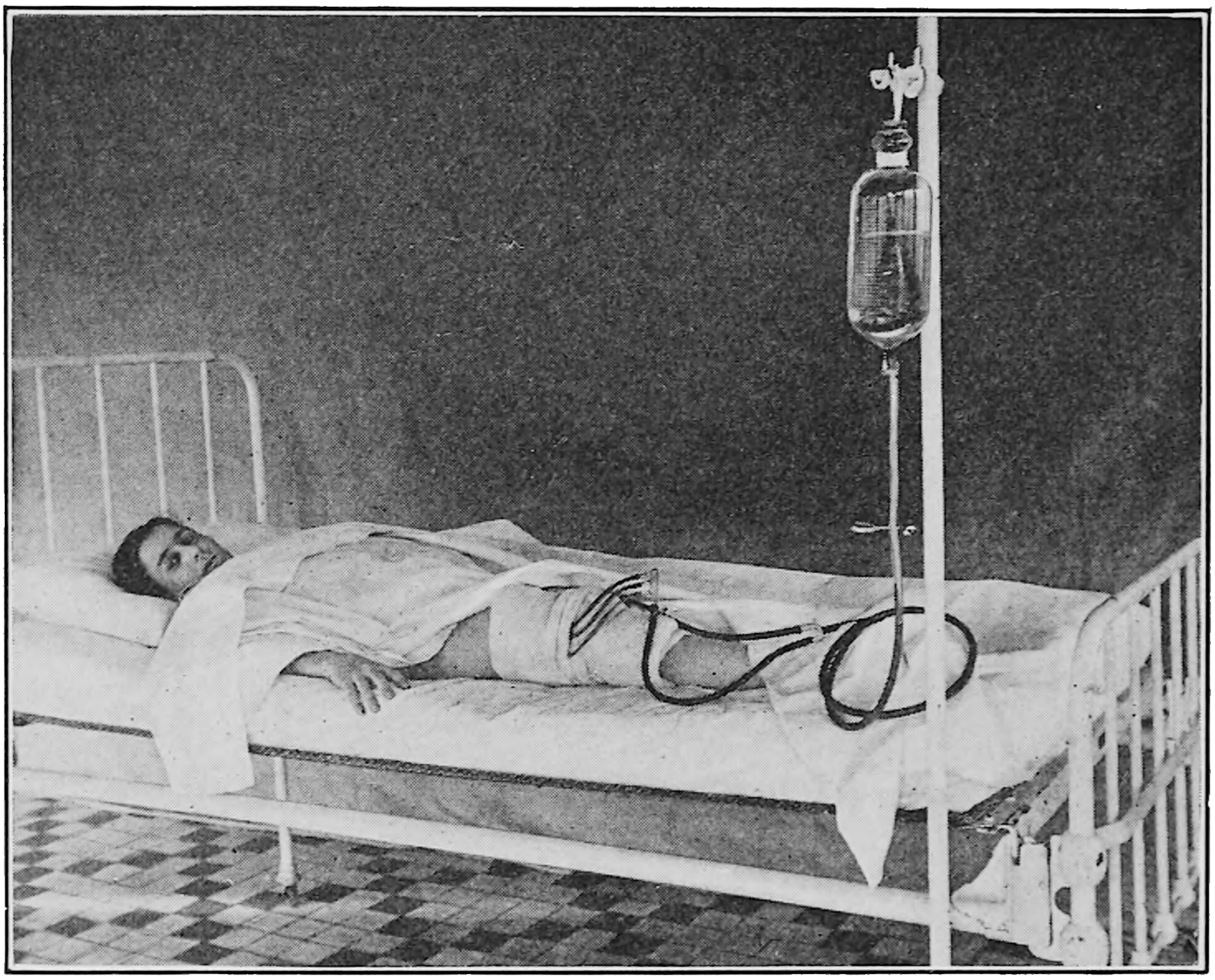


Fig. 105.—Arrangement of the Apparatus for the Reservoir Method of Instillation.

The chief object to keep in mind at this point is to arrange the patient and bedding, in relation to the wound, in such a way as to make possible the administration of the Dakin solution without any disturbance or discomfort to the patient.

Your next step will depend upon which of the several methods

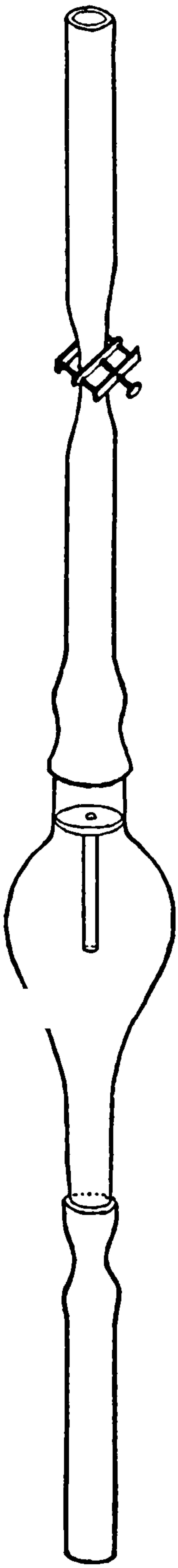


FIG. 107.—ARRANGEMENT OF THE SCREW STOPCOCK AND THE GLASS DROPPER TUBE ON THE MAIN SUPPLY TUBE FOR THE RESERVOIR CONTINUOUS METHOD OF INSTILLATION.

tion from the same source (Fig. 106). A study of this illustration will furnish enough suggestions to cover any case.

b. For the Reservoir Continuous Method.—When this method is adopted *delivery tube C* (Fig. 95) is used in the wound. Instead of the spring stopcock on the main supply tube the screw one (B of Fig. 98) should be used, and just below this the tube should be cut and the *dropper tube* (Fig. 100) inserted, as indicated in Fig. 107. Otherwise the adjustment is the same as that described above for the reservoir intermittent method.

c. For the Syringe Method.—If the wound tubes are easily accessible no further adjustment is necessary, for the solution can be injected into each individual tube directly from the syringe. If the wound is so situated, however, that this is inconvenient, the glass connecting and distributing tubes and some of the short pieces of supply tubing you have provided can be arranged as for the reservoir method so as to be able to feed the solution from one main tube (Fig. 108).

3. **Instillation of the Solution.**—The standard practice is to administer the solution *every two hours,* day and night. This frequency is determined by the fact that Dakin's solution is very unstable and loses its sterilizing power by the end of this period. The mechanism is so adjusted, as you are now pre-

pared to concede, that, with average care, the treatment can be given without any disturbance or discomfort to the patient, and so, it is just as easily carried out during the night as in the day-time. This is a very merciful feature of the method because this is one treatment which is never interrupted. The importance of *regularity* and *punctuality* in the instillation is one of the most urgent points for the beginner to learn. Another important point to be learned early is to *pay close attention to the amount,* as nearly as possible, of the solution which is required to fully bathe each individual wound and then religiously give just that amount, and no more and no less. If too little is given the germs in the parts of the wound unbathed

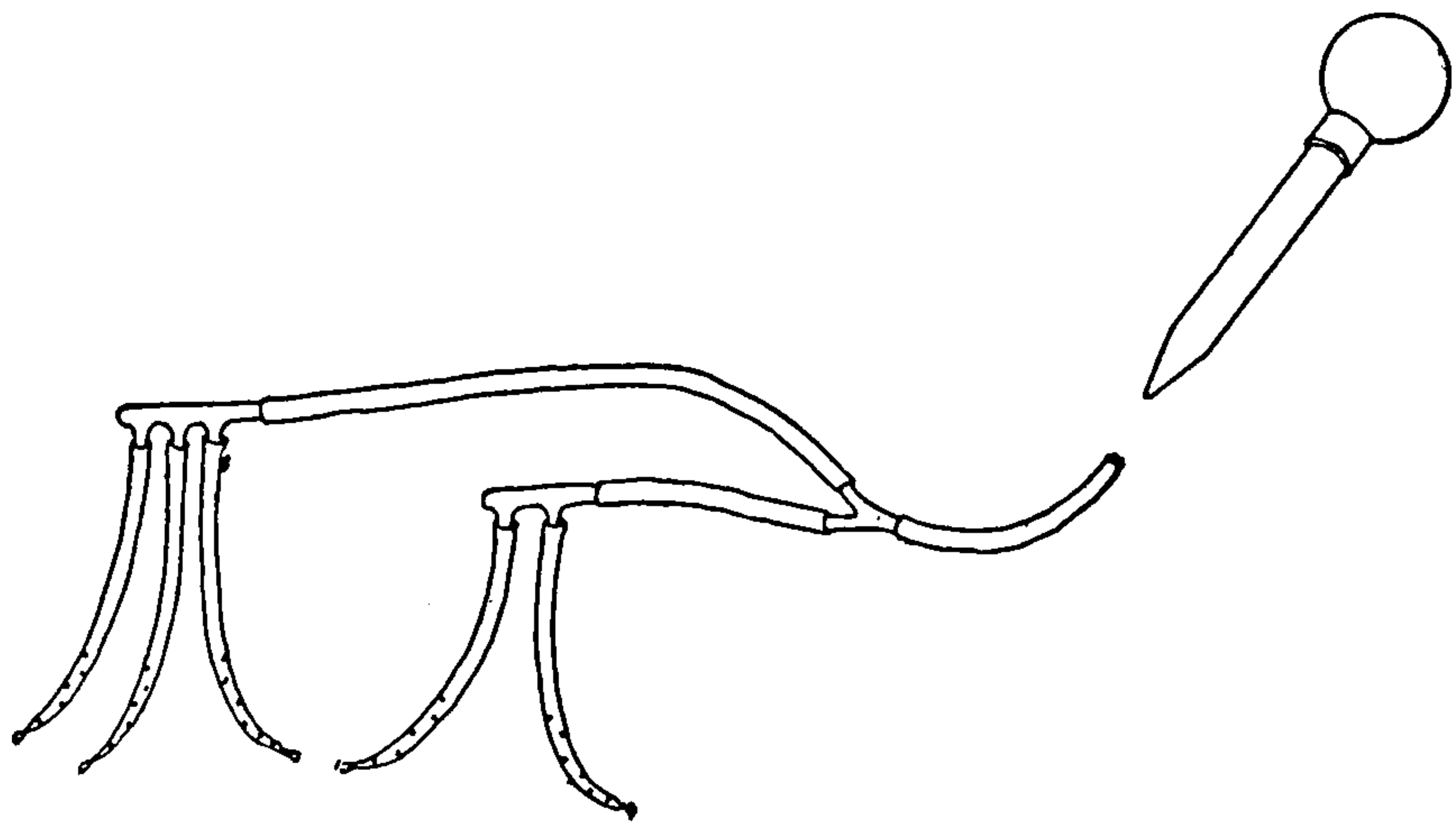


FIG. 108.—METHOD OF CONNECTING INACCESSIBLE WOUND TUBES TO A SINGLE SUPPLY TUBE FOR THE SYRINGE METHOD OF INSTILLATION.

flourish unhindered and indefinitely; if too much is given it may not all be absorbed before the next instillation and the old, useless solution blocks the way for the new. Another menace of too great a quantity is the discomfort, and even injury, to the patient which results from the solution being spilled over healthy surroundings of the wound or onto the bedding and causing irritation of the patient's skin. In some instances the surgeon will, when he has finished the *débridement,* estimate, or even measure, the correct dosage for that particular wound and prescribe this exact amount for each instillation. As you can readily see, in order to carry out this provision it will be necessary that either the syringe method of administration be used, or else, that you be equipped with the graduated glass irrigator. Otherwise, one or two instillations will be enough to teach one the proper quantity for a given wound, but if there must be doubt at any time it is better to err on the side of too much than on that of too little. Of course, as the wound heals a smaller dosage of the solution will be necessary, but this variation will be determined from time to time when the wound is dressed.

Details of the actual instillation for the several methods are as follows:

a. The Reservoir Intermittent Method.—All the nurse has to do to make the instillation by this means is to *open the stopcock* for the time necessary for the passage of the amount of the solution prescribed or estimated.

The two great errors that are most easily committed by this method are to allow the solution to flow too suddenly and too forcefully, and to give too large a dose. Sudden and forceful instillations are painful to the patient, especially if the solution is cold. The objections to overdosage have been mentioned above.

Another difficulty is to determine whether or not all the *delivery tubes are functioning.* It is possible, however, to get this information by the closest scrutiny of the glass distributing tube while the solution is flowing. When one does become blocked it may sometimes be opened by disconnecting it at the glass distributing tube and gently forcing some of the Dakin's solution into it with a syringe. This should be done with great care, however.

b. The Reservoir Continuous Method.—The screw stopcock is so adjusted that the solution *drops through the glass dropper* to the wound at the proper rate to keep the dressings at an even degree of moisture. The actual rate will depend, of course, upon the area supplied by the tube, but it will probably be somewhere between 5 and 10 drops per minute.

This was the method originally recommended by Dr. Carrel, but it has now been rather laid aside in favor of the others.

c. The Syringe Method.—It need hardly be said that this method consists merely of injecting the Dakin solution into the

The first smear or two may not show much decrease in the number of germs, but after that there should be a gradual decrease, and the zero mark on the chart is reached in from a few days to several weeks, depending upon the severity of the injury and upon the type of tissue involved; that is, whether it is the soft parts of the body, bone, etc.

If the expected downward course of the count does not take place promptly *all possible causes should be investigated,* and

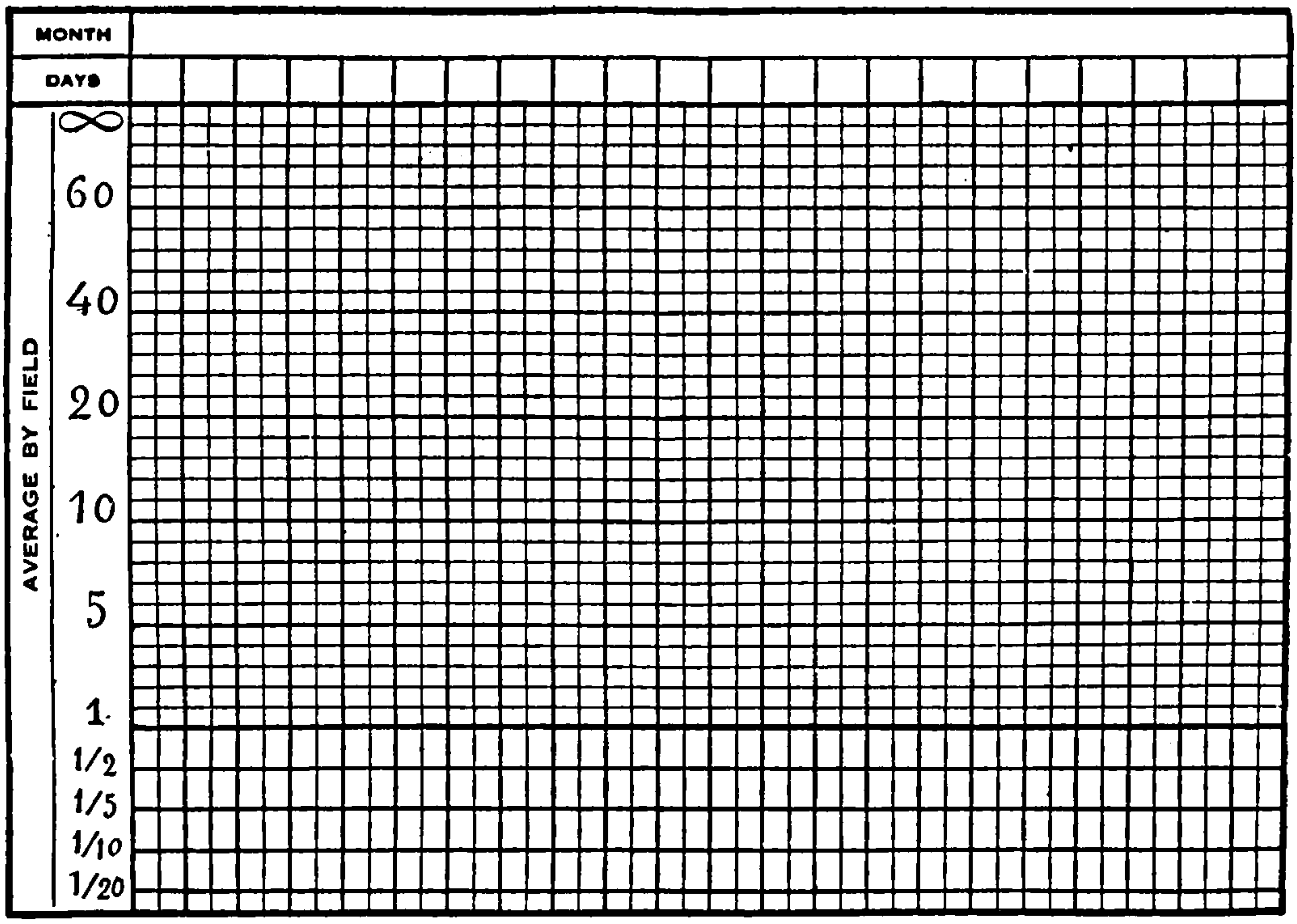


FIG. 109.—DR. CARREL'S BACTERIOLOGICAL CHART FOR A TRACED RECORD OF THE MICROSCOPICAL COUNT OF THE BACTERIA IN THE SMEARS TAKEN FROM THE WOUND DURING THE COURSE OF THE CARREL-DAKIN TREATMENT.

the trouble will usually be traced to one or more of the following causes:

1. Incomplete *débridement.*
2. Incorrectly placed delivery tubes.
3. Insufficient number of delivery tubes.
4. Insufficient amount of instillation.
5. Faulty adjustment of dressings.
6. Flaw in technic somewhere along the line from *débridement* to instillation.

The surgeon or the pathologist will do this bacteriological part of the technic, though there may be cases in which the nurse will be called upon to take the smear from the wound. It should not be necessary to remind the nurse that the *strictest aseptic technic* must be observed in this act, and that the slide must be carefully protected from contamination until delivered to the pathologist.

The smears should be taken at the *same hour each day;* not sooner than *two hours after an instillation;* and the various operations from the taking of the smear to the counting of the germs should be *done by the same person* or persons throughout the course for a given case, so as to eliminate all variations due to causes outside of the wound itself.

IV. SUTURING OF THE WOUND

When three successive smears have shown no germs the surgeon then sutures the wound, which should heal uneventfully. It must not be forgotten, however, that this *sterilized wound is not yet safe,* but that it may be reinfected unless the rigid asepsis is maintained until healing is complete.

One case has now been carried through the entire course of the Carrel-Dakin treatment and we shall proceed to learn *how to treat the tubes* for the next one.

DISPOSAL OF USED DELIVERY TUBES

If in good condition these *tubes may be used again,* but the greatest care must be exercised in the re-preparation of them.

Immediately upon removal from the wound the *tubes should be stored in some antiseptic solution.* If this is not possible immediately they should at least be put into a basin of saline solution or even plain water, because if they are allowed to become dry before washing it will often be very difficult to get them clean. Any antiseptic solution which will not injure rubber will do, such as lysol or carbolic. Dakin's solution may be used, of course, but unless one's supply is very abundant this is more extravagant than necessary.

In any case, the *tubes should be allowed to soak for several hours* in the antiseptic solution before anyone is asked to handle them for washing. It is probably true, however, that these tubes are not greatly infected, particularly on the inside, because of the fact that they have constantly been in contact with the Dakin solution while in the wound.

Nevertheless, *rubber gloves should be worn when washing them,* and care should be taken not to splash the wash water into the eyes, mouth, etc. This point may seem an unnecessary one to remind nurses of, for they learn early in their work to beware of such accidents, but this is a peculiar case because of the fact that, in order to get the tubes clean on the inside, it is necessary (for they are tied shut at one end) to struggle considerably with them while holding them stretched out enough to enlarge the perforations sufficiently to allow what is inside to be washed out. They will inevitably snap out of one's fingers repeatedly and should not be able to splash anything about which is not reasonably clean. Clear *running water* should be used first in the washing, and then *soap and water.* The use of a forceful syringe is an advantage at this stage. After a thorough rinsing the tubes are ready for the *final boiling.*

THE DAKIN SOLUTION

What It Is Made From.—Dakin's solution is usually made from three well-known chemical substances, namely, *chloride of lime, carbonate of soda* (washing soda), and *bicarbonate of soda.* This sounds as though it should be a very simple chemical and a very easily prepared one, but as we shall see later, when we get down to the study of its chemistry, it is really far from simple.

When we come to the instructions for making the solution we shall give a process in which the chloride of lime is not used, but since this other method only uses another means of obtaining the all-important chemical, *chlorine,* it involves no vital difference.

What It Is.—In simple terms Dakin's solution is a 0.45 to 0.50 per cent. *solution of sodium hypochlorite. Chlorine,* as you may know, is one of the most active of the chemical elements,

be kept in mind at all times when administering the treatment.

Dakin's solution is also a deodorant. Perhaps one of the first points that a nurse will note about her first "Dakinized" wound is, that where otherwise there would be an offensive odor of pus there is only the fresh, clean odor of the chlorine.

Another graceful service which this highly accomplished solution gives is to *beautify the wound* into a healthful-appearing, rich, red color.

How It Is Made.—The accurate compounding of the Dakin solution is *a very exact and technical chemical process,* and should be done by an experienced chemist; but as a matter of knowledge and reference we give here the early crude process and the later more elaborate one.

Dakin's Early Process

Ordinary water	10 litres
Anhydrous carbonate of soda	140 grams
or, Crystallized salt	400 grams
Chloride of lime	200 grams

Shake the mixture well. After half an hour siphon off the clear liquid and filter through cotton. Add to this solution:

Boric acid	40 grams

Daufresne's Technic

This is Dr. Carrel's own description of the process as published in the *Journal of the American Medical Association*, December 9, 1916.

Dakin's solution is a solution of sodium hypochlorite for surgical use, the characteristics of which, established after numerous tests and a long practical experience, are as follows:

(a) **Complete Absence of Caustic Alkali.**—The absolute necessity for employing in the treatment of wounds a solution free from alkali hydroxide excludes the commercial Javelle water, Labarraque's solution and all the solutions prepared by any other procedure than the following:

(b) **Concentration.**—The concentration of sodium hypochlorite must be exactly between 0.45 and 0.50 per cent. Below 0.45 per cent. of hypochlorite the solution is not sufficiently active; above 0.50 per cent. it becomes irritating.

(c) **Chemicals Required for the Preparation.**—Three chemical substances are indispensable to Dakin's solution: Chlorinated lime, anhydrous sodium carbonate, and sodium bicarbonate. Among these three products the latter two are of a practically adequate constancy, but this is not the case with the first. Its content in active chlorine (decoloring chlorine) varies within wide limits, and it is absolutely indispensable to titrate it before using it.

Titration of the Chlorinated Lime.—There must be on hand for this special purpose:

A 25 c.c. buret graduated in 0.1 c.c.

A pipet gauged for 10 c.c.

A decinormal solution of sodium thiosulphite (hyposulphite).

This decinormal solution of sodium thiosulphite can be obtained in the market; it can also be prepared by dissolving 25 grams of pure crystalline sodium thiosulphite in 1 litre of distilled water and verifying by the decoloration of an equal volume of the decinormal solution of iodine by this solution. The iodine is prepared by dissolving 1.27 grams iodine and 5 grams potassium iodide in 100 c.c. of water.

The material for the dosage thus provided, a sample of the provision of chlorinated lime on hand is taken up either with a special sound or in small quantities from the mass which then are carefully mixed.

Weigh out 20 grams of this average sample, mix it as completely as possible with 1 litre of ordinary water, and leave it in contact a few hours, agitating it from time to time. Filter.

Measure exactly with a gauged pipet 10 c.c. of the clear fluid; add to it 20 c.c. of a 1:10 solution of potassium iodide and 2 c.c. of acetic or hydrochloric acid. Drop, a drop at a time, into this mixture a decinormal solution of sodium thiosulphite until decoloration is complete.

The number of cubic centimetres of the hypochlorite solution required for complete decoloration, multiplied by 1.775 gives the weight of the active chlorine contained in 100 grams of the chlorinated lime.

This figure being known, it is applied to the accompanying table, which will give the quantities of chlorinated lime, of sodium carbonate, and of sodium bicarbonate which are to be employed to prepare 10 litres of Dakin's solution.

Quantities of Ingredients for Ten Litres of Dakin's Solution

Titer of Chlorinated Lime	Chlorinated Lime Gm.	Anhydrous Sodium Carbonate Gm.	Sodium Bicarbonate Gm.
20	230	115	96
21	220	110	92
22	210	105	88
23	200	100	84
24	192	96	80
25	184	92	76
26	177	89	72
27	170	85	70
28	164	82	68
29	159	80	66
30	154	77	64
31	148	74	62
32	144	72	60
33	140	70	59
34	135	68	57
35	132	66	55
36	128	64	53
37	124	62	52

Example.—If it required 16.6 c.c. of the decinormal solution of the sodium thiosulphite for complete decoloration, the titer of the chlorinated lime in active chlorine is:

$$16.6 \times 1.775 = 29.7 \text{ percent.}$$

The quantities to be employed to prepare 10 litres of the solution will be in this case:

Chlorinated lime ....154 grams
Dry sodium carbonate .... 77 grams
Sodium bicarbonate .... 62 grams

from 12 to 13 c.c. of decinormal thiosulphite are required to complete the decoloration:

$$13 \times 0.03725 = 0.485 \text{ per cent. of NaOCl}$$

The Test for the Alkalinity of Dakin's Solution.—It is easy to differentiate the solution obtained by this procedure from the commercial hypochlorites and from Labarraque's solution: Pour into a glass about 20 c.c. of the fluid, and drop on the surface a few centigrams of phenolphthalein in powdered form. Dakin's solution, correctly prepared, gives absolutely no change in tint, while in the same conditions Javelle water and Labarraque's fluid give an intense red coloration which indicates in the latter two solutions the presence of free caustic sodium.

Another method which simplifies the manufacture of the Dakin solution if the requisite apparatus can be secured is simply to dissolve the sodium carbonate in the proper amount of water and then pass the chlorine gas directly into this solution from cylinders of the compressed gas. A meter is used to measure the gas as it flows, but the tests used in the above process for the finished product must be made in this case also.

CHAPTER XX

BANDAGING

THE subject of bandaging is one which can be disposed of with a few arbitrary demonstrations, and some pupils can be trained thus into dextrous bandagers; but on the whole, time can be saved and more intelligent skill attained if demonstration and practice are reserved till a general survey of the field has been made from the more purely theoretical standpoint. It may be true that the art of bandaging is not a major subject, speaking theoretically, but there are certain real principles involved which must be observed in all bandaging that is worthy of the name, and though they are few they are important enough to be dignified by serious classification and study as a foundation for practice. Before we take up the actual practice of the art of bandaging, therefore, let us prepare ourselves to do it as intelligently as we can.

DEFINITIONS

A *bandage* may be defined as a piece of flexible material suitably fashioned for application about something as a covering, a reinforcement, or a compressor.

The term *bandaging* will then mean the art of applying the bandage for any of these purposes.

USES OF BANDAGES

The purposes for which bandages are used may be summed up under these headings:

1. *To hold dressings, splints, and other appliances in place.*
2. *For support*, as in the case of a sprained joint, etc.
3. *For pressure*, as in the case of a bleeding vessel, etc.

The specific uses are too numerous to mention here, and they will be readily gathered in the following pages.

FORMS OF BANDAGES

Under the general definition the bandage may be of a great number of forms, but those in more common and standard use are: (a) *The Roller Bandage,* (b) *The Triangular Bandage,* (c) *The Many-Tailed Bandage.*

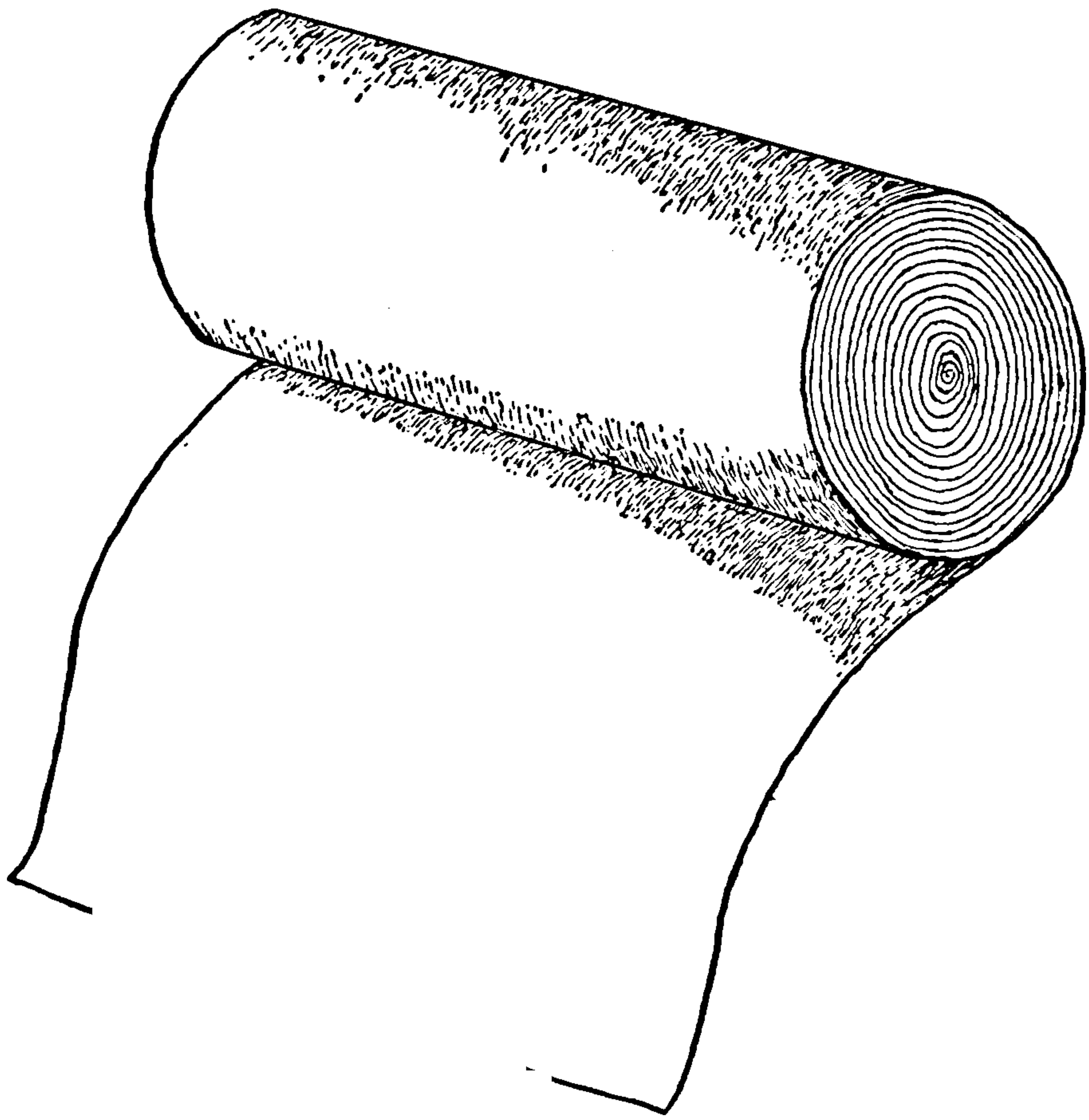


FIG. 110.—THE ROLLER BANDAGE.

(a) *The Roller Bandage* (Fig. 110) is merely the bandage material which has been cut into a long, narrow strip and rolled up, from one end to the other, into a compact cylinder so that it may be more easily and quickly handled and used.

The market supplies these bandages in all materials and sizes ready for use, but there will be occasions when these will not be available and every student should learn the several methods for preparing them. There are numerous hand machines for

rolling bandages, and the nurse will have access to these in most hospitals, but as a preparation against the times when she will be out of reach of machines she should practice one or both of the *hand methods* illustrated in Fig. 111. This is really a simple thing to do and the only points to bear in mind about it are that a solidly rolled bandage is much more satisfactorily applied than a softly rolled one, and that to secure a solidly rolled one it must be very compactly rolled from the very beginning because the whole will have no more body in the end than its core.

The roller bandage is by far the more commonly used one, and the one which is adaptable to the greatest variety of purposes.

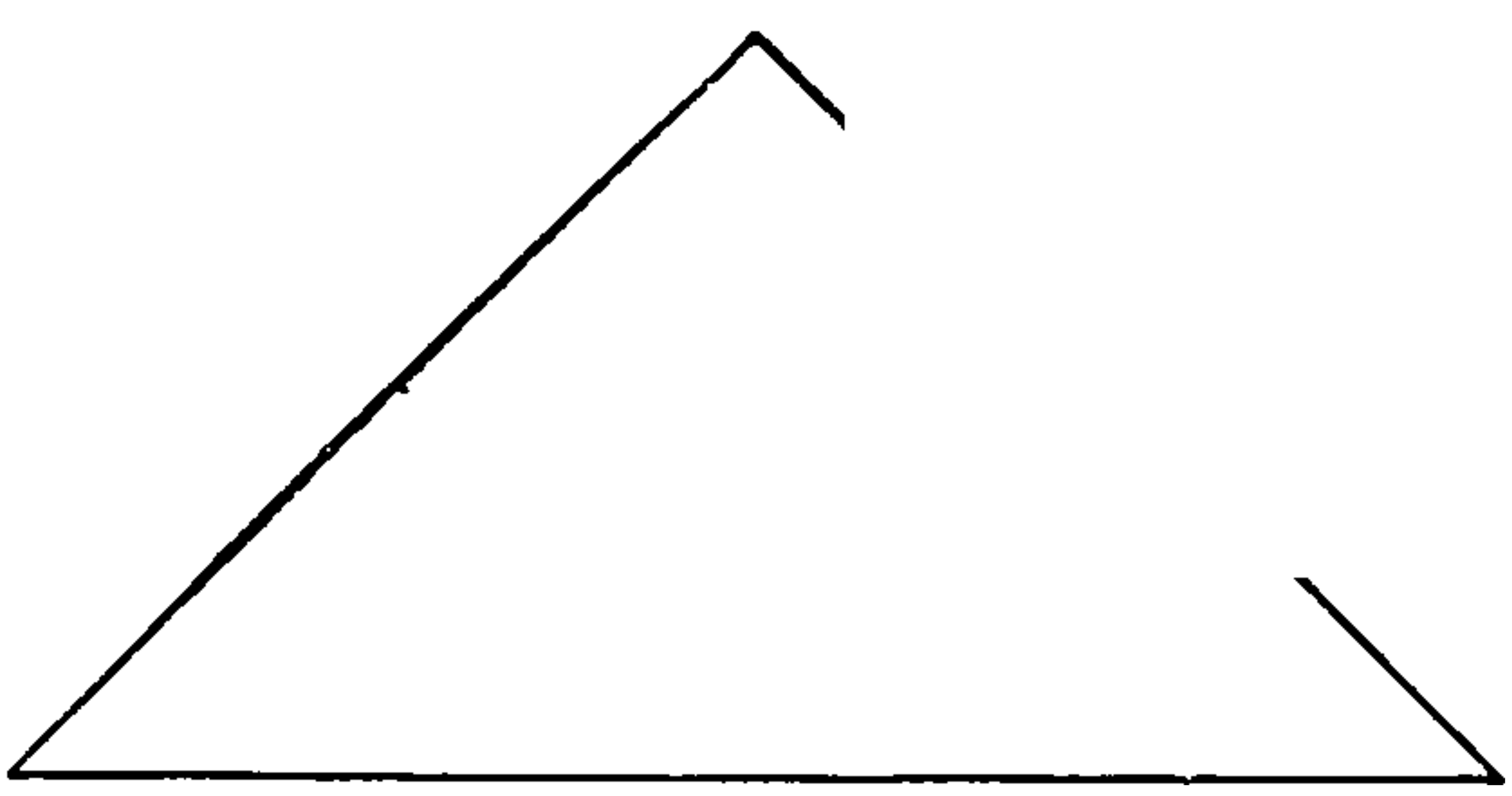


FIG. 112.—THE TRIANGULAR BANDAGE, OR SLING.

(b) *The Triangular Bandage* (Fig. 112) is simply a three-cornered piece of material the shape of the half of a square which has been cut from one corner to the diagonally opposite one, or which has been folded double along this line. Aside from one or two uses which will be encountered later, this bandage will be employed only as a substitute for the roller bandage in emergency cases, as it is more easily and quickly improvised than the roller one.

(c) *The Many-Tailed Bandage* (Fig. 113) is made in a number of slightly varying designs but consists essentially either of a single oblong piece of material which has been split at each end into two or more tails (A and B of the illustration), or of a combination of two or more strips whose edges have been overlapped and stitched together in the middle, leaving the ends free (C of the illustration). The particular type C is commonly known as the *Scultetus bandage* or binder. The many-tailed bandage serves few purposes for which the roller bandage will not be preferred, but it has wide application and constitutes a very serviceable emergency form because it is simple to make and easy to apply.

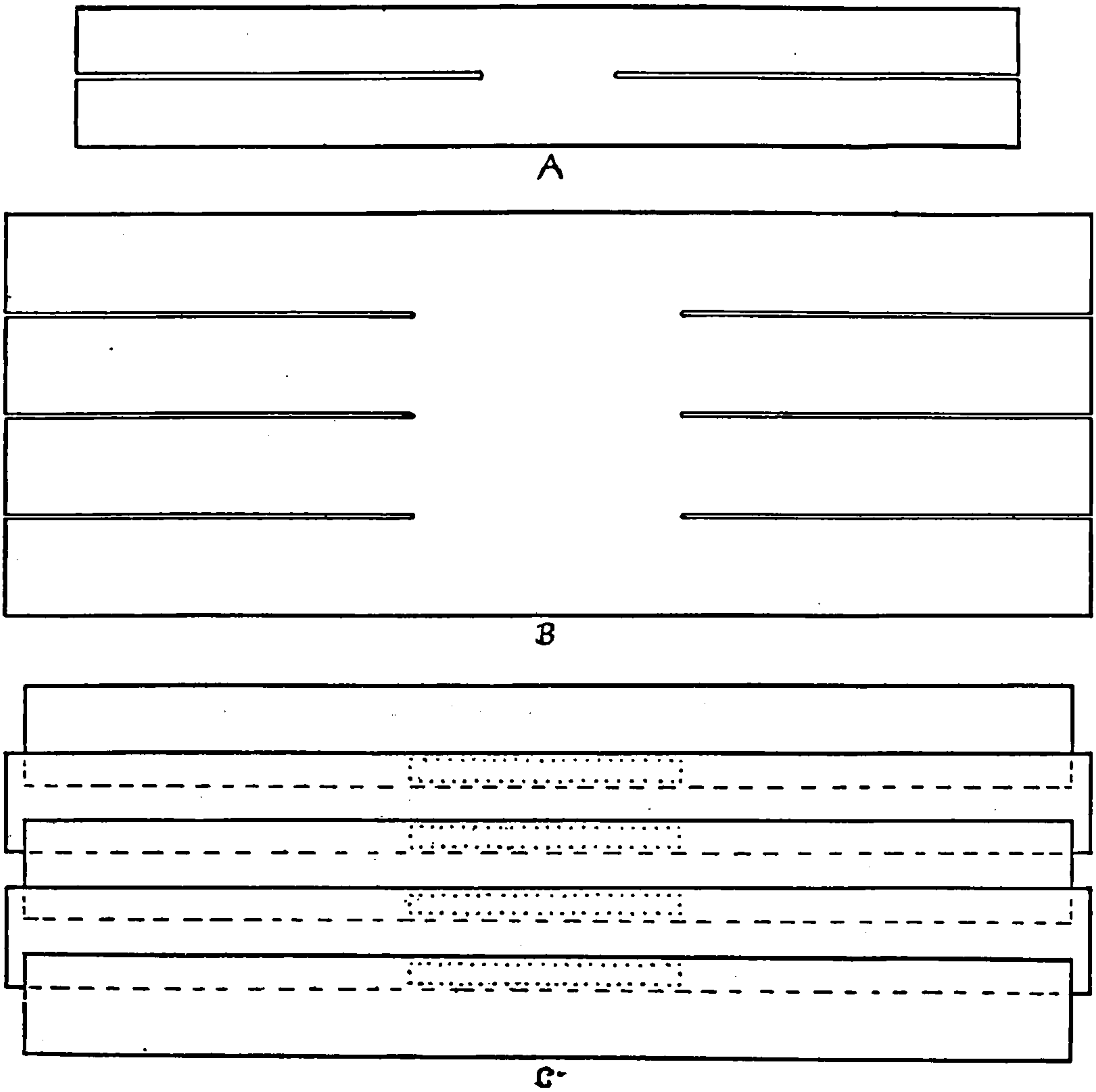


FIG. 113.—MANY-TAILED BANDAGES. *A* and *B*, the simple design made by splitting the ends of an oblong piece of material; *C*, the Scultetus bandage or binder made from strips of material lapped one upon the other and stitched together for a short distance in the middle.

MATERIALS USED FOR BANDAGES

It would be impossible to give an exhaustive list of the materials from which bandages are made because there is scarcely any limiting requisite except that of flexibility. However, the more or less standard ones for the three forms of bandages are as follows:

(a) *Roller Bandage*

Gauze
Muslin
Canton flannel
Woolen flannel

"Elastic" webbing (woven cotton bandage)
Rubber
Crinoline impregnated with starch—the "starch bandage"
Crinoline impregnated with plaster of Paris—the "plaster of Paris bandage"
Crêpe paper

Gauze is the most frequently used material. Its advantages are that it is light in weight, cool, and so flexible that it is easily fitted to all parts. It cannot be washed or used a second time with satisfaction and is therefore a relatively expensive material.

Muslin is very suitable where greater strength is needed, as in the application of the larger splints, in the arrest of hemorrhage, and in other cases where more pressure is required than gauze will supply. It withstands washing and repeated usage.

Canton flannel, because of its combined softness to the touch and its strength, is often used where pressure is necessary over a sensitive part. It is also useful as padding underneath a plaster or starch bandage.

Woolen flannel is used chiefly for its softness of texture. It, too, is washable and can be used repeatedly.

"Elastic" webbing is a specially woven cotton material which furnishes the advantages of the adaptability and a large part of the lightness of the gauze, a measure of the strength of the muslin, the softness of the flannel, and the elasticity of the rubber. As a substitute for the rubber this bandage has the very desirable superiority of being highly porous, but its strength is considerably less.

The *rubber* bandage, commonly known as the "Esmarch," is made of gum rubber. It is used as a pressure or constricting bandage for the arrest of hemorrhage, or for special treatment (see page 390).

The *starch* bandage is merely crinoline which has been saturated with a boiled solution of starch, and rolled loosely after it has become dry. It is softened again in warm water for the application, and when it has dried in place it constitutes a fairly rigid and relatively light cast or splint. It will be used for the immobilization of fractured or otherwise injured parts.

(b) *Triangular Bandage*

Muslin is the usual material for this bandage, but any similar material will, of course, serve as well.

(c) *Many-Tailed Bandage*

Muslin and Canton flannel will be used for this bandage, the choice depending upon the purpose it is to serve and the part to which it is applied.

SIZES OF BANDAGES

(a) *The Roller Bandage*

The *length* of the factory-rolled gauze bandage is usually 10 yards, and that of the muslin and flannel ones 5 yards. These have proved to be the most serviceable lengths on the whole, for these materials, the greater length being needed in the gauze because of its lighter weight and inferior strength which necessitate the use of more layers of it. The crinoline for the starch and plaster of Paris bandages may be of any length, but it is wise to vary the length with the width—that is, the narrower ones need not be as long as the wider ones.

The *width* of the roller bandage will depend upon the part to which it is applied and will vary roughly as follows:

Finger	¾ to 1 inch
Hand and arm	1½ to 2½ inches
Foot and leg	1½ to 3 inches
Hip	3 to 4 inches
Body (chest and abdomen)	3 to 5 inches

(b) *The Triangular Bandage*

This bandage will vary in size with the part upon which it is used and will be in general as follows:

Arm (the sling)	the half of 1 square yard
Hand	the quarter of the sling
Foot	the half of the sling
Head	the half of the sling
Shoulder	the half of 1 square yard
Hip	the half of 1 square yard

(c) *The Many-Tailed Bandage*

It will not be very helpful to prescribe dimensions for this bandage as it will need to be fitted to each patient, and the illustrations in Fig. 145, page 389, will guide the student as to the proper measurements to make.

PRINCIPLES OF BANDAGING

Before we undertake to apply a bandage we should adopt as our fixed, guiding influences these three principles of the art:

1. *Evenness of Pressure*
2. *Durability*
3. *Neatness*

These principles are stated in the order of their importance, and in the order in which they should be put into effect by the beginner, but one may not call herself a finished practitioner until she is able to observe the three simultaneously. They scarcely need elucidation, but a few important details pertaining to each of them which the student should be reminded of are as follows:

1. **Evenness of Pressure.**—Every bandage necessarily exerts a certain amount of pressure depending upon the part to which it is applied and the purpose which it is to serve. A bony part, such as the skull, for instance, will need and endure, in general, more pressure than a yielding part, such as the hand; and a bandage applied to compress a bleeding vessel must, of course, exert more pressure than one which serves the mere purpose of keeping a dressing in place. *Much practice* is the only means of acquiring good judgment as to the suitable amount of pressure for any given case, and this must always be guided by an intelligent comprehension of the object of the treatment and the condition of the part bandaged, and by due consideration for the patient's immediate and future comfort.

Whatever the tension of the bandage, however, the important point, from all standpoints, is that it should be equal throughout, because very serious results may follow otherwise. In the first place, a bandage which constricts in lines here and there is very *uncomfortable.* This objection will often take care of itself, however, through the complaint of the patient; but the really serious damage is done in those cases where the part was previously so painful throughout or so subnormally sensitive for some reason that the patient does not accuse the bandage. In these instances the unevenly-applied bandage may so constrict blood vessels and compress nerves as to cause *gangrene or paralysis* in the part.

Of course, a bandaged part is always kept under observation, but the best precaution against accidents from unevenness of pressure is plenty of diligent practice with the bandage.

2. **Durability.**—The importance of durability in an applied bandage is so self-evident as to need no comment, except, perhaps, the reminder that an unstable bandage is usually a very *uncomfortable* thing to wear.

When one has learned the first principle well she has progressed a long way toward the secret of this second one. That is, a bandage which is *evenly applied,* within the limitations of reasonably good pressure, is more likely to stay in place than the uneven one. However, the problem of durability involves much more than this and it is perhaps not an exaggeration to say that excellence is harder to attain under this principle than under either of the other two.

Much may be accomplished as to durability by placing the part in its *customary position* or in the desired permanent one before applying the bandage, because muscular motion underneath a bandage will surely disarrange it more or less.

Finally, faithfulness to the *method customary* for the part or purpose will be of great importance because experience is responsible for the particular method and it will be rare that the best results will follow any considerable departure from the advice of long experience. These various methods will be taken up a few pages hence and the student will do well when she reaches them to accord them a special mark of respect for the sake of this principle of durability.

3. **Neatness.**—This last principle is very unproverbial in

as illustrated in Fig. 115—that is, one hand prepares to place and keep the free end where it belongs and the other to control the unwinding of the bandage as it is applied. We then study the five different modes thus:

1. **Circular Mode.**—*The head* is one of the subjects for this type of bandage, and so with both hands we lay the bandage against the forehead (Fig. 116), a small portion having been unrolled for ease in properly locating it. The free end is held against the temple with the one hand while with the other the bandage is rolled around the circumference of the head with

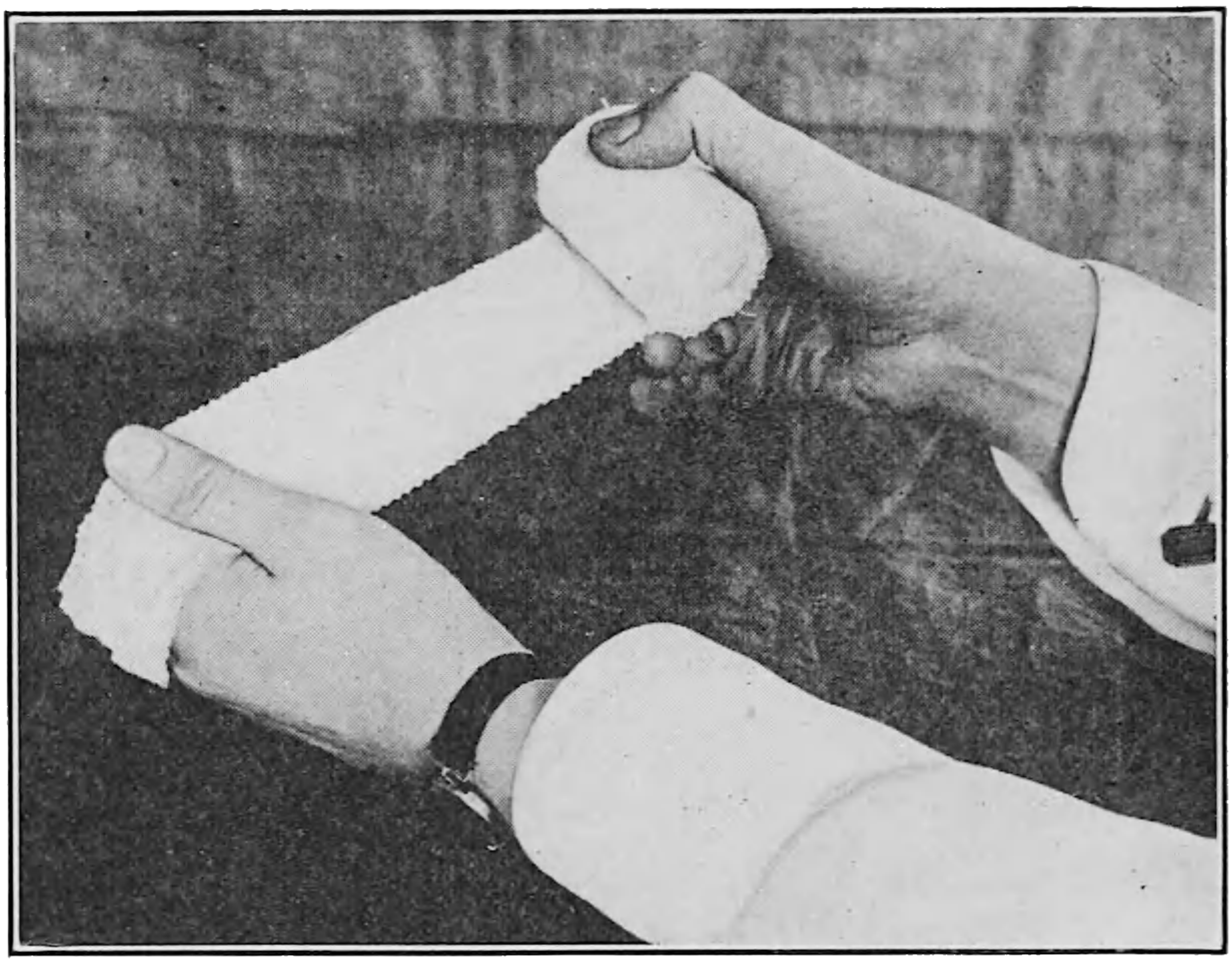


Fig. 115.—The Way to Grasp the Roller Bandage Preparatory to Applying It.

even and firm tension till it reaches the free end when it is continned over this and around the head again in exactly the same track. After the end has been secured the hand which held it will be released, of course, to assist the other one by carrying the roll around on its side of the head. When the roll reaches the location of the free end the second time we have a circle of two layers of bandage around the head (Fig. 117), and have thus secured by friction and stress, or, in other words, have "*anchored,*" our bandage; and at the same time we have applied the amount of bandage which may be taken as a *standard foundation*—that is, two layers. This will rarely ever constitute a complete piece of bandaging, but it does enter

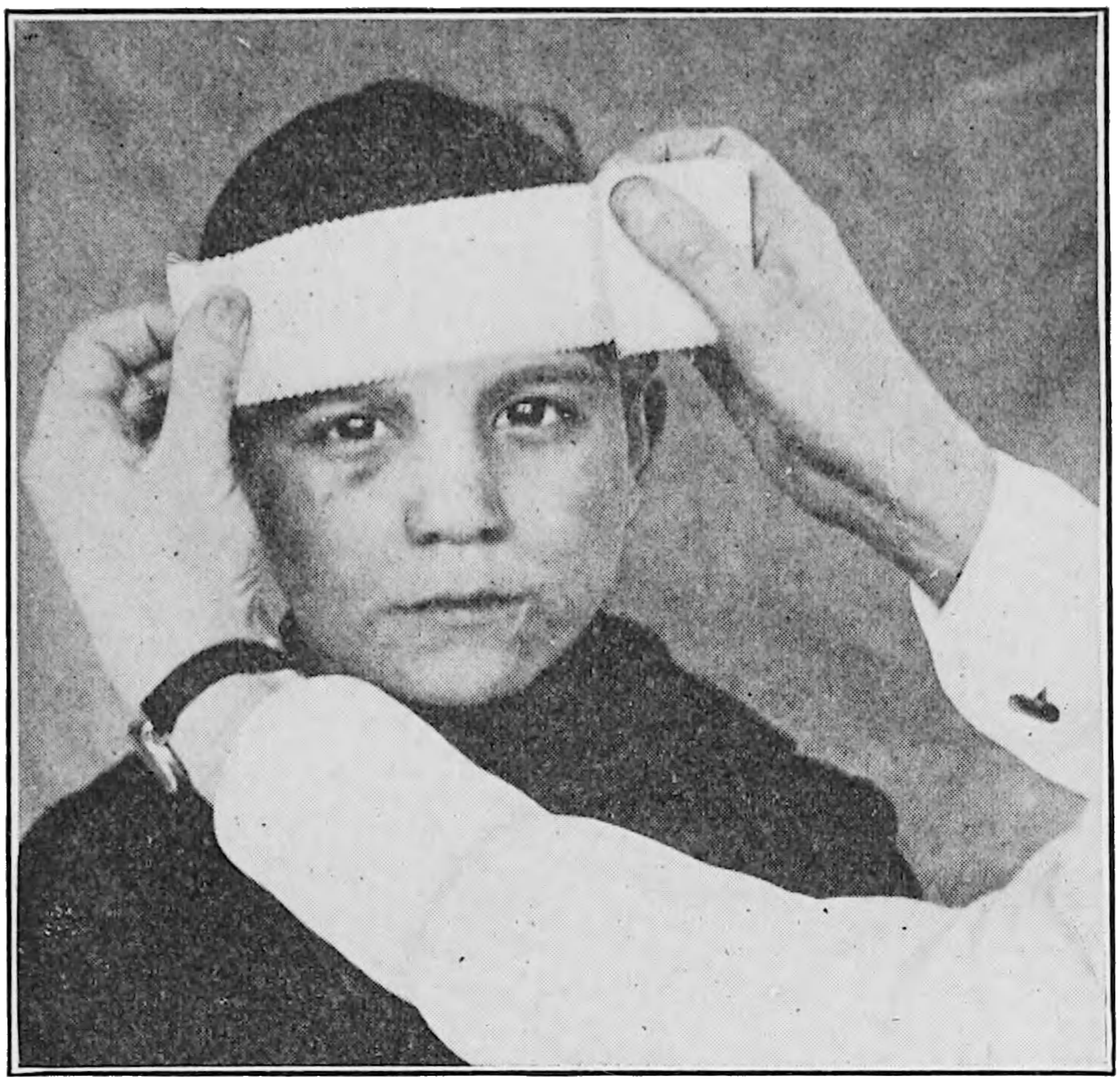


FIG. 116.—THE WAY TO BEGIN THE APPLICATION OF THE ROLLER BANDAGE

FIG. 117.—THE CIRCULAR MODE OF BANDAGING—the usual anchorage for the applied roller bandage.

into nearly every bandage as the means of both anchoring it in the beginning and of securing it at the end.

2. **Spiral Mode.**—For this demonstration we shall select

the *upper arm.* Grasp the bandage as before, lay it upon the arm near the elbow, and apply a circular bandage—that is, two layers, one directly upon the other, entirely around the arm. Then begin to travel upward with slow spiral turns of the bandage (Fig. 118), allowing each turn to cover at least one-third of the width of the previously-applied one. Keep in mind, as you do this, your *three principles,* maintaining the same tension on your bandage throughout, rolling the layers on smoothly and at a stable angle (that is, not so great an angle that they will have a tendency to creep back), and make it as neat as you can by keeping the edges of every two layers parallel and by covering the same fraction of the width of the previous layer every time. Finished with two or more of the circular turns, this will make a complete design which is applicable only to such comparatively *parallel-sided parts* as some upper arms, the fingers, etc., or to similarly-shaped splints.

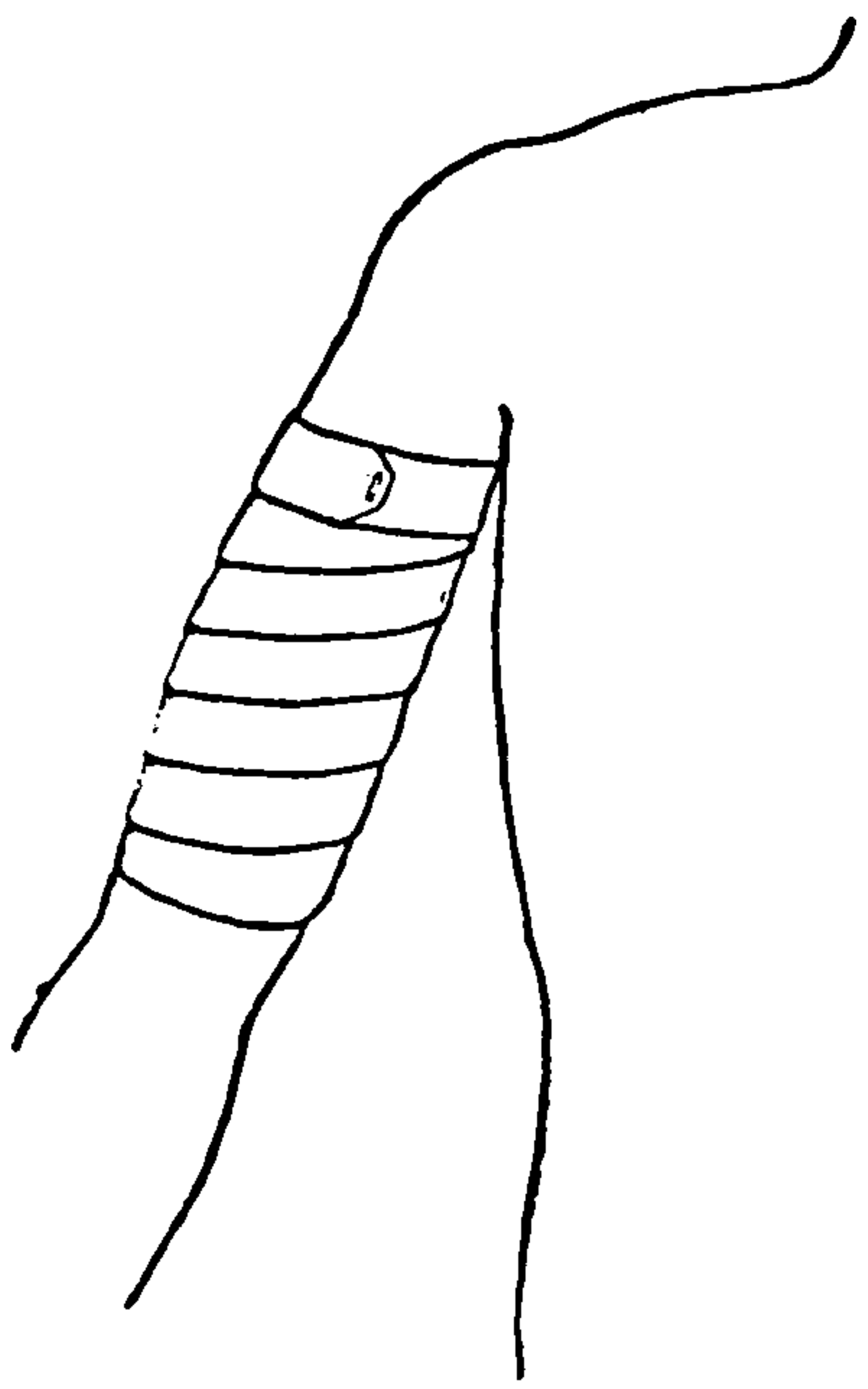


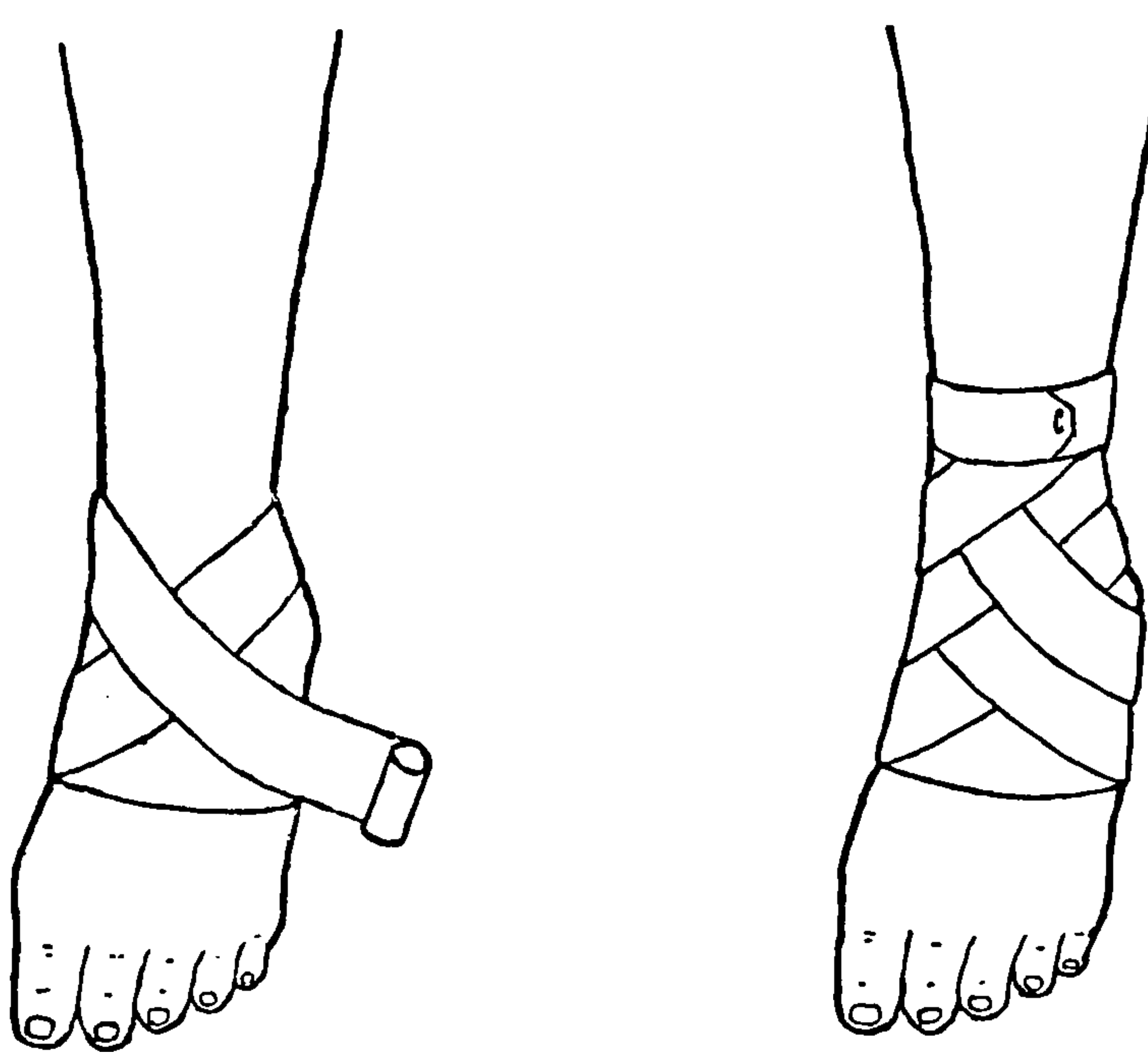
Fig. 118.—The Spiral Mode of Bandaging.

3. **Reverse Mode.**—The *forearm* is a suitable part upon which to demonstrate this mode because of its cone-like outline. It will be a good plan for the beginner to apply, first of all, a few turns of the spiral bandage to this part in order to learn at once why it will not answer (Fig. 119). She will see that it embodies an infraction of every one of the three principles of bandaging—that is, the two edges of the bandage exert unequal degrees of pressure, which is very clear from the fact that one of them is entirely free of tension in a part of every turn; it will not stay in place, as its appearance very clearly indicates and as a slight pull would demonstrate; and it certainly does not look neat. We can correct all these evils very easily, however, in this way:

Start just above the wrist with the now familiar circular bandage; then begin one of the spiral turns, but just as the

into one flat fold. This is done by holding the applied bandage down with one hand just at the site of the reverse while the free part is allowed to slacken slightly for the moment of the reversal, after which the usual tension is resumed for the next turn. This bandage will be secured at the end with the usual circular bandage.

A great deal of practice will be required before one can apply the bandage well by this mode, and if it cannot be done well



A B

FIG. 121.—THE FIGURE-OF-8 MODE OF BANDAGING. *A*, the first turns; *B*, the completed bandage of the ankle.

some other mode should be used instead for there are too many loopholes in it for offenses against all of the three principles of bandaging. It is a very suitable method, however, for tapering parts, such as the arm and leg, and if one wishes to become a versatile bandager she must learn it.

4. **Figure-of-8 Mode.**—*The ankle* furnishes us with a good subject for this mode of bandaging. Start, as usual, with the circular bandage as your anchorage, placing it around the foot just at the base of the arch; then pass the bandage in figure-of-8 style thus: Diagonally across the instep toward the base of the heel, around the back of the heel, and across the instep

again in the other diagonal to the original circular bandage on the side opposite the starting point of the first diagonal (A of Fig. 121). This completes one figure-of-8 turn, and the bandage is continued simply by repeating this maneuver till the part is covered, lapping each turn over one-third or one-half of the width of the preceding one. If this is to constitute a com-

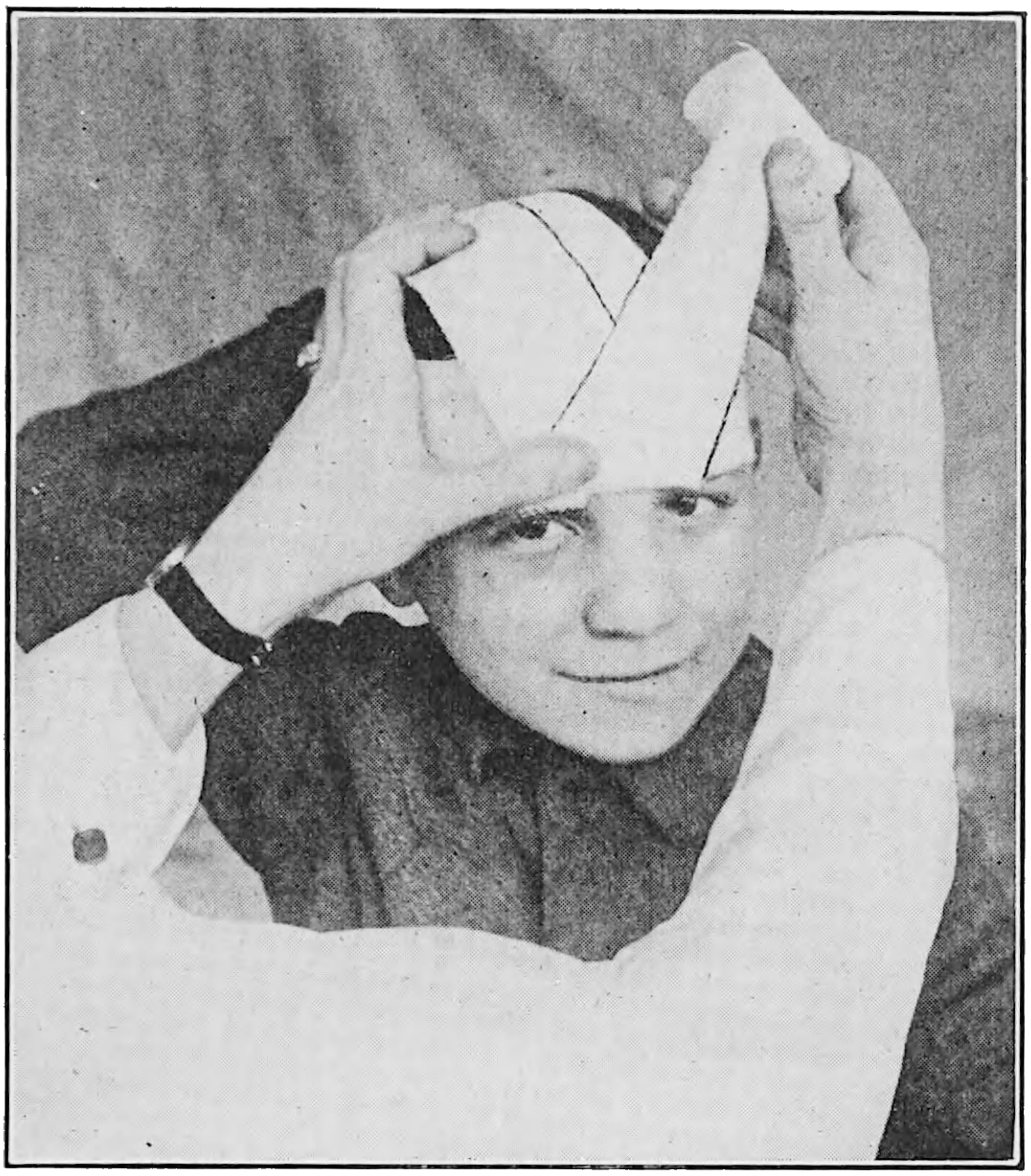


FIG. 122.—THE RECURRENT MODE OF BANDAGING. The patient is holding the reverses in place at the back of the head. On a smaller part, such as the stump of a limb, the bandager can control the entire operation himself.

plete dressing it will be secured by the circular bandage around the ankle (B of Fig. 121).

Though the design of this bandage is not the simplest one to learn, aside from that it is one of the easiest modes with which to secure good results under all of the three principles. Durability is an especially prominent feature of the figure-of-8 bandage, and its appearance can be made to compete very favorably with that of any of the other modes.

The figure-of-8 design has a very wide application, being almost the only suitable one for the *joints of the body,* particularly the larger ones, such as the ankle, knee, hip, wrist, elbow, and shoulder; and it is also applicable, *in combination with the reverse mode,* in various other parts which will be indicated later.

5. **Recurrent Mode.**—This is perhaps the most difficult mode to learn and it is also rather awkward to apply, in that it requires the assistance of a third hand when applied to the head, which is the most common subject for it. Often the patient himself will be able to lend this helping hand but if he cannot do this an assistant must be provided. As it will probably be the only available part for practice, we shall select the head for our subject. Pass a circular bandage around the head, as described in Mode 1, stopping at the middle of the forehead; then reverse the bandage by the same maneuver as you used for the reverse Mode (Fig. 120, page 369), and pass the roller backward across the middle of the head and down over the circular turn at the back, holding the fold of the reverse firmly in place with the thumb of the other hand meanwhile, and now asking the patient or the assistant to place his hand upon the intersection of the layers on the other side (Fig. 122). Repeat this process, back and forth, till the whole head is covered, working from the middle toward the sides alternately, and covering one-half of the previous layer each time (Fig. 123). In stationing the reverses it will be found possible and easiest to group them closely together (each immediately on top of the previous one) in the middle of either side rather than to distribute them along the circular bandage, as they can be more easily held in place this way and they will usually fit the part better thus. When the head has been entirely covered the bandage is again reversed to the direction of the original circular bandage and two more circular

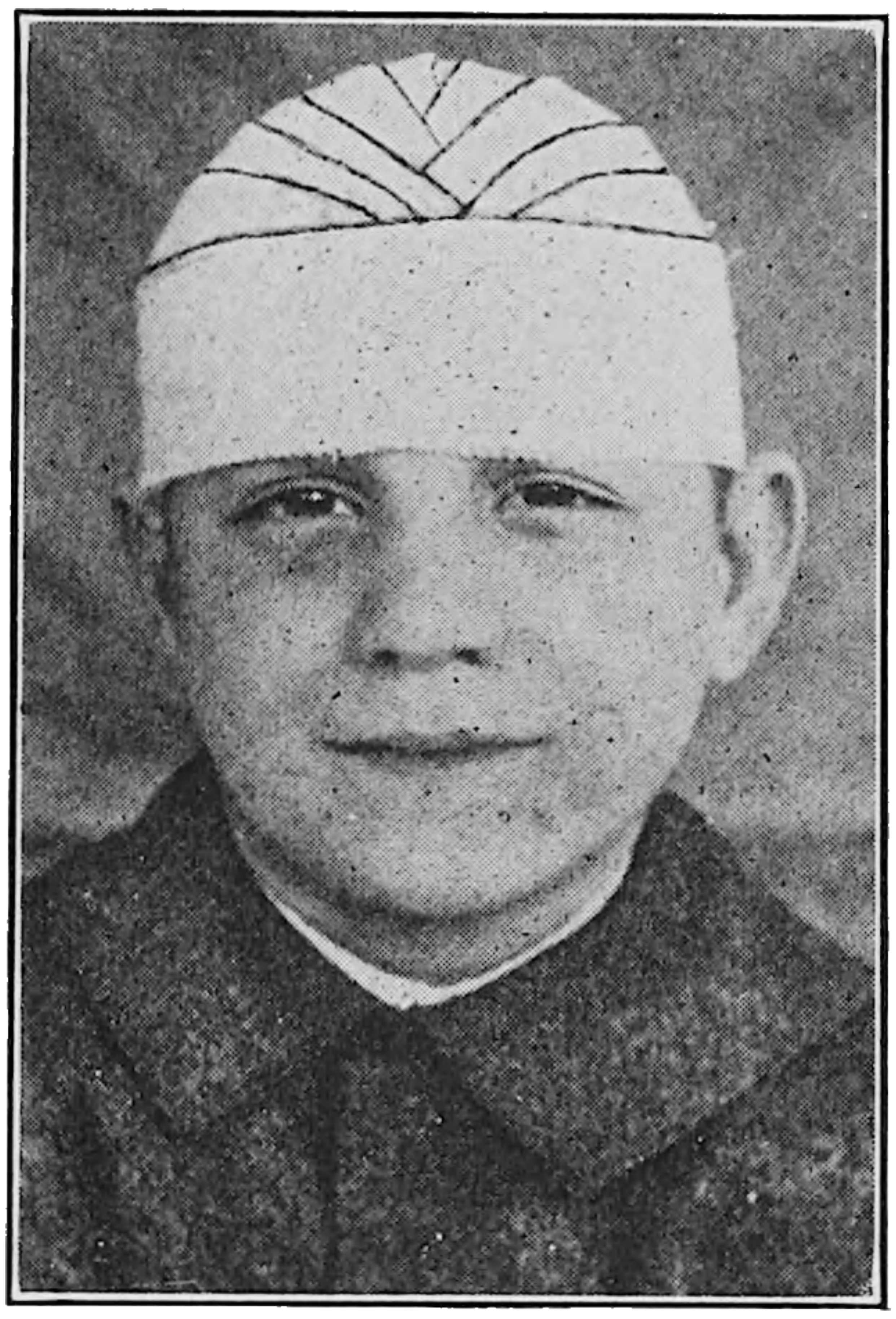


FIG. 123.—COMPLETED RECURRENT BANDAGE. Note that the turns all lie flat, and that they converge toward the middle of the forehead, which means that the reverses are lying directly over one another, as they should do.

page 371). The finger bandage may be anchored either around the wrist or the end of the finger.

The *thumb* presents a somewhat different case from the fingers in that it is nearly always bandaged with what is termed the "*spica*" bandage (Fig. 125). This spica involves nothing

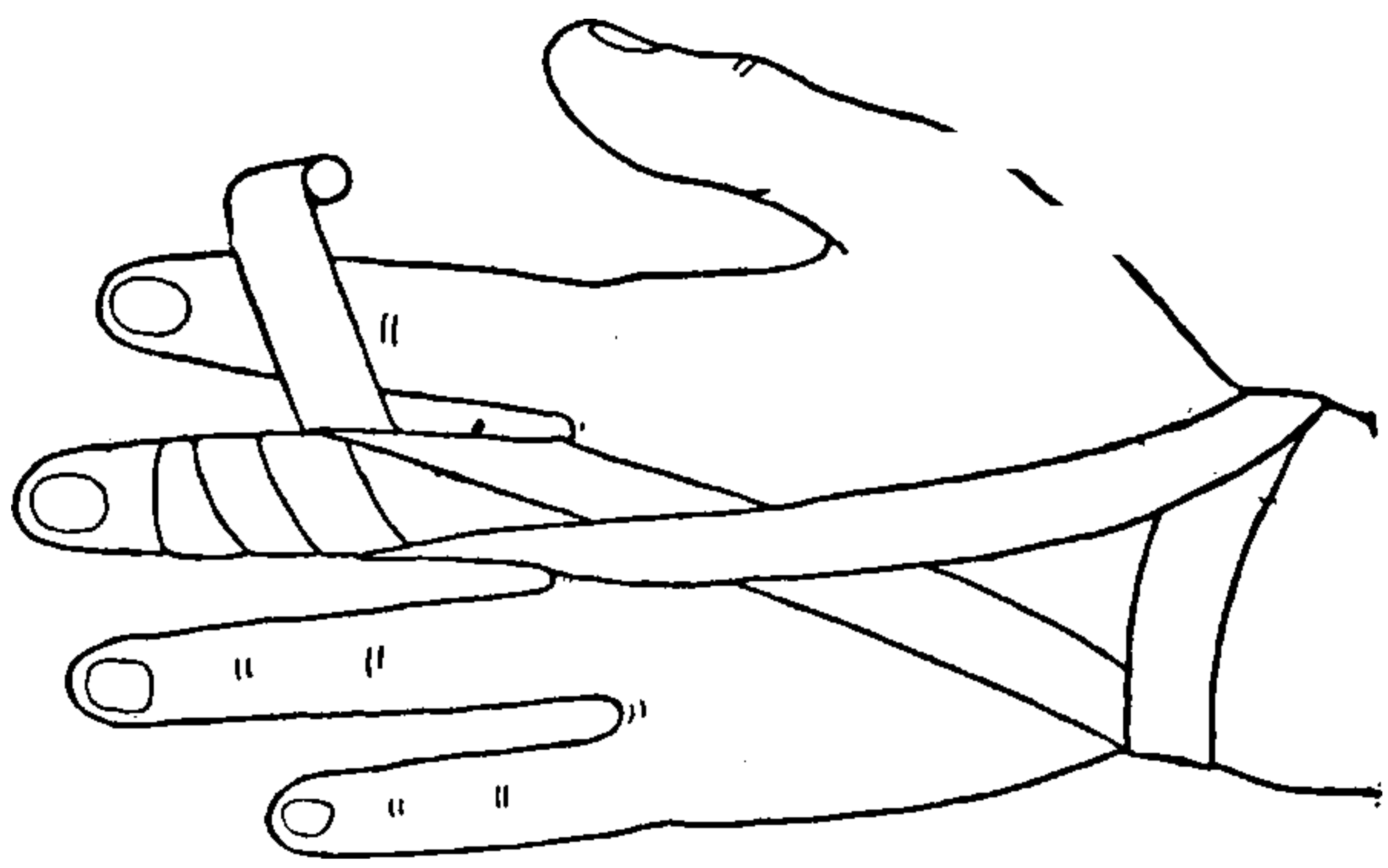


FIG. 124.—SPIRAL BANDAGE OF THE FINGER ANCHORED TO THE WRIST WITH A FIGURE-OF-8 AND A CIRCULAR TURN.

new as to mode, for it is a pure figure-of-8, but it so happens that in the complete design the layers present the appearance of the spikes in a head of barley, and therefore the bandage has been given the distinctive name "spica." Though the term has its origin in the mere appearance of the completed bandage,

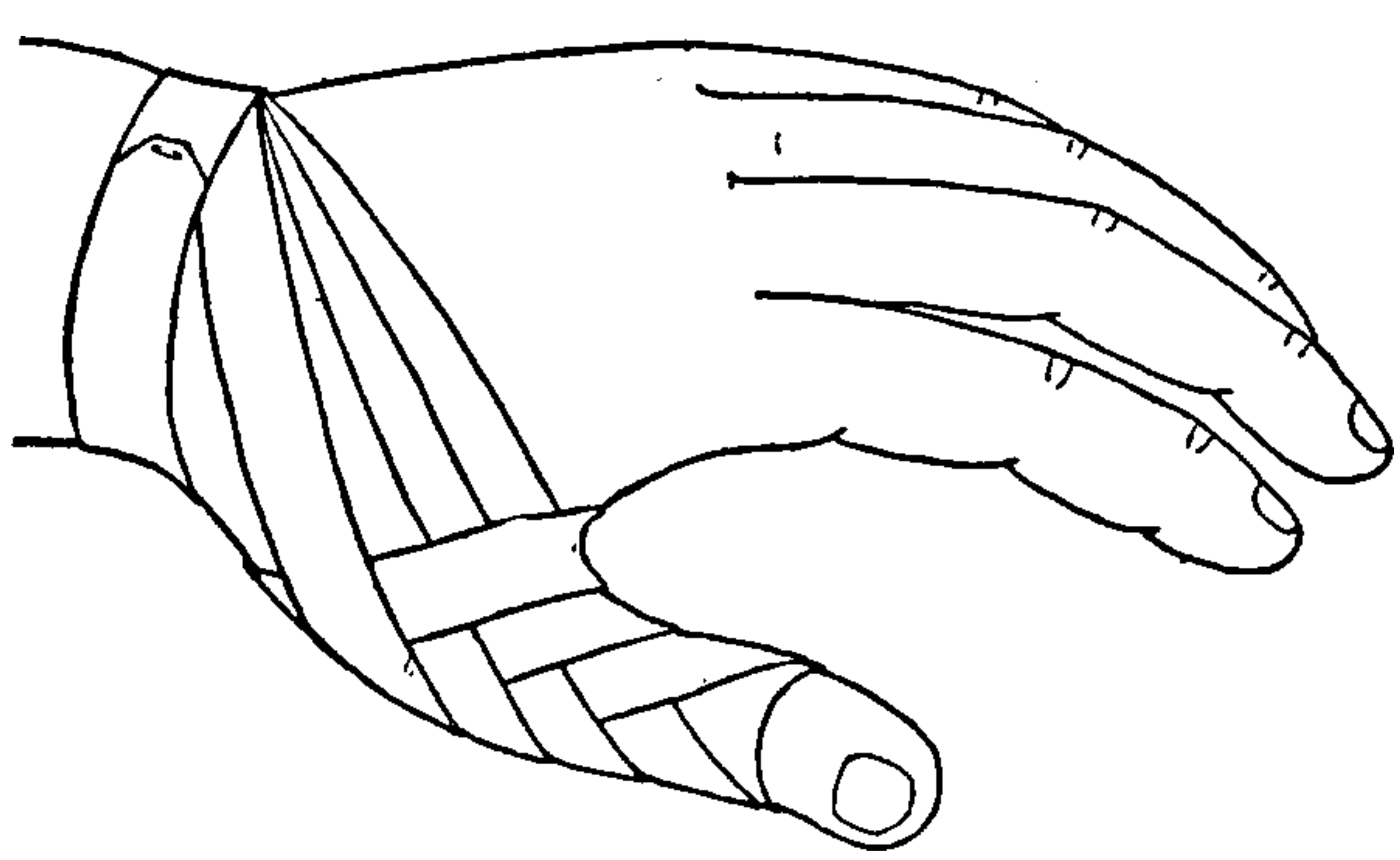


FIG. 125.—THE THUMB SPICA.

"spica" always carries with it the meaning of a joint bandage because the figure-of-8 takes on this appearance in all cases of its application to a joint which connects an appendage to its trunk. The application of a thumb spica will present no new problem to the student, and we have emphasized it here only for the sake of introducing the term which will arise in several other cases later.

Whether or not the fingers and the thumb are involved, our method of procedure for the *hand and arm* will be this (Fig. 126): Begin about the palm with the circular bandage, then a spiral or two if necessary, and proceed with the figure-of-8 over the back of the hand and the wrist, around the wrist with

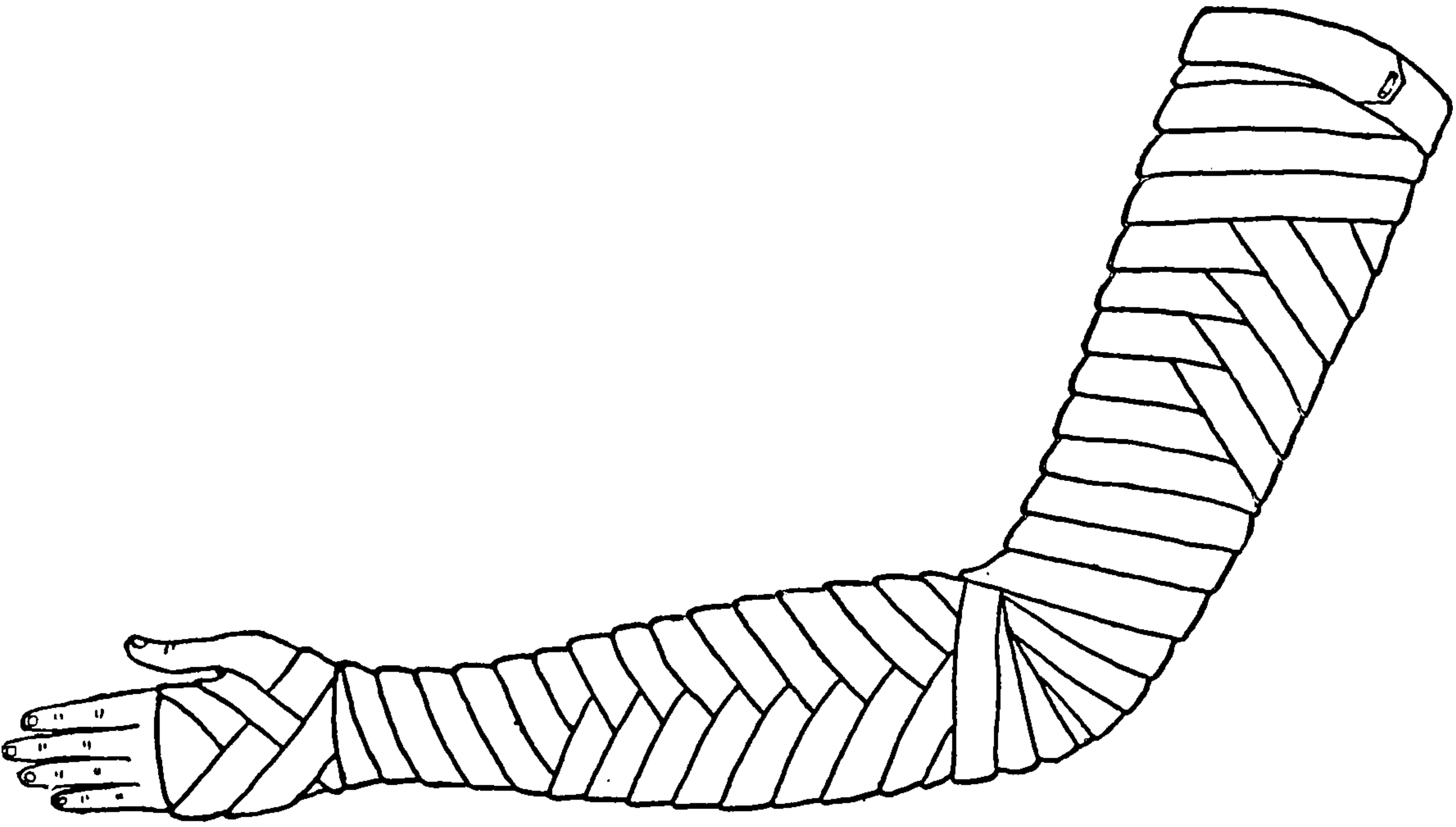


FIG. 126.—COMPLETE BANDAGE FOR THE HAND AND ARM.

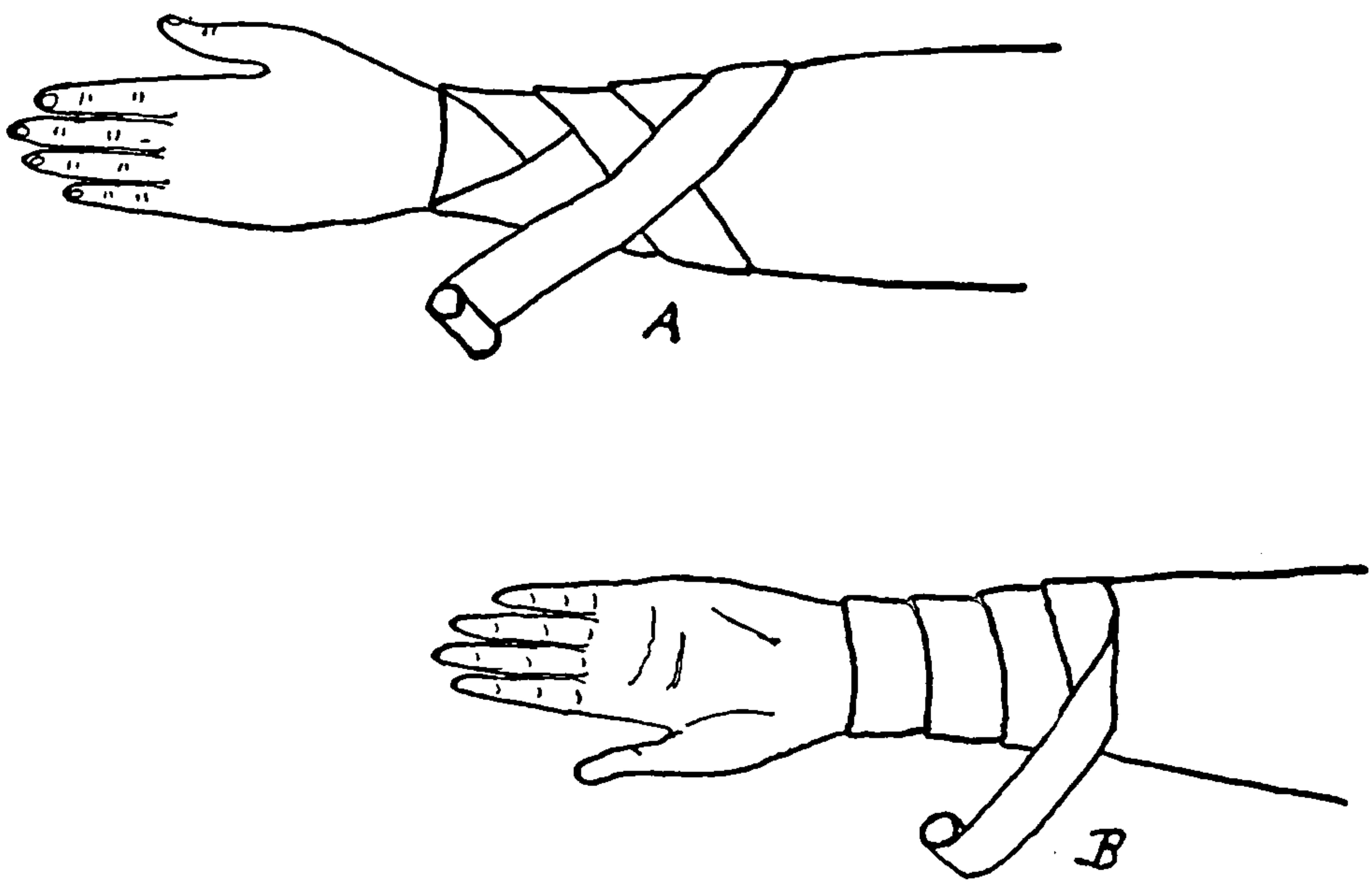


FIG. 127.—REVERSE FIGURE-OF-8 BANDAGE. *A,* front view showing the figure-of-8 turn; *B,* rear view showing the reverse turn.

the circular, upward over the cylindrical part of the forearm with the spiral, and thence with the reverse over the conical part to the elbow. The elbow (in a slightly flexed position) is then covered, directly over the joint, with two or three circular turns, several figure-of-8 turns (enough to cover it securely) are passed over this and about the joint, working upward and downward from the joint alternately. The upper arm is then covered with either the spiral or the reverse, depending upon whether it is of a general cylindrical shape or a conical one.

On the *shafts of the arm* a combination of the figure-of-8 and the reverse modes are very suitable, the figure-of-8 being used as the theme and the reverse being introduced only when needed to keep the bandage lying flat and to equalize the tension of the edges, which will usually be every second turn (Fig. 127). In this case the cross of the figure-of-8 turn is made on the top

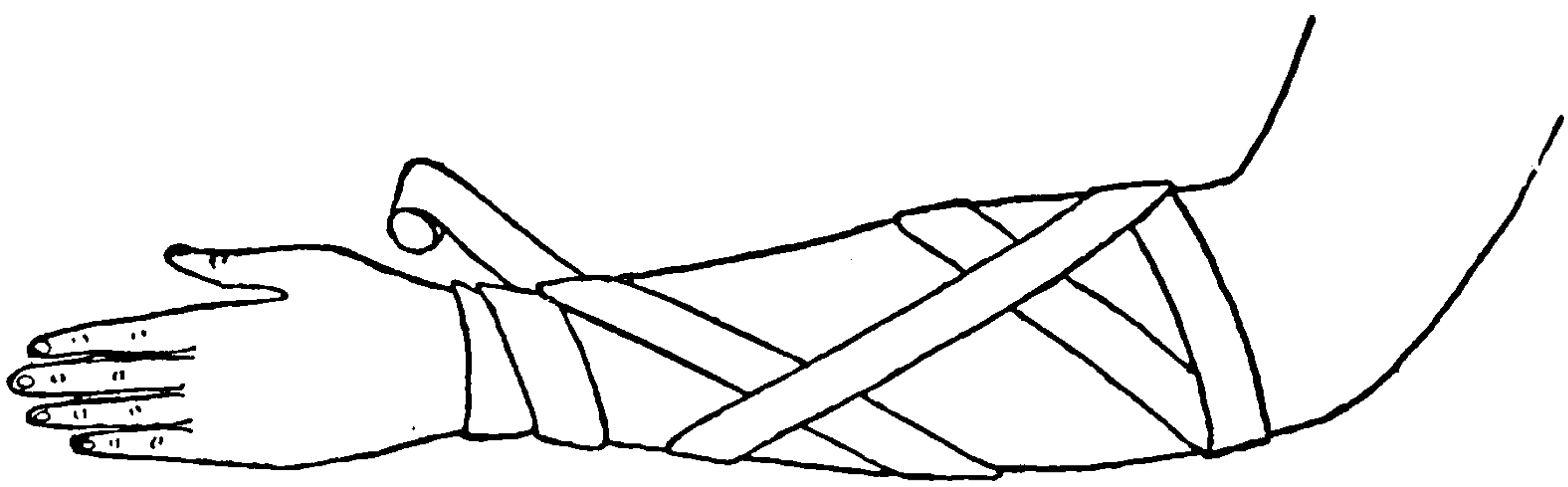


FIG. 128.—METHOD FOR SECURING BETTER ANCHORAGE OF A BANDAGE ON A TAPERING PART. The long spiral turns provide friction for the remainder of the bandage and also stabilize the wrist portion.

of the arm (A of Fig. 127) and the reverse on the back (B of Fig. 127). This bandage is very much preferred to any other by some persons because of its *superior durability.*

Another variation sometimes employed for securing durability in a bandage of a forearm which is extremely conical in shape is to run a *long spiral turn* (just after completing the wrist section) from the wrist to the elbow, one or two circular turns around the arm just below the elbow, and then the long spiral back again (Fig. 128). This gives the forearm bandage the advantage of a little *more friction* for keeping it in place on the sloping part, as it will not tend to slip so much on these turns of gauze as it would on the bare skin; and these layers have been made very secure by the turns at the elbow.

Foot and Leg

The *toes* may be bandaged separately, like the fingers; and when the figure-of-8 extension is necessary to keep it in place

turns, and one or two spirals if needed. Then cover the heel as described in the preceding paragraphs. This will entail the figure-of-8 of the ankle which was described under Mode 4, page 370. The details for the remainder of the leg will then

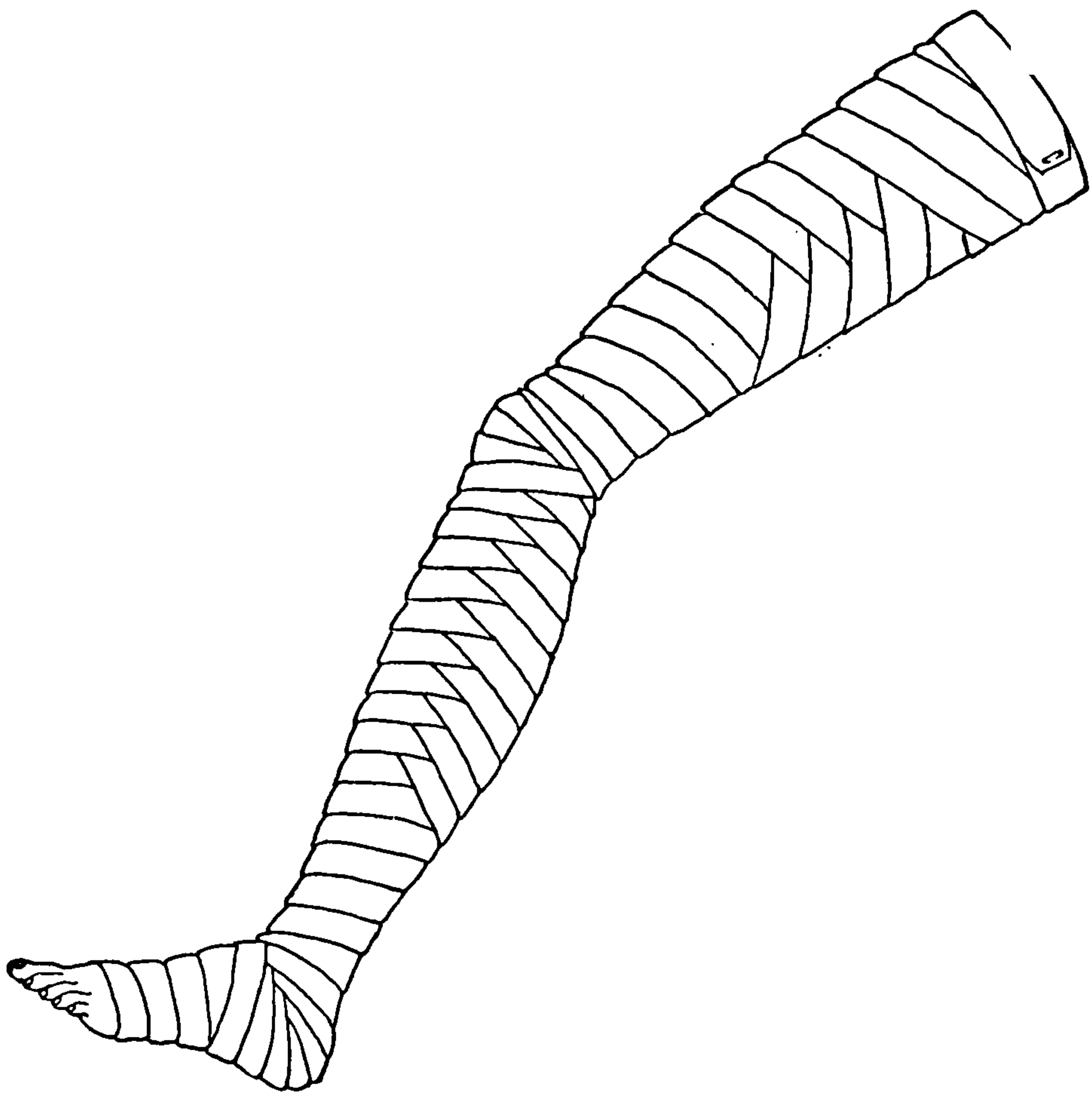


Fig. 130.—Complete Bandage for the Foot and Leg.

correspond exactly with those given for the arm, including the several variations pointed out there (Fig. 130).

The knee-joint bandage, of course, will be upside down from the standpoint of the bandager as compared with the elbow, but this will not cause any noteworthy confusion.

The Eye

The eye bandage becomes a very simple one if we conceive of it as being constructed, as it really is, entirely from the elementary circular bandage. Accordingly, let us imagine our standard circular bandage to be rigid, like a barrel hoop, and fit it thus into the several positions of the layers in the eye bandage. First of all, we place it around the top of the head as we did the circular bandage in the demonstration of Mode No. 1; this is our foundation, or anchorage. Then we imagine this circle on a pivot near the base of the nose and swing it down over the eye we are to bandage till it reaches the neck just below the ear on that side, and meanwhile, on the opposite side just over the other ear, it will have risen somewhat above our foundation circle. The two circles will now cross each other

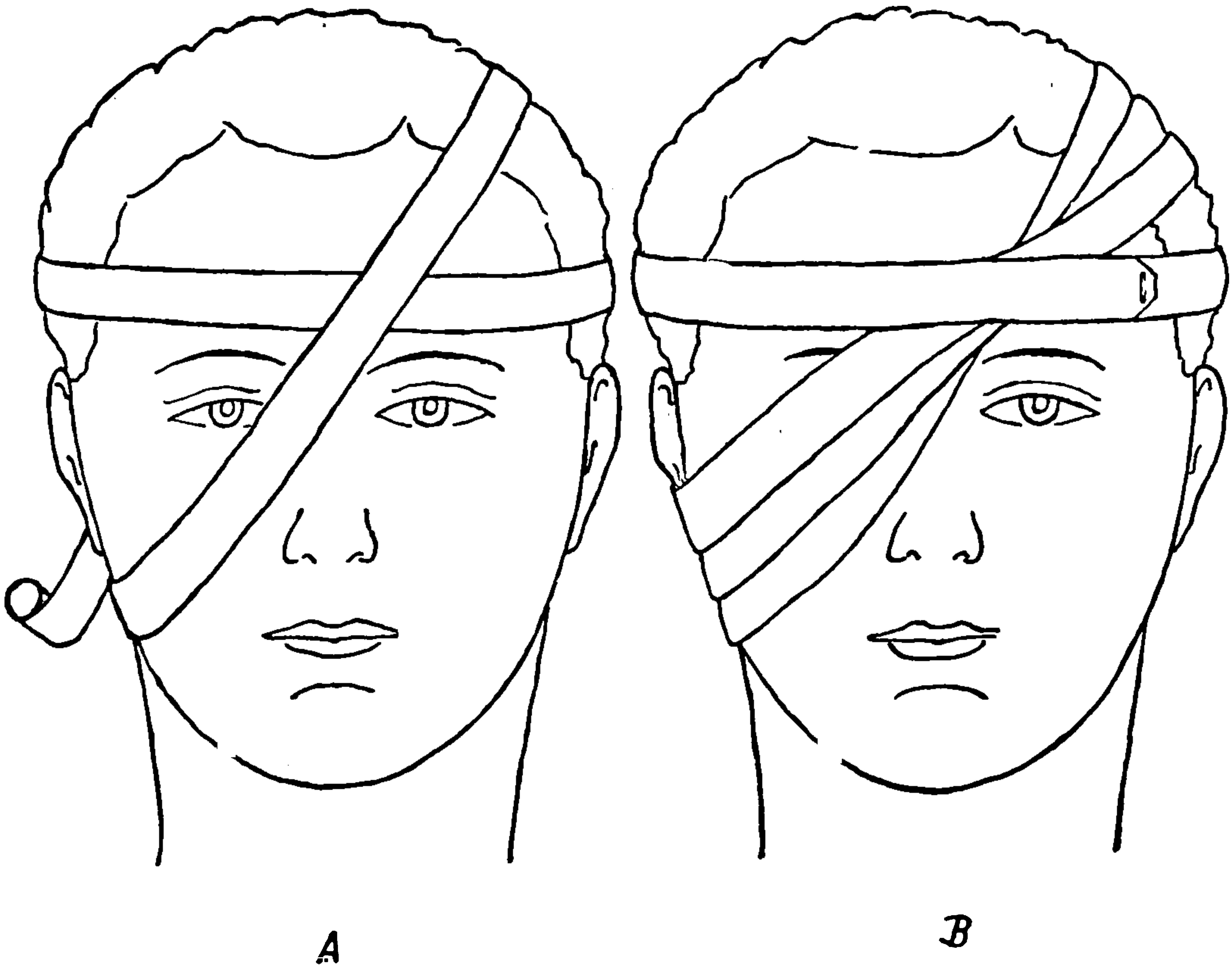


FIG. 131.—THE EYE BANDAGE. *A*, the first two circular turns in place; *B*, the completed bandage for one eye.

on the forehead and on the back of the head (A of Fig. 131). Then we swing our circle again but only far enough this time to cover one-half or one-third of the width of the parts of the other layers which lie below the one ear and above the other. In other words, this layer lies the width of the lap nearer each ear than the preceding one and crosses it on the forehead and on the back of the head at the sites of its intersections with the horizontal turn. This maneuver is repeated until we have enough angling layers (usually two or three) to cover the eye well, and then we swing our circle back again into the first

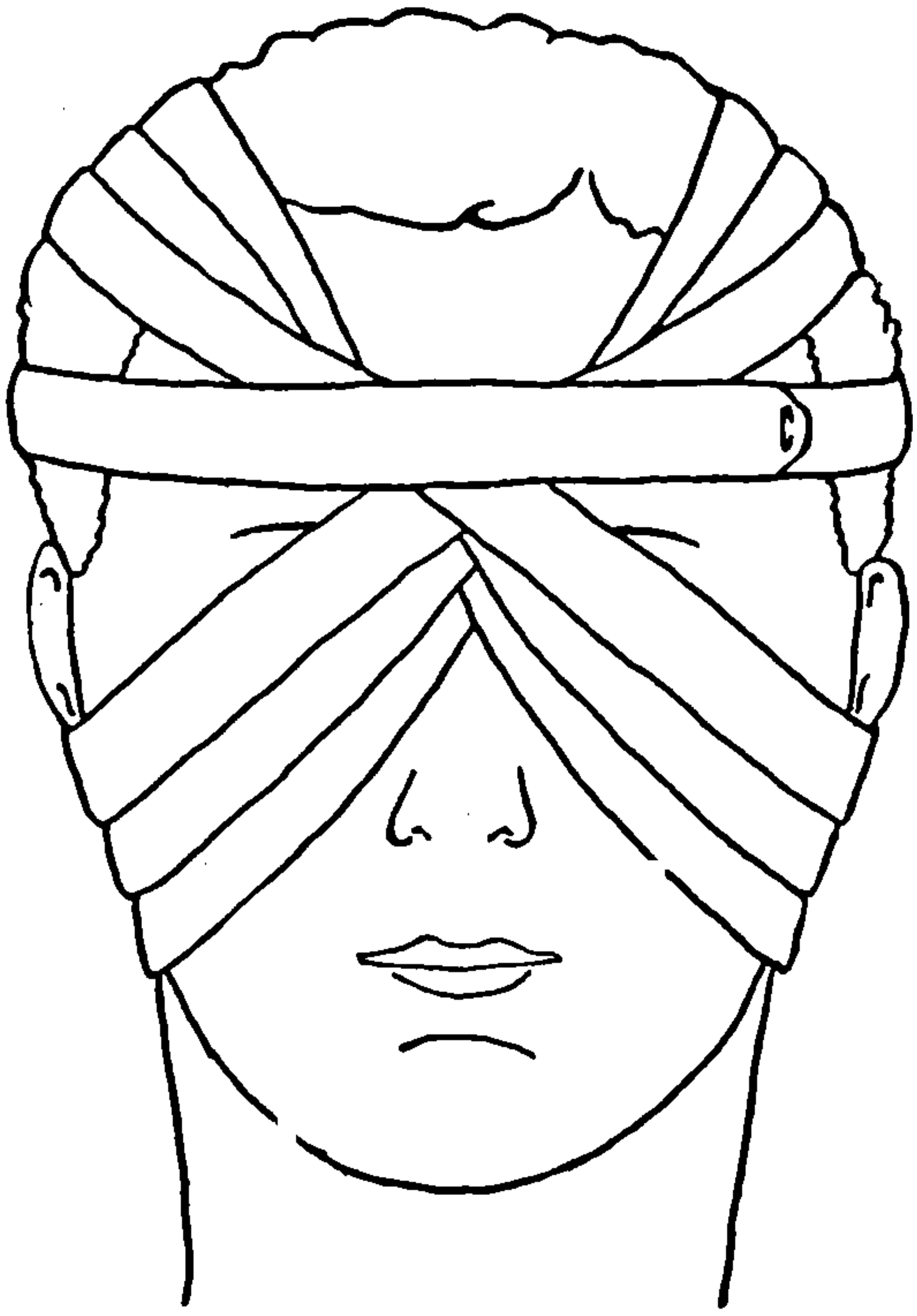


FIG. 132.—DOUBLE EYE BANDAGE.

position and apply one or two of the horizontal turns to anchor the whole (B of Fig. 131). On some heads it may be necessary to anchor each angling circle with the horizontal one, but this will mean merely swinging the circle alternately from one position to the other.

The flexible bandage will not perform with all the mechanical exactitude of the rigid hoop, of course, and the changes in plane will have to be made with gradual sweeps, but these will be easily managed if the student has her picture of the hoop structure clearly in mind.

To bandage both eyes all one needs to do is to alternate the angling turns between the two eyes, and as a rule one anchoring turn should be applied for each pair of angling ones. The whole is, of course, anchored finally with one or two of the horizontal turns (Fig. 132).

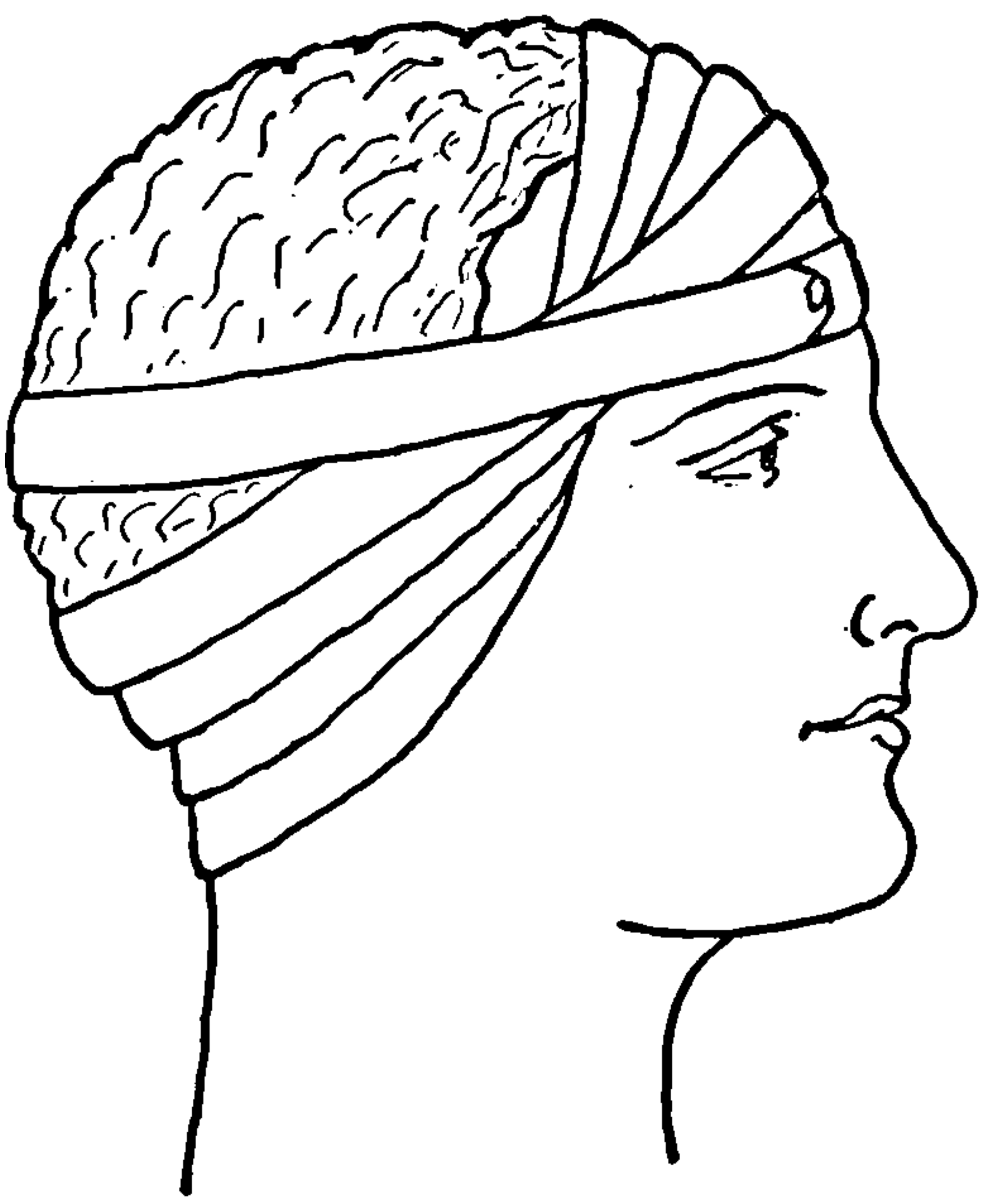


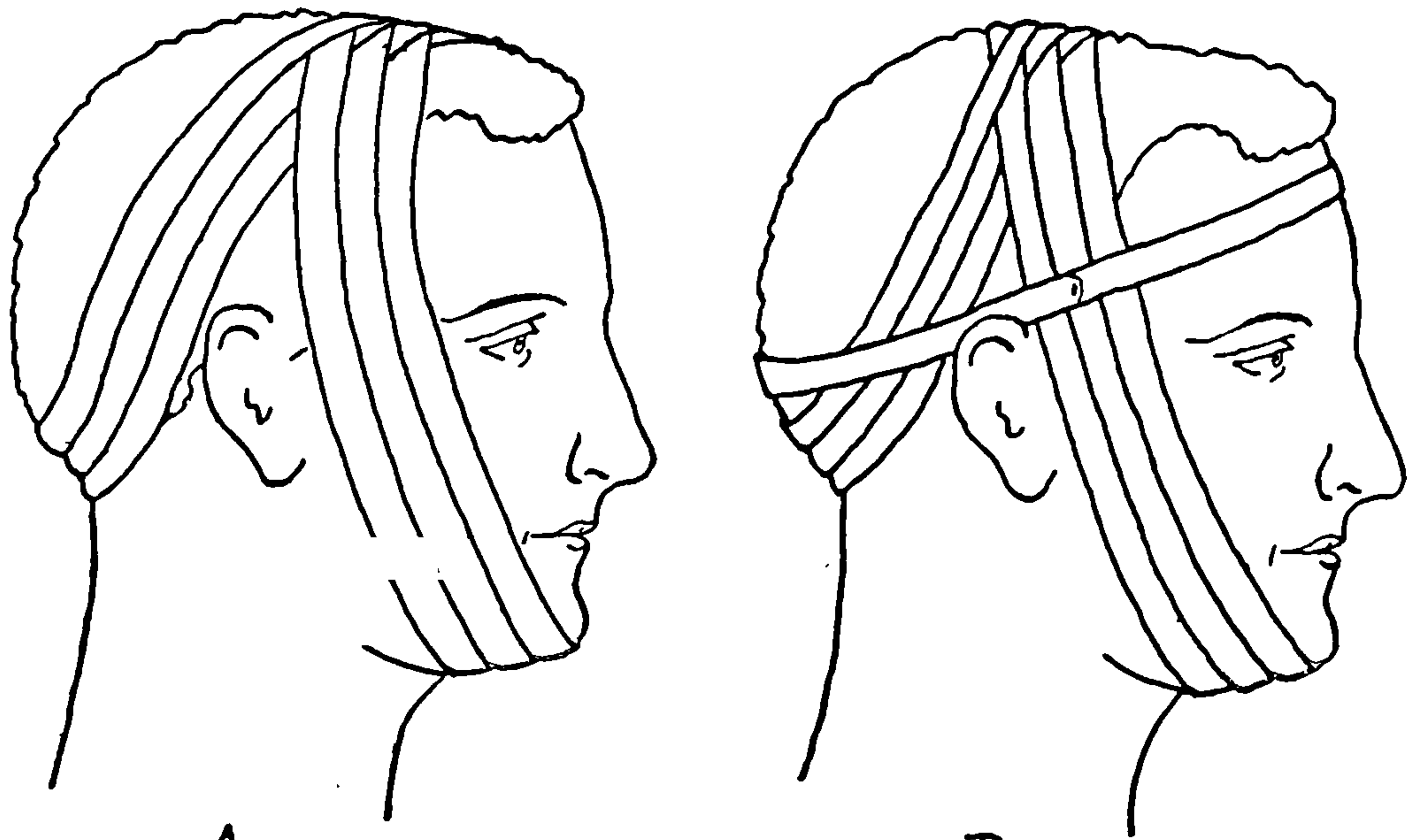
FIG. 133.—THE EAR BANDAGE. Note that it is merely the eye bandage design slipped about one-quarter of the way around the head, and that more turns are required for the ear region than were needed for the eye.

The Ear

The ear bandage, for either one or both ears, will correspond to that for the eyes in all detail except that more turns will be necessary as a rule (Fig. 133). In bandaging one ear it is sometimes difficult to avoid covering the opposite one also, but

This bandage will usually be applied under considerable tension.

The illustrations (Fig. 135) show *two ways of applying a bandage to the cheek, temple, or chin.* They need no special explanation except that they are started like the Barton bandage.



A B

FIG. 135.—TWO METHODS OF BANDAGING THE CHEEK, TEMPLE, OR CHIN. *A*, a simple figure-of-8 which will fit a head with a prominent crown; *B*, method necessary when the crown of the head is flatter, the turns about the forehead alternating with the others and binding them in place. Bandage *A* is fastened on the other side of the head.

age. Since heads vary so much in shape a trial must always be made of the first turn of these bandages to make sure that it is stably stationed. A variation forward or backward, on the top of the head, of the starting point, will always enable one to find the proper balance.

The Head

The appropriate bandage for the head is the recurrent one which we described under Mode No. 5 (Figs. 122 and 123, pages 371 and 372).

A more convenient way to apply the head bandage, however, is with *two roller bandages,* the ends of which have been carefully pinned or sewed together (Fig. 136). For this we proceed thus: Lay the bandages against the middle of the forehead, and then hold one stationary while you apply the anchoring circular bandage about the head with the other. Then pass the bandage which has been idle across the top of the head to the circular turn at the back, roll the other bandage across this (Fig. 137), and then continue carrying the one

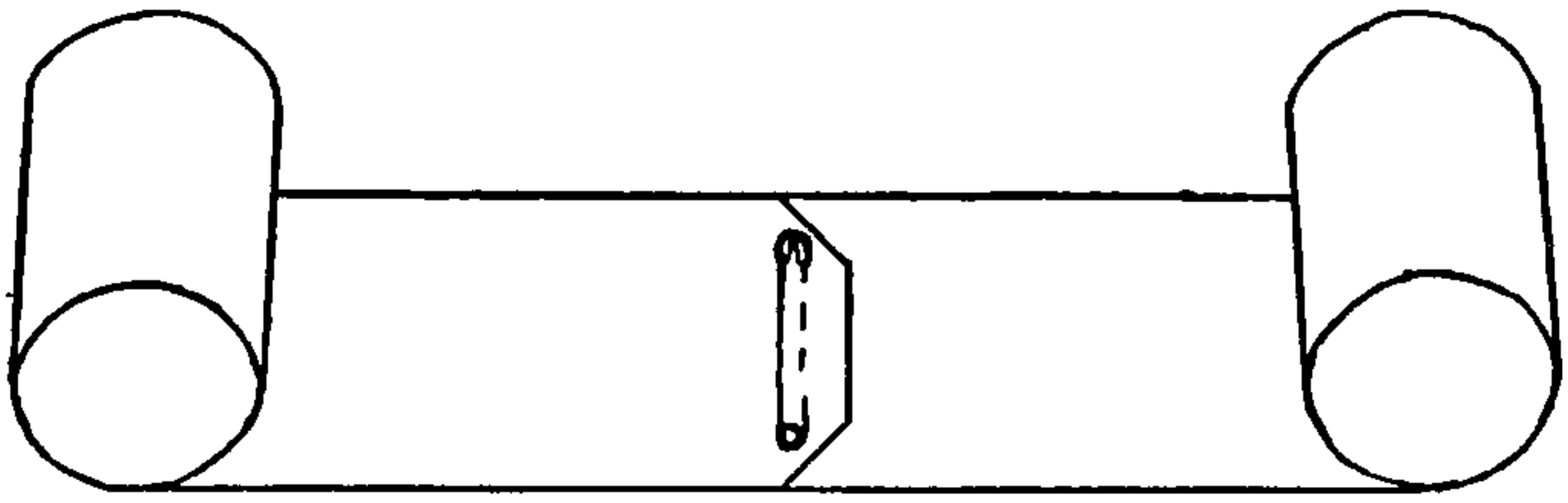


FIG. 136.—DOUBLE ROLLER BANDAGE FOR THE APPLICATION OF THE RECURRENT BANDAGE.

bandage back and forth over the top of the head and binding it down at each end by the circular turns of the other.

The whole head may, of course, need to be covered thus, but the student should form the habit (which does not seem nat-

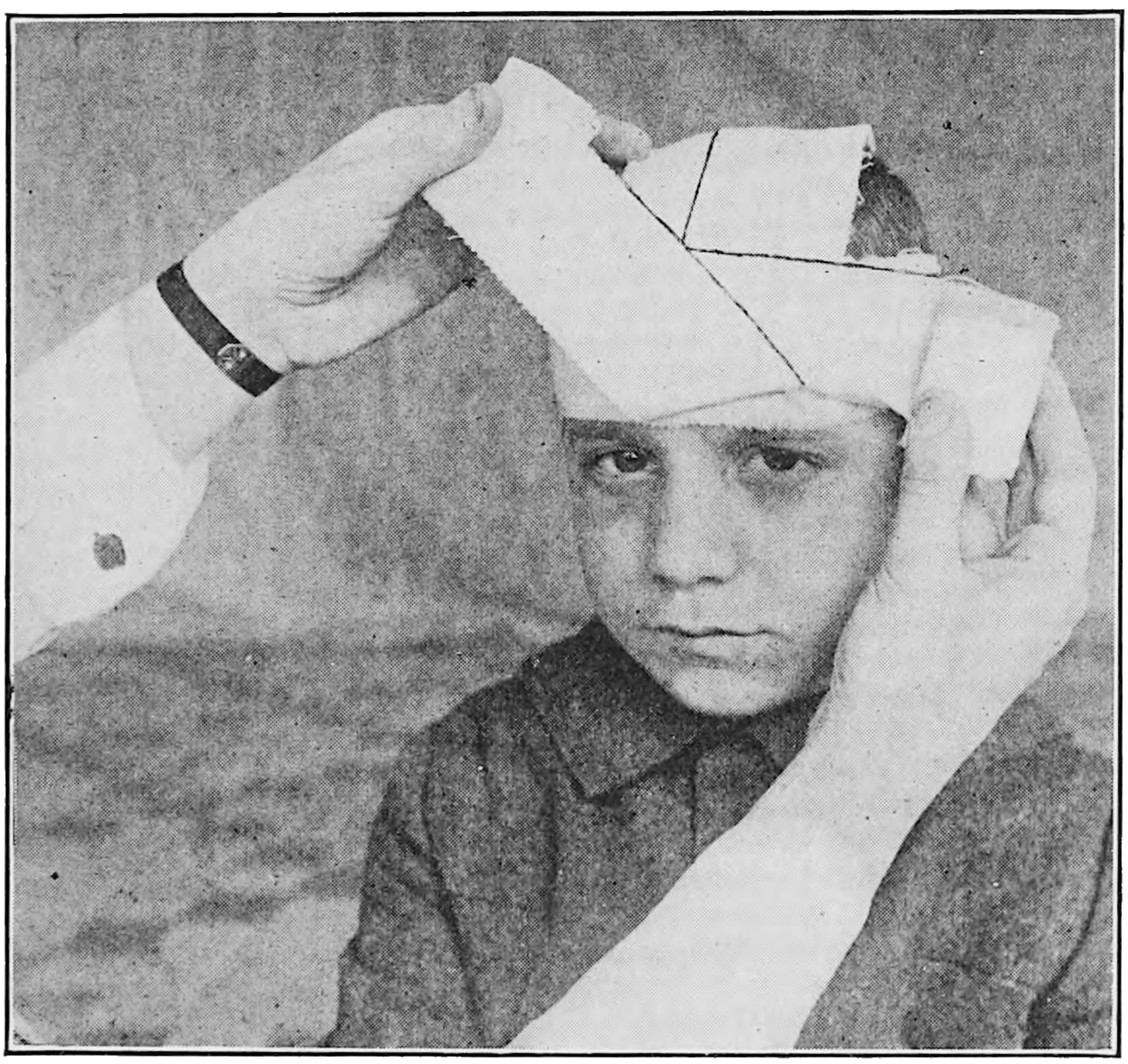


FIG. 137.—THE WAY TO USE THE DOUBLE ROLLER BANDAGE.

ural for beginners) of putting on only as much of the head bandage as is necessary to keep the dressing in place, as it is very easily discontinued at any point.

This recurrent bandage, especially when applied to the head, is usually designated as the *"capeline" bandage,* because of its likeness to an iron skull cap which was worn by soldiers in the Middle Ages.

The Shoulder and Axilla

The "spica" is the bandage most frequently used for the shoulder (Fig. 138). Like the thumb spica, of course, it is merely a figure-of-8 design, and needs no comment except, perhaps, to point out that the application of it is begun about the arm, and that a few spiral or reverse turns should be made around the arm for secure anchorage before beginning the spica proper.

When there is a dressing in the axilla to be covered *the shoulder spica may be varied* by alternating turns around the chest with the figure-of-8 turns (Fig. 139).

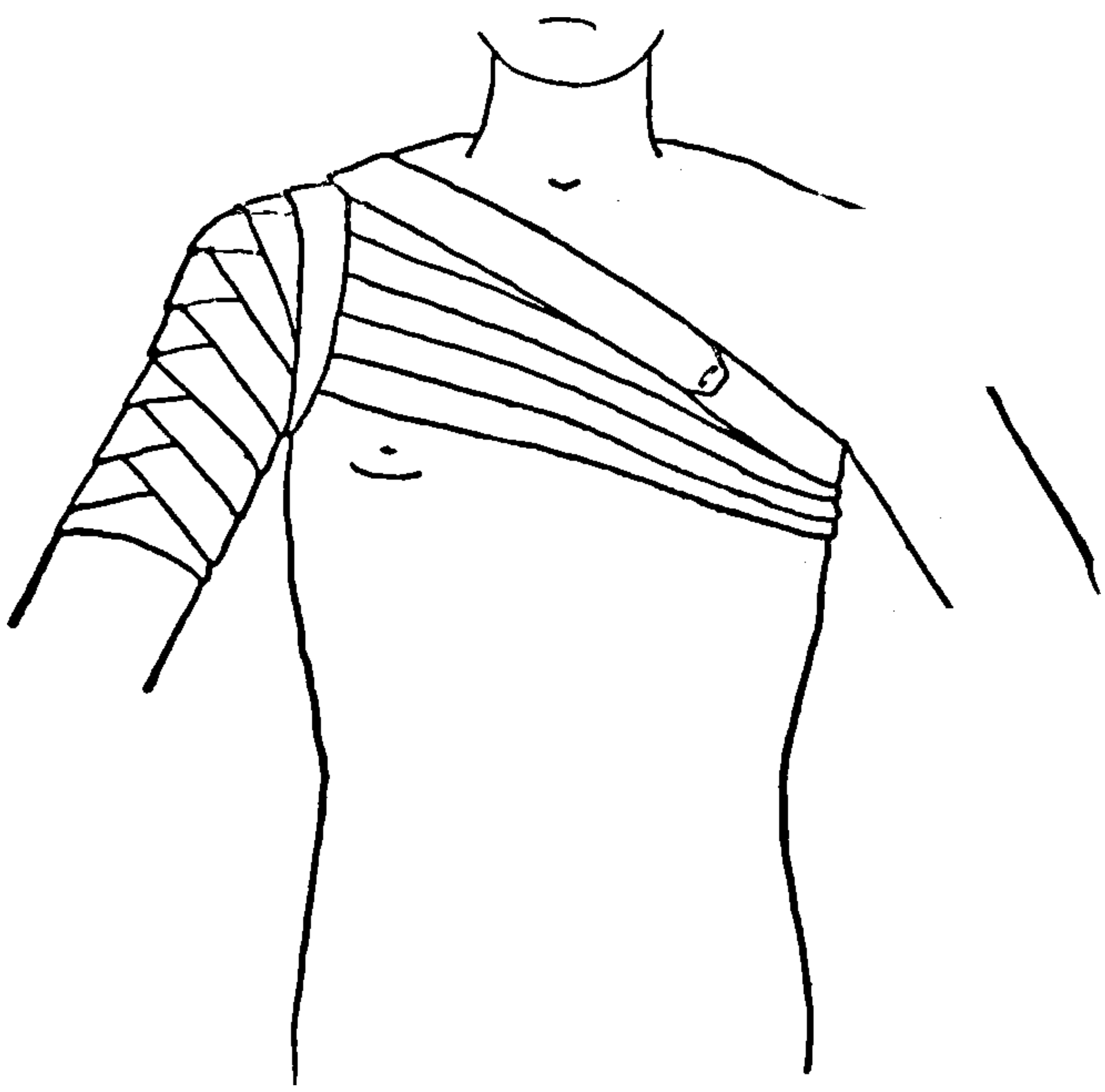


FIG. 138.—THE SPICA BANDAGE OF THE SHOULDER.

The Velpeau bandage will be used to immobilize the shoulder in such cases as fracture of the clavicle or scapula or dislocation of the shoulder. Place the arm of the injured side across the chest so that the hand lies well up toward the other shoulder. Start the bandage by placing the end over the scapula of the sound side, carry the roller forward over the injured shoulder, angling downward and underneath the humerus, and thence forward over the anterior chest and around to the starting point (A of Fig. 140). Repeat this turn once for security and

between the affected side and the opposite shoulder (A of Fig. 141).

Start underneath the arm of the affected side and anchor the bandage with two circular turns about the chest just beneath

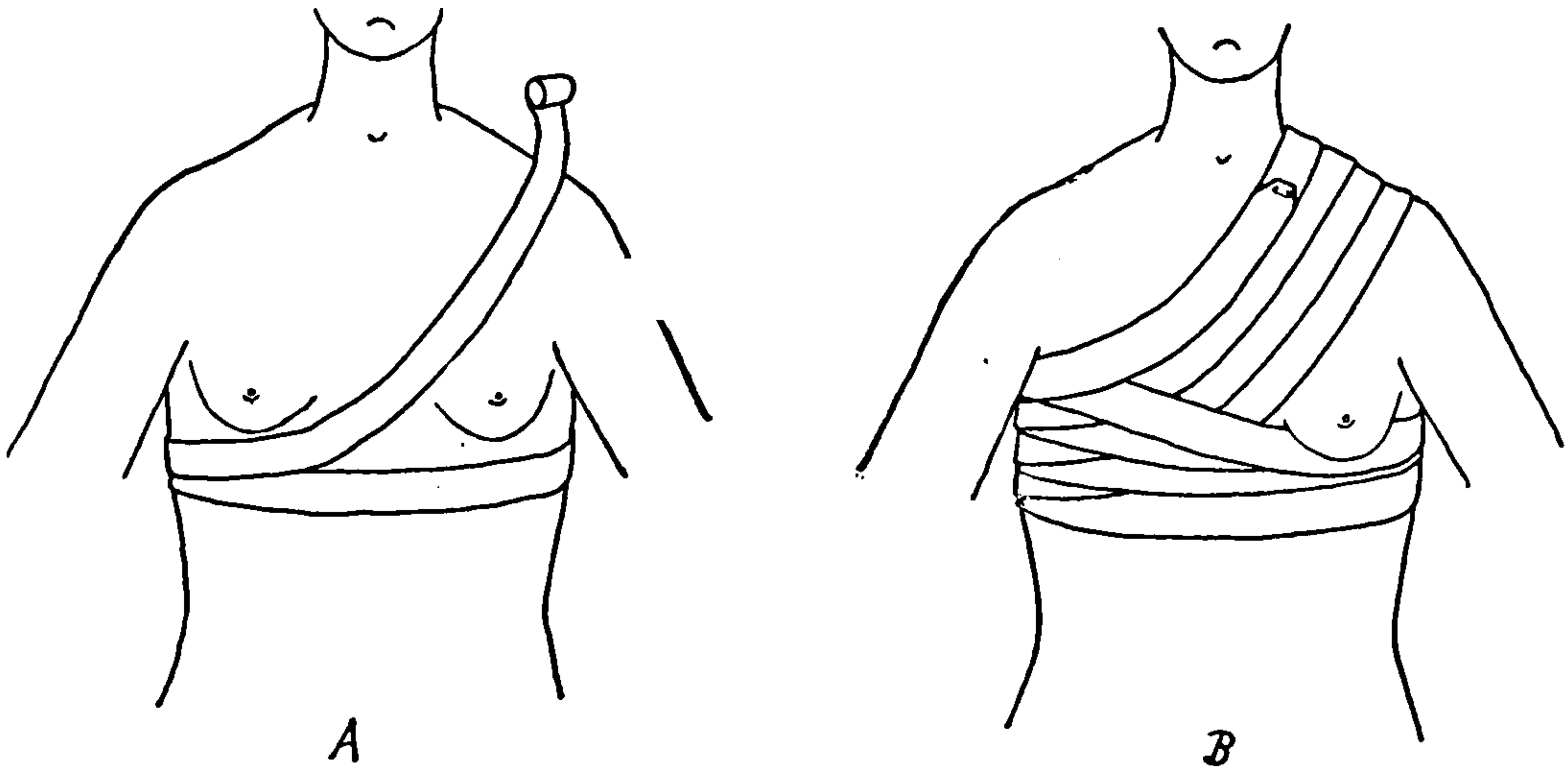


FIG. 141.—THE BREAST BANDAGE. *A*, the way to start the bandage; *B*, the complete design.

the breast, passing the roller across the anterior chest first and then around the back—that is, when the right breast is to be bandaged the end of the bandage is placed under the right arm and the roller is carried across the anterior chest to the left arm; and for the left breast the direction is reversed. The anchorage completed, the first diagonal turn is started directly underneath the breast, and is carried well over on the opposite shoulder, thence angling downward across the back and around to the starting point. These alternate horizontal and diagonal turns are then repeated till the whole breast is covered (B of Fig. 141).

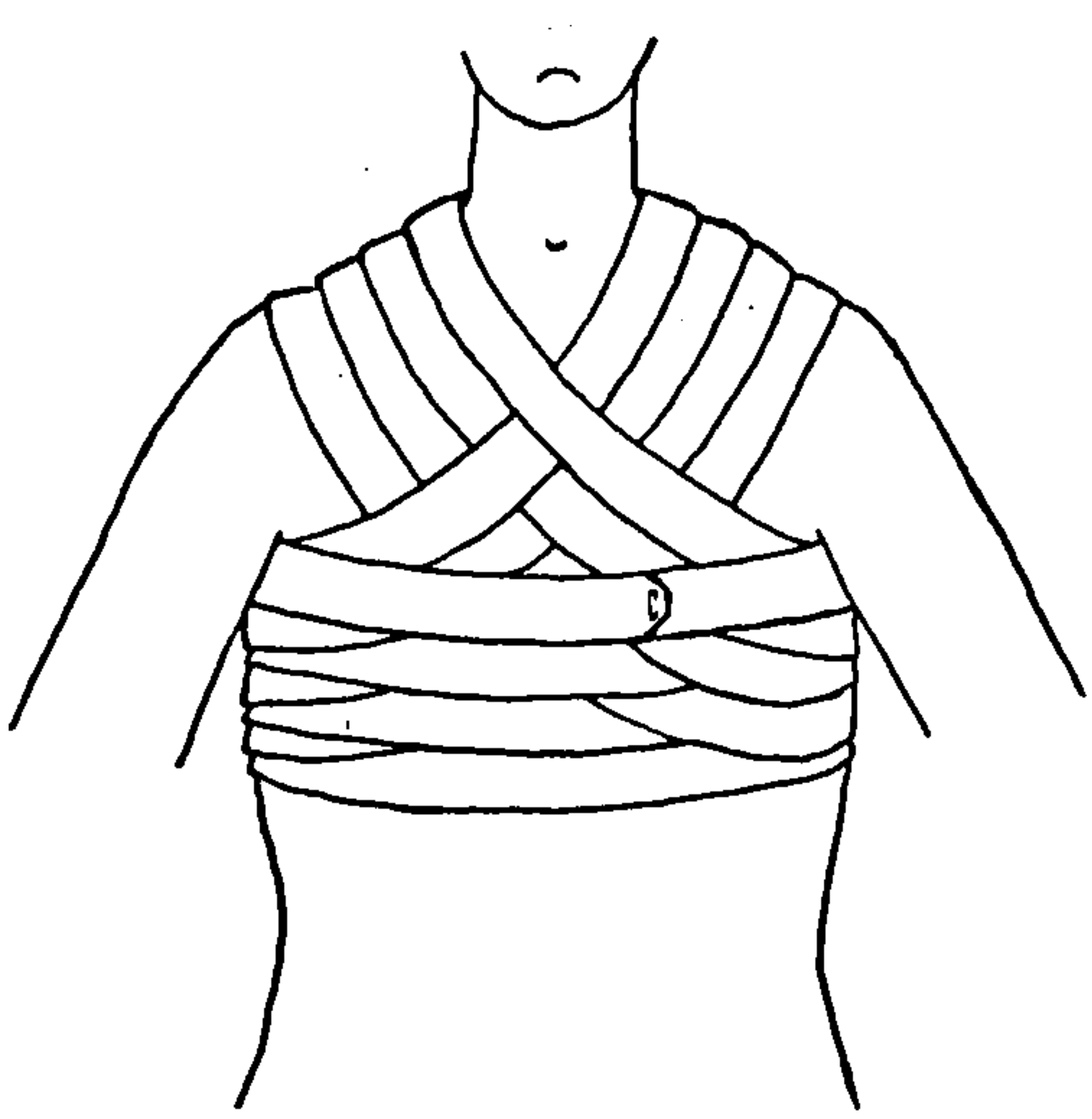
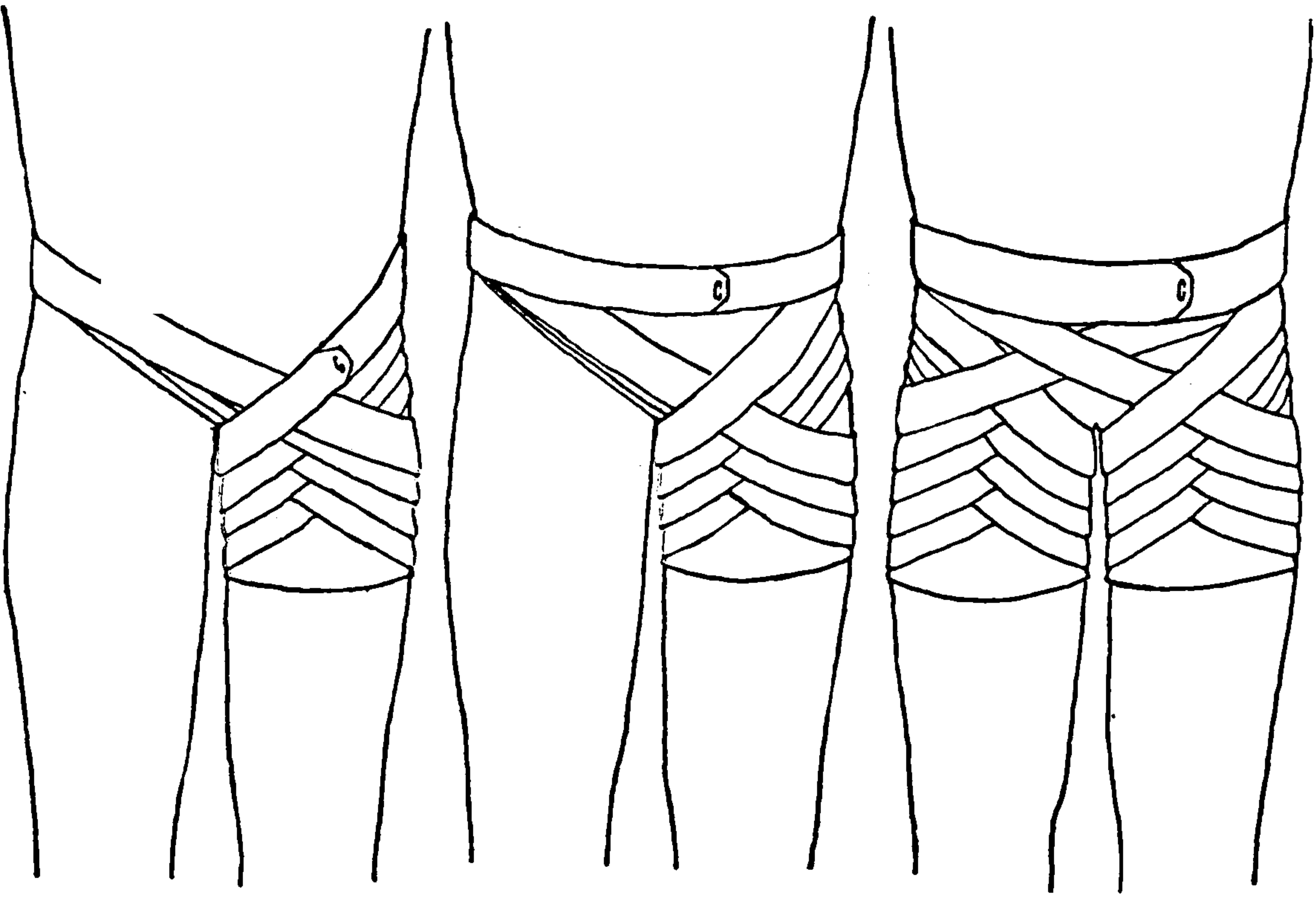


FIG. 142.—THE DOUBLE BREAST BANDAGE.

To bandage *both breasts* at the same time, start as for one. Apply the first diagonal turn, start the next horizontal turn but carry it only as far as the opposite side and then instead of completing it carry it diagonally upward across the back to the other shoulder, and thence diagonally downward across the anterior chest and underneath the other breast. Then apply a complete circular turn and extend it around to the starting point under the first breast. Continue the bandage by alternating the diagonal maneuvers with the horizontal one till the breasts are covered (Fig. 142).

Hip Spica

There is no essential difference between this bandage and the spica of the thumb. The hip spica is sometimes applied without the circular turns about the waist (A of Fig. 143), but the alternation of the circular turn with each figure-of-8 (B of



A B C

FIG. 143.—THE HIP SPICA BANDAGE. *A,* without the circular turn about the waist; *B,* with the circular tuin alternating with each figure-of-8; *C,* the double spica applied with a single bandage.

Fig. 143) makes a more durable bandage and one which will be more comfortable for most patients. Any part of the hip region may be covered with this bandage by simply placing the spica directly over the wound. This bandage may be started around either the waist or the leg.

A double hip spica is very readily applied with one bandage by simply alternating the figure-of-8's between the sides and inserting circular turns about the waist between them each time (C of Fig. 143). This bandage may be started around either the waist or one leg.

For the application of these bandages it will be necessary to elevate the patient's hips on some such rest as that shown in B of Fig. 43, page 220.

(b) *The Triangular Bandage*

As remarked previously, the triangular form of bandage, with one or two exceptions (chiefly the sling), is an emergency

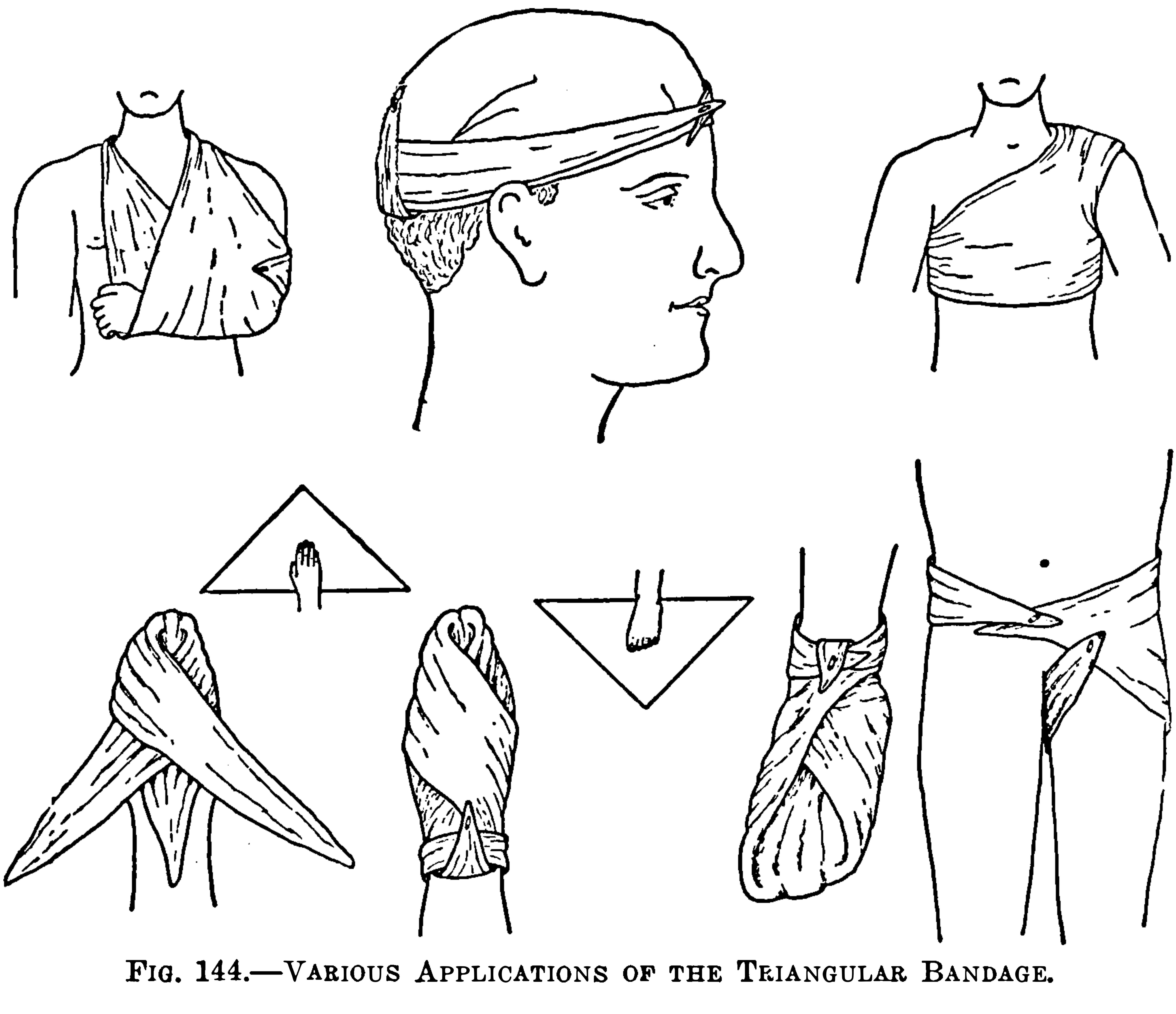


FIG. 144.—VARIOUS APPLICATIONS OF THE TRIANGULAR BANDAGE.

one and will be used only in the absence of the roller bandage. Emergencies, however, are very important and the nurse should, therefore, not consider her bandaging education complete till she has become adept with the triangular bandage. Parts to

MISCELLANEOUS SPECIAL BANDAGES

The *plaster of Paris bandage* is a roller bandage, but as it is applied wet and eventually becomes very rigid its application involves a few points which differentiate it from the average roller bandage. First of all, the plaster is never placed directly upon the skin, a substantial padding of cotton, Canton flannel, or stockinet, etc., always being used underneath it. The nurse will rarely ever apply this bandage herself but she will assist with it and her part will doubtless be the soaking of it. This she will do by standing it on end in a basin of sufficient warm water or weak salt solution to cover it. A very few moments will suffice for saturating it, the cessation of the bubbling which always follows immersion indicating that it is ready for use. Since you have probably made the bandage yourself you will know how insecure the plaster is within it and will therefore be very cautious about the removal of it from the water. It must be squeezed just enough so that the water will no longer drip from it—no more and no less—for if too wet the dripping water will carry the plaster away with it and will unnecessarily wet the padding, and if too dry it will become hard before it can be applied. Your method, therefore, will be to encircle the bandage very cautiously with a hand at either end, compress the ends gently at the same time, lift it out of the water, and simultaneously extend your pressure over the remaining surface just sufficiently to stop the dripping—but do not twist it. Practice is required to do this well and without wastage of the bandages, for it must be done quickly as well as carefully. As light wood splints are sometimes used to reinforce this bandage they will be part of the nurse's preparation, as will also a small amount of dry plaster which is sometimes used for finishing the surface of it.

For the application of *the starch bandage* the nurse's preparation will be similar to that for the plaster, but the bandages will not require the extreme care in handling and they may be more nearly freed of the water.

The *Esmarch bandage* is sometimes applied for the purpose of reducing the venous circulation of a congested part and thereby increasing its arterial supply and the accompanying local nourishment. This constitutes a special treatment known as the "Bier's" treatment. It will, therefore, never be administered except by special order, but it belongs to the subject of bandaging and there are several points about it which the nurse should learn.

The treatment is usually administered to some inflamed part of the extremities, and the general rule of applying the bandage from below upward will hold in this case. The mode of application will be the spiral one; the bandage will be applied above the inflamed part; and as the object of the bandage will be to restrict the venous circulation and not the arterial, it must not be applied too tightly. The frequency and duration of this treatment will be prescribed, and while it is in operation the nursing attention must be faithful. The parts below the bandage should retain their normal temperature; there should be no accompanying pain; the pulse in the part should not be altered; but a moderate amount of swelling and edema, and a bluish-red color, should be expected. As a rule, the part will be elevated after the bandage has been removed to hasten the reduction of the edema, but the nurse will be guided by instructions from the surgeon as to this.

Varicose veins of the leg are sometimes treated with a *pressure bandage.* The material to be used for this bandage will usually be prescribed, and it may be any one of those we have already discussed. The elastic materials, however, will probably be given preference, though where elasticity is desired it may be secured in some degree with an inelastic bandage by first covering the part with a thin layer of non-absorbent cotton. The importance of this bandage from our present standpoint lies in the requirements that it be very smoothly and evenly applied, that its tension be sufficient to support the enlarged veins without obliterating them, and that it be applied as follows: Elevate the foot somewhat before applying the bandage so that the veins will not be unnecessarily engorged; start the bandage near the toes; and use the spiral form as much as possible throughout, departing from it only sufficiently to secure even pressure over the more irregularly-shaped parts.

A pressure bandage is sometimes applied to the extremities, particularly the legs, in case of shock to reduce the circulation in them to some degree and thereby to conserve the heart's energy somewhat. A generous layer of non-absorbent cotton should always be used under this bandage because, while it furnishes the usually desired elasticity it also conserves the body heat which is vitally important in such cases.

Many of the bandages described in the practical discussion above might properly be classified here also as "special" bandages—for examples, the ankle bandage in a case of sprain, the Velpeau, the Barton, some of the spicas, and sometimes the breast bandage—but as they are thus distinguished merely by their greater tension they merit only mention in this connection.

THE FASTENING OF THE BANDAGE

(a) *The Roller Bandage*

First of all, *the site selected* for the securing of the end of the bandage should be remote enough from the wound to avoid causing pain to the patient by the manipulation necessary. If not inconsistent with this point, an accessible place should be chosen for evident reasons. And of not the least importance is the point that all fastenings that protrude, such as knots and safety pins, should be so placed that the patient will not have the discomfort of resting upon them.

There are only about *four good methods* for fastening the bandage and they have their special adaptations and limitations as follows:

1. **Safety Pin.**—This fastener (A of Fig. 146) will apply to most bandages and it is a very satisfactory one because it can be passed through all the underlying layers and so bind them all securely together. It may sometimes be objectionable, however, for children in places where they can reach it and open it, or where they might injure themselves upon it. Likewise, irrational patients are liable to interfere with this fastener.

2. **Adhesive Plaster.**—This is an unobtrusive and neat fastener (B of Fig. 146) but it is not as secure as the safety

3. **Tying.**—This is a rough-and-ready method (C of Fig. 146) which can always be resorted to in the absence of other means. To fasten the bandage by this method, tear or cut it down the middle of the end, tie a knot at the bottom of the slit to prevent further tearing, and then tie these strips around the part. The student should learn this method but she should immediately store it away for emergency use only, as it is almost never comfortable to the patient because of the fact that if it is tight enough to hold the bandage in place it will cause a line of stricture.

The Esmarch bandage is an exception to this case in that tying is about the only suitable method for it. The rubber will not, of course, be split to make the strings, for tapes are usually cemented to one end for the purpose. If these are lacking, however, a few turns of a gauze bandage, a piece of tape, or anything similar may be fastened about the terminus of the Esmarch. The above-mentioned objection to tying does not enter into this case because the rubber is rigid enough to dissipate the objectionable pressure of the string.

4. **Sewing.**—This method (D of Fig. 146) is applicable where greater strength is needed, or in the case of children or irrational patients. It goes without saying, of course, that great caution is necessary in sewing a bandage on a patient.

(b) *The Triangular Bandage*

The safety pin, tying of the corners, or both (see Fig. 144, page 388), will cover all cases for this bandage.

(c) *The Many-Tailed Bandages*

Tying of the ends or safety pins will answer for the head and chin bandages, but for the other parts safety pins are all but indispensable (see Fig. 145, page 389).

MISCELLANEOUS BANDAGING RULES

1. *Never bandage two surfaces of skin together*—separate them with gauze or cotton, preferably non-absorbent cotton. There is always a certain amount of moisture present on the

surface of the skin and if this is confined it will accumulate, and in addition to being uncomfortable it may seriously chafe the parts in time. The non-absorbent cotton keeps these surfaces apart and allows evaporation of the moisture, whereas absorbent cotton or gauze absorbs and retains it. This applies particularly to the fingers, toes, axilla, and the arm and chest in the case of the Velpeau bandage.

2. In all cases where surgical necessity does not contravene, *parts should be bandaged in their accustomed position.* This applies with special emphasis to the ears, which should always have sufficient padding behind them to prevent their being held more closely to the head than is natural for them. Bandages of the neck, axilla, the hand and fingers, and the toes, also call for special consideration in this respect.

3. In bandaging the hand and foot *leave the fingers and toes exposed* if possible so that they may be watched as guides to the condition of the circulation of the limb. Coldness, blueness, and swelling of the fingers or toes, or of any part below a bandage, are signs that it is too tight at some point. This accident is very largely precluded by attention to pressure in the application of the bandage, but it must not be forgotten that parts under even the most expertly applied bandage may swell later from causes entirely unrelated to the bandage itself. In the cases of the arm or leg the pulse, if accessible, at the radius or the dorsum of the foot will, of course, be a valuable guide to the state of the arterial circulation.

4. *Do not apply a wet bandage* because it will probably shrink in drying and become too tight. The plaster of Paris and starch bandages are, of course, exceptions, but they are always applied with this in mind, and a thick padding of stockinet, cotton, or Canton flannel is usually provided underneath them to guard against this danger.

5. When applying a *bandage over a wet dressing,* or over a Carrel-Dakin dressing which will eventually become wet, remember this probability of shrinkage and apply it correspondingly *loosely.*

6. If necessary to *bandage a dressing under a splint,* remember to do it *loosely* because, even though you may be able to note

the condition of the part, it will be very inconvenient to correct undue tightness in this case, and durability is not important here since the splint and its bandage will give the additional security needed.

7. In *placing the reverses* of the reverse bandage, see that they are not over bony or prominent parts, such as the shin or radius, for they may become very painful because of the uneven surface they create. The line of these reverses is best placed on the outside of the leg and arm.

8. Always *apply the roller bandage from below upward,* particularly when exerting special pressure, because when put on in the opposite direction it allows the veins, which are eventually to be underneath it, to become engorged with blood which is thus imprisoned and may later be the cause of much discomfort and even more far-reaching trouble. Likewise, the Scultetus bandage should be fastened from below upward.

9. Make it a rule in applying the roller bandage to the extremities to *start by rolling it outward* rather than inward—that is, to bandage a right arm or leg (assuming that you are face-to-face with your patient), hold the roller in your left hand and start by rolling it toward your left side; to bandage a left arm or leg, then, you will hold the bandage in your right hand and start it toward your right. A test application will show you that observance of this rule will give you greater freedom and ease in the adjustment of the reverses and the figure-of-8's.

THE REMOVAL OF ROLLER BANDAGES

Gauze and paper bandages are rarely ever used more than once and they are therefore usually cut away. If one is equipped with the special bandage scissors (Fig. 147), the operation is very simple as the blunt point can be passed underneath the bandage with perfect safety, provided, of course, that the region of the wound is entirely avoided, as it should be in any case.

The *washable and rubber bandages* will simply be unwound, and a little practice will enable one to roll them together loosely

there is one); and to save labor one should select the shortest lines that will answer the purpose. Some labor may be saved in the sawing process by wetting the plaster immediately ahead of the instrument with a few drops of hydrogen peroxide, acetic acid, or bichloride solution. These solutions have a slightly solvent power over the plaster, but a little plain water answers the purpose very well also. Care should be taken not to use enough of these solutions to wet bandages or dressings underneath, and it should also be remembered that the bichloride will be very unkind to the metal instruments if exposed to them too long. The precaution should always be taken of discarding the knife or saw in favor of the scissors before this bandage is entirely severed to escape the danger of cutting the patient. Sometimes this labor will be obviated by the surgeon who will cut the plaster just after applying it and while it is still soft. In this case the cast will be bound together by a strong bandage and its removal will then be a simple matter

Starch bandages can usually be cut with strong bandage scissors, though if they are thick the plaster knife or saw may be needed.

Finally, *practice* is your great highway to success in the art of bandaging. We may seem to have led you through more devious byways than necessary to bring you to it, but we believe this is a case of the longest way around being the shortest way home.

CHAPTER XXI

OPERATIONS IN THE HOME

THERE is perhaps no greater bugbear to the young nurse than the prospect of having to prepare for an operation in the home. No matter how excellent her course of training may have been in general, she very rarely has learned the solutions of the many practical problems which will arise when she is out of reach of the elaborate equipment and the ready-to-use supplies which made life comparatively simple for her in the hospital operating room. However, the nurse who has learned her hospital lessons best will, of course, succeed best in the home because operations in the home, while they do not call for new principles, they do call with a vengeance for special combinations and adaptations of the old ones. This is really a hard task until one has had a little experience, and even with experience each home will make some new demand upon one's ingenuity and technical elasticity. System and good technic are easy in the hospital operating room where practice has standardized everything in such a way as to make them almost automatic, but in the home natural conditions are often quite adverse. One can always succeed, however, by virtue of the very fact which often hinders system in the hospital, namely, that there are so many roadways to Rome.

We shall now assume that you have had a good course of training in the hospital operating room, that you have studied Chapters XIV to XVII thoroughly, and that you have in mind clearly the things you will need and your general course of action, and with this for your armament we shall take you into the home and endeavor to guide you there in the preparation for an operation.

If you have been nursing the patient a day or so before the operation you may have had some warning and will therefore have the advantage of doing some preliminary preparation leisurely. If you are called on short notice, however, you must know how to make the most of your time, because shortness of time is not always a good excuse for poor work. In general, then, we shall say that when you are called to prepare for an operation in the home you should proceed in this order:

First Step.—*See to the supply of sterile gauze dressings, towels, sheets, caps, gowns, masks, and gloves.* Often the surgeon will have these in readiness in his office and you will not need to supply them. In other cases you may be so situated that you can buy everything you will need from some supply house. But often you will need to collect the best supply you can find about the house or elsewhere and sterilize it by any means you can devise.

There is scarcely any substitute for gauze in an operation, but either it or its first cousin, cheesecloth, will be available in the most remote place. How you make up your dressings will depend chiefly upon the time you have, but be as simple as possible. If the operation is to be an abdominal one you should provide, if you can, something to answer the purpose of the *abdominal tail pads* described on page 224. The other gauze supplies besides the wipes and wound dressings will depend entirely upon the case.

Gowns will not be found in the home, and if the surgeon does not supply them you will need to substitute something else. About the only thing you can use is a large *muslin sheet,* and this can be made to work very well indeed by draping it about the body in some such fashion as that illustrated in Fig. 149.

Improvisation of the cap will be very simple for any nurse with a piece of muslin or gauze (Fig. 149).

Likewise, the face mask can be very quickly made from gauze or muslin (see mask C, Fig. 45, page 222).

Sheets and towels must be what you can get, but always use the muslin ones rather than the linen if you have a choice, as they are more satisfactory in every respect.

It will rarely ever be advisable to undertake to provide a supply of dry sterile *gloves* because there will be no suitable

allow free circulation of the steam through them, particularly from the bottom upward—a kitchen colander, sieve, or a wire dish-draining tray may be well adapted to this purpose. *Cover the boiler* tightly. After the water has reached the boiling point the heat supply should be so regulated as to keep it barely boiling because the steam is all you need for your purpose and you gain nothing by the vigorous boiling except unnecessary splashing of the water over the supplies. If the cover fits well the weight of it will compress the steam slightly and thereby raise its temperature somewhat. Do not make the mistake, however, of trying to secure the lid of an ordinary wash boiler sufficiently to make it steam tight as this may result very disastrously.

Continue the steaming for at least one hour.

The parcels must then be dried, of course, and this may be done in the kitchen oven, on the radiator, in the sunshine, or if there is a little time to spare, an electric fan will answer. Care must be taken when using the kitchen oven not to have it so hot that it will scorch the supplies.

The baking oven also furnishes another means of sterilization. If one has a thermometer, the oven can be made to serve quite satisfactorily, as the gauze and muslin materials are safe from scorching below 300°F. and a much lower temperature than that will not sterilize unless maintained for an impracticably long time. However, in the absence of a thermometer one can regulate the temperature fairly accurately around the scorching point by testing it with a loose piece of gauze or muslin or a piece of newspaper and regulating the supply of heat so as to keep the temperature just below this point. This is a rather unrefined method but it is better than none. As the parts of the supplies which come in contact with the metal of the oven will burn sooner than the free parts, it is advisable to put several layers of newspaper under the parcels, as this will serve as an insulator and will also show when the oven is too hot before the damage spreads to the supplies. When there is a shelf in the oven it is better to use this than the floor of it because the shelf will allow better distribution of the heat.

An hour should be allowed for this method of sterilization also.

Parcels to be sterilized by such improvised methods must not be made too large nor too compact because the lack of pressure and exact regulation of temperature make thorough penetration rather uncertain.

In a very rare case you may be so isolated from supplies and so short of time that you cannot apply any of the above methods of sterilization. In such an emergency it would, of course, be possible to get along by *boiling towels and sheets*, and even dressings, and using them wet, but such an exigency is so improbable as scarcely to be worthy of mention.

Second Step.—*Select the most suitable room.* First, determine the transportability of the patient, and if there is no limitation on that ground you may proceed thus: If the operation is to be done in the daytime *the best lighted* room possible is the one to choose. If it is done at night, or if there is not good daylight available, consideration must be given to the artificial light equipment before the room is decided upon.

If it is large enough and has the necessary light, *the bathroom* is perhaps the best one because it can be most easily cleansed both before and after the operation. *The kitchen* is perhaps the last choice because it will disturb the household routine more than that of any other, and the sanitary objections from the standpoint of both the kitchen and the operation are very strong. Of the remaining rooms the choice will depend, first of all, upon the light, and secondly upon the amount of work and confusion necessary to adapt them for the purpose.

Cases in which you are obliged to use an otherwise undesirable room because the patient cannot be moved will be rare, and you will have to make the best of the situation; but, after all, lack of light would be about the only serious obstacle which would ever arise in such a case.

When the patient's bedroom itself must be used the preparation must be made as brief and simple as possible because it will be an exceptional patient who will not be considerably unnerved by having his misfortune thus emphasized for him. Screens will, of course, help in most cases to shield the patient somewhat, but all rearrangement of the room which is not absolutely necessary should be avoided, and everything possible of a surgical appearance should be kept outside till the anesthesia has been started.

Third Step.—*Renovate the room selected.* This step can be overdone as well as underdone. The room must, of course, be thoroughly clean, but if little time is to intervene between the renovation and the operation the removal of carpets, pictures, etc., will do more harm than good by raising dust which will not have time to settle sufficiently. When there is a day's warning, for instance, we should remove the carpet in the interest of both itself and the operation, but it is doubtful that it is ever necessary to go to the extreme of removing wall hangings because these articles can usually be made as sanitary as the walls themselves by careful moist dusting. Also, the removal of furniture can be carried to an extreme, because such articles as tables, dressers, etc., can be reasonably cleaned and used as convenient pieces of operating room furniture. One must use a great deal of common sense in adapting a room for operations, and in doing so the time provided will take first place in making decisions, confusion of the household second place, and technical convenience last place. By technical convenience we do not mean technical safety, because safety can be secured under almost any conditions by skilled management after the stage is set.

When carpets are left in place they must be carefully covered both for their own protection and for the confinement in them of any dust which might otherwise be raised. This is easily done by spreading several layers of newspaper upon them, and if the lower layer is moistened with water we may feel that the room is very well insulated from the dust of the carpet. Sheets may be tacked down over the newspapers if desired, but the newspapers themselves probably make a better floor surface for the purpose than the sheets. A large rubber sheet immediately under the operating table is, of course, ideal, but unless it is known that there will be considerable drainage from the wound an extra amount of newspaper will serve as well. The practice of covering pictures, furniture, etc., with sheets is a doubtful

For the anesthetist's seat a small, low stand may answer, books or a box may be placed upon a chair, or any one of a dozen substitutes may be devised.

Make sure that there will be the proper kind of light. There will usually be an extension light of some kind in the home which may be appropriated if the ordinary light of the room is not sufficient or is inconveniently located.

Sixth Step.—*Collect those other things which will need to be sterilized, such as solution basins, pitcher, irrigator, hand brushes, etc.* Recall the articles we have listed in Chapter XIV on pages 212-213, decide upon which you will need, and then select the best substitute available. Hand basins and the other smaller basins can usually be found among the kitchen equipment; a pitcher will always be at hand; a rubber douche bag, or a kitchen funnel and rubber tube will take the place of the irrigating can for irrigations, infusions, etc.; and hand brushes may be found in every household.

The simplest way to sterilize these things is to *boil them* in the wash boiler or some large kettle on the kitchen stove. If you cannot find anything large enough in which to do this you may have to boil the larger basins directly on the stove with the smaller things inside of them. Basins sterilized in this way will be sterile on the outside as well as the inside, but after standing over a gas flame or a stove of any kind it must be remembered that they will not be clean enough on the outside to associate with the other supplies, and must be kept away from them. Sometimes you may need to resort to the method of sterilizing the interiors of some of these things by means of the *alcohol flame* as described in Chapter XV on page 242, or one of the chemical solutions may have to serve. With careful management the unsterile outsides of these articles will not do any harm.

In sterilizing these household articles great consideration must be accorded them, and nothing should be used in any way that may be injurious to it unless the family is willing to have it sacrificed. As a rule the family will place anything in the house at your service at this time, but you have so much latitude in the way of substitutes that you need not make any inroads upon family valuables.

At this time boil another teakettleful of water and keep it hot for *the hot sterile water* supply.

Seventh Step.—*Collect such unsterile articles as you are likely to need.* Blankets and hot water bottles are always easily secured; one or two kitchen pails of any sort will answer for floor basins; a pillow for the patient's head and several others for adjustment of the patient's position should be ready; one or two extra unsterile sheets, and a few towels will be needed; adhesive plaster, bandages, and safety pins are, of course, elementary provisions for all operations.

You should, of course, think of the possibility of *a hypodermic* of some stimulant or sedative and make a rule of having your own syringe in readiness, though the surgeon or anesthetist will doubtless see to this also.

Provision for the *preparation of the operative field* should also be made and you should have at hand whatever of the probable things you can secure. Soap and alcohol will nearly always be available, and in the modern household you will be very likely to find iodine. This is another responsibility of which the surgeon will probably relieve you.

Eighth Step.—*If the rubber gloves have not been otherwise prepared you will now boil them* for about 5 minutes with the basins and other things which have been boiling and then store them in one of the basins in some antiseptic solution. It is always a good plan when boiling a number of gloves to put them into a bag for the process. This makes handling easier and safer, and the parcel itself can simply be placed in the solution basin and the gloves used directly from it without any previous handling.

You may or may not need to concern yourself about the *instruments* as the surgeon may bring them with him at the last moment ready for use. However, unless you know that this will be the case you should have boiling soda water ready for them in a suitable basin; or, if you have them in advance, now is the time to see that they are boiled. If you have the advantage of an electric or gas boiler or a portable stove of any kind which may be heated in the operating room, that will be ideal, as it is always a comfort to have the instrument boiler reasonably near the operating table.

Great care must always be taken, however, with *an open fire* of any kind in the operating room to keep it a safe distance from the ether, chloroform, or ethyl chloride, as these anesthetics are highly inflammable. Also, intense heat, and particularly an open flame, decomposes chloroform vapor and forms phosgene and hydrochloric acid gases which, if released in a poorly ventilated or small room, may seriously irritate the eyes and the respiratory tract of the occupants.

Ninth Step.—All unsterile supplies being in place, and the sterile ones either ready or almost so, about one-half hour before the appointed time for the operation you should *begin the sterile preparation of the room.*

You have, of course, provided a place and the supplies for *sterilization of the hands.* The bathroom basin will probably answer this purpose whether you are using the room for the operation or not. Any running water available should be utilized, but in cases where there is none you will need to provide hand basins and plenty of both unsterile and sterile water in pails or pitchers. The method of hand sterilization you prepare for will depend upon what antiseptics you can get, but in most cases you can follow one of those suggested on page 263.

The general technic for "setting up" the room can be the same as in the hospital. Your sterile basins, instruments, etc., are in the kitchen or wherever you may have boiled them, and if they cannot be transported sterilly by an unsterile assistant you may have to bring them yourself after you are sterile. If you have used a wash boiler the probability is that everything is in it (with the exception of the instruments which you may have boiled separately) and unsterile assistants can carry this to the operating room when you are ready for it.

Dispose all the sterile supplies as accessibly as possible, for assistants will usually be fewer in the home than in the hospital and you will have to perform more than the usual duties assigned to one person there. Also, plan well ahead for the unsterile work, because you may have to depend upon untrained persons for this.

Likewise, you are the person to see that all soiled gauze is safely disposed of, and that the other articles which have been used are thoroughly cleansed and resterilized. Also, if the floor, walls, or other parts of the room have been contaminated in any way the responsibility is yours of seeing that they are restored for family use. In other words, you do as a well-trained nurse always does, namely, leave things as you found them. Where servants are plentiful you will doubtless be relieved of most of the reorganization of the room, but sterilization is a professional responsibility and you should not delegate any part of it to untrained persons.

What you do in the home with instruments or other things which you or the surgeon may have brought in will depend upon whether you remain to nurse the patient or are free. If you can cleanse and resterilize these things without disturbance to the patient it will be better practice to do this before carrying them about, but your chief concern should always be to restore the normal conditions of the home as soon and as unobtrusively as possible under existing circumstances.

IMPROVISED OPERATIVE POSITIONS

The arrangement of special positions will be rather difficult in cases where the surgeon does not provide the portable operating table, and even then some of the more elaborate attachments will doubtless be missing. The portable tables usually provide for the lithotomy and Trendelenburg positions, but for gall bladder and kidney positions you will need a substitute for the elevating attachment, and for arm cases you may need an arm board substitute. The following suggestions will provide ways out of these difficulties:

Trendelenburg Position.—Sometimes it may be possible to incline the entire improvised table enough to answer the purpose, but a plan which can always be used in the home is to arrange a small chair on the table as illustrated in Fig. 150. To overcome the tendency of the patient to slide on this the shoulders may be lashed to the table by means of a strong bandage or a small sheet. Pillows and blankets must be freely used with this contrivance to pad or supplement it.

Gall Bladder Position.—All you will need for this is a suitable pillow to take the place of the usual table rest shown in Fig. 65, page 272.

Kidney Position.—A large pillow will be needed in this case to take the place of the table rest (Fig. 67, page 274). Other pillows will make good substitutes for the sandbags, but compact bundles of old magazines or any other suitable articles, such as sheets, blankets, etc., may be fitted to the purpose.

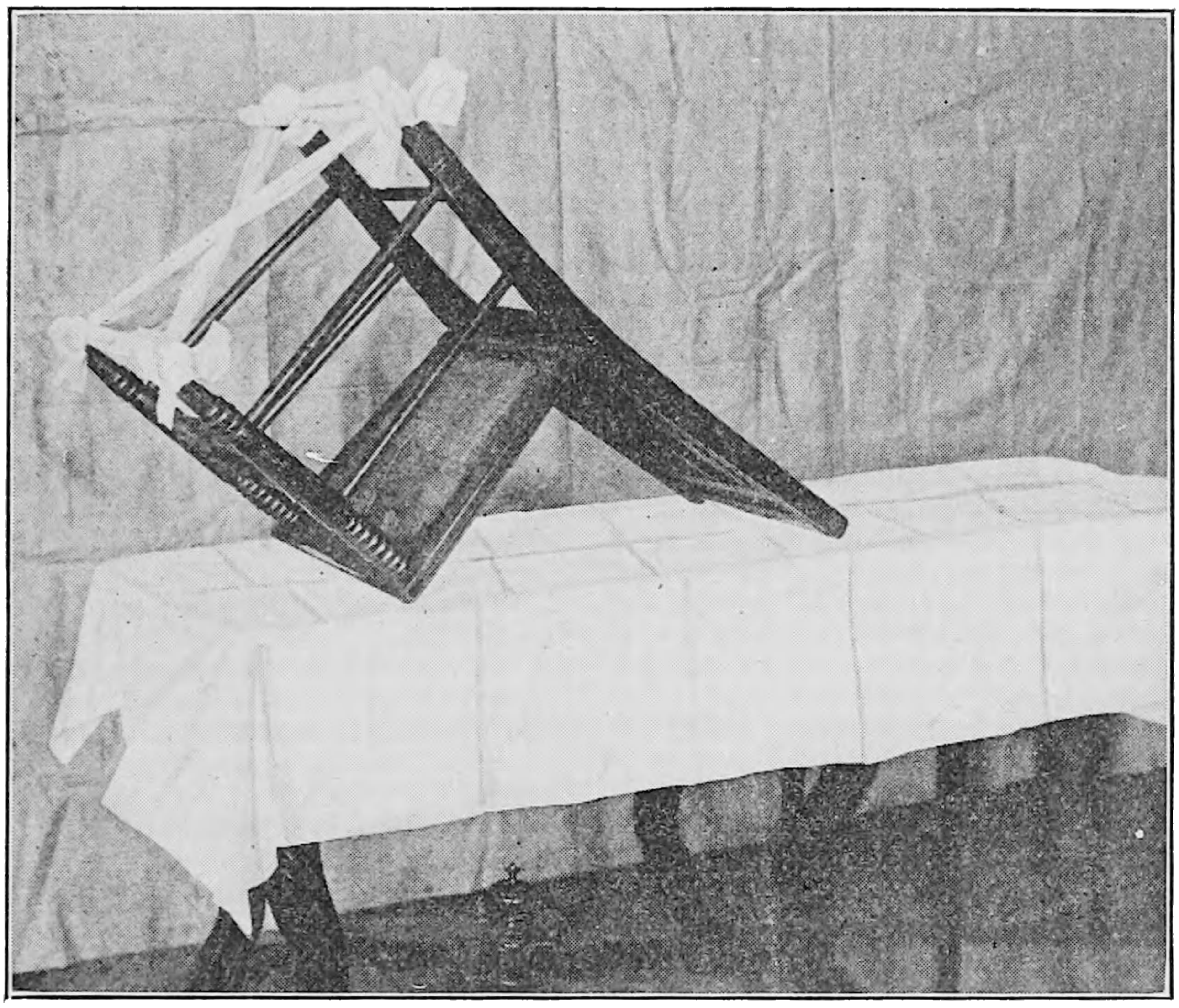


Fig. 150.—Ordinary Chair Adapted for Improvisation of the Trendelenburg Position. The bandage is first wound very tightly from leg to leg and afterward, to keep it from slipping downward, it is lashed to each leg by tying a short piece of bandage tightly around it and over the end of the leg. It will be necessary to use plenty of pillows or folded blankets over the bandage and the back of the chair, both for the protection of the patient and for the adjustment of his position.

Lithotomy Position.—Some means of supporting the legs will be your first concern for this position. There are several designs of "lithotomy crutches" (Fig. 151) on the market to which you may have access. Otherwise, a large sheet may be used as illustrated in Fig. 152. This sheet has been folded diagonally into a neat strap before application because it is more compact and stronger this way. Note that the sheet is passed on the outside of the thigh rather than the inside before it is tied or pinned below the knee, because otherwise the feet will tend to turn inward where they will be in the way of the surgeon. If the knees tend to fall so far outward as to cause too much strain upon the hip joints the bandage shown in the

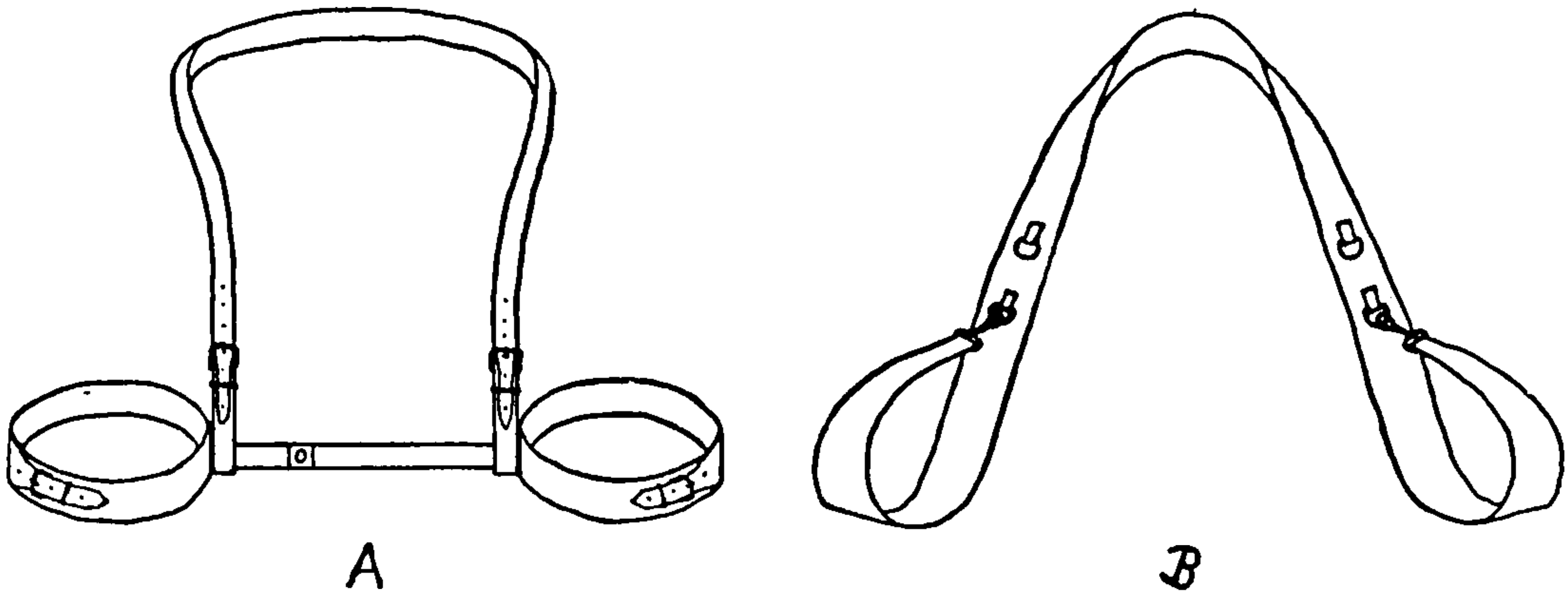


FIG. 151.—LITHOTOMY CRUTCHES, OR LEG HOLDERS, FOR SUPPORTING THE LEGS IN THE LITHOTOMY POSITION. *A*, of the illustration, shows the essential principles of the Clover crutch, which is adjustable in all parts. The leg straps are fastened around the thighs; the horizontal portion is made of metal and holds the legs from swaying sidewise; and the long strap passes underneath the back. *B* represents the Robb leg holder. This, also, is anchored under the patient's back.

illustration connecting the knees should be used, but this will not always be necessary. A strong bandage or any other strap-like contrivance may be used instead of the sheet. In some cases

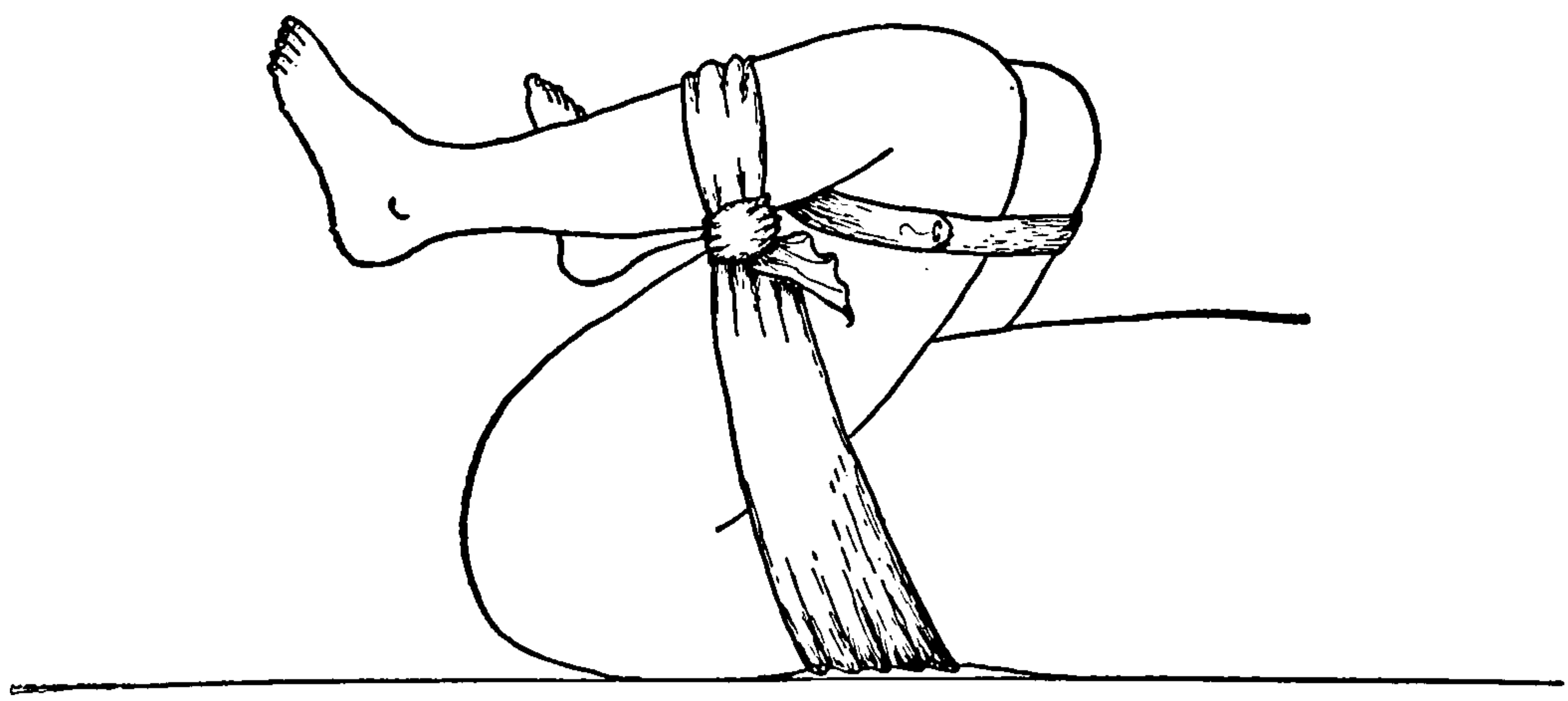


FIG. 152.—METHOD OF IMPROVISING A LITHOTOMY CRUTCH FROM AN ORDINARY SHEET FOLDED INTO A STRAP, WITH THE ADDITION OF A FEW TURNS OF A BANDAGE ABOUT THE THIGHS IF NECESSARY.

where the operation is to be short and there are assistants available two persons may hold the legs in position.

Some substitute for the Kelly pad will be necessary. For this you will require a waterproof sheet of some sort about a yard square. In the absence of a rubber sheet a piece of oil-

more importance than elegance of equipment. This is not meant as an indorsement of neglect to do the best you can in any respect, but merely to urge emphasis upon essentials. In this, as in all human activities, experience will be the best teacher.

APPENDIX

SOLUTIONS

A solution is a liquid which has dissolved within it some solid, gas, or other liquid substance.

Liquids differ greatly as to the amount of any given substance they can hold in solution, each one varies with its temperature, and also there are wide differences among the various substances as to the amounts of them which any given liquid is capable of dissolving. The differences pertaining to the various liquids themselves are not of practical interest to the nurse because water is about the only solvent she uses, so the following remarks about solutions will refer to those made with water, and the substances considered will be only the more common ones which the nurse will encounter in everyday practice.

Two extreme instances of the limitations which substances impose upon the solvent power of water are those of silver nitrate and boric acid. We can dissolve in 1 ounce of water at a certain temperature more than 2 ounces of silver nitrate but only about 25 grains of boric acid, and if we put any greater proportion of one of these substances into the water the excess will merely remain undissolved either in the bottom of the container or in suspension in the water, and the solution itself will be what is called a saturated one. Likewise, there is a definite saturation point for every other substance.

A saturated solution of any given substance, then, is one in which the liquid is holding in solution all of the substance which it is capable of dissolving.

The power of water to dissolve any substance, however, varies with the temperature, the rule being that the higher the temperature the more it can hold in solution. Therefore, the term "saturated solution" is only a relative one. In the following table of a few substances frequently used by the nurse are given the amounts of water in which 1 gram of the substance makes a saturated solution. The figures are those given in the United States Pharmacopœia, and they apply only when the water is at the temperature of 25° Centigrade (77° Fahrenheit), which is the temperature adopted in the Pharmacopœia as the standard normal one. The milliliter is used in the table as the unit of volume instead of the cubic centimeter, but although the two units are not quite identical they are given the same apothecary equivalent (16.23 minims) and it does not matter, for present purposes, which term is applied.

Table of Amounts of Water in Which 1 Gram Makes a Saturated Solution

Alum	7.2 mils
Bichloride of mercury	13.5 "
Boric acid	18.0 "
Carbolic acid	15.0 "
Magnesium sulphate	1.0 mil
Potassium permanganate	13.5 mils
Silver nitrate	0.4 mil
Sodium bicarbonate	10.0 mils
Sodium chloride	2.8 "

With a table of figures at hand for reference a saturated solution is easy to make, but this strength of any substance is not often used and the nurse's chief concern will be about the weaker solutions which she will have to make either from the undissolved substance, the saturated solution, or from a solution of some other strength.

The strengths of solutions are indicated either by the per cent method, as a 5% solution, or by the arithmetical ratio method, as a 1 in 20 solution, both terms showing the ratio which the weight of the dissolved solid substance bears to the corresponding measure of the whole amount of solution. That is, they will stand for grains in minims, ounces in ounces, grams in cubic centimeters or mils, etc. For large quantities, of course, multiples of these units are substituted in practice, and for smaller quantities fractions will enter into the computation.

The per cent method of reckoning solutions is often very puzzling to beginners, but it is in reality comparatively easy because it involves only the simple rudiments of percentage. The term per cent means merely, by the hundred, and the symbol, %, is only an abbreviated form of $\frac{1}{100}$. The 5% solution, then, could be designated as a $\frac{5}{100}$ (five one-hundredths) solution, or a 5 in 100 solution, which means that there is the proportion of 5 grains in every 100 minims. This is the same as a 1 in 20 solution, since, if there are 5 parts in every 100 parts there must be 1 part in every one-fifth of 100, or 1 in every 20 (usually written 1-20). Similarly, the process of division may be carried into fractions, for if there is 1 in 20, there must be ½ in 10, and ¼ in 5. The minim, of course, is not divisible in practice, but the grain may be fractioned indefinitely, as will be shown later on. Also, instead of dividing both these numbers they may be multiplied, which will be convenient in case large quantities of solutions are to be made, and thus the 1-20 solution could be considered a 10 in 200 or a 50 in 1000 solution, and so on indefinitely, though the practical

of bichloride in 1000 minims, there must be $\frac{1}{10}$ of a grain in 100 minims and $\frac{1}{100}$ of a grain in 10 minims, and the strength of the 1-1000 solution could be written $\frac{1}{10}$-100, $\frac{1}{100}$-10, and so on.

In the following problems, the per cent and the ratio designations of solution strengths will be intermingled, and the student should make it a point to be able to translate from one to the other at sight.

Tablets and powders, as our source of supply, will not entail any difficulties except those which arise also with the various stock solutions, so we shall use stock solutions chiefly and the tablet and powder problems will take care of themselves at the same time.

Problem.—*Make 5 ounces of 2% silver nitrate solution from a 25% stock solution.*

In quantities no larger than this it will be best to reduce the ounces to minims, first of all.

Then, $5 \times 480 = 2400$

The total number of minims desired, therefore, is 2400; and as 2%, or $\frac{2}{100}$ of this amount is eventually to be silver nitrate,

then, 2% of 2400

or, $\frac{2}{100} \times 2400 = 48$, the number of grains needed.

The next step is to get this 48 grains from the 25% stock solution; and this solution may be analyzed thus:

25 grains = 100 minims
5 " = 20 "
1 grain = 4 "

To get the 48 grains, then, we take from the stock bottle 48 times the quantity which contains 1 grain, or,

$48 \times 4 = 192$, the number of minims to take,
$= 3$ drams, 12 minims.

In making the solution, remember that this 3 drams and 12 minims must constitute a part of the total 5 ounces prescribed instead of being an addition to it. This will be clear to the pupil because when she started out she desired 5 ounces, not 5 ounces plus 3 drams and 12 minims, and made all her calculations for the even 5 ounces. The practical way of securing this amount, if a large enough measure is at hand, will be to put the 3 drams and 12 minims into it first and then add water up to the 5-ounce mark. If a smaller measure must be used, the only way will be to reckon the difference between 5 ounces and the 3 drams and 12 minims and measure out only that amount of water.

Students who are familiar with the subject of *algebraic proportions* will find it very applicable in a case like that of the above problem, for we can reason thus: The quantity of 25% solution which we must use will bear the same relation to our final quantity of 2% solution that 2% bears to 25%; and with

x = quantity of stock solution we must use
a = quantity of dilute solution we are making
b = strength of dilute solution we are making
c = strength of stock solution

we can state our problem thus:

$$x : a = b : c$$

In other words, when we take a small amount of 25% solution and convert it into a larger amount of 2% solution we merely accept the ratio which the strengths of the two solutions dictate and then, by the use of a certain quantity of water, relate such portions of the solutions as have the inverse of their strength ratio. Then, we can solve our problem thus:

Let x = the number of minims of the 25% solution we shall have to use

Then, $x : 2400 = 2\% : 25\%$

Solving for x, $25x = 2 \text{ x } 2400$

$= 4800$

$x = 192$

Remember, that if we let x equal the number of minims we must convert our 5 ounces to minims, and that if we prefer to use 5 ounces or 40 drams we must let x equal the number of ounces or drams.

We can solve any form of solution problem with this formula by merely using x for the unknown term. Apply it, then, to the same solution under the following various conditions:

Problem.—*How much of a 1-4 solution of silver nitrate will be needed to make 5 ounces of a 2% solution?*

Let x = the number of minims of the 1-4 solution needed, and 1-4 = 25%.

Then, $x : 2400 = 2\% : 25\%$

$25x = 4800$

$x = 192$

Or, let x = the number of minims of the 1-4 solution needed, and 2% = 1-50.

Then, $x : 2400 = 1\text{-}50 : 1\text{-}4$

$= 4 : 50$

$50x = 9600$

$x = 192$

Problem.—*How many grains of silver nitrate will be needed to make 5 ounces of a 2% solution?*

Let x = the number of grains needed, and 2% = 1-50.

Then, $x : 2400 = 1 : 50$

$50x = 2400$

$x = 48$

Problem.—*What is the strength of a silver nitrate solution in which there are 48 grains of silver nitrate to every 5 ounces?*

Let $x =$ the per cent of strength
then, x-100 = the ratio of strength

Hence,
$$x:100 = 48:2400$$
$$2400x = 4800$$
$$x = 2$$
and
$$x\text{-}100 = 2\text{-}100$$
$$= 1\text{-}50$$

Problem.—*Make 5 ounces of 1-50 silver nitrate solution from a 25% solution.*

Let $x =$ the number of minims of the 25% solution needed,
and 1-50 = 2%

Then,
$$x:2400 = 2\%:25\%$$
$$25x = 4800$$
$$x = 192$$

Problem.—*How much 2% solution can be made from 48 grains of silver nitrate?*

Let $x =$ the number of minims that can be made,
and 2% = 1-50.

Then,
$$48:x = 1:50$$
or,
$$x:48 = 50:1$$
$$x = 2400$$

The above method works perfectly until we have a problem that requires us to use a stock solution which will not yield the grains or fractions of a grain we need in whole minims. For instance, apply it to this

Problem.—*Make 1 ounce of $\frac{1}{7}$ % silver nitrate solution from a 5% solution.*

Let $x =$ the number of minims of the 5% solution needed,
and 1 ounce = 480 minims.

Then,
$$x:480 = \tfrac{1}{7}\%:5\%$$
$$5x = \tfrac{480}{7}$$
$$x = 13\tfrac{5}{7}$$

Thus, we need $13\frac{5}{7}$ minims. But we can not measure $\frac{5}{7}$ of a minim. In many cases $\frac{5}{7}$ of a minim would be so unimportant that it could be dropped; but if we were dealing with morphine, for instance, it would not be unimportant and we must, therefore, know some way out of such a difficulty.

We shall now formulate *a rule which will cover the most involved fractions,* and it will be worth while for the pupil to work this out, for when she has done so she will be equal to the most intricate problems and will understand the short cuts of the simple ones all the better.

(4.) *How can 15 minims of water be divided into 105 parts?*

The addition of water to the 15 minims of silver nitrate solution will not change the amount of silver nitrate in the whole quantity, but it will change the amount in each minim. We can, therefore, add enough minims to the 15 so that each of its 105 parts of a grain will have a certain number of whole minims to itself.

Thus, $15 + 90 = 105 = 1$ minim for each $\frac{1}{140}$ of a grain,
and $15 + 195 = 210 = 2$ minims " " " " " "

and so on indefinitely.

With a different stock solution it might have happened that the $\frac{105}{140}$ of a grain were in more than 105 minims of water in the beginning. For instance, from a ½% stock solution, 150 minims would have to be taken to get $\frac{105}{140}$ of a grain.

Then, $150 + 60 = 210 = 2$ minims for each $\frac{1}{140}$ of a grain,
and $150 + 165 = 315 = 3$ minims " " " " " "

and so on indefinitely.

Thus, we could add as much water as we pleased as long as our total number of minims could be distributed equally among the 105 parts of a grain which we know they hold in solution. In other words, we must add to our portion of stock solution the number of minims of water that will make the total number exactly divisible by the number of parts of a grain which are in it.

(5.) *How, then, do we determine the actual number of minims which we must take from this new solution in order to get exactly the $\frac{24}{35}$ or $\frac{96}{140}$ of a grain we need?*

Since $\frac{1}{140} = 1$ minim
then $\frac{96}{140} = 96 \times 1$
$= 96$ minims

Therefore, 96 minims will be the amount of this diluted stock solution to use to get $\frac{96}{140}$ or $\frac{24}{35}$ of a grain.

Likewise, if $\frac{1}{140} = 2$ minims
then $\frac{96}{140} = 96 \times 2$
$= 192$ minims,

and 192 minims would be the portion to use.

Then, we can summarize the process for solving fractional solution problems thus:

(1.) *Determine the fraction of a grain needed.*
(2.) *Take from the stock solution the number of minims which contain the fraction of a grain nearest this (at least as large, of course).*
(3.) *Reduce these two fractions to a common denominator.*
(4.) *Add enough water (if any is necessary) to the portion of stock solution so that the total number of minims will be divisible by*

the number of parts of a grain which it contains (the numerator of the larger fraction); and note the number of minims provided for each of these parts.

(5.) *Multiply this number of minims by the number of parts of the grain needed (the numerator of the smaller fraction). This will be the number of minims to use.*

To become familiar with the rule, apply it step by step to several more problems:

Problem.—*Make 1 ounce of $\frac{1}{5}$ % solution of boric acid from a 4% stock solution.*

(1.) $\frac{1}{5}\%$ or $\frac{1}{500}$ of $480 = \frac{24}{25}$, the needed fraction of a grain.

(2.) $4\% = 4\text{-}100$

$= 1\text{-}25$

$= \frac{1}{5}\text{-}5$

Since $\frac{24}{25}$ is very little less than 1 grain, a whole grain, or 25 minims, will have to be taken from the 4% stock solution.

(3.) $1 = \frac{25}{25}$

Thus, the two fractions we have to deal with already have a common denominator.

(4.) Our portion of stock solution is 25 minims, a number which is divisible by the number of parts of a grain in it, so no water need be added in this case; and we have 1 minim for each $\frac{1}{25}$ of a grain.

(5.) $24 \times 1 = 24$,

and 24 is therefore the number of minims to use to get $\frac{24}{25}$ of a grain of boric acid.

The experienced student will be able to solve this problem by mere inspection, for it happens that steps (3), (4), and (5) solved themselves in the nature of the case and were evident at a glance.

In a case like this it would be just as simple to put the whole grain into 500 minims of water and discard the 20 minims containing the unwanted $\frac{1}{25}$ of a grain, since the wastage is the same in the two cases and they require about the same work to carry out. Sometimes, however, wastage will not be so negligible, and it will not always be necessary under the rule.

Problem.—*Make 4 ounces of 1-7000 potassium permanganate solution from a 1% stock solution.*

(1.) $1\text{-}7000 = \frac{1}{70}\%$

$\frac{1}{70}\%$ of 4 ounces

or, $\frac{1}{7000}$ of $1920 = \frac{48}{175}$, the fraction of a grain needed.

(2.) $1\% = 1\text{-}100$

$= \frac{1}{2}\text{-}50$

$= \frac{2}{5}\text{-}40$

$= \frac{3}{10}\text{-}30$

The $\frac{8}{10}$ of a grain is the nearest to what we need, so 30 minims is our quantity.

(3.) $\frac{8}{10}$ and $\frac{48}{175} = \frac{105}{350}$ and $\frac{96}{350}$.

(4.) $30 + 75 = 105$

$= 1$ minim for each $\frac{1}{350}$ of a grain.

(5.) $96 \times 1 = 96$,

and 96 is therefore the number of minims we need to use to get $\frac{96}{350}$, or $\frac{48}{175}$ of a grain.

Problem.—*Make 100 minims of $\frac{1}{3}$% cocaine solution from a 1% stock solution.*

(1.) $\frac{1}{3}$% of $100 = \frac{1}{3}$, the fraction of a grain we need.

(2.) 1% = 1-100

= ½-50

= ⅖-40

Therefore, use the $\frac{2}{5}$ of a grain in 40 minims.

(3.) $\frac{2}{5}$ and $\frac{1}{3} = \frac{6}{15}$ and $\frac{5}{15}$

(4.) $40 + 2 = 42$

$= 7$ minims to each $\frac{1}{15}$ of a grain.

(5.) $5 \times 7 = 35$,

and therefore 35 minims is the amount to use to get $\frac{5}{15}$, or $\frac{1}{3}$ of a grain.

Problem.—*Make 1½ ounces of 1-1000 bichloride solution from a 1-16 stock solution.*

(1.) 1½ ounces = 720 minims

1-1000 = $\frac{1}{10}$%

$\frac{1}{10}$% of 720 minims = $\frac{720}{1000}$

= $\frac{18}{25}$, the fraction of a grain needed.

(2.) Stock solution = 1-16

= ½-8

= ¼-4

= ¾-12

The 12 minims containing ¾ of a grain will yield the amount we wish.

(3.) $\frac{3}{4}$ and $\frac{18}{25} = \frac{75}{100}$ and $\frac{72}{100}$.

(4.) $12 + 63 = 75 = 1$ minim to each $\frac{1}{100}$ of a grain.

$72 \times 1 = 72$, the number of minims to use.

All but a few solutions are more easily and quickly made with warm water than with cold, and as they are nearly always warmed for use it will be the best practice to warm the water first. In making a saturated solution, however, the element of temperature, already pointed out, must be remembered.

The temperatures of water understood by the terms "cold," "warm," etc., as adopted in the U. S. P., are as follows:

Usual Strengths of Solutions

Alum	5%
Argyrol	1-1000 to 25%
Bichloride of mercury	1-1000 to 1-10,000
Boric acid	2% to 5%
Carbolic acid	1-20 to 1-60
Creolin	½% to 2%
Formalin	½% to 1%
Ichthyol	3% to 50%
Lysol	½% to 2%
Potassium permanganate	1-1000 to 1-10,000
Silver nitrate	0.1% to 5%
Sodium bicarbonate	1% to 10%
Sodium chloride	0.6% to 0.9%

WEIGHTS AND MEASURES

Apothecaries' Weight

Pound lb.		Ounces ℥		Drams ʒ		Scruples ℈		Grains gr.
1	=	12	=	96	=	288	=	5760
		1	=	8	=	24	=	480
				1	=	3	=	60
						1	=	20

Avoirdupois Weight

Pound lb.		Ounces oz.		Drams dr.		Grains gr.
1	=	16	=	256	=	7000.0
		1	=	16	=	437.5
				1	=	27.34375

Metric Weight

10 milligrams	=	1 centigram
10 centigrams	=	1 decigram
10 decigrams	=	*1 gram*
10 grams	=	1 decagram
10 decagrams	=	1 hectogram
10 hectograms	=	1 kilogram
10 kilograms	=	1 myriagram
10 myriagrams	=	1 quintal
10 quintals	=	1 tonneau

Equivalent Weights

Apothecary	Avoirdupois	Metric
1.0 gr. =	1.0 gr. =	0.065 Gm.
15.43 " =	15.43 " =	1.0 "
1.0 ʒ = 60.0 " =	60.0 " =	3.89 "
0.91 ℥ = 7.29 " = 437.5 " =	1.0 oz. = 16.0 dr. = 437.5 " =	28.35 "
1.0 " = 8.0 " = 480.0 " =	1.097 " = 17.55 " = 480.0 " =	31.1 "
14.58 " = 7000.0 " =	1.0 lb. = 16.0 " = 7000.0 " =	453.6 "
32.15 " =	2.2 " = 35.27 " =	1000.0 " (1 kilo)

Apothecaries' or Wine Measure

Gallon		Pints		Fluidounces		Fluidrams		Minims
C.		O.		f℥		fʒ		♏
1	=	8	=	128	=	1024	=	61,440
		1	=	16	=	128	=	7,680
				1	=	8	=	480
						1	=	60

Metric Dry and Liquid Measure

10 milliliters	=	1 centiliter
10 centiliters	=	1 deciliter
10 deciliters	=	*1 liter*
10 liters	=	1 decaliter
10 decaliters	=	1 hectoliter
10 hectoliters	=	1 kiloliter
10 kiloliters	=	1 myrialiter

EQUIVALENT TEMPERATURE SCALES

	Fahrenheit Degrees	Centigrade Degrees
Boiling point of water	212	100
	200	93.3
	190	87.8
	180	82.2
	170	76.7
	160	71.1
	150	65.6
	140	60
	130	54.4
	120	48.9
	110	43.3
Normal body temperature	98.6	37
	90	32.2
	80	26.7
	70	21.1
	60	15.6
	50	10
	40	4.4
Freezing point of water	32	0
	20	—6.7
	10	—12.2
	0	—17.8

The Fahrenheit scale is used chiefly in the English-speaking countries. *The Centigrade scale* is used in Europe and Latin-America chiefly, but it is considerably used also in most of the other countries.

The conversion of any given reading of one scale into its equivalent in the other is very easy. If 32 (the number of degrees below the freezing point in the Fahrenheit scale) is subtracted from 212 (the boiling point on the Fahrenheit scale) the remainder will be 180, which is the actual number of degrees on the Fahrenheit scale between freezing and boiling. On the Centigrade scale the corresponding number is 100. Then, any given number of degrees on the Fahrenheit scale (after 32 has been subtracted) is to the corresponding one on the Centigrade scale as 180 is to 100, or, reduced to lowest terms, as 9 is to 5. In other words, the Centigrade reading will be five-ninths ($\frac{5}{9}$) of the Fahrenheit one.

Example.—Convert 98.6° Fahrenheit into Centigrade.

$98.6 - 32 = 66.6$

$66.6 \times \frac{5}{9} = 37$, the corresponding reading on the Centigrade thermometer.

To work the problem backward, and *convert Centigrade degrees into Fahrenheit* ones, the fraction will simply be inverted; that is, the Centigrade degrees will be multiplied by nine-fifths ($\frac{9}{5}$). It must be remembered, however, that the resulting figure will represent only the number of degrees above the freezing point on the Fahrenheit scale, and 32 must be added in this case to get the true Fahrenheit reading.

Example.—Convert 37° Centigrade into Fahrenheit.

$37 \times \frac{9}{5} = 66.6$

$66.6 + 32 = 98.6$, the true corresponding reading on the Fahrenheit thermometer.

ABBREVIATIONS AND SYMBOLS

āā, *ana,* equal parts of each.
A.c., *ante cibum,* before meals.
Ad, to, up to.
A.D., *auris dexter,* right ear.
Ad 2 vic., *ad duas vices,* for two doses.
Add., *adde,* add to it.
Ad lib., *ad libitum,* whenever desired.
Ag *argentum,* silver.
Al aluminum.
Al. dieb., *alterius diebus,* every other day.
Alt. hor., *alterius horis,* every other hour.
Alt. noc., *alterna nocte,* every other night.
Aq., *aqua,* water.
Aq. astr., *aqua astricta,* ice.
Aq. bull., *aqua bulliens,* boiling water.
Aq. com., *aqua communis,* common water.
Aq. dest., *aqua destillatu,* distilled water.
Aq. ferv., *aqua fervens,* hot water.
Aq. pur., *aqua pura,* pure water.
As, arsenic.
A. S., *auris sinister,* left ear.
At. wt., atomic weight.
Au, *aurum,* gold.
Av., avoirdupois.
Bi, bismuth.
Bib., *bibe,* drink.
B. i. d., *bis in die,* twice a day.
Bis, twice.
Bis hor., *bis horis,* every two hours.
Br, bromine.
Bull., *bulliat,* let it boil.

c̄., *cum,* with.
C, carbon, centigrade.
C., or Cong., *congius,* a gallon.
Ca, calcium.
Calef., *calefactus,* warm, let it be made warm.
Cap., *capiat,* let him take.
C.c., cubic centimeter.
Ce, cerium.
Cent., centigrade.
Cg., centigram.
Cib., *cibus,* food.
Cl, chlorine.
Cm., centimeter.
C. m., *cras mane,* tomorrow morning.
C. m. s., *cras mane sumendus,* to be taken tomorrow morning.
C. n., *cras nocte,* tomorrow night.
Cochl., *cochleare,* spoonful.
Cochleat., *cochleatim,* by spoonfuls.
Cochl. ampl., *cochleare amplum,* a tablespoonful.
Cochl. infant., *cochleare infantis,* a teaspoonful.
Cochl. mag., *cochleare magnum,* a tablespoonful.
Cochl. med., *cochleare medum,* a dessertspoonful.
Cochl. parav., *cochleare parvum,* a teaspoonful.
Col., *cola,* strain.
Colet., *coletur,* let it be strained.
Collut., *collutorium,* a mouth wash.
Collyr., *collyrium,* a mouth wash.
Comp., *compositus,* compound.
Cong., *congius,* gallon.
Cons., *conserva,* keep.
Contim., *contimetur,* let it be continued.
Cont. rem., *contimetur remedia,* let the medicine be continued.
Coq., *coque,* boil.
Coq. in s. a., *coque in sufficiente aqua,* boil in sufficient water.
C. P., chemically pure.
Crast., *crastinus,* for tomorrow.
Cu, *cuprum,* copper.
C. v., *cras vespere,* tomorrow evening.
Cwt., a hundredweight.
Cyath., *cyathus,* a glassful.
Cyath. vin., *cyathus vinarius,* a wine glass.
Decoct. hord., *decoctum hordei,* barley water.
Decub., *decubitus,* lying down.
De d. in d., *de die in diem,* from day to day.
Deg., degree.

H. s., *hora somni,* at bedtime.
I, iodine.
Id., *idem,* the same.
In aq., *in aqua,* in water.
In d., *in die,* daily.
Inf., *infusum,* an infusion.
Inject., *injectis,* an injection.
K, *kalium,* potassium.
Kg., kilogram.
L., liter.
Lat. dol., *lateri dolenti,* to the painful side.
Lb., *libra,* a pound.
Li, lithium.
Lin., *linimentum,* liniment.
Liq., liquor.
Loc. dol., *loco dolenti,* to the painful spot.
Lot., *lotio,* a lotion.
M., *misce,* mix.
Mac., *macera,* macerate.
Man., manip., *manipulus,* a handful.
Man. pr., *mane primo,* early in the morning.
Mass. pil., *massa pilularum,* pill-mass.
Matut., *matutinus,* in the morning.
M. et N., *mane et nocte,* morning and night.
M. ft., let a mixture be made.
Mg, magnesium.
Mist., *mistura,* a mixture.
Mn, manganese.
Mor. dict., *more dicto,* in the manner directed.
Mor. sol., *more solito,* in the usual way.
N, nitrogen.
Na, sodium.
Ne rep., *ne repetatur,* not to be repeated.
Noct., *nocte,* at night.
Noct. maneq., *nocte maneque,* at night and in the morning.
Non repetat., *non repetatur,* do not repeat.
O, oxygen.
O., *octarius,* a pint.
O^2, both eyes.
O. d., *omne die,* every day.
O. D., *oculus dexter,* right eye.
Ol., *oleum,* oil.
Ol. oliv., *oleum olivae,* olive oil.
O. m., *omni mane,* every morning.
Omn. bih., *omni bihora,* every two hours.

Omn. hor., *omni hora,* every hour.
Omn. noct., *omni nocte,* every night.
O. n., *omni nocte,* every night.
O. S., *oculus sinister,* left eye.
O. U., *oculus uterque,* either eye.
Ov., *ovum,* an egg.
Oz., ounce.
P, phosphorus.
P. or pug., *pugillus,* a pinch.
Part. aeq., *partes aequales,* equal parts.
Part. vic., *partibus vicibus,* in divided doses.
Pb., *plumbum,* lead.
P. c., *post cibum,* after meals.
Pil., *pilula,* a pill.
Pond., *pondere,* by weight.
P. rat. aetat., *pro rata aetatis,* in proportion to the age.
P. r. n., *pro re nata,* according to need.
Pro, for.
Pt., pint.
Pulv., *pulvis,* powder.
Q. d., *quarter in die,* four times a day.
Q. h., *quaque hora,* every hour.
Q. i. d., *quarter in die,* four times a day.
Q. l., *quantum libet,* as much as you choose.
Q. p., *quantum placeat,* at will.
Q. q. h., *quaque quarta hora,* every fourth hour.
Q. s., *quantum sufficit,* as much as is necessary.
Qt., quart.
Quotid., *quotidie,* daily.
Q. v., *quantum vis,* as much as you wish.
Ra, radium.
Rad., *radix,* root.
Rect., *rectificatus,* rectified.
Rep., *repetatur,* let it be repeated.
S., *sine,* without.
S. or sig., *signa,* write.
Sat., saturated.
Sb, *stibium,* antimony.
Semih., *semihora,* half an hour.
Sig., *signetur,* let it be labeled.
Sig., *signa,* write.
Simul, together.
Sing., *singulorum,* of each.
Sol., solution.
Solv., *solve,* dissolve.

S. o. s., *si opus sit,* if necessary.
Sp., *spiritus,* spirit.
Sp. gr., specific gravity.
Spir., *spiritus,* spirit.
Spt., *spiritus,* spirit.
St., stet, let it stand.
Stat., *statim,* at once.
Ss., *semissis,* a half.
Su., *sumet,* let him take.
Sum., *sumendus,* to be taken.
S. v., *spiritus vini,* alcoholic spirit.
S. v. r., *spiritus vini rectificatus,* rectified spirit of wine.
S. v. t., *spiritus vini tenuis,* dilute alcohol, proof spirit.
Syr., syrup.
T., temperature.
T., *ter,* three times.
T. i. d., *ter in die,* three times a day.
Tinct., tincture.
Tr., tincture.
Ult. præs., *ultimum præscriptus,* last prescribed.
Ung., *unguentum,* ointment.
U. S. P., United States Pharmacopœia.
Ut dict., *ut dictum,* as directed.
Vitel., *vitellus,* yolk.
Vitel. ovi, *vitellus ovi,* yolk of egg.
Viz., *videlicet,* namely.
Wt., weight.
Zn, zinc.
ʒ, dram.
℥, ounce.
℈, scruple.
℞, recipe, take.
♏, minim.