OPERATIVE GYNECOLOGY

VOLUME I

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BY

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WITH TWENTY-FOUR PLATES AND OVER
FIVE HUNDRED AND FIFTY ORIGINAL ILLUSTRATIONS

VOL. I

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TO

ROBERT P. HARRIS, M. D.,

WHOSE KINDLY SYMPATHY AND GOOD ADVICE

HAVE AIDED ME FROM THE FIRST,

I DEDICATE THIS BOOK.

"And this is the reason why the cure of many diseases is unknown to the physicians of Hellas, because they are ignorant of the whole, which ought to be studied also; for the part can never be well unless the whole is well."

SOCRATES IN THE CHARMIDES OF PLATO.

Translated by B. Jowett, vol. i, p. 11.

PREFACE.

My aim in writing this book has been to place in the hands of the many friends who have from time to time visited me and followed my work, a convenient summary of the various gynecological operations I have found best in my own practice. It is far from my purpose to present a digest of the literature of the subject, or even to describe all the important operations; if I had set out to do this, the book would never have been written in the midst of the pressing practical duties of my work.

Gynecology is so young a science, and many of its surgical procedures are as yet so incompletely developed, that I think the best service a gynecologist can render his specialty is to record accurately his own experiences. Scientific accuracy is especially necessary in gynecology, in which the discovery of anesthesia and the perfection of an aseptic technique have rendered operations safe which a few years ago would have been necessarily fatal. It is comparatively easy now to open the abdomen; it is no easier than it ever was to combat the causes of disease. This fact is emphasized not only by the number and variety of operations proposed, but also by a healthy tendency toward conservatism. Although I have spent several years in the preparation of my book, so rapid have been the changes in the gynecological field that I have found it necessary to rewrite some of the chapters two and even three times.

I have few claims to originality to urge, and these are, I think, clearly set forth in the text. I should further explain that I have taken the liberty afforded by the more general scope of the work of often omitting references where it would have consumed time to search for them. My own special researches are connected with the operation for suspension of the uterus, and with the investigation of vesical and ureteral diseases. In the classification of tumors of the bladder, I have largely used the work of Clado.

I have many acknowledgments to make and many kind friends to thank for their aid throughout.

First of all, I want to express my indebtedness to Dr. Mary Augusta Scott, to whose constant kindly stimulus and friendly help more than to any one else the work owes its existence. Dr. Scott has arranged, revised, and edited the book.

I am glad of this opportunity to thank my colleague, Prof. William H. Welch, for suggestions as to Chapter I. I have also to thank Dr. B. Meade Bolton for Chapter III, and Dr. L. F. Barker for Chapter XXXVIII; and also

Dr. J. M. T. Finney. Dr. S. Flexner has kindly read over the section on peritonitis in Chapter XXII, and Dr. J. Whitridge Williams has reviewed the first part of Chapter XXXIV for me. Dr. W. W. Russell assisted in the preparation of Chapter XXX. Dr. Thomas S. Cullen has been a valuable helper throughout, furnishing pathological reports and identifying cases.

I am under especial obligation to Dr. John G. Clark for furnishing material and for criticising the work while in progress in places too numerous to mention. Dr. Otto Ramsay has carefully reviewed several of the chapters, especially Chapters XII and XIII, on the bladder and ureters, where his special studies have been of service in rendering the discussion of the subject more accurate. Dr. J. E. Stokes helped to identify cases from our histories, and read over Chapter II in the light of his experience in assisting me in operations in private. I must also thank Dr. J. H. Durkee, Dr. G. W. Dobbin, and Dr. B. B. Lanier.

The illustrations have all been made by Mr. Max Brödel and Mr. H. Becker. I am particularly indebted to Mr. Brödel for his unflagging interest and for the great zeal with which he has thrown himself into the work from the beginning. His pictures speak for themselves. Mr. A. S. Murray has been associated with my work for the past five years and has furnished me with over sixteen hundred photographs. The illustrations have been drawn partly from these photographs, and partly from my own sketches made on the spot, at operations or immediately afterwards. Mr. Murray has also devised various original ways of photographing patients on the operating table, among them vertical photography.

Finally, many thanks are due to Miss Jennie Gill, my efficient secretary, for setting up the manuscript.

HOWARD A. KELLY.

BALTIMORE, *July 2, 1897.*

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SEPSIS.

Surgical sepsis arises from the invasion of a wound by pathogenic micro-organisms which find in the tissues suitable conditions for their development and growth.

The micro-organisms most frequently concerned in traumatic infections are the pyogenic bacteria, of which the most important representatives are the pyogenic staphylococci and streptococci, although under special conditions many other bacterial species may cause suppurative inflammation. The simple conception which once prevailed that a wound becomes infected, in much the same way as an artificial culture medium, by the mere entrance of pathogenic bacteria, has been greatly modified by bacteriological studies of the conditions underlying the infection of wounds. There are various circumstances besides the mere presence of bacteria which determine the occurrence and the character of traumatic infections.

A fresh wound in healthy tissues, while it resembles an artificial culture medium in offering suitable food for the development of many kinds of bacteria, differs from such a medium in the presence of various properties of cells, tissues, and fluids which are hostile to the life and growth of many bacteria. In the study of the causation of traumatic infections it is important to consider not only the invading micro-organisms, but also the germicidal powers of the cells and fluids of the body. Experiments of Dr. W. H. Welch and others have demonstrated that even the most careful antiseptic or aseptic surgical technique often fails to exclude the entrance of bacteria, including sometimes even the ubiquitous pyogenic cocci, into wounds which heal without infectious inflammation. Under these circumstances the antibacterial properties of the living cells

and of the fluids in the wounded area suffice to inhibit the growth or the pathogenic manifestations of the invading bacteria. It is largely to these natural inhibitive forces of the living tissues that we must ascribe the good results obtained in many surgical operations conducted even under a bad technique.

It would, however, be a serious error to rely exclusively in surgical technique upon the germ-destroying powers of the living tissues and fluids of the body, great as these undoubtedly are and important as it is not to interfere with these natural germicidal agencies. In a large proportion of the cases in which bacteria have been found in so-called aseptic wounds the bacteria have been either non-pathogenic or possessed of little virulence. It is exceptional to find virulent pyogenic bacteria in wounds without any manifestations of their pathogenic activity.

The most common invader of wounds of the skin is a variety of the staphylococcus pyogenes albus called by Welch (*Conditions underlying the Infection of Wounds.' Trans. of the Congress of American Physicians and Surgeons*, vol. ii) the staphylococcus epidermidis albus, as it is a regular inhabitant of the epidermis and hair follicles. The investigations of Drs. H. Robb and A. A. Ghriskey (*Johns Hopkins Hospital Bulletin*, vol. iii, p. 37, 1892) have shown that most wounds through the skin sooner or later become contaminated with this organism, and yet its presence may not interfere with primary union. An important point relating to the presence of the staphylococcus epidermidis albus in the healthy skin is that it lies so deeply in the epidermis or hair follicles that chemical disinfection of the superficial layers of the skin does not destroy it, as may be demonstrated by the following experiment: After thorough disinfection of the skin by permanganate of potash and oxalic acid, in the way subsequently described, cultures made from scrapings of the surface usually show no growth. If, now, sterilized silk sutures be passed one or more times through the skin in the disinfected area, and a tube of nutrient agar-agar be inoculated with the sutures, the presence of the white staphylococcus, often in pure culture, can be demonstrated in parts of the epidermis deeper than those acted upon by any chemical methods of disinfection of the surface of the integument.

Welch believes that the staphylococcus epidermidis albus is but rarely pyogenic, and that its pathogenic activity depends largely upon decreased resistance in the germicidal forces of the wound area.

The most recent bacteriological and practical experiments on infection of wounds point conclusively to the fact that the skin is a common habitat for various organisms, and that this must be taken into careful consideration in the preliminary disinfection of all operative fields. As already stated, in a large proportion of cases these organisms are non-pathogenic, and a fresh wound containing them may, from a surgical standpoint, be regarded as aseptic when the process of healing is in no way interfered with.

Cultures taken from beneath the most carefully applied surgical dressings very frequently show growths which can be accounted for only on the supposi-

tion that bacteria were present before the operation, or were deposited in the wound during the progress of the operation, or gained access later from the adjacent skin. Suppuration occurs when the organism is virulent, the condition of the wound favorable for growth, and the normal inhibitory activity of the tissues is reduced.

In the following quotation from Dr. Welch's paper he summarizes the conditions underlying wound infection: "The effects produced in the animal body by the pyogenic cocci are determined by many factors relating to the infectious agent and to the individual exposed to infection. There are differences in these effects, depending upon the species of animal; upon the tissues and parts of the body infected; upon the readiness of absorption from the affected parts; upon the source, the number, and the virulence of the organisms; upon the nature and amount of toxic substances accompanying and produced by the bacteria; upon general predisposing conditions of the body; and upon local conditions in a wound, such as the presence of foreign bodies, of pathological products, of dead spaces, of bruised, necrotic, and strangulated tissues."

Notwithstanding the constancy of micro-organisms in the air and on all objects with which we come in contact, we are usually able, by carrying out a rigid technique, to prevent the invasion of a wound by virulent pyogenic organisms in sufficient number to produce harm. The realization of the difficulty of obtaining a germ-free wound should stimulate surgeons to observe the most painstaking care in the preliminary preparation in order to reduce the amount of contamination to a minimum.

ASEPSIS.

In a surgical sense asepsis is the absence of septic germs; an aseptic wound is one which remains free from invasion by these germs in sufficient number to disturb the healing process.

The common means for the introduction of the germs are the hands of the surgeon or of his assistants, the instruments, or the surgical accessories.

The surface of the body, the digestive canal, and the female genital tract up to the internal os uteri are normally the habitat of many species of micro-organisms. As it is not practicable to differentiate beforehand the specific character of the various germs which are present, especially as to their pyogenic properties and virulence, modern surgery first proceeds upon the assumption that the skin of the patient, of the surgeon, and of the assistants, the instruments, the dressings, etc., are in an infected state until rendered aseptic by the use of antiseptic measures; and second, it endeavors to maintain the aseptic condition thus established throughout and after an operation.

The surgeon must also be constantly alive to the fact that his work and that of his assistants and the nurses may bring them into daily contact with septic matter, and that extraordinary precautions are necessary to avoid conveying such infected material from case to case. There is a well-recognized

liability of septic cases to occur in groups in hospital practice. As an example of this in my own practice, in 1892 I ruptured a large streptococcus abscess in removing it, and the patient died shortly afterward. Three cases immediately following this had an erysipelatous inflammation of the wound and narrowly escaped with their lives.

ANTISEPSIS.

Antisepsis is a term used to designate any active means whatever by which septic germs are removed, destroyed, or rendered inactive.

The antiseptic principle may be worked out in a variety of ways. The demonstration, however, of the value of any antiseptic procedure must come through the more rigid scientific methods of the bacteriologist, and in all cases of innovation as to ways and means his experiments must be recognized as the authoritative tests.

The mechanical removal of germs by scrubbing with soap and water, and their destruction by steam or boiling solutions, are the best antiseptic agents which we possess. It is a noteworthy fact that the housewife's simple remedies against dirt and against fermentation, as in preserving fruits, appear to be the final outcome in this direction of the surgical activity of the last half of this century.

The usual methods of applying heat as a germicide are the hot dry-air oven, the steam oven, or steam cylinder, and boiling soda solution.

Hot-air disinfection requires too high a temperature—176·6° C. (350° F.)—to be satisfactory for most purposes, and is injurious also to sharp instruments. I have for this reason abandoned it in favor of steam disinfection.

Steam disinfection in an oven, jacketed to prevent the steam from condensing, destroys the most resistant organisms.

In order to destroy all germs with their spores, sterilization by live steam must be repeated for two or more successive days, an hour the first time and half an hour on each subsequent occasion. The spores of pathogenic bacteria are less resistant than those of some saprophytic bacteria, such as the bacillus subtilis, and the former are destroyed by exposure for half an hour to the temperature of live steam. Steam under pressure of ten or fifteen pounds destroys even the most resistant spores by a single exposure for twenty minutes to half an hour.

The Arnold or E. Boeckmann steam sterilizer, or some sterilizer similarly constructed, is cheap and effective. The steam is generated rapidly in a small, hollow plate by a Bunsen flame, and then passes through a short shaft into a jacketed cylinder containing the articles to be sterilized. Circulating from this under an outside copper jacket which covers the whole, it is recondensed and drips into a pan, from which it runs through small holes into the hollow plate, and begins to travel the circuit again.

Institutions supplied with steam heat may convey the live steam directly into the sterilizers—a practical, effective, and rapid means of sterilization. An apparatus long in use in the gynecological operating room of the Johns Hopkins

Hospital, connected in this way with the general steam-heating system, has proved most satisfactory.

Two sterilizers are employed—one for water, the other for dressings, etc. The sterilizer for dressings consists of a cylindrical copper reservoir containing a steam coil which enters from above, and has its exit from below. The bottom slopes toward the center, forming a shallow funnel with a drainage-tube for the escape of the condensed steam. A wire netting is placed two inches from the bottom, upon which the objects to be sterilized are deposited. The circulation is so arranged that when active sterilization is required live steam can be turned into the cylinder, penetrating the linen envelopes of the dressings and the cotton plugs of the flasks and tubes.

When the sterilization is completed the live steam is turned from the reservoir into the coil by simple gate-valves, and so quickly dries the dressings before they are removed from the sterilizer. In order that the drying process may be facilitated, the cover should be lifted and air allowed to enter.

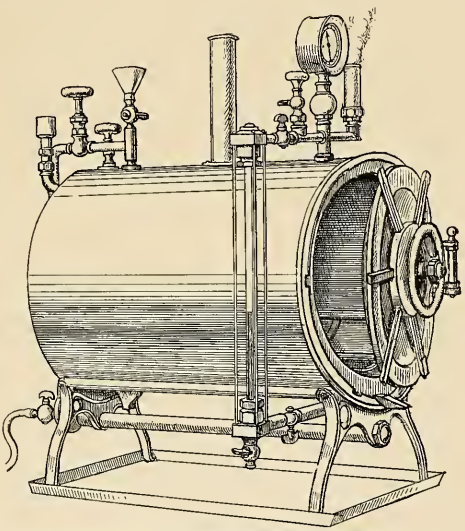

FIG. 1.—STEAM STERILIZER FOR DRESSINGS AND DISHES, THE DOOR PARTLY OPEN.

When the dressings are put in and the door closed a slight turn fixes the projecting lugs in under the rim; the ring in the center of the door is then revolved until the door is jammed down and a steam-tight joint secured. The steam is generated in the jacket by a long gas jet or steam pipes underneath. The amount of water in the jacket is indicated by the gauge at the side. The steam guage on top registers the pressure inside the chamber. After heating and exhausting the air in the sterilization chamber the steam is let in by a screw and the sterilization begins. At the completion of sterilization the steam is turned off and the dressings in the boiler thoroughly dried before removal.

Steam sterilization under pressure is more rapid and more effective than that conducted without it. One of the latest and best sterilizers on this plan is the Sprague, manufactured by Richard Kny & Company, constructed on the principle of the autoclave used in the bacteriological laboratory.

The apparatus consists of an inner and an outer cylinder, the outer serving as a jacket for the inner one. The sterilizing chamber is barrel-shaped, and is closed by a secure door, which makes it steam-tight. A steam gauge indicates the pressure, which may be carried up to thirty pounds, and a safety valve is security against explosion.

Before beginning the sterilization a small quantity of water is placed in the outer cylinder after the inner cylinder has been packed with the objects to be sterilized. The door is then closed and screwed down securely. The gas jet is lit under the cylinder and steam quickly generated, which passes up around the inner cylinder, where it enters a pipe on the top, to be conducted down beneath the perforated rack which supports the dressings; it then passes on up through the middle of the cylinder, and so through a vent into the outer cylinder.

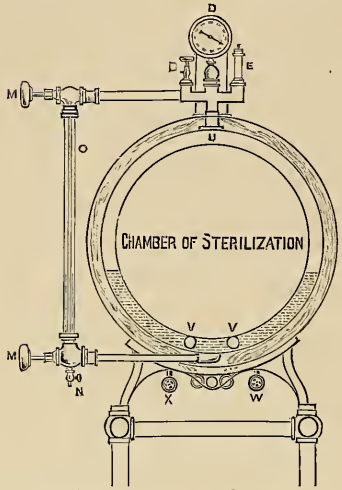

FIG. 2. — SECTIONAL VIEW OF STERILIZER FOR DRESSINGS AND DISHES, WITH STEAM IN CENTRAL CHAMBER UNDER PRESSURE.

B is valve for the discharge of air displaced by the water: *D* is pressure indicator; *E* is the safety valve; *M*, *M* are valves connected with water gauges; *N* is the draw-off valve, water from jacket, for cleansing purposes; *O* is glass water gauge; *U*, steam space in jacket; *V*, coils for heating water, using steam from the general plant of an institution; *W*, steam inlet valve; *X*, outlet valve, condensation from coil.

When the sterilization is completed a valve is opened and the air enters, quickly drying the small amount of moisture collected on the dressings.

In this way we can conveniently sterilize in the chamber, which measures 20 inches in diameter by 28 inches or more in depth, silk ligatures, dressings of all sorts, dishes, operating suits, visitors' gowns, sheets, towels, napkins, and blankets.

Boiling Soda Solution.—Boiling water containing 10 grams (150 grains) of powdered carbonate of soda to the liter is the best antiseptic for instruments, because it dissolves the capsule of the germs and destroys them within five minutes, while simple boiling water and steam demand a much longer time. The soda solution also has the great advantage of preventing rust.

A convenient vessel for boiling instruments is a long, narrow tin bath or porcelain fish boiler, 5 to 7 centimeters (2 to 3 inches) deep, containing a tray for holding them during immersion. A row of Bunsen burners beneath the boiler raises the water to the boiling point in two or three minutes, and in five minutes more the sterilization is complete.

As a fixture in an operating room it is convenient to employ a receptacle, rectangular in form, measuring 15 inches in length by 8 inches in width and 6 inches deep, made of sheet bronze, polished on the outside, and coated internally with pure tin, over which a coating of nickel is deposited. The oval cover of the vessel opens on "slip hinges," and two perforated metal trays hold the instruments in the sterilizer. The instruments are immersed in a 1 to 2 per cent solution of the carbonate of soda, which is brought to the boiling point and kept there for five or ten minutes.

The boiler is arranged for heating either by gas or by steam.

Chemical Antiseptics.—As far as possible, it is safer to depend upon steam or heat sterilization rather than upon chemicals.

Experiments have shown that the solution of bichloride of mercury, frequently employed in surgical work, does not under all conditions manifest its germicidal powers. It often merely inhibits germ growth, but to what extent this inhibition is valuable is as yet unknown. The inefficiency of bichloride of mercury as a cutaneous germicide can be tested for practical purposes by immersing the hands for ten minutes in a 1–500 aqueous solution, and then in a sterilized ammonium sulphide solution to precipitate the mercury. After this, by scraping the epithelium, cultures can usually be obtained which will grow in ordinary media.

If dishes and porcelain ware are to be efficiently sterilized by this means, they must be kept in a strong solution of corrosive sublimate (1–500) for fifteen minutes after they have been thoroughly scrubbed with soap and water; the sublimate kills most of the bacteria and renders the rest inactive.

In the experiments on skin disinfection we have a factor to consider which we do not meet with in the sterilization of the dishes. The albuminate of mercury which is formed in the tissues, when brought in contact with corrosive sublimate solutions, may encapsulate the organisms, and so render them incapable of growth. When dishes, on the other hand, are submerged in the disinfectant

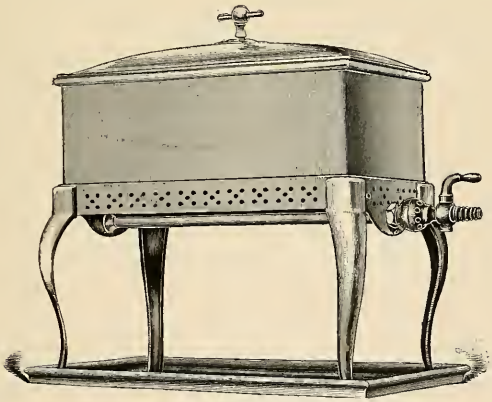

Fig. 3.—Instrument Sterilizer.

solution, the organisms are at once brought in contact with the bichloride of mercury without the formation of this albuminate, and the sterilization is more effective.

The use of chemical solutions, such as carbolic acid and corrosive sublimate, for disinfection of wounds is objectionable, because their value depends upon the

strength of the solution, and a solution of sufficient strength to act as a germicide acts as an irritant. Dr. W. S. Halsted has shown that the irrigation of fresh wounds with a corrosive sublimate solution as weak as 1–10,000 is followed by a distinct necrosis demonstrable under the microscope. This necrotic material may retard the healing process and act as a culture medium for any germs deposited in the wound subsequently; the danger of acute poisoning from the absorption of the mercury must also be considered.

I have long since given up the use of carbolic acid solutions for instruments, and only use sterilized water to submerge them in during operation. The germicidal effect of carbolic acid solutions is more than counterbalanced by the injury which it causes to the hands. I have seen the hands so badly cracked and chapped by the carbolic solutions that it was impossible to scrub them perfectly with nail brushes.

The Operating Room.—For private hospitals or small public institutions the best form of operating room is a simple, spacious, rectangular structure well lighted by skylight and northern windows. The various architectural details should be so arranged as to facilitate the work for which the room is designed, and to carry out the principles governing surgical procedures. The doors should be of the noiseless sliding kind, so as to offer no obstruction to the easy transportation of patients to and fro. Any elaborate ornamentation of the room must be eschewed. The walls must be smooth, of hard finish, or coated with enamel water-proof paint, to resist the disintegrating action of steam. The cleansing of the walls and floors is helped by rounded angles. The walls may be paneled with broad slabs of African marble, which extend five feet up from the floor as a wainscot, or, as in some clinics, all the way to the ceiling. There are several kinds of material useful for flooring; the most common are the square encaustic tiles and the mosaic blocks. When properly laid, so that there are no crevices or cracks, either makes a serviceable and ornamental floor. In paving the floor with the blocks care must be observed to secure a uniform smoothness over the entire surface. By mopping the floor daily and scrubbing it twice a week with sapolio its surface is kept clean. Where economy in construction is considered, a cement pavement or bolted boiler iron covered with ship's paint makes a good floor, which can be easily kept clean. The floors of some operating rooms are laid to slope toward the center or toward one corner of the room, where there is a drainage vent; this convenience would appear to be more dangerous than useful, for the waste pipe may become clogged.

Ventilation must also be considered, for, while we do not attribute so much risk to contamination from the air as formerly, we dare not ignore the fact that infection may occasionally be carried in this way. The entrance for fresh air and the exit for impure air should be so placed that the circulation will not be conducted over the operating table. This precaution is further necessary on account of the possibility of chilling the patient.

The ventilators should be so set that they can be easily taken out of their sockets and cleansed, and some filtering material may be placed in the ventilators.

A sloping skylight, looking to the north, gives an evenly distributed light, which is never glaring.

The equipment of the operating room must be simple.

A prime requisite is a row of large, oval marble basins plentifully supplied with hot and cold water. To facilitate the most perfect details of the aseptic principle, the taps may be connected with a pedal attachment like that devised by Dr. H. Robb, which permits the water to be turned on or off by the foot.

The most glaring inconsistency in the aseptic arrangement of most operating rooms is the impossibility of thoroughly sterilizing the hand basins, which are

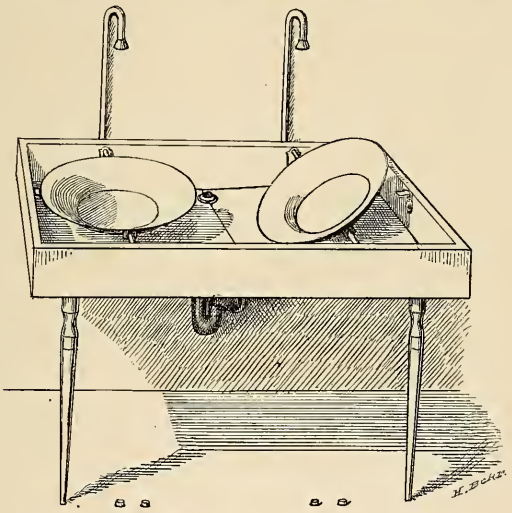

FIG. 4.—HAND BASINS SET ON PIVOTS FOR REMOVAL AND STERILIZATION.

The hot and cold water are mixed in a rose jet a foot above the basin. The flow of hot or cold water is controlled by the foot taps on the floor.

contaminated at every washing and are liable to hold grease. This may be avoided by using movable metal basins made of plated copper or solid nickel, and swung over a porcelain hopper or sink, as shown in the figure.

A large sink for the immersion of dishes, etc., and a hopper for waste water, should be in a convenient location. The traps in all the pipes must be inspected and disinfected frequently.

The room should be fitted with electric-light and gas fixtures, and an electric-light bracket should be placed near the operating table, so that a portable light with reflector may be attached easily. A group of four incandescent lights with reflectors should be suspended over the table.

The other furnishings of the operating room should be as few as possible; all apparatus—such as dressings, sterilizers, water-boilers, etc.—should be placed

in an adjoining room. The instrument case should be conveniently located, either near the operating table or in an adjoining room, so that at any time an instrument may be quickly obtained if required in the midst of an operation.

Glassware for instruments and solutions, and jars for sterilized ligatures, gauze, cotton, and towels, are kept in a room especially set aside for storage.

The sterilization of instruments, dressings, etc., should not be done in the operating room, as the combustion products vitiate the atmosphere, and during the summer months the temperature of the room becomes excessive with the additional heat.

The anesthesia room should be conveniently placed, but great care must be observed to have it so planned that noises from the operating room will not be heard by a waiting patient.

Operating Table.—The gynecological operating table should be of metal with a movable glass top, which can be raised or lowered as required.

The Kelly table shown in the figure is arranged with a support for the

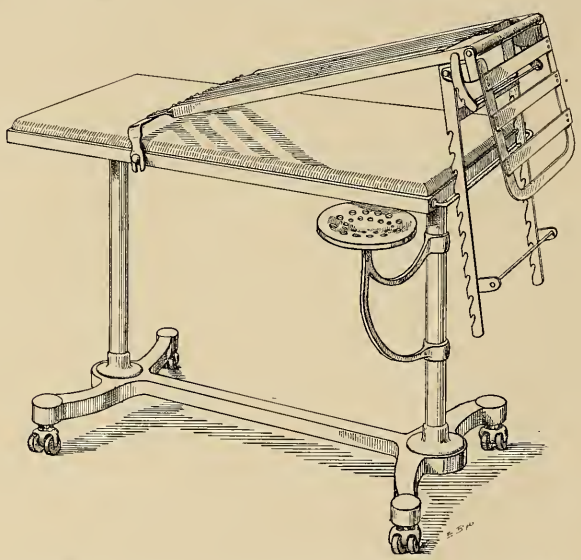

Fig. 5.—Operating Table, with stout Brass Legs and Frame and heavy Glass Top.

Simple attachment with ratchet for the elevation of the pelvis. This is lifted off during vaginal operations, and the seat under the table drawn around for the anesthetizer to sit on, while the operator occupies a stool at the opposite end of the table.

patient's feet below the top. A simple lattice of interwoven metal slats, with a ratchet and crossbar, gives the needed elevation of the pelvis.

The height of the table is 78·5 centimeters (31 inches); width, 53·5 centimeters (21 inches); and length, 113 centimeters (44 inches).

Edebohls's table, one of the simplest and best constructed, and the Boldt table, which inclines the whole body, are both well arranged for self-drainage and easy adjustment.

Sterilized Water.—An abundant supply of sterilized water should always be on hand in the operating room. Water drawn from the tap can be sterilized by boiling it for half an hour. If it is allowed to stand covered for several hours after boiling, the organic matter settles to the bottom, and the clear water above this can be drawn off by a spigot placed in the vessel about 10 centimeters (4 inches) from the bottom. A ready method of sterilizing water in a clinic is by means of a copper reservoir lined with a steam coil. To use this, fill the reservoir with water, and then open a valve in the coil, letting in the steam, when the water is quickly brought to a boiling point. Another way of getting sterile water is by distillation; water can be distilled in quantity, from 80 to 120 liters (20 to 30 gallons) daily, by means of a gas flame, running water, and a small copper still, hung on a bracket against the wall. The cold-water faucet taking its supply from the street is connected with the still by a rubber tube and a slow flow started; a Bunsen burner beneath the still condenses a small portion of the water passing through it, and in this way 6 or 8 gallons or more can be secured every twenty-four hours. The distilled water is conveniently stored in large agate-ware pails and boiled as required for use.

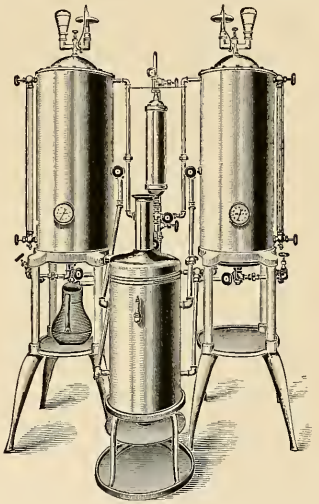

Fig. 6.—Tanks for Storage of Hot and Cold Water.

In a large clinic the quantity of sterilized water, both hot and cold, which is needed for daily use is so great that an apparatus such as that shown in Fig. 6 is a great convenience.

The water, entering from the house tap, is first filtered in the narrow cylinder between the two large ones, to remove all visible impurities. It is then boiled, either by a gas engine, below in the center, or by steam coils, and stored in the large reservoirs seen at the sides, holding from 60 to 75 gallons or more, so arranged that one holds hot and the other cold water. Gauges show the amount of water in the tanks, and thermometers register the temperature. The water is drawn mixed at the desired temperature. Air-filtering vacuum valves above the cylinders provide for the entrance of pure air as the water is withdrawn.

Sterilization and Preservation of Instruments.—It is but a few years since the care of the instruments amounted to nothing more than washing them, often

hurriedly, with soap and warm water, and putting them away in a velvet-lined case, ready for use at the next operation. A close observer could then frequently detect dried blood clinging to the joints of forceps and scissors, and dirt lodged in the eyes of the needles.

No part of the gynecological technique is to-day considered more important than the sterilization of the instruments. To facilitate cleansing, a preference must always be given to the simplest forms of instruments; joints, corrugations, and rough surfaces on the handles must be avoided whenever possible. In the locks of scissors and forceps the screw joint must be rejected, and in its place the French lock, or one similar to a device of my own, are recommended.

After an operation the instruments are gathered together, the paired instruments, such as forceps and scissors, separated, and knives and needles laid apart. They are then placed with handles together in a large dish and washed with soap and hot water. If tarnished, they may be polished with the best grade of sapolio. The first assistant lifts up one instrument after another, rinsing it and wiping it clean; he hands it to the second assistant, who dries it, inspecting carefully all its parts before placing it on a clean dry towel spread on a table. When all the instruments have been cleaned, they are classified and put away in the instrument case on glass shelves to await the next operation. After septic operations, dealing with purulent peritonitis, abscesses, sloughs, etc., the instruments, in addition to being washed, must be sterilized before being returned to the case. By using water not far from the boiling point in cleansing them, the instruments become so hot that they dry much more rapidly.

Before every operation the proper instruments are selected and placed in a bag, or wrapped in a towel, and laid on a tray for sterilization, for five minutes in a 1 per cent bicarbonate of soda solution, as devised by C. Schimmelbusch. When lifted out of the solution they are placed in glass dishes on a table close to the operating table, where they are classified by an assistant whose hands have been sterilized; they are then covered with hot water. One of the great advantages of the soda solution is that it does not tarnish and dull the edges of the instruments as steam sterilization does. Such glaring inconsistencies as drying the instruments with a soiled towel or taking them up with unclean hands must be avoided. Instruments taken out of the case for inspection by visitors must be laid aside for sterilization before being returned.

Fig. 7.—Three Sizes of Silk Used — Fine, Intermediate, and Heavy.

Only the sterilized hands of the operator and his assistants should come in contact with the instruments used during the operation. An instrument which falls to the table or floor, or touches garments or face, is septic until resterilized.

Sterilization and Preservation of Ligatures and Sutures.—Silk and silkworm gut are sterilized by the fractional method.

The best quality of surgeon's twisted silk must be secured in three sizes:

fine (No. 2), intermediate (No. 3), and heavy (No. 4). The fine silk is used to make the carrier loops in the needles and for intestinal suture. The intermediate silk is used in general to tie vessels and to bring together wound surfaces, and often to tie small pedicles. The stout ligature is only used in tying a large quantity of tissue in a pedicle.

The following method of sterilizing silk we owe to Dr. W. S. Halsted, of the Johns Hopkins Hospital: The skeins of silk are opened and cut in lengths of 40 centimeters (11 inches) for carriers, and 24 to 30 centimeters (9 to 12 inches) for ligatures and sutures. Ten of these are wound on a glass reel, and several such reels of one size, or of assorted sizes, are dropped into a stout glass ignition tube devised for this purpose; several of these tubes, plugged loosely with cotton, are put in a steam sterilizer for an hour the first day, and on the two following days for half an hour each time. The steam passes through the cotton without restraint, and acts upon the silk as easily as if it lay loose in the sterilizer. On removing the tubes, the cotton in the mouth is pushed tightly in and they are stored away in glass jars until wanted. Silk which remains over after an operation may be resterilized in the same way, but it is apt to be weakened after the second sterilization.

If it is necessary to take but one reel of silk out of a tube, it may be done without contaminating the rest by carefully removing the cotton stopper between the third and fourth fingers, taking care that the surface of the cotton which comes in contact with the tube does not touch anything else, while holding the tube obliquely to facilitate removing the reel with a pair of sterilized forceps.

Silkworm Gut.—To sterilize silkworm gut, a dozen pieces or more are loosely twisted together, doubled, and put into an ignition tube or a piece of ignition glass tubing plugged at both ends, and sterilized in the same way as the silk.

Catgut.—The employment of catgut sterilized by defective methods has, in at least three recorded instances in my own practice, been productive of serious outbreaks of infection. That the majority of methods are unsafe is shown by the great number proposed. From 1890 to 1894 I used catgut prepared by soaking in ether and then boiling in alcohol under pressure. The results from its use were good until the beginning of 1894, when an outbreak of sepsis occurred which caused four deaths, and while we had no direct bacteriolog-

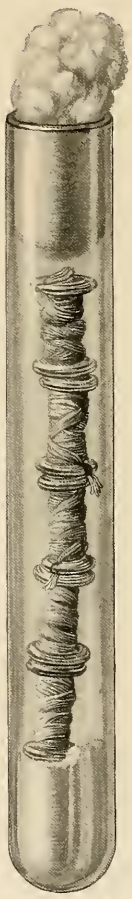

Fig. 8.—Rolls of Sterilized Silk Threads on Glass Bobbins Preserved in stout Glass Ignition Tubes. ¾ Ordinary size.

ical evidence against the suspected catgut, all of which had been used, circumstantial evidence was so strong as to leave little doubt as to its rôle. Catgut was therefore given up entirely, and was not used again until 1895, when I adopted Krönig's cumol catgut.

Fig. 9.—Skeins of Catgut Sterilized with Cumol and Preserved in Glass Ignition Tubes. ¾ Ordinary size.

Briefly stated, Krönig's method consists in the gradual heating of the catgut at 70° C. for two hours, to drive off the hygroscopic water; second, heating in cumol to a temperature of 165° C.; third, transferring to benzine, where it may remain until ready for use, or whence it can be transferred to Petri dishes.

The experiments made by Drs. Clark and Miller, of the Johns Hopkins Hospital gynecological staff, demonstrated beyond doubt the correctness of Krönig's method in general, but showed that it was defective, in that the catgut was transferred to benzine, which is not always sterile. It was therefore possible that the suture material might become reinfected by the benzine. As a result of their experiments the following modified method has been adopted:

1. Cut the catgut into the desired lengths and wind twelve strands into a figure-of-eight form so that it may be slipped into a large test tube.

2. Bring the catgut gradually up to a temperature of 80° C., and hold it at this point one hour.

3. Place the catgut in cumol, which must not be above a temperature of 100° C.; raise it to 165° C. and hold it at this point for one hour.

4. Pour off the cumol and either allow the heat of the sand bath to dry the catgut or transfer it to a hot-air oven, at a temperature of 100° C., for two hours.

5. Transfer the rings with sterile forceps to test tubes, previously sterilized as in the laboratory.

In making the catgut up into skeins it is only necessary to tie the ends in the isthmus of the figure of eight to hold them securely in proper shape. If conve-

nient, it is better to use the hot-air oven for the drying process, but this is not absolutely essential, as a sand bath can be improvised, as suggested by Krönig, to serve this purpose. A beaker glass of at least a half-liter capacity is imbedded three fourths of its height in a tin or agate-ware vessel of sufficient capacity to permit three fourths of an inch of sand to be packed about the sides and beneath the glass.

In drying or boiling, the catgut should not come in contact with the bottom or sides of the vessel, but should be suspended on slender wire supports or placed upon cotton loosely packed in the bottom. During the drying process the beaker glass is covered with a sheet of pasteboard, through which a centigrade thermometer is thrust, so that the mercury bulb may be suspended about midway in the vessel. In this way the temperature can be regulated perfectly. A Bunsen burner is placed under the sand bath and the temperature in the beaker glass is slowly brought up to 80° C., where it is held for one hour to dry the catgut. A higher temperature than 100° C., before the catgut is thoroughly dry, renders it brittle; this step in the method must be carried out most carefully. When the drying process is completed the cumol is poured into the beaker glass and brought up to a temperature of 165° C., a little short of the boiling point, with two Bunsen burners. A copper-wire netting should be placed over the beaker glass to prevent the ignition of the cumol. This temperature is more than sufficient to kill all micro-organisms, and it is not necessary to allow the cumol to boil, which causes unnecessary evaporation. The catgut is left for one hour at this temperature, when the cumol is poured off for subsequent use.

Cumol, which is of a clear limpid or slightly yellowish appearance when procured from the chemist, is changed to a brownish color by boiling.

The catgut is allowed to remain in the sand bath until the excess of cumol is driven off and it appears entirely free from any oily matter. A period of one to two hours is usually sufficient to dry it thoroughly.

From the sand bath or hot-air oven it is transferred with sterile forceps to sterile test tubes, such as are used for culture media, in which it is preserved from contamination until ready for use. Small quantities should be placed in each tube, to obviate the necessity of opening them too frequently.

In conclusion, it is well to bear in mind that while cumol is not explosive it is very inflammable, and great care should be observed in lifting the wire screen from the beaker glass to prevent drops of the cumol from falling into the flame or on the heated piece of metal on which the sand bath rests, as it will take fire, flare up, and ignite the fluid in the beaker glass. Such an accident has occurred three times in our experience.

Catgut may be sterilized with perfect safety and with certainty by using the following apparatus constructed by Dr. J. G. Clark with the aid of Mr. A. V. M. Sprague: The materials are brass and copper, brass for the cast parts and copper for the cylinders. A cylindrical vessel of copper 6 inches in diameter and 8 inches high is fixed within a similar larger cylinder, so as to leave a space of one inch on all sides and at the bottom between the two. This space is com-

pactly filled with dry sand. The apparatus is supported on legs raising it 6 inches above the tray on which it rests. The upper end terminates in a bronze metal flanged top, upon which rests a dome head of cast bronze. The head is bolted tightly to the body of the apparatus, but may be quickly removed so as to reach the interior. The sterilizer is provided with a glass gauge to show the quantity of cumol in the cylinder, and a thermometer registers the temperature of the fluid; there is an attachment for a hose to carry off the vapor as it is generated. The sand between the cylinders is heated by a Bunsen gas burner, which stands on the tray; a uniform heat is easily generated, raising the temperature of the cumol quickly to C. (331° F.), necessary for the sterilization.

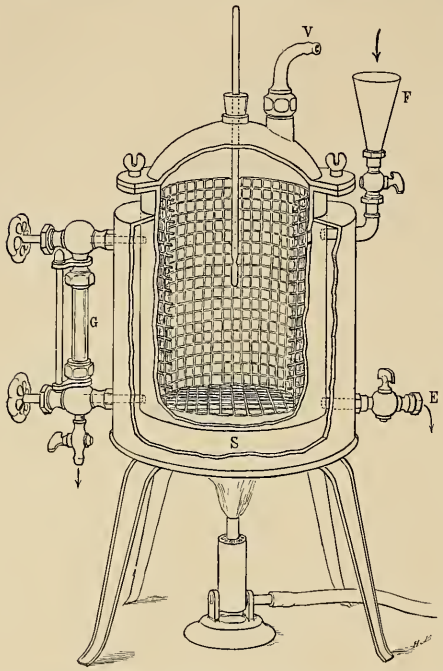

Fig. 10.—Cumol Sterilizer.

E, tap for removing cumol from cylinder; F, funnel through which cumol is poured into cylinder; G, glass tube connected above and below with cylinder to show the amount of cumol; S, sand between outer and inner vessels; V, vent.

Gauze, or cheese cloth, is used in large quantities during operations and for the dressings afterward, and is bought to advantage in bales of one hundred yards each. It forms the best covering for parts of the body around the field of operation, and is a good absorbent and protective when laid as a dressing, six to eight folds thick, on wounds. It is also valuable for making pads to be used in the abdomen during an operation, and for small gauze sponges.

Absorbent cotton, which is common cotton cleansed and deprived of its oil in order to render it absorbent, is the most efficient dressing we possess for taking up discharges, whether applied to the vulva or over an abdominal wound, either directly or on top of a gauze pad. It is also used in padding the inequalities of the abdomen after an abdominal operation before applying a bandage.

Cotton bolsters covered with gauze are needed to hold back the obtruding coils of intestines in abdominal operations. They are made of non-absorbent

cotton, which does not take up moisture, and so preserves its elasticity. The cotton is prepared in rolls 4 to 6 centimeters ($1\frac{1}{2}$ to $2\frac{1}{2}$ inches) in diameter, which are then cut in lengths of 12 centimeters (5 inches) and covered with gauze.

Gauze, cotton, towels, and bandages must be sterilized fractionally by placing them in the steam sterilizer for an hour, then taking them out and again sterilizing them for half an hour at a time on two successive days. After sterilization they should be preserved in large glass jars. It is easier to take what is wanted from the stock without contaminating the rest if, instead of keeping it in bulk, it is broken up into smaller packages before sterilization and rolled in towels or gauze. These small rolls should be kept unopened until needed. When called for, the nurse lifts one of the rolls from the jar, and, unpinning it without touching its contents, lets the ends fall back and holds it to the operator or dresser, who then takes what he wants. Dressings sterilized for immediate use may be used with perfect safety, the fractional sterilization only being necessary when they are to be stored for future use.

Where enormous quantities of gauze are used the expense may be diminished one half by sterilizing and using it over again, as suggested by Dr. J. C. Bloodgood, of the Johns Hopkins Hospital, where the gauze, after using it once, unless the case is known to have been a streptococcus infection, is washed out in cold water and then soaked in a strong solution of bicarbonate of soda to cleanse and remove the blood; it is then taken to the laundry, boiled and dried, and sent back. The patients now smooth it out and roll it up, after which it is sterilized in a steam sterilizer for a half an hour, and used in the ward for various dressings. But a layer of new gauze is always put next to a recent wound.

Iodoform gauze is prepared with aseptic hands by rolling plain sterilized gauze in 3-meter (about 3-yard) lengths, and then cutting up the roll into different lengths and breadths to meet the various requirements.

Before dividing the large roll into these smaller pieces it is saturated with the following iodoform mixture: To 180 cubic centimeters (6 ounces) of warm water, made into a good suds with Castile soap, add 45 cubic centimeters (an ounce and a half) of powdered iodoform, and mix it well in a clean basin with a glass rod. Then immerse the roll of gauze in the liquid, and work it with the hands until the iodoform has been completely taken up into the meshes of the roll. This is now sterilized three times in the steam sterilizer.

Sponges.—Sponges are difficult to sterilize, and for this reason were for some time largely abandoned, but at present they are again used more freely in abdominal surgery. When suitably sterilized, no other substitute possesses the same degree of elasticity and absorptive power. But the responsibility of sterilizing sponges is so great that it must never be left to druggists or instrument makers.

Steps in the preparation of sponges.

1. Lay them in a stout cloth and pound sufficiently to break up grit and lime.
2. Rinse with warm water ten or more times until it remains clear.

3. Immerse in a muriatic acid solution, 15 cubic centimeters to 1 liter (℥ij to Oj), for twenty-four hours.

4. Immerse in saturated warm permanganate of potash solution.

5. Decolorize in a hot saturated oxalic acid solution.

6. Pass through limewater to take out all the oxalic acid.

7. Rinse thoroughly in plain sterilized water.

8. Immerse in a 1–1,000 solution of bichloride of mercury for twenty-four hours.

9. Preserve, until used, in a 3 per cent carbolic acid solution.

The hands manipulating the sponges during these preparations, from step four on, must be sterile, and much of the manipulation may be done with instruments.

When wanted for use, the sponges are lifted out with a long pair of sterilized forceps and rinsed in sterilized water. I never use the same sponge twice, although this may be safely done after aseptic operations.

The best substitute for a sponge is Berlin wool made into a small ball and covered with gauze, which can be sterilized in the ordinary way in the steam sterilizer. Another good substitute for sponges are small gauze mops, made by cutting gauze into convenient strips and rolling them into small balls; a sufficient quantity of these sponges can be prepared before operation by the nurse and stored in linen bags and sterilized by the fractional method.

In operations in private houses, where the water supply is questionable, the so-called dry technique, in which dry gauze and sponges are used instead of water, is decidedly safer.

Rubber drainage pads are especially valuable in permitting an abundant use of water without wetting the patient's clothes or the floor. The largest size, devised for drainage in ovariotomy and abdominal surgery in general, is a circular sheet of rubber 62 centimeters (25 inches) in diameter, with a rim 10 centimeters (4 inches) in diameter, which is inflated when in use. An apron 61 centimeters (24 inches) long, extending over the edge of the table down into a bucket, carries away the waste. The patient rests with her buttocks at about the center of the cushion, and her clothes drawn well above it; all water poured on the abdomen runs over the sides or between the thighs down on to the rubber, where it is diverted by the inflated rim toward the apron, and so carried over the edge of the table into the bucket.

A rectangular perineal pad is needed in vaginal operations, facilitating the abundant use of water by protecting the back and sides, and diverting the water by its inflated rim and apron over the side of the table into a receptacle. Its measurements are: Width, 34 centimeters (14 inches); length of apron, 54 centimeters (22 inches); and size of inflated rim, 9 centimeters (4 inches).

These pads are cleansed by scrubbing after each operation with soap and water. If they are discolored they are sponged off with a saturated oxalic acid solution. If infected, they may be rinsed with a 1–500 bichloride solution and hung in a sunny place to dry.

Vessels.—Glass, hard-rubber, porcelain-lined, or agate-ware vessels hold the instruments, immersed in hot water, during the operation. The smooth, hard surface does not readily lodge septic material, and is easily cleansed after an operation. Rubber trays are useful in private practice, on account of lightness in transportation, and the fact that a number can be nested without chipping. Glass vessels are the most satisfactory for clinics and operating rooms; clear glass readily reveals spots and gives the appearance of cleanliness in harmony with the surroundings.

In clinics where the steam sterilizer is large enough the best way to sterilize the dishes is to put them in the steam bath along with the dressings.

PREPARATION OF THE OPERATOR, ASSISTANTS, AND NURSES.

Personal cleanliness must be observed by frequent bathing, changes of underclothing and of linen, and by wearing clean, well-brushed clothes. A man who is dirty in his general habits is unfit to practice surgery. The obligation to keep clean begins long before entering the operating room for the purpose of "washing up"; it is a duty devolving upon surgeon, assistants, and nurses, at all times, to avoid direct contact with septic materials whenever it is possible, and to scrub the hands thoroughly and, in many cases, to sterilize them carefully immediately after any such contact. Both surgeon and assistants should acquire a feeling of instinctive aversion to touching anything septic.

Septic cases must be relegated to the end of the operating list. On concluding a septic operation the conscientious operator will at once think of his next work, though it may be several days off, and he will immediately proceed, while his hands are still moist, to secure a thorough mechanical disinfection with soap and water. He will also do well to repeat this several times in the interval, at home or in the clinic.

The preparation for an operation begins, therefore, at the preceding operation; it may be days beforehand.

An assistant whose ward work brings him into direct contact with abscesses and sloughing carcinomatous cases, and, above all, one who has charge of or has examined a case of puerperal fever, must be debarred from helping at operations.

Operating Suit.—Preparatory to operation, the coat, vest, shirt, and trousers must be removed and a sterilized linen suit put on; the jacket is made with short sleeves, for the upper arm only, and buttoned up the back; the trousers, if made of a separate piece, have a draw-string at the waist, and are made without buttons or buckles. A sterilized linen cap and white canvas shoes complete a costume fulfilling the requirements of an aseptic technique. Just before each operation the nurse takes a sterilized apron out of her stock of supplies and puts it on the operator, covering that part of his suit which necessarily becomes contaminated in moving about the room before and between operations.

Brushes.—The brushes for scrubbing the hands and nails must be made of stiff bristles, or, better, of a vegetable fiber, such as the Mexican Tampico grass, of durable quality; they are sterilized after every use in the steam sterilizer, and kept in a wire basket. The brush should have a strong wooden back, to afford a good grasp, and should not measure less than 12 by 4·5 centimeters. The fiber brushes stand repeated sterilizations. As soon as the fiber gets soft the brush must be thrown away. The same brush must never be used by two different persons, or twice by the same person without resterilization.

As I visit various clinics I often see no more serious defect in the technique than the miserable, insignificant, flabby nail brushes often used by the surgeon and all his assistants in common, without any or with but one sterilization. Scrubbing the hands, and particularly the nails, with such brushes becomes a farce.

Disinfection of Hands and Forearms.—The first duty of the operator, assistants, and nurses upon entering the operating room is to remove from hands and forearms all contamination from the thousand contacts of daily life, as well as to destroy those germs which have their habitat in the superficial parts of the skin and under the nails.

Many methods of hand disinfection have been proposed. Among these, Fürbringer's is perhaps the most commonly known and generally used. To carry out this method the hands are actually scrubbed for a minute with soap and water as hot as can be borne; they are then rubbed for a minute with 80 per cent alcohol, and finally washed with a ½ per cent sublimate solution.

This method yields fair results, but it is not absolutely certain, as shown by my own experiments; for even after the most careful use of the agent, if the mercury is precipitated by a sulphide of ammonium solution, cultures can often be obtained from the scrapings from the skin.

Welch says in this connection: "It may be urged that it is not necessary actually to kill the bacteria upon the skin; it is sufficient if they are rendered incapable of growth; and as most of those which are not killed by the sublimate do not grow upon our ordinary nutrient media, it is reasonable to infer that they will not grow upon wounds. This line of argument certainly deserves consideration. Nevertheless, there is no positive proof that these bacteria will not grow in wounds under some conditions, and surely we shall feel safer with a method of disinfection which actually kills the bacteria."

I adopted, in 1889, the permanganate of potash and oxalic acid method of disinfection of hands, which had been used by Prof. F. Schatz, of Rostock, for the purpose of prolonging the act of washing the hands for greater security, but not with any germicidal intent. In 1891 my assistants, Drs. Ghriskey and Robb, carried out a series of bacteriological experiments to test the efficacy of this method, and these were embodied in an article written for the *Amer. Jour. of Obst.*, vol. xxiv.

From these studies I arrived at the following conclusions, which have stood the test of time:

1. Staphylococci are present on the hands of all persons.

2. It is impossible to get rid of these organisms even by scrubbing the hands and nails from ten to twenty-five minutes with a sterilized brush, soap, and water at a temperature of 40° C.

3. The bichloride of mercury solutions as used, up to 1 to 500, are not as germicidal as supposed, but they are inhibitory, as demonstrated by cultures growing after the precipitation of the bichloride with ammonium sulphide (Geppert).

At the time these experiments were conducted it was believed that the permanganate of potassium was the active germicidal agent, the oxalic acid being used simply to neutralize and decolorize the permanganate of potassium.

A series of experiments by Dr. Mary Sherwood, conducted in 1893, at my request, to determine the relative part played by these two chemicals in the process of disinfection, however, led to the conclusion that both the permanganate of potassium and oxalic acid were germicides, but that the oxalic acid, at a temperature of about 40° C., is a much more powerful germicide than permanganate of potassium. (See *Johns Hopkins Hospital Reports*, vol. iii, p. 359.)

The strong evidence furnished by these two series of experiments as to the efficacy of the permanganate and oxalic acid as disinfectants is further sustained by an extended practical experience.

In my clinic the cleansing and disinfection of the hands and forearms is accomplished in four steps:

1. The hands and forearms are first vigorously scrubbed for ten minutes with a brush, using common brown kitchen soap or green soap and hot water. Particular attention must be given to scrubbing the surfaces between the fingers, and to the nails, which must not be more than a millimeter in length. The most vigorous efforts in washing must be devoted to the spaces beneath and about the nails. The water should be as warm as can be comfortably borne, and either constantly changed with fresh water running in, or poured out and changed completely four or five times. The duration of this important step must not be measured by guessing; a clock must stand directly over the wash-basins, and assistants and nurses for the first three months should be required to spend never less than ten minutes in cleansing their hands. After the experience in washing thus gained, the time may be reduced to five minutes. Although the hands and arms now appear clean, they are not aseptic, for cultures taken from beneath the nails and from the skin will develop colonies of micrococci, often in large number, in spite of any washing, however prolonged and thorough.

2. The hands, thus mechanically cleaned and softened, are next immersed in a hot saturated solution of permanganate of potash until stained a deep mahogany color.

3. They are then immersed at once in a saturated solution of oxalic acid, which decolorizes and completely sterilizes them. The oxalic acid solution should be as warm as can conveniently be borne.

4. The oxalic acid may be removed by rinsing the hands in warm water, but

it is better for this purpose to keep a dish of sterilized limewater on hand, which at once precipitates the oxalate of lime.

After such a thorough preliminary disinfection it will be necessary to return to the wash-basins frequently during the preparations and during the operation to remove the contamination of various necessary contacts with substances not sterilized—such as the body of the patient, the outer surfaces of dishes, lids, etc.

By turning again to the wash-basins and vigorously scrubbing for ten or fifteen seconds with a fresh brush, the danger of contamination is removed.

Pads of sterilized gauze 15 centimeters (6 inches) square are useful in enabling assistants and nurses to touch handles and lids of jars, etc., without contamination.

With the completion of these antiseptic preparations the operator and his assistants are in a position to go on with their work dominated by a different impulse; for the efficient employment of antisepsis before the operation has secured a condition of asepsis which it will henceforth be the constant effort of surgeon, assistants, and nurses to maintain throughout and after the operation.

Although the methods just detailed are indispensable in the preparations for an operation, it is still more important that the surgeon, assistants, and nurses should live under such a keen realization of the vital relations of sepsis, antisepsis, and asepsis to their work that they shall always feel an instinctive repugnance to contact with any septic material. This sensibility must be especially alert in relation to intestinal and vaginal examinations, treating abscesses, handling sloughs, or touching pathological matter at autopsies, etc. The occasions are rare which justify a surgeon in engaging directly in a post-mortem examination or in handling septic specimens at all. After any such necessary exposure the operator should scrub his hands and forearms thoroughly with soap and warm water, and finally sterilize them with the hot saturated permanganate of potash and oxalic acid solutions.

Surgical assistants and nurses are at all times disqualified by their occupation from taking any part in a post-mortem examination. This instinctive shrinking from infection, keeping always on guard against sepsis, may well be termed "the antiseptic conscience."

CHAPTER II.

ANTISEPSIS AND ASEPSIS IN PRIVATE PRACTICE.

1. Difference between private and hospital surgery.
2. Three plans for preparing sterilized kit: In a public hospital. Room prepared in surgeon's own house. By associate in private hospital.
3. Equipment of sterilizing room at surgeon's house.
4. Sterilization of instruments, dressings, and ligatures.
5. Instrument bags. Contents. Plastic operations. Abdominal operations.
6. Preparation of room for operation.

Difference between Private and Hospital Surgery.—Antisepsis and asepsis can only be attained and carried out in private practice with a greater expenditure of time and trouble, in marked contrast to the facilities of the operating room in the modern hospital. With due care, however, and constant painstaking attention to details, a room in a private house may be so prepared that the principles already laid down need not be violated.

The chief difficulties encountered are the thorough sterilization and the preservation of the instruments and dressings in an aseptic state, and the proper preparation of vessels, towels, and sheets at the patient's home. The surgeon is sometimes compelled to intrust these matters to unskilled assistants, or, in an emergency, even to the family servants. Another reason why work in private houses is less satisfactory must not be overlooked; it is the embarrassment of the new surroundings to the surgeon himself. The number and disposition of assistants, the source of light, the slight delays on the part of the nurses in attending to their duties, as well as the many minor questions as to the bacteriological condition of this or that article, all contribute to emphasize the difference between routine and emergency work. Not the least distressing feature of surgical work in private practice is the liability to forget important instruments in packing the kit, or the awkwardness of a makeshift when an unexpected need has arisen which can not be supplied from the armamentarium at hand.

But, in spite of all the objections which may be raised, a large amount of gynecological work will continue to be done in private houses. Such are the emergency cases which dare not travel, and the patients of the surgeon without satisfactory clinical conveniences or whose practice lies largely in country districts, where a repugnance to a hospital still lingers.

In spite of all precautions and preparations, I confess to a feeling of anxiety after important operations in private, which is only relieved when the patient is convalescent. The first difficulty to be met is the need of suitable assistance. Every operator with a large practice must have a trained assistant to

help him in his private operations, to care for the instruments, and to make the necessary preliminary preparations for operation at the house of the patient. Such an assistant must be a man with a broad hospital training. The second point of importance is the sterilization of the instruments and dressings. The instruments may be sterilized either before going to the patient's house or upon arriving there; the dressings must always be sterilized beforehand.

My own method has been to sterilize and pack away all instruments and dressings immediately after returning from an operation, so as to be ready for a call at any moment. I keep prepared in this way three bags of instruments and dressings: one, for an ordinary gynecological examination and dilatation and curettage; another, for plastic operations; and the third, for abdominal surgery.

I have tried three plans in the preparation of an instrument kit: first, to have it prepared by my resident at a public hospital; second, to fit up a sterilizing room in my own house; and, third—my present plan—to place all preparations in the hands of my associate in my private hospital, who supervises the work of the operating-room nurse in putting them in order. The last plan is the most satisfactory, but, for the sake of the great number of surgeons who must prepare at home, I describe the

Equipment of a Sterilizing Room at the Surgeon's Home.—When possible, a special room should be set apart for this purpose. It need not be larger than 8 by 10 feet—big enough to hold the instrument case and receptacles for dressings, a sterilizer, and a washstand. It should be well lighted, with walls coated with a light enamel paint. If the floor is not close jointed, linoleum or oilcloth, turned up against the washboard at the edges, gives a clean surface, which may be frequently mopped.

A glass instrument case with a metal frame is the best for purposes of cleanliness, but one of hard wood, preferably oak, will answer. The shelves upon which the instruments lie should be of glass or covered with glass plates.

A steam sterilizer of the Arnold pattern occupies one corner of the room, with a large Bunsen burner beneath it. A sink, 2 by 4 feet, supplied with hot and cold water, is an important but not an essential convenience.

A wooden table with a glass or paraffined top, a bench, glass jars for dressings, sponges, and ligatures, 3 enameled tin basins, 1 enameled dipper of a liter capacity, 2 agate-ware reservoirs holding 10 gallons each, and a large shallow boiler on a gas burner for the instruments, complete the furniture of the room.

Sterilization of Instruments, Dressings, and Ligatures.—A large quantity of sterilized dressings, sponges, and ligatures ought always to be ready, so that they may be taken out of the supply jars at a moment's notice, without waiting to sterilize more; but the dressings should not be kept over a month without re-sterilizing them.

The instruments must be sterilized immediately after returning from an operation. To do this, they are first scrubbed with a brush with soap and warm

water, taking especial care to remove all visible traces of dirt from joints and corrugations. They are then wrapped in a towel and put on a rack in the long shallow boiler and boiled for five minutes in a 1 per cent solution of carbonate of soda. The knives must be wrapped separately in absorbent cotton to protect the edges.

Before beginning the preparations, the floor is mopped up and the table and bench washed off with hot water and soap to remove the dust. All the agate-ware vessels are scrubbed with soap and water and scalded out with boiling water, and the two large reservoirs are filled two thirds full with water boiled for half an hour, and one of them set aside to cool. A half liter of a saturated solution of oxalic acid and a half liter of a saturated potassium permanganate solution are prepared in two of the agate basins, while a third basin is left for the hands.

The hands are now scrubbed and disinfected by the permanganate of potash and oxalic acid solution, as described in Chapter I; or a pair of sterilized rubber gloves may be worn, and the thorough sterilization of the hands left until all the preparations have been made. The instruments are lifted out of the boiler and rinsed with plain boiling water taken with a sterilized cup from the agate-ware reservoir. They are laid on one of the sterilized towels and at once wiped perfectly dry with another towel. If the water used is hot, they will dry much more rapidly. They are next assorted, the knives put in a special sterilized metal box by themselves, and placed in a sterilized bag of butcher's linen. Sterilized instruments thus put away in a bag and stored in the kit will remain sterile until the bag is again opened.

Dressings, ligatures, and sponges are best sterilized in bulk beforehand, when the following preparations are necessary:

Silk and silkworm gut are cut the desired lengths and placed in stout ignition tubes, plugged with cotton, and put in a wire basket. A dozen assorted needles are threaded with carriers and stuck in a large gauze pad, like a needle-book, so as to be rolled up.

Towels are made up into bundles of two sizes, one containing 4 and the other 10 towels, and inclosed in a linen bag.

Cotton is cut in strips 30 centimeters (12 inches) in length, and made up into convenient-sized packages and rolled in towels securely pinned.

The gauze is doubled and cut in pieces one meter (40 inches) square and one half meter (20 inches) square, and into pads 15 by 20 centimeters (6 by 8 inches) in size and several folds thick. The large sizes are used to cover the abdomen in abdominal operations, and to cover the buttocks in vaginal operations; the medium sizes to lay in the abdominal cavity over the intestines during an operation; and the smaller pieces to protect the hands in grasping contaminated objects, such as cautery handle, etc. For abdominal cases four large, four medium, and four small pieces should be put up into one package, while for plastic cases only two of the large and two of the small pieces are required. Each package should be wrapped in a towel and then inclosed in an outer protector and sterilized. This enables the assistant to open the covering be-

fore sterilizing his hands, and so does away with the necessity of having some one else open the packages for him later on when his hands are sterilized. Protective stockings for perineal operations and T and abdominal bandages are laid in bags to be sterilized. Every bag before sterilization must bear a label stating its contents; this may be done by writing on the bag in large letters with indelible ink. When these packages are all ready they are put, loosely packed, together with the wire basket full of ignition tubes, into the sterilizer and steamed for one hour. Dressings thus sterilized only once should not be used except in cases of emergency; if there is time for deliberate preparation, the fractional method must be followed by sterilizing for half an hour upon each of the two following days. While the dressings are being sterilized the glass jars in which they are to be stored must be thoroughly washed with soap and water, and rinsed out with a 1–500 bichloride solution, followed by warm sterilized water. After the first sterilization the wire basket containing the ligatures is lifted out and set aside, preferably in a sunny place, until the next day. The dressings, protected by a towel, are left to dry in the sterilizer with the top off.

The following day the wire basket is again placed in the sterilizer with the dressings and steamed for half an hour, and after twenty-four hours the process is repeated, completing the fractional sterilization and destroying spores and germs absolutely.

The ignition tubes containing ligatures are now marked with a label stating the size of the ligatures and the date of sterilization, after which they are stored away in glass jars, ready for use at any time, safe from the invasion of microorganisms, which will not penetrate the cotton plugs or the linen envelopes. The linen bags are made up, in various sizes, of heavy butcher's linen, closed with a draw-string. The bag should be enough longer than the instruments for the top to fold well over before tying. I use bags of the following dimensions: The larger size, 38 by 20 centimeters (15 by 8 inches), for instruments and dressings; the smaller sizes, 30 by 15 centimeters (11 by 6 inches), and 12 by 8 centimeters (5 by 3 inches), for the rubber tubing, needles, etc.

Rubber cloths and pads should be disinfected by scrubbing with soap and water and rinsing with boiling water, and finally sponging with a 1–1,000 bichloride of mercury solution, which is washed off, and they are dried in the sunlight and inclosed in linen bags. The agate instrument trays should be rinsed with boiling water and set aside, filled with a 1–1,000 solution of bichloride for an hour; they are then rinsed off and enclosed in linen bags. From 50 to 100 sponges should be sterilized at one time, according to the method described in the preceding chapter. They are preserved in a carbolic acid solution (3 per cent), which must be changed at least once in ten days. All the dressings, instruments, sponges, and accessories having been prepared, the operating bag may now be packed.

Instrument Bags.

Canvas telescopic bags make a satisfactory operating kit. The most useful sizes are 38 by 21 centimeters (15 by 8 inches), 60 by 30 centimeters (24 by 12 inches), and 56 by 30 centimeters (22 by 12 inches). The largest size is for the abdominal instruments and accessories, the intermediate for plastic operations, and the smallest for making examinations, removal of sutures, dilatation, and curettage.

To pack the bag, a sterilized linen cloth is first laid in it, hanging well out over the edges; then the instruments are put in, and finally a complete list, distinctly written on a card, is placed conspicuously on the inside cover. By consulting this list at any subsequent time the surgeon knows at once what articles the bag contains without opening the packages, and can add any special instruments needed for particular cases. As the nurse packs the kit, she keeps the appropriate list, for plastic or abdominal operations, before her, checking the articles as they are put in. The glass must be stored in the center to prevent breakage. When the bag is full a towel is laid over its contents, and the linen cover is brought together and pinned over all. The instruments to be taken in plastic cases will be found enumerated in Chapter VI.

Kit containing instruments and accessories for abdominal operations in private practice:

Four nail brushes, sterilized and wrapped in gauze.
Soap in metal box.
Tablets of bichloride of mercury, 5 grains each.
Tablets of sodium chloride.
Two ounces of oxalic acid in a bottle.
Two ounces of permanganate of potassium in a bottle.
Brandy, 8 ounces; alcohol, 8 ounces.
Iodoform and boric-acid powder (1 to 7).
Razor in case.
Ether and cone, chloroform and mask.
Hypodermic needle, with hypodermic tablets of strychnine, grain $\frac{1}{40}$, and atropine, grain $\frac{1}{100}$.
Gauze (2 large, 2 medium, and 4 small pieces in package).
12 sterilized towels in bag.
Seven sponges in 2 jars.
Iodoform gauze.
One package of absorbent cotton (6 pieces).
Irrigation bag with tube and glass nozzle.
Ovariotomy pad.
Abdominal bandage.
Storage battery and headlight.
2 porcelain-lined hand basins.
Rubber gloves, sterilized in the soda solution with the instruments and put in a linen bag.

2 rubber sheets.
Duck suits and canvas shoes for surgeon and assistants.
Safety pins.

If the operation is to be an abdominal one, it is essential to send with the kit a portable Trendelenburg table. One of the best I know of is that of Dr.

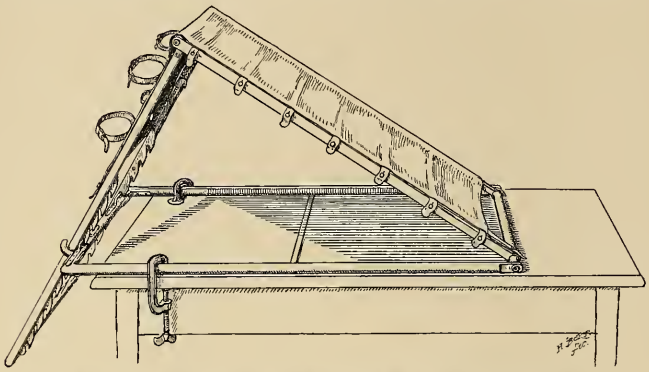

Fig. 11.—McKelway's Portable Frame for Elevation of the Pelvis.

The frame is made of tough wood, with a water-proof support for the body buttoned fast to it. It is kept in position by a simple ratchet, and it can be attached to any ordinary table by two clamps.

G. I. McKelway, of Philadelphia, made with a light wooden frame, with impermeable cover, weighing altogether 18 pounds. It is clamped on an ordinary kitchen table when used. Dr. G. M. Edebohls, of New York, has devised a beautiful light metal table swinging on its support at any angle desired; it weighs 36 pounds in its case, ready for shipping, and 34 pounds without the case.

Preparation of the Room for Operation.

When possible, the surgeon, or his assistant, or a trained nurse, should go to the house of the patient the day before the operation to select a suitable room and to give directions how to prepare it, getting ready towels, bed linen, water, and vessels. It is my custom to forward these directions:

"Arrange, if you can, a room on the second floor, with good light and ventilation. Remove carpets, curtains, upholstery, and any unnecessary articles of furniture, such as sofas, rocking chairs, fancy tables, brackets, pictures, etc. Have the mattress thoroughly aired and the bed cleaned and made up with a fresh draw sheet with a rubber sheet beneath. I prefer a single bed. Scrub the floor thoroughly, wipe off the walls, and particularly tops of doors and windows, removing every particle of dust, and on the morning of operation go over all again with a wet cloth. Do not use a dry duster in the room.

"Provide these articles: 4 chairs with wood or cane seats; a table 4 feet

long, 2 feet wide, and 30 inches high (common kitchen table); 2 small square tables (I can use a bureau or marble-top washstand if necessary); 2 clean buckets, a foot-bath tub, 3 china pitchers and basins, a dozen clean towels (not new), 2 sheets, 2 blankets, a new wash boiler, 8 bottles with corks for hot water, 2 pounds of absorbent cotton, a rubber sheet, and 1 bedpan."

I often add to the list a small tin sterilizer and a gas stove.

The wash boiler must be thoroughly scrubbed and rinsed with boiling water on the morning of the operation and filled with water, distilled if obtainable, and put on to boil for an hour, and set aside on the stove, well covered, keeping it at about 50° C. (120° F.) when desired for use. The three china pitchers must be scrubbed and scalded out and filled with water from the boiler, which has become cold, and then covered with towels. It is safer to have the dishes scalded once more just before use. Wash-basins must be scrubbed with soap and water, scalded, and turned upside down on clean towels so as not to catch the dust of the room.

When the surgeon arrives he should see for himself that his instructions have been fully carried out.

If it has been impossible to give full instructions beforehand regarding the selection and preparation of the room, the assistants and nurse must go to work at once on their arrival, and do the best they can under the circumstances in the time at their disposal. It is better not to take up the carpets on the morning of an operation, but unnecessary furniture should be removed, and a drugget or dampened sheet spread on the floor.

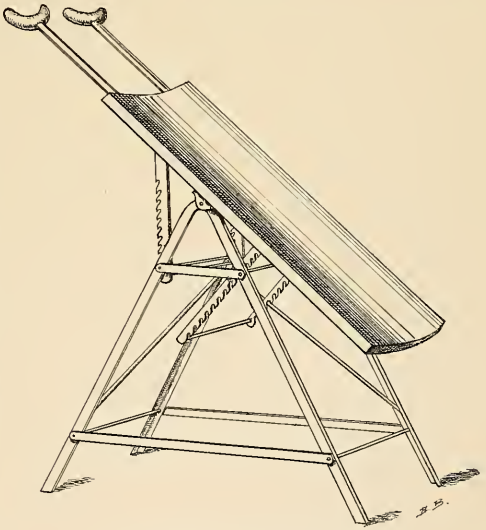

Fig. 12.—Edebohls' Light Portable Table.

The table weighs 34 pounds without the case, and 36 pounds cased; it holds the heaviest patients without rocking, and is easily changed to any degree of elevation.

To the operating table is clamped the portable Trendelenburg table covered with a folded blanket, protected by a sheet. A chair is placed at the end of the table, covered with a blanket and sheet, to serve as a rest for the patient's feet during a celiotomy.

The ovariotomy pad is placed on the table so that the patient's buttocks will

lie squarely upon it, while its apron hangs over the edge, on the operator's side, into the foot bath or bucket. Two smaller tables are covered with sterilized towels, and are used by the assistants; upon one of them the dressings are placed, and upon the other the instruments, still in the bags.

The oxalic acid and permanganate of potash solutions are now prepared in two basins, and two other basins for the hands are filled, one with a bichloride solution (1–1,000), and the other with pure warm water, and placed on the chairs. The basin of bichloride must stand farthest from the operator, in order that he may be less likely to put his hands into it unintentionally during the operation.

The nail brushes, resting in the gauze they were wrapped in, and the soap, are laid by the basins. The rubber bag is filled with warm water and hung about three feet above the table. Basins for sponges and gauze are filled with boiled water, and the razor, soap, and solutions for cleansing the abdomen or perineum laid on a towel within easy reach.

The assistant now sterilizes his hands and forearms, scrubbing them with soap and water and disinfecting them with the permanganate and oxalic acid solutions, as described in Chapter I, and following the rules as to touching unsterilized objects in force in the operating room at the hospital. When packages are to be opened, pitchers to be picked up, etc., the nurse must be called upon to do it.

The instruments are arranged in one of the trays, and preferably covered with boiled water, although some surgeons like to use them dry. The needles, threaded with carriers, together with the suture materials, are placed in another tray. Antiseptic chemical solutions poured on the instruments and ligatures only injure them, and are dangerous to the patient, besides not helping the technique.

Three free sponges and four sponges on holders, in a basin near by, are sufficient for the average abdominal operation. With instruments and sponges arranged, the assistant turns his attention to the dressings, which are ready to be opened and handed to him by the nurse.

A sterilized bag of gauze sponges should be carried, so that in case it is impossible to obtain water which is unquestionably safe, the dry gauze may be used instead of the regular sponges.

When all these arrangements are completed, the assistant makes a final examination, inspecting the preparations and noting where the various articles required during the operation are to be found.

The patient, who has been anesthetized in the adjoining room, is now carried in and placed on the table. In helping to arrange the patient, shaving, and washing the abdomen, the assistant puts on the sterilized rubber gloves, which perfectly protect his sterilized hands from contamination during the various manipulations.

As soon as these preparations are completed the nurse draws the gloves off his hands; and he arranges the sterilized towels and gauze about the field of operation, and then takes his place opposite the operator.

A slit is made in the gauze sheet over the site of the incision, and the operator, who has also disinfected his hands, begins his work.

The small pads of sterilized gauze must always be used to protect the hands in taking hold of anything not sterilized, such as a cautery handle, a basin, or a pitcher.

The surgeon and his assistants must constantly be on the watch to see not only that they themselves commit no errors in technique, but also that the nurses, who are more easily embarrassed by their new surroundings, do not infringe on these rules as the operation progresses.

The after-care of the patient will prove easy or difficult, according as her surroundings have been altered to the simple arrangement of a hospital room. Plain, bare furnishings will also materially relieve the nurse in maintaining strict cleanliness. The high narrow hospital bed is convenient, because it facilitates dressing the wound and feeding and caring for the patient.

A small sterilizer on an alcohol or gas lamp, or even the kitchen range, will serve to sterilize the cotton, bandages, towels, and the instruments used in removing dressings each time just before use, so that this part of the technique need in no respect be inferior to that of the hospital.

CHAPTER III.

BACTERIOLOGY.

1. Two views of the normal vaginal organisms. Döderlein's: as long as the vaginal secretion remains acid and contains the Döderlein bacillus there is no danger of infection. Krönig's: that the normal vaginal secretion contains a number of different bacteria, which can be cultivated under anaërobic conditions only.
2. Natural safeguards against infection. Vagina normally closed. The vaginal secretion is germicidal. Law of Wyssakovitsch: that the cells covering any part of the body, so long as they preserve their integrity, protect the underlying tissues. Law of Metschnikoff: wherever the body is attacked by bacteria the polynuclear leucocytes and the large mononuclear leucocytes quickly come to the rescue as phagocytes.
3. The probabilities of autoinfection.
4. Infection by way of the bladder.
5. Special consideration of the different forms of bacteria. Gonococcus. Syphilis, no micro-organism yet known as cause. Tubercle bacillus.
6. Suppuration. Streptococcus pyogenes. Staphylococcus pyogenes aureus. Staphylococcus pyogenes albus. Staphylococcus pyogenes citreus.
7. Bacillus aërogenes capsulatus.

Apart from the relation which bacteria bear to general surgery, they also play an important and peculiar rôle in gynecological and obstetrical practice. Since the vagina forms one of the portals of entry for bacteria, and since the bacteria may thence find their way to all parts of the genital tract, it is essential at the outset to understand the conditions favoring their entrance into the vagina and their further progress, as well as the natural and artificial means for guarding against infection by this avenue. Unfortunately, it has not been possible to come to a decision in regard to some of the most important points at issue, and the results of the observation and experiments of equally trustworthy authorities are still at variance with one another. It may be broadly stated that these results fall into two categories—viz., one going to show that as long as the secretion of the vagina remains acid, as it normally is, and contains a peculiar bacillus, first described by A. Döderlein and called the Döderlein bacillus, there is no danger of infection. If, however, the secretion loses its acid reaction—as, for example, during the lochial discharge—this safeguard against infection is overcome. The normal vaginal bacillus present during pregnancy makes way for cocci in the lochia, but reappears under ordinary circumstances at the end of the puerperium. Döderlein therefore recommends the use of douches of lactic acid during the lochial discharge, in order to prevent the action of the normal secretion from being overcome. His object is to keep the discharges acid in order to furnish the conditions most favorable for the growth of the normal bacillus, and to prevent the growth of pathogenic micro-organisms, most of which, as is well known, prefer alkaline media.

Opposed to these results of Döderlein are those obtained by B. Krönig and others, which go to show that the normal secretions contain a number of differ-

DESCRIPTION OF PLATE I.

Fig. 1.—Chains of streptococci, in some places lying in single rows, in other places grouped in rows. From a culture.

Fig. 2.—Gonococci from pus, lying free and in the pus cells. Note their characteristic biscuit shape.

Fig. 3.—Tubercle bacilli. They are long and slender, straight or curved, and stain irregularly, giving one the impression that they contain spores. The blue masses are the nuclei of cells. Chiefly polymorpho-nuclear leucocytes.

Fig. 4.—Bacillus coli communis. These bacilli are short, have rounded ends, and are rather plump; when very short they may be mistaken for cocci.

Fig. 5.—Staphylococcus pyogenes aureus. The cocci occur principally in masses, somewhat resembling bunches of grapes. They are also found singly, and may be seen in short chains.

Fig. 6.—Bacillus aërogenes capsulatus (Welch and Nuttall). A bacillus of variable length, occurring in pairs and surrounded by a clear capsule, as shown in the plate.

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PLATE I.

Fig.1.

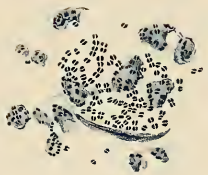

Fig.2.

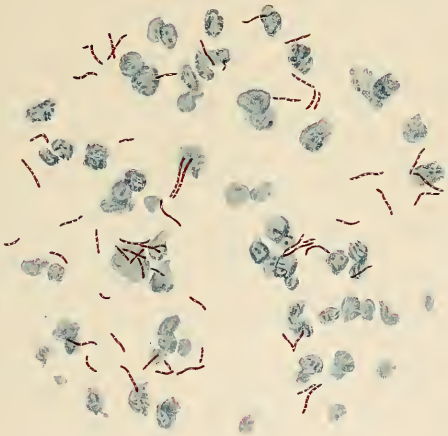

Fig.3.

Fig.4

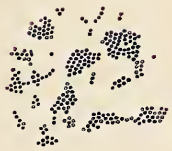

Fig.5.

Fig.6.

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ent bacteria which can be cultivated, however, under anaërobic conditions only. Krönig has described two of these, both of them anaërobic, non-pathogenic streptococci. It is claimed that but few aërobic and facultative aërobic organisms are to be found, and that the latter prefer acid media, and, furthermore, that the vaginal secretion, whether normal or not, always destroys pyogenic micro-organisms introduced into the vagina. It is not yet known what element in the secretion acts as a germicide; but whatever it is, it is claimed by Krönig to be more active and efficient than any antiseptic applied in the form of douches.

It is still impossible to reconcile these contradictory views. It seems, however, well established that the portal of entry afforded by the female genital tract for the invasion of bacteria is provided with its own safeguards of defense. It has been pointed out that the vagina is normally closed and is opened only to allow the escape of the uterine contents during menstruation and parturition, and during coitus and vaginal examinations. Except under the last two conditions the natural tendency is rather to remove any micro-organisms already present than to admit them from the outside. The fact that the vagina is usually closed probably offers an obstacle to the invasion of the bacteria, but this would hardly be sufficient unless the secretion which glues the walls together is itself antagonistic to the bacteria, for the closure can hardly be so perfect that bacteria would meet with an efficient mechanical obstruction. Still this must be regarded as one of the safeguards, imperfect as it is. Another safeguard is undoubtedly the vaginal secretion, which, as has just been said, according to some authorities, acts only when it is normal, but according to others is equally effective even when it is pathological. Whatever the germicidal power of the vaginal secretion may be due to—whether to its acid reaction, or to a special bacterium, or to several bacteria which find nutrition peculiarly suitable to their growth in the secretion, or whether its action is purely mechanical in coating over the mucous membrane, in transporting the bacteria outward and hermetically sealing the vagina—it is agreed on all sides that the secretion does act as a protection against the invasion of the pathogenic bacteria. M. Walthard has shown that this germicidal power is not due to the mucin present in the secretion.

Another safeguard to be considered is the law of Wissakovitsch, according to which the cells covering any part of the body protect the underlying tissue as long as they preserve their integrity. If, for example, the outer cells of the mucous membrane of the vagina are removed mechanically or by erosion an important safeguard is destroyed; this destruction may take place by the introduction of the finger or of instruments in examinations and in giving douches. In any enumeration of the means of defense against bacterial invasion in any part of the body the law of Metschnikoff should always be included, and no exception in this respect is found in the female genital tract. According to E. Metschnikoff, wherever the body is attacked by bacteria the polymorpho-nuclear leucocytes and the large mononuclear leucocytes quickly come to the rescue and act as phagocytes.

K. Menge sums up the means of defense and the circumstances which weaken these and make infection possible as follows:

"The normal conditions warding off the invasion of pathogenic bacteria are the various harmless bacteria and their products, the acid reaction, the secretion from the tissues, the leucocytes, and the insufficiency of oxygen. These safeguards are diminished in the newborn, and in the adult during menstruation, also where there is a superabundant secretion from the cervix and body of the uterus, or from the cervix alone, and at the climacteric. Infection is also apt to take place where the vulva gapes wide open and the vagina is everted."

If the safeguards are overcome in any way and infection takes place, the question arises whether this is due necessarily to bacteria introduced from without, or whether the bacteria have been lying in wait in the genital tract for an opportunity to attack the tissues. In regard to this important point opinion seems also to be divided. G. Winter finds micro-organisms, which may be pathogenic, constantly present in the lower part of the cervix in pregnant as well as in non-pregnant women. The wider the opening of the os, the farther up the organisms are found. The upper part of the cervix is free from micro-organisms. M. Walthard finds that the genital canal of unexamined pregnant women may be divided in this respect into the portions lying externally and more or less in communication with the outside, on the one hand, and those portions which are better protected, on the other. Bacteria are constantly present all the way from the vestibule to the upper part of the cervical canal, the uterus and tubes being free. He thinks the uterine cavity is protected by the mucus in the cervix. In the portions of the canal where the bacteria are normally found the number is small at the beginning of labor and larger at the close; and in pregnancy, parturition, and the puerperium the streptococcus, staphylococcus, gonococcus, and colon bacillus are often present. In twenty-seven cases out of a hundred, streptococci were found which were nonpathogenic, it is true, but which he thinks might have become virulent.

Fr. Vahle finds pathogenic bacteria present oftener than the staphylococcus aureus or albus. The number and virulence of the organisms are variable. It seems therefore probable that pathogenic bacteria are sometimes present in the genital tract, and under these conditions it requires only a transitory weakening of the normal safeguards to bring about an infection. It does not seem impossible, therefore, that autoinfection may take place; but where infection occurs it is most likely that the bacteria are introduced by manipulation of some kind shortly before the symptoms appear; for, after all, the pathogenic bacteria probably do not lie dormant in the genital tract for any great length of time.

The significance of the presence of pathogenic bacteria varies according to the species found, for this fact determines whether in case of invasion the process will remain purely local and insignificant, or will spread to other parts and so cause a general infection. If the staphylococci alone are present, especially the comparatively harmless citreus, albus, or epidermidis albus, the danger to the health of the patient is much less than in the case

of the streptococcus which tends to produce a general infection. If gonococci are found in the vagina the danger of an infection of the Fallopian tubes becomes imminent. In view of the proximity of the anus, the colon bacillus is frequently found, but its presence has little significance. The finding of an organism which retains its stain by Gabbett's method should not lead to a diagnosis of tuberculosis without other tests, for the smegma bacillus also holds this stain, and is in so far indistinguishable from the tubercle bacillus. Wertheim considers that a cover-glass preparation made and examined during the course of an abdominal operation is sufficient for the prognosis, and enables one to determine whether drainage should be used or not. He recommends drainage on the basis of such an examination only where streptococci or the staphylococci are found. Processes caused by the gonococcus, on the other hand, do not require drainage, since this organism causes at most only a local peritonitis, and never general sepsis.

In my own clinic drainage is rarely ever employed, and its use is uninfluenced by the character of the organisms found during the operation.

Besides the easy means of ingress formed by the vagina for micro-organisms, the female bladder is an easier avenue of entrance than the male bladder on account of its shorter urethra. Infection of the bladder usually takes place through the introduction of the bacteria upon unsterilized instruments or upon instruments contaminated during their introduction into the bladder by the bacteria at the vaginal outlet. The micro-organisms may find their way from the bladder up the ureters to the kidneys, or they may be conveyed to the kidneys and other parts of the body by the blood current, leaving the ureters unaffected. In the latter mode of spreading the smallest lesion or erosion of the wall of the bladder may afford the opportunity for the bacterial invasion. It is not always apparent why infection sometimes becomes general and sometimes remains local. The bacteria may attack the walls of the bladder immediately, or they may first cause an ammoniacal fermentation of the urine. According to Noël Hallé, the organisms most often concerned are the bacillus coli communis, the urobacillus liquefaciens septicus, the tubercle bacillus, and certain other bacilli and cocci. The pus cocci are also found, but not as frequently as other organisms.

The colon bacillus attacks the walls of the bladder immediately, without first causing fermentation of the urine. The colon bacillus, the pus cocci, and the urobacillus liquefaciens are not as prone to travel up the ureters as they are to be taken up by the blood current and form embolic foci in the kidneys and other organs.

Pathogenic Bacteria met with in Gynecological Practice.

Gonorrhea.—According to E. Wertheim, gonorrhea is the most frequent cause of suppuration met with in gynecological practice. It is caused by a specific organism, and hence can be contracted only by direct or indirect contact with a gonorrheal discharge. According to Cahen-Brach, in children indi-

rect infection is more frequent than in grown persons. In children infection usually starts at the vulva, whence it spreads to the urethra and vagina, and seldom to the cervix and corpus uteri and tubes; in children also joint metastases are rare. In women, according to J. Veit, the first attack of gonorrhea usually disappears spontaneously, and the tubes become involved in the first attack only in the rare cases of infection shortly before or shortly after delivery. During childbed gonorrhea may cause a special form of peritonitis characterized by an explosion beginning in the latter days of confinement; repeated attacks only are to be regarded as dangerous.

Kapytowsky finds that ten per cent of prostitutes still have gonococci in the vaginal secretions after they have been discharged from the hospital as cured of gonorrhea. He finds that seven per cent of prostitutes admitted to the hospital for diseases other than gonorrhea have gonococci in the secretion, and that eight per cent of all healthy prostitutes harbor the gonococcus. Klein has found that in chronic gonorrhea the individual may become accustomed to the presence of the gonococci, but the micro-organisms from such cases may cause the virulent disease in other persons, and can then cause reinfection of the original person. Furthermore, that immunity after recovery does not seem to take place.

The micrococcus gonorrhœæ, or gonococcus, was first observed by Neisser in gonorrheal pus, and was subsequently cultivated by E. Bumm upon artificial media, from which the cultures were successfully inoculated upon human beings. The gonococcus is found in the gonorrheal discharge lodged within the pus cells, and this is its characteristic feature. In gonorrheal pus numerous gonococci are also found lying free between the pus cells; frequently there are clumps of the cocci about the size and shape of a pus cell, evidently resulting from the destruction of the cell by the growth of the cocci. The cocci occur in pairs, occasionally as tetrads. Their opposing surfaces are flat or slightly concave.

The gonococcus is colored readily by the ordinary aniline stains, but does not retain the stain by Gram's method. In stained preparations the band between the cocci remains clear. The morphology and staining properties do not suffice alone to distinguish the gonococcus from other similar micro-organisms, but its peculiar grouping within the pus cells is quite characteristic. The gonococcus does not grow upon the usual culture media employed for other bacteria. It was first cultivated upon human blood serum, upon which medium it grows in the form of a thin layer, scarcely visible to the naked eye. The surface is smooth and glistening; by reflected light the color is grayish yellow. The growth is weak at best and ceases in two or three days; the organism often stops growing for no apparent reason.

E. Wertheim made an important advance in the study of the gonococcus by discovering that the micro-organism grows much better upon blood serum mixed with nutrient agar. The best plan is to use human blood serum, though cattle serum will also give some growth. The gonorrheal pus should be mixed with the uncoagulated serum, and the mixture added to one or two parts of melted

agar at about 40° or 45° C. This mixture is then allowed to solidify in an oblique position in the tube. The growth is particularly abundant in the absence of oxygen, as in Büchner's pyrogallic acid and potassium hydrate method. Superficial colonies are described as having a compact center with a very delicate, transparent, finely granular zone with projections, like peninsulas on a map. Deeper colonies have a solid, clumpy appearance, but with a sharp, regular contour.

Wertheim, contrary to the experience of others, succeeded in getting a scanty growth of the gonococcus upon ordinary agar and upon glycerin agar; he also succeeded in getting the organism to grow and produce inflammation in the peritoneum of animals; white mice were found to be especially adapted to this experiment. The process always remains local, and does not lead to general peritonitis; it goes on, in other words, just as it does in the human peritoneum.

E. Wertheim's method as above described is the one most usually employed, but various other special media have been recommended. Abel recommends smearing the surface of an oblique agar tube with blood serum in the manner employed by Pfeiffer for cultivating the influenza bacillus. Ghon and Schlagenhaufer also obtained results in this way, and by the use of one part of urine to two of agar. Blood serum and urine in the proportions of two to one have also been employed, and urine in various proportions to agar. Dr. Simon Flexner has cultivated the organism upon a medium prepared from the embryos of hogs.

Probably the most satisfactory medium is the one recently recommended by Young and Hagner. It is as follows:

Collect acid urine containing 0·5 per cent or more of albumin, allowing it to decompose. Boil the urine until a large albuminous precipitate falls, then filter. The filtered urine should be clear.

Boil the urine again, and add 1·8 per cent agar, 0·3 per cent beef extract, 0·5 per cent sodium chloride, and 1 per cent peptone; render neutral or slightly acid, and after cooling to 60° C. (140° F.), clear up with one or two eggs. In short, adopt the same procedure as in making simple agar, merely substituting the boiled and filtered albuminous urine for water. When the medium is ready for use, it is clear, neutral, or slightly alkaline, and may be treated as ordinary agar, being subsequently slanted or plated. On this albumen-urine-agar the gonococcus appears as small, round, elevated, grayish-white, semi-translucent colonies visible in from thirty-six to forty-eight hours. The virtue of this medium is probably due to albumin which is not coagulated by heat.

Syphilis.—No micro-organism has as yet been shown to be the cause of syphilis. A bacillus described by Lustgarten is in all probability not the cause. The disease is specific and infectious, and is conveyed, like gonorrhea, by impure coitus and by contact with articles that have been contaminated with the virus of a syphilitic person. Owing to the obscurity of the etiology, the subject hardly belongs as yet to the domain of bacteriology.

Tuberculosis.—Primary tuberculosis of the kidneys, according to Dr. William Osler, is not rare, but is more frequent in men than in women, and the infection usually takes place through the blood; one or both kidneys may be involved, usually one kidney only, and the presence of tubercle bacilli may be demonstrated in the urine. Primary tuberculosis of the tube is not uncommon, but tuberculosis of the uterus is rare. The detection of the tubercle bacillus is usually a matter of little difficulty; it must be borne in mind, however, that the smegma bacillus, a normal inhabitant of the prepuce, may lead to error owing to its many points of similarity to the tubercle bacillus. The most probable source of infection lies in the dust that has become contaminated with sputum from a tuberculous individual. The portal of entry into the genito-urinary tract is not always apparent. The micro-organism which is the cause, and the only cause, of the disease, is the same as that which causes tuberculosis of the lungs, scrofula, lupus, and other tubercular processes.

The tubercle bacillus is a slender stave with rounded ends. It measures from a sixth to a half as long as the diameter of a red blood-corpuscle. In stained preparations portions of the rods frequently remain unstained, making it appear as if the rods were broken up into fragments. These fragments are often nearly or quite spherical, closely resembling streptococci, but they could never be mistaken for these, owing to the peculiar staining properties of the tubercle bacilli. Sometimes the unstained portions of the rods are more or less spherical, and resemble endogenous spores. It is probable, however, that the tubercle bacillus does not form spores.

The character which distinguishes this bacillus from nearly all others is its peculiar behavior toward staining dyes. The bacteria in general are readily stained with ordinary aqueous solutions of the aniline dyes, and are completely decolorized by treatment for a few minutes or seconds by dilute mineral acids. There have been a great many methods devised for differential staining of the tubercle bacillus. The formulæ for three of these methods are given below.

The Koch-Erlich Method for staining Tubercle Bacilli.—The solution consists of a saturated aqueous solution of aniline oil to which is added enough of a saturated alcoholic solution of fuchsin, or gentian violet, or methyl violet, to give a deep stain.

The Ehrlich-Weigert solution is practically the same as the Koch-Ehrlich, and is made by mixing 11 cubic centimeters of the saturated alcoholic solution of the dye, 10 cubic centimeters of absolute alcohol, and 100 cubic centimeters of the saturated aqueous solution of aniline oil. The saturated aqueous solution of aniline oil is prepared by shaking up thoroughly 6 or 7 cubic centimeters of aniline oil in 100 cubic centimeters of water, and filtering. The solution will be of about 5 per cent strength. The Koch-Ehrlich or the Ehrlich-Weigert stains should be allowed to act upon the material to be stained for about twenty-four hours in the cold, or fifteen to twenty minutes if heated. The material should be spread out thin over the cover glass or slide, allowed to dry in the air, and then fixed upon the glass by passing a few times through the Bunsen flame. Sections of tissue are simply left in the stain-

ing solution for fifteen to twenty minutes, when the solution is heated, or left for twenty-four hours in the cold. Decolorization is effected by immersion in a 33 per cent nitric acid solution, or more gradually in 3 to 5 per cent of hydrochloric acid in alcohol. With either agent the preparation is left in until there is little or no stain visible to the naked eye, when it will be found with the microscope that only the tubercle bacilli, if any are present, will be stained; some of the tissue nuclei may retain some stain, but none of the bacteria will retain it. The bacillus of leprosy is the only other organism known to hold its stain by this method of decolorization.

The Ziehl-Neelsen method of staining tubercle bacilli consists in using a solution of one gram of powdered fuchsin to 100 cubic centimeters of a 5 per cent solution of carbolic acid. This solution stains the tubercle bacilli in a few minutes; the decolorization of the rest of the preparation may be effected as above mentioned, or, according to Gabbett's method, with 25 per cent of sulphuric acid containing 2 per cent of powdered methylene blue. This not only takes the fuchsin out of the background, but stains the latter blue at the same time. Leprosy bacilli and the bacilli constantly present in the smegma of untidy persons retain the stain by this method as well as tubercle bacilli.

According to Grethe, the best ready method of differentiating between tubercle bacilli and smegma bacilli is Weichselbaum's method for staining tubercle bacilli—namely, by staining the preparation with carbolic acid fuchsin and counterstaining with concentrated alcoholic solution of methylene blue. Tubercle bacilli remain stained, but smegma bacilli become decolorized.

The tubercle bacillus is not only peculiar in its behavior toward staining dyes, but it is also peculiar in its requirements for cultivation upon artificial culture media. It will not grow upon most of the ordinary media used, and requires a temperature of about 35° to 39° C. on special media. Roux and E. Nocard state that the best temperature is 39° C. Many special media have been recommended, of which the most commonly used are beef-blood serum coagulated in oblique test tubes and sterilized, boiled potatoes in test tubes, and Roux-Nocard's glycerin agar, which consists of ordinary nutrient agar with the addition of 6 or 7 per cent of glycerin. The growth is slow, becoming appreciable to the naked eye in from four to six weeks.

Suppuration.

Although many different micro-organisms have been found as the active causes of the formation of pus, it is usual to restrict the term "micro-organisms of suppuration" to the streptococcus pyogenes and the staphylococcus pyogenes aureus, staphylococcus pyogenes albus, and staphylococcus pyogenes citreus. The gonococcus is a pyogenic organism, and the typhoid fever bacillus, the bacillus coli communis, and others have also been found as the cause of suppuration, but the organisms most usually encountered and referred to in this connection are the pus cocci already named.

The streptococcus pyogenes resembles closely, if it is not identical with, the streptococcus of erysipelas. It causes local suppuration in any part of the genital tract, and is prone to spread and cause peritonitis and general septicemia. Most cases of puerperal septicemia are probably due to this microorganism. It is apt to cause a mixed infection, following in the wake of tuberculosis; its virulence is variable.

The individual streptococci are larger than staphylococci, and are usually made up of two symmetrical hemispheres. Frequently some of the cells are much larger and stain more deeply than the others. These are supposed to be arthrospores. It is one of the characteristic features of these cells that they hang together in longer or shorter chains. They stain readily with any of the ordinary aqueous staining solutions. They grow in the form of small, discrete, white colonies upon all the usual solid media, but most luxuriantly upon alkaline media, though they are said to retain their virulence best when gradually accustomed to acid media. In liquid media the chains are usually longer than on solid media. The growth in all cases is delicate.

The staphylococci are found in various pathogenic processes, either alone or in association with the streptococcus. They tend to remain local, but the staphylococcus pyogenes aureus may cause extensive lesions, or even general septicemia. The aureus is the most virulent of the three, and the albus next, though the virulence of all of them is variable. They resemble one another closely under the microscope, and also macroscopically, in cultures, except for the difference in color, which makes its appearance in the culture of the aureus and citreus, as the names of these imply. For a day or more before the color develops they are indistinguishable. The growth on all media is much more vigorous than that of the streptococcus, forming dense masses. The cells are spherical and clump together in irregular masses, though sometimes there is a tendency to form short chains.

Bacillus Aërogenes Capsulatus.—There is another organism, which, although not pyogenic, is not infrequently the cause of death. This is the bacillus aërogenes capsulatus, first described by Welch and Nuttall in 1892 (*Johns Hopkins Hospital Bulletin*, July–August, 1892, p. 81). This bacillus has been found in the blood vessels during autopsies, in the wombs of women dying of septicemia after confinement, especially after abortion cases, and in emphysematous gangrenes.

It is a large, straight bacillus, with rounded ends averaging 3 to 6 millimeters in length, and about three times as long as broad; it usually grows singly, but may occur in chains of three or four, but without the chain tendency, as seen in anthrax. One of its chief characteristics is a distinct capsule. The bacillus is not motile and only forms spores on blood serum; it is strictly anaërobic. It stains well with all the aniline dyes, and fairly well with Gram's solution. Capsules can sometimes be seen when ordinarily stained, but they are much more distinct if treated with acid and gentian violet, as advised by Welch. It is an obligate anaërobe, growing only when oxygen is entirely excluded, and

best at a temperature of 35° to 37° C. (95° to 99° F.); but it will grow at the ordinary temperature of a room.

On agar slants it appears at the end of twenty-four hours as a pale, whitish moist growth; sometimes a few gas bubbles are seen in the substance of the agar. In tubes containing one per cent of glucose or lactose agar, which have been melted and inoculated after cooling to 40° C., there is an abundant growth at the end of twenty-four hours, forming numerous fine white colonies, and the media are split up by an abundant formation of gas. Bouillon cultures show clouding at the end of twenty-four hours and a few gas bubbles on the surface, but after forty-eight hours the liquid clears and the growth sinks to the bottom; if sugar be added to the bouillon, the gas production is much more marked. Litmus milk is coagulated and acidified after forty-eight hours. In gelatin there is softening along the line of puncture after from five to six days, and the growth sinks to the bottom, but there is no general liquefaction of the media. On potato there is a faint white growth after forty-eight hours. Blood serum is not liquefied, but spores are found after twenty-four hours.

If inoculated subcutaneously it is pathogenic for mice, guinea-pigs, rabbits, and pigeons, the animal dying in from twenty-four to forty-eight hours with an enormous development of gas around the site of inoculation. If it is injected into the circulation it is rarely fatal; if, however, the animal is killed soon after receiving the injection and left in a warm place for ten or twelve hours, there will be an enormous development of gas throughout the tissues, which burns when brought into contact with a light.

Dr. B. B. Lanier, in 1897, described a gas bacillus very like this one, agreeing with it in every particular, except growth in the presence of oxygen; it is found in the same class of cases. He calls the new organism the bacillus aërogenes capsulatus II.

CHAPTER IV.

TOPOGRAPHICAL ANATOMY.

1. Difference between infantile and adult uterus and adnexa (Figs. 13 and 14).
2. Superficial and deep layers of abdominal muscles (Figs. 15 and 16).
3. Scheme of relations of the muscles and fascia of the abdominal walls in transverse section (Figs. 17 and 18).
4. The "celiotomy veins" (Fig. 19).
5. The topographical anatomy of the small intestines (Figs. 20 and 21). (Grouping of intestines (Fig. 21). Relations of folds of mesentery (Fig. 20).)
6. Position of anterior abdominal wall and intestines in an emaciated body (Figs. 22 and 23).
7. Topography of appendix vermiformis and termination of ilium (Fig. 24).
8. The pelvic viscera in normal position (Fig. 25).
9. The utero-sacral ligaments and Douglas's *cul-de-sac* (Fig. 26).
10. Vascular trunks of lower abdomen and pelvis (Figs. 27 and 28).
11. Relation of the ureter to the uterine vessels *in situ* (Fig. 29).
12. Vascular supply of uterus, ovary, and tube (Fig. 30).
13. Arterial blood supply of ovary (Fig. 31).
14. Parovarium (Fig. 32).
15. Lymphatic system of the pelvic organs (Fig. 33).
16. Vascularization of the vault of the bladder (Fig. 34).
17. Vascularization of the vesical mucosa (Fig. 35).
18. Areas of vascularization of the vesical mucosa (Fig. 36).
19. Topography of fixed part of bladder (Fig. 37).
20. Blood supply of lower sigmoid and rectum (Fig. 38).
21. Sagittal section through the pelvis showing vessels and nerves posteriorly (Fig. 39).
22. Same, after removal of the viscera (Fig. 40).
23. Round ligament, inguinal and femoral rings as seen from within (Fig. 41).
24. Topography of round ligament (Fig. 42).
25. The pelvis after removal of the viscera, seen through the superior strait (Fig. 43).
26. Course of the internal pudic artery from its origin to its termination (Fig. 44).
27. Arterial vascularization of the perineum and pelvic floor from below (Fig. 45).
28. Muscles and nerves of the perineum and pelvic floor from below (Fig. 46).
29. Origin and insertion of the fibers of the levator ani muscles (Fig. 47).
30. Sagittal section showing the mechanism of the levator ani muscles (Fig. 48).
31. Blending of the levator ani muscle with the muscle of the rectum (Fig. 49).
32. Coronal section of the pelvis, showing its posterior half and the relations of the levator ani muscles to the rectum (Fig. 50).

A KNOWLEDGE of anatomy and physiology is just as essential to the gynecologist as a familiarity with the general principles of surgery; indeed, the very foundation stones of successful work are laid in envisaging the relations of the parts to be dealt with so clearly that the operator divides layer from layer almost as if the coverings of the body were transparent. Without this accurate knowledge of the component parts of the pelvis and abdomen and their mutual relations, to be gained only by actual dissections, surgery is not an art, but at best a haphazard procedure guided by luck; without a knowledge of physiology an operator will often ruthlessly sacrifice organs or parts of organs whose functional activity is essential to the happiness and well-being of the patient.

I wish to emphasize these facts because so many men enter the ranks of gynecology from general practice with only such medical training as is given in the schools—insufficient to make them safe operators.

I shall not attempt in this chapter to describe the pelvic anatomy as it is laid down in the various accessible manuals for dissectors, but shall rather take up the anatomy of the abdominal pelvic viscera, first, as they are approached in an operation from above, and then from below, purely from the practical standpoint. Descriptions of the relations of organs are so lifeless without satisfactory pictures that I have confined the text for the most part to the description of topographical drawings. These are all from original dissections except two.

From birth down to the period of full sexual maturity of women there is a gradual progressive change in the position and relations of the pelvic viscera—in fact, in the infant the bladder and the uterus can be named "pelvic viscera" only by reference to what they are to become, for at this early period both organs lie

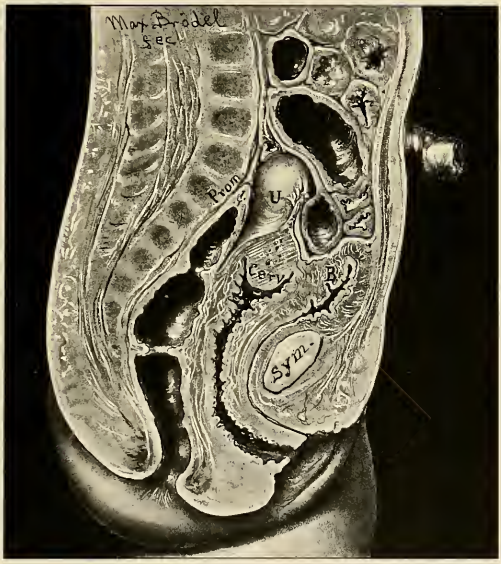

Fig. 13.—Infantile Pelvis, Natural size, seen in Sagittal Section.

above the superior strait among the other abdominal organs, as shown in the figure drawn from a frozen section of a mature newborn child.

The comparison between the infantile and the adult pelvis is well shown by placing beside a child's pelvis of natural size that of a fully developed woman, reduced to correspond. (Figs. 13 and 14.)

One of the most striking differences to be noted is the alteration in the direction of the axis of the pelvis; in the child this is a simple straight prolongation of the abdominal cavity, in the woman the pelvic axis is set at a marked angle. While the uterus in the adult is seen lying in anteflexion wholly within the pel-

vis, at an acute angle with the vagina, with well-developed corpus and small cervix, in the infantile pelvis the uterus lies almost wholly within the abdomen, as a rule compressed between the rectum and bladder in an upright position, without any angle of flexion. In the example figured the uterus lies on the left side of the median line and is cut through close to the cervix; the fundus rests on the last lumbar vertebra, and the mesentery of the small intestine is situated in front of it between the uterus and bladder. The cervix is large as compared with the fundus; the long rugose vagina lies just anterior to the axis of the pelvis, following its curve, and without the sigmoid curve, which is so characteristic in the adult.

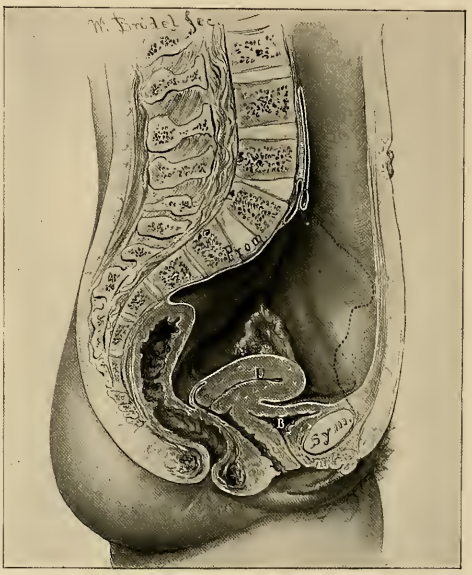

Fig. 14.—Pelvis of Adult Woman in Sagittal Section, Reduced to the same size as an Infantile Pelvis for Comparison.

The thick-walled bladder lies in the anterior part of the pelvic cavity just above the symphysis. The almost straight rectum is divided into three cavities by two valve-like folds of mucosa, the lower one situated just above the middle of the vagina, on a line drawn from the lower border of the symphysis to the coccyx, the upper one opposite the vaginal vault. The umbilicus, as in the adult, is opposite the second lumbar vertebra.

Fig. 15 shows the oval contour of the abdominal cavity, covered by the external and internal oblique muscles; the right and left recti muscles form strong bands, uniting symphysis pubis to sternum; they are bound together in the center by the linea alba and bordered on their outer margins by the semilunar

lines. The sheath of the right rectus is opened below, showing the right pyramidalis muscle, which arises by a narrow base from the symphysis pubis and extends upward one third the way to the umbilicus, overlying the rectus.

The semilunar line on the left is seen about halfway out between the

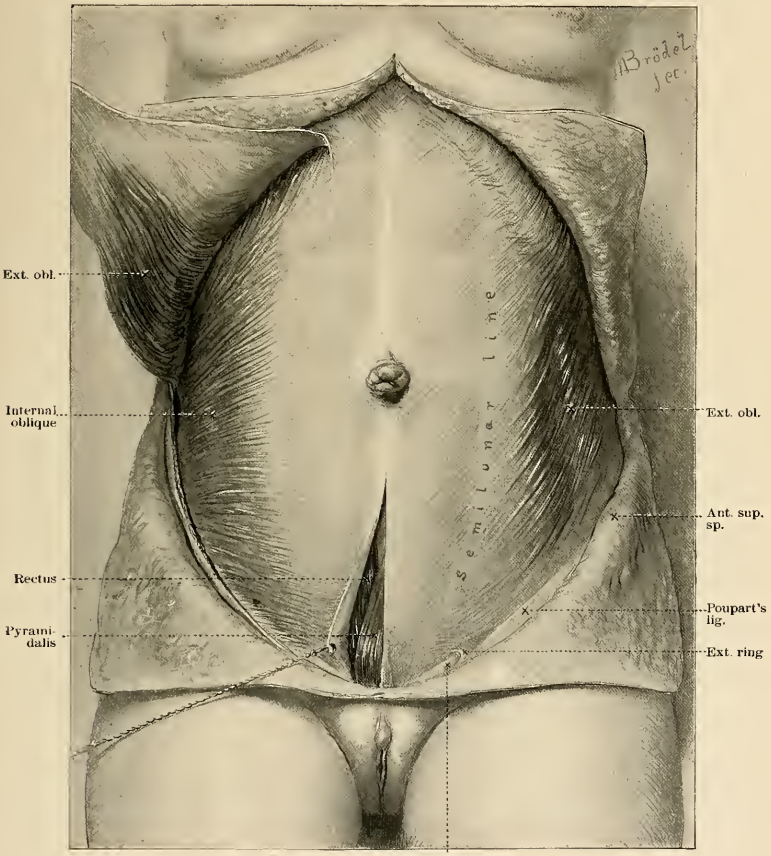

FIG. 15.

median line and the left lumbar region, looking at the body from the front. The external oblique muscle is well shown on this side with its fibers radiating from the costal margin and the left lumbar region out toward

the rectus of the same side. Below, just above Poupart's ligament, the parting of the fibers is seen at the external ring out of which the round ligament emerges.

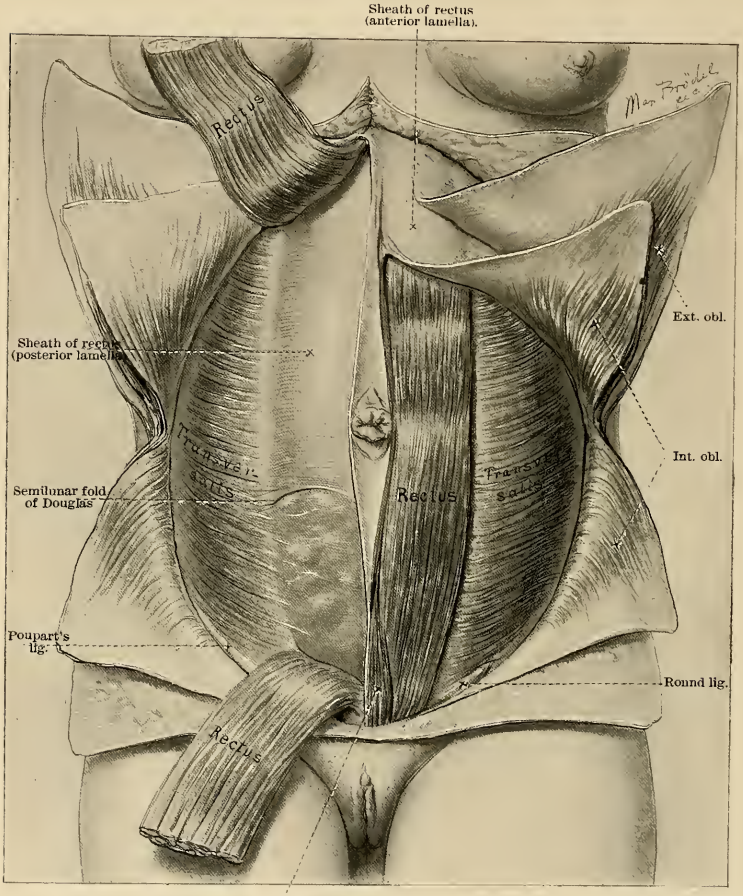

FIG. 16.

The position of Poupart's ligament between the spine of the pubis and the anterior-superior spine of the ilium is clearly indicated by the white line.

On the right side the external oblique muscle has been dissected off and reflected upward, exposing the internal oblique muscle; the tendinous aponeuro-

sis has been detached from the fibrous fascia overlying the rectus as far forward as the dissection could be carried.

Fig. 16. The deepest of the three muscular layers forming the abdominal walls are formed by the right and left transverse muscles, whose fibers run horizontally, and parallel to the short axis of the body. The external and internal

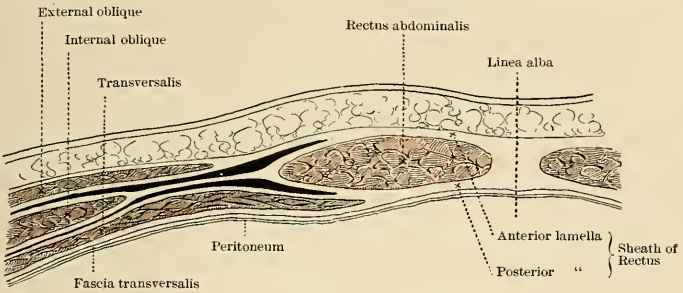

Fig. 17.

oblique muscles have been reflected, the external being turned up and the internal divided and turned both up and down on the margins of the ribs and Poupart's ligament.

The left rectus muscle is exposed with its pyramidal muscle below, and on the right the rectus has been divided in the middle, showing the transversalis fascia, which forms its sheath posteriorly, extending from the margin of the ribs down to the semilunar fold of Douglas, which lies at a point about 3 centimeters below the umbilicus. Below this point the thin tissue allows the convolutions of the intestines to be seen through the fascia and peritoneum. The

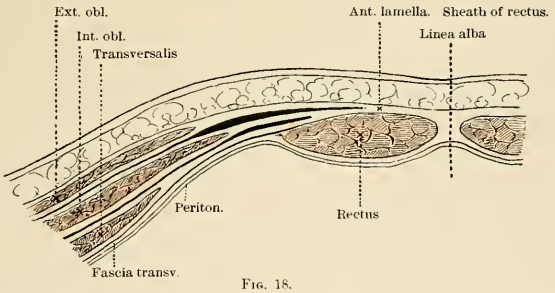

Fig. 18.

abdominal wall below the semilunar line owes the thinness of its fascia, posterior to the rectus, to the cessation of the transversalis fascia at this semilunar line.

Figs. 17 and 18. The scheme of the relations of the muscles and fascia of the abdominal walls as they are seen in transverse section has been made accord-

ing to Braune. Fig. 17 shows the section of the walls above the semilunar folds of Douglas, and Fig. 18 shows the section below the folds of Douglas. Both pictures exhibit the relations of the oval recti to the transverse and internal and external oblique muscles.

Fig. 19.—A, Celiotomy Veins; B, Large Transverse Vessel; Umb, Umbilicus drawn to the Left.

In the section above the folds of Douglas, Fig. 17, it is important to notice the relation of the aponeurosis, indicated by the white spaces between the muscles. The division of the fascia of the internal oblique muscle is seen at the rectus, one lamella passing in front to unite with the fascia of the external oblique, the other lamella passing posteriorly to join the transversalis tendon, and so to continue as a conjoined tendon until it unites with its fellow of the opposite side.

In Fig. 18 quite a different arrangement of the muscles is seen; the external oblique muscle remains about the same, while the internal oblique advances much closer to the rectus, and the transversalis, instead of passing behind the rectus, as in Fig. 17, lies farther back toward the lumbar region than either of the others. In Fig. 18 the fascia of the external and internal oblique muscles blend at a point nearer the median line, as shown also in Fig. 17. The internal oblique also fails to split, sending its entire tendinous aponeurosis in front of the rectus along with that of the transversalis muscle.

Fig. 19 shows what I have for some years been in the habit of calling "the celiotomy veins." In opening the abdomen in the linea alba in its lower third,

these veins are almost invariably found lying just over the peritoneum. Sometimes there is but one large vein 1½ or 2 millimeters in diameter, but usually there are two of them from 1 to 1½ millimeter in diameter, separated by an interval of 3 or 4 millimeters; they follow a slightly winding, but in general straight, course down to the symphysis pubis, over which they pass to the neck of the bladder, where they empty into the large vesical plexus of veins. I have not seen any arteries accompanying these veins. They are usually large enough to give rise to some persistent oozing, if injured, and for this reason should be carefully observed in every case, in order to cut between them, or to one side when there is but one vein. In a series of twenty abdominal sections, taken consecutively, the celiotomy vein was seen sixteen times; in most cases it ascended straight up the median line just beneath the peritoneum, a little to the right or to the left; six times it was seen bifurcating. In four cases the diameter was at least 2 millimeters, in all the rest it was less than 2 millimeters.

In the subcutaneous fat the position of a transverse vessel is indicated on both sides of the incision at a point about 2 centimeters (¾ of an inch) above the symphysis pubis. This vessel is quite constant, and when divided spouts out a little stream of arterial blood on one side and venous blood on the other; sometimes there is arterial bleeding from both sides, showing a free anastomosis. The umbilicus in the figure is shown displaced to the left.

THE TOPOGRAPHICAL ANATOMY OF THE SMALL INTESTINES.

Figs. 20 and 21 have been drawn directly from the subject to demonstrate important points in the topographical anatomy of the small intestines. This subject has been carefully worked up by D. Sernoff (*Internat. Monats. f. Anat. u. Phys.*, Bd. xi, 1894) and others, and elaborated with important additions by Dr. F. P. Mall, whose demonstrations have been followed in preparing the figures.

In order to expose the intestines in their normal positions, the abdominal cavity has been opened by a crucial incision, and each of the four flaps reflected outward. Letters have been placed upon the small intestines, associating them in groups. Each one of these groups is so attached to a series of lamellæ of the mesentery that by picking up one of the groups of lamellæ at its base near the vertebral column the entire bunch of small intestines attached to it is also lifted up.

In describing the groups I begin at the duodenum, Fig. 20, and note the lamellæ under the left splenic flexure of the colon included in the letters A and B; from this group the mesentery crosses the vertebral column to the right side, where it forms a series of folds under the right hepatic flexure of the colon; this group is included between the letters B and C; crossing the vertebral column once more to the left, the next group is found lying in the left iliac fossa, included between the letters C and D; the fourth and last group of lamellæ, between D and E, fills the lower abdomen and right iliac fossa, and it is particularly important to note the straight line of the terminal portion ascending

from the pelvis to the head of the colon as the mesentery rapidly shortens from its extreme length down to nothing at all. The only loops of the intestines which in all cases cross the median line are those going from the first to the second and from the second to the third groups. The oblique attachment of the mesentery is well shown, extending from above downward and from left to right, in striking contrast to the horizontal attachment found in the fetus. I

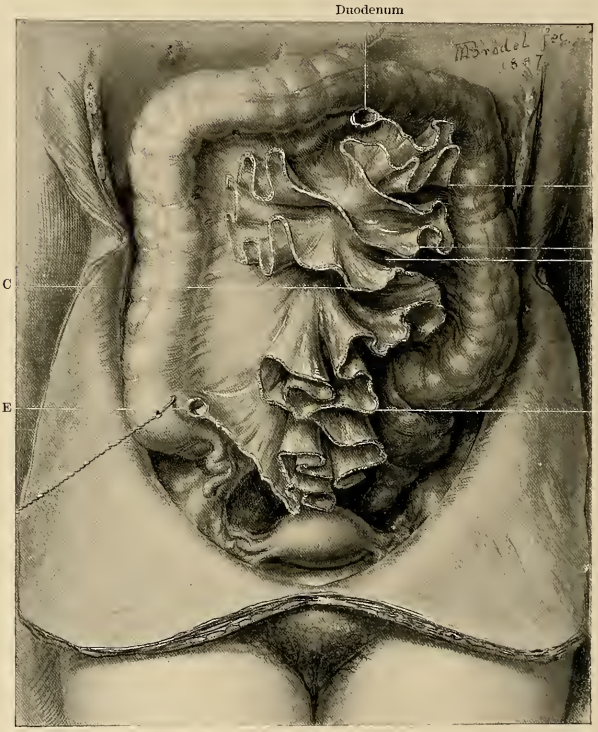

Fig. 20.

have shown the relations of the folds of the mesentery in Fig. 20 in order to simplify the study of the relations of groups of intestines attached to them. It will at once be seen in glancing at Fig. 21 that while the relations of the mesenteric folds appear comparatively simple, the relations of the intestinal folds, which are precisely the same, appear much more complicated.

The cadaver from which the drawings have been taken represents the average normal relation as found in 21 out of 40 cases examined by Dr. Mall.

In order to facilitate the study of the groups of intestines, of which I have just described four, the same letters are used, marking the same divisions seen in the

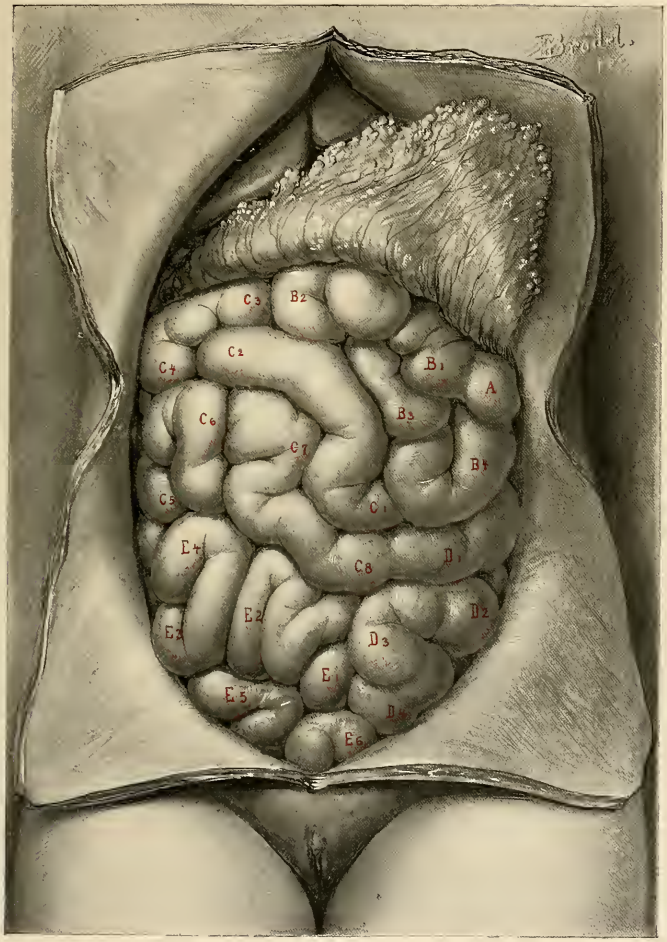

Fig. 21.

preceding figure. The figures accompanying the letters in Fig. 21 indicate the superficial direction of the bowel. Sernoff found that the exposed or periph-

eral part of the intestines constituted only about one sixth of the entire length of the canal from duodenum to cecum; the average length of the small intes-

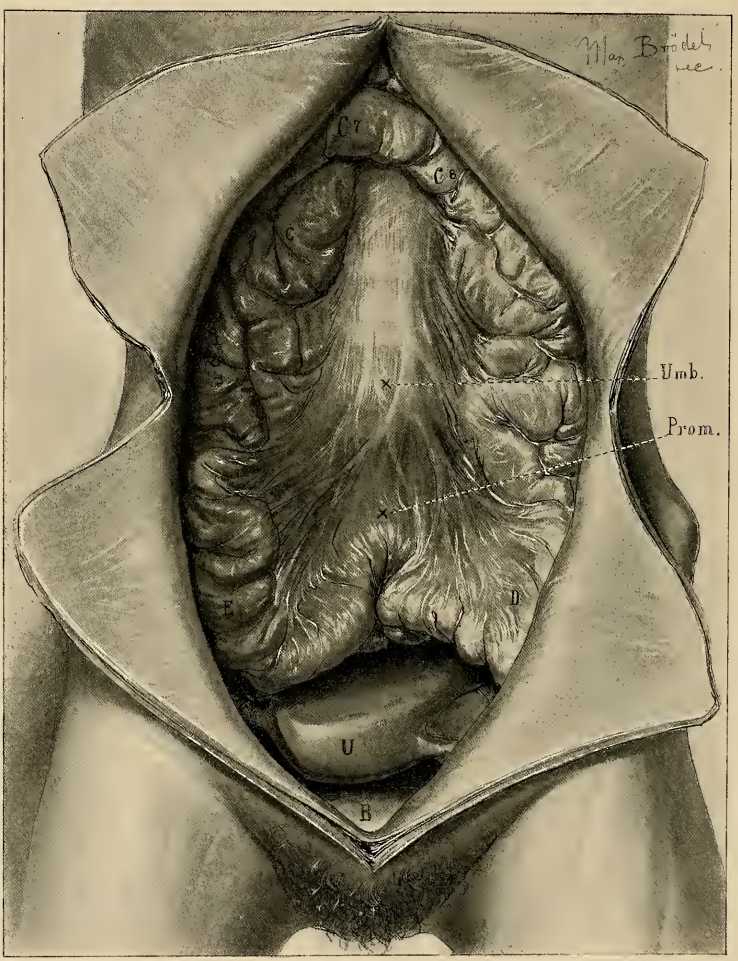

Fig. 22.

tine, according to Sernoff, is 537 centimeters (214·8 inches). The distance from B_1 to B_2 and from B_2 to B_3, etc., by no means represents a uniform space.

Group B (Fig. 21) of the bowels lies under the left splenic flexure of the colon, and, by passing the hand down to the mesentery at this point, can be picked up *en masse*. Group C, under the hepatic flexure of the colon, can be picked up by carrying the hand down to the mesentery between the colon and small intestines; by throwing this group over to the left side, the whole of the right renal region is exposed. Below B and above C there is a natural fissure or separation between the bowels (fissure of Henke) which goes all the way back to the psoas muscle.

The following variations in relation to these groups are often found:

Variation 1: Group C is displaced from its position under the right hepatic flexure over into the left flank.

Variation 2: Group B crosses the median line and occupies the position of Group C under the hepatic flexure, while Group C goes to the left.

Variation 3: Group C goes down to the left, and Groups B and D go across and ascend on the right to occupy its place.

Fig. 22. Almost all anatomical drawings of the abdominal cavity fall into the error of placing the anterior abdominal wall at too great a distance from the lumbar vertebræ; the separation between the two will vary according to the dis-

Fig. 23.

tention of the intestines, which float up and push the wall forward, and so lift it 2, 3, 5, or more centimeters from the promontory of the sacrum; as the intestines contract again they retire to the upper part of the abdomen, to the right and left flanks, and to the pelvis.

Fig. 23. In emaciated patients the anterior abdominal wall may not infrequently be found so closely applied over the lower part of the vertebral column that its rounded form is plainly seen. In one of my abdominal operations, removing an extensively adherent parovarian cyst, the collapsed walls actually became

adherent to the vertebral column, causing the patient great discomfort in her convalescence. Figs. 22 and 23 show an extreme case in which the abdominal walls were not more than 3 millimeters thick. Here the groups of in-

Fig. 24.

testines are all displaced toward the periphery, and the bowel crosses from right to left opposite the second instead of opposite the fourth and fifth lumbar vertebræ. Groups B and C are crowded up under the vault of the thorax, Group D lies in the left flank, while Group E has dropped into the pelvis, which it fills. The abdominal wall rests directly upon the aorta and the vena cava and the mesentery with its vessels. It is interesting to note the plastic flattening and the ridges on the body of the uterus due to post-mortem compression by the intestines, seen in both Figs. 22 and 23.

Fig. 24. It is particularly important to the gynecologist to be familiar with

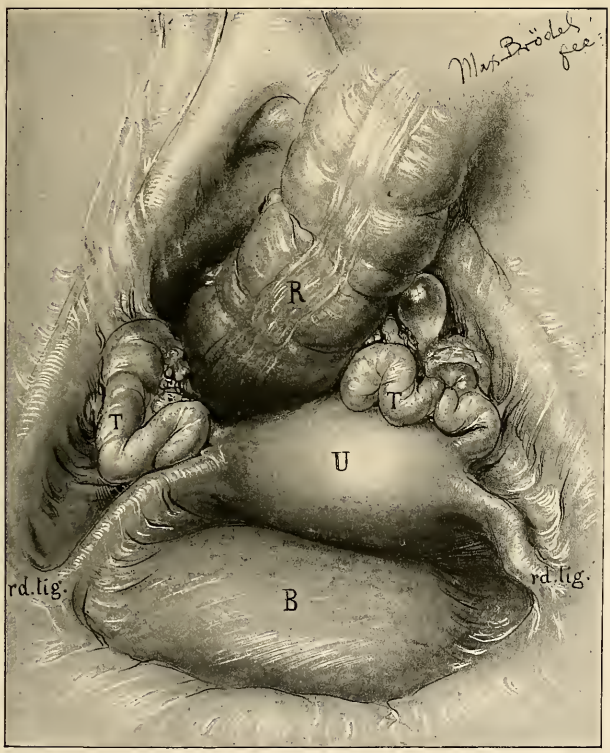

Fig. 25.

the anatomy of the terminal portion of the ileum, that part of the intestine which is most liable to drop into the pelvis and to be involved in the various inflammatory gynecological processes.

The figure shows the cecum in the right iliac fossa with its longitudinal fibers leading down to the vermiform appendix, which lies coiled above the common iliac artery on the psoas muscle. The straight ascent of the ileum out of the pelvis and over the sacro-iliac junction to its point of exit in the cecum is especially noteworthy. This arrangement appears to be a mechanical necessity due to the triangular form of the end of the mesentery which terminates at the cecum in a point.

Fig. 25 shows the mutual relations of the pelvic viscera as seen upon opening the abdomen through the superior strait. The drawing is after nature exactly, and, although presenting some slight individual peculiarities, does not deviate in any important particular from the average case.

The bladder in front is moderately distended, somewhat gibbous in form, and fullest on the right side. The rectum passes down into the pelvis to the right of the promontory of the sacrum, necessitating a slight left lateral displacement of the uterus, which lies between the rectum and the bladder; this

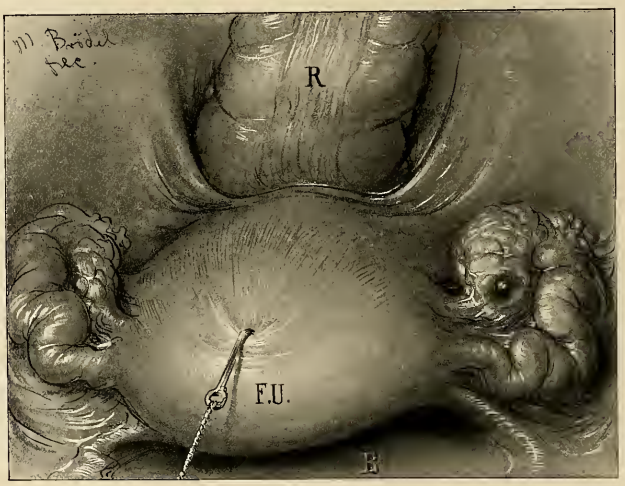

Fig. 26.

has the effect of lengthening the right and shortening the left round ligament, and of causing their curves to differ. The tubes and ovaries on each side fill up the triangular spaces left between the rectum and uterus and the pelvic walls.

Fig. 26 shows the utero-sacral ligaments coursing from the cervix on the right and left in a curved line around the rectum. Below and between the ligaments in front and the rectum lies Douglas's *cul-de-sac*.

The next dissection (Fig. 27) exposes the great vascular trunks of the lower

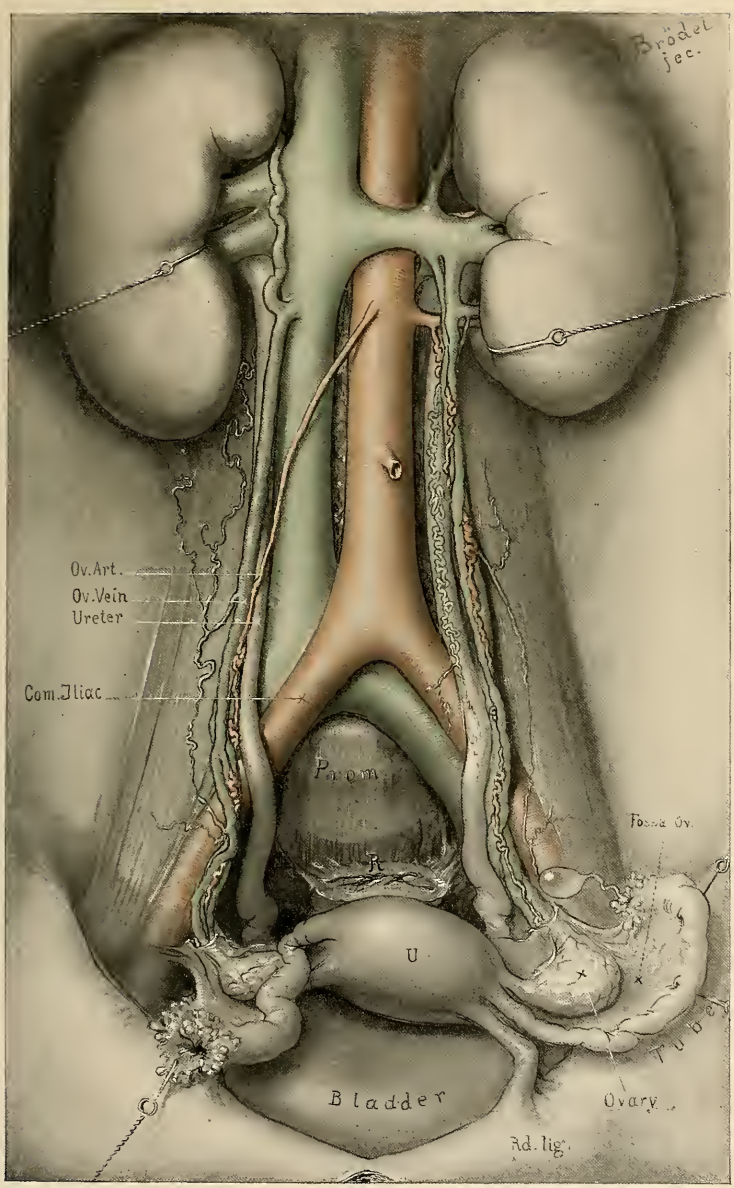

Fig. 27.—Vascular Trunks of the Lower Abdomen.

abdomen and pelvis. The aorta is seen above on the left bifurcating in front of the last lumbar vertebra into the right and left common iliac arteries; the right iliac lies upon the common iliac vein, concealing it, while the left lies above and to the outside of the vein.

The ureters are seen descending from the kidneys into the pelvis; their upper extremities lie concealed behind the renal vessels. In the upper half of

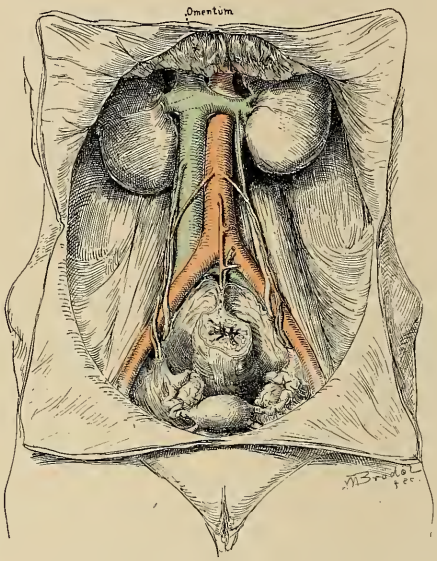

Fig. 28.

their course they lie posterior to the ovarian vessels, but in the lower half the ureter crosses and lies to the inside of the ovarian vessels and drops into the pelvis over its brim, from $2\frac{1}{2}$ to 3 centimeters to the right and left of the promontory. The distance between them at the pelvic brim is about 5 centimeters (2 inches). The nutrient vessels accompanying the ureter are clearly seen on their surface, and on the left side there is an unusually injected large tortuous vein. The right ovarian artery is seen springing from the aorta, while the left in the dissection before us arises from an aberrant renal artery. Fig. 28 shows the common method of origin of ovarian vessels. The ovarian veins on the right side empty into the vena cava at an acute angle, while those on the left empty into the left renal vein at a right angle; the mechanical disadvantage of the left side, as compared with the right, causes greater pressure, and hence a

more marked distention of the vessels on the left. On the right side three veins are seen in the pelvis in the neighborhood of the ovary, and as they ascend toward the brim two of these unite, making two veins; then the common trunk thus formed unites with the third vein to make but one on the surface of the psoas muscle. The cadaver was injected before dissection, which explains the great distention of the veins.

Fig. 29 shows a bird's-eye view of the important vascular trunks of the uterus on the left side, from the standpoint of the operator. The ureter is seen

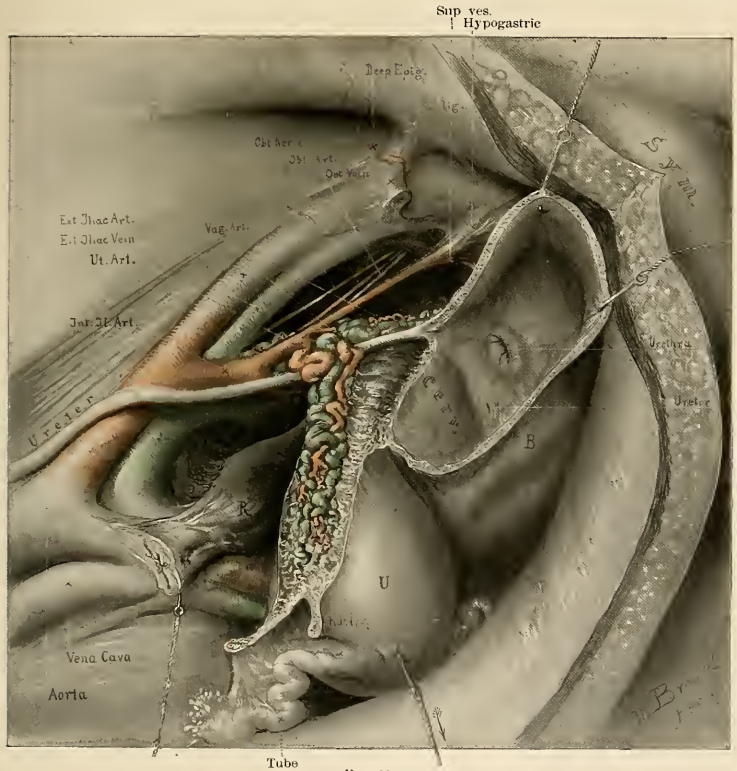

Fig. 29.

below beneath the vessels, and the bladder has been opened to show the point of entrance of the left ureter. The internal urethral orifice is well shown. The uterine artery is shown in its course from the bifurcation of the common iliac artery into the internal iliac and anterior and posterior trunks. The uterine

artery arises from the anterior trunk in common with the hypogastric artery. The origin of the vaginal artery is well shown. The ureter lies closer to the cervix uteri on the left side.

Fig. 30 is taken from an injected pelvis of a fully developed multipara, and

Fig. 30.

shows the entire vascular relations of the uterus, ovary, and Fallopian tube, as seen from the front. The anterior leaf of peritoneum has been removed, leaving the vessels *in situ*, and held in place by the posterior leaf.

The relations of the uterine vessels to the ureter, the cervix, and the vaginal vault should be carefully noted. The ureter lies below the uterine artery and two of its veins, and above a large vaginal and uterine vein. The uterine artery

Fig. 31.

ascends beside the uterus from 1 to 2 or 3 millimeters away from it, tortuous and interwoven with its veins. At the neck of the uterus, opposite the internal os, it gives off a large artery which penetrates the uterine body; all the other

Fig. 32.

branches which go to the uterus are small. Up near the cornu uteri the terminal branch of the uterine artery anastomoses with a branch of the ovarian artery.

The ovarian artery enters the pelvis in the suspensory ligament of the ovary (infundibulo-pelvic ligament); it divides just before it reaches the hilum of the

ovary into two branches, a and b; the main branch continues on in its course toward the cornu uteri, giving off numerous small vessels into the ovarian hilum; on reaching the utero-ovarian ligament, it penetrates it and passes through its substance until it reaches the side of the uterus, where it anastomoses with the uterine artery. In its course in the utero-ovarian ligament the ovarian artery gives off a secondary branch, c, which pierces the ligament about 1 centimeter from the uterus, and divides into two other branches going in opposite directions, one

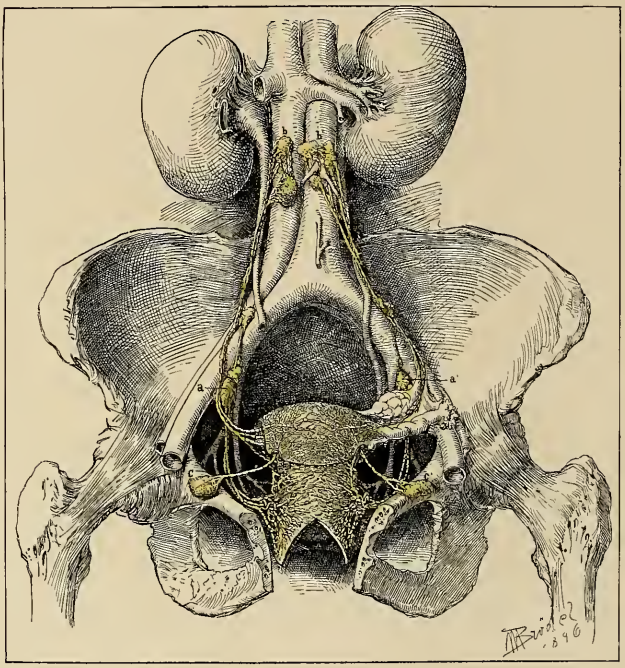

Fig. 33.

to supply the round ligament, and the other running along the base of the mesosalpinx parallel to the tube and anastomosing with the vessels of the first branch of the ovarian artery. The horizontal vessel formed by this anastomosis gives off from four to six ascending straight branches which traverse the mesosalpinx to the mesenteric attachment of the tube. These branches run out under the tube and form a series of loops by anastomosis.

Fig. 31 shows in accurate detail the ovarian artery as it reaches the utero-ovarian ligament, and divides into a uterine branch and a short trunk which

pierces the ligament to give off the round ligament artery and the horizontal tubal branch.

Fig. 32 shows the parovarium of a girl nineteen years old. The Fallopian tube is quite delicate. The ovary is not distinctly seen, because it lies behind

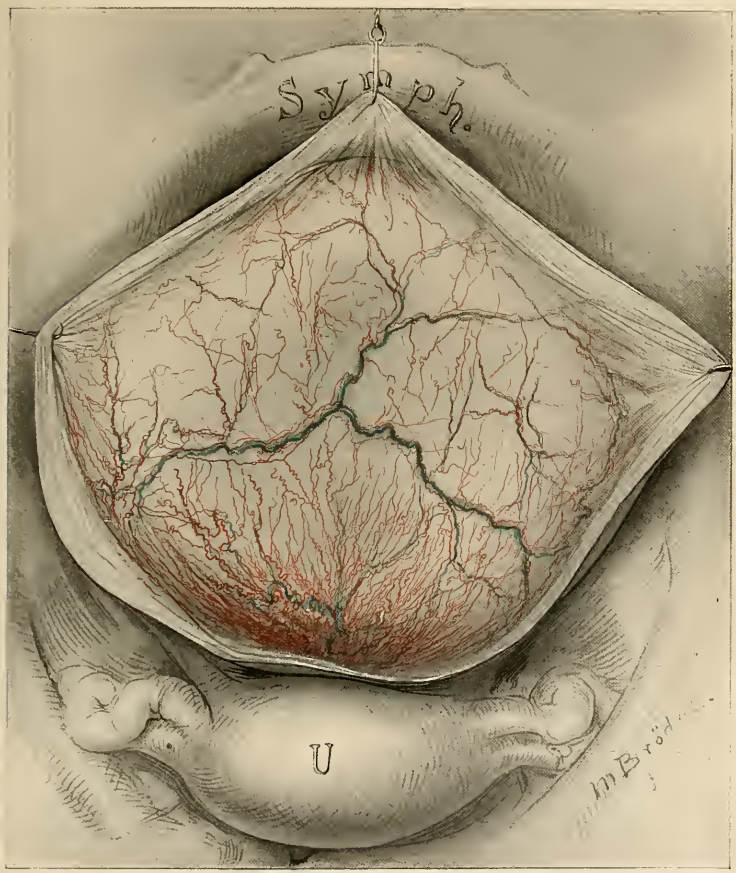

Fig. 34.

the broad ligament, which is viewed from the front. The attachment of the hilum of the ovary is, however, indicated by the shaded area. The delicacy of the blood vessels is striking. The parovarium, made up of horizontal tubules, is well shown lying in the mesosalpinx situated about halfway between the tube

and the ovary, running parallel to the tube and giving off about fifteen vertical tubules converging toward the hilum of the ovary. Some of the outer tubules are beautifully convoluted. The outer extremity of the horizontal branch ter-

Fig. 35.

minates in two so-called hydatids, hanging free by a little pedicle from the front of the broad ligament across the tubo-ovarian fimbria.

Fig. 33. The lymphatic system of the pelvic organs. The uterus and its appendages and the vagina are everywhere covered by a rich network of lymphatic vessels with whose anatomical arrangement we have become acquainted through the observations of Mascagni and Poirier. This vascular network surrounds the uterus and vagina like the finest lace. Upon leaving the uterus, the smaller vessels collect into larger trunks, which then discharge into the various neighboring glands. From the upper part of the vagina and lower cervix the lymph vessels collect to enter the glands on the pelvic floor and accompany the uterine and internal iliac vessels, to the next system of glands, in the bifurcation of the common iliac arteries (a a′). From this point the lymph channel leads

over the artery to a gland often found on its upper side well above the bifurcation, and so on up to the lumbar glands (b b′). The lymph vessels of the body of the uterus either pass out through the mesosalpinx near the ovarian attachment, and on up the suspensory ligament of the ovary to the lumbar glands (b b′), or take quite another direction and course down the round ligaments to the deep inguinal glands (c c′). The lowest part of the vagina and external genitals are richly supplied with lymphatics, which communicate with the superficial and deep inguinal glands, and through these with the glands lying upon the external iliac arteries.

Fig. 34 gives a good idea of the vascularization of the vault of the bladder —that part of the bladder which is in relation to the peritoneum. The peritoneum has been dissected off to show the circulation. The veins are seen anastomosing across from one side to the other, and terminating below in the urethrovesical plexus at the neck of the urethra. The superior vesical arteries are also seen. It is important to note the unusual injection in the neighborhood of the cervix uteri.

Fig. 35 shows the vascularization of the vesical mucosa, and exhibits beautifully the dendritic arrangement of the little branches of the superior, middle, and inferior vesical vessels as they plunge through the coats of the bladder and come to view on the mucous surface, branching out into small vessels and capillaries. It will be seen that certain definite areas of the bladder are constantly vascularized by the same groups of vessels.

The first great group is at the trigonal area where the vessels branch out into the bladder from the internal urethral orifice like a fan, appearing at the upper edges of the papillæ and coursing toward the ureteral orifices; they then continue parallel to the ureteral folds, and so reach the side walls of the bladder.

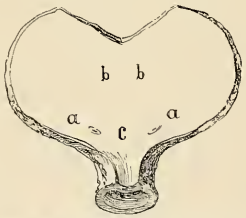

Fig. 36.—Vascularization of the Vesical Mucosa by the Right and Left Superior, Middle, and Inferior Vesical Arteries.

The superior vesical arteries (*a*) are distributed over the superior and lateral regions of the bladder. The middle vesical arteries (*b*) are distributed over the posterior portion which lies in relation to the uterus and upper vagina. The inferior vesical arteries (*c*) are distributed to the trigonum and the middle part of the vagina.

This group of vessels anastomoses with the next, which is seen just below the edges of the cut; the second group is derived from the superior vesical vessels, and several vascular trees are seen coming through to the surface of the mucosa and distributing themselves over it in fine branches. In the posterior part of the bladder the middle vesical vessels occupy the area in the neighborhood of the cervix uteri; vascular trees from this source on the right and on the left side are quite constantly found, and form a characteristic landmark in the examination of the living subject through the speculum.

Fig. 37 shows the topography of the fixed part of the bladder—that part which is attached to the symphysis pubis, vagina, and cervix uteri, as contrasted with the upper movable peritoneal portion. The first striking feature is the hexagonal form, which is caused by the attachment

of the bladder to the symphysis and its angular reflection out over the lateral pubic rami. From the posterior point of attachment to the pubic rami

Fig. 37.

it is reflected again at an angle to its cervical attachment, which it also meets at an angle, completing the hexagon. The trigonum is well shown and the internal urethral orifice lies a little in advance of the center, forming a transverse fold with a sharp ridge above it, and with numerous fine radiating folds en-

tering the opening from below. The ureteral orifices are about $2\frac{1}{2}$ centimeters apart, and the same distance from the urethra; each orifice is situated on a little mons ureteris. The inter-ureteric ligament is evident by a slight eleva-

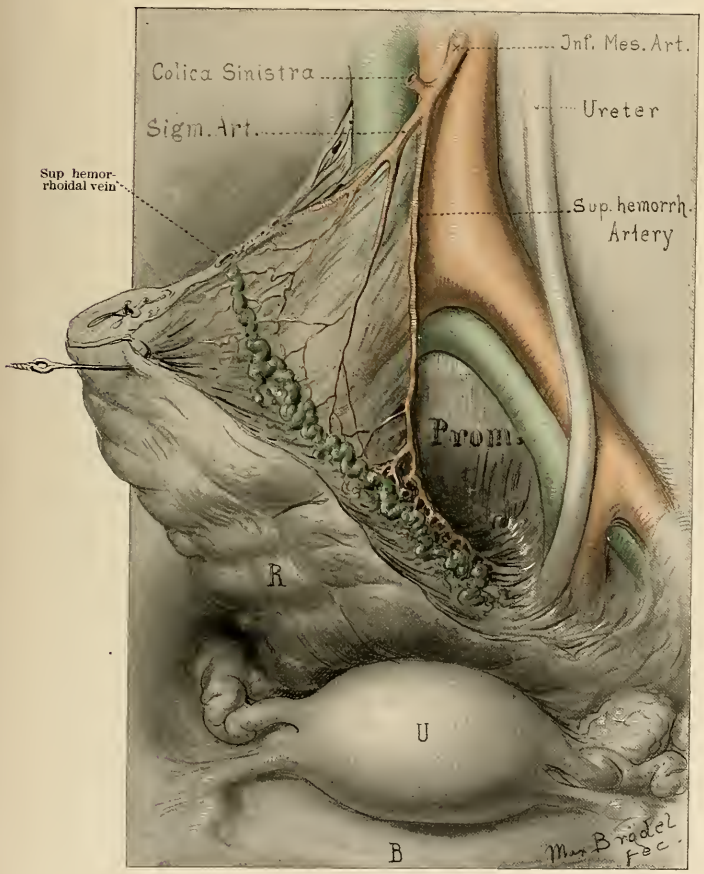

FIG. 38.

tion. Posterior to the inter-ureteric ligament is that part of the base of the bladder which lies in relation to the upper vagina.

Fig. 38 shows the blood supply of the lower sigmoid and rectum. In order to expose its vessels, the rectum has been thrown over to the right, uncovering

the left ureter. The inferior mesenteric artery is seen giving off the left colic branches and then its sigmoid branches, and terminating in the superior hemorrhoidal artery. All these branches radiate out toward the bowel, and the superior hemorrhoidal divides into two branches, one on each side of the rectum, lying close to the bowel in the pelvis. The large superior hemorrhoidal vein empties into the inferior mesenteric, and so into the portal.

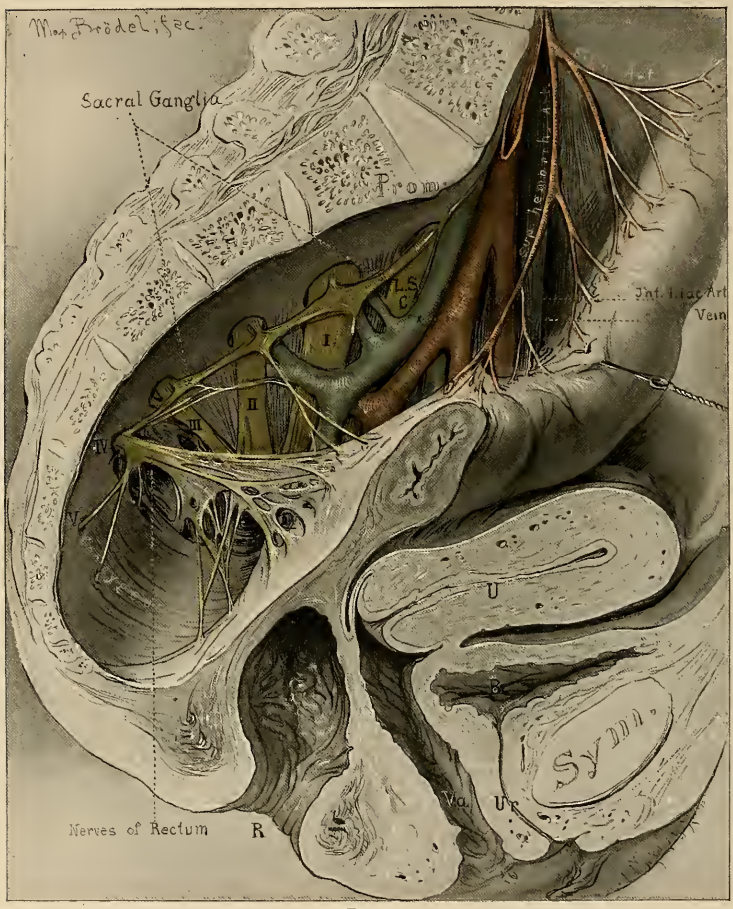

FIG. 39.

Fig. 39 is a sagittal section of the pelvis, showing the rectum drawn away from the sacrum, in order to demonstrate the arteries, veins, and nerves of the sacral and lateral pelvic regions. The distribution of the superior hemorrhoidal vessels is the same as that shown in Fig. 38. The sacral plexus of nerves is seen to emerge from the sacral foramina, forming the lumbo-sacral

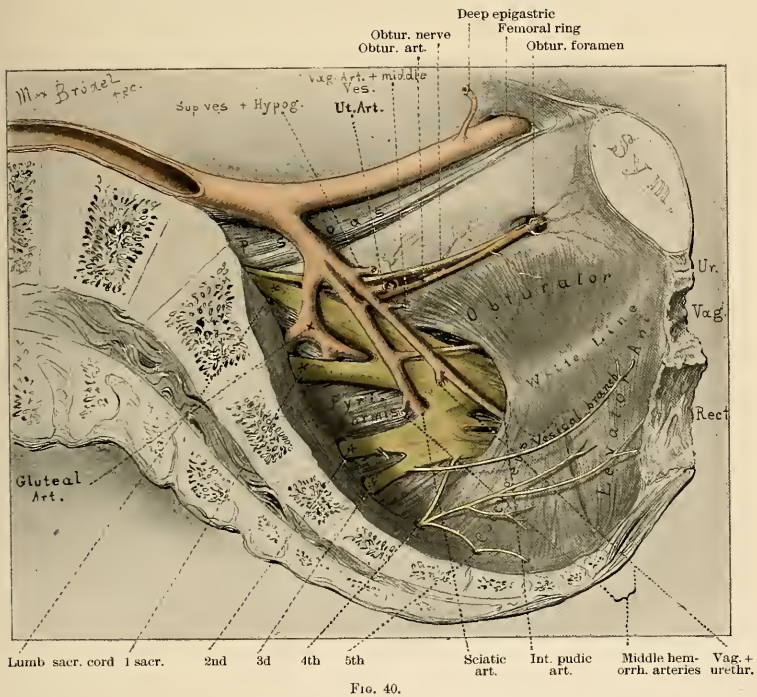

Fig. 40.

cord, and the first, second, third, fourth, and fifth sacral cords, which converge toward the great sacro-sciatic foramen, to unite in the sciatic nerve. The sacral ganglia of the sympathetic nerve are seen lying upon these nerves as they emerge from the foramen. Observe the nerves going from the fourth sacral cord to the lower part of the rectum and the coccygeus muscle.

Fig. 40 shows the muscles of the pelvis in sagittal section with arteries and nerves, after removal of the viscera. The psoas muscle is seen overhanging the brim of the pelvis and narrowing its superior strait; upon the psoas lie the common and external iliac arteries, and it is crossed by the internal iliac artery. The obturator muscle covers the obturator foramen, and its fibers converge

to its tendon, which passes out of the pelvis through the lesser sciatic notch. At the lower margin of the obturator muscle is the white line of fascia which marks the upper border of the levator ani muscle. The levator ani seen arising from the fibrous line will be described more particularly in connection with Figs. 46 to 50. The coccygeus muscle borders the posterior margin of the

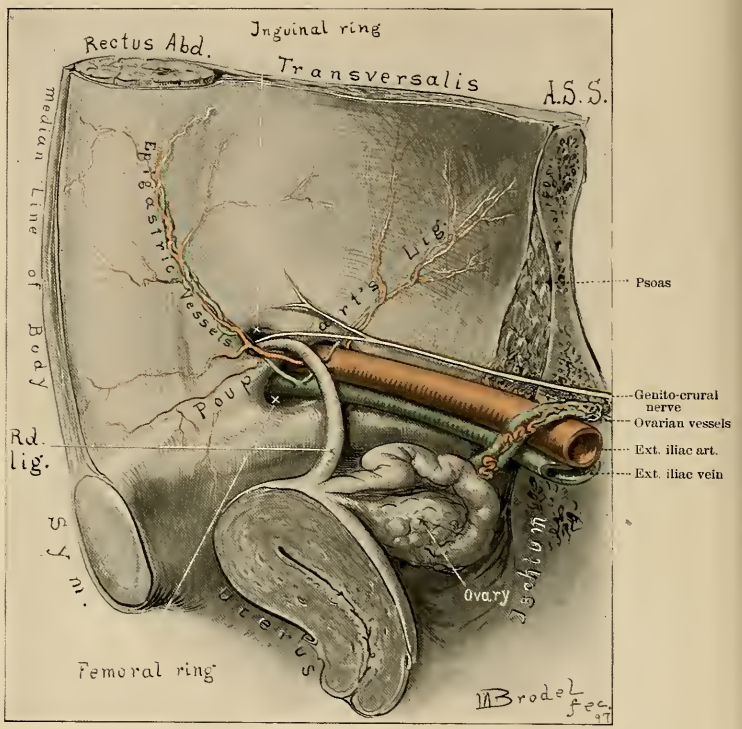

Fig. 41.

levator ani, is fan-shaped, and is attached by its base to the side of the lower sacrum and coccyx, and by its apex to the spine of the ischium. The pyriformis muscle pads the posterior part of the pelvis, rising in muscular bundles from the front of the sacrum and gradually converging and passing out of the pelvis through the great sacro-sciatic foramen, posterior to the sciatic nerve. The sacral plexus forming the sciatic nerve is seen as in Fig. 39. The obturator nerve courses around the pelvic wall parallel to and below the brim of the pelvis to the obturator foramen, where it leaves the pelvis. The vesical branch

from the third sacral cord is shown, and the nerves from the fourth sacral cord going to the rectum, levator ani, and coccygeus.

Fig. 41 shows the internal inguinal and femoral rings and the round ligament, as viewed from within the body. Poupart's ligament divides the inguinal ring above from the femoral ring below. The external iliac artery and vein pass out of the pelvis under Poupart's ligament, and give off the deep epigastric vessels which course up to the under surface of the abdominal wall around the inside of the internal inguinal ring. The epigastric artery courses in an

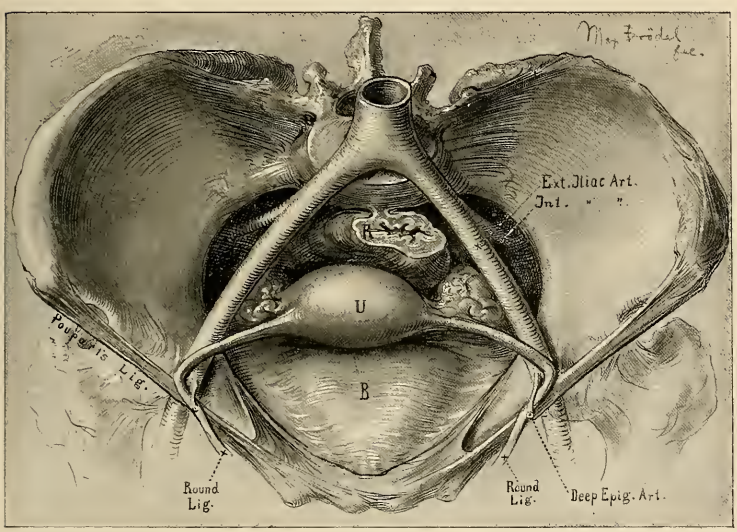

Fig. 42.

oblique direction to the rectus muscle, whose outer border it follows beneath the transversalis fascia for about 5 centimeters, when it pierces the rectus and lies well inside the semilunar line. The round ligament crosses and lies upon all these important vessels in its terminal portion in the abdominal cavity.

Fig. 42 shows the pelvic viscera and the round ligament from above. The directions of the round ligaments and the exact angles they make with the uterus and abdominal wall are accurately drawn in order to demonstrate the mechanical effects of traction made upon the ligaments at the internal inguinal ring; it is evident that the ligaments have more of a lifting effect upon the uterus, and do not serve to bring it forward to any marked extent.

Fig. 43 shows the pelvic floor as seen through the superior strait when all the viscera are removed. Note the relations of the three orifices of exit—the urethra, the vagina, and the rectum—in the muscular diaphragm of the pelvic

floor, and the relation of these to their surrounding bony supports. The pelvis is funnel-shaped and the orifices disposed in the anterior portion; the urethra appears as a small slit surrounded by thick walls just under the pubic arch.

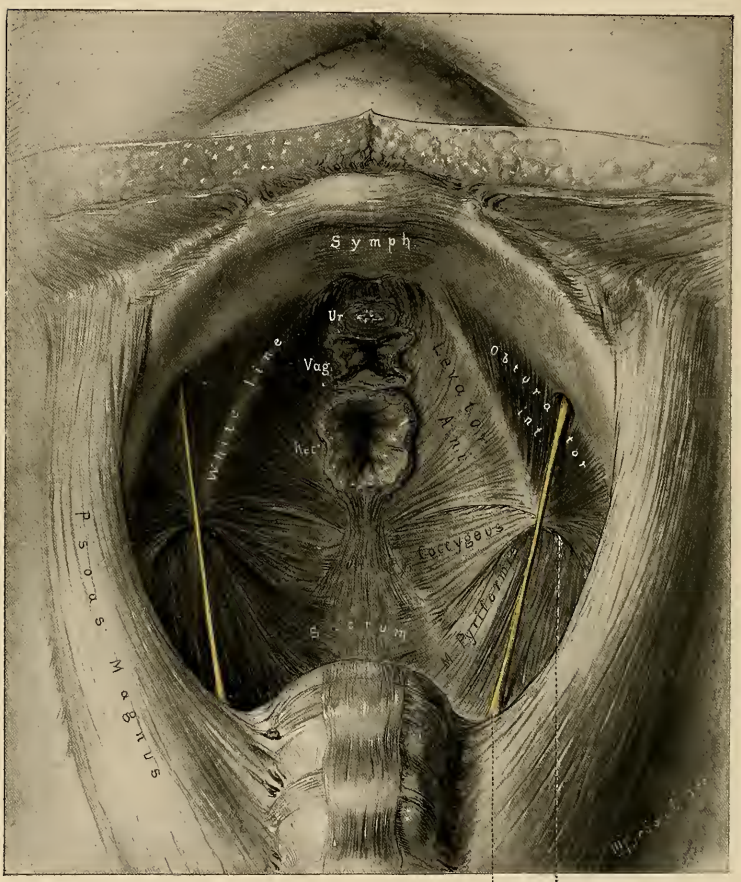

FIG. 43.

The vagina has the characteristic shape of the letter H lying on its side, and appears embraced by the muscular fibers of the levator ani, which hold the lower part of the rectum forward. The puckered rectal opening is grasped in

a sling of muscular fibers from the anterior portion of the levator ani, and attached posteriorly to the coccyx by a fibrous band. The levator ani extends from the inner surface of the pubic rami in a slightly curved line, which crosses the obturator internus to the spine of the ischium behind. From this line of origin its fibers converge to form a muscular sling, attached to and embracing the lower end of the rectum, so directed as to pull the rectum upward and forward. The anterior thick bundles of fibers arising from the upper inner part of the pubic rami serve to draw the lower part of the bowel well forward,

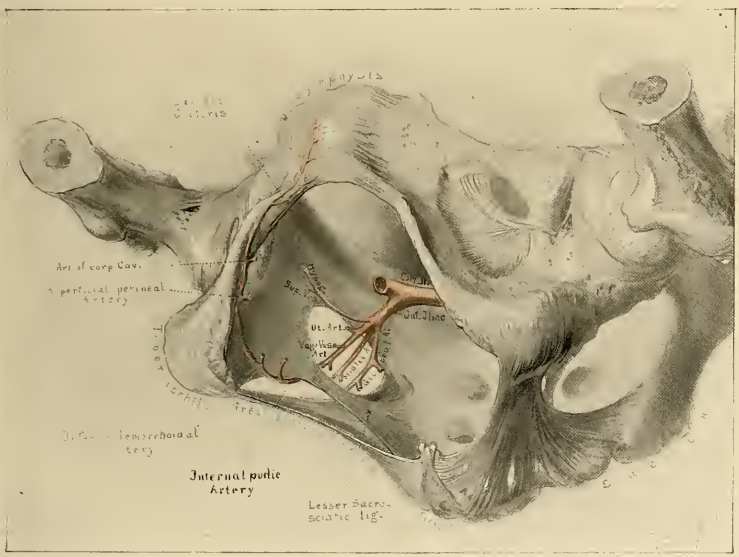

Fig. 44.

and so act indirectly as closers of the vagina. The action of the posterior fibers is simply that of holding the bowel up. The coccygeus, pyriformis, and psoas muscles are seen as described in Fig. 40.

Fig. 44 shows the mode of origin of the internal pudic artery as it arises from the anterior branch of the internal iliac, passes out of the pelvis through the great sacro-sciatic foramen, and crosses the spine of the ischium to re-enter the pelvis through the lesser sacral foramen. From this point it arches forward in a gentle curve, giving off its various branches, which course over the inner surface of the tuberosity of the ischium and cross from under the pubic arch. about halfway between the symphysis and the tuberosity, to the outer surface of the descending pubic ramus; it terminates on the anterior surface of the symphysis and the dorsum of the clitoris. The various trunks of origin of the

inferior hemorrhoidal, superficial perineal artery, artery of the bulb, and corpus cavernosum are all shown.

Fig. 45 shows the arterial vascularization of the floor of the pelvis as seen from without. The various arterial branches drawn are the derivatives of the internal pudics already indicated in their origin in Fig. 44.

Within the bony framework of the pelvic outlet, as formed laterally and posteriorly by the great sacro-sciatic ligaments, are seen the three pelvic outlets—the

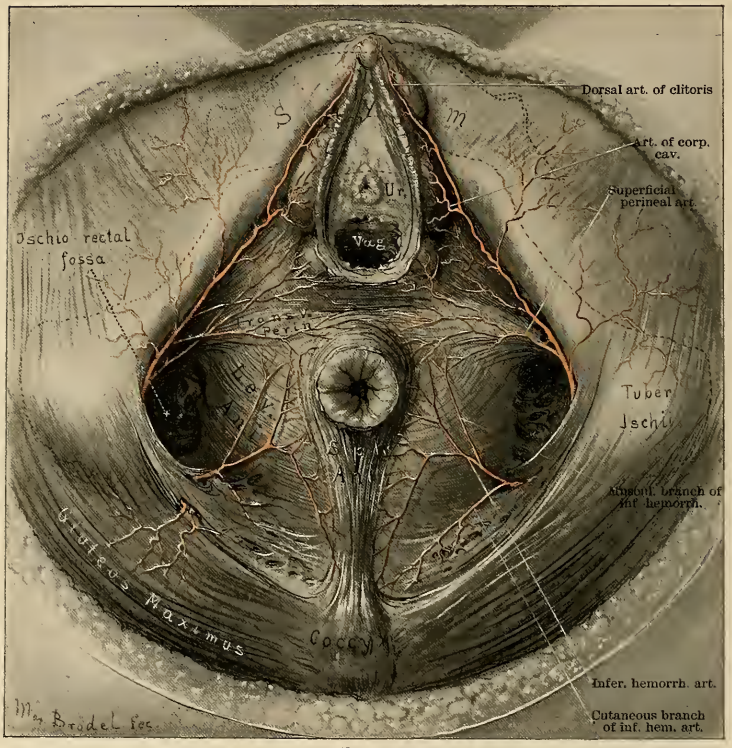

Fig. 45.

urethral, vaginal, and anal—corresponding to the same outlets seen from within in the complementary picture (Fig. 43). It is important again to notice the position of the urethra high up under the pubic arch, with the vagina immediately beneath it; the anal orifice is at about the center of the figure, halfway between the pubic arch and coccyx and the tuberosities of the ischium. A striking

feature in the picture is the ischio-rectal fossæ between each tuberosity and the levator-ani muscle. Posteriorly the inferior hemorrhoidal arteries are seen emerging from the ischio-rectal fossæ and curving forward, and branching over the levator ani muscle, to be distributed to the lower part of the rectum and the sphincter ani muscle. The superficial perineal arteries are seen emerging from the depths of the ischio-rectal fossæ anteriorly, and coursing forward in front of the rectum over the transverse perineal muscles. The terminal branches of the internal pudic artery are seen in their distribution, a small branch going to

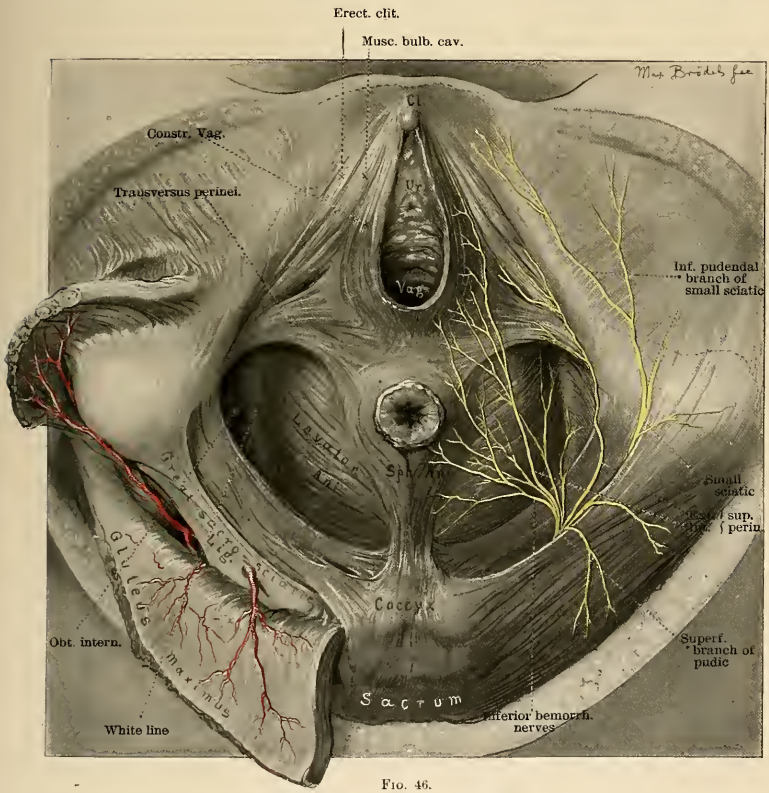

Fig. 46.

Bartholin's gland, a branch above this to the bulb of the clitoris, and the remaining branches supplying the corpora cavernosa and the dorsum of the clitoris.

Fig. 46 shows the muscles of the pelvic floor in their relation to the vaginal

and rectal openings, together with the distribution of the terminal branches of the nerves. Posterior to a line drawn between the anterior margins of the tuberosities of the ischium are seen the following muscles. The transverse perineal muscles take their origin beneath the tuberosities of the ischium and cross the perineal body horizontally between the vaginal outlet and the anal orifice, each one fusing with its fellow on the opposite side. A number of the muscular bundles diverge from the horizontal fibers anteriorly and posteriorly

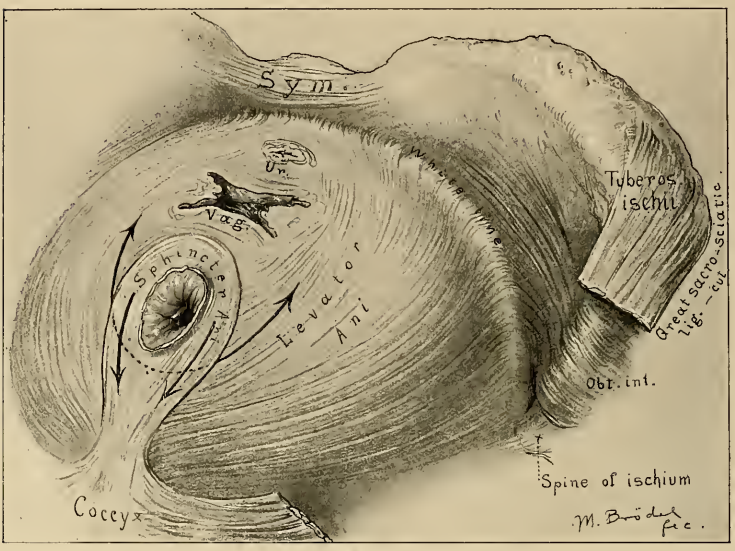

Fig. 47.

at angles of about 30 degrees, to fuse in front with the constrictor vaginæ, and behind with the sphincter ani and levator.

The most conspicuous feature in the center of the figure is the roll of muscular fibers surrounding the rectal outlet, and so forming the external sphincter; these fibers posteriorly are seen attached to the end of the coccyx.

The levator ani muscles are seen on each side, filling the space between the sphincter ani and the tuberosities of the ischium. Each levator ani rises high up under the internal surface of the descending pubic ramus, from a white line of fibrous tissue stretching from the internal surface of the pubic ramus to the spine of the ischium. The anterior portion of the levator ani muscles can not be seen in this drawing, but a portion of the white fibrous line is well shown. Between this line and the tuberosity of the ischium a portion of the obturator internus muscle is visible. The coccygeus muscle, which appears almost as a

continuation of the levator ani posteriorly, is seen filling out the space between the levator and the great sacro-sciatic ligaments. In the anterior half of the picture, lying in front of the transverse perineal muscles, are shown the constrictor vaginæ made up of a few delicate muscular fibers, embracing the vaginal outlet. External to the constrictor vaginæ lie the bulbo-cavernosus and the erector clitoris muscles, arising from the pubic arch posteriorly, and converging toward the dorsum of the clitoris. On the right side of the picture are shown the internal pudic nerve and the inferior pudendal nerve. The various branches of the internal pudic nerve, similar in name and distribution to the corresponding arteries as described in Fig. 45, are seen in their distribution to the muscles of the pelvic floor, perineum, and vaginal outlet.

Fig. 47 shows the origin and insertion of the fibers of the levator ani muscle, as seen from below. The sphincter ani, the lower part of the vagina, and the

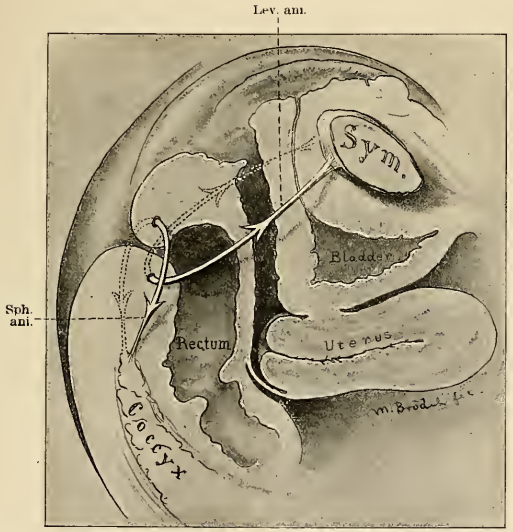

Fig. 48.—Sagittal Section of Pelvis in Fig. 47, Demonstrating in a Schematic Way the Actions of the Levator Ani and the Sphincter Ani Muscles.

extremity of the urethra have been cut off on a level with the attachments of this muscle. Important landmarks are the symphysis, coccyx, and the left tuberosity of the ischium. Just inside the tuber ischii the fibers of the internal obturator muscle are seen arising from the inner surface of the obturator foramen and the adjacent pubic ramus and converging to the tendon, which passes out of the lesser sacro-sciatic foramen. The great sacro-sciatic ligament has been cut away in order to expose the levator ani muscle in its entirety.

The line of origin of the levator ani is well shown, stretching from the inner surface of the pubic arch about 3 millimeters below its horizontal portion and back in a gently curved line to the spine of the ischium. The direction of the fibers of this muscle change from the anterior to the posterior part to such an extent that the fibers from the pubic arch form almost a right angle with the posterior fibers.

Owing to the direction of the anterior fibers, and their insertion into the fibrous tissues of the perineum and the sides of the rectum, they have a lifting power upon these structures which is efficient in closing the vaginal outlet (Fig. 48). It is important to note the blending of the levator ani muscle with the external longitudinal fibers of the rectum (see Fig. 49).

Fig. 50 is a coronal section of the pelvis through the iliac crests, the acetabula, and the tuberosities of the ischium, showing the posterior part of the

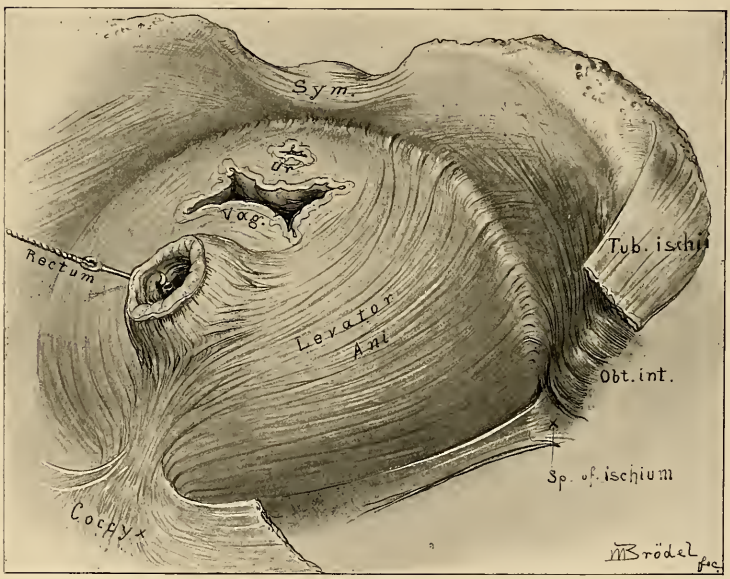

Fig. 49.

pelvis and the levator ani muscles and rectum in vertical section. The thin leaf-like nature of the muscle is well shown. The funnel shape of the posterior part of the levator ani muscle, extending from the spine of the ischium to the coccyx, is brought out. The broader surface of attachment is also shown blending with the longitudinal muscular fibers of the rectum and with the sphincter ani muscle. The division of the fascia ensheathing the obturator internus at

the point called "the white line" is shown. The obturator internus appears in section between the levator ani and the ischium, and in the depths of the ischio-rectal fossa below the levator appear the pudic vessels and nerves lying close to the tuberosity of the ischium. The coccygeus and pyriformis muscles appear

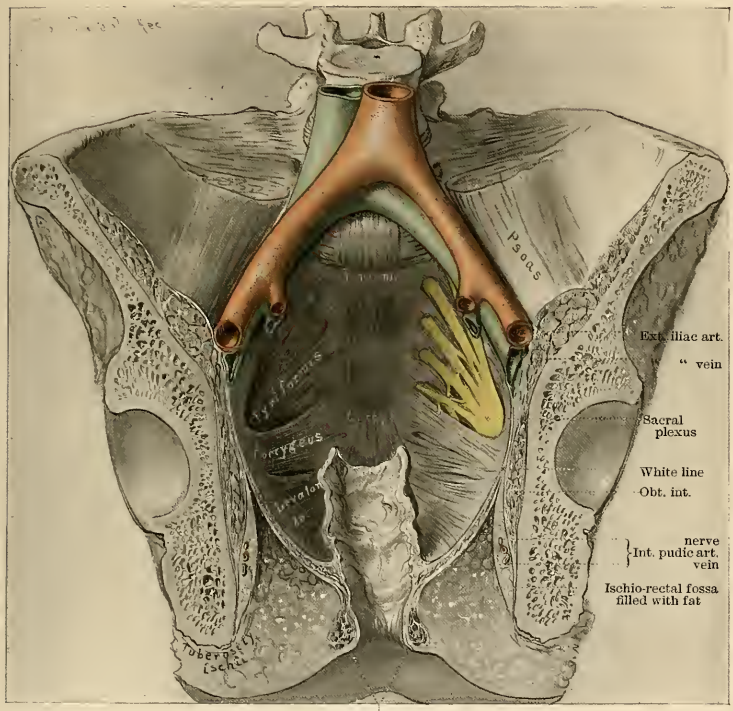

Fig. 50.

as continuations of the levator, parallel to its upper fibers and clothing the posterior pelvic walls on both sides of the sacrum. The sacral plexus is seen overlying the pyriformis muscle on the left.

CHAPTER V.

THE GYNECOLOGICAL EXAMINATION.

1. The gynecological examination. Inspection. Measurements. Photography. The normal abdomen. Abdomen of ovarian cyst. Abdomen of fibroid tumors of the uterus. Ascitic abdomen. The use of specula in inspection. Percussion. Auscultation. Palpation. Postures employed. Standing. Squatting or crouching. Sitting and bending forward. The left lateral, or Sims's posture. The knee-chest. The dorsal. Examination of the pelvic organs in the dorsal position. Simple examination with one hand in vagina or rectum. The bimanual examination:—With the organs *in situ*. Invagination of the pelvic floor. Examination of the uterus. Examination of the ovaries. Examination of the Fallopian tubes. Bimanual examination by the rectum and abdominal walls. Bimanual examination by rectum and abdomen after atmospheric distention of the rectum. Bimanual examination in the dorsal position with elevated pelvis; the same with the uterus in artificial retroposition. The bimanual examination with the uterus drawn down to the vaginal outlet. Examination of the anterior surface of the uterus through the rectum. Examination in pelvic disease. Pelvimetry:—Four ways of measuring the true conjugate diameter. Anesthesia. Rules for use of anesthesia. Preparation of patient. The examination. Displacements affecting position. Descensus. Anteflexion. Retropositions. Ascensus uteri. Fixations and adhesions affecting mobility. Inflammation and tumors affecting size and form. Peculiarities of sensitiveness. Peculiarities of consistency. Information derived from curettage of the uterus. Microscopic examination of a piece of tissue excised. Microscopic and bacteriological examination of uterine, vaginal, and other discharges. Examination of the rectum. Examination of the vermiform appendix.
2. The general examination. Age. Heredity. Temperament. Habit. Color. Diseases to look out for. Lung disease. Affections of the heart and arteries. Affections of the alimentary canal. Diseases of the liver. Diseases of the kidney. Taking the history. Skeleton outlines of history and treatment. Diagrams of pelvic lesions. Minuter examinations of gynecological cases.

THE recent progress in gynecology is chiefly due to the new and better methods of examining patients, which constitute a fundamental difference between the gynecology of to-day and that of our immediate predecessors.

The gynecological examination includes both an investigation of any existing pelvic disorders and a careful inquiry into the patient's general condition. The natural order of inquiry is first to take the history, then to examine the pelvic organs, and finally to make the general examination.

GYNECOLOGICAL EXAMINATION.

The examination proceeds by making an orderly investigation of the pelvic and abdominal organs by means of inspection, palpation, percussion, and auscultation.

Inspection.—Inspection is limited to the surface of the abdomen, the external genitals, and those parts of the rectum, vagina, and cervix which can be exposed to view, either directly or by instrumental aid. In doubtful cases inspection may even go so far as to make a direct examination of the uterus, ovaries, and tubes through an exploratory incision in the abdominal wall.

DESCRIPTION OF PLATE II.

Diagnosis of abdominal tumor by inspection: the lower abdominal walls are splinted and held immovable by the tumor behind them. The hazy line above the umbilicus shows the respiratory motion.

M. Pirodon fec.

Heliotype Printing

The general condition of the body—whether fat, well nourished, or emaciated—is naturally the first point to attract attention. Inspection also notes peculiarities of color affecting the skin and the mucous membranes. The greenish-yellow hue of the chlorotic woman will often at once explain an amenorrhea; the cachexia of a cancerous patient is characteristic and easy to remember when once seen; the ovarian facies bespeaks malnutrition, and the pallor of hemorrhage in myomata or extra-uterine pregnancy is a diagnostic factor of the highest importance. The septic patient has a peculiar sallow, anemic appearance. Inspection also notes the face indicative of hysteria. The careful slow gait of the patient with pelvic peritonitis and any peculiarities in the way of protecting tender parts from touch or shock by pressure with the hands are also to be noted.

Inspection of the abdomen is of the greatest value when the eye is trained to know its various contours in health. Variations between the normal and abnormal contour of the abdomen produced by the growth of tumors, or by ascitic effusions, or by gas, can be readily seen. In abdominal tumors the inspection is limited to outlines, and is only one diagnostic measure, which, in association with other aids, enables us to arrive at a correct estimate of the character of the disease beneath.

While a simple inspection is sufficient for the immediate purposes of the diagnosis, careful measurements of abdominal enlargements should always be made and recorded. By means of measurements at different times changes in the size of a distended abdomen are made evident and imperceptible differences of a few centimetres can be accurately determined. Besides, we also do away with such vague terms as "a small tumor," or "a large" or "enormous one," eliminating the large personal equation lurking in these statements.

The following are the usual measurements made:

Circumference of the abdomen at the umbilicus.

Circumference halfway below the umbilicus.

Elevation of highest point of abdominal wall above the plane of the anterior-superior spines.

Distance from sternal notch to symphysis pubis.

Distance from umbilicus to pubis.

Distance from umbilicus to right and left anterior-superior spines respectively.

By such measurements the degree and form of abdominal enlargements are determined, whether more in the lower or upper abdomen, or in one flank, and whether symmetrical or asymmetrical.

Photography is a valuable adjunct to descriptive records; the photograph gives an instantaneous idea of form, often better than an elaborate description. The photograph with the patient lying on the table can be taken with advantage from three points of view: A profile from the side, showing the general enlargement of the abdomen; a profile from below, showing symmetry or asymmetry; while a quartering view halfway between these two posi-

tions and looking rather down on to the abdomen gives a general view of the relations of the parts of the tumor to the abdominal landmarks. When possi-

FIG. 51.—SAGITTAL SECTION THROUGH ADULT BODY, SHOWING THE NORMAL POSITION AND RELATIONS OF THE UTERUS, BLADDER, RECTUM, AND ABDOMINAL WALLS.

The intestines are not shown, and the dotted line represents the outline of the pelvic bones. It is important to note the proximity of the anterior abdominal wall to the sacral promontory.

ble, the umbilicus should be included in the picture, as the most important landmark. A profile view, with the patient erect, shows the anterior displacement of a large tumor.

A beautiful graphic record demonstrating the presence of a tumor within the abdomen is furnished by the profile photograph shown in Plate II. The diagnostic sign rests upon the hazy contour of the upper half of the abdomen, beginning at the umbilicus; at first sight, the indistinct line looks like a fault

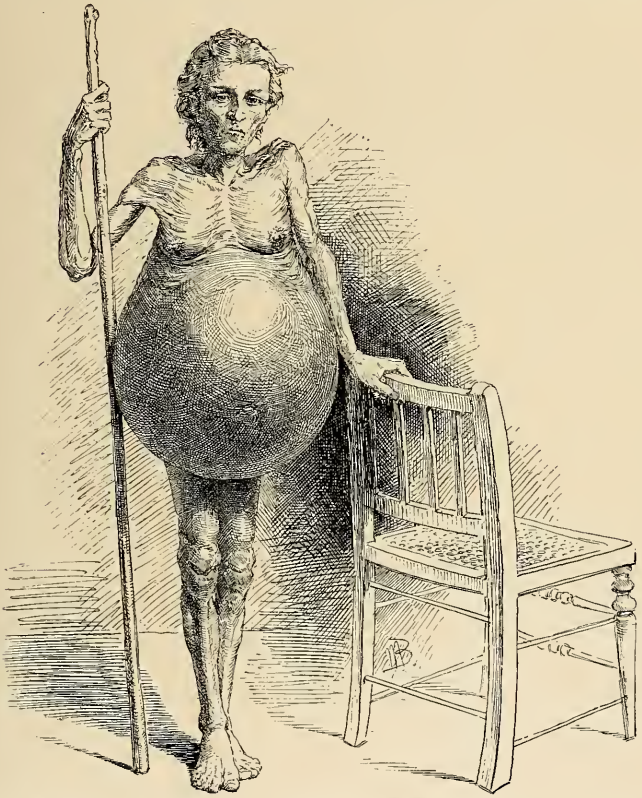

Fig. 52.—Enormous Ovarian Cystoma, with Globular Pendulous Abdomen, and the Characteristic Emaciation.

in the picture, but this is due to the fact that it registers the natural movements of the abdominal wall during expiration and inspiration which are cut short below by the tumor splinting the lower abdomen so that it can not move, as it would do if no tumor were present.

Marked departures from the normal may occur within the limits of health, of which the most frequent are distention from tympany or the

accumulation of fat in the omentum and abdominal walls. Tympany produces a symmetrical form, by the uniform expansion of the intestines in all directions, the greatest prominence being around the umbilicus. The general appearance of such an enlargement may not differ at all from that of an encysted tumor. In a fatty abdomen, if the fat is in the walls, it is often

FIG. 53.—SYMMETRICAL CIRCULAR OUTLINE OF ABDOMEN CHARACTERISTIC OF A LARGE OVARIAN CYST.

characterized by the presence of creases from side to side; if it is inside the cavity, on the omentum and mesentery, in the nullipara, the rotundity is simply increased; but in the multiparous woman the walls appear flabby and the abdomen flat and distended in the flanks. These changes occur commonly after the menopause. If an abdominal tumor is present under these circumstances, it often becomes a difficult task to make a diagnosis, and the physician may easily be misled into concluding that there is no tumor within.

Fig. 51. The importance of knowing the normal abdomen and its variations within the limits of health becomes evident as we study the changes in form brought about by tumors in the peritoneal cavity. Such a pathological enlargement is either uniform over the whole abdomen or localized in some special area. The enlargement itself may present a uniformly convex surface,

or it may be marked by bosses and grooves. A uniform increase in the size of the whole abdomen is only produced by tumors of the largest size and by ascites. Such a case is shown in the figure of Mrs. D., who had an ovarian cyst weighing 100 pounds, which I removed in Philadelphia, in May, 1887. (Fig. 52.)

A symmetrical convex surface over an abdominal tumor indicates a corresponding symmetry of surface of the tumor within. The contrast afforded in this way with a bossed surface serves to distinguish certain groups of tumors. In gastric, splenic, or hepatic tumors of the upper abdomen the swelling is more above, while in pelvic tumors the enlargement is mostly below.

The pregnant uterus may be taken as the type of symmetrical lower abdominal and pelvic tumors; here the chief distention is below the umbilicus, and in the first pregnancy up to the eighth month the prominence in the median line is like that of an ovarian cyst or a myomatous uterus of the same size.

Fig. 53. The form characteristic of large ovarian cysts is an ovoid distention of a part or of the whole abdomen, with more or less smooth outlines. Such tumors at first involve the lower or infra-umbilical part of the abdomen greatly in excess of the upper part, and if the tumor is of enormous

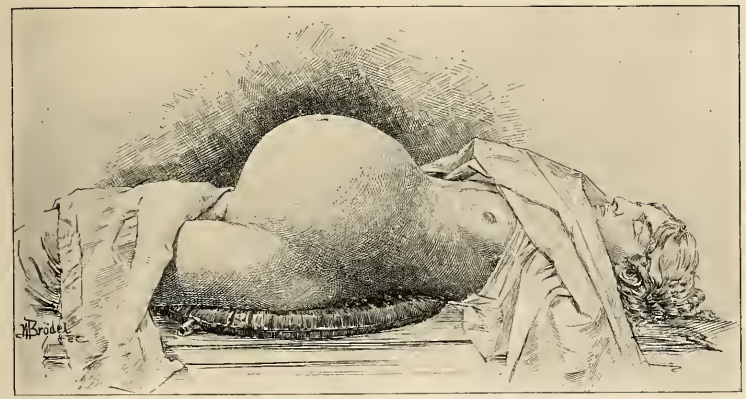

Fig. 54.—Abdomen Distended by a Large Parovarian Cyst.

Note particularly the gentle line of elevation from the sternum to the umbilicus, an area rarely encroached upon by myomata.

size it may even hang below the knees. The enlargement is always uniform in parovarian cysts, Fig. 54, and in polycystic tumors with but few bosses; in the latter case the smaller nodular prominences are usually displaced into the flanks by the movements of the abdominal walls accommodating the convex smooth surface of the tumor to the concave inner surface of the anterior wall. Sometimes the surface of the abdomen appears nodular from the presence within of

an ovarian tumor made up of a number of *loculi* of about the same size, or when adhesions prevent the tumor from rotating and accommodating itself.

Figs. 55 and 56. *Two forms of enlarged abdomen are characteristic of fibroid tumors of the uterus:* one in which the distention is spherical, looking as if the cavity contained a cannon ball, while the drop from the top of the tumor to the normal level of the abdominal wall, as the patient lies on her back, is often almost vertical. This is rarely seen in ovarian tumors. The other form has an appearance of irregular nodular masses distributed in the lower abdomen, Fig. 57.

Figs. 58, 59, and 60. Enlargement of the abdomen frequently arises from ascitic accumulations, which tend to take the form of a flattened

Fig. 55.—Form of Abdomen Characteristic of a Large Globular Myomatous Uterus. Note particularly the abrupt lines of elevation, especially from epigastrium to umbilicus.

ovoid, the regions of greatest prominence being in the flanks, whither the fluid gravitates. While the flattening is an important differential point between an ascitic accumulation and circumscribed encysted fluids, yet occasionally in a nullipara ascites may present the domelike prominence of a cyst, and the difference can only be detected after palpation and percussion in various positions. See Figs. 61 and 62.

Inspection is the essential factor in the diagnosis of diseases of the external genitalia, vagina, and vaginal cervix. The vagina and cervix can be exposed to view by the aid of instruments. Relaxed outlet, rupture of the outlet, prolapsus, and affections of Bartholin's glands, such as cysts and abscesses, etc., are diagnosed at once by simple inspection.

Inspection of the vagina and vaginal cervix is effected

by means of specula. The best are Fergusson's tubular, Sims's duck-bill, Goodell's bivalve, and Nelson's trivalve speculum, and Kelly's small cylindrical specula. The valvular specula are introduced to their full extent closed, and then opened, when the cervix is brought plainly into view. Upon withdrawing the speculum the vaginal walls are examined as they slowly roll over the end. Ordinary specula, however, must not be used in examining unmarried women, for they destroy the hymen and produce a dilatation of the vaginal outlet. I have often seen a distention from specular examinations great enough to admit four fingers. Small cylindrical specula, 9 centimetres (3½ inches) long and 8, 10, 12, 14, and 16 millimetres in diameter, must be used in examining and treating the vagina and cervix in unmarried women and girls. The patient is put in the knee-breast position, and the speculum with an obturator introduced without injuring the hymen; as soon as the obturator is withdrawn the vagina fills with air, and every part of it, with the cervix, is plainly exposed to view by a light reflected from a head mirror.

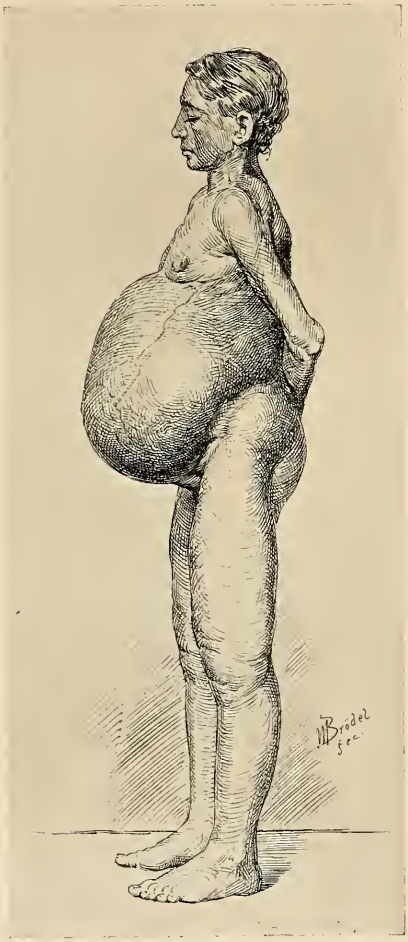

FIG. 56.—ABDOMEN DISTENDED BY A LARGE CYSTIC MYOMA, ABDOMINAL WALL SIMPLY PUSHED OUT WITHOUT SAGGING. Note dilated superficial epigastric vein and edematous legs.

Percussion.—Percussion is a valuable adjunct to inspection and palpation in the differential diagnosis of abdominal tumors. There are in general three kinds of percussion notes—flat, tympanitic, and dull. The flat note, drawn from the most prominent part of an ovarian or uterine tumor, is in striking contrast to the high-pitched tympany of the intestines sur-

rounding it. The edge of the tumor is defined by an area of relative dulness or "tympanitic dulness."

The part of the abdomen from which an abdominal tumor has arisen may

Fig. 57.—Showing Form of the Abdomen Characteristic of a Large Multinodular Subperitoneal Myoma with Thin Abdominal Walls.

Fig. 58.—Characteristic Form of a Flaccid Abdomen with Ascites.

The fluid has gravitated down into the flanks, and the anterior abdominal wall in the median line almost rests on the vertebræ.

often be determined by percussion, by outlining the growth and noting on which side the resonance is wanting; in almost every case that will be the original

habitat of the tumor from which it has developed out toward the middle of the abdominal cavity, the direction of least resistance.

The outlines of most pelvic tumors are more or less crescentic and surrounded by an area of resonance called the corona, corona ovariana, or corona uterina.

Percussion is of the greatest service in differentiating cystic and solid tumors from tympany and ascites. The tympanitic abdomen is resonant all over; the ascitic abdomen yields a dull note in the flanks and tympany above, from the

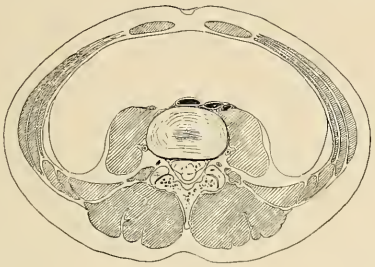

Fig. 59.

Fig. 60.

Characteristic form of section through normal abdomen (Fig. 59) compared with ascitic abdomen (Fig. 60). Section made through umbilicus and fourth lumbar vertebra.

gravitation of the fluid and the floating up of the intestines. When the accumulation is extreme, however, the distention of the abdomen may be so great as to lift the walls farther from the back than the mesentery can reach; in such cases the intestines are everywhere covered with fluid and percussion yields a flat or dull tympanitic note in all directions. Moderate accumulations may be made to gravitate from one side to the other, or into the lower or upper abdomen, by changing the position of the patient; and the dull and tympanitic areas will change with each alteration of posture.

The most important use of percussion in diagnosis is the recognition of an area of tympany overlying retroperitoneal tumors, usually renal, which lift the colon forward as they advance toward the anterior abdominal wall; in this

way the error of mistaking an enlarged kidney for an ovarian tumor is always to be avoided.

Auscultation.—Auscultation is limited to the surface of the abdomen and is chiefly valuable in discriminating abdominal tumors from pregnancy, where the sound of the fetal heart-beats is the distinctive sign. In fibroid tumors a loud bruit is often heard, caused by the free circulation of the blood in the great vascular channels; this must not be mistaken for the bruit of pregnancy. The only way to make the distinction clear is by discovering other signs of pregnancy.

Palpation.—After inspection and percussion we proceed to examine by touch. No other diagnostic procedure is equally satisfactory and so certain in its results as the sense of touch applied to the various organs through the abdominal,

Fig. 61.—Cylindrical Flattened Abdomen Characteristic of Ascites.

vaginal, or rectal walls. It is not unusual for the beginner to feel discouraged with the results of palpation, which at first are crude and indefinite, but by persistent practice the tactile sense becomes acute, and the consistence as well as the minuter outlines and relations of the various organs in health and disease are easily appreciated.

By palpation we outline structures normal and abnormal, and determine the relative position, consistence, mobility, and sensitiveness of the parts under investigation. In this way cystic tumors are at once differentiated from hard ones, and masses are easily detected in the lower abdomen, where they are hidden behind the symphysis, or in the flanks. Again, the degree of relaxation of the outlet and the condition of the vaginal walls and of the cervix are at once determined by digital palpation. Palpation is greatly facilitated by the use of certain postures, which are so important that I shall describe them in detail.

The various useful postures are the standing, squatting, sitting, and bending forward, the left lateral or Sims's, the knee-breast, and the dorsal or lithotomy.

Standing Posture.—In this posture the patient stands with one foot on the floor and the other resting on a stool six or eight inches high, while the physician stoops before her and, resting the elbow of his examining hand on his knee, proceeds to make a digital examination of the vaginal outlet, the vagina,

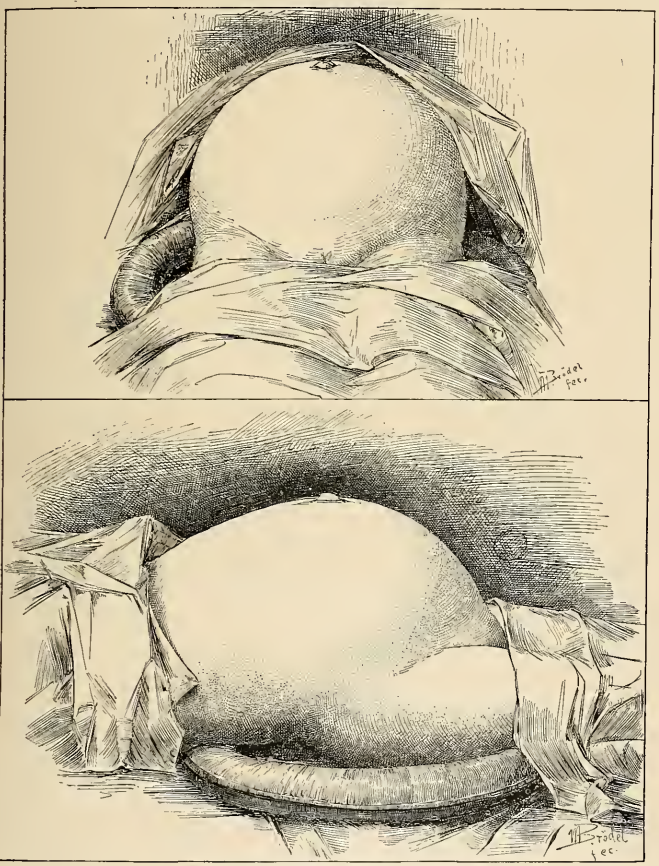

Fig. 62.—Ovarian Tumor with Ascites.

The upper picture shows the form of abdomen as seen from below; the lower picture the form seen from the side. Note protrusion at the umbilicus. M. E., op., Dec. 23, 1895.

and the other pelvic organs. The hand can be placed at rest and the arm lengthened or shortened at will by supporting the leg on the ball of the foot,

keeping the heel off the floor. This gives a springy support and takes away the natural tendency to stiffen the arm in pushing the hand high up into the vagina. Relaxation of the vaginal outlet and descensus uteri are most easily recognised in this way. While standing, also, if there is a movable kidney, it drops forward and is readily grasped between the hands.

Squatting or Crouching Posture.—The patient takes the same posture as in defecation, and by a slight straining effort is able to demonstrate to the examiner behind her the least tendency to prolapse and eversion of the vaginal walls. The full effect of a relaxed outlet may be brought out in this way better than by any other means.

Sitting and Bending Forward.—The patient leans forward, resting the weight of her body on the shoulder of a nurse, and so thoroughly relaxes the abdominal muscles; the examiner then sits before her or at her side, and makes counter-pressure with one hand over the back while with the other he palpates deeply through the lax abdominal walls.

Fig. 63. The Left Lateral or Sims's Posture.—In this position the patient lies on her left side with her left arm behind her back and both legs flexed upon the abdomen, the right drawn up above the left, and the pelvis

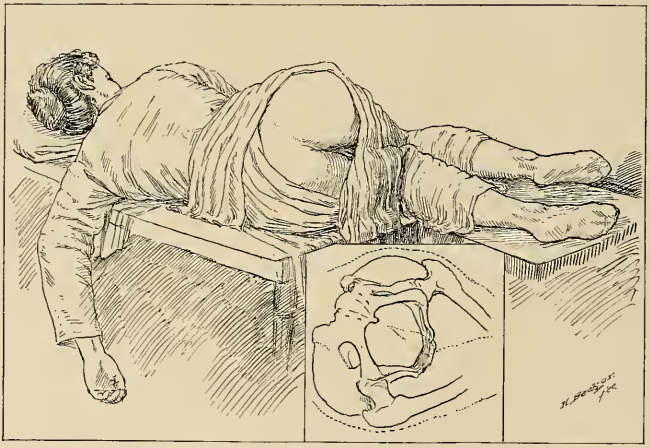

Fig. 63.—Sims's Posture.

Showing the position of the legs and chest, and especially the inclination of the pelvis, as seen in outline below.

tilted decidedly over toward the table, so as to facilitate the gravitation of its contents through the superior strait in the direction of the anterior abdominal wall; this causes the vagina to balloon out with air as soon as the posterior wall is retracted. The distention will not take place, however, unless the pelvis is sufficiently tilted, so that if the patient persists in lying with her right hip vertically above the left, the difficulty must be overcome by requesting her to

lie more on her stomach. This posture is useful for vaginal inspection, local treatments, and some operations. A digital examination in this position is always unsatisfactory, as the hand is impeded by the perineum.

To expose the cervix take a Sims's speculum, dip it in warm water, and anoint it with vaseline; the right buttock is then lifted with the left hand, until the vaginal outlet is seen, when the speculum is engaged in the fourchette and gently slipped back into the vagina, avoiding the urethral orifice, and following the sigmoid curve of the posterior vaginal wall, which it retracts at the same time.

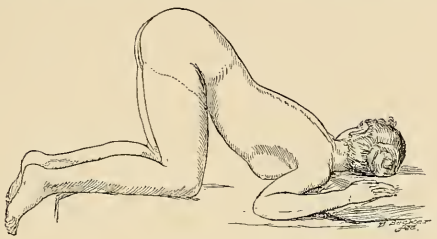

Fig. 64.—Knee-chest Posture.

If the outlet is relaxed, the posterior wall may be retracted with the fingers alone, and the vagina and cervix exposed as well as with a speculum. In this posture, in cases of pelvic inflammatory disease, the uterus and its appendages often do not recede into the pelvis, but remain fixed by their adhesion, while the vagina does not expand.

Fig. 64. The Knee-chest Posture, like the one described, is not often of special value in digital explorations, but for the inspection of the vagina and the vaginal cervix it is by far the best. In order to obtain the full advantage of the posture, the patient must be placed with her head turned sidewise upon the table so as to bring her chest as close to it as possible; then with the back bowed in, the pelvis is inverted so that the viscera naturally pitch downward toward the diaphragm. The effect of this posture may be exaggerated by lifting the pelvis with a pillow placed under the knees. The corset must always be removed and the clothes drawn above the knees on the table and over the hips behind. Upon introducing the Sims's or a tubular speculum the air rushes into the vagina and balloons it out, bringing the cervix and vaginal walls into perfect view. If there is an adherent inflammatory mass in the pelvis, the vagina will only distend to a limited extent, and the swelling at the site of the tumor may be visible.

This is the best position in examining the virgin, for the whole vagina can be perfectly seen through a small cylindrical speculum only 10 or 12 millimetres in diameter, and without injuring the hymen.

The Dorsal Posture.—In this position the patient lies relaxed on a short table, with her head resting on a pillow and the legs and thighs flexed, and covered with a sheet. The clothing must be drawn above the hips behind and above the knees in front, and the corsets should be loosened. The effect is increased by elevating the head and chest upon pillows so as to shorten the distance between the symphysis pubis and the sternum. By this means the recti muscles are relaxed and offer less resistance to the invagination of the abdomi-

nal wall through the superior strait in a bimanual examination. The feet in the dorsal position should not be more than 15 to 20 centimetres (6 to 8 inches) apart, throwing the knees outward, and facilitating the investigation by permitting freer access to the pelvis. If the feet are widely separated—a fault common to the arrangement of most tables and gynecological chairs—the knees are thrown inward, and the patient's inclination becomes almost irresistible to draw the thighs together the moment the finger touches the vulva, rendering the examination difficult, or preventing it altogether.

EXAMINATION OF THE PELVIC ORGANS IN THE DORSAL POSITION.

For the sake of comparison, a knowledge of the normal pelvic organs is indispensable as a standard in judging of their condition in disease. Palpation, or examination by indirect touch, is the only accurate means of determining the condition of the uterus, tubes, and ovaries in the living subject. The normal uterus, broad ligaments, tubes, and ovaries can always be palpated by a skilled examiner.

The methods of examination are four:

First, a simple exploration with one hand by the vagina or rectum; second, the bimanual examination through the vagina or rectum and abdominal wall, with the organs in situ; third, the bimanual examination through the vagina or rectum and abdominal wall, with the uterus artificially displaced backward; fourth, the examination through the vagina, or rectum and abdominal wall, with the uterus drawn down to the vaginal outlet.

a. Simple examination with one hand in the vagina or rectum:

This is usually employed as a preliminary. Bartholin's glands are examined on both sides between the thumb and forefinger. The condition of the outlet is estimated by one or two fingers making backward pressure. The rugæ of the normal vagina are felt like rough ridges on the anterior vaginal wall, while they are smoothed out in the relaxed vagina.

The cervix is next felt as a knoblike prominence in the vault of the vagina, its axis pointing downward in a line with that of the vagina, or backward toward the sacrum, or forward toward the symphysis, depending upon the position of the uterus. If the os uteri points downward in the axis of the vagina in the nulliparous woman it indicates either a marked anteflexion due to an undeveloped uterus or a retroflexion, while in a child-bearing woman it means retroflexion. A lacerated cervix, infiltrated or studded with follicles, or the indurated ulceration of carcinoma, are readily distinguished from the normal, smooth, knob-like cervix. If the uterus is slightly anteposed, its body can not be felt by one hand alone; but if it is acutely anteposed, by giving the anterior vaginal vault in front of the cervix a quick blow the fundus will be detected as a resisting body.

In examining with one hand by the vagina, the ovary can not be felt unless it is abnormally displaced downward into the recto-uterine pouch, where it may

be discovered by pressure behind the cervix uteri a little to the right or left. It feels like a rounded, somewhat elastic body, slipping up and away under the pressure. Any attempt with one hand to feel the ovary not displaced fails, or gives at the utmost but an uncertain idea of its presence; because as soon as it is touched it yields to the pressure, and is displaced upward and out of reach. An examination of the deeper pelvic structures with one hand is therefore incomplete.

b. The bimanual method of examination is conducted either with the organs *in situ* or with the uterus in artificial displacement.

The bimanual examination with the organs *in situ* depends for its success upon the invagination of the abdominal wall just above the symphysis pubis,

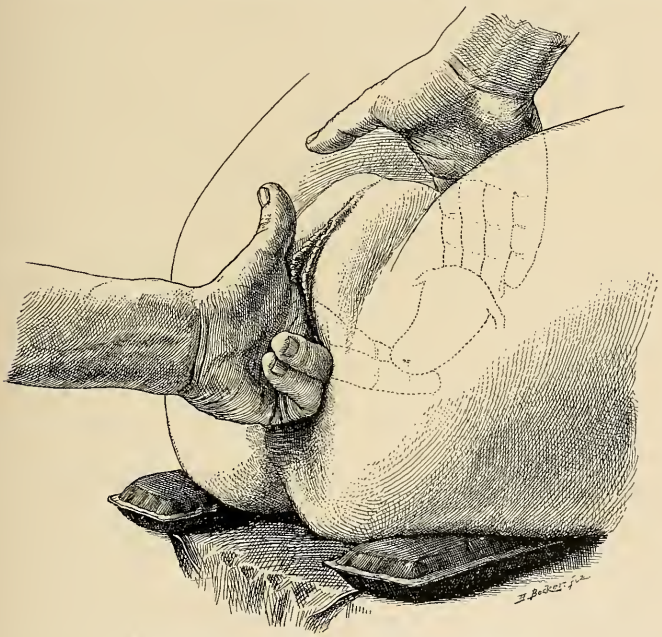

FIG. 65.—BIMANUAL EXAMINATION OF THE PELVIC VISCERA.

Same as before, but with the third and fourth fingers flexed upon the palm and the pelvic floor invaginated, adding an inch or more to the length of the fingers. Left view.

through the superior strait, with one hand, while with the other hand the examination is made through the inferior strait. The index finger, or both index and middle fingers, if the vagina is sufficiently lax, is introduced as far as the cervix. The palmar surface of the last joint of the finger must always be used in palpating; it is a beginner's error to use the radial side of the finger.

There are two ways of holding the rest of the hand which is outside during the examination, either with the fingers strongly flexed in the palm, Fig. 65, or with the thumb and fingers widely separated, the thumb resting upon the symphysis and the unemployed fingers on the perineum, Fig. 66. The first posi-

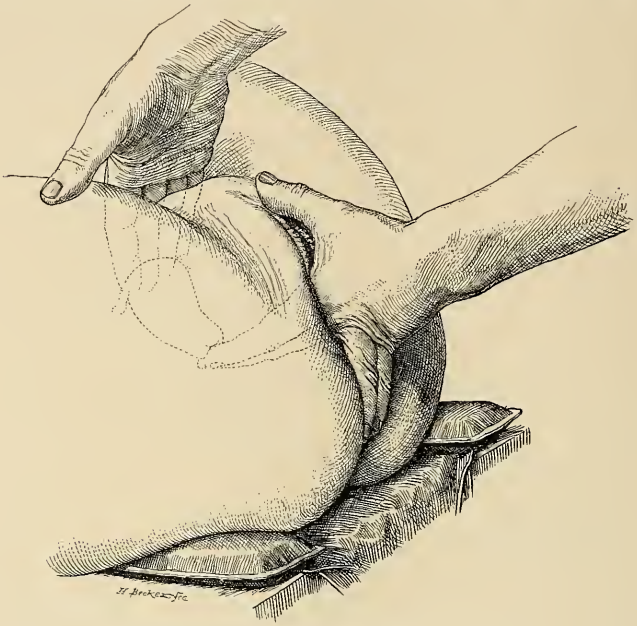

FIG. 66.—BIMANUAL EXAMINATION OF THE PELVIC VISCERA.

The upper, abdominal hand, pushes the abdominal walls in behind the uterus, while the lower, vaginal hand, catches the cervix. Note the position of the third and fourth fingers extended in the gluteal cleft. Right view.

tion is best when the examination can be conducted without bending the flexed fingers beyond a right angle with the examining finger; otherwise, the second method is preferable.

Simultaneously with the introduction of the finger into the vagina slight pressure is made over the middle of the superior strait, with the tips of the fingers of the other hand resting upon the abdomen above the symphysis.

In most cases only slight pressure is required throughout to make a complete examination of the pelvic organs; in other cases it is necessary to overcome resistance by making a gradually increased pressure downward until the structures are felt. As a rule, the outlines of the pelvic organs are not minutely examined by the abdominal hand, which serves more as a plane of resistance to prevent the upward displacement and gliding away of uterus and ovaries when touched

by the finger within the vagina. When the abdominal walls are thin and lax the outer hand may also be employed in studying the outlines of the organs.

Fig. 67. Invagination of the Pelvic Floor.—In spite of the assistance given by the external hand, the bimanual examination would often prove unsatisfactory if the vaginal hand were limited by the length of the index and middle fingers. Invagination of the pelvic floor is therefore a necessary

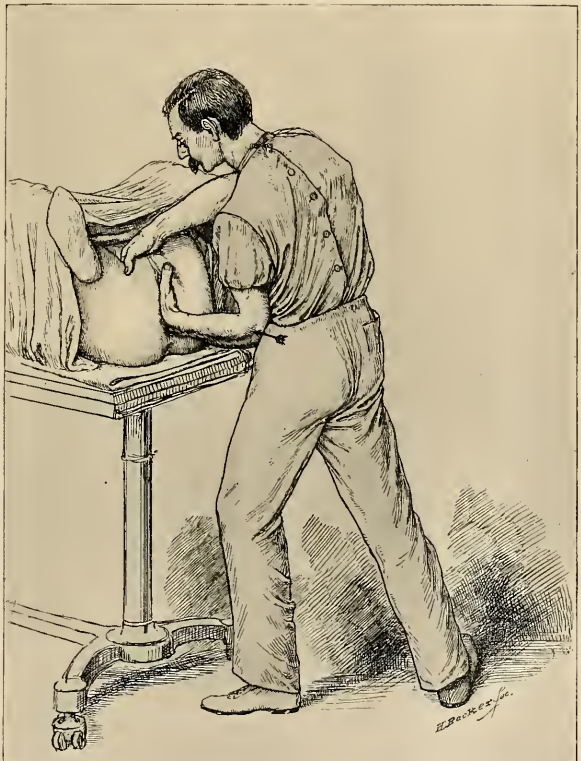

Fig. 67.—Bimanual Examination, showing the Deep Invagination of the Pelvic Floor, Adding Several Centimeters to the Length of the Fingers.

The left forearm and hand are placed at rest by making the pressure from the hip in the direction of the arrow.

aid, as by this means the examining finger is practically lengthened from 4 to 6 centimetres (1½ to 2½ inches). This is accomplished by pressing the perineum up into the pelvis in the axis of the inferior strait. The pubic arch and the

tuberosities of the ischium are obstacles to invagination, but a skilful examiner may overcome them by cramping the fingers a little more closely together or by making pressure farther back. Another difficulty in the way of securing the fullest advantages from this method of examining is an involuntary stiffening of the wrist and finger muscles. This may be overcome by pushing from the elbow, while the hand remains perfectly flexible, in order not to interfere with the delicacy of its tactile sense. Where the resistance is unusually great or the act proves tiresome, the examiner will help himself materially by supporting the elbow on his pelvis and pushing from his hip, relieving the arm entirely.

The examination of the uterus is begun by the vaginal hand giving the cervix a slight blow, which sends it upward at the moment the abdominal hand bears down upon the same spot. Several such movements rapidly repeated in front of and behind the cervix at once decide whether the body of the womb lies in anteposition or retroposition. When the fundus lies in advance of the cervix, by sliding the vaginal finger forward and bringing the abdominal hand a little closer to the symphysis and pressing downward, a plane of resistance is furnished upon which the vaginal finger rolls and palpates the whole organ, while the hand above also appreciates every movement given, and so by their combined action a judgment is almost instinctively formed.

Examination of the Ovaries.—By carrying the vaginal finger far up into the lateral fornix posterior to the cervix, and then pushing out toward the lateral wall of the pelvis, while deep pressure is made with the abdominal hand in the same direction through the corresponding semilunar line, the ovary can usually be caught and palpated. It is not sufficient simply to touch the ovary, but it must be caught repeatedly and allowed to slip between the fingers in various directions until it has been thoroughly examined on both surfaces and its free border. The ovary feels like a firm body about as big as the end of the thumb, with a rounded border and convex surfaces, slightly irregular. It is freely movable in all directions.

Examination of the Fallopian Tubes.—These structures in their normal condition are not often easily felt with certainty through the vagina. If they are thickened by disease, the uterine end may be rolled between the fingers like a stout cord and traced outward toward the pelvic walls.

Bimanual Examination by the Rectum and Abdominal Walls.—A retroflexed fundus is felt and outlined with marvellous distinctness when held down upon the rectal finger by the abdominal hand pressing in through the superior strait. The crucial point in this examination is the recognition of the angle between the cervix and fundus, associated with the absence of the fundus in front. The ovaries are felt by making combined pressure in the same direction as in the examination through the vagina. If the ovary is not at once found, the surest guide is the utero-ovarian ligament, recognised as a prominent fold on the posterior surface of the broad ligament just below the cornu uteri; by following this out with the finger for 2 to 2½ centimetres (¾ to 1 inch) the inner border of the ovary is felt.

Bimanual Examination by the Rectum and Abdomen after Atmospheric Distention of the Rectum.—When the ordinary recto-abdominal bimanual examination is impeded by coils of small intestines filling the posterior pelvis and interfering with the fingers in their efforts to search out and palpate the ovaries and tubes, this difficulty may be removed by the following expedient: The rectum and bladder are first evacuated and the patient is put in the knee-chest posture and a speculum introduced into the rectum. This lets in a large amount of air, and the bowel balloons out and applies itself broadly over the sacral hollow and the posterior surfaces of the uterus and left broad ligament, and at the same time the small intestines fall away into the upper abdomen after a minute or two. The patient must then be turned on to her back, taking care to keep the pelvis constantly higher than the rest of the abdomen, so as not to let the intestines gravitate again into the pelvic cavity.

On making the bimanual examination the pelvic viscera are felt with startling distinctness, the rectal finger enters a large air cavity no longer impeded by

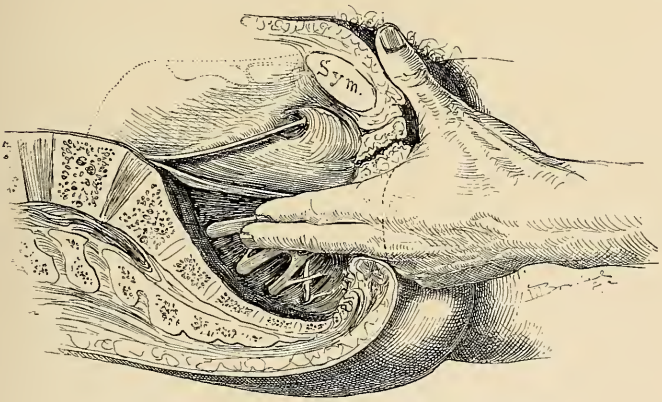

Fig. 68.—Palpating the Roots of the Sciatic Nerve by the Rectum.

the mucous folds, the opening from the ampulla into the upper bowel is readily found, and the posterior surface of the uterus and the ovaries and tubes feels as if skeletonized in the pelvis. They lie so clearly exposed to touch that their minuter surface peculiarities, fissures and elevations, and variations in consistence can be detected.

The roots of the sciatic nerve may also be palpated by the rectum, as shown in Fig. 68; such an examination will sometimes reveal the source of an obscure intra-pelvic pain which has previously been attributed to an ovarian or a uterine origin. The patient must be conscious, and as the fingers are drawn over the tender cord a cry of pain will be elicited.

c. Bimanual examination in the dorsal position with elevated pelvis; the same with the uterus in artificial retroposition:

If the pelvis of a patient in the dorsal position and with strongly flexed knees and thighs is elevated high above the level of the body on the table the intestines will gravitate upward and the lower abdominal walls fall in toward the pelvic viscera, which are now conveniently disposed for a searching deep bimanual examination through vagina or rectum and abdominal walls. The examiner now stands on one side of the patient and proceeds with the investigation with unusual ease, the curves of the flexed hands naturally following the hollow of the sacrum and the curved pelvic canal.

Not infrequently the posterior surfaces of the uterus, ovaries, tubes, and broad ligaments can not be distinctly palpated by any of these methods, either because the fundus lies too far forward, with the cervix too far back, or because the patient is so stout that the finger can not reach far enough. A satisfactory examination of the surface of the uterus and its adnexa can often be made under these circumstances by forcing the organ back into retroposition and pushing it down on the floor of the pelvis, where it is easily palpated, together with its adnexa, by the vaginal or rectal finger. In order to produce this artificial retrodisplacement it is generally necessary to have the patient under the influence of an anesthetic, so that she will be completely relaxed. The examination proceeds as follows: The abdominal hand is first pressed down behind the symphysis pubis to catch the fundus, while the other hand lifts it through the anterior vaginal wall. The fundus brought within the grasp of the external hand by this means is caught and pushed backward in the direction of the sacral hollow. The backward displacement is finally completed by continuing the pressure on the anterior face of the uterus with the abdominal hand, while the vaginal finger hooked behind the cervix rotates it forward and upward. Each of these three movements forms a step in the backward rotation of the uterus upon its transverse axis through the junction of the cervix with the body.

While the abdominal hand keeps up the pressure and so holds the uterus in its abnormal position, the vaginal finger is withdrawn and inserted in the rectum, up beyond the ampulla, through the sphincter-like orifice between the utero-sacral ligaments, where the whole posterior surface of the uterus and the broad ligaments, including ovaries and tubes, can be minutely palpated. The utero-ovarian ligaments stand out as sharply defined folds on either side of the uterus just below its cornua, and form the best guides in locating the ovaries when they are difficult to find.

d. The bimanual examination with the uterus drawn down to the vaginal outlet:

The advantages of this mode of examination is that the uterus is acted upon in three different directions at once. It depends for its success upon the great natural mobility of the organ, which allows it not only to be forced back into retroposition, but tolerates a marked artificial *descensus*. The normal uterus may be displaced without injury downward in the vagina until the cervix ap-

pears at the hymen. In this way we secure the completest possible investigation of the condition of the peritoneal surfaces of the uterus and its adnexa, short of an exploratory celiotomy, and indeed in many cases it is quite as accurate.

Fig. 69. This method of examination is carried out as follows: First introduce the index finger up to the cervix, to act as a guide for the tenaculum

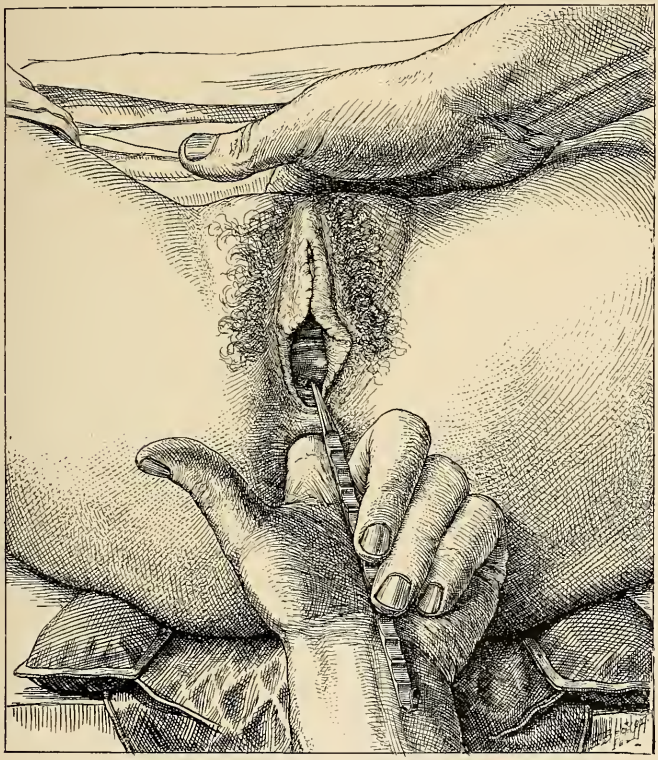

Fig. 69.—Bimanual Examination with the Uterus in Artificial Descensus.

The cervix is caught with the corrugated tenaculum and drawn down to the outlet; then the tenaculum is held against the ball of the thumb while the index finger is inserted into the rectum and used, in conjunction with the abdominal hand, to examine the pelvic organs.

forceps, or Kelly's corrugated tenaculum, which is firmly hooked in the anterior lip just within the canal. Then make traction, displacing the whole uterus downward in the axis of the vagina, until the cervix is at or near the vaginal outlet. An assistant now takes the tenaculum and retains the uterus there, and

the examiner employs the abdominal hand in pushing down on the fundus to steady it, while with the index finger of the other hand he palpates, through the rectum, the whole organ and its displaced adnexa with the greatest ease. If the corrugated tenaculum is used, the necessity of an assistant is dispensed with, for the corrugations afford a sufficient hold to be grasped between the ball of the thumb and the middle and ring fingers, or, exceptionally, between the palmar surface of the ring finger and the dorsal surface of the second joint of the little finger.

This method is of especial service in revealing small myomata on the uterus, from the size of a pea up, or cysts in either ovary, or light adhesions, or smaller degrees of hydrosalpinx. In some pelvic inflammatory conditions such traction is dangerous; it should therefore always be preceded by a preliminary bimanual examination, without displacement, when, if doubt remains, the traction may be begun and continued only under constant observation by the rectum, and any resistance on the part of the tissues should be respected by instant cessation.

One more manipulative procedure still remains for consideration.

The examination of the anterior surface of the uterus through the rectum:

This is done by displacing the uterus as just described, and adding to it a marked retroflexion, secured by hooking the index finger in the rectum over the fundus and gently pulling it down toward the anus. In this way a retroflexion is produced and the anterior wall can be as distinctly palpated as the posterior.

After a displacement examination of any kind it is not sufficient to release the cervix from the tenaculum or forceps in order to restore the parts, but the uterus should be carefully put back into its original situation. To do this, the hand which has been engaged in examining through the rectum is withdrawn and washed, and then introduced into the vagina, when, by pushing on the anterior lip of the cervix, the uterus is restored to its position in the pelvis, and at the same time, if necessary, the fundus is caught by the abdominal hand and drawn into anteflexion. The patient should remain in bed from twenty-four to forty-eight hours, or longer, if she continues to experience any discomfort from the examination. But the facility with which the whole manipulation is effected is usually so great that no after-effects are observed by the time the recovery from the anesthesia is complete.

EXAMINATION IN PELVIC DISEASE.

The beginner must train himself from the very outset to go through a certain routine in the examination of every case, for it is only in this way that a comprehensive view can be secured; by this routine he will also often discover important minor points which have a direct bearing on major lesions under investigation.

It is the serious fault of some examiners that as soon as they find a lesion

anywhere in the genital tract which may account for some of the symptoms they at once concentrate their entire attention and treatment upon that point, forgetting the fact that the patient may have other lesions as well. This is best illustrated by the numerous cases of lacerated cervix and "ulcers of the mouth of the womb" persistently treated where the serious disease lies in the inflamed Fallopian tubes.

To avoid this superficial treatment the examination begins by noting all the peculiarities of the external genitalia. The orifices of Bartholin's glands must be looked at for the *taches* significant of infection, and the glands themselves should be felt to see if they are enlarged or pus can be squeezed out of the duct. The state of the hymen must be noted—whether intact, dilated, or torn. The urethral orifice, by a puffy reddened condition, often gives evidence of a gonorrheal infection, and a little pus can be milked down the urethra by the finger stroking the anterior vaginal wall. By firmer pressure of the outer part of the urethra against the pubic arch, Skene's ducts are emptied of any accumulated pus. Scars at the vaginal outlet and the relaxed condition following childbirth or the use of large instruments are also to be noted, as well as the functional activity of the anterior fibres of the levator ani muscle.

The vagina is noted as short or long, and rugose or smoothed out, and especial note is taken of any cysts in it. The rectum can be palpated through the posterior vaginal wall, feeling like a stringy collapsed tube easily moved from side to side; if it contains any fecal masses this is evident to touch. Anteriorly the base of the bladder, and antero-laterally the ureters, can be felt through the vagina, and if they are inflamed, touch will always elicit complaint. The cervix is the most prominent feature in the vault of the vagina; its direction is important, whether lying in or across the vaginal axis, and its form, whether conical with a small os, or split and everted and containing distended follicles. At the vault of the vagina, in front of, behind, or at the sides of the cervix, hard masses may be felt which will require a careful bimanual examination to determine their identity. The condition of the rectum should be carefully inquired into in every gynecological case, and any symptoms pointing in that direction should be investigated with care. The gynecologist will in this way take particular note of hemorrhoids, fissures, fistula, proctitis, and especially of strictures.

The examination of the urethra, bladder, ureters, and kidneys are described in Chapters XII and XIII.

The bimanual examination by one of the methods described follows next; the position of the uterus is observed, together with its size, surfaces, mobility, and sensitiveness. Finally, the tubes, ovaries, and broad ligaments are palpated.

When such a routine is regularly followed, instead of merely noting one lesion, the observer will often find several, either independent or in conjunction, in the same patient; for example, a deep laceration or a complete tear through the septum at the vaginal outlet is often found associated with extensive scar tissue in the vagina, a lacerated cervix, and a retroflexed uterus; or, on the other hand, the external tear, which is the sign of a difficult forceps labor, is

associated with a pelvic tubal abscess, the sequela of a puerperal infection. One of the most striking complications I have seen was that of a patient with a gonorrheal urethritis. Pressure on Bartholin's glands squeezed out a little pus and showed she had also Bartholinitis. Pus taken from the vagina contained numerous gonococci; an endocervicitis and an endometritis were also gonorrheal. When the abdomen was opened, pus oozing from the tubes was found to contain the same organisms, and, lastly, they were found abundantly in pus taken from the peritoneal cavity.

Pelvimetry.—Pelvimetry is of the utmost service to scientific gynecology, and should be constantly practiced in all clinics, as the gynecological lesions found are often explainable by the discovery of a deformed pelvis. The various external measurements should be made as described in the obstetrical text-books —viz., the distance between the anterior-superior iliac spines, between the iliac crests, Baudelocque's diameter, and the intertrochanteric diameter.

There are four ways of measuring the true conjugate diameter of the superior strait, which is the most important single measurement: In the first place, it may be estimated, as usual, from the diagonal conjugate through the vagina; this, however, is often impracticable in gynecology, first, either because the vaginal canal is too short and rigid, or because of scar tissue at the vaginal vault, or of masses in the pelvis above the vault which prevent the necessary displacement of the vagina up to the sacral promontory. In the second place, a diagonal conjugate may sometimes be obtained under these circumstances by pressing the finger up through the rectum until it touches the promontory, and so measuring the distance to the under surface of the pubic arch. In the third place, I have found the following procedure, which I call "the external direct method of measuring the true conjugate," to be most generally useful:

The patient lies on the back, with slightly flexed thighs and knees, and the head and chest elevated, so as to relax the abdominal muscles perfectly. The examiner then stands on her right or left side, according as he intends to use his right or his left hand with the palmar surface down. Then with gently increasing pressure he makes deep palpation above the symphysis pubis backward toward the vertebral column, feeling for the promontory of the sacrum with the tips of the fingers, sweeping from the abdominal cavity down into the pelvis, deeper and deeper each time until the characteristic median projection of the promontory is recognized. As soon as the promontory is felt he sweeps the fingers of the open flat hand several times down over it into the pelvis, gaining a distinct impression as to its exact position; then the fingers are allowed to rest vertically above the promontory; in this way the posterior point of the conjugate diameter is fixed. The free hand now determines the anterior point, by pressing the middle finger down behind the symphysis pubis, until the most prominent point on its posterior border is distinctly felt. Directly over this an indentation is made with the finger nail on the outstretched hand, Fig. 70. The hand is then raised from the abdomen, keeping the fingers rigidly in the same position, and the distance from the tip of the finger to the mark made on the palm will be the true conjugate diameter, Fig. 71.

The chief sources of error arise either from measuring directly over the summit of the symphysis or from pressing the finger tips against the promontory instead of over it, thus interposing the thickness of the abdominal wall.

Judgment necessary to tell when the fingers are vertically above the promontory through abdominal walls of varying thickness is the chief factor in

Fig. 70.—First Step in the External Direct Method of Measuring the Conjugata Vera.

The tip of the middle finger of the left hand rests just above the promontory of the sacrum, while the middle finger of the right hand indents the palm at a point just above the inner face of the symphysis. The distance marked off in this way is the true conjugate.

making the measurement. Experience will gradually eliminate grosser errors and bring a sufficient degree of certainty for practical purposes. The more contracted the pelvis the less is the liability to error.

In illustration I will cite the following case (see George W. Dobbin, *Amer. Jour. Obst.*, vol. xxxii, No. 2, 1895): Mrs. H., admitted to the Johns Hopkins Hospital, January 3, 1895, had had two severe instrumental labors within two years, both children dying during labor. Since the second labor she had had no control of loose bowels and there was a constant dribbling of urine.

The examination revealed an extensive dermatitis with edema of the external genitals. The recto-vaginal septum was torn through and the sphincter pits separated 3 centimeters (1¼ inch), although in spite of this the vaginal outlet was well lifted up. The vagina was smooth throughout; at the vault there was a sharp falciform scar at the junction of the right lateral and anterior vaginal walls. The cervix was stellately lacerated and divided into one posterior and two anterior portions. A sulcus of scar tissue between the two anterior por-

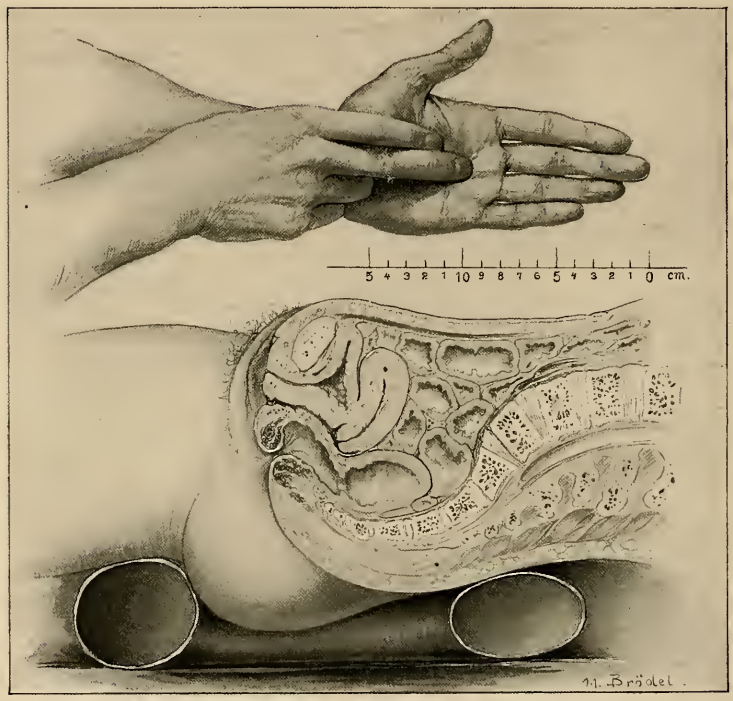

FIG. 71.—SECOND STEP IN THE MEASUREMENT OF THE CONJUGATA VERA.
Taking the measure marked as described in Fig. 70.

tions ended at a vesico-vaginal fistula 3 millimeters in diameter. The uterus lay in retroposition reclining in the sacral hollow. The tubes and ovaries were normal. On account of the dense unyielding scar tissue in the vaginal vault, it was impossible to measure the oblique conjugate either by the vagina or by the rectum. By the external direct method the true conjugate was found to be only 7 centimeters

(3 inches). The patient had a flat pelvis of high grade, the obstetrical difficulties were fully explained, and the gynecological condition etiologically accounted for.

In the fourth place, the most accurate method of all is the direct measurement of the conjugate from sacral promontory to posterior surface of the symphysis pubis, through the abdominal incision in the course of a celiotomy; this is easily obtained by guiding the tip of a graduated sound to the promontory by the index finger, and then feeling for the posterior surface of the symphysis with the other index finger, and estimating the corresponding point on the sound, which is now taken out and the marking read off.

This is particularly useful in pelvic inflammatory cases where the disease has come from a difficult labor and the abdomen has to be opened to remove it.

EXAMINATION UNDER ANESTHESIA.

I feel that I can not emphasize too much the extreme importance of a routine use of ether or chloroform anesthesia to the point of complete relaxation in investigating intrapelvic diseases. Weeks, months, or even years of useless palliative measures will be saved in many cases if the patient is anesthetized and examined before beginning treatment. The purpose of the anesthesia is to do away with all resistance on the part of the patient, relaxing the abdominal muscles completely and preventing the possibility of unexpected resistance when tender points are touched. The examination with the anesthetic can be conducted with a thoroughness which is impossible without it, the uterus can be drawn down, adhesions pulled upon, the perineum deeply invaginated, and inflamed tubes and ovaries handled in a way which is impossible as long as the patient remains conscious.

I may add also that it is a definite advantage to the operator to be able to devote his concentrated attention to the examination and not to be distracted by his anxiety as to how much pain he is giving his patient.

Rules for the Use of Anesthesia.—I recommend, therefore, the following rules: Use an anesthetic in all cases

(a) Where doubt exists after an ordinary bimanual examination.

(b) Where a patient comes to the specialist after having had treatment for a long time at other hands without improvement.

(c) In all cases of pelvic peritonitis involving one or both ovaries or tubes, without producing any gross tumor, when the use of the anesthetic is to find out the extent of the disease.

(d) Always in unmarried women.

Preparation of the Patient for Anesthesia.—The lower bowel must be emptied by taking a purgative the night before, and if this does not act freely enough, an enema in the morning. The bladder should be emptied by catheter at the last moment. It is best to examine early in the morning and about an hour after a light breakfast, such as a cup of tea and a piece of toast. The early hour has the advantage of relieving the patient from a day of anxious expectation.

After completely anesthetizing her, if it is done in her room, she should be brought across the bed, with her hips projecting a little over the edge and legs and thighs held well flexed by assistants or a leg holder. It must be the aim in the examination to keep her unconscious as short a time as is consistent with a thorough investigation, in order to diminish the after-discomforts with the liability to distressing nausea. Patients who have come into the house from the outdoor department simply for the ether examination usually go home late in the afternoon of the same day, but it is better, as a rule, to keep them quietly in bed for a full day afterward.

Exposure of any part of the body during the examination must be guarded against as much as possible, no matter what the patient's station in life may be, partly on the ground of a proper respect for the sex in general, partly because of the sacred obligation to treat the patient in her helpless condition with that deference which is her due in return for her confidence in putting herself in this way into her physician's hands, and partly because of the inevitable demoralizing effect on nurses, the doctor, and assistants that comes from a careless indifference to the dictates of a proper modesty. While the patient is being examined no persons not directly interested, professionally or otherwise, should be present.

Classes of students must be admitted to the examining room in limited numbers only; in no case should more than three or four students examine the same patient, and the physician who is responsible for her must exercise a constant watchful care to keep any student from examining too long and from using unnecessary force.

The hands must be specially prepared for the examination by a thorough scrubbing with soap and warm water, and by cutting the nails short, so that they will not bruise the skin in making the bimanual examination. After each examination the hands must be washed afresh to prevent carrying contamination from one case to another. An examination should never be made with a sore hand. Vaseline is a good lubricant for the vaginal and rectal fingers. When the hymen is intact the examination should be made, as stated in the rules, under an anesthetic; in this condition it is sometimes possible to introduce a small finger into the vagina without making any rupture, but it is better to omit the digital examination by the vagina entirely, and to conduct it wholly through the rectum and abdominal walls. If it is necessary to catch the cervix and draw the uterus down to get at the tubes and ovaries, this may be done by introducing into the vagina the bullet forceps closed, and then, guided by the rectal finger, which feels the cervix distinctly, to open the forceps and grasp the cervix.

A perfectly satisfactory inspection of the vagina, and without injury to the hymen, may be made by using a small cylindrical speculum in the knee-breast position.

The Examination.—The various methods of handling the normal pelvic organs and the different avenues of access to them are also used in investigating the diseases of these organs; and the knowledge acquired in gaining a thorough familiarity with the condition and relations of the healthy organs is indispensable

in estimating the presence and extent of disease, for the normal condition is the only standard of comparison. Owing to a want of familiarity with the normal structures, operators have frequently made the frightful mistake of removing sound organs.

Almost all morbid changes advanced enough to call for operative interfer-

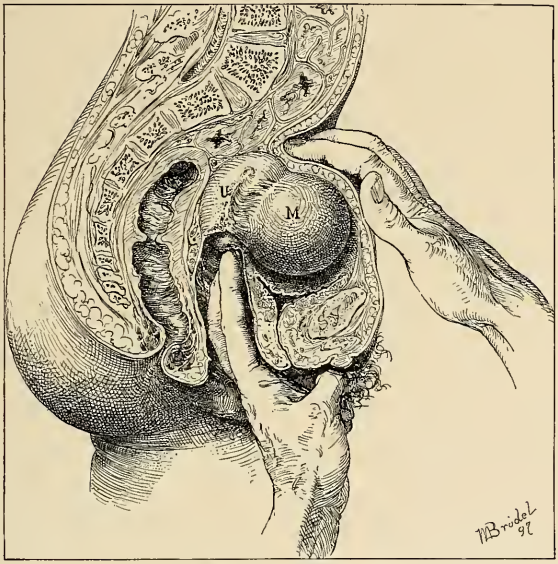

FIG. 72.—DIFFERENTIATION BETWEEN A MYOMA IN THE ANTERIOR UTERINE WALL AND AN ENLARGED UTERUS IN ANTEFLEXION.

By a bimanual examination, while the vaginal fingers, resting upon the cervix, hold the mass up, the abdominal fingers are able to discover the little sulcus between the fundus and the tumor, and to appreciate the slight but distinct mobility of the myoma as separate from the fundus. H. op. Oct. 24, '96.

ence produce alterations of the normal structures which can be recognized by an investigation which considers the following points:

(a) Displacements affecting position.

(b) Fixation and adhesions affecting mobility.

(c) Inflammation and tumors affecting size and form.

(d) Any abnormal sensitiveness.

(e) Peculiarities of consistence.

(f) Information derived from curettage of the uterus.

(g) The microscopic examination of a piece of tissue excised.

(h) The microscopic and bacteriological examination of uterine, vaginal, and other discharges.

The skilled examiner never makes his diagnosis by taking these questions up and applying them one after another, seriatim, to a case in hand; he proceeds, on the contrary, to make the investigation with a trained touch which at once recognizes any abnormalities, and instinctively selects the essential points for

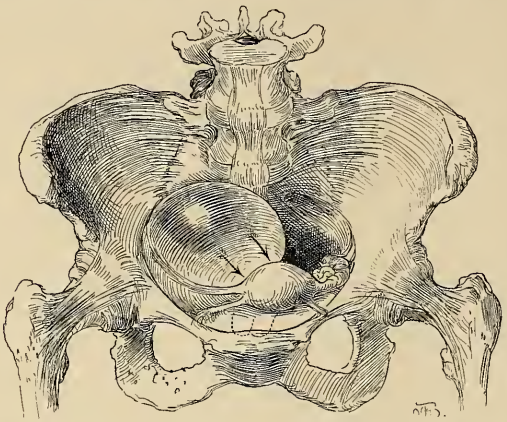

Fig. 73.—Showing the Left Lateral Displacement of the Uterus, which is Pushed to the Opposite Side, in the Direction of the Arrows, by an Ovarian Cyst on the Right.

more special attention. Such a plan is not without the risk of occasionally overlooking some point of importance, particularly if the examination is a hurried one.

The beginner will always find it better to take the questions up and apply them categorically, at least until the routine becomes so fixed in his mind that its application is afterward more or less instinctive. This, too, is the only satisfactory plan for a text-book.

(a) **Displacements affecting the Position of the Pelvic Organs.**—Descensus.—The index finger carried up the vagina notes whether the cervix is well back in the pelvis or lies low down on the pelvic floor in the axis of the vagina, indicating a descent of the uterus.

Anteflexion.—A little sudden pressure against the anterior vaginal wall will often encounter a resisting body, which at once recedes by using the other hand to make counter-pressure through the lower abdominal wall; if the recession is prevented and the body, palpated carefully, is found to be movable, ovoid in form, and by carrying the bimanual palpation a little farther back, organically connected with the vaginal cervix, the uterus is in normal anteflexion. When the cervix lies in the axis of the vagina, and the body of the womb lies against the anterior vaginal wall parallel to it, the angle between the two is very acute and a pathological anteflexion exists. Fig. 72.

Retropositions.—The two forms of retroposition are retroversion and retroflexion, and a diagnosis is made by demonstrating bimanually (1) the ab-

sence of the fundus from its normal position in the front part of the pelvis, and (2) its presence somewhere in the back part of the pelvis, behind the cervix, by feeling it there with the vaginal finger as a round, resisting mass, and tracing its direct connection with the cervix. If the bridge of tissue joining the vaginal cervix to the body supposed to be the fundus can not be satisfactorily palpated, it will be felt more clearly if the cervix is caught with a tenaculum forceps and pulled down. The bimanual palpation sometimes shows that the fundus lies to the right or left in lateral flexion; this is due to adhesions drawing it in the direction of the flexion, or to a tumor filling the opposite side and pushing it over; or again to a large ovarian tumor of the side to which the uterus inclines, which pulls on the broad ligament as the tumor escapes into the abdomen. Figs. 73 and 74.

Ascensus Uteri.—In ascension the cervix is lifted up above its normal position in the pelvis, and in an extreme form the whole womb may be displaced out of the pelvis into the abdomen. This may happen in the case of a broad-ligament tumor, or of an ovarian tumor adherent to its posterior surface and drawing it into the abdomen.

(b) **Fixation and Adhesions affecting Mobility.**—If the uterus is found fixed in a certain position, and does not move easily upward in making slight pres-

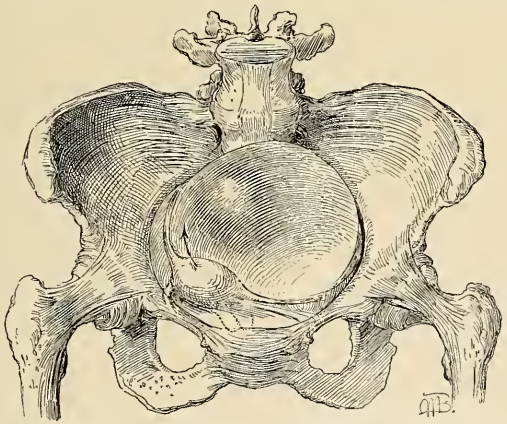

Fig. 74.—Showing the Displacement of the Uterus toward the Side from which the Tumor Grows, Due to the Enlargement of the Cyst which now Fills the Pelvis and, by Traction on its Pedicle, Draws the Uterus in the Opposite Direction.

sure on the cervix, its condition is abnormal, and the cause must be sought for. I know of but one apparent exception to this rule, and that is where the uterus responds but slightly to pressure on account of a stout tense abdomen and increased intra-abdominal pressure. When the cervix is occupied by a cancer which has extended out into one or both broad ligaments the whole organ feels

as if held in a vise by the hard masses extending out to the pelvic walls. Adhesions of the posterior uterine surface to the pelvic floor restrict its mobility, forming an adherent retroflexed uterus. This is tested by pulling down the cervix and trying to raise the fundus, when the adhesions are put on the stretch and felt. I would caution the beginner here not to conclude that a retroflexed fundus is adherent because he can not push it up through the vagina. The normal mobility is also greatly restricted in almost all cases of inflammation of the tubes and the pelvic peritoneum, which result in masses behind the broad ligaments. Ovarian and tubal adhesions are best felt bimanually with one or two fingers in the rectum. The adhesions, whether light and velamentous, like a web, or short and firm, binding the ovary to the posterior surface of the broad ligament, are easily felt upon attempting to handle the ovary in order to examine both its surfaces, as described in the examination of the normal ovary. An adherent tube is almost always involved with the ovary in pelvic inflammatory disease, and is also usually enlarged.

(c) **Inflammation and Tumors affecting Size and Form.**—Only the trained fingers familiar with the normal organs will recognize at once all deviations in size. Both the enlarged infiltrated and the cancerous cervix are characteristically different from the normal, and lacerated everted cervical lips can be recognized at once.

The trained clinician, knowing how large the normal nulliparous uterus ought to be, and what is the size of the average parous uterus, will have little difficulty in deciding whether the uterus of a young woman is undersized—that is, puerile or infantile; or in the case of a woman of advanced years, whether it is senile. The large body of a subinvoluted uterus differs as much from the normal to the touch as a hydrocephalic head does from a sound fetal head.

The myomatous uterus, from the small nodules just projecting from the serous surface, often not as big as a pea, all the way to the vast masses filling the abdomen, presents unmistakable characteristics in the enlargements and irregular bizarre shapes assumed. Often the only suggestion of a cancer of the body of the uterus found at a first examination is the increased size and the globular form of the uterine body. In pregnancy we trace a uniform development in the size of the uterine body from the fourth week on to the end. The most sensitive touch will be the quickest to appreciate this change at its earliest stage, from the fourth to the sixth week.

The Fallopian tubes are changed in size and form by all inflammatory diseases, more particularly in those in which the outer extremities are occluded and the secretions retained, called sactosalpinx. With the thickening of its coats and the distention of its lumen the tube becomes harder and larger, and so is the more easily palpated. The inflamed tube assumes a sausage shape with two or three convolutions.

Alterations in the size and form of the ovaries may affect a part or the whole of the organ. A little hard mass projecting from its surface is most likely a *corpus fibrosum;* a nodular swelling projecting from one part of the periphery and not more than 2 or 3 centimeters ($\frac{3}{4}$ to $1\frac{1}{4}$ inch) in diame-

ter is a cystic Graafian follicle, or the last menstrual *corpus nigrum*. A larger cystic tumor with a smooth surface, from 4 to 6 or even 10 centimeters (1½ to 2½ or 5 inches) in diameter, is a Graafian cyst, or a cystic *corpus luteum*. Small dermoid cysts may also present similar characteristics. An ovarian abscess is usually distinguished by the dense surrounding adhesions, but a suppurating dermoid will also present these signs. The larger ovarian tumors are usually associated with a complete disappearance of the ovary and its replacement by a smooth or irregular mass, according as there is one or a number of cysts.

(d). **Peculiarities of Sensitiveness.**—Normally the pelvic organs are not at all sensitive to the ordinary bimanual manipulation. The ovaries alone are painful if a decided pressure is made upon them. Frequently, however, patients come for examination in whom the only discoverable difficulty is an abdominal sensitiveness, and the most painstaking investigation fails to show any other trouble. This hyperesthesia is often confined to one ovary, generally the left, which the patient can not bear to have touched; in other cases both ovaries are sensitive, and there may be a perfectly normal uterus, so tender that not even the lightest pressure can be borne. In extreme cases the whole pelvic and even lower abdominal peritoneum shows the same sensitiveness. I know of no cause for this; it is often associated with other disturbances which are presumably circulatory. It is important that every practitioner should recognize this ailment, so as to avoid the common mistake of estimating the amount of disease present by the tenderness complained of as soon as pressure is made on the pelvic viscera. Ovaries and tubes have been removed repeatedly where the only demonstrable difficulty was a persistent sense of discomfort and sensitiveness to pressure, only to discover that the mutilation has not in the least relieved the difficulty.

Pelvic sensitiveness is also peculiarly the mark of the hysterical patient whose attention has become fixed on these organs. All inflammatory affections are characterized not only by pain during the exacerbations, but by a persistent sensitiveness of the inflamed structures, which makes it difficult to handle and outline them. Under such circumstances it is necessary to put the patient under anesthesia to make a thorough investigation.

(e) **Peculiarities of Consistence.**—In addition to peculiarities in position, in mobility, in form, and in size, the pelvic organs in disease also exhibit marked peculiarities in consistence. Each organ has its own individual standard, differing from every other organ in this respect. For example, the consistence of the cervix is one thing, that of the uterus and ovary another. The most striking example is the change in the vaginal portion of the cervix in pregnancy from a firm, hard, resistant tissue to a soft and even flabby condition. The cheesy friability of a cancerous cervix also differs from any other state. There is a putty-like condition of the subinvoluted uterus, which indents on pressure, and which ought to be a warning against the use of the sound. I have seen the sound go through the uterine wall in these cases with as much ease as if it were a piece of blotting paper. Again, the soft semifluctuation of the pregnant uterus from the third to the fifth months is different from the hard fibroid uterus. Occa-

sionally a vascular fibroid will simulate pregnancy. In diseases of the tubes and ovaries there is no more important distinction to be made than the changes in consistence. In infected cases a dense hardness, which replaces the soft pliability of the pelvic floor, is characteristic, and is only imitated by adherent cancerous ovaries. The consistence of the enlarged Graafian follicle is also characteristic in the paper-like thinness of its shell, which is easily recognized by the finger. I have twice recognized a rupture in an ovarian cyst made up of a mass of little cysts by putting the finger through the hole which happened to be on the pelvic floor and feeling the little cysts within. The consistence of an abdominal ascites, and of a parovarian cyst or a multilocular ovarian cyst, differs in each case, and is often the most characteristic diagnostic feature.

(f) **Information Derived from Curettage of the Uterus.**—By curettage of the uterus and a microscopical examination of the scrapings we determine the difference between glandular hyperplasia, endometritis, carcinoma, sarcoma, the remains of an abortion, and tuberculosis of the endometrium (for details, see Chapter XIV).

(g) **The Tissues.**—In the same way, by making a microscopic examination of a piece of tissue excised from the cervix, a differential diagnosis is established between inflammatory conditions and carcinoma (see Chapter XVI).

(h) **Secretions.**—The examination of the secretions, commonly called leucorrheal, from the uterus, cervix, vagina, and vulva, often gives important information, and either throws light upon the cause of an existing disease or shows the presence of elements in these secretions liable under favorable conditions to endanger health and life. The purpose of this examination is to discover the presence of one or other of the commoner pyogenic organisms—the streptococcus, the staphylococcus, the gonococcus, and perhaps the tubercle bacillus and the colon bacillus. The examination includes observations as to the presence of any secretion, its location, quantity, appearance, consistence, chemical reaction, bacteriological character, and any local reaction.

For accuracy of investigation, the following regions should be examined:

The ducts of Bartholin's glands.

The vulvar commissure.

The urethral orifice and Skene's glands.

The lower vagina.

The vaginal vault.

The cervical canal.

The uterine body.

The normal secretions which contain numerous micro-organisms but none of the pyogenic bacteria form the standard of comparison. No bacteria of any kind are found in the cavity of the uterus.

In young women and in those not infected the secretions within the vulva and at the vaginal outlet are those which have escaped from the vagina above. The natural appearance of the secretion is scanty, milky-white; it consists of desquamated vaginal epithelial cells, with mucus and a few leucocytes, and its

chemical reaction is acid. The normal cervical secretion is a clear tenacious mucus. The secretion from Bartholin's glands is small in quantity and thin and clear. There is no secretion about the urethra.

In disease there is an entire change in the character of these secretions, which become abundant, and change to a muco-purulent character. By squeezing Bartholin's ducts a drop or two of pus is made to exude at the orifice, and on separating the labia the discharge may be taken up from the commissure. To get secretion from the vaginal vault and the cervix without contamination, the patient may be put in the knee-breast position and a small cylindrical speculum inserted, which admits air and does not touch the upper part of the vagina. In the infected cases the cervix is often puffy, and its everted mucosa weeps an abundant stringy muco-purulent discharge from its surface. The most striking example of the utility of the examination of these secretions is that of the puerperal infections, where the exact nature of the infection may be determined. The probable nature of a pelvic abscess may be traced to a gonorrheal infection, if the gonococcus is found to be a resident in the lower genital tract. The commonest points in which a latent gonorrhea may lurk are the cervix uteri, the ducts of Bartholin's glands, and Skene's glands.

The technique of the examination for these bacteria and the methods of cultivating them are described in Chapter III.

EXAMINATION OF THE RECTUM.

The close relationship between the rectum and the other pelvic organs involves both in many common affections, liable to affect any portion of the bowel, from anal orifice to the brim of the pelvis. The commonest of these diseases may be arranged under three heads: (a) Fistulæ and rupture of the recto-vaginal septum; (b) the extension of a malignant growth from one organ to the other; (c) compression of the bowel either by increase in volume of uterus or ovaries, or by inflammatory products which constrict its lumen.

Examination of the rectum is also frequently called for on account of the liability of the patient to refer disorders of the bowel to the uterus and its adnexa. In this way a fissure of the rectum may be overlooked and a long and useless course of treatment undertaken to relieve a pain from a source felt higher up in the pelvis; the congestion of hemorrhoids often produces a sense of weight and bearing down in the pelvis, easily mistaken for the symptoms of prolapse of the uterus.

For all these reasons it is important to make some statement about the condition of the rectum in every gynecological record. Sometimes it is well to make the examination without special preparation for it on the part of the patient, when the physician may better judge of the habitual state of the bowel. For a thorough examination the lower bowel must be completely emptied. Anesthesia is not necessary as a rule. There are two methods of examining—(a) by palpation, and (b) by inspection.

Palpation.—The finger introduced into the vagina easily feels the lower part of the rectum from the cervix down through the posterior vaginal wall, and by pressing upon it and rolling it from side to side, its size, mobility, and sensitiveness may be estimated. The normal rectal tube feels like a flat band with longitudinal striæ, which, under pressure, slips freely from side to side and without pain. Any fecal accumulation presses forward into the vagina and gives the bowel a more cylindrical form. The presence of feces can be recognized by indenting the putty-like mass with the fingers.

The upper part of the rectum behind the cervix is often markedly sensitive, and becomes more so when it is distended. This must never be forgotten when a sensitive spot is found behind the cervix. I have seen an erroneous diagnosis made of tumor behind the uterus and "inflamed ovary" when there was really nothing the matter. A loaded upper rectum crowds out behind both broad ligaments, filling the pelvis with fecal masses readily confused with ovarian and

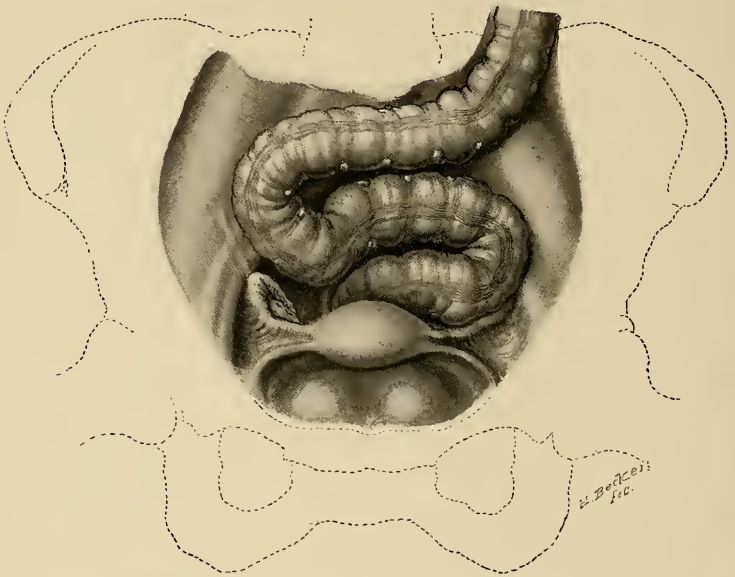

FIG. 75.—DEVIATION OF THE SIGMOID FLEXURE.

The bowel crosses the promontory of the sacrum on the right side, and then returns to the left pelvic brim and drops into the pelvis just behind the uterus.

tubal tumors. In a more moderate distention the mass may lie on the pelvic floor behind the left broad ligament. By palpation a distended upper rectum and sigmoid flexure can be easily mapped out through the abdominal wall, if it is not too thick and rigid. The differential diagnosis between these fecal tumors

and true pelvic tumors is so important that I present several diagrams, tracings from actual cases taken out of a large number which have come under my observation. (Figs. 75, 76, 77, and 78.)

In order to make the examination, the patient lies on her back in a position of relaxation, with her shoulders slightly raised and knees drawn up. The examiner then stands on her left side, and gradually makes deeper and deeper

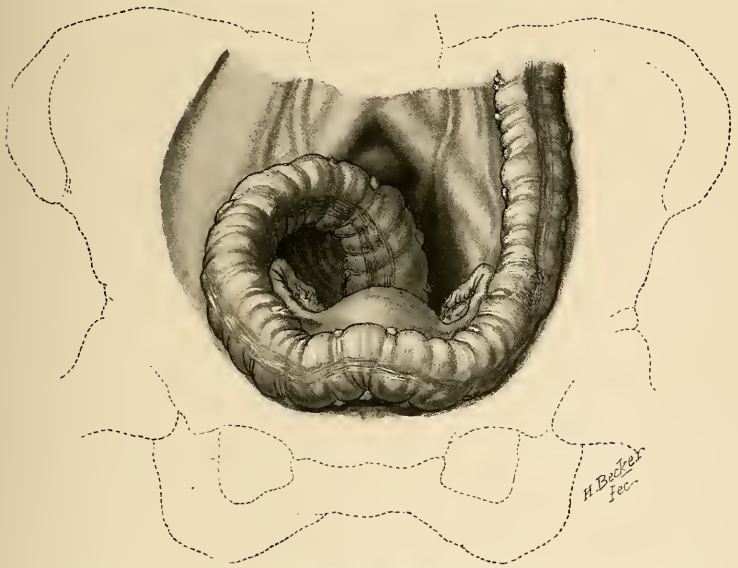

FIG. 76.—DEVIATION OF THE SIGMOID FLEXURE.

The bowel skirts the anterior pelvic brim from left to right, and drops down into the pelvis on the right side.

pressure through the lower abdominal wall in the left semilunar line, until he reaches the pelvic brim, without giving any discomfort to the patient to cause her to resist. By gently drawing the fingers forward along the superior strait, the empty sigmoid is felt slipping beneath them like a large, flat cord. If it is distended it becomes still more distinct. In marked distention the bowel follows in general one of three directions: In the first, the bowel describes a sigmoid curve behind both broad ligaments, Fig. 75; second, it curves out into the anterior part of the pelvis over the bladder and then back to the sacrum, Fig. 76; third, the distention is upward into the abdomen and then down into the pelvis from the right side, Fig. 77; and, fourth, the bowel passes in front of the bladder almost to the region of the right round ligament, where it is bent on itself; when it reaches the promontory of the sacrum it makes a plunge down into the pelvis. Fig. 78.

These fecal tumors are diagnosed bimanually by being continuous with a fecal mass behind the vagina or behind the uterus low down, about the nature of which there is no doubt. They occupy peculiar positions in the upper pelvis, and are elongate, and markedly movable on account of a long meso-sigmoid;

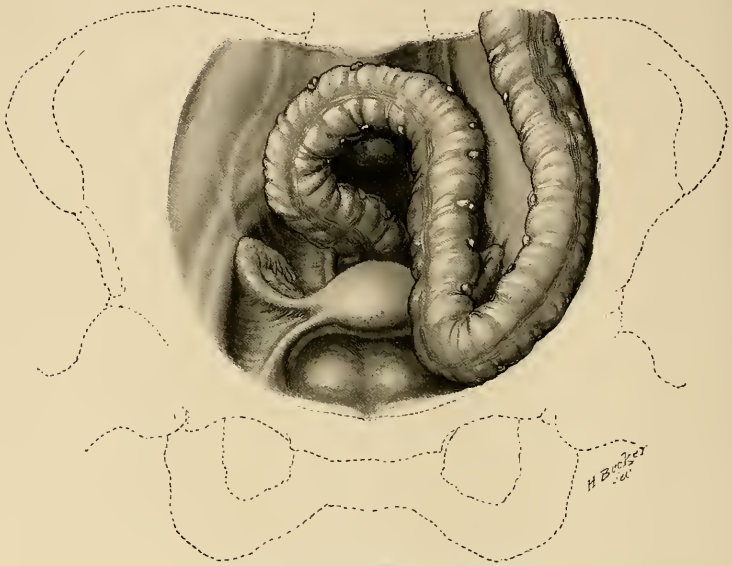

FIG. 77.—DEVIATION OF THE SIGMOID FLEXURE.

The bowel extends down to Poupart's ligament on the left side, and then skirts the left pelvic brim and drops into the pelvis on the right side.

they are often made up of a number of scybalous nodules. The customary sensitiveness must not mislead. Any doubt remaining after such an examination can be cleared up by a purgative or enema, and by an inspection with a sigmoidoscope.

A digital examination of the anus shows the existence of abnormalities, and when the finger is carried up into the ampulla and the rectum immediately above that it demonstrates the presence of any marked changes, more especially constriction by inflammatory masses; when the finger passes between the utero-sacral ligaments it seems to be entering a long, rigid tube with smooth walls. Amid the redundant folds of the ampulla it is sometimes hard to find the entrance into the bowel above. The proper point is best located by taking the cervix as a guide and seeking the opening right behind it.

Inspection.—Under inspection the whole mucous surface of the lower bowel is exposed to view, from its external orifice up to the sigmoid flexure and colon,

and any alterations in color or unevenness of surface and deposits, together with changes in caliber and points of fixation, are at once evident, Fig. 79. To make the best possible examination in this way, the bowel must be emptied of feces and the patient placed in the knee-chest posture; the thighs should be vertical, the back well curved in, and the chest as close as possible to the table; the patient should wear no corsets or any constricting garments on the upper abdomen. A cylindrical speculum of suitable length and caliber is now introduced and the bowel examined by a light reflected from a head mirror.

The following specula are useful: A short and a long proctoscope, a sigmoidoscope, and a sphincteroscope.

The cylinder of the short proctoscope is 14 centimeters (5½ inches) long and 22 millimeters in diameter; the long proctoscope is 20 centimeters (8 inches) long and 22 millimeters in diameter; and the sigmoidoscope is 35 centimeters (14 inches) long and 22 millimeters in diameter. At the outer end of the cylin-

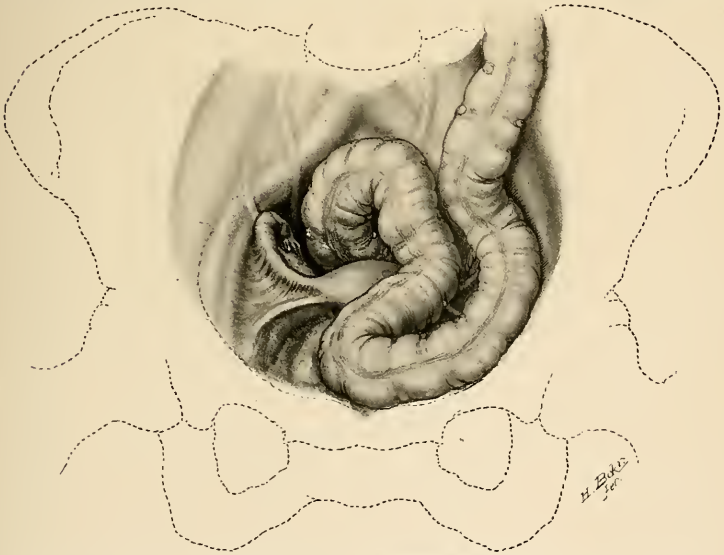

FIG 78.—DEVIATION OF THE SIGMOID FLEXURE.

The bowel forms a sharp angle just behind the symphysis pubis, and then crosses the left broad ligament to the promontory of the sacrum and descends into the pelvis in the median line.

drical tube is a funnel-shaped rim to which the stout handle, big enough to be grasped in the whole fist, is attached. Each speculum has an obturator, blunt at the end and provided with a strong stem and handle.

The sphincteroscope is short and slightly conical, the diameter at the lower end of the tube being 2·5 centimeters (1 inch) and at the upper 3 centimeters

($1\frac{1}{8}$ inch), while the outer rim of the funnel-shaped flange is 5 centimeters (2 inches) in diameter. The strong handle is set on this. The obturator is like that in the other specula.

To make the examination, the speculum is coated with vaseline and the buttocks are drawn apart, exposing the anus. The round end of the obturator is laid upon the orifice, and, grasping the speculum in the fist so that the palm

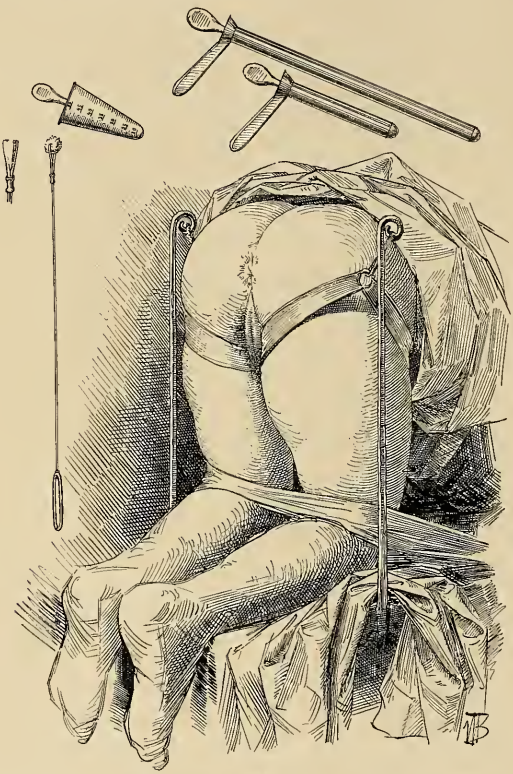

Fig. 79.—Patient Supported by Uprights and Straps in Position for a Rectal Examination.

The instruments—conical sphincter dilator, proctoscope, sigmoidoscope, applicator with cotton pledget—are reduced in proportion to the size of the patient.

keeps pushing the obturator in, it is carried into the bowel in a direction at first downward and forward, and then upward toward the sacral hollow. Sometimes the end catches in the groove between external and internal sphincters; if this happens, it must be withdrawn and pushed in again in a slightly different direc-

tion. As soon as it has fairly entered, the obturator is pulled out and the air rushes audibly in, widely distending the bowel. The examination is now made by reflecting the rays of light from an electric droplight, or a lamp, or good daylight, by a head mirror, down the tube into the bowel, which is so well illuminated that the smallest points on its surface become visible, Fig. 80. It is possible to detect differences not larger than the pores on the palm of the hand. It will often be found that the speculum is turned too much downward, and that it is necessary to drop the handle to bring an extensive area of bowel into view. By turning the tube a little from side to side the whole dilated ampulla

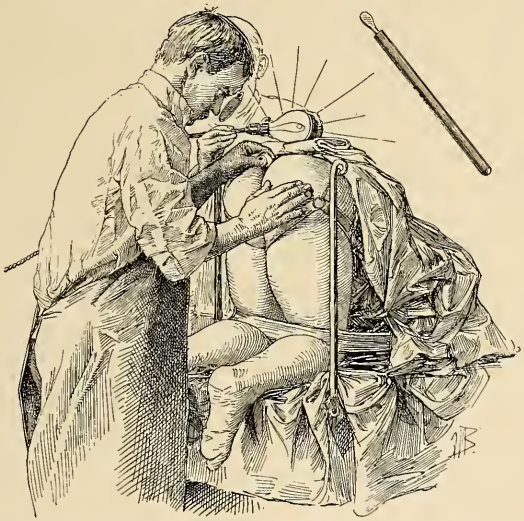

Fig. 80.—Examination of the Rectum by Reflected Light.

The instrument seen above to the right, drawn on the same scale of reduction as the body, is introduced to its full length. The electric light, held by an assistant close to the sacrum, is reflected down the tube by a head-mirror. This picture is drawn from a photograph.

is inspected in a few moments. The ground color of this and other parts of the bowel is a pale red with large vessels like veins dividing up the surface at wide intervals. The normal bowel is never intensely red and injected in this posture, neither does it have a hazy appearance.

After studying the ampulla, upon looking up the lumen of the bowel a series of half valves are seen cutting into its lumen on the right and on the left. The tube passes easily through each of these, displacing first one and then another, without perceptible resistance, exposing to view successive lengths of the bowel hugging the sacral hollow. The promontory often appears characteristically projecting as a rounded smooth eminence on the upper surface; its bony nature is evident on touching it with the end of the speculum.

The bowel distends so widely in this position that any fecal masses lie loose in the lumen, and the speculum may often be carried beyond without removing them and without their choking its lumen. Sometimes, on introducing the speculum, the bowel will be found in the act of gradually opening up, expanding fold by fold. The dilatation ceases in some part of the sigmoid flexure, where the mucous surfaces suddenly come together, but a little pushing with the end of the speculum, or by observing the mucous folds as they part in the escape of flatus, the lumen is found, and the speculum can be pushed still farther up, although the view is no longer so perfect as in the lower atmospherically distended bowel.

To continue the inspection beyond the rectum on up into the sigmoid flexure, the longer reach of the sigmoidoscope is necessary. The direction of the instrument is no longer confined to the median line, but by degrees turns more and more to the patient's left. I have introduced this speculum as far as 30 centimeters (12 inches) beyond the anus.

The purpose of the inspection is to note all alterations from the normal appearance of the bowel, such as patches of congestion, mucus lying on the surface, ulceration, and polyps. Strictures are found most commonly, in connection with pelvic tumors, when there is a sudden narrowing of the lumen, beyond which the speculum can not pass, and the bowel seems rigidly fixed.

Pelvic peritonitis, especially that form due to abscesses in the ovaries and tubes, is particularly liable to produce stricture of the rectum at any point from the brim of the pelvis down to the ampulla. In one of my cases the rectum was choked by a large tubal abscess on the right side; above the constriction, which extended from the ampulla to the upper part of the pelvis, the bowel was greatly distended and there was an opening between the sac and the rectum. In another case, in which dense inflammatory masses with abscesses on both sides were taken out together with the uterus, a tight stricture of the bowel was found just below the promontory of the sacrum. This was about 4 centimeters (1½ inch) long, and not more than 1½ centimeter (½ inch) in diameter, measured on the outside.

A fistulous orifice seen foreshortened in the side of the bowel is easily passed over, and must be carefully sought for by pressing so as to flatten the mucosa out on the end of the speculum.

The sphincteroscope is used by pushing it into the ampulla, withdrawing the obturator, and then drawing the speculum out a little until the inner sphincter circle begins to close over it, and then pushing it back in. In doing this it does not re-enter the portion of the bowel just left, but simply spreads the area within view over the end, giving a flat field for inspection. In this way, step by step, the whole sphincter area is exposed, and any abnormalities easily detected. For children and nervous patients who are difficult to examine, a speculum 12 centimeters (5 inches) long and only 18 to 20 millimeters in diameter is most useful.

EXAMINATION OF THE VERMIFORM APPENDIX.

The gynecologist must be familiar with the position and methods of palpating the normal and diseased vermiform appendix, in order not to confuse its affections with those of the right tube and ovary near by. We owe the discovery of this valuable means of diagnosis to Dr. George M. Edebohls, of New York (see *New York Jour. of Gyn. and Obst.*, Feb., 1894, and *Amer. Jour. of the Med. Sci.*, May, 1894).

Under ordinary circumstances the normal vermiform appendix can be felt through the abdominal wall against its underlying iliac muscle as a short distinct cord, moderately or not at all sensitive, extending from its base at a point in a line between the umbilicus and the right anterior-superior iliac spine, downward and inward to the pelvic brim. To find it the patient lies with the abdomen bare and knees and thighs flexed without effort, and the examiner, standing at the patient's right side, makes pressure inward in the right semilunar line just below McBurney's point. He increases the pressure gradually until the posterior abdominal wall is reached. This may be felt, if desired, to make certain of the position.

The fingers, keeping up the pressure, then glide in a direction downward and outward toward Poupart's ligament, until a delicate, cord-like structure is felt to slip beneath them. The maneuver is then repeated a little higher up, and then a little lower down, changing the position until the length and direction of the appendix are ascertained. The upper end disappears at McBurney's point, and the lower end at the brim of the pelvis as a rule. A loop of intestine or muscular fibers in the abdominal wall may be mistaken for the appendix, but any overlying small intestine may be disposed of by placing the patient for a few minutes in the knee-breast posture, and by careful attention the more superficial position of the muscular strands will be recognized. A diseased appendix is often still more easily recognized from its extreme sensitiveness and its increase in size, making it feel like a big hard cord, more or less fixed.

If there is an inflammatory exudate about the appendix the organ can not as a rule be felt, but the position and distribution of the mass are both characteristic of appendical as contrasted with tubal and ovarian inflammatory disease.

An exception to the general principles here laid down are those cases in which the inflamed end of the appendix lies in the pelvis involved with the right tube and ovary.

INVESTIGATION OF THE GENERAL CONDITION OF THE PATIENT.

Upon completing the gynecological examination, the specialist must turn his attention to the condition of all the other vital organs in the body, associating the results with the facts elicited by the examination of the pelvic organs; he is then in a position to estimate the relative importance of any gynecological ailment.

This examination is valuable in several ways: It often happens that the pel-

vic disease is but a part of a general morbid condition, or is dependent upon disease elsewhere for its continuance; this is the case when pulmonary phthisis is associated with the tubercular tubes and ovaries, and tubercular peritonitis, or when a disposition to uterine hemorrhage is but one of the manipulations of a crippled heart or a cirrhotic liver. On the other hand, a pyonephrosis may be due primarily to a pelvic abscess blocking the ureter and furnishing the source of infection.

It often happens, too, that there may be some grave organic disease of one of the other organs which is simply an accidental complication, but nevertheless forbids the performance of any serious gynecological operation.

The inquiry will be commenced by asking about any strong family tendency to hereditary diseases which may bear an etiological relation to any local affection, or so complicate the local conditions that they must be taken into consideration in the prognosis and treatment. The risks attending a plastic operation upon the cervix or vagina, for example, are of no moment in properly selected cases, but they may be followed by disastrous results if certain constitutional diseases, such as advanced nephritis, tuberculosis of the lungs, diabetes, etc., are overlooked.

The main points of the general gynecological examination are age, heredity, temperament, habit, color, and the following diseases: tuberculosis, pneumonia, pleurisy, hydrothorax, heart disease, affections of the alimentary tract, diseases of the liver, spleen, and kidneys.

Age.—Other conditions being equal, women between the ages of twenty and forty withstand the effects of operation best. But, with Dr. Mary Sherwood, I have collected recently statistics in 100 cases which show that ovariotomy in women between the ages of seventy and eighty-two is attended with a mortality only slightly greater than in women of younger years (*Johns Hopkins Hospital Reports. Gynecological Fasciculus*, No. II, p. 509); in 115 cases in the hands of 66 operators, only 12 per cent died. (See Chapter XXI.)

Between twenty and forty women are in the prime of life, and resist the effects of shock, hemorrhage, and infection better than those whose vital forces are impaired by advancing years. In the aged the minor gynecological ailments, such as retroflexion, lacerated cervix, relaxed outlet, and often even the marked forms of prolapse of the uterus, should not be treated by operation unless the patient experiences serious discomfort. The old are much more easily depressed by the loss of blood, and recover more slowly from shock. Convalescence is longer with the aged, because the recuperative powers are feebler. Carcinoma of the uterus in its early stage and diseases of the appendages, which, if not interfered with, will destroy health or terminate life, should be submitted to operation regardless of age, if this is the only contra-indication.

Heredity.—The hereditary predisposition to certain diseases must be carefully inquired into, because any marked family tendency may have an important bearing on the etiology. When there is a hereditary tendency to insanity, especially in patients inclined to be morbid or melancholy, any operation is attended with risk of precipitating an attack of insanity, as a post-operative

complication. In neurotic families the results of surgical work are always less satisfactory. A family tendency to excessive menstrual flow may account for what would in other cases be significant of disease. A strong tendency to cancer in the family will arouse suspicion as to cervical erosions or persisting uterine hemorrhages.

A family tendency to tuberculosis of the lungs in a patient who has the general appearance of being tubercular, without signs of the disease, must put the operator on his guard, as the convalescence is apt to be slow, and the patient is often a long time in acquiring any vigorous health.

Temperament.—The temperament of the patient exercises more or less influence on the results of operation, and it is a good thing for the surgeon to study the character and disposition of his patient beforehand. Bright, cheerful women approach an operation with more composure and recover from its effects more rapidly than the despondent. A buoyant disposition is especially helpful in shortening the convalescence.

Hysteria and various neurotic ailments often accompany pelvic diseases in women, and the effects of their presence must be noted and weighed well before operation. On the other hand, certain classes of nervous patients need a strong mental impression made upon them, and are greatly benefited by even trivial operations. In hysterical women the convalescence is often marked by nerve storms which are difficult to control.

I have seen patients so discouraged by the naturally depressing effects of the disease, superadded to a despondent temperament, that they refuse to acknowledge they were any better after complete relief of their ailment.

Bodily Habit.—The better the general health of the patient, the better able is she to withstand the effects of operation. It is, however, a constant matter of surprise to note the rapid recovery of comparatively feeble and delicate women from the effects of a severe operation. A robust appearance is not always the best indication that the convalescence will be short. The imponderable factor of vitality has everything to do with it.

Color.—Contrary to the common dictum, I find the negress less demonstrative after operation than white women. She frequently approaches the operation with greater fear, but her naturally buoyant, forgetful nature gains the ascendency soon afterward, and she makes a rapid recovery. The mulatto, on account of her mixed strain, may show the same characteristics as the negress, or she may partake of the higher nervous development of the white race.

In making an examination it is helpful to know of any special racial tendencies. I find that out of 100 operations for pelvic diseases in colored women, 32 per cent were for myomata; 50 cases were of pelvic inflammatory disease; there were 3 cases of extra-uterine pregnancy, and 1 ovarian cystoma; there were also 3 dermoid cysts, 1 papilloma, and 1 sarcoma. The marked preponderance of the fibroid tumors and inflammatory diseases and the conspicuous absence of the glandular ovarian cystomata are striking features in the *résumé* of cases.

After such a general consideration of the status of the patient following the

pelvic examination, all the important organs of the body should be examined seriatim. It is often most convenient to proceed directly from the pelvic examination to that of the abdominal viscera. When the history points to some chest complications the heart and lungs will naturally be examined first.

Lung Diseases.—Tuberculosis of the lungs must be sought for and its extent carefully noted. Even a pneumonia might be overlooked without making a routine examination and the dyspnea present attributed to the pressure of a large tumor. Pleurisy and effusions in the chest are by no means rare complications. Bronchitis is often made worse by the administration of an anesthetic, and may even cause death.

Emphysema and asthma should also be considered, as the embarrassed breathing, coughing, and deficient oxygenation render both operation and after-treatment difficult.

Heart Disease and Arterio-sclerosis.—In valvular diseases of the heart, the question to be decided in operative cases is whether the compensation will be sufficient to stand the strain upon it. So long as the function of the heart is well maintained, as indicated by the general health, minor degrees of valvular disease are of no particular moment. Failure in compensation, as shown by the impaired circulation in the extremities, difficulty in breathing on exertion, and attacks of dyspnea, must be carefully noted. I lost one case in this way; the patient was extremely cyanosed and suffered from a great dyspnea throughout the operation, from which she never recovered.

In all cases of painful menstruation and menorrhagia the heart must be carefully examined, as these disabilities may be associated with valvular diseases and venous stasis. One of the most important and serious affections is disease of the coronary arteries, liable to cause sudden death in the midst of an apparently perfect convalescence. Arterio-sclerosis, with its weakened vascular system, must be noted as it holds a definite relation to the repair of wounds, making vessels difficult to control and increasing the risks of secondary hemorrhage.

Affections of the Alimentary Canal.—Dyspepsia must be looked for together with its associated ailments, headache, depression, and nausea. Graver affections of the alimentary tract, such as aggravated forms of dyspepsia, gastric ulcer, and dysentery, are associated with depraved nutrition and demand close attention. A possible cancer of the stomach needs consideration. I have several times had such patients come to me for gynecological treatment.

Constipation is perhaps the commonest ailment associated with these affections; it is important to note its degree and the means habitually adopted by the patient to relieve it.

Diseases of the Liver.—In examining the right hypochondrium, cirrhosis, cancer, and abscess of the liver must be borne in mind. The palpating fingers should also always try to touch the gall bladder. I have several times found this enlarged. In one case of large papilloma of the ovary the gall bladder was as big as the fist, distended with a cement-like substance. In another, with a

dense fibroid weighing forty-nine pounds, much pain was felt in a nodule on the right on top of the tumor. I decided that this was the gall bladder, and, at the removal of the tumor, opened the gall bladder, letting out a quantity of pus and removing a stone.

Diseases of the Kidney.—The examination of the kidneys and their function must be more carefully conducted than that of any other extra-pelvic organ. They are the emunctories whose activity is most important after any operation, and on account of the intimate association of the ureters with the uterus, ovaries, and tubes, their function may be seriously impaired when these organs are diseased. The presence of albumin and casts and pus and the amount of urea excreted must always be inquired into.

Diabetes is such a serious complication that it must be looked for in every instance.

TAKING THE HISTORY.

An accurate history of a case can not always be obtained at the first consultation, as nervous women frequently give such indefinite answers that it is best to leave some parts to be written at a future visit. I think it is a good plan to allow the patient to begin by describing her condition without plying any questions. During the recital the general appearance of the patient, her habit, complexion, temperament, peculiarities of manner or of conversation, and any other points which may have a bearing on her case should be noted. By associating this general view with the general physical examination, the gynecologist is able to form a better estimate of the possibilities of partial relief or of complete cure.

After the patient has talked a while, if she inclines to wander and be indefinite and trivial, I do not hesitate to interrupt with certain routine questions. To this end I find a skeleton outline in my case book invaluable in keeping important headings constantly in view. I insert a facsimile of one of the pages. As far as possible it is filled in at the first visit. It is important to note in every gynecological history the presence of a variety of associated ailments cited in the list, which may have a bearing in one way or another upon the pelvic affection.

Further, to avoid pursuing an aimless or indefinite line of treatment, I always record an outline of the course to be pursued in each case after a thorough examination. It is only by doing this that palliative measures may be tested satisfactorily, associated functional disorders relieved, and the patient placed in the best possible condition for an operation. For example, I note in a case of myoma of the uterus in which the patient is debilitated the following *régime:* "Rest in bed, with massage and electricity on alternate days; careful diet, largely liquid; regulation of bowels; when patient is sufficiently built up, the tumor to be removed by abdominal hystero-myomectomy."

A diagram representing the relations and lesions of the pelvic organs should accompany the history, for even if the sketch be a rough one, it often furnishes a more definite idea of the case at a later date than the elaborate description.

Date *Diagnosis*

Name *S. W. M.* *Age* *Resides*

Occupation *Par* *Miscarriages* *Patient of Dr.*

Instr. deliv. *fever*

Menstr. hist. *Gen. appearance*

Weight

Headaches

Leucor. *Sleep*

Complains now of the following symptoms *Appetite*

Digestion

Bowels

Float. kid.

Urination

Urinary analysis

History of development of present condition

Bladder

Rectum

General previous hist. *rheumatism* *fevers, etc.*

Family history

SKETCH

PHYSICAL EXAM. OF PELVIS AND ABDOMEN

Vag. outlet

Vagina

Cervix

Uterus

Fallopian tubes and ovaries

Outline of treatment to be followed

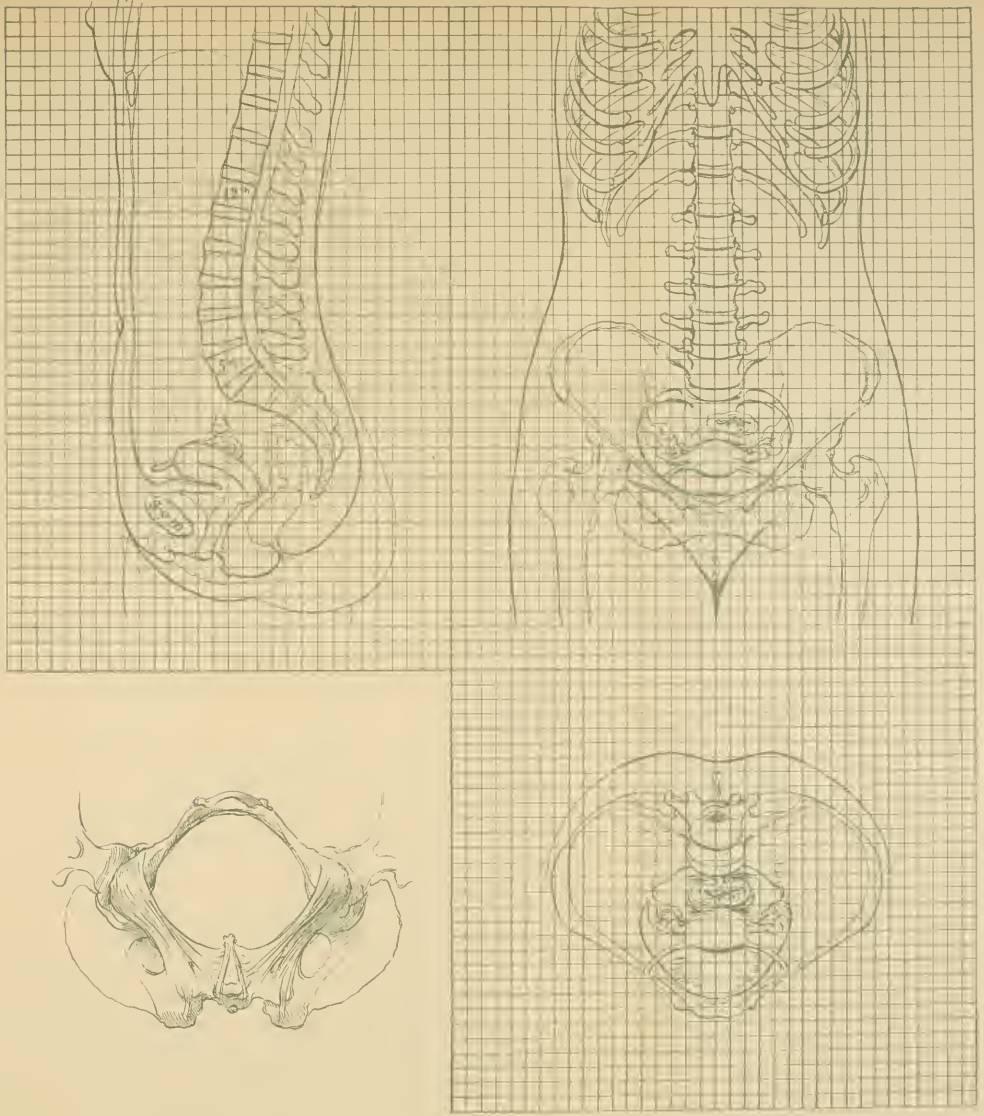

Fig. 81. The Four Cardinal Projections of the Abdomen and Pelvis, reduced on the Same Scale.

Any point in the abdomen can be located by following the parallel lines in the three projections. The lower diagrams are viewed perpendicularly to the plane of the superior strait.

There are four outlines necessary to illustrate properly the pelvis and its contents. Prof. Schultze, of Jena, and Dr. R. L. Dickinson, of this country, have devised rubber stamps by means of which a diagrammatic view of several aspects of the pelvis can be reproduced in a case book, or upon a history blank. I prefer in some instances, however, to make a free-hand drawing, because individual peculiarities may be best brought out in this way. A sagittal section is used to indicate uterine displacements and the position of tumors in front of or behind the uterus.

A coronal section through the crests of the ilia, the acetabula, and the tuberosities of the ischium is necessary to demonstrate lateral displacements of the uterus and the location of inflammatory masses on the right and on the left. If the examination be unsatisfactory, and there is doubt concerning the existence of disease on either side, an interrogation mark indicates that the question is unsettled, and leaves it open for future determination in an examination under anesthesia.

Lesions lateral or posterior to the uterus, in order to be properly indicated diagrammatically, require an outline of the pelvis looking in from above. Such a diagram is especially valuable for filling in after operation, because by it the exact position and relationship of inflammatory masses to the pelvic organs can be graphically shown. Adhesions are conveniently indicated by zigzag or straight lines.

Areas of resistance in the vault of the vagina not clearly outlined bimanually are best registered on a diagram of the inferior strait seen from below. Fig. 81 shows the three geometrical projections of the normal body: first, a sagital section, viewed perpendicularly to the cut surface; second, a front view of the body, seen perpendicularly to its long axis; and third, a view of the pelvis from above and perpendicular to the superior strait. These diagrams have been drawn on the same scale and are covered by a double system of parallel lines, thus dividing each of the three projections into a certain number of squares, which have their corresponding fellows on the other projections. In other words, the body has been imagined divided into a system of cubes, the projections of which we see in the three planes as a square network. The fourth diagram, in the left lower corner of the plate, is a view of the inferior strait seen from below. It is evident that by following this system every given point, or a tumor, in the body can be registered with great accuracy, as illustrated in Fig. 82, where the position of an ovarian cyst has been located in its three dimensions.

The location of abdominal tumors and dull and tympanitic areas may be indicated on a large diagrammatic outline of the abdomen. In Fig. 83, on the left, the abdomen is shown in outline with its contained viscera, and those organs from which abdominal tumors most frequently develop are seen distributed around the periphery; in Fig 83, on the right, is a diagrammatic illustration of the directions taken by the various abdominal tumors in the course of their development, as indicated by the arrows. These directions, as will be seen, are centripetal—that is to say, from the more resisting periphery to the more yielding center.

The enlarging mass projecting toward the center in this way has a corona of resonance, with a dull base at its point of origin. Tumors of the omentum, as indicated by the circular arrow, are surrounded on all sides by an area of resonance.

The characteristic difference in the location of upper and lower abdominal

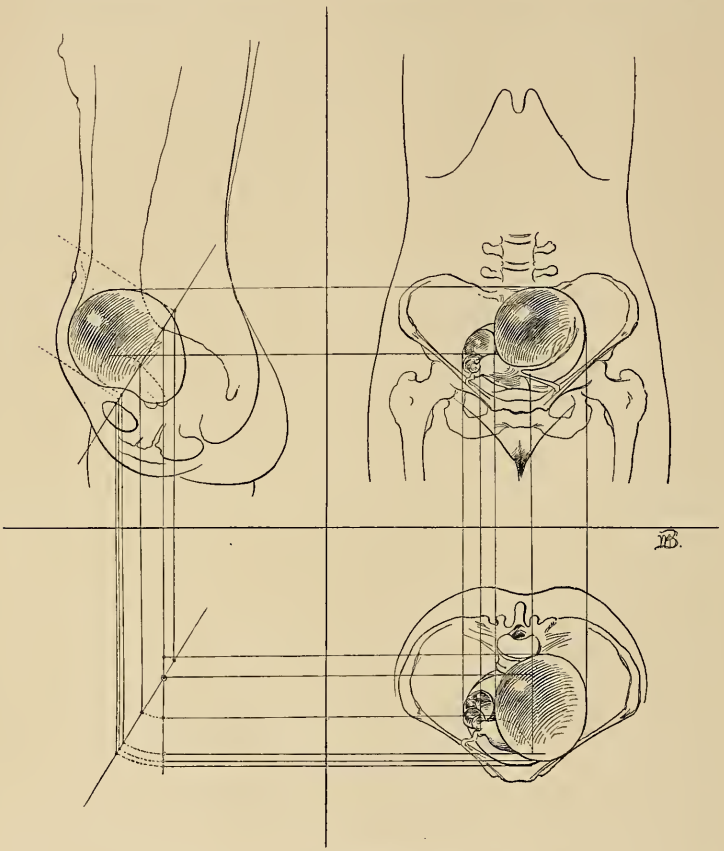

FIG. 82.—DIAGRAM SHOWING HOW TO USE THE PROJECTIONS OF FIG. 81 IN THE CASE OF A PELVIC TUMOR ACCURATELY LOCATING IT AND REGISTERING ITS FORM.

tumors is one which appeals at once to the eye, as shown in Fig. 84, drawn from life, in a case of enormous accumulation of feces in the transverse colon, due to carcinoma of the uterus and rectum.—*M. R., Op.* 7, 29, 96.

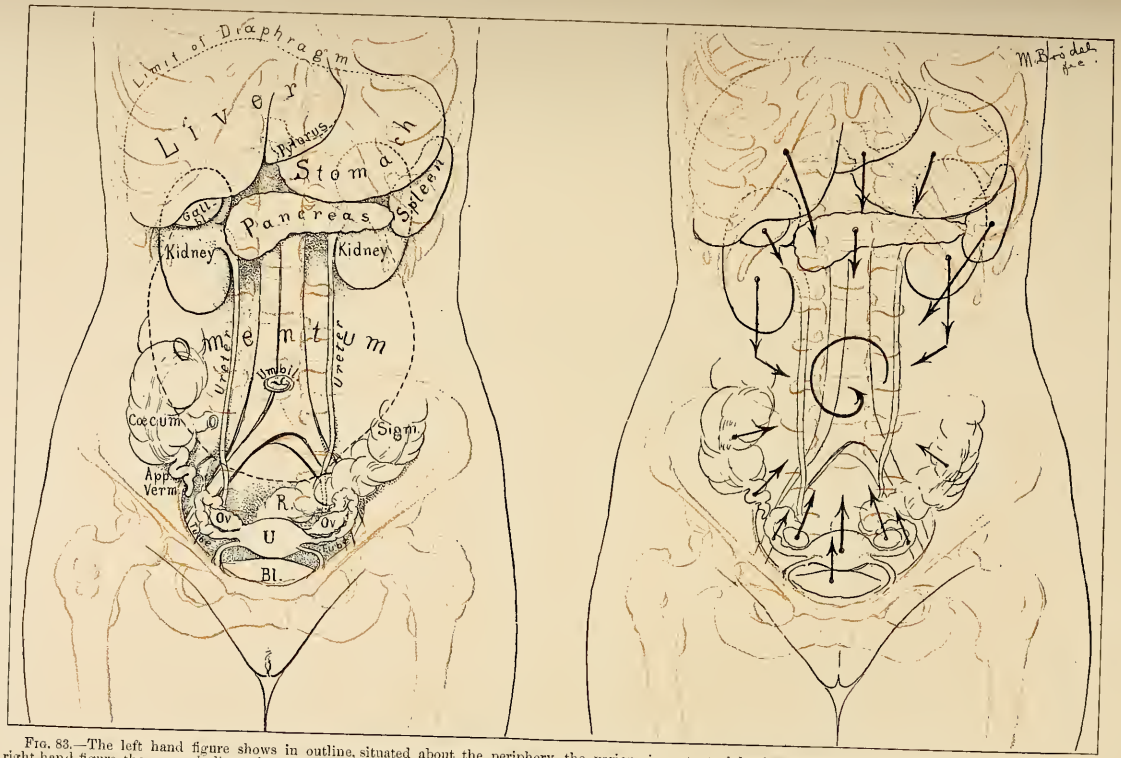

FIG. 83.—The left hand figure shows in outline, situated about the periphery, the various important abdominal organs from which tumors may arise. In the right hand figure, the arrows indicate the directions taken by these tumors from the periphery toward the centre, where the resistance is least.

Before closing this subject I wish to urge the importance of minuter investigations, so as to bring out prominently the individual features. To the unscientific surgeon all cases are roughly classified under a few heads; one ovarian tumor is the same as another, except in size, and a prolapsus is a prolapsus, and nothing more. A closer scrutiny, however, will always bring out an infinite variety of individual differences, and attention to these in time serves to shed light upon the causes of disease.

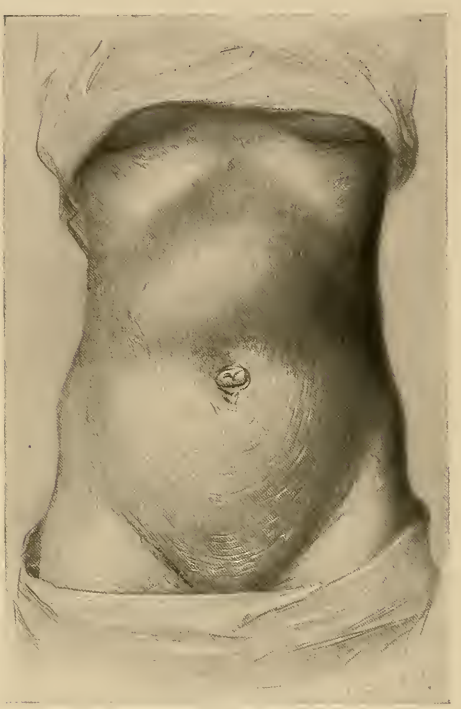

FIG. 84.—TUMOR EXTENDING TRANSVERSELY ACROSS THE UPPER ABDOMEN JUST ABOVE THE UMBILICUS, DUE TO A LARGE ACCUMULATION OF FECES IN THE TRANSVERSE COLON, FROM A CARCINOMA OF THE RECTUM AND UTERUS. RESONANCE ON ALL SIDES.

M. R., oper., July 29, '96.

To illustrate, in a relaxed vaginal outlet the following questions ought to be answered: The exact degree of the relaxation, the amount of protrusion of the vaginal walls, the condition of the levator fibers as felt through the vagina, the increase of the protrusion at the outlet on straining while standing, the difference in the degree of relaxation produced by anesthesia, the tendency to prolapse; and the history should note the number and character of the labors (whether instrumental or natural) and the size of the children. Careful measurements should then be made with a pelvimeter to demonstrate whether difficult labors have been due to a contracted pelvis. All sorts of reflex disturbances ought also to be put down.

CHAPTER VI.

GYNECOLOGICAL INSTRUMENTS AND DRESSINGS.

1. Introduction.
2. Illumination.
3. Specula: Nelson's trivalve speculum. Goodell-Baer bivalve speculum. Kelly's small cylindrical specula for virgins. Sims's speculum. Simon's speculum.
4. Retractors, vaginal and abdominal.
5. Knives: Ordinary scalpel. Broad-bladed scalpel, with a large handle.
6. Scissors: Straight, sharp-pointed, and blunt. Emmet's left-curved scissors.
7. Tenacula: Straight. Curved. Corrugated. Shepherd's crook.
8. Forceps: Tenaculum forceps. Long straight dressing forceps. Long rat-toothed forceps. Rat-toothed dissecting forceps. Hemostatic forceps. Sponge forceps. Polyp forceps.
9. Ligature and suture materials: Silk in three sizes—fine, medium, and stout. Silkworm gut. Catgut. Kangaroo tendon. Silver wire. Tying knots with silk and catgut.
10. Needles: Curved and straight. Carrier. Needle holder. Transfixion needles.
11. Packer.
12. Glass catheter.
13. Large glass trocars for tapping cysts, curved and pointed.
14. Leg holder.
15. Aspirator: Dieulafoy-Potain aspirator. Syringe aspirator.
16. Cautery: Paquelin's thermo-cautery. Electro-cautery.

GYNECOLOGICAL INSTRUMENTS.

A LARGE, carefully selected armamentarium is essential to the gynecologist. He needs instruments of three sorts:

(1) Instruments for exposing the field of operation in vagina or abdomen.

(2) Instruments for special operations.

(3) Instruments and accessories for closing the wound.

The field of the operation is often remote from the surface, either deep down on the pelvic floor or at the vaginal vault, and necessitates the use of specula and retractors to make it accessible. But specula are useless without a good light well directed upon the field; for this reason I will consider first the prime requisite—illumination.

The Illumination.—For the illumination of the field of operation, a good diffused sunlight is best of all. This is attained in the operating room by plenty of windows and a large skylight, and by walls painted with a light color. The direct rays of the sun are embarrassing, and so a north exposure is best. No operator, however, can afford to depend on this source of light alone, on account of the uncertainties of the weather and the frequent call for an intense illumination localized at one point.

In an emergency in private practice a common candle with a tin reflector, or a mirror held so as to direct its rays, may be used. In the clinic the electric

light is the best artificial illuminant. The current may be conducted from a wall bracket by a long insulated flexible wire to the 16-candle-power lamp, with a tin reflector enameled white inside and attached to a handle, as shown in the figure in Chapter XX. This can be held by an assistant so as effectively to illuminate the wound area. A simple extemporized reflector may be made by enclosing the electric light in a cone of white paper covered with black cloth. Where an electric street current is not available, a storage battery is a satisfactory substitute, running a 6- or 8-candle-power lamp.

Specula.—For inspection of the vaginal vault the best specula are Nelson's trivalve speculum, Goodell's bivalve speculum, modified by B. F. Baer, and Kelly's small cylindrical specula, Nos. 12–15 of the cystoscopic set, for use in the virgin. The utility of these instruments is limited to an examination for diagnostic purposes, to treatments applied to the vaginal vault, and to the application of packings. Sims's and Simon's specula are useful both in making an examination and in exposing the field during an operation at the vaginal vault, serving the double purpose of specula and retractors. The Sims's speculum is most used by the New York school of gynecologists, and is more serviceable with the patient in the left lateral position. Several sizes are needed, differing in length and breadth, for narrow and relaxed and for long and short vaginas. The Simon specula are purchased in sets, and consist of two handles with adjustable blades of varying lengths and breadths, for both the anterior and the posterior vaginal walls. They are used in the dorsal position.

Fig. 85.—Emmet's Left-curved Scissors for Plastic Operations at the Vaginal Outlet.

Vaginal retractors, with long light handles, are used to hold back the lateral and upper walls of the vagina, and to keep the field of operation free. The blades of these retractors should be of two sizes—2 by 7 centimeters and 3 by 7 centimeters.

Abdominal retractors serve to lift up or to draw aside one of the walls on either side of an abdominal incision to enable the operator to inspect the pelvic viscera. The best patterns are Halsted's, with concave blades, 4 by 7 and 6 by 7 centimeters in size.

Knives.—The knives used in gynecological surgery are the ordinary scalpels, made of solid metal, with handles smooth or grooved to afford a better grasp. For opening the abdomen, I like a broad-bladed scalpel with a large handle, and for marking areas of denudation in the vagina or on the cervix, or for delicate dissections in the pelvis, I prefer a knife with a slender blade and a sharp point.

In transporting or sterilizing knives the blades must be wrapped in cotton, or they must be fastened in a rack in a metal box to protect them.

Scissors.—Scissors are among the most important of all gynecological instruments, and, through the inventive genius and teaching of Dr. T. A. Emmet,

of New York, they have come to be so widely used in this country as to constitute a characteristic feature of American gynecology. Straight and curved scissors are used—the straight scissors for all ordinary cutting, and the curved scissors in making denudations. Two pairs of straight scissors are useful—one sharp-pointed, with a cutting edge 5½ centimeters long and handles 14 centimeters long, for removing sutures, cutting ligatures, and in making short, straight incisions; the other pair are blunt-pointed, with a cutting edge of 7 centimeters and a handle 18 centimeters in length, for enlarging the abdominal incision, for cutting the pedicles of tumors, and in excising thick areas of tissue. Large scissors angled on the edge are also used in extending the abdominal incision.

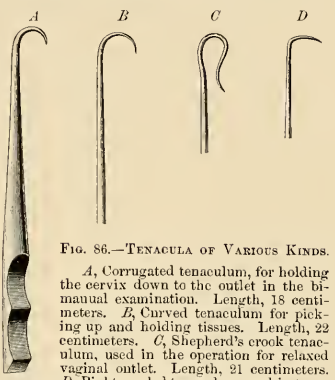

Fig. 86.—Tenacula of Various Kinds.

A, Corrugated tenaculum, for holding the cervix down to the outlet in the bimanual examination. Length, 18 centimeters. *B*, Curved tenaculum for picking up and holding tissues. Length, 22 centimeters. *C*, Shepherd's crook tenaculum, used in the operation for relaxed vaginal outlet. Length, 21 centimeters. *D*, Right-angled tenaculum used in turning in the edges of the tissues in approximation by suture. Length, 19 centimeters.

Emmet's left-curved scissors (Fig. 85) are invaluable in making denudations in the vagina, but it is necessary to see that these scissors have a good curve, and that they cut evenly from shoulder to end.

Tenacula.—Tenacula are used to catch and hold movable tissues which are being sutured, to steady the cervix uteri, and to catch bleeding vessels down in the pelvis and lift them up while a ligature is being applied; but the tenaculum has not the importance now that it had some years ago (Fig. 86).

There are two varieties of tenacula—the straight and the curved. The straight tenaculum, D, is employed in tucking in and in approximating tissue which pouts out of an incision while it is being sutured, as well as in catching up small areas of tissue which are to be trimmed off with knife and scissors. The curved tenacula are of three kinds: the simple curved, B, the corrugated, A, and the shepherd's crook, C. The simple curved tenaculum is used to catch tissue which is to be firmly held; the hooked end keeps it from slipping off.

The corrugated tenaculum serves as a tractor to bring the uterus down for examination. My shepherd's crook tenaculum is used in the operation for relaxation of the vaginal outlet. After this tenaculum is once put in place it may be dropped repeatedly without losing its hold on the tissue.

Forceps.—Under this name are classified a variety of instruments differing widely in use and construction, but having one common end in view—that of grasping and holding tissues.

The following kinds of forceps are used in gynecological surgery:

Tenaculum forceps.

Long straight dressing forceps.

Long rat-toothed forceps.

Rat-toothed dissecting forceps.

Hemostatic forceps.
Sponge forceps.
Polyp forceps.

Tenaculum forceps, or double tenaculum forceps, resemble two tenacula fastened so as to work together in opposite directions. They are used to grasp and draw the cervix down, to steady it while the uterine dilator is introduced, and to catch and hold a bleeding pedicle which has dropped back into the abdomen. They ought to be made strong enough to resist feathering, and the ends must be slightly curved at right angles to the shaft and tapered, as shown in the figure, to prevent tearing the tissues. The figure (Fig. 87) shows a small tenaculum forceps which I have found especially useful. If the tenaculum tears out, a three-pronged tenaculum may be used to advantage (Fig. 88).

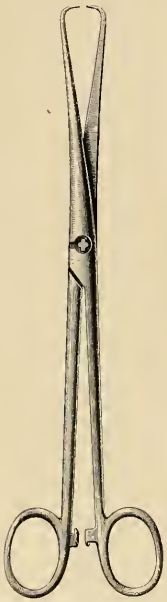

Fig. 87. — Tenaculum Forceps, with Catch and Open Lock. ½ Ordinary Size.

Long straight dressing forceps are constantly used in removing and applying dressings, in carrying pledgets of cotton into the vagina to cleanse it, and in making applications.

Long Rat-toothed Forceps.—I find a pair of long rat-toothed forceps, like those figured in the text (Fig. 89), one of my most useful instruments in abdominal surgery, effectually taking the place of a hand deep down in the pelvis.

Rat-toothed dissecting forceps are needed in picking up the layers of tissue, in making the abdominal incision, and in catching the tissue in vaginal and cervical denudations.

Hemostatic Forceps. - At least two dozen artery forceps should be included in a set of abdominal instruments, but only four sets are required for most vaginal operations. The original forceps were devised by Koeberlé, of Strassburg, and are excellent for the compression of vessels lying in soft tissues, as in the abdominal walls and on the floor of the vagina. For general use the forceps figured in the text and in use in the Johns Hopkins Hospital are the most satisfactory (Fig. 90). They are 15 centimeters in length, and have a curved biting surface 4 centimeters long; the lock shown in the figure is an improvement on my own lock. The especial points of value in these forceps are (1) that the jaws are longer than usual and gently curved, and (2) that the tips of the jaws grasp the tissue before the first shoulder is reached. This permits a small bit of tissue or an artery to be clamped by the points if the

Fig. 88.—Cullen's Three-pronged Tenaculum Forceps for holding down the Cervix Uteri. Actual Size.

forceps are only closed one or two notches, while a large area may be clamped if they are closed completely.

Sponge Forceps or Holders.—Sponges in abdominal surgery are chiefly of service in cleansing the pelvic cavity, in taking up pus rapidly, and in holding back the intestines. The best sponge holder is my own with a lock devised by Dr. G. B. Miller, of the gynecological staff of the Johns Hopkins Hospital, and shown in the accompanying figures (Fig. 91). The essential features of these forceps are the blunt teeth at the lower end which hold the sponge, and the clasp which slides freely under one handle until it is slipped over the neck of the other handle and pushed down, fixing the sponge. The entire length of the forceps is 22·5 centimeters, and the whole separates into three pieces for cleansing.

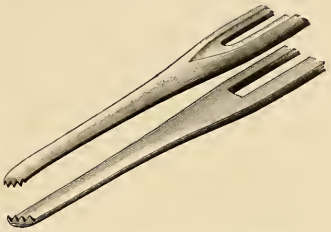

Fig. 89.—End of Large Rat-toothed Forceps, for use deep in the Pelvis. Whole Length, 3 Centimeters.

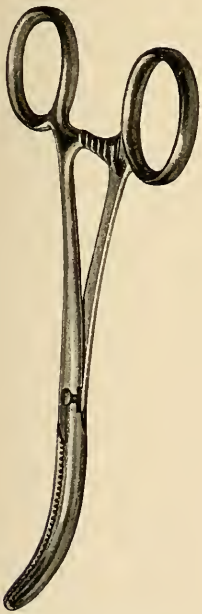

Fig. 90.—Hemostatic Forceps with Open Lock.

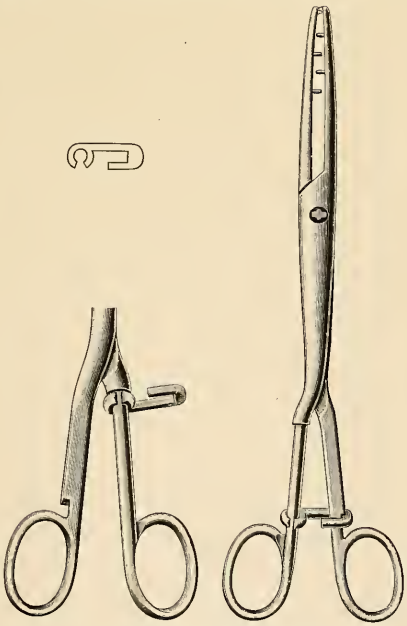

Fig. 91.—Miller's Sponge Forceps.

The hook shown above, in outline, hangs loose on the round handle until the forceps are locked, as seen in the right-hand figure.

Polyp Forceps.—The best forceps for grasping small polyps or for removing a small ovum or pieces of placenta are those shown in the text (Fig. 92). The form of the blade is shown in the figure, and the handles are 27·5 centimeters long and provided with a catch.

The ligature and suture materials used in gynecology are silk, silkworm gut, catgut, and silver wire, which are conveniently abbreviated in clinical records by using the initial letters only before the word "suture," as s., s. w. g., c. g., s. w. sutures.

Fig. 92.—Placenta and Polyp Forceps. Length, 30·5 Centimeters.

Silk.—Pure Chinese silk is used in three sizes—fine, medium, and coarse.

Fine silk is best adapted for the ligation of small vessels, for suturing the intestines, for approximating peritoneal surfaces, and for bringing wound surfaces into apposition when there is no tension.

Medium silk is used in ligating large vessels and in tying off the ovarian vessels in a bunch. This size should always be used in preference to heavier silk in all cases where it can stand the strain.

Coarse silk ligatures should only be used in vaginal hysterectomy in tying off the broad ligaments. Coarse silk ligatures are also used as tractors to pull the uterus down in vaginal hysterectomy.

Silkworm gut is one of the best plastic suture materials we have, and once introduced and tied or clamped with shot, preserves a well-rounded, elastic loop indefinitely or until it is removed. The fact that it possesses no meshes gives it a great advantage over silk, which in time forms a seton, furnishing a highway of communication for germs from the surface into the deeper tissues. Silkworm gut is rarely used as a buried suture, either in the abdominal cavity or in the vagina. It is used by many surgeons in closing the abdominal wound after celiotomy, in cervical operations, and as a tension suture in the operation for relaxed vaginal outlet or lacerated perineum.

Catgut, properly sterilized, is valuable as ligature and suture material, because it is absorbed by the tissues and does not require removal. The chief objections to catgut are the difficulty of sterilizing it, its too rapid absorption, and the fact that it may come untied. Only intermediate and heavy-sized catgut should be used, as finer strands are too weak. Water swells and softens catgut so quickly that it must be kept immersed in alcohol until it is used. The too rapid absorption of catgut is prevented by the preparation in cumol (see Chapter I). In vaginal operations catgut is chiefly used as an accurate approximation suture; if it holds but four days, the tissues, as a rule, are sufficiently united, so that sutures are no longer necessary. Its greatest advantage here is that the removal of sutures is avoided.

Kangaroo tendon, the split sinews of the kangaroo's tail, introduced by Dr. Henry O. Marcy, of Boston, has the advantage of being absorbed much more

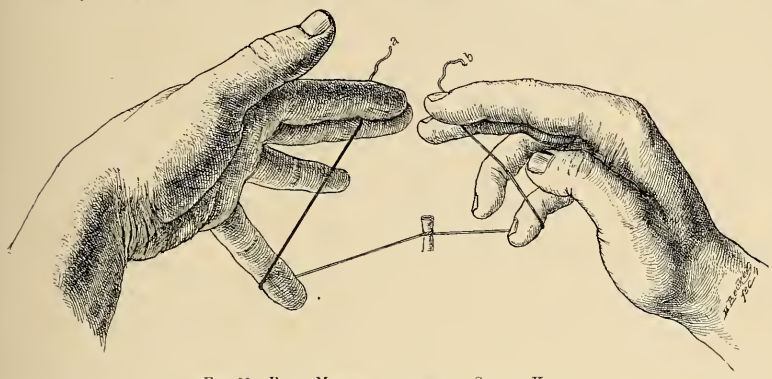

Fig. 93.—Rapid Method of tying the Square Knot.
First step: the first knot is tied and the ligature grasped as shown in the figure.

slowly than catgut. It is useful in all forms of suturing and ligating, and Dr. Marcy advocates it especially for radical hernia operations.

Silver Wire.—Stout silver wire has been introduced by Dr. W. S. Halsted as a buried suture. Its chief use as a permanent suture is in holding together

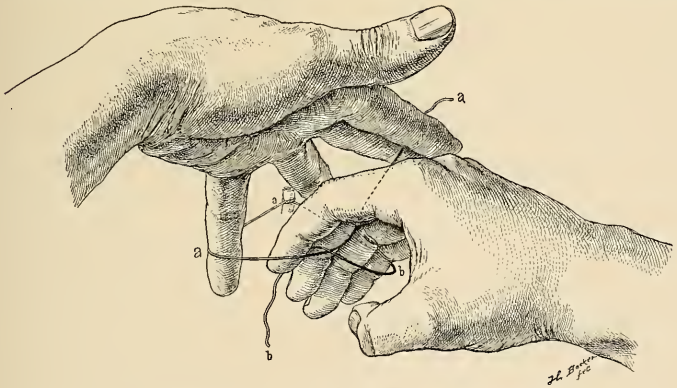

Fig. 94.—Second step: the end *b* is passed over *a* to make the second knot.

the fasciæ of the abdominal incision when it is closed, and in uniting the muscles and fasciæ in the radical cure for hernia. The wire is best introduced as a mattress suture, the ends twisted four times at an obtuse angle, cut off, and turned down at one side of the incision. These sutures re-

main indefinitely in place, and rarely have to be taken out, like buried sutures of silkworm gut.

Tying Knots with Silk and Catgut.—Much time may be lost by tying knots clumsily, and the surgeon will be a gainer all his life long if he will learn at the outset a definite rapid method of tying both silk and catgut. I always tie in the following manner: the first knot is tied with the inner strand in the right hand, thrown *over* and then *under* the outer strand held in the left hand, and drawn tight down on the vessel. Then, by following the four steps which are seen in the diagrams better than can be described, the second knot is quickly drawn down on the first and tightened by supporting the thumbs against each other as shown, to avoid tugging on the tissue (Figs. 93, 94, 95, and 96). Silkworm gut is best tied in a square knot, and after immersion in warm water. Catgut is best tied dry. If a third knot is added, either to the silkworm gut or the catgut, as suggested by Dr. C. P. Noble, the ends may then be safely cut off close to the ligature; the use of a third knot leaves less foreign material behind, and the knot is less liable to slip, and also, in the case of silkworm gut, the little ends which are liable to irritate the tissue are removed.

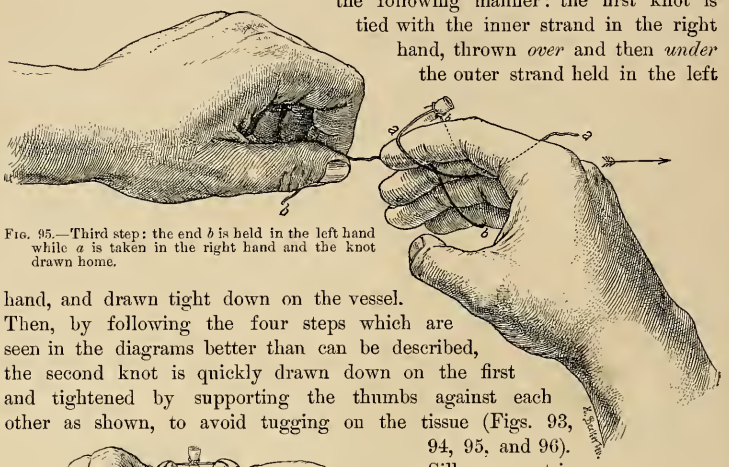

FIG. 95.—Third step: the end *b* is held in the left hand while *a* is taken in the right hand and the knot drawn home.

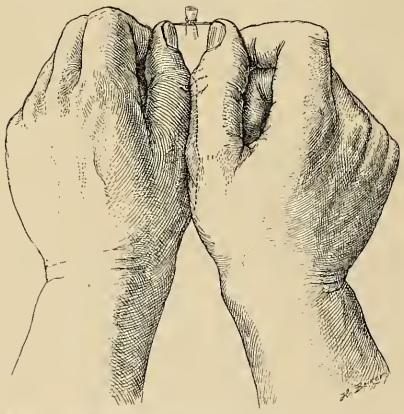

FIG. 96.—Final step: tying the ligature tight without rocking the tissue by buttressing the thumbs against each other. The dotted line shows the overlapping of the left thumb by the right.

Needles. — Curved needles (Fig. 97) are the best for almost all gynecological purposes; they should be of three sizes, as shown in figures, and must answer the following requirements: A good temper, a good open eye, a short straight shank just

below the eye for the grasp of the needle holder, and a cutting surface not wider than the body of the needle; the point must follow the curve of the needle, and must not be bent inward. One of the commonest faults is a kink or a curve just below the eye, making the needle liable to break in the grasp of the holder. Simple straight cambric needles, with a round sharp point and without any cutting edge, are the best for intestinal suturing; they are held in the fingers so that the sense of resistance at the point may enable the operator to recognize the position of the submucous fibrous coat, and so to pick it up.

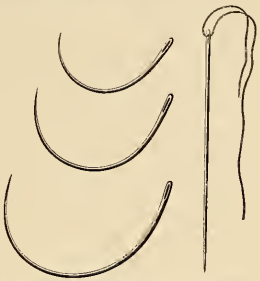

Fig. 97.—Curved Needles, 3 Sizes.

Used in plastic work and all kinds of suturing, except suture of the intestines. Straight straw needle, used in intestinal suturing, on the right.

The Suture Carrier.—The suture carrier is a silk loop tied to the eye of a needle for the purpose of pulling interrupted sutures through in rapid succession. It is tied by taking a long piece of medium silk 52 centimeters (21 inches)

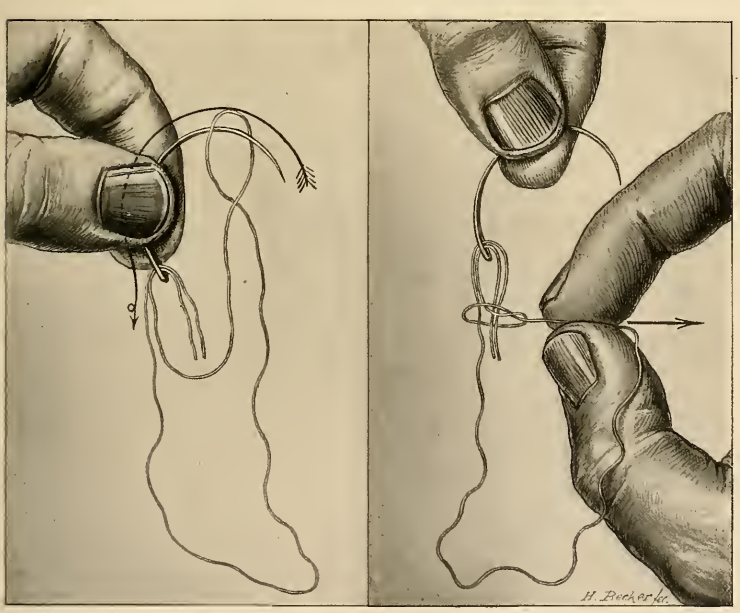

Fig. 98. Fig. 99.

First and second steps in making the silk carrier. Both ends of the thread are put through the eye of the needle in the same direction, and a loop is formed passing over the needle in the direction of the arrow, as shown in Fig. 98; the loop is then brought down below the eye and drawn tight, fixing the carrier, as shown in Fig. 99.

long, putting both ends together through the eye of a needle, and then making a loop on one of the ends, slipping it over the needle beyond the eye, and pulling it tight (Figs. 98 and 99). The length of the carrier loop made in this way is 20 centimeters (8 inches) long. In using the carrier the needle is passed through

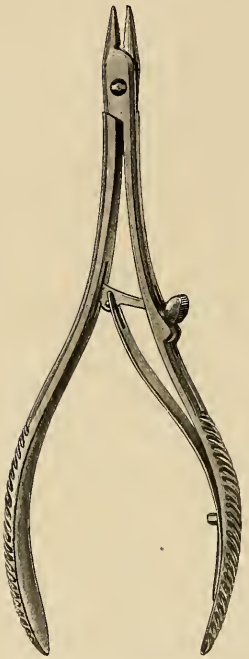

Fig. 100.—Needle Forceps for Curved Needles. ⅔ Ordinary Size.

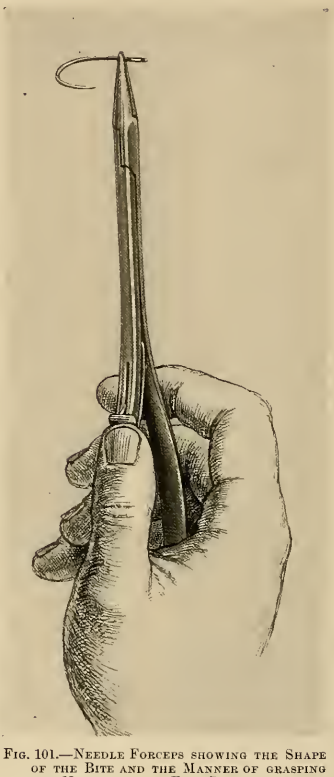

Fig. 101.—Needle Forceps showing the Shape of the Bite and the Manner of grasping the Needle on the Flat Part just below the Eye.

the tissue, and when the loop, threaded by the assistant, is drawn through, the suture is in place. Sutures may be placed more rapidly in this way than by any other means. The intestinal needles are each armed with a single thread of fine black silk. The carrier is never used here to avoid making any larger hole than is absolutely necessary.

Needle Holder.—The most satisfactory needle holder for curved needles is the one figured here (Figs. 100 and 101).

It is important that the handles should be large enough to afford a good

grip, that the catch should work easily and smoothly, and that the end which holds the needle should be narrow, well tapered, and copper-faced.

Transfixion Needles.—Transfixion needles are used to carry stout ligatures through the broad ligament in vaginal hysterectomy. The important requisites are a big handle for a convenient grasp, a stout shank which will not bend, and a well curved end with a big eye just behind a point neither sharp nor very blunt. I only use the needle curved from right to left.

Packer.—A three-pronged packer, modeled like a miniature blunt pitchfork, is valuable in introducing dressings into the vagina and in arranging properly a gauze drain in the abdomen. It is also used in packing cotton, wool, or gauze against the vaginal vault while the patient is in the left lateral semiprone position (Fig. 102.)

Fig. 102. Packer for placing Cotton or Gauze in Position. Length, 20·5 Centimeters.

Glass Catheters.—Short glass catheters should supersede the metal ones for women, as they are so easily made aseptic and kept clean by immersion in a carbolic or boric acid solution. There is no danger of the catheter breaking while being used if it is not cracked when introduced. The catheter measures 13 centimeters in length and 5 millimeters in diameter. It is gently curved in opposite directions at the ends, and there is a large eye on each side near the end, as well as a small hole at the end, to facilitate cleansing.

Trocars. The Large Glass Trocars for tapping Cysts.—For the evacuation of large ovarian cysts I use only glass trocars, curved at one end and pointed at the other, with large fenestræ on both sides, near the pointed end. The end of the trocar beyond the fenestræ is closed by a glass partition to prevent dirt lodging there, while the discharging end has a collar over which the rubber tube is slipped. The clear glass discloses the slightest trace of dirt and renders it possible to sterilize these instruments much more satisfactorily than the metal trocars.

Leg Holder.—In operations requiring the lithotomy position it is necessary to use some kind of a leg holder to retain the legs flexed and drawn upon the abdomen out of the way during the operation. My own leg holder, or Robb's modification of it, is the simplest form both for use and for transportation. The holder is composed of three parts: two canvas rings which are put on the thighs just above the knees, and a broad canvas strap which goes from one loop to the other around the neck. The rings are made of two thicknesses of heavy canton flannel quilted together. The ring is widest below, where the greatest pressure comes, being 13 centimeters (5 inches) in width, and narrowest on top, $2\frac{1}{2}$ centimeters (1 inch) in width, where a galvanized ring is placed to hold the neck strap. The canvas rings should be 50 centimeters (20 inches) in circumference. The neck strap is made of a double canvas quilted like the loops, 89 centimeters (35 inches) in

length, and 6½ centimeters (2½ inches) wider in the middle, gradually tapering to the ends. Harness straps at the ends and three metal rings about 15 centimeters apart make the leg holder adjustable.

Aspirator.—The aspirator, at one time largely given up, has in recent years again become an indispensable instrument. The Dieulafoy-Potain aspirator is one of the best, and is so well known as to need no description. During the operation the aspirator should be in the hands of a competent assistant, who should be sure that the bottle is well exhausted and the suction channel unobstructed before use. Immediately after using the instrument the suction tube should be cleansed by creating a vacuum in the bottle and immersing the point in warm water. The tubing, after being washed out in this way, should be placed in a bichloride solution (1–1,000) for at least an hour, after which it is dried and put away in the case. The needles and trocars should be sterilized after every operation by boiling in a carbonate of sodium solution (1 per cent) for five minutes, and dried in a Bunsen or an alcohol flame. The receiving bottle should be sterile, as it is often desirable to make cultures from its contents.

Syringe Aspirator.—My own aspirator is like a large glass syringe, a pint in capacity, with a metal point to which a piece of rubber tubing, with a needle, is attached. The piston must fit perfectly to keep the air from entering. A switch and an opening on the side provide for the discharge of the contents of the barrel without withdrawing the trocar.

Cautery.—The term cautery is used in contrast to chemical cauterization produced by nitric acid, chloride of zinc, nitrate of silver and caustic potash, etc.

The irons of ancient surgery have been replaced in modern times by Paquelin's thermo-cautery or one of its modifications, too familiar to need description. One of the best forms is that in which the tube passes directly through the middle of a small bottle holding the benzine.

The Electro-cautery.—In the clinic room an electro-cautery is often more convenient than the thermo-cantery. The electricity is supplied from a storage battery, or, better still, from a street current which is cut down. I use in my clinic an alternating current controller, in which induction is used for resistance, in place of a sectional coil and point switch. A 52-volt alternating current is employed and reduced by the controller from 0 to 5 volts with an ampèrage of from 1 to 35.

CHAPTER VII.

ANESTHESIA.

1. Local and general anesthesia.
2. Local: Cold. Cocain. Endermic injections.
3. General anesthesia: Introductory. Anesthetizer. Signs of complete relaxation. Danger symptoms. Oxygen after anesthesia. Anesthesia slip.
4. Chloroform.
5. General rules for administering any anesthetic.
6. Rules for administering chloroform.
7. Resuscitation of the asphyxiated.
8. Ether: Operation under the primary effect of ether.
9. Death from anesthesia.

The choice of the best anesthetic and the safest method of administering it are questions of the utmost importance, for its improper use often mocks at skill and converts one of the greatest surgical blessings into an agent of death.

There are two forms of anesthesia employed in gynecology—local, in which only a small area of the body is anesthetized, and general, where the anesthetic is inhaled and induces a state of unconsciousness, during which the most extensive and prolonged operation can be done without pain.

LOCAL ANESTHESIA.

Local anesthesia is best adapted to those cases in which the operation is confined to a small exposed area, whether on the surface of the body or in the vagina, where the operation is of a minor character and of short duration. Local anesthesia is induced either by applying cold or a solution of cocain, or by injecting normal salt solution into the deeper layers of the skin, or by constriction.

Cold.—Cold anesthetizes the surface by reducing the temperature close to the freezing point, paralyzing the nerves of sensation. The application of cold for anesthetic purposes about the pelvis is restricted to a narrow field. It may thus be employed in "freezing" the skin over a labial abscess, which can then be quickly opened, or in benumbing the skin on the lower part of the abdomen for the purpose of making a small incision through which a trocar is to be thrust to tap an ascites or an ovarian cyst.

Anesthesia by cold may be produced either by the application of ice or by directing a fine ether spray against the part for about five minutes. If a lump of ice is used it should be sprinkled with salt, wrapped in a thin cloth, and the salted side applied to the spot for about five minutes, when the blanched surface will show the effect of the agent. The refrigeration of the surface by ethyl chloride is perhaps the best way to apply cold over a small area, and I know of

no better arrangement than the ethyl chloride (Bengué) supplied to the trade in glass vials with brass tops perforated by a capillary opening and closed by a screw cap. Each tube contains 30 grams of ether, and is sufficient for from ten to fifteen minor operations.

The efficacy of the ethyl chloride depends upon its low boiling point, which is 12·5° C. Ethyl chloride anesthesia will be found valuable in such minor operations as evacuating abscesses about the vulva, opening stitch-hole abscesses, incising a suppurating pile, etc. The anesthetic effect is obtained by holding the nozzle from six to eight inches away from the skin while the fine spray plays upon it. The color at once changes, and in less than half a minute a white parchment-like appearance is produced, with an anesthesia which lasts about two minutes. The freezing is more rapid in summer.

Cocain.—Cocain hydrochlorate may be used for short operations on the skin or the mucous membrane, either by local application or by injection under the surface of the skin. Operations to which cocain is best adapted are the removal of pediculated tumors, the incision of a suppurating gland or a vaginal cyst, or in the preparation of the surface of the rectal mucosa to render painless the injection of hemorrhoids with carbolic acid, or in allaying the sensitiveness of the urethra before introducing a speculum. It takes about five minutes to produce local anesthesia by this means. Solutions of cocain should never be injected into the urethra or rectum, as the drug is quickly absorbed, and in a certain percentage of cases its use is followed by collapse.

I did a celiotomy in 1888 under local anesthesia produced by injecting 10 or 12 minims of a 2 per cent solution of this drug at several points in the line of incision. The patient experienced no pain until the peritoneal cavity was opened and the pelvic organs were pulled upon. The incision was sewed up while the tissues were yet under the effects of the cocain, and the patient was put to bed, having been conscious of every step of the operation, with only slight pain.

For operations in the vagina requiring local anesthesia a pledget of absorbent cotton is saturated with a 5 to 10 per cent solution and applied to the part for five minutes. The application may be repeated from time to time during the operation, although a free flow of blood seriously interferes with the effectiveness of subsequent applications by washing away the solution as soon as it comes in contact with the tissues.

Cocain may sometimes be used to enable the surgeon to operate upon the perineum without resorting to a general anesthesia. In this case a few minims of a 2 per cent solution should be injected by multiple punctures quite superficially along the line of incision or denudation. Such an operation can only be done on a patient who has excellent control of her nerves. It is well to begin the operation about three minutes after the injection and before the fluid is absorbed; the denudation in the anesthetized tissues then permits the injected fluid to escape over the wound and keeps up an anesthetic effect. Such an operation must be performed rapidly, all materials must be at hand, and assistance must be prompt. The concluding steps are sometimes painful, and are

completed satisfactorily only by exercising a great deal of moral suasion over the patient. The great difficulty in local anesthesia by injecting cocain is that it is often impossible to tell beforehand how long an operation will last, and in long operations cocain can not be depended upon.

Endermic Injections.—This method has superseded in many clinics the use of cocain, proving more efficient and less dangerous. The procedure is simple and rapid, and for minor operations on skin surfaces is the best method devised. It consists of injecting by the hypodermic needle some innocuous fluid into the deep layers of the skin, producing thereby a small area of localized edema. The principle is the same as that of inducing anesthesia by constriction, the distention being sufficient to stop the circulation and paralyze the terminal nerve endings. Sterilized normal salt solution is the fluid commonly used.

The technique of the method is as follows:

The field of operation must be thoroughly cleansed and the procedure conducted throughout with the usual antiseptic precautions. The filled hypodermic needle is then introduced as nearly parallel to the surface as possible until the deep layers of the skin are reached. The fluid is then slowly forced in until a wheal from 1 to 3 centimeters in size is raised. This becomes blanched and sharply defined from the surrounding skin. By successive injections into the periphery of the wheals an area of desirable size can be anesthetized without further pain. The effect disappears as the artificial edema is absorbed, but the period is of sufficient length to enable one to open abscesses, remove sutures, or excise small tumors.

Schleich advocates injecting in the same manner a weak solution of morphine and cocain, but it does not seem to improve the efficiency of the method, the quantity of the drugs being too small to produce a decided physiological action.

GENERAL ANESTHESIA.

General anesthesia suspends consciousness, relaxes the whole body, and puts the patient for the time completely at the disposal of the operator. It is therefore suitable for prolonged, difficult, and painful operations.

The Anesthetizer.—The office of the anesthetizer is scarcely secondary in importance to that of the operator; it is one of the most serious errors to hold that this responsible position may be delegated to an inexperienced person or a mere student, for timidity or bad judgment on the part of the anesthetizer may result in an imperfect anesthesia which interrupts and harasses the operator, while too profound an anesthesia may kill the patient on the table or by an excessive use of the drug produce a bronchitis or pneumonia which may prove fatal.

An unskillful anesthetizer is also prone to forget his office and become absorbed in the operation with imminent risk to his charge. As the surgeon's attention must be engrossed by the operation, it is highly essential that the assistant who gives the anesthetic should be thoroughly reliable, because to him must be intrusted the administration of stimulants if danger symptoms arise; if

the operator has to direct the anesthetizer, it is confusing to both, and the anesthetic is likely to be improperly administered. If it is necessary to call upon an inexperienced person to administer the anesthetic, he should be fully instructed beforehand, and the operator should be constantly on the watch.

Ether and chloroform are the only anesthetics universally used, and each of them has its marked peculiarities. The employment of the one or the other is for the most part determined rather by national and geographical boundaries than by the special adaptability to the particular case. Chloroform, for example, is used almost universally in England and on the continent of Europe, although ether has been recently making its way more and more into the German clinics. Ether is par excellence the anesthetic of the United States, but this is not without the notable exception of nearly all the Southern States, where chloroform is used almost exclusively.

The anesthetic of the future will certainly be given in an atmosphere definitely diluted. Spenzer (*Western Reserve Medical Journal*, November, 1894) has recently definitely shown that ether in a 3·5 per cent solution can be given to dogs for hours without ill effects, while 6 per cent will prove fatal in a short time.

In prolonged operations or operations upon debilitated patients, the patient should be kept thoroughly warm, to counteract the depressing drop of temperature of the anesthesia; this is best accomplished by hot-water bags placed near different parts of the body.

Signs of Complete Relaxation.—1. Loss of conjunctival reflex. The common practice of testing the eye reflex by touching the conjunctiva with the finger tip is to be severely condemned, for not a few patients have developed a severe conjunctivitis from such treatment.

2. Fixed, contracted pupils.

3. Slow, regular, and deep inspiration.

4. Complete loss of general reflexes and resistance.

I have never had occasion to pass a ligature through the tongue to pull it forward. This can only be necessary during operation on the face or throat, where it is impossible to pull the jaw forward and throw the head backward, which if skilfully done will open the upper air passages. In hundreds of cases I have never been compelled to use swabs to clear the throat and mouth of mucus. If the position of the head and jaw is correct, the collection of mucus will work itself into the mouth, where it can be gently removed by a soft towel or a piece of gauze.

I have found the greatest difficulty in anesthetizing patients addicted to the use of morphine and alcohol. It is sometimes almost impossible to obtain complete relaxation, and the breathing throughout is stertorous, and interferes seriously with the proper exposure in abdominal operations by constantly forcing the intestines into the field of operation. Stertorous breathing, if prolonged, is an indication of asphyxia, and is usually quickly relieved by allowing the patient more air, or by throwing the head backward and the jaw forward, or by clearing the mouth of mucus.

The difference in color of the face between simple mechanical asphyxia and

that produced physiologically by the drug is worthy of attention; in the former the face becomes blue, the eyes protrude, and the features swell, while in the latter the change is more gradual, the face does not swell, it becomes livid, and changes slowly into a grayish pallor. This pallor is often the first signal of danger, as the respirations may become shallower and shallower imperceptibly without mechanical signs of interference, and the anesthetizer may be unaware of the change.

The danger symptoms are:

1. Cessation of respiration.
2. Stoppage of the pulse.
3. Sudden pallor.
4. Dilated, fixed pupils.
5. Dark-hued blood replacing bright arterial blood.
6. Sudden cessation of bleeding in the course of operation. The anesthetizer will naturally notice the first four points, and the operator the other two, and sometimes the first.

Pneumonia may follow the administration of the anesthetic, whether ether or chloroform is given. Out of 1,800 administrations I have seen this complication eight times. The liability to pneumonia is increased if the patient has a slight bronchitis or a coryza beforehand.

Oxygen after Anesthesia.—The administration of oxygen gas to the patient coming out of the anesthetic is at present being extensively employed, both to hasten the complete recovery of consciousness and to lessen the nausea. It is particularly recommended for old and feeble patients, and for those who have a tendency to bronchorrhea, and after prolonged, exhausting operations. The oxygen, stored in a small cylinder, is passed through a bottle containing water, by which the rate of flow can be estimated; it is then given diluted with the air by holding the end of a tube near the face. Chloroform may be administered in the same way by allowing the oxygen to pass through a bottle containing chloroform instead of water.

Oxygen is also often given during the anesthesia in the same manner by conducting a rubber tube connected with the cylinder of compressed oxygen under one side of the ether cone or through its point, or indeed by passing a small rubber tube into one nostril even. The gas liberated by the removal of the pressure slowly bubbles through the water bottle and enters the air passages along with the anesthetic with every breath.

Although many surgeons express great satisfaction with this adjuvant, its real value has not yet been determined and awaits careful investigation.

The following slip is kept and filled out by the anesthetizer in my clinic:

ANESTHESIA SLIP.

No.

Name, *Ward*,

Date, *Age*,

General condition of patient,

Examination of chest,

Pulse before anesthesia,

Pulse after anesthetic,

Anesthetic used,

Anesthetic started,

Anesthetic ended,

Amount of anesthetic consumed,

Operation started,

Operation completed,

Diagnosis,

Operation,

Mode of closure of incision,

Dressing,

Operator,

Incision closed by

Saline infusion, by rectum, *into abdomen*, *into cellular tissue*,

Irrigation,

Enema,

Strychninæ sulphas, gr.

Atropinæ sulphas, gr.

Nitro-glycerin, gr.

REMARKS.

CHLOROFORM.

Only chloroform manufactured by perfectly responsible chemists should be used, owing to the increased dangers from adulteration.

The advantages of chloroform are in some respects greater than those of any other anesthetic. By its means we are able to bring the patient more quickly and more comfortably into a state of unconsciousness. She remains more quietly under its influence, and as a rule nausea is not so extreme as after taking ether. In my experience the percentage of cases entirely free from nausea is as great after ether as after chloroform anesthesia. Out of 50 cases of chloroform anesthesia, 6 were free from nausea afterward; and out of 200 cases of ether anesthesia, 28 were free. These advantages are more than counterbalanced, however, by the greater risk to life in using chloroform. The mortality from chloroform is about one case in 3,000. Chloroform is contra-indicated on account of its increased danger in a weak heart or in an overtaxed right heart. It is not contra-indicated in valvular disease with good compensation or in any particular form of abdominal disease. It is also probably better in nephritis, but, as Hare says, quantity for quantity, compared with ether, it is more irritating in this condition. Its administration is preferable in old people with atheromatous vessels, in children, or in patients who struggle violently.

Operations must not be performed under chloroform during the stage of primary anesthesia, so frequently utilized for short operations under ether. Deaths have occurred in this way which were apparently due to sudden inhibition of the heart from shock not felt in complete anesthesia. The quiet even anesthesia produced by chloroform is such an advantage in abdominal surgery that it would be indicated in all cases were it not for these dangers.

It kills by paralyzing either the heart or, more frequently, the respiratory centers, according to the report of the Hyderabad Chloroform Commission, which is supported by the investigations of Dr. H. A. Hare. The first symptom of danger is either a complete relaxation of the pupils, a sudden pallor of the face, or a weakening of the respiratory movements, which become feeble and intermittent, accompanied or followed by sudden or gradual failure in the pulse. It has been my experience in two cases to see the respirations fail first, while in at least two other cases there was an alarming failure in the heart's action, the respiratory movements being still good. The first warning may be the sudden ashy pallor, which should call for immediate resuscitative measures, as it is always a precursor of graver danger. The respiration should be as closely observed as the pulse, and any change in its depth or rhythm should be carefully noted.

Before giving any anesthetic at all the character of the respiration must be noted, and the heart must be carefully examined.

The nature and action of the anesthetic should be explained to the patient, and it is always best to tell her that she may hear peculiar sounds or that she may have the sensation of falling, etc.; otherwise the occurrence of these phenomena in the first stage of anesthesia may frighten her, causing her to struggle violently. The face should be lightly anointed with vaseline and the eyes and

mouth covered with soft towels. I have seen the whole side of the face badly burned by chloroform, due to the neglect of this precaution. The room must be perfectly quiet, and no talking should be permitted to excite the patient and retard the progress of the anesthesia.

It is best for the anesthetizer to accustom himself to taking the pulse in the temporal or facial artery. It is much more convenient than the radial pulse.

The following rules regarding the preparation for anesthesia apply to the administration of both ether and chloroform:

1. The diet should be carefully regulated, if possible, several days before administering an anesthetic, only easily digested foods being given. On the day preceding, liquid or soft diet should be insisted upon. During this period the bowels must be freely moved each day, either by an enema or a mild laxative. Nausea and vomiting will be much less if the patient fast at least six hours before taking the anesthetic.

2. In very nervous patients a small dose of morphine, given about half an hour before anesthetizing, renders them more tractable. Atropine, in doses of $\frac{1}{150}$ to $\frac{1}{200}$ of a grain, is said to lessen the bronchial secretion and to act as a mild respiratory stimulant, but in my experience it has not proved of great value.

3. False teeth and all foreign bodies should be removed from the mouth.

4. Bands which tend to constrict the neck or waist must be loosened.

Rules for Administering Chloroform.—The following rules are to be observed in the administration of chloroform:

(a) An examination of the patient beforehand as to the condition of her vascular system, lungs, and kidneys. A weak or a laboring, dilated heart are contra-indications prohibiting the use of chloroform.

(b) The assistant who gives the chloroform must be accustomed to its use, and must realize keenly that there is danger in every case.

(c) It is never right to assign the administration of chloroform to one who has been accustomed to administer ether only, and in no case should anesthesia by chloroform be intrusted to a nurse, unless a responsible physician keeps the patient constantly under his supervision during its use.

(d) Chloroform should never be given, except in obstetrics, without abundant help close at hand to resuscitate in case of asphyxia.

(e) The patient must not be disturbed in the early stages of anesthesia by slamming doors, loud walking, or talking. I have seen a patient jump up and refuse to take more when frightened in this way.

(f) Chloroform must be given from a graduated bottle containing a definite quantity, a few drops at a time on the inhaler, with an abundant admixture of air.

(g) The anesthesia must never be hurried, and, above all, the person giving it must not use the common exhortation, "Breathe deeply."

(h) The head must never be raised higher than the body, to avoid sudden anemia of the brain.

(i) If the patient vomits, the chloroform should be put aside and the jaw

drawn forward, by hooking the fingers behind the angle, and the face turned to the side, until she is quiet again, when the anesthetic may be resumed.

(k) If the anesthetizer notes any alarming change in the patient's pulse, respiration, color, or pupils, he must at once suspend the anesthesia, and, if the condition persists, proceed to resuscitate.

(l) If the respiration becomes unequal or stormy the chloroform must be immediately withdrawn, as there is no way of judging how much more of the drug is being absorbed than under ordinary conditions of breathing.

The patient must be carefully and continuously watched after the anesthesia is over until she becomes conscious, as she may die in this post-operative stage. When a patient does not rally well and promptly she should be watched with increased care, and stimulants in the form of external heat, stimulating rectal enemata, and hypodermics of brandy, digitalis, and strychnine must be given. In such cases death has occurred several hours or longer after the operation.

A satisfactory way of using chloroform is completely to anesthetize the patient with it, and then to continue the anesthesia throughout the operation with ether. Chloroform may be given at the start by a physician, and the ether anesthesia kept up by an experienced nurse.

The best method of giving chloroform is with the Esmarch inhaler. A few drops—not more than four or five—are poured on the flannel hood covering the little rounded wire frame, which is held at least five inches from the face. The patient should be slowly and gently brought under its influence by adding a few drops from time to time, and gradually bringing the inhaler closer to the face.

In case of difficult breathing arising from the root of the tongue dropping back in the fauces, the lower jaw must be seized behind the angles and pulled forward, producing subluxation, and the head at the same time extended, so as to bring the upper air passages and the trachea into line. (H. A. Hare's method, *Johns Hopkins Hosp. Bull.*, January, 1895.) The practice of using much force in pulling the jaw forward is reprehensible; patients frequently complain for days of soreness at the angles of the jaw, and I have seen parotitis occur as a result of the traumatism. If moderate force is not sufficient to draw the jaw forward it should be protected with pads of cotton or gauze, or the mouth should be opened and the tongue pulled forward with a tongue clamp; but it is rarely necessary to resort to this measure.

In giving chloroform the anesthesia must never be hastened; in this respect the rule is diametrically opposite to that for the use of sulphuric ether.

Resuscitation of the Asphyxiated.—As soon as a pallid face, dilated pupils, a feeble pulse, and cessation of respiration are noticed, no time must be lost in proceeding at once to resuscitate the patient.

The operation must be instantly suspended, arteries in the field of operation whose lumina can be seen (for they will have ceased to bleed) must be temporarily clamped, and the wound hastily protected with sterilized gauze, while an assistant jumps upon the table, grasps the patient's legs beneath the knees, and lifts the body up to an angle of 40 or 45 degrees, until it rests on the shoulders. In this way the blood gravitates down into the head and heart.

The surgeon takes his stand at the head, which lies extended over the edge of the table, and proceeds at once to establish artificial respiration by placing both hands behind the chest and drawing it toward him, producing inspiration (Fig. 103); by the reverse movement, pushing backward and inward, expiration is produced (Fig. 104). An assistant making pressure in the epigas-

Fig. 103.—Induction of Artificial Respiration after Chloroform Asphyxia.

The patient's head hangs extended over the edge of the table while an assistant on the table elevates her body. The operator then induces inspiration by drawing the lower thorax well forward.

trium prevents the effect of the respiratory efforts being lost on the abdominal viscera. The air can be heard rushing in and out, pulsation is soon felt at the wrist, at first feebly, then stronger, the color becomes natural, at-

tempts are made to respire, and in a short time the danger is past, when the operation may be resumed. If the pulse can not be felt at the wrist it may be found by feeling the abdominal aorta through the incision. If it is not

Fig. 104.—The Induction of an Inspiration is followed by the Compression of the Lower Chest, producing a Forced Expiration.

felt there the hand may press up through the diaphragm and feel the heart directly.

Where the lower chest is contracted by the wearing of corsets and when the costal cartilages are calcified this manipulation will not produce respiration, and it is necessary to force air in and out of the chest by placing one hand on the middle or lower thoracic spine and the other on the sternum. Then, com-

pressing the chest, air is forced out, and by relaxing the pressure it rushes in again. In this way a regular respiration may be maintained until it is established voluntarily. The larynx can be kept open by hooking an index finger into it.

If it is necessary to resort to artificial respiration when there is not a sufficient number of assistants present to carry out the method just described, as may occur in private practice, the plan formulated by Dr. Sylvester should be followed. By this method the patient is quickly placed in position across the bed with a pillow or roll of clothing beneath the thorax. The surgeon, standing at the head of the patient, grasps her arms at the elbows and draws them upward and outward, describing a circle, until they meet above the head. This movement induces inspiration by expanding the chest through the agency of the pectoral muscles. After a pause of two or three seconds the arms are swept downward and outward to the sides of the chest, against which they are firmly pressed. This maneuver induces expiration by diminishing the capacity of the chest. The two movements should average eighteen to the minute.

ETHER.

Under this title, in America, washed sulphuric ether is universally understood. Only that brand known to be the purest in the market should be used. Ether is contra-indicated in bronchial catarrh, or where its use excites bronchorrhea, or constant coughing with asphyxia due to irritation of the air passages, or violent continuous nausea. Chloroform must then be used. It is not contra-indicated in kidney disease, nor in any other disease, except where the act of straining may prove injurious, or where the patient is so weak that any little additional exertion may prove fatal. I have lost but one case on the table from ether anesthesia, and the autopsy showed atheromatous arteries and chronic myocarditis.

Various styles of ether inhalers have been devised, but I consider the towel cone, stiffened with paper, as after all the most satisfactory; it is easily made, and a fresh one can be prepared for each patient. A stiff piece of blotting paper or moderately heavy manilla paper, 15×10 inches in diameter, should be covered with oiled muslin, and this in turn with a clean towel. The oiled muslin may be dispensed with if not at hand. This pad is then twisted into the shape of a cone and then pinned together. A moistened sponge or piece of cotton is lightly packed into the apex, and upon this the ether is poured. It is always best to give ether gently, soothing the patient and letting her grow gradually accustomed to the vapor as it is brought nearer and nearer to the face. A few minutes spent in this way will obviate entirely the necessity of forcing the patient down on the table and strangling her with the drug, a procedure never to be forgotten.

In the early part of the anesthesia only small quantities of ether should be used, and no attempt should be made to force the patient to take it rapidly. If the patient is told to breathe deeply the respirations will continue full and regu-

lar, according to the suggestion of the anesthetizer, until her volition is overcome, when there is a cessation in the breathing which prevents the even administration of the ether. For this reason I think it is best to instruct the patient to breathe naturally, and only to command her to breathe deeply when she persists in holding her breath. By gradually bringing the inhaler nearer the face and allowing at short intervals a breath or two of fresh air the disagreeable strangling sensation is avoided. As soon as she loses consciousness it is an error to remove the ether whenever there is a disposition to vomit; this is best overcome by increasing the quantity of ether and getting her more completely anesthetized. A timid anesthetizer, by hesitating at this point, can harass an operator throughout a long operation.

Operation under the Primary Effect of Ether.—At an early stage of the anesthesia, just as consciousness is lost, there comes a short period of relaxation and insensibility, which can be utilized for such short operations as paracentesis, dilating a sphincter, opening an abscess, excising a small tumor on the surface, or passing two or three sutures.

In two or three minutes this stage is passed and a noisy, excited stage may follow, which lasts ten or fifteen minutes or longer, finally passing into the stage of profound anesthesia. When this final stage is reached it is important to give just enough ether to keep the patient completely relaxed and unconscious, and not a bit more. While coming out of ether anesthesia the patient must be watched, and assisted when she vomits by turning the head and body to one side, cleansing the mouth, and keeping her face clean and her pillow protected. Care must be exercised to keep her fauces clear and to prevent her from inspiring regurgitated food.

The duration of the period of unconsciousness depends greatly upon idiosyncrasy and upon the amount of the anesthetic taken; while one patient may come to in a half hour, another will lie sleeping or in a dazed state for four or five hours. It is generally safe in private practice for the physician to leave her in the care of the nurse after she has spoken.

The liability of patients coughing and straining excessively as they are coming out of the anesthesia must be borne in mind, and stitches and ligatures must always be put in so that they can not possibly tear out or give way from any such cause.

Death from Anesthesia.—In about 8,500 administrations of ether I have lost two patients from the anesthetic.

One of these, a woman of forty, died after the removal of an adherent ovarian cyst, presenting no unusual difficulties and not involving the loss of much blood. She died as the wound was being closed, after an operation lasting forty minutes; the first danger sign was a deep congestion of the intestines followed by cyanosis of the face, bulging eyes with widely dilated pupils, and an imperceptible pulse. Respiration became shallower and shallower, and there was no response to any form of stimulation or to all efforts to induce respiration. No cause for the death could be discovered.

The second death after ether occurred shortly afterward in the case of a

woman sixty-four years old—L. T. N., 4232, March 18, 1896—after an abdominal hysterectomy for an adeno-carcinoma of the uterus, lasting two hours. The patient was obese, weighing 235 pounds, and took the ether badly from the start. The pulse, which had become steadily more rapid and small, ceased first, while the respirations, labored throughout, became more labored and gasping, and the face livid. Artificial respiration could not be carried out on account of the unwieldy form of the patient.

One death has occurred in about 1,500 chloroform anesthesias. This was the case of a colored woman of forty-seven—B. B., 3257, January 1, 1895—who died during the early stages of the anesthesia.

She had taken chloroform on one occasion before, and objected so strenuously to ether that chloroform was again used. The first part of the anesthesia passed off quietly, but when placed for operation she became so rigid that the Esmarch inhaler was brought closer to the face, at no time nearer than two inches. This did not help the rigidity, and the respirations grew shallower. The chloroform was taken away at once and ether sent for; but the temporal and radial pulses had become imperceptible, and then respiration ceased. Efforts at artificial respiration were utterly ineffectual, owing to the fact that she had a rigid chicken-breasted chest with calcified cartilages. The autopsy revealed also an adherent left lung, abdominal viscera everywhere mutually adherent and attached to the diaphragm, and atheromatous vessels (see *Johns Hopkins Hosp. Bull.*, vol. vi, May-June, 1895).

CHAPTER VIII.

GENERAL PRINCIPLES INVOLVED IN PLASTIC OPERATIONS.

1. Preparation. Rest. Bowels. Urine. Dress for operation.
2. Operation. Position of patient. Washing of genitalia. Assistants. Irrigation. The operation. Dressings after operation.
3. Care during convalescence. Position of patient in bed. Douching, if necessary. Catheterization. Care of bowels. Diet. Care of wound. Removal of sutures. Rest and tonic treatment. Hemorrhage following operation. Infection.

All plastic operations about the vulva, vaginal outlet, vagina, and cervix have certain common details, which may be considered in the following order:

1. Preparation for operation.
2. The operation.
3. Care during convalescence.

PREPARATION FOR OPERATION.

Every patient should be subjected to a thorough general physical examination before the performance of any gynecological operation, in order to exclude the possible presence of any obscure disease that might account for the condition of ill health. If the examination shows that an operation is necessary, and the general health of the patient is much impaired, a rest of a week or more in bed will hasten the convalescence, toning up the system and quieting the mind. Such a preparation is especially valuable in the case of nervous women. Constipation, which is obstinate in many uterine affections, should be overcome by a purgative, the continued use of mild laxatives, and a light but nourishing diet should be given. If there is loss of appetite, a simple tonic, such as tincture of nux vomica, calumbo, or gentian, is often helpful. Women with marked debility will be benefited by massage, cold baths, and electricity. When, however, the general health of the patient is good and she is clearly suffering from purely local symptoms, the preliminary period of rest and tonic treatment may be dispensed with, and the operation may be done with but one or two days' preparatory treatment.

The older gynecologists invariably put their patients under a protracted course of preparation for an operation, while the present rule is to operate immediately and to build up the patient during her convalescence.

Immediately preceding the operation the bowels should be carefully evacuated, so as to avoid disturbing them for at least two days afterward. To insure thorough purgation, ʒij of licorice powder, or a similar amount of magnesium sulphate, should be administered (both morning and evening of the day before),

followed the next morning at six o'clock by a warm enema of a pint of soap and water. If the patient is delicate a milder purgative, such as a pill of aloes, strychnine, and belladonna, or the solution of citrate of magnesium, ℥ viij, may be given with good effect. The enema should be given quite three hours before the operation, regardless of the effect of the purgative, as it is essential to have the rectum and sigmoid flexure clear of feces. The action of an enema given later than the time specified is often delayed until the operation is under way, when the surgeon may be annoyed by the constant ejection of semi-fluid feces over the gauze diaphragm in front of the buttocks.

The urine must always be carefully examined both chemically and microscopically before operation. Diabetes is a contra-indication to any surgical operation in most cases. Nephritis in its early stages does not materially decrease the patient's chances of recovery. If, however, the constitutional and local symptoms indicate advanced nephritis, the operation should in no case be performed.

The early morning is the best time to operate, when the surgeon feels fresh for his duty and his hands are free from the contamination of his daily work; the patient should also have a good night's rest, insured if need be by a mild sedative. The evening before operation the patient should take a hot bath, and immediately go to bed. The following morning, after the enema, the vagina should be thoroughly cleansed with a douche of carbolic acid solution (2 per cent), or boric acid (32 grains to the liter), at a temperature of 110 F. As a rule, no food of any kind is given on the morning of the operation. If, however, the patient is weak or feels faint, a glass of warm milk, or a cup of tea diluted with milk, may be given.

The patient's dress for operation consists of an undervest of warm flannel in winter, or of gauze in summer, a nightgown open up the back, and a pair of long woolen stockings. The hair is most conveniently dressed by plaiting it in two braids.

If the operation is to be performed in a private house, the patient should be anesthetized in a room adjoining the one selected for the operation; in a hospital the anesthetizing room is always separate from the operating room.

THE OPERATION.

The Position of the Patient.—The operating table is covered with a blanket protected by a sterilized sheet, and upon this, at the end of the table upon which the buttocks are to rest, is placed a rubber perineal drainage cushion. The buttocks rest squarely upon the cushion, projecting slightly over the edge of the table, and the legs and thighs are held flexed upon the abdomen by a leg holder. To apply Kelly's or Robb's leg holder, buckle one end of it around the thigh just above the popliteal space, taking care to keep the band smooth, so that it does not bind the leg too tight. The other end is then carried up under the shoulder, around the neck and down to the opposite side, where it is similarly buckled above the popliteal space. When the patient is thoroughly under

the anesthetic this leg holder simply detains the legs, without cramping them, and the knees fall apart naturally without the assistance of the leather crutches and bar so much used in the past. The arms of the patient should be folded across her breast and retained in this position by drawing the skirt of the undervest well up over the elbows. The nightgown should be pushed up under the small of the back above the drainage cushion.

The external genitals are thoroughly soaped and shaved up to the mons veneris. Robb's razor, with a short fixed metal handle devised for this purpose, is useful. After shaving, the genitals should again be thoroughly washed with soap and water. Green soap or soft soap serves admirably for the purpose; it can be thoroughly rubbed into the skin, cleansing better than hard soap. Be careful to cleanse all furrows between the labia and about the clitoris.

After the external parts have been cleansed, the assistant takes a pledget of cotton covered with soap, and introducing it into the vagina with long forceps, under a stream of water from the irrigator, smooths out all furrows and scrubs thoroughly all accessible parts, so as to remove the discharges and accumulated epithelial *débris*. Then the vagina is douched with a 10 per cent creolin solution, which sterilizes and acts as an efficient detergent. This solution is followed by a bichloride of mercury solution (1–2,000), and this again by warm water. A thorough vaginal cleansing will require from three to five minutes.

Long sterilized canton flannel stockings are now drawn over the patient's legs and fastened above the knees with a draw string. A protector 1 meter square (1 yard), composed of two thicknesses of gauze, is spread between the thighs, covering all the exposed parts, and hanging well down over the buttocks onto the cushion; as the surgeon takes his seat he cuts a small opening in the protector corresponding to the vulva so as to expose the field of operation.

Assistants.—For convenience of rapid work the surgeon will do best with four assistants—one to give the anesthetic, two standing on either side of the patient to help the operator, while the fourth hands the instruments and ligatures as wanted. In operations conducted in a private house or private hospital the operator can make shift with two assistants—one to give the anesthetic and one to assist him directly.

Irrigation.—Irrigation by a continuous stream of warm water directed over the field of operation is the best means of removing the blood, leaving the line of incision and denudation constantly clear. Sponging is not so good, only imperfectly removing the blood, which remains to coagulate about the ligatures and to cling to the hands of the surgeon, rendering them sticky and slippery. A glass reservoir holding several gallons of water should be placed on a shelf at an elevation of five feet above the operating table. The rubber tubing from the reservoir, when not in use, should be coiled and kept immersed in a 5 per cent carbolic solution. It is best to regulate the flow by a glass douche nozzle, an Esmarch's hard rubber stopcock, or an efficient ball-and-

socket nozzle, like the one here figured, because either can be easily detached for sterilization.

The assistant on the right hand of the patient takes charge of the irrigation, keeping the area upon which the surgeon is working free from blood.

Fig. 105.—Swedish Hard Rubber Ball and Nozzle Irrigator.

By bending the nozzle in the ball at an angle the flow is controlled or stopped altogether.

In vaginal hysterectomy a normal salt solution ($\frac{6}{10}$ of 1 per cent) should be used; it is not irritating and does no harm even though it enters the peritoneal cavity.

The Operation.—Just as the artist, with a few rapid strokes, sketches in the outline of his picture, so the surgeon will first outline his field of a plastic operation by incisions, marking its outer limits. This will enable him to judge more deliberately as to the amount of tissue to be removed; it is better, of course, to err on the side of a small outline than a large one, because a small outline may be enlarged so as to include more tissue, if found necessary. Outlining with the knife is especially important where scissors are to be used; the knife cuts a sharp line and the mucous surfaces then pull apart, permitting a rapid denudation with the scissors and subsequent accurate coaptation of the edges.

Bleeding is rarely active in plastic operations, the vessels being of smaller caliber. If, however, there is enough bleeding to annoy the operator, the vessels may be temporarily caught with artery forceps until the sutures are introduced. A large vessel which persists in bleeding after the forceps are taken off may be controlled by introducing one of the sutures approximating the parts, so as to grasp the vessel in its loop; this suture should be tied tighter than an ordinary approximating suture, so as to check the bleeding, and thus it serves the purpose of both suture and ligature.

The sutures are of three kinds—silkworm gut, silk, and catgut. Silkworm-gut sutures best bear the tension in bringing together widely separated areas. Silk and catgut sutures are used for accurate approximation, either to supplement the silkworm-gut sutures, or alone, where there is but slight tension in bringing the wounded surfaces together. Catgut is ill adapted for use, if there is any outward traction of the wound. The best suture for close approximation is fine silk, which offers the least possible opportunity for the entrance of septic matter. Silver wire is now rarely used, and there are no circumstances under which it is better than silkworm gut.

Dressings after the Operation.—At the end of the operation the vagina and external genitals are dried by pledgets of sterilized cotton. A strip of iodoform gauze may then be inserted into the vagina with the three-pronged packer as far up as the cervix, loosely filling the upper vagina and just appearing at the outlet; this should be taken out in five or six days and the vagina douched daily afterward.

It is my practice at present to use no vaginal dressing at all, but simply to

protect the vulva by a sterilized gauze pad held in place by a T-bandage. The pad is changed several times daily, and if there are any offensive discharges the vagina is douched out with a warm boric or carbolic solution once or twice a day. I have found a powder composed of boric acid, 3 ounces; alum, 1 ounce; carbolic acid, ½ ounce; and oil of peppermint, 1½ drachm, very satisfactory in relieving the odor and irritation which are sometimes distressing during the convalescence from a plastic operation.

Before removing the patient from the table draw the urine with a glass catheter, loosen the leg holder, and raise the buttocks by carrying the feet of the patient toward her head; dry the genitals, buttocks, and back with a towel, and remove the drainage pad.

The external genitals should be powdered with iodoform and boric acid (1–7), and then covered with a loose pad of sterilized cotton, held in place by a T-bandage.

CARE DURING CONVALESCENCE.

A nurse or doctor should remain with every patient, controlling any violent movements until she has fully recovered consciousness. In rectal and perineal operations it is not necessary to follow the old practice of restricting the movements of the legs with a binder after she becomes conscious. She may also be turned on her side if she wishes.

In perineal operations the bedpan must be used for two weeks and straining avoided. After cervical operations this restriction is not necessary, and cervical cases are required to stay in bed from seven to ten days only. If the patient can pass her urine voluntarily from the first she should be permitted to do so.

The vaginal pack is removed when a discharge appears externally, and when the discharge continues a douche is necessary; it should be given with the greatest care, to avoid pressure of the nozzle on the wound, once or twice daily. A trained nurse, or the physician himself, should attend to this duty, for it has not infrequently happened that an unskilled nurse or an ignorant attendant has thrust the point of the syringe through a recently repaired perineum.

The nurse should be instructed how to separate the labia and expose the outlet with one hand by pushing downward and backward without making traction on any sutures. Secretions are now removed with pledgets of cotton held in the dressing forceps, and the blunt glass douche nozzle, gently poised between the thumb and index finger, is introduced in a direction backward and inward. Be careful to expel the air from the douche nozzle before it is introduced into the vagina. After the douche is given the genitals are dried with pledgets of sterilized cotton dusted with iodoform and boric powder (1–7), and covered again with a sterilized cotton vulvar pad. Under no circumstances should the hands come in contact with the field of operation. Except in cases of infection, douches should not be given earlier than the seventh day.

Catheterization.—A serious complication to be guarded against in all plastic operations is a cystitis caused by catheterization, and for this reason I wish to speak with special emphasis about catheterizing and the care of the catheter.

In skilled hands the glass catheter is best. Immediately after use it should be rinsed in warm water and boiled for five minutes in a soda solution, and preserved aseptically, wrapped in sterilized gauze, or immersed in a bottle of carbolic solution (5 per cent); or it may be stored in a glass ignition tube, resting on cotton and plugged with sterilized cotton. Metal catheters should not be used. Rubber catheters are safest in untrained hands, and are sterilized by keeping them in a carbolic solution (20 per cent); the catheter should be rinsed in boiling water before using.

Catheterization must be performed in the following manner: The vulva is exposed under a good light, so as to bring the urethral orifice into full view upon separation of the labia with the thumb and forefinger of the left hand. Then, with the dressing forceps in the right hand, the parts immediately surrounding the urethra may be cleansed with pledgets of sterilized cotton saturated with boric acid solution; now take the catheter from its receptacle, without touching its vesical end, and introduce it gently into the bladder, not attempting in any way to control its direction: it will follow naturally the course of the urethra. Before withdrawing the catheter, stop up its outer end by the finger to prevent the urine from dribbling over the parts. Finally, dust the vulva with iodoform powder, and replace the sterilized T-bandage.

Care of the Bowels.—On the second evening following the operation a pill of aloin, strychnine, and belladonna, or two drachms of licorice powder, or a half drachm of cascara, is given, followed the next morning, if necessary, by a soap and water enema. The custom of confining the bowels for eight or ten days is reprehensible. There is no danger of fecal matter gaining access to the wound, even where sutures have been passed on the rectal surface if they have been properly placed and properly tied. There is likewise no danger of disturbing united wound surfaces by the downward displacement of the pelvic floor during defecation on the third or fourth day following operation, if the feces are soft or fluid. When the bowels are confined for a longer period, there is often great difficulty in securing a movement, and the effort to pass the scybalous masses is now attended with real danger, because the sutures have become loosened and the union of parts is not sufficiently firm to withstand the pressure.

Only a trained nurse or the surgeon himself should give the enema. I have known an inexperienced person to push the nozzle of the syringe through the coats of the bowel and force the injection into the pelvic cellular tissue. In one case I knew a nurse to push the end of the syringe through the stitches of a ruptured perineum and inject into the vagina. The most convenient position for giving the enema is with the patient lying on the left side. If a scybalous mass blocks the rectum the surgeon must himself introduce his index finger, break it up, and hook it out, making pressure in a direction away from the wound. When the bowels are once thoroughly opened, they should be kept open by a mild laxative, or an enema given every other day.

Diet.—No food is given until the patient has recovered from the nausea following the anesthetic. After from twelve to twenty-eight hours the stomach

is usually sufficiently settled to permit the retention of small amounts of liquid nutriment. It is best to commence with from 30–60 cubic centimeters (1-2 ounces) of milk every two or three hours, followed in a day or two by light broths of chicken, beef, or mutton. If nausea is persistent, a nutrient enema should be given to sustain strength, consisting of 60 cubic centimeters of milk and the yolks of two eggs, with enough water to make 120 cubic centimeters (4 ounces). Tea well diluted with milk, hot beef tea with the yolk of a raw egg stirred in, rice soup, kumiss, are usually well borne.

From the third to the seventh or tenth days soft diet is best—soft boiled eggs, sweetbreads, oysters, white meat of chicken, milk toast, rice, bread, mush, baked apples, and baked potatoes. After the seventh day full diet may be gradually resumed.

Care of the Wound.—Where the wound is entirely or partly on the surface, the chief point in its care is to keep all objects which might convey infection from coming in contact with it; for this reason neither the surgeon nor the nurse should touch the wound with the hands in the subsequent dressings. The removal of discharge and arrangement of the gauze or cotton dressings should be effected with sterilized forceps.

If there is free discharge, it should be removed once or twice daily with pledgets of cotton, followed by a light dusting of the surface with the iodoform and boric powder mixture.

The length of time during which the sutures should be allowed to remain varies both with their position and with the results aimed at. If the healing is uninterrupted, the skin sutures may be removed with safety on the eighth day. Those within the vagina should not be removed before the twelfth day, or even later, on account of the danger of separating surfaces not yet firmly united.

Cervical sutures of silkworm gut may remain in place almost indefinitely, and, if the operation has been one of combined cervical and perineal repair, their removal should never be attempted until the perineum is quite firm and sound again, in from four to six weeks.

In order to remove the sutures, the patient is brought across the bed, or, better still, placed on a table, with the buttocks toward a good light, and the legs flexed upon the abdomen. The dressings and any incrusted powder are removed by sopping the parts with a warm boric acid solution; if the field of operation is within the vagina it is exposed with specula or retractors. In removing cervical sutures a Sims's speculum is inserted and the posterior vaginal wall retracted, while the anterior wall is elevated by a narrow flat retractor. The first suture seen is caught with forceps and pulled upon until its loop comes into view, which is then cut and the suture withdrawn. The remaining sutures are found by displacing the cervix first to one side and then to the other. Sutures upon the floor of the vagina can not always be readily exposed, and are often best located by touch and then grasped with forceps and removed.

Stitches on the rectal side are readily removed by drawing them through the fenestrum of a rectal speculum which is pushed into the bowel, exposing

the line of union, as practiced by Dr. G. M. Tuttle, of New York. Care must be taken in cutting the loop not to cut off both sides at once, as a loop thus left in the tissues will invariably cause persistent irritation and discharge, and must be removed sooner or later.

Rest and Tonic Treatment.—A patient upon whom a minor plastic operation has been performed should remain in bed for two weeks or longer, both for the purpose of securing firm union of the tissues, as well as for the equally important purpose of building up the nervous system and recruiting the general health. Advantage should be taken of the opportunity to keep neurasthenic patients in bed eight weeks or longer, giving them at the same time the benefit of a rest cure. From the fourteenth to the eighteenth day, depending upon the general improvement in symptoms, the patient may be permitted to put on a light wrapper and sit in a reclining chair or lie on a couch in sunny parts of the room. By the twentieth day she may resume her lighter duties, gradually increasing them during the succeeding days, until she has returned to her customary routine of work. The tendency of our hospitals is to make the stay of poor patients too short and to hurry them home.

It is a serious error to consider the function of the surgeon at an end when the wound is well healed and the operation in a technical sense successful. Patients who have long been in bad health before operation should be kept under observation for months afterwards, for the purpose of directing exercise, diet, and tonic treatment. Suitable exercise should be regularly and persistently taken, short daily walks in the open air, and rubbing down with alcohol or cacao butter on going to bed. Morning and afternoon the patient should rest for an hour on the back. Gymnastic exercises are not necessary, and exhausting exertion, such as shopping and dress fitting, must be avoided. Such tonics as tincture of nux vomica and the preparations of hypophosphites combined with cinchona often encourage a poor appetite. Koumiss, malt extract, or malt and milk, are valuable aids to the ordinary diet. One of the best therapeutic agents is a complete change of air for two or three months—in winter to a warmer climate, in early spring to the seashore, or in summer to the mountains.

In all of these cases it is absolutely essential to a perfect recovery to relieve the patient's mind of anxiety; for this reason the burdens of her regular duties, whether social or domestic, must be cast off or lightened as much as possible. As a general rule, the sexual relation should be prohibited for three months after plastic operations involving the vagina, and should then not be permitted oftener than once a week.

Hemorrhage following Operation.—An active hemorrhage is occasionally seen after a vaginal operation; it usually arises within the first week and persists for twelve, twenty-four, or forty-eight hours, or even longer, if unchecked. Such bleeding, while rarely threatening life, is always an annoying complication on account of the difficulty of access to the bleeding point; it also renders the patient profoundly weak and anemic, and prolongs convalescence. To control the hemorrhage, bring the patient across the bed or on a table in the lithotomy position, with a good light on the parts. Withdraw the vaginal pack if there is

one, and wash the vagina free of all clots; after the douche, elevate the anterior vaginal wall with a small speculum and expose the whole wound area, cleansing it with small pledgets of cotton until the bleeding point is found. A curved needle carrying a small silk suture is then passed deeply beneath the point and the suture tied, controlling the flow. When the circumstances are not favorable for such a prompt and direct treatment, a tampon of sterilized non-absorbent cotton must be applied in such a manner as to make pressure upon the whole wound area. After twenty-four or thirty-six hours the pack is removed, but if the oozing persists it must be again applied. A tight pack skilfully applied does not often interfere with the union of the parts.

Infection.—The symptoms of infection following plastic operations are similar to those which may arise from an infected wound anywhere in the body. Ordinarily they do not show themselves before the third day, and it may be even longer than that before the surgeon is able to differentiate clearly between the usual sequelæ of operation and an infected process. Fever is usually present, and the pain of beginning sepsis is lancinating in character, and extends from the labia down the inner thigh. When the patient locates pain in this region no time should be lost in discovering the seat of infection. If it is about one of the sutures, as is most likely to be the case, the suture should be removed at once, and if a pus cavity of considerable size is found, it must be freely drained. In the early stages, where the symptoms are suspicious but the seat of infection can not be accurately determined, the application of hot poultices will not only relieve the pain, but so hasten the inflammatory process that a definite diagnosis can be made.

Hot injections of a solution of bichloride of mercury (1–5,000) every four or five hours also gives relief. But this treatment should not be continued longer than forty-eight hours, on account of the danger of mercurial poisoning. If the whole wound looks red and angry, all the sutures must be taken out and the wound allowed to heal by granulation. Sometimes an abscess of considerable size forms laterally, near one or the other of Bartholin's glands; in this case an incision should be made directly into the cavity, as far as possible away from the seat of operation, so that the ultimate results of the operation may not suffer from the infection.

Very often, by taking out a single stitch, a small stitch-hole abscess will discharge and the trouble be over. The outcome of a bad infection, extensive in area, may sometimes be surprisingly good; I have seen a complete rupture of the perineum granulate down to perfect control over the sphincter ani.