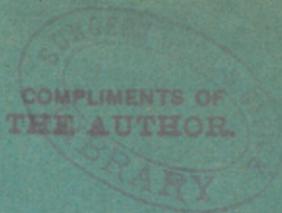


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*Antisepsis and Asepsis Before and After
Major Gynecological Operations.*

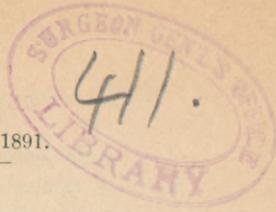
BY

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OBSTETRICIAN TO THE JOHNS HOPKINS HOSPITAL.



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ANTISEPSIS AND ASEPSIS BEFORE AND AFTER MAJOR
GYNECOLOGICAL OPERATIONS.

BY HOWARD A. KELLY, M.D.,

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WHILE operative surgery is ever a more brilliant subject for a discourse, there are some plain matters which lie at the bottom of all successful work about which surgeons are not yet practically united, and my observation for some years past has taught me that the rising gynecologists need above all else minute painstaking instructions in these fundamental principles—the practical significance of “sepsis,” “antiseptis,” and “asepsis.” The greatest gynecological want is that men should be taught to apply in the simplest way the recent teachings of bacteriology.

The touchstone revealing the character of a man's work is the view he holds of this important question.

“Cleanliness” (microscopic), the methods of securing it, and the methods of maintaining it, are the very bone and marrow of all good surgical work to-day.

“Sepsis”¹ is a morbid condition of the body, due to the action of septic germs, which are the septic agents.

“Antiseptis” is any efficient means put in action by which these germs are rendered inactive, destroyed, or removed from the body.

“Asepsis” is the condition of the body, or a part of the body, free from septic germs.

Cleanliness in this sense is asepsis, and is microscopic, not macroscopic.

These definitions at once do honor to the great army of workers who, within the past twenty years, have shown us why suppuration and sloughing (septic processes) were wont to prevent the rapid healing of fresh wounds. They at the same time place a wide gulf between those who thus accept the conclusions of our contemporaries working in the bacteriological field, endeavoring to ground all their surgical work upon the principles by them laid down, and those on the other side who, with a remarkable pertinacity, still insist that nothing new has been discovered, and that scientific surgery has received no riches from the bac-

¹ “Sepsis” is used in this connection as a convenient general term to designate traumatic infections.

teriological laboratory; even resorting to an unworthy *double-entendre* on the word "cleanliness," trying to confuse the new "microscopic" with the old "macroscopic" cleanliness, to prove that "since the fathers fell asleep all things continue as they were."

This microscopic cleanliness is the keynote of all successful gynecological surgery, and must pervade the work from beginning to end.

The great growth in the success of gynecological operations within the past few years has been due to the simplification and perfection of the means taken to secure this important end, with the abandonment of the complicated unnecessary machinery at first hastily thrown up to protect our patients, as soon as we learned that the enemies to our success were the hardy, minute, all-pervading microorganisms.

I shall in this paper dwell at some length upon this and some other important principles, controlling all of our gynecological work, illustrating the application of the former by means of major cases, with a clear understanding that the same laws apply to the lesser or minor gynecological cases—here, as elsewhere, the major thus including the minor.

The applications of these principles to a given operation must be considered at three different periods:

First. The condition of and the preparation of the patient for the operation, and the preparation of operator, assistants, instruments, and dressings.

Second. The personal cleanliness of the operator and his assistants during the operation; and

Third. The care of the patient and the wound after the operation.

THE SELECTION OF THE PATIENT.

It is important that a gynecological operator should first learn to select his cases with care, making sure that no grave organic disease complicates the local trouble, that there is no other coexisting ill from which the patient must soon die, even if she be cured of a tumor or other pelvic ailment.

An oversight of this kind is often attended by the most serious immediate consequences, and lives are thus frequently shortened, which could have been preserved for months or years by a little more insight and careful preliminary analysis. Surely nothing can exceed the chagrin of a specialist who has had the narrowness of his horizon demonstrated by any such accident.

I venture, therefore, to name in a brief review some of the chief stumbling-blocks which I have thus repeatedly found in my way.

To avoid this error a careful history of every case must be taken, including notes upon family tendencies to particular diseases, such as

cancer, Bright's disease, phthisis. An examination should always be made into the patient's mental condition, with inquiry about insanity in the family, or previous attacks in the patient. It is well known that a fresh attack of mania may be precipitated by an operation, and a great many patients in gynecological hospitals are paranoiacs. Next look into the condition of the heart and lungs. I have seen a patient with a large dilated heart die from the simple tapping of an ascites. With a hydrothorax it would be dangerous even to give an anæsthetic.

If the heart has a valvular lesion I prefer chloroform anæsthesia, which I have thus employed repeatedly.

Phthisis, however, even when far advanced, does not necessarily contra-indicate operation. Some nine years ago I operated on the relaxed vaginal outlet of a woman so far reduced by this disease that she could scarcely drag herself from room to room. She at once improved remarkably, and for years seemed comparatively well, and is, for aught I know to the contrary, living to-day.

I would even recommend the removal of tuberculous tubes and ovaries and draining a tuberculous peritonitis in a phthisical patient, where the abdominal disease has advanced so far as to be distressing to the patient. The improvement in such cases is sometimes very great and prolonged.

Below the diaphragm lie a number of dangerous traps for the unwary gynecologist.

Abscess of the liver may prove a complication. I recently lost a case where there was gangrene of the right ovary and tube, with gangrene of the vermiform appendix, which had sloughed off at its attachment to the colon. The patient recovered from the operation, got up, and went about, but died on the twenty-sixth day from a large concealed metastatic abscess in the liver, arising from the gangrenous appendix, transmitted through the portal system. The abscess ruptured into the bronchial tube, and drowned her at once.

Cancer of the ovary is not unfrequently complicated by a cancer of the pylorus, which makes pelvic operation futile. Two such cases have occurred in my experience. In the first, I operated removing the large brain-like ovary. The patient recovered, and went home, and died some months later of her pyloric disease.

In the second case I refused to do more than tap the abdomen, removing a large ascitic accumulation. The autopsy confirmed the diagnosis, revealing as well disseminated cancerous plates on the peritoneum.

A peri-appendicitis with adhesions is frequently found associated with tubo-ovarian inflammatory diseases, and in no way contra-indicates operation. In one of my cases of pyosalpinx there was, as well, an independent abscess of the vermiform appendix.

Of all the organs in the body whose functional activity is vitally important to the convalescent, after a serious gynecological operation, the

kidneys may be said to be paramount, and the writer would feel himself criminally negligent if he failed in any instance to determine the exact condition of the renal secretion before opening the abdomen.

Careful statistics will show that with the expulsion of sepsis from the mortality record after gynecological operations, uræmia has stepped very high in the list of fatalities.

Without entering into the causes, we have but to recall the familiar facts that the prolonged presence of pus in the body is productive of serious changes in the kidneys, heart, and liver; and again that the gonorrhœa which produces the pyosalpinx, may produce at the same time, by travelling up the bladder and ureter, a pyelo-nephrosis; and more important still, because most frequent, we must recall the fact that any mechanical obstruction to the flow of urine tends to produce nephritis.

My work has abundantly proven these observations, showing that the presence of pelvic tumors is frequently a cause of albuminuria.

In the ninth paper of my recent work, I issued a preliminary report on the urinary examination of ninety-five gynecological cases.¹ Out of these were fifty cases of abdominal section taken successively, showing the presence of some albumin in fifteen instances, or thirty per cent.

In eight of the fifteen, hyaline and granular casts appeared. Thus sixteen per cent. had both albumin and casts in their urine. The significance of this discovery may be appreciated by citing such an extreme case as that in the third article of the report (*v. supra*), where a colored woman died (without operation) of the renal changes induced by a large myoma uteri. The anatomical diagnosis reads: "Myoma of uterus, with central necrosis; dilatation of ureters from pressure; pyelo-nephrosis; chronic passive congestion and emphysema of lungs; displacement of viscera and deformity of thorax, in consequence of tumor. General marasmus. Heart hypertrophy, with hyaline calcific and fatty degeneration."

I do not as yet wish to lay too much stress on these figures, which are astonishingly large, but insist that if only one or two per cent. are found to be thus affected, the investigation is a vitally important one!

Albuminuria and milder grades of Bright's disease are not contra-indications: I do not hesitate to operate where I find albuminuria and even casts; but when it is necessary to operate on such cases, it is better to be forewarned as to the dangers, so that by using chloroform, and shortening the time of the anæsthesia, and by supplying external heat, the shock to the system may be as slight as possible; also by the use of the drainage-tube we may avoid to the utmost any taxation of the emunctories. We must also avoid opiates, and by free purgation save

¹ The Johns Hopkins Hospital Reports, vol. ii., Nos. 3, 4, Paper ix.

and supplement the crippled renal emunctory to the utmost. Advanced Bright's disease is an absolute contra-indication against any elective gynecological operation requiring anæsthesia.

In three cases out of fifty, two pus cases and one large ovarian tumor, in which albumin with hyaline and granular casts was found before operation, the urine exhibited nothing abnormal upon their discharge from the hospital, showing that the tumors had acted as causes in producing the renal disturbance.

PREPARATION OF THE PATIENT FOR THE OPERATION.

The guiding rule in fixing the date for operation is to take as much time as is necessary to get the patient in the best possible condition her disease will admit of. In a suppurative peritonitis, and ruptured extra-uterine pregnancy, there is, as a rule, no time for previous preparation beyond the administration of a purgative and enema and some stimulants, while the surgeon is getting to the patient; but in almost all other cases we shall do better to make haste slowly.

With rest in bed for one or two weeks or longer, and with careful feeding five or six times a day, a wretched, pinched, and worn-out body will usually recover some of its pristine vigor, and be thus better able to stand the shock of an operation.

It is of paramount importance in this connection to recognize the fact that ovarian and tubal abscesses are naturally characterized by repeated attacks of pelvic peritonitis, confining the patient to bed for one or more weeks with a swelled abdomen, quickened pulse, elevated temperature, and severe abdominal pains. But after one of these attacks is over, the patient usually improves until she feels quite well again.

It is better not to operate during such an attack, but to wait for the interval of comparative health and strength, when the operation will be better borne. One must, however, carefully distinguish the profounder shock with collapse, due to an abscess ruptured into the free peritoneal cavity, a condition admitting of no delay.

Where the operator selects his own time for an operation, he should at once begin not only to tone up the patient's general health by rest and feeding, but to quicken the action of the skin and the bowels by baths and free evacuations, and to prepare the abdomen and genitals by daily washing, and two or three days beforehand by careful scrubbing, along with daily vaginal douches, one pint of a solution of bichloride of mercury (1 : 5000) or carbolic acid (3 per cent.).

A thin poultice of *sapo viridis*, one foot square, laid on the abdomen two hours beforehand, softens the superficial layer of epithelium for the last washing, which it receives on the operating-table. A half-hour before the operation the patient receives forty grains of the subnitrate

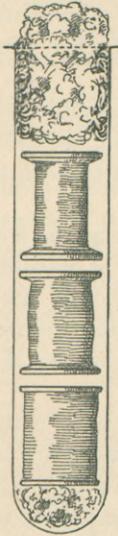
of bismuth, and, if there is no contra-indication, a quarter of a grain of morphia. The latter makes the patient more susceptible to, and less anxious about, the anæsthetic, and the bismuth acts by contracting the intestines and thus allowing more room to work in the abdominal cavity.

INSTRUMENTS, LIGATURES, DRESSINGS.

Five years ago I used for the disinfection of my instruments a double-walled copper oven, raised to the temperature of 140° C. (315° F.), for an hour. It was then demonstrated by bacteriologists that moist heat at 212° F. (100° C.) was even more effective.

It is now more than a year since I brought from Europe a newly-devised Rohrbeck oven for disinfection by steam. It is possible in this apparatus, after due exposure to the steam, by turning a ventilator and shutting off the heat, to convert it at once into a drying oven, thus automatically drying the instruments and dressings.

FIG. 1.



My final step in this direction was taken some months ago when I adopted a simple copper steam-sterilizer (Arnold's), made in America, for the disinfection of instruments and all dressings. Dr. Abbot's tests have shown this to be thoroughly reliable, giving a uniform heat of 212° F. in all parts of the cylinder, and its simplicity commends it for all practical purposes.

After an operation of a septic nature, the instruments are first washed, and then sterilized for a half-hour in this boiler, when they are taken out and dried at once. Again before the next operation they are laid in the sterilizer for a half-hour, when they are removed and placed in the trays and immersed in water, ready for use. As soon as the instruments are removed, the dressings—absorbent cotton and bandage—are put in, and left there until required at the close of the operation.

So satisfactory, so thorough, and so reliable is this steam disinfection, that I have also entirely given up boiling the silk ligatures, as well as the use of any antiseptic solutions, as heretofore, in their preparation, adopting instead a plan invented by Dr. Halsted. The silk is cut in required lengths and wound on glass spools, these are then put in a long test-tube of large calibre, plugged with cotton, in the same manner as the gelatine culture-tubes. (Fig. 1.) The tube thus loaded is placed in the steam cylinder for a half-hour without removing the cotton; it is then taken out, and put back again for a half-hour on the following day, when the sterilization is absolutely certain.

The cotton plug must not at any time be removed from the tube until

the ligatures are needed for use. Silk prepared in this way retains all its strength and remains sterile indefinitely until the tube is uncorked.

With the steam thus in constant use, towels and gauze, and even long stockings drawn over the legs in perineal operations, are also readily sterilized without the use of any antiseptic solutions.

THE OPERATOR AND THE ASSISTANTS.

The operator and his assistants should spend not less than ten minutes in scrubbing their hands with soap and warm water, devoting particular attention to the nails. That this alone is not sufficient to remove all the pus germs from the fingers, I have demonstrated in a series of experiments in which Dr. Ghriskey, the gynecological assistant, has each time succeeded in getting staphylococcus cultures after the most thorough, careful scrubbing on my part. Moreover, the cultures thus made were always taken from the nail of the index finger of my left hand, to which I had devoted the most painstaking attention in the cleansing. I follow this washing with water by an immersion of the hands for a half minute in a saturated solution of potas. permang., this is next removed by a saturated solution of oxalic acid in water, and finally the hands are immersed in a bichloride of mercury solution (1 : 1000) for one minute.

I am at present conducting a series of experiments to determine whether the danger of infection is as great after the bichloride as after the soap and water, when I shall be able to decide on scientific grounds as to the further use or the discontinuance of the drug.

When the patient is placed on the table for operation, her abdomen is first washed with soap and water followed by ether, and finally the bichloride in water (1 : 1000). The field of operation thus prepared is secluded by aseptic sterilized towels, placed across the chest and over the thighs and on either side; a piece of gauze, large enough to reach from the chest to the knees, covers the whole abdomen. A slit is cut in the centre of this, and when its edges are pulled apart the abdomen is bared from umbilicus to pubes. Through this opening, thus protected on all sides, the operation is performed.

The central idea which must dominate operator and assistants throughout the operation is, that having thus come to the work under conditions absolutely aseptic, they must be kept so throughout. There must be no break in the phalanx, such as occurs when operator or assistant shakes hands with visitors or touches unprepared parts of the patient, or an assistant dips water out of the reservoir with a cup or pitcher which has been standing on a table or shelf not included in the field prepared for the operation, etc., *ad infinitum*, including hosts of slips in the technique, only avoided after long experience, which finally

develops a keenness of perception for inconsistencies in the technique which may well be designated an "antiseptic conscience."

It is true that all these antiseptic precautions are frequently set at naught by the amount of sepsis encountered inside the patient as soon as the abdomen is opened.

Shall we for this reason relax our precautions and be careless about outside contamination even in these cases? By no means; the rule must be in all cases the utmost cleanliness attainable under the circumstances, even the worst. The principle must never be voluntarily sacrificed by the operator. In addition to this we cannot be sure of such hastily-drawn conclusions, for much of this ill-looking pus found in tubes and ovaries contains no germs which can be demonstrated, and is often, if at all, but mildly septic.

ASEPSIS AFTER THE OPERATION.

After a clean aseptic operation one great danger of septic invasion is from suppuration in the wound in the abdominal wall. Every effort should, therefore, be directed toward securing primary union. Septic material may work into the lips of the wound, or down the suture-tracks, the silk sutures acting like setons, the poison thus even penetrating the abdomen and causing death. A stitch-hole abscess in the abdominal wall is, unfortunately, a common sequence to an abdominal operation. This painful complication, which so seriously retards the recovery, can best be avoided by the following measures: the abdominal wound must be accurately approximated by the sterilized silk sutures, deep and superficial, three or four of each to the inch. The whole line of the incision thus closed is then coated with a mixture of iodoform and collodion (1:15) in a viscid state. This mixture is applied to every suture, with especial care to *saturate* every visible part of it with the viscid fluid, which dries at once. By this means the wound is concealed and the silk sutures are transformed from a bundle of threads with powers of capillary attraction, into a solid cord, like silkworm-gut or silver wire. The whole wound is at once dusted thickly over with iodoform and boric acid powder (1:7), which adheres tightly to the collodion. This makes an admirable occlusive dressing. A few layers of simple sterilized absorbent cotton are next applied, and finally over all a many-tailed bandage, held down by two tails between the thighs, pinned in front.

Whenever a drainage-tube is inserted, which translated practically means, whenever an open hole is left in the abdomen, the dangers of infection, after the operation, are greatly enhanced. The open tract down into the abdomen, with the presence there of free serum, as a culture medium, affords an excellent nidus for infection. The sepsis thus entering does not come from the air, nor apparently from the

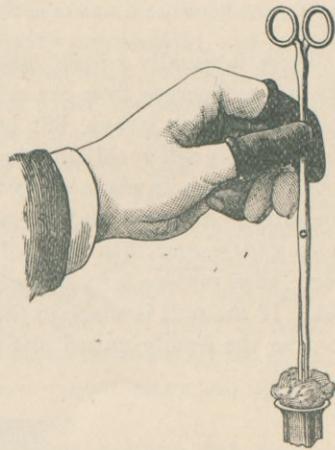
surrounding skin of the patient, but from the hands of the man who dresses the tube. A ready explanation of this exists in the fact that it is impossible, where a number of cases need dressing, to cleanse the hands each time with the same thoroughness considered necessary before an abdominal section; and yet the wound is the same, and the same absolute cleanliness is certainly called for.

My treatment of the tube is as follows: Just before applying the dressings and bandage, a small piece of sponge is grasped in the tube-forceps (specially constructed for the purpose) and the tube is cleaned with this until it is dry; a long, loose roll of gauze is then laid in the tube, which acts by capillary attraction, continuously sucking up and discharging fluids from the floor of the pelvis on to the dry absorbent dressings above.

In the subsequent dressings the tube is cleaned, first by lifting out the piece of gauze saturated with blood, then one of a number of little balls of sterilized cotton, about a third of an inch in diameter, kept in a glass-stoppered bottle, is picked up in the tube-forceps and carried to the bottom of the tube, at once soaking up any fluid lying there; this is then thrown away, and the process repeated until the tube is dry, when a gauze plug is again inserted until the next dressing. The great danger of contamination lies in handling the tube, and the gauze, and cotton dressings which enter it. To avoid this, I have arranged that while manipulating the drainage-tube and cotton balls, the thumb, index, and middle fingers of both hands are covered with rubber finger-stalls, taken out of a carbolic solution and washed and put back after using. By using these it is easy to prevent the naked skin from coming into contact with the tube or any substance entering it. As soon as a free discharge from the pelvis ceases (generally from the second to the third day after operation), the tube is pulled entirely out, and the hole obliterated by drawing up the loose suture lying in its track and left untied for this purpose.

The catheterization of the patient is not a minor matter, but one of the most important procedures, for by means of the catheter, through carelessness, a violent cystitis can be excited. To catheterize, the nurse must expose the parts, cleanse the genitals, very carefully wiping the orifice of the urethra with a little absorbent cotton, and only then cath-

FIG. 2.

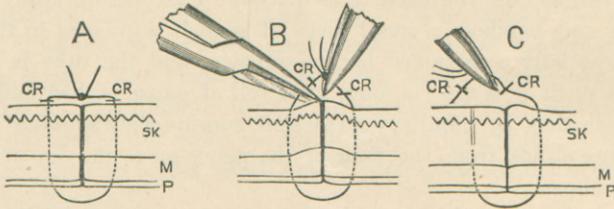


Hand grasping tube-forceps.

eterize when it is impossible that any foreign matter can be carried up into the bladder on the point of the catheter from the outside.

The sutures closing the abdominal incision should all be removed in from seven to eight days. Care must be taken in their removal not to convert this simple step into a source of irritation or infection of the wound.

FIG. 3

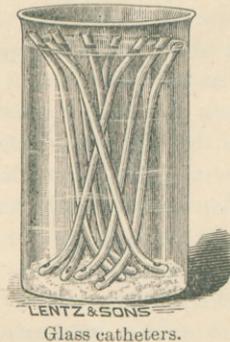


Removal of the abdominal suture.

A shows the suture *in situ* passing through skin, muscle, and peritoneum. CR, CR are the little masses of incrustation of hardened lymph, discharged from the suture-track. B shows the removal of the suture, elevated and cut below the crust. C shows the direction in which it is to be pulled out.

There is usually a little cake of incrustated lymph and powder where the suture emerges from the skin; and in removing the suture its loop must not be cut above, but below this point, where it is moist and pliable; this will avoid dragging the ragged foreign mass clinging to the suture, through its whole long track and through the peritoneum. To get the suture out, catch its free ends in a pair of dressing-forceps and pull it up a little, and then carefully clip one side of the loop in the moist part; then remove it by pulling it toward the side on which it has been cut. If the pull is made in the opposite direction the tendency will be to drag the freshly-united surfaces apart.

FIG. 4.



I have for years used nothing but glass catheters, which are cheaper and cleaner than any others. Several of these can be conveniently kept

in a large test-tube, closed with cotton and sterilized in the same manner as the ligatures. Or, they can be kept standing in a five-per-cent carbolic acid solution in a jar with some cotton on the bottom, to prevent them from breaking when dropped in. Each catheter should be washed thoroughly after using it, and preserved in the solution until wanted again. A sigmoid self-retaining catheter can be readily made from one of these over the alcohol lamp. My catheters are now in general use all over the country.

ASEPSIS AWAY FROM THE HOSPITAL.

It is manifestly not very difficult with careful training amidst all the conveniences of a specially-prepared clinic, to keep up an aseptic condition for any given length of time.

A question of the utmost practical importance, which has not yet been answered, is, "How far can we successfully apply these principles to emergency cases, and to operations in private houses?"

The difficulties in the way of operating aseptically in private, especially among the poor and middle classes, are due, in part, to the unskilled voluntary assistants in the preliminary preparations, and to the use of various household vessels and utensils whose microscopic cleanliness is uncertain—thus, the water used, the boiler, the pitchers and the basins, and the towels are each and all open to grave suspicion. These sources of error in the technique are dangerous, and must hang like a pall on the conscience of a careful man. They can be avoided by the following simple devices. Instruments which have been sterilized are put at once in tin, copper, or nickel-plated boxes, and, together with the ligatures in the sterilized tubes, and the dressings wrapped in wax paper, should be carefully packed away in the operator's kit ready for a call at any moment. It is important to avoid using domestic towels, plates, and other dishes by providing one's self with instrument and ligature trays, of hard rubber, porcelain-coated, or glass.

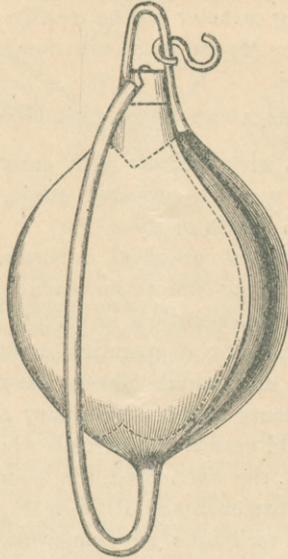
A convenient and cheap dish for ligatures, needles, and needle-holder, is a clever adaptation of Dr. Robb's, consisting of a porcelain plate divided into sections large enough to hold all of these separately in the various compartments.

Three difficulties and inconsistencies remain to be overcome: the water, the boiler, and the pitchers, not one of which is safe for use as it is handed to us labelled "clean" by the housewife or servant. I have overcome this weakness in the technique by carrying a copper boiler with me, 11x16x10 inches, which just fills the leather case holding my instruments, trays, and dressings, all of which are thus packed into the boiler.

I use instead of pitchers a bag made of rubber, ending in a hose below, holding five quarts (Fig. 5). This is hung up by the hook,

and the water is drawn off by unhooking the hose hanging on the lip of the bag and letting the end down, when the water rushes out into the basin. Tap-water boiled for an hour is perfectly safe.

FIG. 5



Collapsible rubber bag holding five quarts of water, used in place of a pitcher.

To such an extent has the elaborate technique of antiseptic surgery been simplified. Let no one imagine that there is any relaxation of the "antiseptic conscience." The appearance of laxity in dispensing, as far as possible, with antiseptic drugs, is in appearance only; the fact is, that in disposing of these means the necessity of keeping the principle constantly in view is all the greater and more urgent. If I shall have thus elucidated the principles and persuaded one man to exercise more care in securing and maintaining microscopic cleanliness in his work, and if by any simplification of the technique I have made the difficulties in the path of rigid scientific cleanliness seem a little less, I shall feel well rewarded for my efforts.

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