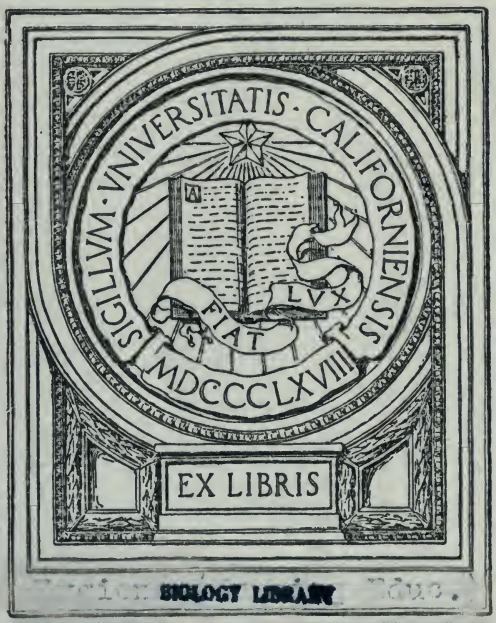

SURGICAL NURSING AND TECHNIQUE

THEATRE SISTER PREPARED FOR OPERATION.

Frontispiece.

SURGICAL NURSING AND TECHNIQUE

A BOOK FOR NURSES, DRESSERS, HOUSE SURGEONS, ETC.

BY

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DEDICATED TO

THE SISTERS AND NURSES

OF

THE ROYAL PORTSMOUTH HOSPITAL

IN THE HOPE THAT IT MAY BE OF ASSISTANCE TO THEM

IN THEIR SURGICAL WORK

PREFACE TO THE THIRD EDITION

THE second edition of this book was sold out in half the time that it took to dispose of the first. This is gratifying when it is remembered that it occurred during a time when surgical effort was directed to channels of antiseptic rather than aseptic surgery, to acquiring knowledge of the technique required to sterilize wounds already septic rather than of preventing the access of infection to wounds, which is what this work is designed to deal with. The first was the goal of the treatment of the wounds of war made by the enemy; the second is the goal of the treatment of the wounds of peace made by the surgeon's knife. The first deals with cure, the second with prevention. Both require as their foundation a sound knowledge of the causes and means of introduction of infection. Neither can be strictly separated from the other. An intimate knowledge of sepsis, with all its horrors and dangers and attendant disabilities, acquired during the late war should make aseptic technique, which can now happily come into its own again, more thorough and exacting if possible than ever it was before. This emboldens me to place yet a third edition of this book, dealing chiefly with modern surgical aseptic technique, before my readers. A feature of the second edition, noticed by almost every reviewer, was my strong condemnation of the long hours worked by nurses in hospitals, and the inadequate remuneration they received. I may hope that it had

some small share in awakening authorities to this crying injustice, and in the amelioration we see coming to the nursing profession in both directions. The short chapter on nursing in military hospitals has been omitted, as it only dealt in the barest and most perfunctory method with the subject, and no useful purpose would be served by retaining it now. Plates of the tetanus bacillus and the *Bacillus perfringens*, which gained such an unenviable notoriety during the war, with short descriptions of them, have been added. Inasmuch as the treatment of the septic wounds of war made such enormous advances, we may expect in the future a great improvement in the treatment of the septic wounds of peace, such as arise from accidents of various kinds, and the bearing of aseptic technique upon these, derived from the war's experience, has been emphasized on many occasions in this edition. I have also introduced the latest information on wound shock, which engaged the attention of so many investigators during the war, and have drawn attention to its bearing on the incidence and treatment of operative shock and shock following the accidents of civil life. A few modern instruments have been introduced, and plates of those going or gone out of use have been omitted, and the book has been generally brought up to date. The war has, as might have been expected, furnished great opportunities for surgery, and surgeons and nurses alike will revert to the practice of civil surgery better equipped in many particulars for the exercise of their calling. I have endeavoured to indicate these in the present edition.

CHARLES P. CHILDE.

PORTSMOUTH,
June, 1920.

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CHAPTER I

THE MODERN SURGICAL NURSE

THE practical outcome of the revolution in surgery, known as the antiseptic or aseptic system, is an attention to detail and technique which involves great responsibilities on all those entrusted with the care of a patient who finds himself compelled to undergo a surgical operation. Not the least important of these is the surgical nurse. The antiseptic system of surgery has revolutionized her no less than the surgeon. The result is that a more highly educated and intelligent class of women enters the nursing profession than formerly to meet the demands of modern surgery. However important the knowledge of the way to take a temperature, feed a patient, give an enema, etc., may be ; however desirable the adoption of a sympathetic manner towards the patient, modern surgery exacts other and more important requirements of the nurse. These consist in the mastery of a complicated technique, which places her profession on a higher plane than formerly, and makes her the partaker in the triumphs of every modern operation and literally the surgeon's " right-

hand man." The nurse may therefore congratulate herself equally with the surgeon on the great discovery of Lister. She contributes to the success of every surgical operation in no small degree, and, except possibly in regard to the skill of his anæsthetist, the first anxiety of every surgeon who has an important operation to perform lies in the direction of the reliability and conscientiousness of his nurse. The knowledge, therefore, of her value and importance in modern surgery should stimulate her to a keen interest in her work and a thorough mastery of it, and she will always gain her reward in the confidence which every generous surgeon will accord her when that confidence has once been established.

I shall now allude briefly to what I consider the most desirable qualities in a surgical nurse. Nurses, when divested of their uniform, are much like other women, neither better nor worse. It is not to be supposed that many women undertake the profession of nursing because they feel they have a special call to tend the sick. Probably most of them adopt it for a livelihood. We may expect, therefore, to find—as we do, in fact, find—many grades of quality and capability among surgical nurses, as in those following other professions. Some, owing to their intelligence, tact, powers of observation, sympathy, and practical ability, are eminently suited to the profession of nursing, and win high honours in it; others, owing to the complete lack of all or some of these qualities, seem to have mistaken their calling; while the large majority fall somewhere between these two extremes. Perfection is not of this world, and the perfect surgical nurse has possibly yet to be found. Still, though it may be impossible for a nurse to change her nature because she dons a uniform, there are some

qualities in which she should endeavour especially to educate herself if she is ambitious of success in the profession she has adopted.

She should first of all cultivate and train her powers of observation. Nothing about the patient under her charge should escape her, or should seem too trivial to note. Naturally, she may be expected sometimes to draw attention to matters which are of no importance. She will not be appreciated the less by the surgeon for this, and increased experience will enable her to sift the wheat from the chaff; but if she omits to make note of a matter which should obviously have been reported, she will lose a mark in the estimation of the surgeon, and will shake his confidence in her. For instance, a patient may have a headache, may not have slept well, may seem restless. It should be recorded and reported. It does not require much professional training to take cognizance of the fact that the patient has had a rigor and the temperature has risen to 105° F. Even a lay attendant would probably guess that that was worth mentioning. It is in the record of the small and apparently trivial deviations from the normal that the good nurse shows her alertness and capability. Again, she should make a point of always preserving anything unusual for the surgeon to see. Some nurses have a perfect mania for throwing things away. How often, for instance, does it not occur to be told that the patient has been unexpectedly sick, but the vomited matter has been thrown down the sink ; or that an abnormal stool has been passed, but it has not been saved ! And how exasperating it is to the medical attendant ! The nurse should make a point, therefore, of saving anything abnormal or unexpected for the surgeon to see. He will appreciate her for it.

The nurse should cultivate the habit of strict obedience to instructions given her—in other words, she should be absolutely loyal to those under whom she is working for the time being. Occasionally a nurse is induced to win a little cheap reputation at the expense of the medical attendant. She may have seen things done differently and, in her opinion, better by others, and she is tempted to let the patient know this, and to carry out some detail of treatment in her own way, and in defiance of the instructions which have been given her. Such behaviour is quite contrary to the ethics of nursing. Whatever her private opinion may be on any line of treatment, it is her duty to conscientiously and faithfully carry out the instructions given her by her superior officer for the time being, and not in any way to undermine the confidence existing between doctor and patient. The loyal medical man, on his part, will be careful not to shake the confidence of the patient in his nurse, and if he discovers the latter in error he will take her aside and correct her without the cognizance of the patient. If nurses always observed this elementary rule of obedience, and doctors this elementary rule of courtesy, friction and unpleasantness would frequently be avoided.

The nurse should endeavour to be always cheerful. I do not mean by this that she should go about with a chronic smile on her face, but the doleful nurse has mistaken her vocation, and is out of place amongst the depressing surroundings of the sick-room. Especially should nurses assume a cheerful demeanour towards a patient prior to operation. Fear and shock are closely allied, and nothing should reach the patient's ears which will be likely to carry doubt of the success of an operation, and thus add to the nervous strain inseparable

from it. She should also, while remaining firm, always be sympathetic. Sympathy is so deeply rooted in woman's nature—one of the many qualities which render her so peculiarly suited to tend those overcome by illness—that it would hardly seem necessary to labour this point. Yet the constant touch with suffering is wont to harden the softest natures; indeed, if it were not so, the strain inseparable from nursing would become an intolerable load. The nurse should, therefore, ever be on her guard against letting the patient become aware of this. I have often heard patients complain that nurses look upon them only as "a case." It is a mistake to allow the patient ever to have such an impression of the nurse. After a medical training it is very difficult to realize through what different spectacles the layman views illness from the professional man or woman. A sympathetic manner towards the patient should, therefore, always be cultivated, and though after a professional training it may be impossible, and not even desirable, to feel the keen edge of suffering, yet the patient should never be permitted to imagine that the milk of human kindness has become dry in the nurse's heart. The nurse, on the other hand, must be firm, always master of the patient, and must never lose her professional hold upon him.

Not least, nurses should ever remember that "silence is golden," and should refrain from gossiping about their patients. By every ethical rule of the nursing profession, as much as of the medical, the secrets of the sick-room are sacred. Every medical man is probably painfully aware of the harm that has been done and the misunderstandings that have arisen owing to the professional gossip that sometimes goes on in the sick-room. It is a practice to be unhesitatingly condemned, and no nurse

with an appreciation of the duties and responsibilities of her profession will indulge in it.

Lastly, a rigid conscientiousness I regard as the most essential quality of all in a surgical nurse. It must be borne in mind that when a failure occurs in the aseptic course of an operation, it is seldom that we are able to place our finger on the exact source of infection, and to state positively that such or such an error in the technique was the cause of it. This is the unsatisfactory part of the business. If we could always, instead of almost never, ascertain the fault, and bring the defaulter to book, we should possess a powerful weapon against "slackness," and should be in a position to expose the delinquent and convince her of her error. As, however, the reverse is the case, the moral responsibility resting on everyone who takes part in a sugical operation is manifest, and unless a woman has a conscience she is unfit to undertake surgical work. *Humanum est errare.* Anybody may make a mistake, but nobody should undertake operative surgical nursing who does not thoroughly recognize its responsibilities and who is not prepared to appoint her own conscience a searching judge of her every action. The thoroughly conscientious nurse is the desideratum in modern surgery. One who is not so is not only a constant source of danger to the patient, but may be the cause of suspicion falling unjustly upon others who have faithfully done their duty. A woman's conscience, as a rule, is her sole accuser, and should be self-appointed her pitiless judge.

I have indicated above what, in my opinion, the ambition of the surgical nurse should be, and have set her a high standard in her profession. Hers is a very interesting and at the same time very exacting calling. It demands long hours, devotion to work, tact, patience,

often under trying and difficult circumstances, organizing power and skill of a high order. A sound constitution and good health are requisite.

It is undeniable that the latter has been hitherto incompatible with the excessive demands made upon her physical endurance, except in the case of the very strongest, and that the former has been all too often undermined. We welcome the change that is coming, and credit should be given to those hospital authorities which have led the way: those that are lagging behind will be compelled to follow. I wrote in the last edition of this book: "As regards hours of work, what is known as the three-shift instead of the present two-shift system is the solution." It is satisfactory to know that some hospitals have adopted this within the past year, and it is safe to predict that within the next decade it will become the recognized practice. It is the eight-hour day; and surely, if workers generally, with their six-days' working week, demand this as a right, the justice of the nurses' claim to an eight-hour day, with Sundays no exception, will not be denied. All hospitals are shortening the working day, which, as I demonstrated in a previous edition of this book, amounted to roughly ten hours, inclusive of Sundays—a monstrous slavery, and nothing less. All are not able at present to adopt the three-shift system, owing to financial embarrassments and lack of accommodation, but all are increasing their staffs, shortening the working hours, and granting more off-duty time. This may be regarded as only a temporary stage on the way to the three-shift system, when the above-mentioned difficulties can be overcome. For instance, my own hospital has increased its staff of probationers by 25 per cent., grants one whole day off duty every week, and three

hours every day—a vast improvement on the one-day a month and two hours each day which has hitherto been the rule. The return will be an increased interest and efficiency in the work; a premium on brains, and not mere brute strength; leisure time for a woman during her training to read and study her profession; a healthy, cheerful, and willing worker in place of an anæmic, irritable, worn-out drudge.

In a previous edition I also drew attention to the hours and wages of hospital sisters—not apprentices who are learning their profession, but women who have undergone their three years' training, have become skilled workers indispensable in the running of any hospital, and are the very pick of the nursing profession. I demonstrated that their hours of work were very little shorter than those of the probationers, and their salaries less than that of a decent cook. Here, also, there is a change for the better. They are, of course, participating with the probationers in the abbreviated hours of labour, and are receiving higher salaries—£50 to £60 a year, where they formerly had £30 to £36. In view of the diminished value of the sovereign this does not represent much; still, it is evidence of a more generous disposition towards them on behalf of hospital authorities, but does not by any means cover the liability of the latter in view of present ruling prices. It is obviously not enough, though it may be all they can afford to give in the present circumstances.

Again, sisters and nurses should receive generous treatment at the hands of hospital authorities in the shape of accommodation and food. It is impossible for a woman to do her best work unless she is well fed, and after long hours in the wards or theatre she should, in her off-duty hours, be accommodated with comfortable

—nay, luxurious—quarters. In many hospitals whose funds allow of it, or as the result of private generosity, this is accomplished; but I fear in some, which feel the pinch of poverty, the sisters and nurses are apt to suffer, and have not all the comforts they deserve. As I have said, their working hours are long, are generally spent amidst depressing circumstances and anything but the best sanitary surroundings, are always attended with considerable anxiety. It is a paramount duty, therefore, of hospital authorities to see that their "off-duty" hours are made comfortable, cheerful, and healthy. The sick are a constant source of anxiety and attention in hospitals. Surely those who tend the sick have an equal claim to consideration. If this is not so, the hospital itself suffers. After a few months the sisters move on and seek employment, naturally enough, amid more congenial surroundings. Now, a hospital does not gain by constant changes. Though to a lay committee one sister may be as good as another, the staff know very well that the medical work—which, after all, is the most important in hospitals, and, in fact, the *raison d'être* of their existence—suffers from the loss of a good ward or theatre sister. Machinery which was working smoothly has to be started again, confidence is lost, the all-round work deteriorates. Women, on the other hand, should not, like surgeons, be retained at hospitals too long, and there should be compulsory retirement after a certain age. Hospital work involves a great strain, requiring good physical strength, and when a woman has passed her most active years, she is probably better employed, both in her own interest and that of the hospital, in some lighter phase of nursing. The Royal National Pension Fund for Nurses, to which some hospitals contribute part of the premium for their

nurses, is a wise and generous provision against the time when the latter are no longer able to earn their living.

Some hospital authorities always obtain their sisters by promotion from their own nursing staff; others make a point of not doing so. I think the *via media* here, as in most things, is the best course. Nurses should be eligible for promotion in their own hospitals, though it is conducive to better discipline if, after their training is complete, they spend a year or two elsewhere first. At the same time, vacancies should be open to outsiders, and a certain proportion of these should be elected. It is good for a hospital to import new blood. Methods vary in different hospitals, and I have frequently derived a valuable hint from a sister in regard to some detail of treatment adopted at another hospital. It is especially desirable in small hospitals that sisters from other institutions should be imported from time to time.

Nurses are sometimes wont to regret that they have not been trained at a medical school or large hospital. Though the latter possess some advantages in the way of greater regularity and better organization, it is, after all, the methods adopted and the class of work which they see and participate in which matter more. I have frequently encountered a first-class nurse trained at a small and comparatively unknown hospital, and the reverse from one with a big reputation. Also, smaller hospitals have their compensating advantages, which, I think, accounts in large measure for their frequently turning out first-class nurses. Nurses in them fill the places and do the work of dressers in medical schools. They get in this way a more practical training, and are thrown more upon their own resources. A great deal that they are mere spectators of in large hospitals they

do themselves in smaller institutions, and in such a practical profession as surgery this is of great advantage to them. For instance, they apply dressings, frequently take histories of cases, assist at operations, etc., and after a while do these very well. In medical schools work of this kind falls to dressers, and nurses do not get the same practical opportunities.

Every patient's stay in a hospital or home for an operation of any magnitude is divisible into three stages —that previous to operation, that during operation, and that subsequent to operation. Each of these has its duties and responsibilities for the surgical nurse. I propose in the following pages to indicate to the best of my ability what they are. The first two are the most important, and it is chiefly by skill and attention in these, the first two, that we seek to abolish the anxieties of the third.

Modern surgical work well illustrates the old adage, "Prevention is better than cure." The entire aim of modern operative surgery is so to conduct the patient to the end of the operation that the after-treatment shall be abolished or reduced to a minimum; and in direct proportion as the stages of preparation for and the conduct of the operation approach perfection, generally speaking, will the anxieties of the after-treatment recede into the background. Nevertheless, there are always important matters requiring attention after an operation. The nurse must make herself mistress of these, and must be well equipped in the signs which indicate any deviation from the convalescence which follows most operations nowadays, and may happily be termed the normal course of events. One still sometimes hears the remark, made with an air of satisfaction, that the wound healed by first intention.

It is time that it was an accepted fact that this is just the natural and normal course that wounds should take, and that only the suppurating wound should be noted as a proof of some shortcoming in our work and a reproach to our methods.

After a few general remarks on antisepsis and asepsis in surgery, the scheme I propose to follow in these pages is to trace a patient from his entry into hospital or home for an operation, throughout his stay there to his departure, and to emphasize the most important points for the nurse to attend to during each of the stages I have referred to above.

CHAPTER II

ANTISEPSIS AND ASEPSIS IN OPERATIVE SURGERY

In order that the nurse may have a full appreciation of her duties and responsibilities in modern surgery, it is necessary that she should clearly comprehend the meaning of the word "sepsis," and of its antitheses, "antisepsis" and "asepsis." Without this knowledge, she will not understand the why and wherefore of her actions. She will confuse asepsis with cleanliness; she will never grasp the principle and acquire the habit which must become a second nature to her if she is to make herself a really efficient surgical nurse. Inflammation in its widest sense has been described as the series of local changes which constitute the reaction to injury or irritation of a part. When the injury or irritation is caused by any of the various forms of germ life, the reaction which follows and gives rise to inflammation is called "sepsis," or "septic inflammation." Sepsis or septic inflammation in wounds, therefore, is due to the entry into them and action upon them of certain minute forms of vegetable life called germs, bacteria, or micro-organisms. This is the inflammation we have to prevent in operative wounds, and we seek to prevent it by directing our utmost efforts, firstly, to conducting our operations in situations and amid surroundings as free as possible from germs; and, secondly, by seeing to it that during the operation we bring nothing that is not germ-free into direct contact with the wound. The

reason we take these precautions is this: We know, as a result both of scientific investigation and experience, that if an operation is so conducted that at the termination of it the wound is free of germs, it will heal right away in a few days by what is known as first intention, and the patient will have an easy and painless convalescence. We know equally well that if germs are introduced into the wound in sufficient numbers or of sufficient virulence to overcome the natural defensive powers of the tissues against them, the best that can happen to the patient is that septic inflammation and suppuration will take place in his wound, that it will take several weeks to heal, and that he will be liable to a long and painful illness; the worst that can happen to him is that the germs may gain the upper hand to such an extent that he may lose a limb or his life, owing to such illnesses as toxæmia, septicæmia, or pyæmia, which are all due to the poisons produced in the wound by germs, and absorbed thence into the system. It will, therefore, be realized at once how vital in the most literal meaning of the word this matter of asepsis in operative surgery becomes, and how far removed it is from a mere slipshod cleanliness, for which it is all too often mistaken.

There is no necessity to complicate the matter with rare exceptions, such, for instance, as the possibility of germs gaining access to the body through some other channel—*e.g.*, the lungs or alimentary canal—and being carried to the wound area by the lymph or blood stream. It may be stated generally that when sepsis occurs in a wound, the introduction of germs responsible for it takes place through the breach of surface in the skin or mucous membrane made by the surgeon, known as the "operation wound." Indeed, it will be well to forget

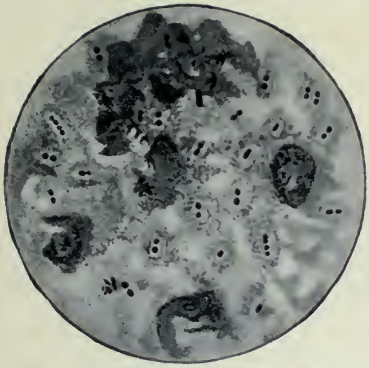


FIG. 1.—PNEUMOCOCCUS. ×1000 (Lehmann and Neumann).

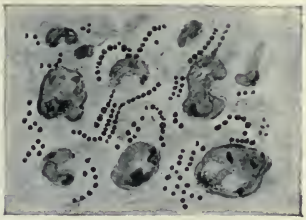


FIG. 2.—STREPTOCOCCUS PYOGENES. ×1000 (Lehmann and Neumann).

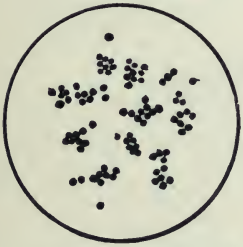


FIG. 3.—STAPHYLOCOCCUS PYOGENES. ×1000 (Keen's 'Surgery').

FIG. 4.—BACILLUS COLI COMMUNIS. ×500 (Keen's 'Surgery').

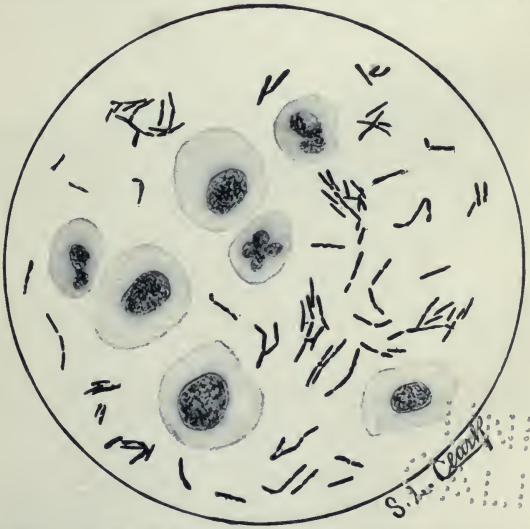
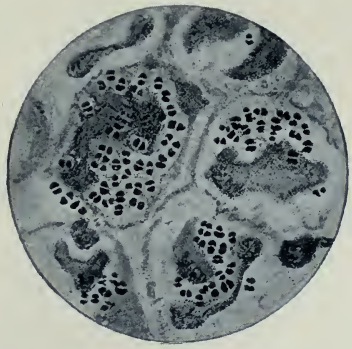


FIG. 5.—TUBERCLE BACILLI FROM SPUTUM. (Keen's 'Surgery').

To face p. 14.



FIGS. 6 and 7.—MICROCOCCUS GONORRHŒÆ. ×1000 (Lehmann and Neumann).

FIG. 8.—TETANUS BACILLUS. (Hughes and Banks, p. 169, fig. 40.)

FIG. 9.—BACILLUS PERFRINGENS. (Hughes and Banks, p. 68, fig. 21.)

To face p. 15.

any other rare and possible path of introduction, and to accept it as an axiom that *every case of sepsis in a wound results from the entry into it of germs at the site of operation.* This is undoubtedly so true of almost every case that it may be practically accepted as true of all. A brief account will here be given of the germs or micro-organisms most frequently met with in civil surgical practice, and which ordinarily cause inflammation and suppuration in wounds. To this will be added that of two micro-organisms which gained an unenviable notoriety during the late war, taxed the energy and skill of our surgeons at the front to the utmost, and will not be forgotten during the present generation—viz., the *tetanus bacillus* and the *gas gangrene bacillus.*

1. The *Staphylococcus pyogenes aureus,* so called because, when examined under the microscope in pus, it is seen to be arranged more or less in small clusters, and because of its cultures assuming a golden yellow tinge. It is present in the air, upon the skin, beneath the nails, in the mouth and nose, and on the various tangible surroundings of the patient. It is the most common cause of suppuration, and is constantly present in localized abscesses, boils, carbuncles, acute suppurative periostitis, etc.

2. The *Staphylococcus pyogenes albus* has similar characteristics to the preceding, except that its colonies appear white. It is found constantly in the deeper layers of the skin. It is generally regarded as less virulent than the *Staphylococcus pyogenes aureus.*

3. The *Streptococcus pyogenes,* so called from its arrangement in pus in chains. It is present, like the staphylococcus, in the air, upon the skin, within the nose, mouth, and vagina, and on the various tangible surroundings of the patient. It is the active agent in

the production of acute spreading inflammations and infections, such as erysipelas, diffuse phlegmon, lymphangitis, osteomyelitis, septicæmia, etc. It is commonly found in such conditions associated with the *Staphylococcus*. It is responsible for most of the severe infections of wounds.

4. The *Pneumococcus* is closely connected with the *Streptococcus pyogenes*, if not identical with it. It most frequently appears under the microscope in pairs. It is commonly present in the mouth and nose, even in health. It is the active agent in the production of inflammation of the lungs, and in surgery is chiefly met with in connection with inflammation and suppuration of serous membranes (*e.g.*, the peritoneum, pleura, etc.) of the ear and of joints.

5. The *Bacillus coli communis*, a short rod-shaped micro-organism, is a constant inhabitant of the alimentary canal. Outside the body its presence is chiefly due to contamination of various objects with the fæces of man or animals, and it is therefore very widely distributed. It occurs on the skin, beneath the nails, in the mouth, nose, and vagina, as well as on all the tangible surroundings of patients. In surgery it is chiefly encountered in the foul abscesses, often containing stinking gas, which occur in the vicinity of the bowel, the infection having taken place from that source. The most familiar of these is the appendix abscess. It has also been frequently demonstrated in severe infections of the urinary bladder, gall-bladder, etc.

6. The *Gonococcus* is kidney-shaped, and occurs usually in pairs. It is not met with in healthy individuals, but occurs in the inflammatory and suppurative conditions due to gonorrhœa. It is, therefore, frequently encountered in surgery. Thus it is present in cases of

pyosalpinx due to gonorrhœa, in gonorrhœal conjunctivitis, cystitis, epididymitis, peritonitis, etc., and in the various foci of suppuration (*e.g.*, suppurating joints) associated with a general infection following this disease.

7. In addition to the foregoing, which are, as stated above, the germs most frequently associated with inflammation and suppuration, the *tubercle bacillus* is the cause of a very large number of surgical affections. It is a small rod-shaped micro-organism, invariably present in the various tubercular lesions of man and the lower animals. From these it reaches the air in sputum, milk, sweat, urine, the discharges from tubercular affections, etc. It soon dries and settles in dust, and in this medium is very readily disseminated. It may also be spread by the eating of imperfectly cooked tuberculous meat. It is introduced into the body of the infected person either through the lungs (inhalation) or the alimentary canal (ingestion), or, lastly and rarely, by inoculation through a wound. From its focus of introduction it is carried to the various parts of the body, chiefly by the lymph-stream, more rarely by the blood-stream. It is the causative agent in the production of all surgical tubercular affections—*e.g.*, tubercular glands, tubercular diseases of the bones and joints, of the genito-urinary tract, etc. It is likewise the active agent in the production of such familiar medical diseases as phthisis, tubercular meningitis, etc.

The above-mentioned germs are those ordinarily encountered in operative surgical practice. Besides these, there are many others which have been proved to be associated with special surgical diseases—*e.g.*, the *anthrax bacillus* with woolsorters' disease, the *Bacillus actinomyces* with actinomycosis, and so forth; but these diseases are comparatively rare, and the micro-organ-

isms producing them are not met with in the ordinary routine of surgical work.

8. The *tetanus bacillus* was the cause of many deaths during the earlier years of the Great War. Later on, owing to improved methods in the treatment of wounds, and the prophylactic use of anti-tetanic serum, tetanus became a rare event. The bacillus has the shape of a drum-stick, owing to its spore being terminal. It is what is called an anaerobe—*i.e.*, it thrives only in the absence of oxygen. Its toxin travels from the wound up the nerve trunks to the spinal cord, and gives rise to the terrible disease tetanus. Spasm or stiffness in the muscles in the neighbourhood of the wound is the earliest symptom, should at once arouse suspicion, and is the urgent call for immediate treatment.

9. The *Bacillus perfringens* is the bacillus of gas gangrene, the most serious and fatal of all infections that attacked our wounded soldiers in the late war. It is a large stout bacillus, and, like the *tetanus bacillus*, an anaerobe. Both the *tetanus bacillus* and the *gas gangrene bacillus*, besides many others, were present in especial abundance and in very virulent form in the richly manured soil of Northern France, and found their way into the serious wounds caused by modern explosives with deadly effect, especially during the earlier years of the war.

The preceding brief description has been chiefly drawn from the articles, " Suppuration, Abscess, and Fistula," by Leonard Freeman; " Surgical Tuberculosis," by John Chalmers da Costa, appearing in Keen's " System of Surgery," vol. i.; and from " War Surgery," Hughes and Banks; and the author's thanks are gratefully accorded to the writers of these articles, as well as to the publishers, W. B. Saunders and Company, and Messrs. Baillière,

Tindall and Cox, for their kind permission to use the illustrations.

From the account here given of the distribution of the various germs commonly met with in surgical practice it will be realized that, in the event of an operation, they are present everywhere in the surroundings of the intended wound—in the air, in the patient's, surgeon's, and nurse's skin; on the towels, swabs, and dressings; on the instruments; on the furniture of the operating-room; on the clothes of those taking part in or looking on at the operation; in the breath of those speaking or coughing into the atmosphere of the theatre; in the water necessary for the lotions, etc. Dust and dirt of all kinds are the great germ-carriers, and are loaded with them, and wherever dust and dirt are deposited, there will be found live germs or their spores. Though invisible, they are none the less real. I have been in the habit during my lectures of showing nurses specimens of various germs through the microscope, not, of course, because their recognition forms any part of a nurse's requirements, but with the view of impressing upon them the reality of the invisible army they are continually engaged in fighting. There are other and possibly even more realistic methods by which they may bring home to themselves the actuality and omnipresence of germs. Let any room in a crowded town be left undusted for a single day; let the nurse then inspect the furniture in a good light. The amount of dust she will find upon every article will impress upon her the ubiquity of germ life, if she realizes that each particle she sees is loaded with it. Again, let her some morning, when not on duty, scrub her hands and clean her nails so thoroughly that there remains not a speck of visible dirt about them; let her abstain from washing for the

rest of the day; let her then look at her hands and nails, and after a thorough washing inspect the colour of the water she has washed in. She will appreciate the amount of dirt, and with it germ life, that she is able to pick up in the course of a single day. Yet again: let her brush her clothes thoroughly at the beginning of the day, and see how much more dust and dirt she can brush out of them in the evening. By such simple means as these she can bring home to herself the omnipresence of germs, the hosts of them that pervade all her surroundings, and have collected about her during the space of a few hours.

Up to this point the nurse will have grasped three facts: first, the absolute ubiquity of germ life; second, that it is the introduction of this germ life into wounds which is the cause of sepsis, with its consequences—inflammation and suppuration locally, and more remotely toxæmia, septicæmia, pyæmia, etc.; and, third, that this introduction practically always takes place at the site of the operation wound. She is now in a position to realize the meaning of antisepsis and asepsis, and the principle of antiseptic and aseptic surgery. Antisepsis literally means against sepsis, and by antiseptic surgery is meant the adoption of measures to prevent sepsis in operation wounds by destroying or inhibiting the growth of any germs that may have been accidentally introduced into them. Asepsis means absence of sepsis, and by aseptic surgery is understood the adoption of means to prevent the entry of germs into a wound at all. The principle of antiseptic and aseptic surgery is therefore definite and simple. It is so to conduct an operation that at its close no germs, or no live germs, shall be left in the wound capable of producing sepsis, and so of exciting septic inflammation. Probably few operations are so

perfectly conducted that the presence of all germs is excluded, but in an operation performed with due surgical skill and care those introduced are too few to overcome the natural defensive powers of the tissues—in other words, something short of perfection answers practically, enabling the wound to heal without inflammation and suppuration. The aim is to exclude all germs. That is the ideal. It will be realized at once that, though the principle is simple enough, the carrying out of the principle is very complicated, and involves an attention to detail and technique the mastery of which requires much care and thought. It is not such an easy matter so to conduct an operation that none of these invisible germs, which it has been explained are present in countless numbers in all the surroundings of the operation wound, will be introduced into it, or introduced in insufficient numbers to be harmful; and it is manifest that it can only be accomplished by everyone grasping the principle involved, and carrying out conscientiously and as a matter of habit his or her share in the transaction. For instance, it will be useless, and will involve a flaw in the technique, if one of the sterilized towels placed round the operation area drops on the floor and is picked up and replaced; it will be useless if one of the instruments falls to the ground and is recovered and handled by the surgeon without a resterilization; it will be useless if, after the instruments have been boiled, and so rendered aseptic, the nurse takes hold of them with fingers that have not been adequately disinfected; it will be useless if a nurse, after having prepared her hands, touches anything that has not been sterilized, and then handles anything within the field of operation; it will be useless if the instruments, etc., have been efficiently sterilized, but the patient's skin into which the incision is to be

made has not been adequately prepared; and so forth. Fortunately for the patient, but unfortunately for the surgeon and the nurse, a flaw in the technique is not invariably followed by sepsis in the wound. If every time some glaring error occurred in the aseptic conduct of the operation, the wound promptly suppurated or the patient died, the careless would be rudely convinced that the game was not worth the candle. But this is not the case. It may be that the patient has abnormally good defensive powers against suppuration; it may be that though ample means for the introduction of septic germs into the wound are provided, nothing very virulent happens to be introduced; or, for various other reasons, that the wound does not become infected; and a watchful Providence seems to take special care of some delinquents. They are called "lucky," and I have even heard it triumphantly recorded that though some glaring error was committed, yet the wound healed by first intention. This is no particular reason for gratification. It simply means that the patient did well in spite of, not because of, the treatment adopted. The point the nurse has to bear in mind is that, though in every operation conducted without regard to asepsis the wound may not become infected, every wound aseptically treated will heal by first intention, and she will see for herself, as a rule, and in the long run, vastly better results obtained by those who do not disregard any of the rules of the game.

From what has already been said, it will be realized that aseptic surgery is far removed from mere cleanliness. Good results may possibly be obtained by the latter, but it will not produce the invariably good results that it is the aim of modern surgery to obtain, and it is quite a misnomer to substitute cleanliness, valuable as

it is and important a part as it plays in our methods, for the mastery of the complicated technique involved in an aseptic surgical operation.

A brief explanation will not be out of place here of the terms "antiseptic" and "aseptic" surgery. Antiseptic surgery was the name given to the great revolution introduced by Lister in the latter part of the last century, and was the parent of the more recent development—aseptic surgery. It implies the use of various chemical substances in the operative technique for the destruction of germs. As elaborated by its author, its chief details consisted in soaking instruments in 1 in 20 carbolic acid before use; in washing the skin of both surgeon and patient with solutions of carbolic acid; in surrounding the operation field with towels soaked in the same solution; in maintaining a spray of carbolic acid in play upon the wound during the operation; in swilling out wounds with solutions of carbolic acid or bichloride of mercury; and in impregnating the dressings with various chemical germicides. The spray was objectionable, and was soon found to be unnecessary, and a great advance was made by the discovery that heat was a more reliable germicide than chemicals, while at the same time its employment did away with the irritant effect of the latter upon the living tissues. It has come, therefore, to supplant chemicals wherever possible, and has been the chief instrument in the evolution of the aseptic system. For instance, heat is used to destroy germs on instruments that were formerly destroyed by carbolic acid; heat is used to sterilize dressings that were formerly impregnated with various chemicals; heat is used to sterilize water that was formerly mixed with similar substances; and so on. This, in reality, is the substitution of one antiseptic for

another, heat being the most powerful antiseptic we possess. Again, it was found that by attention to various details in the building and equipment of operate ing theatres the presence of germs in them could be reduced to a minimum, if not excluded altogether, and this has been the goal in the large sums of money that have of recent years been expended upon them. Chiefly, then, by these means—viz., rendering the environment of the patient as far as possible germ-free, and by the substitution of the antiseptic heat for chemical antiseptics—the aseptic system of surgery has been evolved, whose aim is the *exclusion* of all germs from operation wounds, thus doing away with the necessity of using chemicals for the destruction of germs which are not present. Heat, however, is not universally applicable in the technique. Chemical antiseptics have to be used in the preparation of the patient's skin, and are advisable for the surgeon's and his assistant's skin, before putting on the boiled rubber gloves in which their hands are encased during an operation. The skin cannot be boiled. It will be seen, therefore, that it is impossible at present to exclude altogether chemical antiseptics from aseptic surgery, and the modern surgical operation involves a blending of the two systems. We have not reached finality.

Some surgeons, though their number nowadays is few, wash out their wounds with weak antiseptic solutions before closing them, with the view of destroying any micro-organisms that may have been accidentally introduced into them during the operation. With the exception of normal saline solution, which is inimical to the tissues, antiseptics, though they doubtless do destroy micro-organisms, inhibit the activity of the

leucocytes, which are the chief natural agents in the destruction of bacteria in wounds. It is, therefore, better to leave the natural defensive agencies in the wound undisturbed and unimpaired to deal with any micro-organisms that may be present at the close of an operation, and to discard other antiseptics than normal saline solution.

Enough has been said in the previous pages to make it plain that the rationale of antiseptic or aseptic surgery is the destruction or exclusion from the wound, as far as in our power lies, of germs which are present in all its surroundings. In some wounds this is easier than in others, and this depends entirely on the region of the body in which the wound is made—in other words, on the varying capability of rendering the wound surface aseptic. The skin, for instance, of the groin, perineum, and toes is particularly difficult to free from germs or render aseptic; that of the forearm comparatively easy. Again, in some regions it is impossible to approach anywhere near an ideal asepsis—in the mouth, for example. Still, even here, by constant tooth-brushing, removal of decayed teeth, antiseptic mouth-washes, feeding with sterilized fluids, etc., we endeavour to attain something bordering on an aseptic wound area, though it is not pretended that this is such a near approach to it as can be effected in regions where the surface can be thoroughly cleansed mechanically, treated with more efficient antiseptics, and adequately protected subsequently against the entry of germs from without.

In the opinion of some medical men, the technique of aseptic surgery is overdone, and opinions are sometimes expressed that some details of it are mere faddism. This is not so. There is no such thing as surgical asepsis,

which, though short of a strict bacteriological asepsis, implies something that will do, something that will satisfy the surgeon, and admittedly may, thanks to the natural defensive powers of the tissues, result in an aseptic healing of the wound. True surgical asepsis *is* bacteriological asepsis, and in the conduct of an aseptic operation just as much care and just as minute precautions should be taken as in a laboratory experiment. It is unfortunate but convenient that sources of error do exist—for example, the patient's skin or the catgut—which can supply an excuse and bear the blame in case of failure, where something far short of an aseptic conduct of the operation is manifest, and many other potential sources of infection have been introduced. It is not possible to attend too minutely to details provided an adequate reason can be advanced for doing so, and it is not justifiable to omit any detail, however minute, and then fall back on the patient's skin or the catgut in case of failure. For instance, one has heard the sterilized masks and caps worn by all really aseptic surgeons criticized as a super-refinement. Yet it is common-sense reasoning that two heads abounding in germs coming together during an operation may scatter them into the wound below; or that the mouth, which is known to be teeming with germs, may, during a cough or in speaking, project them in any quantity within the operation area. It will usually be found that such critics are careless in other details—such, for instance, as stroking on their rubber gloves with their naked hands, and adopting generally a technique which, if the details are minutely examined, is a travesty of an aseptic operation.

As I have stated previously, when there is a failure

in the aseptic course of an operation wound, it is seldom possible to trace or be certain of the source of infection. It is surely, therefore, only common sense to prevent such an occurrence by every means in our power which can be shown to be rational.

CHAPTER III

THE PATIENT IN THE WARD BEFORE OPERATION—DUTIES OF WARD SISTERS, NURSES, DRESSERS, ETC.

THE proper and systematic preparation of a patient for operation is a very important matter, and in one of any magnitude may occupy several days. It is the habit of some surgeons to allow very little time to elapse between the admission of a patient to a hospital or home and the operation. This is not, generally speaking, sound practice. No doubt the anticipation of an operation is a considerable strain on many patients, and in some exceptional cases it may be advisable for this reason to dispense with any delay. It will be understood that I am not in the following remarks advocating any unnecessary postponement.

If an operation has to be done, the sooner it is done the better, consistently with the precautions necessary to insure safety. Such precautions, in my opinion, involve a systematic observation and preparation of the patient, and in an operation of any magnitude it is preferable to have the patient in the ward for a few days, so that there may be time and opportunity for these. If not, sooner or later mistakes are made, and something untoward happens, which the surgeon is conscious that a more thorough attention might have obviated.

In some respects the introduction of aseptic surgery has lessened the importance of certain conditions in the patient previous to operation. In pre-aseptic days when the normal after-course of an operation was inflammation and suppuration in the wound, constituting in itself a severe illness with a protracted convalescence, there is no doubt that the soundness of the patient's heart and kidneys, for instance, were of greater moment than they are now, and operations may be justifiably undertaken under modern conditions in unsound patients which were formerly impossible to entertain. Still, this should not be offered as an excuse for any want of knowledge of the patient, and everything possible should be ascertained constitutionally about him, and locally of his surgical condition, before submitting him to a major operation. This is only possible by having him in hospital under observation for some days, in special cases even longer, and on this ground alone it is to be recommended. Apart from this, the preparation itself occupies some time. It does not only consist in the disinfection of the operation area. It is important, for instance, that the patient be properly dieted; that his kidneys, skin, and bowels should be functioning properly; that his mouth should be clean, etc.; and these details cannot be satisfactorily accomplished in the course of twenty-four hours. During this period, too, of general preparation, as will be explained hereafter, attention may with advantage be directed to the operation area. With these few preliminary remarks on the necessity for adequate observation and preparation of the patient, I pass to the subject proper of this chapter—viz.:

Directions to follow regarding a Patient previous to Operation.

1. **Information about the Patient.**—In the event of *accident*, all possible information should be obtained by the nurse or dresser from the police or others who accompany the patient to hospital. This is especially important in the case of young children or old people, who are seldom able to give a coherent account of what has befallen them. It is also, of course, essential in the case of those admitted in an unconscious condition. The same precaution should be taken in other surgical emergencies. Patients are frequently themselves in too serious a condition to give a satisfactory account of their illness. Again, *in the case of children admitted*, the ward sister or dresser or house-surgeon should obtain and record all information obtainable as to previous history and present illness from parents. Children cannot be expected to give a reliable statement themselves. The observance of this routine is very important. When the surgeon arrives, and has to form a conclusion with regard to such cases, he will be sure to require this information, and will expect to get it from those who were present at the admission, and had an opportunity of interviewing the relatives, friends, or police, as the case may be, who accompanied the patient to hospital. For the assistance of those who may be required to obtain information about such patients, I append here a form which, if adhered to, will enable a brief history of a case to be taken without important omissions:

Name, age, address; date and time of admission; by whom sent; occupation. Whether single, married, widower, or widow.

Family history, including whether parents are living

and in good health; if not, what they have died of, and at what age. The number of brothers and sisters or children living; of what diseases others have died. Any family disease—*e.g.*, tubercle, etc.—present.

Personal history, including the previous illnesses of the patient, if any.

Present illness (including date and history of onset).

(1) *Altered sensation—e.g.*, pain, its character and extent.

(2) *Altered function—e.g.*, vomiting, constipation, diarrhœa, etc.

(3) *Altered general condition—e.g.*, loss of flesh, anæmia, etc.

(4) *Altered physical signs* that may be apparent—*e.g.*, the presence of a swelling, etc.

2. **General Cleansing—The Teeth and Nails.**—As soon after admission as possible, provided that the nature of the case allows of it, the patient is directed to go to the bath-room and have a hot bath, or, if a child, is given a bath by the nurse. He is then provided with a clean nightshirt and ordered to bed. If for any reason he is unable to go to the bath-room, he is given a blanket-bath in his bed—*i.e.*, he is placed between blankets, and the several parts of the body are exposed in turn and washed with soap and warm water till the whole surface has been gone over, and he is thoroughly clean. It is my practice to arrange that the patient have a similar hot bath or blanket-bath every day up to the time of operation. If he goes to the bath-room himself, he is directed to thoroughly soap the skin in the neighbourhood of the intended operation, but not with a brush, and not hard enough to excoriate it. If unable to leave his bed, the nurse pays similar attention to the operation area while the patient is having his blanket-bath. By these

means the body-surface is purified, the skin is made to act well, and a good mechanical cleansing is provided before the time arrives for the preparation proper of the operation area. In sending patients to the bath-room, care must be taken that they are adequately clad, and that they do not get chilled.

In every case attention is tc be directed to the patient's mouth, with a view of rendering it as far as possible aseptic. Each patient provides himself, or is provided, with a new tooth-brush, and is obliged to brush his teeth three times a day after meals, and to rinse his mouth out frequently with Sanitas or Listerine and water (ʒi. to O.i.), or a solution of peroxide of hydrogen of the strength of 5 to 10 volumes, or hypochlorous acid in the form of eusol. Decayed teeth may require removal. It is certain that many of the lung complications following operation are due to septic matter being inhaled into the lungs from the mouth, and post-operative inflammation of the parotid gland arises from septic matter passing up the parotid duct from the same cavity. As these complications are always very serious, and frequently fatal, the importance of insuring against their occurrence as far as possible by careful attention to the mouth, which in hospital patients is often very filthy, cannot be too strongly insisted upon. During the period previous to operation attention should also be directed to the patient's nails, which are to be cut short and cleaned. He should not be permitted to enter the theatre with dirty nails. Quite apart from these measures being necessary if the patient is to come to operation under the best hygienic conditions, it is a good thing to impress upon him during his sojourn in hospital the value which is attached to cleanliness, and it is not too much to hope that in some instances we may inculcate a more cleanly and sanitary habit than obtains

with many hospital patients. Precautions similar to these should be adopted with private patients awaiting operation in surgical homes or houses.

3. **Weight.**—Whenever possible, the patient should be weighed on admission, and the weight recorded on his chart. It should be remembered that the patient be weighed without his clothes and boots on, or, if weighed in them, that their weight be afterwards deducted, and the net weight recorded. After many operations, increase or decrease of weight is a very important consideration, and where the surgeon desires to gauge improvement or the reverse by an increase or decrease in weight, it is mortifying to find that the weight has not been taken previous to operation and that no comparison can consequently be instituted. In every case, therefore, where possible, the patient should be weighed on admission, and his weight recorded.

4. **The Temperature.**—The temperature should be taken on admission, and in an ordinary case should be recorded regularly night and morning up to the time of operation. Of course, in acute cases, or for special reasons, it may be necessary to take the temperature more frequently, and to keep a four-hourly chart, or one even with shorter intervals; but in an ordinary case a morning and evening record, generally taken at 6 a.m. and 6 p.m., is sufficient. In man, as in all warm-blooded animals, the temperature of the body remains constant whatever be the temperature of the air. The normal temperature in man is 98·4° Fahrenheit, and a variation of as little as a degree from this, either in the direction of a rise or fall, is evidence of some unusual influence being at work. In the case of infection of wounds the temperature usually rises, but it must be remembered that in some severe infections there is very little rise and there

may even be a fall, especially when the infection is tending towards a fatal termination.

5. **The Pulse.**—At the same time the temperature is taken the pulse-rate should be recorded. The pulse usually indicates the number of heart-beats, and the normal number of heart-beats per minute is about 72. In women the pulse is generally a few beats faster than in man. In infections of wounds and in surgical emergencies the pulse is usually a far more reliable guide than the temperature as to the condition of the patient.

6. **The Respirations.**—The number of respirations per minute should likewise be recorded. In normal breathing the respiratory act is repeated about seventeen times a minute. When fever is present the respirations are usually increased, and especially so if there is any affection of the lungs or heart, preventing the normal oxidation which takes place as the blood passes through the lungs.

7. **The Examination of the Urine.**—The examination of the urine is usually undertaken by the surgeon himself or the house-surgeon or dresser, and does not come within the province of the nurse. Still, there are a few practical matters in connection with this subject which a surgical nurse ought to know, and there is nothing in the ordinary routine of urine-testing which an intelligent nurse cannot master with a little application. Even if she is not called upon to undertake this duty herself, she should know something of the matters which are considered important in this connection. It will give her an intelligent interest in her work, and will impress upon her the importance of drawing attention to anything she notices in the urine which appears abnormal. No apology, therefore, is needed for the following practical remarks on urine-testing, though it would be outside the scope of this book to deal at all exhaustively with the subject.

First of all, the urine should be tested *as soon as possible after admission.* It should not be left till the day before or the day of the operation. When the surgeon makes an examination of his case, and has to come to a conclusion upon it, he requires to have all the facts before him. He will not be satisfied to be told after the patient has been in the ward three or four days that the urine has not yet been tested. The urine should be collected for examination, examined, and reported on the patient's chart as soon as possible after admission. If there is any possibility of contamination—*e.g.*, by the vaginal discharge—a catheter specimen should be obtained, and the precautions necessary in obtaining such a specimen will be given later (*cf.* p. 63). But it must be remembered that a catheter is never to be passed for this purpose unless it is absolutely necessary. Even in the most careful hands catheterization is sometimes followed by cystitis, a most troublesome and painful affection, and one not without danger. The surgeon or house-surgeon should be informed by the nurse of any possible contamination, and the decision of obtaining a catheter specimen should be left to him; and if this operation devolves on the nurse, it should only be undertaken by one who is thoroughly acquainted with the technique and with the precautions necessary to adopt. Catheters are far too frequently passed in hospitals for this purpose, and without a due appreciation of the possible risks.

Under special circumstances, a more exhaustive and skilled analysis of the urine may be required than will be found here, and any such examination the nurse would, of course, never be required to undertake; but in the average surgical case the points on which information may be required are the following: The quantity,

the colour, the odour, the specific gravity, the reaction, the presence or absence of albumin, the presence or absence of sugar, the amount of urea excreted, the presence or absence of blood or bile, and the significance of any deposit, the most usual of which are urates, uric acid, phosphates, mucus, pus, and blood. A few remarks will be made under each of these heads.

The *amount* passed by the patient in twenty-four hours should be carefully measured and recorded, and the urine to be submitted to examination should be a sample of this. A healthy adult male passes about 50 fluid ounces in twenty-four hours; women do not pass quite so much, and young children still less.

The most important variations in amount are the large quantity passed by those suffering from diabetes and granular contracted kidney, the lessened quantity in febrile conditions, and in the first twenty-four hours after severe operations, and this or a total absence in suppression of urine.

The *colour* should be noted. Normal urine is about the colour of pale sherry, but it varies within considerable limits consistently with health. The most usual deviations from the normal are the dark and high colour of febrile urine, generally associated with deposit of urates; the pale colour in those suffering from hysteria, diabetes, or granular kidney; the evident red colour when blood is present in large quantity, and the smoky colour when in small quantity; the greenish or reddish-green colour from the presence of bile; and the yellowish-white colour from the presence of pus. There are many other deviations from the normal colour, but the above are the most common, and it is not within the scope of a book of this kind to go farther into the matter. The important point is that the nurse should know the

colour and appearance of healthy urine, and should be aware of the fact that deviations from this are frequently significant of serious disease; and if she notices any variation, the specimen should be preserved for the inspection of the surgeon.

The *odour* of normal urine has been described as "aromatic." The most important deviation from the normal is the ammoniacal smell of decomposing urine.

The *specific gravity* or density of the urine is ascertained by means of the urinometer. The urine is allowed to cool in a tall jar, the urinometer cleansed and floated in the jar. The specific gravity is then read off on a level with the surface of the urine. The density of normal urine varies between 1015 and 1025, but if very concentrated it may reach as high as 1030. If it is above this, sugar is to be suspected, and if very low—*e.g.*, 1005 or thereabouts—chronic granular kidney or diabetes insipidus.

The *reaction of the urine* is tested by dipping into it a strip of litmus-paper. Blue litmus-paper is turned red if the urine be acid, the intensity of the red being a direct measure of the acidity. Red litmus-paper is turned blue if it is alkaline. Normal urine is acid in reaction, owing to the presence chiefly of acid phosphate of soda. Decomposing urine is alkaline in reaction, owing to the decomposition of urea into carbonate of ammonia. This is frequent in cystitis, and also takes place if the urine is stale. The reaction of the urine should therefore always be taken while it is fresh.

The *presence of albumin* is tested for in the following way: First of all it is necessary that the urine be clear. If not, it must be filtered till it is. A piece of blue litmus-paper is then dipped into it, and if it is turned red—in other words, if the urine is acid—the test may

be proceeded with at once. If, on the other hand, the urine is alkaline, as indicated by red litmus-paper being turned blue, a few drops of acetic acid must be added till it is slightly acid, which the blue litmus-paper will again show by turning red. Place about 1 inch of this acid-urine in a test-tube, and boil it. If there is no cloudiness produced, albumin is not present. If the urine becomes cloudy, this is due either to albumin or earthy phosphates (calcium and magnesium). Add a drop of strong nitric acid. If the urine becomes clear again, the cloudiness was due to phosphates, and albumin is not present. If it remains cloudy, the turbidity is due to albumin. Another test, known as Heller's, which is very commonly employed for albumin, consists in pouring a little pure nitric acid into a test-tube, and then allowing a little urine to run from a pipette on to its surface. If, after standing for a minute or two, *no* opaque white ring appears at the junction of the two fluids, no albumin is present. It will be seen that this is a test for the absence of albumin, and if no ring appears, we know that the urine contains no albumin. If, on the contrary, a white ring appears, it is probably albumin, though it should be known that two other rarer constituents of the urine give this white ring—viz., albumose and nucleo-albumin. If the ring disappears on heating and reappears on cooling, it is formed by albumose. Nucleo-albumin is distinguished by being precipitated by acetic acid.

The *presence of sugar* (glucose) may be suspected if the urine is passed in large quantity, is of high specific gravity—1030 or more—and is pale in colour. Its presence is confirmed in the following ways, among many others: Fehling's test is the one most usually employed. Fehling's solution must itself be first tested.

For this purpose, add an equal quantity of water, and boil for two minutes. If it remains clear, it is reliable. Add to 1 inch of Fehling's solution a few drops of urine freed from albumin, and boil. A yellow or red precipitate appears if glucose is present in any quantity. I no red precipitate appears, add a quantity of urine equal in amount to the Fehling solution, and boil for two minutes. If after standing the solution still remains clear, no sugar is present.

The picric-acid test may be employed. To 1 inch of urine add ¼ inch of saturated solution of picric acid, a few drops of caustic potash, and heat. If sugar is present, the solution becomes quite black, and is non-transparent on holding it up to the light. Neither of these tests nor Trommer's for sugar is free from certain fallacies, and the only absolutely reliable one is the fermentation test, which will not be described here.

The tests given above are those most usually employed, and for practical purposes may be relied upon.

The *presence of urea* in urine may be determined by placing a drop or two on a slide, adding a drop of nitric acid, and gently heating. On evaporation, rhombic or hexagonal crystals of nitrate of urea separate out if urea is present. The amount of urea excreted by the kidneys is frequently a very important point to determine before submitting a patient to a surgical operation. If no fever is present, and the absence of albumin and sugar has been ascertained, it may be approximately calculated by dividing the last two figures of the specific gravity by ten. This gives the percentage of urea. From this the amount per ounce of urine can be readily reckoned, and if the number of ounces passed in twenty-four hours is measured, the total quantity of urea excreted can be calculated—*e.g.*:

Specific gravity = 1020.

$$\frac{20}{10} = 2 = \text{percentage of urea.}$$

∴ Quantity of urea contained in each ounce of urine $= \frac{2 \times 480}{100} = 9{\cdot}6$ grains.

If 50 ounces of urine are passed in twenty-four hours, the amount of urea excreted in twenty-four hours $= 50 \times 9{\cdot}6 = 480$ grains.

This is a rough-and-ready calculation. If a more accurate estimation is required, it is arrived at by calculating the amount of nitrogen obtained by treating the urine with hypobromite of soda. This requires a special apparatus. The amount of urea excreted per diem by a healthy adult is approximately 500 grains.

Blood shows its presence in urine in small quantity by giving a characteristic smoky appearance; in large quantity it is obvious by the colour it imparts. To test chemically for blood, put 1 inch of urine in a test-tube, and add 2 drops of tincture of guaiacum. A white precipitate forms. Add now 1 inch of ozonic ether without shaking. If blood-pigment is present, a blue colour appears at the junction of the fluids. It must be ascertained that the patient is not taking iodides, otherwise a similar colour appears.

The presence of *bile* in the urine is generally due in surgical affections to some obstruction of the common bile-duct—*e.g.*, by a stone or growth or chronic inflammation. The urine then appears greenish or reddish-yellow in colour. To test for bile-pigments in the urine, a drop is placed on a porcelain dish; a little impure nitric acid is then placed near it. The two fluids are run together, and if bile-pigment is present, a play of

colours—yellow, red, violet, and green—is seen at the junction of the two. The green is the colour characteristic of bile.

The most usual deposits seen in urine are urates, uric acid, phosphates, mucus, pus, and blood. The first four are normal urinary ingredients, but are present in excess in various departures from health. Pus and blood in urine, in however small quantity, are always indications of disease.

Urates (sodium, potassium, and ammonium) form a deposit if the urine is highly acid or concentrated. They are generally present in febrile states, and commonly separate out as the urine cools in cold weather. They form a deposit varying in colour from yellow to brick-red, giving the urine a thick muddy appearance. They are always recognized by disappearing with heat, the urine, if previously clear, becoming so again on warming it over a spirit-lamp.

Uric acid forms a deposit at the bottom of the urine of brick-red grains like cayenne pepper. They are easily recognized by the naked eye, and when once known are not likely to be mistaken for anything else.

Phosphates (calcium and magnesium) separate out, and form a dull whitish deposit, if the urine is alkaline or neutral. Heat aids their precipitation. They are recognized by the fact that the deposit disappears at once on adding a few drops of acetic acid.

Mucus is recognized as a faint woolly-looking cloud which appears after the urine has stood for some time. It is present in normal urine, and in excess in catarrhal conditions of the urinary tract.

Pus forms a whitish deposit in urine, which to the naked eye is indistinguishable from phosphates. They may be distinguished by the two following tests:

(1) On adding acetic acid, phosphates are dissolved, pus is not.

(2) On adding liquor potassæ, a ropy mass is formed if pus is present, which once seen is quite characteristic.

Blood in urine on standing is apt to settle to the bottom of the jar, forming a flocculent brown or red deposit. It can be recognized by the naked eye, and by applying the general test for blood (*cf. ante*, p. 38).

The above elementary remarks on the urine may be useful if a nurse is desirous to know the most important features of it surgically, or is required to test it. Generally, as has been prevously stated, urine-testing does not fall to the nurse; but it may do so, and she should have an elementary practical knowledge of it.

8. **The Examination of the Fæces.**—A word may be said here on the examination of the fæces, which is often necessary during the period a patient is awaiting operation. The nurse will know the characteristic brown colour of normal fæces. She should make a point of saving any stool for the surgeon to see which she notices is abnormal in any respect. The most important deviations from the normal are the following: the constipated stool, the loose stool, the narrow ribbon-like stool in obstruction of the large bowel, the stool containing bright red blood, the black, tarry-looking stool from the presence of altered blood, the pale clayey stool in obstruction of the bile-ducts, etc., and the stool containing mucus in inflammatory and other conditions of the large bowel.

9. **Action of the Bowels.**—Attention should be paid to the regular action of the bowels during the whole of the patient's sojourn in hospital previous to operation. The number of daily motions should be recorded on the chart, and any deviation from the natural, such as constipation, diarrhœa, an abnormally dark or light stool, etc.,

should be reported, and the stool saved for the surgeon or house-surgeon to see (*cf.* par. 8). It is also very important that in all but emergency cases the bowels should have been thoroughly evacuated prior to operation. The intestines are normally loaded with bacteria, and as it is possible for these to gain entrance into the blood through the intestinal wall, and be carried to the operation wound and so infect it, the chance of this happening, however remote, should be reduced to a minimum. The products of intestinal fermentation are also in themselves toxic and should be removed as far as possible by purgation prior to operation. Long before anything was known about bacteria and their toxins and about intestinal fermentation, the wisdom of a thorough evacuation of the intestinal contents before submitting a patient to operation was empirically established. With this object in view on the second evening before the operation, unless otherwise ordered, the patient is given an aperient (castor oil, ℥i., or calomel, gr. iii., followed by a dose of salts in the morning for an adult, and a proportionally smaller dose for a child), and on the morning following the bowel is emptied by a soap-and-water enema. On the morning itself of the operation the enema is repeated. This plan insures, as a rule, a thorough emptying of the bowel, and is preferable to giving an aperient the night before the operation, as adopted in the practice of some surgeons. If the latter is the usage, the patient is very likely to be disturbed two or three times in the night or on the morning of the operation, and this in itself is exhausting. In addition, it is not unlikely that the bowels will act on the table—an unpleasant and often disturbing circumstance. In a rectal case, for instance, if an aperient is given the night before the operation, the bowels will very

probably act during the operation, and interfere very much with it. Lastly, in the routine recommended in these pages, as will be explained hereafter (*cf.* par. 11), the preparation of the skin is left till the morning of the operation, after the final enema, and the patient then remains quietly in bed till he is brought to the theatre, and he is very rarely disturbed by the desire to defæcate. The administration of an aperient the night before, on the other hand, will very likely result in an action or two of the bowels during the morning, after the skin has been prepared and the dressing applied. This is undesirable. It is the duty of the nurse to make sure that the enema is returned, and the bowel is thoroughly emptied. The appearance of the enema in a rectal or perineal case, for instance, is very disconcerting after the operation has begun, and interferes with its comfortable and cleanly performance.

On the second evening before the operation the patient, if previously allowed to get up, usually goes to bed, and remains there till the operation.

10. **Diet.**—Except in special cases—as, for instance, in operations of the stomach—the patient is kept on light nourishing diet, such as chicken, fish, bread-and-butter, etc., during his stay in hospital previous to operation. If the operation is to take place early in the morning—say at 9 a.m., which is the best time—the patient will have his last solid meal the evening before, and a cup of strong beef-tea on the morning of the operation, about four hours previous to it. If the operation is in the afternoon, as in many hospitals, he will have his last solid meal at breakfast on the day of operation, and his cup of beef-tea about four hours before it takes place. The object is to feed patients as nearly up to the operation hour as possible consistently with

their stomachs being empty at the actual time of it. On the one hand is kept in view the necessity of the patient not being exhausted from want of nourishment, and on the other the avoidance of sickness during operation, which is inconvenient and dangerous, as well as the reduction to a minimum of after-sickness, which is exhausting, and prevents a resumption of feeding by the mouth, always desirable as soon as possible. By following the above directions this is secured in most instances. An important point should be noted here. In a long series of consecutive operations in hospital, the first patient may be operated upon at 1.30 p.m., for instance, and the last at 6 p.m., and the ward sister should know approximately at what hour the patient is going to the theatre, and give him his cup of beef-tea accordingly about four hours before. The several patients should obviously not be fed at the same time. In operations on the mouth, stomach, or bowel, the patient is fed for three days previously on sterilized fluids served in sterilized bowls, the object being in these cases to attain as near as possible to an aseptic preparation of the operation area.

In all cases where the patient will require feeding by a nasal tube or by one passed through the mouth, it is important that he be got accustomed to this procedure previous to the operation, and, with this end in view, that the tube be passed a few times beforehand. The passage of these tubes with ease is greatly a matter of confidence on the part of the patient, and if it be undertaken for the first time after the operation it will often alarm a nervous individual, and occasion considerable difficulty to the operator and exhaustion to the patient. In cases requiring it, therefore, the patient should be got thoroughly accustomed to this mode of feeding beforehand.

By the routine adoption of the practice hitherto recommended the bowels and skin are made to function freely, the patient is not loaded up with indigestible food, he is brought into a state of general cleanliness, and the surgeon is in possession of knowledge of his temperature, pulse, respiration, and the state of his kidneys—all very important considerations in the performance of any operation. During this preparatory stage the nurse should keep the patient under close observation, and note and report any variation from the normal—for example, if he is not sleeping well, not taking his food well, appears unduly nervous, has a cough, if there has been difficulty in getting his bowels to act satisfactorily, etc. All of these should be noted and brought to the knowledge of the surgeon before the day fixed for the operation.

We now reach a very important stage—viz.:

11. **The Preparation of the Operation Area.**—Of all the many details in the preparation of a patient for operation, that involving the operation area causes the greatest anxiety, and for the following reason—no chemicals are as efficient in the destruction of germs as heat. Now, in the gradual evolution of the aseptic system we have arrived at this point—that everything, with two exceptions, used in a modern operation can be sterilized by heat. The exceptions are the operation area and the catgut employed by many surgeons for ligatures. Some surgeons get rid of the last difficulty by using silk, which can be boiled for ligatures, and in their practice the operation area is the sole remaining item requiring chemicals for its disinfection.*

* It should be mentioned that there is a method of preparing catgut by heat, known as the xylol process, but it has not been generally adopted.

In regard to the surgeon's and assistants' hands, they are practically rendered sterile by heat, inasmuch as they are covered by rubber cloves, which are boiled. Towels, dressings, instruments, sutures, etc., as will be explained in detail in the following chapter, are all sterilized by heat. The majority of operations involve an incision into the skin; in others, the incision is made into mucous membrane—as, for instance, in operations within the mouth or vagina, or those requiring an incision into the stomach or bowel. In none of these situations obviously can heat be used as a sterilizer, and we are obliged to resort to other measures and to the less efficient chemical disinfectants. Now, although the more superficial layers of the skin can be disinfected by mechanical cleansing and the use of chemicals, the deeper layers, as well as the sebaceous and sweat glands and hair-follicles, are crowded with germs, and hitherto it has been found impossible to get at and destroy these by any chemicals which would not at the same time seriously injure the skin. When we come to deal with internal cavities, the problem is more difficult still. The mouth, for instance, is teeming with germs, and the mechanical process of thoroughly scrubbing with soap and water and the use of strong chemicals are impossible here. We have to be content with general cleansing, which falls far short of an ideal disinfection. The bowel, again, is full of micro-organisms, and it is obvious that this region cannot be got at for a thorough disinfection. Still, even here we endeavour, by means of purgatives, to rid the intestine of as many germs as possible, and to approach some sort of aseptic preparation of the site of operation.

The various structures into which a breach of surface is made during a surgical operation are the skin and the

mucous membrane of the mouth, nose, stomach, intestine, and vagina. The procedures adopted for disinfecting these as far as possible will now be described in detail. It must be understood that surgeons differ considerably in their methods of disinfection and in the chemicals they use, and the nurse will have to acquaint herself with the practice of the surgeon under whom she is working. Nevertheless, there are general principles on which all modern surgeons are agreed. These are the most important, and particular stress will be laid upon them in the following remarks. The various areas will be taken seriatim.

Disinfection of the Skin.—By far the commonest operation area is the skin, and the description of its preparation will be given first. What is known as the Iodine* method has of late years been so generally adopted by surgeons that it alone will be described here. Other methods are in use by some surgeons. Whatever chemicals are employed, there are certain general principles in the preparation of the skin common to all. They are:

(1) The preparation of a sufficient area.
(2) Shaving.
(3) Mechanical cleansing with soap and water.

The most suitable time for these preliminaries is the evening before the operation; and if the iodine method is employed it is the only suitable time, as it is an essential of it that the iodine should be applied to a dry skin.

(1) *The Preparation of a Sufficient Area.*—The first thing the sister or nurse has to do is to map out in her own mind the operation area to be prepared, and if she is in any doubt about this she should seek direction from the house-surgeon. The skin should always be

* Picric acid is used by some surgeons in place of iodine. It has no advantages that I am aware of.

prepared over an area well wide of the actual field of operation. Preparing too much can do harm; preparing too little, on the other hand, involves a re-preparation on the table—a needless waste of time. In this connection it must be borne in mind that the surgeon may be obliged to extend the field of operation, and provision should accordingly be made in the most likely directions. For instance, though the original intention of the operation may have been upon the lower abdomen, he may have to attack the upper, and *vice versa:* in the case of breast cancer, after an inspection of the contents of the axilla, it may be necessary to remove those of the posterior triangle, and so on. The lines to go upon in selecting the operation area may be briefly indicated as follows: In *cerebral cases*, the whole of the head and neck; in *mastoid cases*, an area extending upwards as high as 3 inches above the upper border of the ear, and backwards as far as the mid-line of the neck; in *neck cases*, the ear, the neck, the shoulder, the axilla, and upper half of the thorax on the side to be operated upon, extending to beyond the mid-line back and front (N.B.—In the posterior triangle or back of the neck this will necessitate the shaving and preparation of a considerable area of the head as well; *cf.* Shaving, below); in *breast cases*, if malignant, the whole of the chest and upper part of abdomen as low as the umbilicus, and including it, to well beyond the mid-line in front, and to nearly the mid-line behind, the axilla, arm, and side of the neck to be operated upon—if not malignant, a smaller area in every direction; in *abdominal cases*, the whole abdomen (not forgetting the umbilicus), the lower part of the thorax, loins, pubic area, both groins, and upper parts of thighs; in *kidney cases*, the loin, lower part of thorax, the abdomen to beyond the mid-line in front, behind as far as the spine,

and below well beyond the iliac crest; in *vaginal cases*, the pubic and perineal areas, the buttocks and upper half of thighs; in *rectal or perineal cases*, the surrounding area, including buttocks, perineum, pubic areas, groins, and upper half of thighs; in *operations on the limbs*, the whole limb, including the axilla or groin.

The above will furnish the nurse with the lines which should guide her in the selection of the area of preparation. The next thing requiring attention is the removal of any hair which may happen to be present within the area of preparation. This comprises:

(2) *Shaving.*—It is very important that this be done thoroughly, and the requisites are boiling water, a good lather of soap, and a sharp razor. Amateur barbers are wont to fail in these particulars; the professional knows their value. Not a single stray hair should be visible within the field of operation. The orifices of the hair follicles are crowded with staphylococci, streptococci, and other organisms, and unless the patient has been shaved thoroughly *clean*, it is hopeless to attempt a disinfection of any skin area growing hair. It is generally a fault that too little hair is removed. Too much, rather than too little, should be the rule. A considerable area of the side of the head, commencing on a level with the top of the ear, and curving downwards and backwards to the middle line of the neck behind, should be shaved in operations involving the posterior triangle of the neck; a large area of the side of the head in mastoid cases, commencing at least 3 inches above the level of the top of the ear, and curving downwards and backwards to the mid-line of the neck behind; the whole of the head in cerebral cases; the axilla or perineum when the operation approximates these regions; the whole of the limb in any operation involving one of

these members; the whole of the pubes in operations involving its neighbourhood.*

Care must, of course, be taken that the patient is neither cut nor excoriated. If the nurse has learnt the art of shaving, which includes, as I have said before, boiling water, a sharp razor, and a good lather, there will be little likelihood of this occurrence. In shaving, after each sweep of the razor, the hair on the blade should be wiped off on to a moist swab; otherwise loose hairs very soon begin to collect about the skin, and are very difficult to get rid of.

(3) *Mechanical Cleansing with Soap and Water.*—This should be done the evening before the operation so as to give the skin plenty of time to dry before the iodine, as will be described hereafter, is applied on the morning of the operation. It is manifest that the nurse should not commence the preparation of the patient's skin without preparing her own hands first. The requisites for the preparation of the nurse's skin have first to be collected, and the way these are provided will be briefly described.

The ward sister is supplied with thick rubber gloves, nail-brushes, enamelled bowls, and the chemicals used—viz., turpentine, ether, a lotion of 1 in 500 biniodide of mercury in spirit, called henceforth spirit lotion, and lotion of 1 in 4,000 biniodide of mercury in sterilized water. A sterilizing tin is also provided for each case. Arnold's tins are the best I am acquainted with.

The following description of these tins is taken from the *Clinical Journal:* "Until this kettle was suggested by Mr. Bruce Clarke, there was *no perfect kettle* for sterilizing dressings, as, when dressings are placed in the

* Some patients are naturally very sensitive on this point. The tact of a good nurse will generally succeed in convincing them of its necessity and in overcoming their scruples.

ordinary kettle, the bands, with air-holes round them, are usually turned so as to admit steam into the dressings. After sterilizing, the lid of the sterilizer is opened, and before these bands can be turned to close the openings round the kettle, germs and dust easily get in; whereas, with this new form the dressings are placed in the kettle,

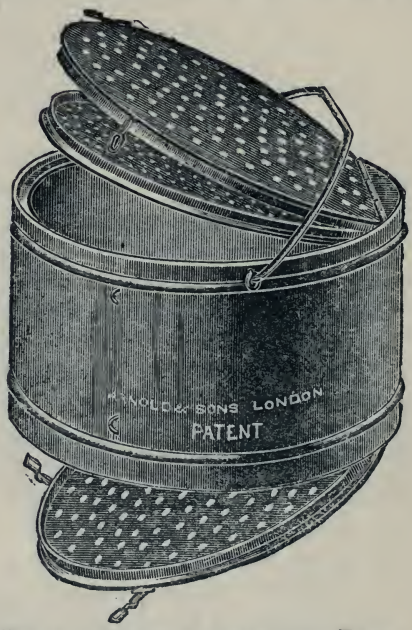


FIG. 10.—ARNOLD'S STERILIZING TINS.

which has a fixed perforated bottom and a hinged perforated top. A piece of cotton-wool is placed on the top and bottom, and a hinged perforated cover is placed on both. It is then put into the sterilizer, and, after sterilization, is taken out and ready for use without having to open or close any part."

On the day previous to the operation the ward sister packs this tin with the material necessary for the preparation of her own and the patient's skin in the following order. At the bottom of the tin are placed bandages of suitable width for the case, and safety-pins; next, a large layer of cotton-wool, a towel to dry the operation area, a second one to cover it when prepared, and the Battist mackintoshes to surround the operation area during the preparation; above these, the gown to be worn by the sister during the preparation; the rubber gloves to be worn during the preparation, with the margin at the wrist turned inside out for about 2 inches; a little French chalk wrapped in thin paper tucked into the space where the wrist margin of the glove is turned over, all wrapped in a large piece of lint; and topmost of all the gauze pads to be used in the preparation of her own hands. If this tin is packed exactly as described here, everything will be found in the order required as the preparation proceeds. The tin is then labelled with the patient's name and ward, and sent to the theatre to be sterilized. In the annex to the ward the sister boils in a copper her lotion-bowls, and in a separate bowl her nail-brushes. She also sterilizes, by boiling, a pair of forceps, which are afterwards placed in 1 in 20 carbolic acid. Soft-soap in a sterile bowl is also provided. She next pours out her chemicals—turpentine, ether, spirit lotion, and lotion of biniodide of mercury (1 in 4,000)—and sterile water into separate sterilized bowls. She is now ready to prepare her own hands. This is done in the following way, and is practically the same method as that employed by the surgeon and any of his assistants before operation:

The first thing to do is to inspect the nails to see if they require cutting, and if so, they should be trimmed

short. Sisters and nurses should be particular always to keep their nails short and clean, and their hands as smooth and free from chaps as possible. Chapped and rough hands are surgically dirty. Glycola is a good preparation for keeping the hands smooth, or equal parts of methylated spirit and glycerine. The arms are bared to the elbow, and the hands and arms are thoroughly scrubbed with soft-soap and water and a nail-brush for three minutes. The nails are then thoroughly cleaned with a blunt nail-cleaner. A knife or scissors with sharp edges should never be used for this purpose, as they scratch the under surface of the nail, and leave crevices, in which dirt subsequently collects. The scrubbing with soap and water is then repeated, special attention being given to the end of the fingers. This second scrubbing gets rid of any of the softened dirt under the nails which has been loosened but not removed by the nail-cleaner. The tin is then opened by a nurse, who lifts the lid and the top cover of cotton-wool, being careful in so doing not to come in contact with the inside of the tin, and with the sterilized forceps the sister takes out the sterilized gauze pads or lint (which, if the tin has been packed in proper order, she will find at the top), and places them in the bowls containing turpentine, ether, and spirit lotion. The hands and arms are next thoroughly rubbed over with a gauze pad soaked in turpentine, followed by one soaked in ether. This dissolves and gets rid of the dirt and sebaceous matter, loaded with germs, in the superficial layers of the epidermis and in the orifices of the sebaceous sweat-glands and hair-follicles. Special attention should be given to the ends of the fingers round about and beneath the nails, to the spaces between each finger, and the palms of the hands, each one being

Fig. 11.—Theatre Nurse lifting Cotton-Wool Cover of Sterilizing Tin.

To face p. 54.

FIG. 24.—THE SURGEON PREPARED FOR OPERATION.

To face p. 55.

treated separately. The hands and arms are finally rubbed over with a sterilized gauze pad soaked in the spirit lotion, special care being given, as before, to the ends of the fingers, the spaces between their roots, and the palms, which are rubbed each one separately. Finally, the hands and arms are immersed in sterilized water to wash off the spirit lotion, which is irritating to the skin.

The next thing to do is to put on the rubber gloves. With her sterilized forceps the sister removes the lint in which the gloves are wrapped, and thoroughly dries her hands with it. She then takes the paper containing the French chalk, opens it, and rubs the chalk over her hands and fingers. She next with the same forceps takes one glove from the tin, and slips her hand into it, handling only the turned-down portion at the wrist. She now with her gloved hand removes the second glove from the tin, and slips her remaining uncovered hand into it. Finally, the turned-down portions at the wrist which the naked hands have touched are immersed in the bowl of 1 in 4,000 biniodide of mercury lotion. The fingers of either glove can now in turn be stroked home by the other gloved hand. The sister finally takes from the tin her sterilized gown, and slips into it from behind. It is pulled on, and buttoned behind by the nurse. The sleeves, which are better without buttons, should reach the wrist, and the wrist-band of the glove is adjusted over these, care being taken not to touch the skin in so doing. Finally, the gloved hands are dipped in biniodide of mercury lotion (1 in 4,000).

The directions given above should be followed implicitly and exactly in the order given. They may seem complicated in description, but in practice they are not so, and it is just as easy in this particular to learn the tight as the wrong way. The sister now, sterile herself,

is ready to prepare her patient. It is accomplished in the following way: She removes from her tin the Battist mackintoshes with which to surround the area of preparation. Having arranged these, she takes out a gauze pad and thoroughly scrubs the operation area with soft-soap and sterile warm water. A good lather must be made, and the skin must be rubbed vigorously, but not roughly enough to excoriate it. For this reason a gauze pad is recommended in preference to a brush, which the skins of many patients will not stand; but in cleansing the feet and hands a brush may frequently be used with advantage. Having thoroughly cleansed the area with soap and water, she takes a sterile towel from her tin and very thoroughly dries it. She then places a second dry sterile towel over the area, covers this with cotton-wool, and bandages it on with a sterile bandage. The cotton-wool will keep the towel in position and prevent it slipping. All of these she will find in order if her tin has been packed as directed above. This dressing is left on till the morning of the operation.

It must be emphasized again that the skin must never be used roughly enough to excoriate it or produce a rash. This is evidence of a faulty preparation. Some discrimination is required in the preparation of the skin. For instance, the skin of the hands and feet is hard, and will stand more vigorous treatment than that of the abdomen and flexor surfaces of the limbs, and, as has been said, a brush may be used for the former. The exercise of a little common sense and practice will make perfect in this respect. The most difficult parts of the skin to disinfect are the head, the axillæ, the elbows, the fingers, the umbilicus, the groins, the pubic and perineal areas, the knees, and the feet. These will always, therefore, require special attention.

All the other items in a modern operation, with the possible exception of catgut, can be sterilized by heat, the best disinfectant. The skin cannot. It requires, therefore, a most thorough mechanical cleansing and chemical disinfection—the next best thing that can be done.

*Chemical Disinfection of the Skin—The Iodine Method.** —The iodine method of disinfecting the skin has during late years been so generally adopted that it alone will be described here. It is certainly the simplest and most handy available, and, from its general and rapid adoption by operating surgeons, it may be concluded that it has proved satisfactory. The solution which has found most favour is an alcoholic one of from 2 to 5 per cent. The essential point about it is that it must be used on a dry operative field. For this reason the mechanical cleansing with soap and water and shaving is done the day before the operation, and a dry dressing is then applied (see above). On the morning of the operation this dressing is removed, and the operative field, by this time thoroughly dry, is painted with the solution. This dries upon the skin in a few moments. When dry, but not before, a sterile towel is bandaged on over it, and the patient is ready for the theatre. Just before the operation commences the towel is removed, and a fresh application of the solution is made. At the completion of the operation the line of incision is again painted with the iodine. The effectiveness of the alcoholic solution of iodine is generally regarded as being due to its hardening effect on the tissues combined with its great penetrative powers.

It thus, in addition to its potent germicidal properties, diminishes the capability of the skin to furnish

* As stated above, some surgeons prefer picric acid in spirit, but I know of no advantage in it. It is a matter of taste.

germs. As I have emphasized above, it is only effective on a dry operative field. In cases of emergency, therefore, the skin must not be previously cleansed with any moist preparation, and it must not be shaved, or, if shaved, the shave must be a dry one. Its only drawback is that it may blister sensitive skins or cause eczema. Therefore on the scrotum, vulva, and other sensitive parts, and on the skins of young children, the solution should not be too strong, and one application only is advisable.

Disinfection of the Mouth.—In every case of operation in any part of the body, attention should be directed to the patient's mouth. This is especially necessary in hospital patients, many of whom rarely or never brush their teeth or clean their mouths. As has been mentioned previously, probably many of the cases of so-called anæsthetic pneumonia and parotitis following operation are due to septic matter being inhaled into the lungs or passing up the parotid duct from the mouth. The "toilet of the mouth" should, therefore, in all cases be attended to, and should be considered as part of the general cleansing and preparation of a patient for operation (*cf.* p. 31).

In cases of operation within the mouth itself—for instance, operations for cancer of the tongue, those on the jaws, etc.—additional measures are necessary. The patient should be put in the hands of the dentist as soon as possible after admission, with the view of removal of decayed stumps or teeth, which may be sources of sepsis, or may, owing to their position, interfere with the conduct of the operation, so as to give the gums time to heal and to be got into a cleanly condition beforehand. It is not sound practice to have the teeth removed on the operation-table or the day before the

operation. In operations within the mouth the same measures should be adopted for cleansing the mouth as have been described in general cleansing, with the exercise, if possible, of additional care. As has been explained in the paragraph on dieting, for three days previous to operation the patient is fed on sterilized food, administered in sterilized bowls. The toilet of the mouth, to sum up, comprises timely removal of decayed teeth, tooth-brushing after each meal, constant washing out the mouth with some antiseptic gargle, such as Sanitas or Listerin and water (ʒi. to O.i.), or a solution of peroxide of hydrogen of the strength of 5 to 10 volumes, or hypochlorous acid in the form of eusol, and the administration of sterile food for some days previous to operation.

Disinfection of the Throat and Nose.—It is essential as a preliminary preparation that any oral sepsis should be corrected (*cf.* previous paragraph). The pharynx, fauces, and tonsillar regions should also be sprayed frequently with the same solutions. Douching the nasal cavities with peroxide of hydrogen of a strength not exceeding 5 volumes, or with a mild alkaline antiseptic containing carbolic acid, should also be carried out. A convenient formula is:

Sodii chlor. } Sodii bibor. }	āā gr. xv.
Acid. carbol. liq.	♏ ii.-iv.
Glycerine	ʒi.
Aq.	ad ℥i.

This should be used tepid by the addition of a little hot water, and is introduced into either nostril alternately by means of a rubber tube attached to a funnel, held a foot or two above the patient's head, which is slightly

bent forward during the proceeding. Previous to the performance of an operation on the nose, the face should be thoroughly cleansed with soft soap and water, and the moustache should be shaved, if present. The after-treatment is carried out on similar lines by nasal douching; and in the case of the throat by spraying, or application on swabs of peroxide of hydrogen.

Disinfection of the Eye.—According to Schweinitz, the skin in the neighbourhood of the closed eye should be thoroughly washed with soap and water, alcohol, and finally with bichloride of mercury solution, 1 in 2,000; the conjunctival sac may be freely irrigated with bichloride of mercury solution, 1 in 8,000. Stronger chemicals cannot be used here.

Disinfection of the Stomach.—The stomach has been shown to be capable of being rendered sterile for operation purposes. Its disinfection consists first of all in a thorough disinfection of the mouth, and the measures which have been described in the toilet of the mouth should be rigorously adopted in all operations contemplated upon the stomach. These include the feeding for three days previous to operation with sterilized fluids (milk, beef-tea, water, etc.), served in sterilized bowls, so as to avoid the introduction of micro-organisms into the stomach. In addition, care should be taken that the stomach is empty of all food at the time of operation, and with this view for six hours previous to operation no food whatever should be administered by the mouth. On the day of the operation, and shortly before it, some surgeons wash the stomach out with the stomach-tube, using sterilized water mixed or not with some mild antiseptic, such as boracic acid or Condy's fluid. I am convinced that this is generally unnecessary, and does more harm than good. To any patient, if he is not

accustomed to it, it is a considerable ordeal, and a nervous patient may be greatly frightened and upset by it. It may be sometimes necessary, as in the case of an operation upon a dilated stomach loaded with fermented matter, but in all but quite exceptional cases I feel sure it is better dispensed with. Ordinarily the stomach contains very few germs, and if the general technique of the operation is carefully conducted, there is no necessity for this very disagreeable procedure. The disinfection of the stomach, therefore, comprises a thorough toilet of the mouth; the feeding of patients for some days previous to operation on sterilized foods, served in sterilized bowls; care in insuring an empty organ at the time of operation, and exceptionally washing out the stomach shortly before its performance.

Disinfection of the Intestine consists almost entirely in the free evacuation of the bowels previous to operation by purgatives and enemata; for it has been found that the emptier the bowel, the freer it is of micro-organisms, and any overloading of it—as, for instance, in cases of intestinal obstruction—is accompanied by great increase in their number and virulence. A thorough emptying of the bowel, therefore, is the paramount indication. In addition, the toilet of the mouth, as previously described, should be strictly enforced, and the patient should be fed on sterilized fluids for some days previous to operation.

Disinfection of the Vagina.—In all operations on the vagina the pubes should, of course, be shaved, and all hair in the neighbourhood be removed. The vagina is best disinfected by douching it with lotio hydrarg. biniodid. (1 in 4,000) previously. The external genitals are disinfected as other parts of the skin (see above), except that the iodine solution should be used weak

(2 per cent.). Just before the operation, and when the patient is under the anæsthetic, the vagina is thoroughly dried out with dry swabs on a holder, and the cavity is painted with the iodine solution.

The description of the disinfection of the various operation areas is now concluded. If they are conscientiously and adequately prepared, there should be no necessity for any elaborate repetition on the operating-table, which involves a waste of time and an unnecessary prolongation of the anæsthesia.

12. **Clothing of the Patient during Operation.**—It is of paramount importance that the patient be kept warm during operation, and too careful attention to this point cannot be given.

During an operation a considerable body-surface has frequently to be denuded of clothing, and, in addition, viscera are frequently by exposure perforce subjected to a lower temperature than the normal body heat. Where shock is present during an operation or follows it, one of its most characteristic features is a depression of the body temperature. In the late war the two outstanding clinical features of the soldier suffering from traumatic shock were thirst and cold, and to relieve his thirst with hot drinks and warm up his shivering body were found by experience to be indispensable preliminaries to submitting him to anæsthesia or operative interference. There is no reason to suppose that shock following the operation of civil practice differs in its essentials, though it may and fortunately does do so in degree, from the terrible shock which accompanied many of the severe wounds of war (*cf.* Shock, p. 131). An obvious indication, therefore, in preventing or combating shock in civil practice is to keep the patient as warm as possible while he is undergoing an operation. With this

end in view, many modern operating-tables are provided with a heating apparatus, and, with the same object, some surgeons prefer operating in very hot rooms. In the following chapter a word will be said as to the temperature of the operating-room. The point requiring emphasis here is that patients should always be warmly clothed during operation. The limbs should be wrapped in cotton-wool, which should be bandaged on; and if the operation is on the abdomen, a cotton-wool jacket should envelop the chest and back; if on the chest, the abdomen and loins should be similarly clad, or pyjamas of gamgee tissue may be used. These should be applied some little time before the patient goes to the theatre, and after operation should not be removed till any shock, if present, has passed off.

13. **Passage of Catheter before Operation.**—In operations on the female pelvis or lower abdomen, the sister of the ward should pass a catheter and empty the patient's bladder just previous to her going to the theatre. Before doing so, the sister thoroughly disinfects her hands, and puts on a sterilized rubber finger-stall. The orifice of the urethra is cleansed with a swab wrung out of 1 in 4,000 biniodide of mercury lotion. The catheter, which should be of glass, is boiled. In drawing off the water after operation, where necessary, these same precautions should be adopted every time.

When the patient's turn comes for operation, he is clad in a flannel theatre-gown, open down the back to admit of easy removal, lifted on to the ambulance, and wheeled to the operating-theatre.

14. **Emergency Operations.**—In case of emergency it is obviously impossible to give the same attention to the preparation as outlined in the previous pages. It is advisable to administer an enema, and the ward sister

should draw off the urine if the patient is a female and requires abdominal section. The patient should also be swathed in cotton-wool. The skin should be painted with the iodine solution without washing it, and if it is shaved, the shave must be a dry one. No water or soap must be used. A sterile towel is then bandaged on. Just before the operation the skin is again gone over with the iodine solution.

15. **Crile's Method.** — Crile's method of guarding against shock, which has attracted a good deal of attention in the surgical world during the past few years, may be briefly alluded to here, as it involves certain additional measures in the preparation of a patient for operation. According to Crile, shock occurring during or after an operation is due to exhaustion of brain cells (which in all cases can be demonstrated microscopically), owing to their giving off energy in response to the various stimuli associated with the performance of any operation. Such stimuli are of two kinds: emotional, caused by the fear of the anæsthetic, operation, etc.; and traumatic, caused by the injury done to the tissues by knife, scissors, needles, etc., as well as by the various manipulations which form part of every operation—*e.g.*, handling tissues, pulling by retractors, etc. According to Crile, ether anæsthesia, although rendering the patient unconscious, and thereby unable to manifest signs of increased energy and consequent brain exhaustion, does not protect the brain cells against that exhaustion, which occurs just as if the patient were awake. Under nitrous oxide anæsthesia much less exhaustion of the brain cells occurs than with ether.* Acting upon these data, Crile, with

* During the late war, gas and oxygen was found to be the anæsthetic the severely wounded could best tolerate when submitted to operative interference.

the view of excluding the emotional stimuli, recommends the utmost tact, gentleness, and hopefulness, both on the part of the surgeon and nurse, in all sayings and dealings with the patient before operation. This, after all, and without Crile's scientific explanation, commends itself as a common-sense measure, and has been specially emphasized in the first chapter of this book. He also recommends the substitution of nitrous oxide anæsthesia, which is pleasant, for ether, which is the reverse, and the administration of a small dose of morphia (gr. $\frac{1}{6}$) and scopolamine (gr. $\frac{1}{150}$) about two hours before operation. This renders the patient drowsy, and more or less oblivious of his coming ordeal. With the view of excluding the traumatic stimuli, he recommends, in addition to clean cutting and gentle handling (also common-sense measures), the complete blocking of all impulses to the brain from the operation area by novocain infiltration as a first step in the operation. Crile has also observed that by these means, in abdominal sections, the uncomfortable gas pains or meteorism which so frequently occur can be almost entirely excluded. Whether Crile's method is adopted by the surgeon or not, the nurse should be most careful to soothe away by every means in her power any fears the patient may have regarding the operation or its outcome; and if this method is practised, she should administer hypodermically the morphia and scopolamine injection mentioned above two hours before the time fixed for the operation. This injection is not to be employed in the case of young children or old people.

CHAPTER IV

THE PATIENT IN THE THEATRE—DUTIES OF HOUSE SURGEONS, THEATRE SISTERS, NURSES, ETC.

THE present chapter naturally divides itself into two sections—first, the description of the various requisites for an aseptic operation; and, second, that of the conduct of the operation itself, with the duties devolving on each participator in it.

SECTION I.—THE REQUISITES FOR AN ASEPTIC OPERATION.

The requisites for an aseptic operation comprise the theatre, the preparation of the theatre, and the various materials used in the operation.

1. The Theatre.

As the result of the development of the aseptic system in surgery, every hospital has recognized the necessity of providing itself with a modern operating-theatre. Wards built on modern lines and in consonance with the principles of aseptic surgery are very desirable, but through lack of funds are not everywhere attainable, and many hospitals are compelled to rest temporarily satisfied with somewhat antiquated buildings for the housing of their patients before and after operation. The theatre has rightly come first in the construction

of up-to-date hospital buildings, for it is recognized that if the patient leaves it without any flaw in the asepsis, he is not likely to become infected by his subsequent surroundings. It is in the adequate preparation of the patient for operation and in the conduct of the operation itself that the chief importance lies, and it is not so much a matter of urgency that he should be subsequently domiciled in a modern ward. I am not in the least minimizing the desirability of replacing out-of-date by up-to-date buildings, but emphasizing the fact that the theatre is the most important requisite in the conduct of aseptic operations in hospitals, and that without it it is impossible to fulfil the conditions of aseptic surgery. The old theatres meantime serve their purpose, and are not so much waste bricks and mortar to be thrown on the scrap-heap. They should, if possible, be retained and utilized for the performance of operations in themselves septic—such, for instance, as those for extravasation of urine, septic cellulitis, etc.—so that the theatre proper may, as far as possible, not be contaminated by cases of this kind at all.

In the description of the theatre very few words are needed. Modern theatres may be seen nowadays in all large towns, and there is no particular advantage in describing them in books. A very few remarks will suffice to give a general idea of the scheme, so as to enable the reader to understand any references thereto in the following pages.

The modern theatre comprises—

(1) **The connecting lobby,** into which the various other rooms open.

(2) **Surgeons' anteroom,** where coats and boots are changed, and a preliminary wash is obtained before entering the theatre at all. It contains for this purpose

a couple of basins, with foot or elbow handles, a glass shelf above these, and an enamelled iron towel-horse for hanging the mackintosh aprons and sleeves upon.

(3) **Anæsthetic room,** opening by one door into the lobby, and by a second into the theatre. It contains a basin for the anæsthetist's use. Here the patient is anæsthetized previous to his entry into the theatre, and one is glad to see the unfortunate subject of a modern operation spared the experience, so common a few years ago, of entering a theatre perhaps full of students, and with all the paraphernalia of the operation in full view.

(4) **The sterilizing room,** opening directly into the theatre on the side opposite the anæsthetic room. It contains a broad metal shelf, on which are the sterilizers for instruments and bowls, heated by Bunsen gas-burners, the water sterilizer, steam sterilizer, a sink for washing instruments, etc., and some glass shelves.

(5) **The theatre,** in which the operation is performed. All theatres should be provided with a stand for visitors, with a separate entrance, and preferably shut off from the well of the theatre by means of a glass screen. None but those taking part in the operation should enter the well of the theatre. It is impossible to carry out the technique of an aseptic operation with visitors crowding round the operation area, and the staff of the hospital, when wishing to view an operation, should set a good example in this respect by taking their places in the stand with outside visitors. The air of the theatre is continually changed by being driven in by an electrically driven fan at the basement, and extracted by a similar apparatus in the roof. It is filtered at its inlet by passing through a screen of muslin, and warmed after this by

passing over copper radiators, which should be on hinges, so that they can be moved out and cleaned.

The fixtures in the theatre comprise at least three basins, whose water-supply is controlled by foot or elbow handles, and which empty into a gutter beneath them; a sink; a glass metal shelf, for the reception of bowls containing overalls, gloves, etc.; glass shelves for the reception of lotion-jars; a good electric-lighting apparatus over the table; and wall connections for hand lights and for the transformers for the electric cautery,

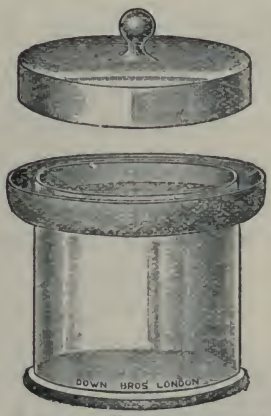


FIG. 13.—LIGATURE JARS.

cystoscope, etc. A fixture for gas should also be provided, in case the electric light fail at any critical moment. The furniture consists of *two* operating-tables (always necessary for the smooth conduct of a series of operations), an anæsthetist's table, a dust-proof instrument cabinet, a dressing-waggon, a wall-stand, two wash-stands for lotion-bowls, and two instrument-tables—one for holding instruments, and the other for the tins containing swabs, packs, dressings, etc. All of these should

be on castors, and easily movable. The large jars for lotions and the smaller jars for ligatures, sutures, etc., should all be of the pattern with the lid fitting over the top. Ligature-jars, as illustrated in the accompanying figure, with the lid not only fitting over the top, but resting in a gutter containing lotio acidi carbolici (1 in 20), are admirable. The best bowls for everything are those of enamelled iron of various sizes. They do not break, and are preferable to glass. As Mr. Harrison points out, those for lotions should be large enough to stand well above the rim of the stand, so that they can easily be lifted out without touching the inside of the bowl (*cf.* frontispiece). A mop for cleaning the floor, and a hose-pipe, connected with the main, for washing it, should also be provided. A Berkefeld filter is in use in some theatres, but is not an absolute necessity.

2. Preparation of the Theatre.

The preparation of the theatre for operation consists in insuring its perfect cleanliness. Every day all the "brights" are cleaned with methylated spirit and Pynka. Sinks, tables, and lights are washed with Monkey Soap and water; walls dusted round with a damp cloth; the glass tops of the tables, wall-stand, etc., are washed with soap and water and polished with methylated spirit. Once a week the theatre walls are washed with carbolic soap and water, tables and castors cleaned with methylated spirit and Pynka, cupboards and drawers are washed out with soap and water, windows cleaned, etc. The large lotion-jars are cleaned and the water sterilizer scrubbed out once a week with soap and water. The routine will vary, and the above account is only intended to give a general idea of what is required.

3. Preparation of the Various Materials used in the Operation.

1. **Costume.**—The costume worn at operation is of the first importance. By a rigid attention to detail it is no exaggeration to say that the surgeon and his assistants can render themselves sterile. The requirements for the sterilization of all participators in the operation and their method of preparation will now be briefly described. The mode of their application will come under the second section.

(i.) *Goloshes* should be worn in place of boots, which will bring into the theatre all kinds of germ-laden dirt from outside. They are commonly merely washed, but, as Mr. Harrison points out in "Modern Methods for Securing Surgical Asepsis," they should be sterilized by boiling for half an hour in water or in a high-pressure sterilizer. They are placed in the anteroom, where the surgeon and house-surgeon change their boots for them.*

(ii.) *Coats.*—These should reach from the neck to the feet, should fasten at the back, and should be provided with long sleeves reaching the wrist, so that the rubber gloves, when finally adjusted, may overlap them. It is impossible to be certain of rendering the skin by any known method sterile. Obviously, therefore, no part of the skin which can be covered with a sterilized garment should be exposed. The gowns are sterilized for one hour in a separate large sterilizing tin, and are then placed on the metal shelf for their reception in the theatre.

(iii.) *Rubber Gloves.*—For rendering their hands sterile

* Mackintosh covers into which the boot is slipped, and which are fastened above or below the knee, answer admirably in place of goloshes.

it is recommended that rubber gloves be worn by all the immediate participators in the operation—*i.e.*, the surgeon, his assistants, and the theatre sister.

Three objections have been urged against rubber gloves:

(*a*) They impair the tactile sense. This is undoubted, and in some operations within the abdomen, in which the chief reliance of the surgeon is on the sense of touch —*e.g.*, in shelling out an adherent appendix or Fallopian tube or ovary—the gloved hand is inferior to the naked hand.

(*b*) In handling especially abdominal contents they prove very slippery, and structures cannot consequently be manipulated with the same ease and dexterity as without them.

(*c*) They are liable to be unwittingly punctured during an operation, and if this happen their protective value is impaired.

These drawbacks obviously have very little, if any, weight in the case of the assistant and theatre sister. They are not likely to prick their fingers, nor is the same delicacy of touch required of them as is necessary for the surgeon. Owing to the increased security they afford against infection by the hands, rubber gloves should therefore unquestionably be worn by them. With regard to the surgeon himself, the matter must be left to individual choice. The slipperiness of gloves can be met by using a piece of thin gauze when handling slippery tissues, and there is no doubt that with practice many surgeons acquire almost, if not quite, the same dexterity with them as without them, and learn not to prick their fingers. The general conclusion is that gloves undoubtedly conduce to a more perfect aseptic operation. They should, therefore, certainly be worn

by all assistants at operations, and always by the surgeon himself, unless he is conscious that his manipulative and operative skill are seriously hampered by their use, and unless he cannot overcome the habit of pricking his fingers. As a matter of fact, all modern surgeons use them.

Before sterilizing the gloves the nurse or sister should fill them with water, and then squeeze each distended finger from base to tip. If there is the smallest puncture in them, the squirting out of a fine jet of water will demonstrate it, and the glove must be discarded. Gloves are usually dry-sterilized in the steam sterilizer. Before placing them in the sterilizer, the wrist-band is turned down for about 2 inches, so that in putting them on, as will hereafter be described, the outside of the glove is not touched with the naked hand. Each pair of gloves is wrapped in a piece of lint or glove-towel, together with a small quantity of French chalk in some tissue paper. It is then placed in the glove-tin, and sterilized for half an hour at 10-pound pressure. If preferred, gloves may be sterilized by placing them in a bowl of water and boiling them for ten minutes.

(iv.) Sterilized *caps* and *masks* are worn by the surgeon and his assistants—*i.e.*, the house-surgeon and theatre sister. Otherwise, heads coming in contact during an operation may scatter germs into the wound, or the act of coughing or speaking may project them into the instrument-trays, etc. They are preferably made in one piece, and are sterilized for one hour in the steam sterilizer in a separate tin, which is then transferred to the stand for their reception in the theatre.

2. **Instruments.**—The sharp instruments used in operations are scissors, needles, and knives. Their cutting edges are blunted by boiling. With regard to scissors

and needles, there is not the same necessity for a perfect edge as with knives; and, in view of the fact that the eyes of needles and the joints of scissors are regions likely to harbour germs, they are submitted to the same treatment as blunt instruments, except that their cutting edges and points are wrapped in cotton-wool during boiling, which to some extent protects them. With knives the case is different. It is impossible to operate cleanly and well without a very sharp knife, and anything like a prolonged boiling blunts them, and renders them unfit for use, even if their edges are wrapped in cotton-wool. Fortunately, knives, as universally manufactured nowadays in one smooth metal piece, contain no crevices about them, and are very easy to clean. A modification in their sterilization may therefore be safely adopted which will be described hereafter. To sum up, all instruments, *except knives*, are prepared in exactly the same way, the only precaution necessary being to wrap the cutting edges of scissors and needles in cotton-wool.

The description of the sterilization of instruments may be most conveniently begun at the far end—*i.e.*, after operation. Modern operating theatres are provided with dust-proof cabinets, for the housing of instruments when not in use. The first rule to observe is *that all instruments should be cleaned at once after operation, sterilized, and replaced in the cabinet.* If instruments are left for any length of time without being cleaned, blood and pus which has collected dries on their surfaces or in their crevices, and is difficult to remove; also by such treatment instruments of course deteriorate. The first care of a keen theatre sister, therefore, after operation, is her instruments. She cleans them at once, sterilizes them, and replaces them in the cabinet. In-

struments are cleaned by being thoroughly scrubbed under a running tap of cold* water, with soap and a nail-brush. Especial attention is paid to the teeth of Spencer Wells and other forceps, and to the joints of any instruments which are jointed. The Spencer Wells forceps are carefully inspected after cleansing, and if any coagulated secretion is present, they are rewashed and rescrubbed till it has disappeared. Hollow instruments—*e.g.*, trocars, catheters—are cleaned by running water through them, boiling them, drying them, and finally syringeing methylated spirit through them. This prevents their rusting. After cleaning, if they have been used in *aseptic* cases only, all instruments are boiled for ten minutes in the instrument sterilizer in water, to each pint of which a teaspoonful of carbonate of soda is added. The latter removes grease, prevents rusting, and slightly raises the boiling-point of the water (Lockwood). Care is taken that the water covers the whole of the instruments; parts of them should not be left sticking out above its surface. Instrument sterilizers should therefore be capacious enough to easily accommodate the largest instruments in use. Knives are not used a second time, and go back to the instrument-maker for resharpening. *After* operation they are therefore boiled for ten minutes with the rest of the instruments. While the instruments are boiling, the sister scrubs and disinfects her own hands (*cf.* p. 53), and gets ready two or three sterilized towels. She dries the instruments with one towel, and lays them on another, and when they are completed she replaces them in the cabinet. If the instruments have been used in a *septic* case, after a very thorough cleaning they are sterilized for *double the time*—

* Cold water, I am informed by our theatre sister, removes discharges much better than hot.

i.e., twenty minutes—before being put away. Instruments which become septic during operation—*e.g.*, those used in an obviously septic case—are best collected and put aside. At the end of the day's work, and after the other instruments have been sterilized and put away, they are given a thorough and deliberate cleaning and sterilization. If an instrument is infected during an operation, and its immediate use is indispensable, it is rinsed clean under the tap, and then boiled for at least five minutes before being introduced again into the operation field. The cabinet and its contents should be looked upon as the theatre sister's private property *pro tem.* She should jealously guard it and keep it locked. Anybody who walks into the theatre should not be at liberty to open the instrument cabinet and handle the instruments, as is frequently done. If these rules of cleaning, sterilizing, and replacing in the cabinet all instruments as soon as possible after operation, and of allowing no instrument to be replaced in the cabinet that has not been sterilized, be rigidly observed, and if the cabinet be kept locked, there will be very little anxiety as regards the instruments when the time comes for their preparation for operation. Also, if these rules are observed, and an instrument which has not been got ready is required in a hurry in the midst of an operation, it is taken with confidence from the cabinet, and used after two minutes' boiling. Of course, this should not be made an excuse for any careless provision for the operation. It should be a prime endeavour to so make preparation beforehand that nothing unforeseen is wanted, and here a good and experienced theatre sister shows her capability. Still, occasional oversight is impossible to avoid, and any danger arising from such an occurrence is obviated if the rules laid down above

are strictly observed. When an operation is about to take place, the instruments for it are selected by the theatre sister. If she is in doubt on any point, she asks the surgeon or house-surgeon. All except the knives are placed in the instrument sterilizer, and boiled for ten minutes previous to the operation, while the patient is being anæsthetized. Just before the operation is about to commence, they are brought in the tray by the theatre nurse to the instrument-table, and arranged by the theatre sister on her instrument-table. The knives are first washed in pure carbolic acid; their blades are then wrapped in cotton-wool, and they are boiled for one minute. This is sufficient to sterilize them, and does not appreciably blunt them. They are prepared after the other instruments are sterilized, and just as the operation is about to commence. The sterilization must be done according to the times stated here by the clock; it must not be left to guess-work.

To summarize, the following rules are observed in the preservation and sterilization of instruments:

(i.) All instruments used are cleaned *immediately after* operation.

(ii.) If used in aseptic cases, they are all boiled for ten minutes.

(iii.) If used in septic cases, they are all boiled for twenty minutes.

(iv.) After boiling, they are replaced at once in the instrument cabinet, which is kept locked.

(v.) Just previous to operation all instruments *except knives* are boiled for ten minutes, the cutting edges of scissors and needles being wrapped in cotton-wool.

(vi.) Knives are sterilized by wiping them over with pure carbolic, wrapping their blades in cotton-wool, and boiling them for one minute.

(vii.) An instrument becoming septic in an operation is, if possible, not used again; if its use is indispensable, it is first rinsed under the tap, and boiled for five minutes.

(viii.) If an instrument is required in a hurry in the midst of an operation, and the above rules are strictly observed, it may be taken from the cabinet and safely used after two minutes' boiling.

3. **Ligatures and Sutures.**—The ligatures and sutures almost universally used by surgeons are silk, silkworm gut, Pagenstecher's celluloid thread, catgut, kangaroo and reindeer tendon. Of these, silk, silkworm gut, and Pagenstecher's thread can be boiled in the ordinary way, and some surgeons, carrying to a logical conclusion their conviction that boiling is the only reliable method of sterilization, use these entirely for ligatures and sutures, and refuse to have anything to do with catgut, etc. There is no disputing the fact, however, that silk is apt to act as an irritant, to cause abscesses, and leave troublesome sinuses, which refuse to heal till it has come away; and this is especially liable to occur if the parts sewn together with it are subjected to constant tension and movement. For instance, though silk may be confidently used to tie the pedicle of a tumour inside the abdomen, after which it lies at rest, and is very unlikely to cause subsequent trouble, if used to bring the abdominal muscles together in a laparotomy or radical cure of hernia, it will, in a certain proportion of cases, cause stitch abscesses and sinuses. Most surgeons, therefore, use absorbable catgut (or animal tendon) for purposes of this kind. The latter is also always used in septic cases, as under these circumstances silk invariably prevents the wound closing till it has come away, and this frequently takes several weeks. The nurse will

have to find out what ligatures and sutures the surgeon is in the habit of using.

(i.) *Silk* is sterilized by being boiled for half an hour in water—*not* in soda solution, which renders it brittle. It is also rendered brittle and unfit for use by repeated boiling, but it will generally go through the process of preparation twice without injury. During boiling it should not be wound tightly on reels, but loosely on large metal spools. If wound tightly on small reels, sufficient heat for complete sterilization may not penetrate its deeper layers. In addition, the winding on small reels makes it curl up and tend to knot itself when in use. If wound on large spools (18 inches long), it will be found free from this inconvenience. Silk is boiled for each operation, and is transferred from the bowl in which it is boiled with sterile forceps to a bowl containing normal saline solution.* It is used commonly for suturing the skin (sizes 1, 2, or 3, according to the size of the wound), for ligaturing the pedicles of abdominal tumours, the broad ligament in hysterectomy, for the peritoneal stitch in intestinal anastomoses—generally, in fact, inside the abdomen in aseptic cases. It is also used for tying the neck of the sac in the operation for hernia. For reasons stated above, it is not used by most surgeons for ligaturing vessels, or for bringing together the deeper parts of wounds. It is never, if it can be dispensed with, used in a septic wound, because it will keep such a wound open till it has come away. Pagenstecher's celluloid thread is used

* The silk may, if preferred, be prepared by boiling some hours before operation, and then transferred with sterilized forceps to a ligature-jar containing 1 in 20 carbolic lotion. Just before each operation what is required is removed from the jar with sterile forceps by the sister.

for the same purposes as silk, and is stronger. It is prepared in the same way as silk, and can be boiled three or four times. After this it frays, and should be thrown away.

(ii.) *Silkworm gut* is prepared in exactly the same way as silk. It is used for the skin instead of silk by many surgeons. It is also very useful in plastic operations, such as cleft-palate, hare-lip, perineorrhaphy, etc., and has largely replaced silver wire for these purposes. Lastly, it is the most suitable material for rapidly closing the abdomen in cases of necessity with a through-and-through suture. For this purpose a stout size must be used, threaded on a large curved needle. It is transferred, like silk, with sterile forceps from the bowls in which it has been boiled into normal saline solution before operation.

(iii.) *Catgut* is generally prepared by the iodine method, which is easily performed and reliable. Most surgeons, myself among the number, prefer preparing their own catgut to using that prepared by the manufacturer, though I believe there are many reliable prepared catguts in the market. A glass jar for ligatures, such as is described on p. 70, is first sterilized by boiling. The theatre sister next disinfects her own hands. Iodide of potassium ʒi.ss. and iodine ʒi. are together dissolved in sterilized water, ʒii.ss., in the jar; O.v. of sterilized water is added. The catgut is dropped into this.

It is not used till the eighth day. I have frequently tested this, and invariably found it sterile. It is transferred immediately before operation with sterile forceps into a bowl containing normal saline solution.

Catgut is generally used for the following purposes:

(*a*) For ligaturing vessels. The thinnest should always

be handed, unless a thicker is asked for. The thinnest catgut is strong enough for the ligature of almost any vessel met with in an ordinary operation.

(*b*) For closing the deeper layers of wounds, as in laparotomy and radical cure of hernia. In closing the abdomen, a continuous suture of the thinnest chromic catgut, threaded on a curved round needle, is used for the peritoneum; for the muscular layer, interrupted sutures of medium catgut on good-sized curved needles; for the aponeurotic layer, a continuous suture of thin catgut on a curved needle. The peritoneal and aponeurotic sutures are, therefore, cut long, the muscular sutures short. In radical cure of hernia the neck of the sac is tied with silk (size 2 or 3), the canal is closed with medium thick chromic catgut on curved needles, the aponeurosis of the external oblique with a continuous suture of fine catgut on a curved needle. The skin is closed with silk or silkworm gut.

(*c*) In septic cases always, whether for ligatures or sutures (except in the skin). Silk here would act as a foreign body, preventing the closure of the wound till it came away, often taking many weeks to do so.

(iv.) *Kangaroo and reindeer tendon* are prepared in the same way as catgut. They are used by some surgeons in preference to catgut in radical cure of hernia, fixation of kidney, etc., and in the ligature of large arteries in their continuity—*e.g.*, ligature of the femoral or carotid.

(v.) *Silver wire* is used for wiring bone, and in plastic operations, such as cleft-palate, by some surgeons. It is also useful in bringing the flaps of large wounds together, so as to avoid tension on the skin stitches—*e.g.*, in Halstead's excision of the breast, and for this purpose a thick wire is necessary. It is prepared in the same way as silk.

4. **Drainage-Tubes.**—Rubber drainage-tubes are prepared by boiling for half an hour.

5. **Swabs, Packs, Towels, Dressings, and Sponges.**—(i.) Swabs and packs are made of gauze in several layers, according to the thickness required. Their edges are tucked in and quilted to avoid fraying. Three sizes are generally used in operation:

Small swabs for sponging, never to be used as packs, and never to leave the surgeon's or assistant's hand if used in abdominal operations.

Thick large gauze packs, made of eight layers of gauze, 14 inches square, for packing away abdominal contents in these operations. They have tapes a foot long attached to one corner, to the end of which a pair of Spencer Wells forceps is fixed after they have been placed in position.*

Thinner large gauze packs, made of three layers of gauze, 10 inches square, for use as an inner layer round the operation area. These are changed as soon as they are soiled, the larger packs being left in position till the wound is about to be closed. They also have tapes, to which Spencer Wells forceps are affixed when they are in position. Swabs and packs are prepared by sterilizing in the steam sterilizer for one hour.

For abdominal cases the small swabs are tied up in packets of twelve, and the large ones in packets of three, to enable them to be counted readily afterwards. In case for any reason a tin of swabs is condemned during an operation, a reserve tin should be at hand prepared.

In addition to these, a tin containing small squares of sterilized lint is prepared separately for use in disinfection of the hands before operation. This is placed on a

* In place of these some surgeons prefer a single roll of wide gauze.

separate table near the basins, with the bowls containing turpentine, ether, and spirit lotion. A pair of sterilized forceps is also placed on this table in a bowl of carbolic acid lotion (1 in 20). With these, as will be explained hereafter, the surgeon and his assistants extract from the tin the pieces of lint to be used in preparing their hands.

(ii.) *Towels* are sterilized in tins in the steam sterilizer for one hour. They should be unfolded before being placed in the tins, otherwise sufficient heat may not penetrate their innermost layers to render them sterile. They cover the mackintoshes surrounding the operation area, and are almost universally nowadays used dry.

(iii.) *The dressings* are cut in the ward by the ward sister, and sent to the theatre on the morning of the operation, each one in a separate tin. Care should be taken that they are of the right size and shape, and if the sister is in any doubt on this point, she should seek direction from the house-surgeon. A little more than will probably be required should be placed in the tins. Any that is not wanted can, of course, be sterilized again, and used in a future case.

At the bottom of the dressing tins are placed three or four safety-pins, and a couple of bandages of suitable breadth. Next in order comes the gamgee tissue cut of sufficient size for the outer dressing, and topmost the gauze, which goes next to the wound. The tin is then closed, a label affixed with the patient's name, and it is sent to the theatre. It is sterilized in the steam sterilizer for one hour, and placed on the instrument-table opposite the surgeon. At the completion of the operation, when the tin is opened, the surgeon finds everything in order, from above downwards, required for the application of the dressing.

(iv.) *Sponges* which cannot be sterilized by boiling are now seldom used in operations, having been replaced almost universally by gauze. Nevertheless, they are occasionally required—for instance, in the rapid removal of a tumour, when free oozing of blood is taking place from many points, or where a vein is bleeding freely from beneath the jaw in dissecting out glands in the neck, or in hæmorrhage after excision of the superior maxilla, nothing equals sponge pressure in arresting it, and it may be necessary to employ them.

The following preparation is recommended in Kelly's "Operative Gynæcology":

(*a*) Lay them in a stout cloth, and pound sufficiently to break up grit and lime.

(*b*) Rinse them in warm water ten times or more, till the water is clear.

(*c*) Immerse them in muriatic solution (ʒii. to O.i.) for twenty-four hours.

(*d*) Immerse them in a saturated warm solution of permanganate of potash.

The nurse then thoroughly sterilizes her own hands, and proceeds.

(*e*) Decolourize in a hot saturated oxalic acid solution.

(*f*) Pass through lime-water with sterilized forceps to take out the oxalic acid.

(*g*) Rinse thoroughly in plain sterilized water.

(*h*) Immerse for twenty-four hours in lotio hydrarg. biniod. (1 in 1,000).

(*i*) Preserve in glass jars containing carbolic acid lotion (1 in 40), the cover of the jar overlapping the neck, and resting in a gutter of carbolic acid lotion (1 in 20).

(*j*) Renew the carbolic lotion once a week.

When required, they are removed with sterile forceps

from the jar containing them, and are rinsed out in sterilized water before use.

Any sponge that has been used in an operation is forthwith burnt; it is not used a second time. Also, it must be remembered that sponges in use must, like packs, be counted and accounted for at the termination of the operation.

6. **Various Utensils.**—Nail-brushes, bowls and dishes, irrigators, jugs for water, saline solution, etc.

(i.) *Nail-brushes* are boiled for half an hour in a copper or a bowl, and are then transferred with sterilized forceps

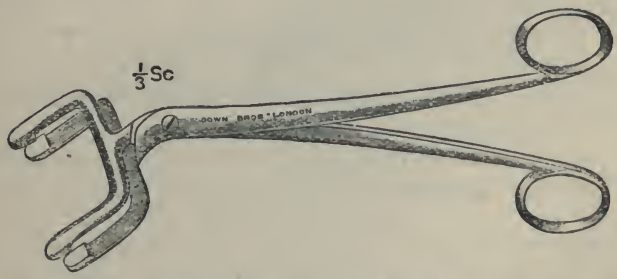


FIG. 14.—HARRISON'S DOUBLE-PRONGED FORCEPS.

to a jar or basin containing lotio hydrarg. biniod. (1 in 1,000) or lotio acidi carbolici (1 in 20). Sufficient brushes are provided, so that there may be a separate one for use by each person disinfecting his hands. A pair of sterilized forceps is used for removal of the brushes from the jar, a succession of hands not being permitted to dip into the jar. When the fibre becomes soft and flabby brushes are to be thrown away.

(ii.) *Bowls and dishes, irrigators, jugs, etc.*, are sterilized for half an hour in a large copper vat (2 feet by 2 feet by 2 feet) over a gas-jet or in the steam sterilizer. When sterilized, the theatre sister puts on a sterile gown, and

slips her hands into a pair of sterilized rubber gloves, or takes a sterile towel, with which she removes them to their required positions in the theatre. If boiled in the copper, they are taken out of the boiling water with Harrison's double-pronged forceps. Washing bowls out with antiseptic solutions is a "make-believe"; it is no use.

Spouts and mouths of cans are covered with sterilized Battist mackintosh, tied with tapes on the side opposite the spout during cooling.

(iii.) *Glass jars* are used for the reception of drainage-tubes, silk, silkworm gut, catgut, and sponges. They are of the pattern previously described, the lid overlapping the top, and resting in a gutter of 1 in 20 carbolic lotion. They are sterilized by placing them in cold water and boiling them for half an hour.

7. **Lotions.**—The stock lotions are kept in large jars, whose lids overlap the top, on a glass shelf in the theatre.

They are carbolic acid lotion (1 in 20), biniodide of mercury lotion (1 in 1,000), and boracic acid lotion (gr. xiv. ad. ℥i.). Rubber tubes closed with clips hang from the jars into bowls containing carbolic acid lotion (1 in 20). The lotions are to be made up with sterilized water by the theatre sister.

Dakin's Solution.—Sodium hypochlorite solution for surgical use must be free of caustic alkali; it must only contain 0·45 to 0·50 per cent. of hypochlorite. Under 0·45 per cent. it is not sufficiently active, and above 0·50 per cent. it is irritant. With chloride of lime (bleaching-powder), having 25 per cent. of active chlorine, the quantities of the necessary chemicals to prepare 10 litres of solution are the following:

Chloride of lime (bleaching-powder) (25 per cent. Cl ash.)	200 grammes.
Sodium carbonate dry (soda of solway)..	100 ,,
Sodium bicarbonate	80 ,,

Put into a 12-litre flask 200 grammes of chloride of lime and 5 litres of ordinary water, shake vigorously for a few minutes, and then leave in contact for six to twelve hours—say one night, for example. (Shake until dissolved—at least the big pieces: not all dissolves; large pieces float; notice only floating pieces.) At the same time dissolve in 5 litres of cold ordinary water the carbonate and bicarbonate of soda. After leaving from six to twelve hours, pour the salt solution into the flask containing the macerated chloride of lime, shake vigorously for a few minutes, and leave time to allow the calcium carbonate to be precipitated. In about half an hour siphon the liquid and filter with a double paper to obtain a good clear liquid.

The solution should be kept in blue or brown coloured bottles, well corked, should be kept in a dark place, and should always be used fresh.

On a second glass shelf stand smaller bottles containing spirit lotion, ether, turpentine, absolute alcohol, pure carbolic acid, iodized phenol, glycerine, Whitehead's varnish, novocain solution, collodion, liquor strychninæ, brandy, etc.

Normal saline solution is made on the day of operation by dissolving 10 drachms of salt in a flask, boiling it, and adding it to a gallon of sterilized water.

Sterilized water is prepared in the water sterilizer, and drawn into jugs, the mouths of which are covered with sterilized Battist mackintosh, tied behind.

The theatre sister should see that the following additional apparatus are always ready for immediate use. They are frequently required on the spur of the moment, and it is disconcerting if they have not been provided. They are kept handy on a separate table.

(i.) Infiltration syringes, with novocain 0·25 per cent. and quinine urea hydrochlorate 0·5 per cent. in separate bottles. These are used in Crile's method (*cf.* p. 64), and are sterilized in the steam sterilizer for three-quarters of an hour.
(ii.) Transfusion apparatus (sterilized), together with knife, dissecting forceps, and aneurism needle, for performing the operation.
(iii.) Exploring needle (sterilized).
(iv.) Aspirator (sterilized).
(v.) Irrigator (sterilized).
(vi.) Forehead electric lamp.
(vii.) Transformer and cautery.
(viii.) Paquelin's cautery.
(ix.) Stomach-pump.

8. **The Anæsthetist's Table.**—This contains the apparatus and particular anæsthetics employed by the anæsthetist—measure-glass, a roll of gauze and lint, vaseline, stethoscope, mouth-gag, tongue forceps, swabs and swab-holders, hypodermic needle, liquor strychninæ, pituitrin, brandy and amyl nitrite capsules, anæsthetic cloths, and porringers. If spinal anæsthesia is employed, the special apparatus for this will be required.

Aseptic surgery must become a habit and routine by all those who aspire to practise it successfully. Its details

should therefore be made as simple and unconfusing as possible. To sum up the result of the previous pages:

I. *Times for Sterilizing.*—These are three, and should be rigidly adhered to by the clock.

1. *Ten minutes* for all instruments in aseptic cases, both before and after operation. (*Exception:* Knives before operation are wiped with pure carbolic acid, and then boiled for one minute.) This time is *doubled* after septic operations, and applies to all instruments used.

2. *Half an hour* for bowls, dishes, jugs, nail-brushes, drainage-tubes, silk, Pagenstecher's thread, silkworm gut, and gloves.

3. *One hour* for gowns, masks, towels, swabs, packs, and dressings.

II. *The Chemicals Used.*—1. Turpentine, ether, and spirit lotion (1 in 500 biniodide of mercury), used in the preparation of the hands, whether gloves are worn or not.

2. Biniodide of mercury lotion (1 in 4,000), for washing the hands in during operation if necessary.

3. Normal saline solution, for washing out wounds, laying instruments in, washing the hands, etc., during operation.

4. Pure carbolic acid, used in preparation of the knives.

5. Alcoholic solution of iodine (2 to 5 per cent.); for disinfecting the skin.

6. Dakin's solution (*cf.* p. 86).

Stronger solutions may be required in special cases. Mercurial solutions cannot be used for instruments, as they stain them. Biniodide of mercury is preferable to

perchloride, as it does not combine with the albumin of the tissues to form an inert albuminate. It does not coagulate albumin, and its penetrating powers are greater.

Except for the disinfection of their hands previous to putting on the rubber gloves, and for the disinfection of the patient's skin, most modern surgeons use no chemicals, except normal saline solution, in their operative work. Some surgeons use only soap and water copiously for their hands before putting on the sterilized rubber gloves. This I do not consider sound practice, and I and my assistants prepare our hands just as carefully as if no gloves were worn, a thorough attempt, which I have often verified by taking cultures to have been successful, being made to render the skin sterile. The reasons for this are obvious. The gloves are handled in putting them on; they should be handled by fingers sterile, or as near sterile as possible. Again, the glove may be pricked or torn without the surgeon noticing it; it is advisable that the skin beneath it be as germ-free as possible. Again, I dip my gloved hand always after putting the glove on, and constantly during the operation, in biniodide lotion (1 in 4,000), washing this off with saline solution. Dry sterile towels are usually employed to surround the operation area, instruments are usually placed in normal saline solution, and wounds are usually swabbed with the same. This is the usual procedure in the conduct of a modern aseptic operation, and, provided conditions for conducting such an operation are to hand, and the technique has been thoroughly mastered by all participating in it, aseptic healing of the wound in a clean case may be confidently anticipated. Where, however, conditions are otherwise,

rendering the aseptic technique defective, the use of weak antiseptics is advisable, and an undoubted safeguard. Thus, the instruments may be placed in weak carbolic lotion (1 in 80), the towels surrounding the operation area may be soaked in the same lotion, and the wound previous to closing it may be swabbed out with it or with biniodide of mercury lotion (1 in 4,000), followed by normal saline solution.

SECTION II.—CONDUCT OF AN ASEPTIC OPERATION.

The only method of efficiently carrying to its conclusion an aseptic operation is by organization. By this is meant that each participator in it has his or her duty allotted, thoroughly understands what it is, and does this and nothing else. If assistants sometimes do one thing and sometimes another, confusion is sure to arise, and confusion in this instance spells sepsis. Those present at an operation include the ward sister, the anæsthetist, the three* persons actually engaged in the operation (viz., the surgeon, house-surgeon, or other assistant, and theatre sister), and, lastly, the theatre nurse and assistant theatre nurse or nurses. All except the theatre nurse and assistant theatre nurse or nurses have absolutely definite duties to perform; the latter, as will be explained hereafter, divide between them

* These three are usually sufficient. It is advantageous, however, to arrange for one of the assistant theatre nurses to have charge of the swabs and packs during an operation of any magnitude, and to do nothing else.

what remains. I shall endeavour in the present section to indicate what the duties of each of these are, and how they should be carried out during the course of an operation.

It may be stated here that all well-equipped theatres are provided with two operating-tables, moving on castors, and with an appliance for instantly fixing them. It will be seen hereafter that this is necessary for the smooth working of a series of operations. Also, two considerations influence the house-surgeon in arranging the order of the operations.

1. If possible, two patients do not come consecutively to the theatre from the same ward.

2. The aseptic cases are always operated upon first; for instance, a radical cure of hernia would be performed before an appendicectomy.

1. **Duties of the Ward Sister.**—At the conclusion of Chapter III. we left the patient ready for his journey to the theatre.

The ward sister superintends his transference on the ambulance from the ward to the anæsthetic room by the porters, and sees that this is done gently and without frightening him. Medical and surgical scenes become part of the daily routine of the expert. It should not be forgotten that the laity look on them from a point of view which the professional mind, from long familiarity, has difficulty in realizing. In the anæsthetic room the ward sister superintends the patient's transference from the ambulance to the operating-table, on which he is anæsthetized. If any particular position is likely to be required during the operation, she makes the necessary preparation for this. For instance, if the Trendelenburg position is likely to be needed, she sees that the patient's knees are over the joint, so that he may not require

shifting after the operation has commenced. If the lithotomy position will be required, she sees that the stays are adjusted, and so forth.

The ward sister remains in the anæsthetic room with the anæsthetist to assist in case the patient struggles, vomits, etc. If the patient is a strong man, the anæsthetist has one of the porters just outside the anæsthetic room, in case the first-named becomes unmanageable during the early stages of the anæsthesia. During the later stages the ward sister thoroughly washes her hands in the anæsthetist's room, and puts on a sterilized gown. When the patient is fully under, the table is wheeled by the anæsthetist into the theatre, placed in position, and fixed, the assistant nurse bringing in his table after him, and placing it by his side. The ward sister now proceeds, with the aid of the assistant theatre nurse (or the house-surgeon, if he is a heavy man and requires lifting), to place the patient in the required position, cuts the bandages over the dressing, arranges the mackintoshes round the field of operation, and finally removes the dressing, taking care not to touch the skin of the operation area in so doing with her naked hand. The operation area is then ready to receive the final coat of iodine by the surgeon or theatre sister. The ward sister's part in the operation ends here. For the rest, she becomes the anæsthetist's assistant, helping him during the operation in any way he may require. She has no other duties, and does nothing else till the operation is completed.

As soon as the anæsthetist considers it safe to leave the patient to anæsthetize the next case, she takes charge of him. With the assistance of one of the theatre nurses, he is wheeled into the lobby, where the porters, under her supervision, lift him on to the ambulance and wheel

him back to the ward. She accompanies him thither, and superintends his final transference to bed. The reason is now apparent why, if possible, two patients do not come consecutively from the same ward to the theatre. It is to enable the ward sister to have charge of the patient at his leaving the ward and on his return to it. If this cannot be arranged for, a ward nurse takes charge of him.

2. **Duties of Anæsthetist.**—These require very brief mention. In the surgeon's anteroom he changes his boots for goloshes.* In the anæsthetic room he washes his hands, puts on a sterilized gown, and commences business. He wheels the table into the theatre when the patient is anæsthetized. When the operation is completed, and he considers it safe, he leaves the patient in charge of the ward sister, as I have explained in the previous paragraph, and returns to the anæsthetic room, where he finds the next patient ready, on the second operating-table, to be anæsthetized, and with the sister of his ward in attendance. The need for a second operating-table is thus manifest.

3. **Duties of Surgeon and House-Surgeon.**—While the patient is being anæsthetized the surgeon and house-surgeon prepare themselves for the operation. They have nothing else to do. Their sole occupation till the commencement of the operation is to render themselves sterile.† This is accomplished as follows: In the anteroom hat, coat, and boots are removed, and sterilized goloshes put on.* Some surgeons even change their

* The mackintosh covers mentioned above may be put over the boots, instead of using goloshes.

† Occasionally, if the patient is heavy and requires some special position (*e.g.*, lifting for the insertion of the sand pillow in a gall-bladder or kidney case), the house-surgeon may have to assist the ward sister after the patient is wheeled into the theatre. This will delay his preparation by a few minutes.

trousers. On the towel-horse are hanging the mackintosh apron and sleeves, and on the glass shelf above the lavatories safety-pins and a blunt nail-cleaner. The surgeon first inspects his nails, and if they require cutting he attends to this. He then puts on his mackintosh apron and sleeves, which are pinned at the shoulder, being assisted in this by the theatre nurse, who is at hand (*cf.* Duties of Theatre Nurse). On the lavatory stand are soap and sterilized nail-brushes in a bowl of 1 in 20 carbolic acid lotion. He thoroughly scrubs his hands and arms, paying particular attention to the ends of his fingers, the spaces between their roots, and the palms of the hands. He then takes a blunt nail-cleaner (not a sharp knife, which scratches the under surface of the nail, and makes crevices for the future lodgment of dirt), and with it any dirt beneath the nails, being softened by the scrub with soap and water, is easily removed. The scrub with soap and water is then repeated. He is now *not* sterile, but *clean* enough to enter the theatre. On the lavatory stand in the theatre are a sterilized jar containing sterilized soft-soap; a second jar, containing sterilized nail-brushes in 1 in 20 carbolic acid lotion, and a bowl in which lie a pair of sterilized forceps and a sterilized spatula in the same lotion. On a small stand adjoining are a tin, containing sterilized swabs; sterilized bowls, containing turpentine, ether, and spirit lotion; and a bowl, containing sterilized forceps in carbolic acid lotion (1 in 20). Also handy is a lotion-stand containing two sterilized basins—one filled with biniodide of mercury lotion (1 in 4,000), and the other with sterile salt solution. On a glass shelf next the lavatories a sterile towel is laid, on which to place the gloves when extracted from the tin in which they have been sterilized; also a sterile bowl containing a pair of forceps lying in

1 in 20 carbolic lotion, with which to remove the gloves from the tin. If the gloves are wet sterilized they lie in a bowl on this shelf containing sterile water, covered with a sterile towel.

The surgeon now proceeds to render himself sterile in the following manner: For reasons stated above (*cf.* p. 90), he endeavours with just the same care to render his hands sterile as if he were not going to wear gloves. With the spatula he takes a lump of soft-soap, and with the sterilized forceps a nail-brush from the jar containing them, replacing the spatula and forceps in the lotion-bowl, where he found them, for the use of the next comer. He now gives his arms and hands a very thorough scrubbing, as before, under a running spray of hot water, and when he has done with the nail-brush he drops it into a receptacle beneath the lavatories, *not* back into the jar containing the brushes. He next approaches the stand containing the turpentine, ether, and spirit lotion. The theatre nurse opens the outer lid of the tin containing the lint, and the surgeon with the sterilized forceps opens the inner lid, extracts a piece of lint, and places it in each of the bowls containing the turpentine, ether, and spirit lotion. The sterilized forceps are then replaced in the lotion for the next comer. The hands and arms are now thoroughly rubbed over, first with turpentine, and then with ether. These remove as far as possible the grease and sebaceous matter in the skin. Finally, the spirit lotion is used, particular attention being paid to the ends of the fingers, the spaces between their roots, and the palms of the hands, each of which is treated separately. In the bowl containing sterilized water he now rinses off the spirit lotion. If the hands are prepared in this thorough manner, they are in many cases sterile. Still, they are not always so,

and inasmuch as it is impossible for the surgeon to know whether they are sterile or not every time, in his subsequent manipulations in putting on the gloves he considers them infected, and takes the following precautions:

The theatre nurse opens the glove-tin, and with the forceps before mentioned the surgeon extracts a pair of gloves wrapped in lint, and places them upon the sterile towel with which the glass shelf has been covered (*cf.* p. 95). He uses the lint to thoroughly dry his hands, leaving the gloves on the sterile towel. He then opens the paper containing the French chalk, and rubs the latter over his hands. He next takes one glove by the turned-down portion, and slips his hand into it, touching no other part of the glove with his naked hand. The remaining glove is put on in the same way, and, finally, the fingers are stroked home with the gloved hand. The naked hand does not touch them. The turned-down portion which the naked hand touched is then dipped in biniodide lotion (1 in 4,000).

If the gloves have been wet sterilized, as already stated, they lie in a bowl of sterilized water. Taking the sterilized forceps from the bowl of carbolic, he removes one glove from the bowl. Then, holding it open with both hands by the turned-down portion, the theatre nurse fills it right to the top with sterilized water. Holding the filled glove open with one hand by the turned-down portion, he can now easily slip the other hand into it right up to the finger-tips. He need touch and touches no other part of the glove with his naked hand. With the gloved hand he extracts the other glove from the bowl, and holding it open in the same way to be filled, he slips in his other hand. For

these manœuvres the only portion of the outside of the gloves which has been touched by his naked hands are the turned-down portions at the wrist. Recognizing that these may be infected, he immerses his gloved hands into biniodide of mercury lotion (1 in 4,000). If now the fingers require stroking down a little, as they generally do, he does this alternately with the gloved fingers of each hand.

The theatre nurse next lifts the lid of the coat-tin, and the surgeon, extracting his gown, slips into it, and the nurse, taking hold of the strings, and being careful to touch no other part of the coat, ties these behind his back.

Finally, he adjusts the wrist-bands of the gloves over the sleeve of the gown, being careful not to touch any part of the naked skin in so doing. This is quite easy.

The theatre nurse next opens the tin containing the cap and mask in one, and the surgeon taking it out and slipping it over his head, the former ties it behind his neck. Prepared in this way, it is no exaggeration to say that the surgeon is completely sterile, and as far as his own person is concerned, he approaches the operation with confidence. The whole preparation takes about ten minutes—just about the time, in fact, occupied in anæsthetizing the patient and carrying out the various other preliminary measures before all is ready for the commencement of the operation. The technique may seem complicated in description, but in practice, if the directions are followed accurately, it is quite easy. Each step requires thinking out, and the disinfection of the surgeon and his immediate assistants is worth thinking out, as they are manifestly potential sources of wound infection

during an operation. It is just as easy to conduct this preparation in the right way as in the slipshod fashion of putting on gloves and coats one sometimes sees, with any number of flaws in the technique. The description of the sterilization of the surgeon has been given here. Exactly the same directions apply to the house-surgeon and theatre sister.

The surgeon, having in this way rendered himself sterile, is ready to commence the operation.

4. **Duties of the Theatre Sister.**—The theatre sister has, previously to the operation, got ready the theatre and the various requisites (*cf.* Preparation of the Theatre, etc.). Before sterilizing herself, she selects the instruments for the operation, and if she is in any doubt, she seeks direction from the surgeon or house-surgeon. The instruments (except the knives) are then placed in the tray of the sterilizer and set to boil, scissors and needles being wrapped round with cotton-wool. The sister then proceeds to render herself sterile in exactly the same way as the surgeon and house-surgeon. She wears gloves, gown, cap, and mask (*cf.* frontispiece). It is absolutely necessary that these three—the surgeon, house-surgeon or other assistant, and theatre sister—who are the immediate participators in the operation, should equally thoroughly prepare themselves. Each one of them has an equal responsibility as far as the aseptic conduct of the operation is concerned, and any one of them failing in this responsibility creates a flaw in the chain, which may result in the wound becoming septic, and, further, in the patient losing his life. It cannot be too forcibly insisted that it is at the time the patient leaves the operating-table that the fate of his wound is usually decided, and maybe that of his life. If there has been no flaw up to that point he is, generally

speaking, safe.* If, on the other hand, a serious mistake has been made, and the case in consequence becomes septic, it is difficult and often impossible to trace the source of error, and it is rare that we are able to undo the mischief. If, for instance, a suppurative peritonitis follows an abdominal section, we are lucky if our efforts avail in saving the patient's life. It is of the utmost consequence, therefore, not to commit an error, which it is so difficult to subsequently rectify.

The theatre sister, having thoroughly prepared herself, in which operation she is assisted, in the same manner as the surgeon and house-surgeon, by the theatre nurse, goes to her table. The instruments, which have by this time boiled for ten minutes, are brought by the theatre nurse from the sterilizer, and tipped into the instrument-tray, the nurse approaching the table from outside the operation field. The instruments are then arrayed in order by the sister. The knives are finally boiled by the nurse for one minute, and brought by her to the theatre sister's table. The theatre nurse next hands the glass jar containing the ligatures and sutures, and lifts the lid. Taking a pair of sterilized forceps, the theatre sister extracts what she requires from them, and places them in bowls containing sterilized water. The theatre nurse next lifts the outer cover of the tins containing the swabs and packs, and the sister, lifting the inner cover (sterilized), takes what she thinks will be required for the operation, and places them in a bowl on her table. The tin is then closed down. At this stage of the proceedings the operation area is given its final coat of

* We except, of course, cases of death from shock or unavoidable sepsis, as, for instance, after an operation for septic peritonitis, or, again, constitutional defect, which are foreign to the present considerations.

iodine by the surgeon or theatre sister. It is painted on with a piece of sterile gauze.* The theatre nurse then lifts the outer cover of the tin containing the sterilized towels to surround the operation area, and the sister, lifting the inner lid, takes out the towels required, and hands them to the surgeon or house-surgeon, who places them in position. The towels having been fixed by clips, the operation commences.

During the operation the sister stands at her table, cuts ligatures and sutures, threads needles, hands instruments, removes them when done with and replaces them in the lotion, holds a retractor if required,† etc. She superintends generally, in fact, the instrument department of the operation. She should be constantly on the lookout for what the surgeon is likely to want, so that he is not required to ask for it, the operation being as far as possible conducted in silence. There is nothing worse than constant conversation during an operation. It is, moreover, not free from risk. The theatre sister never leaves her table during the operation. The theatre nurse (outside the field of operation) is constantly in attendance on her, and gets anything she requires, sterilizes it, and takes it to her (*cf.* Duties of Theatre Nurse). By her side are two lotion-bowls—one containing biniodide of mercury lotion (1 in 4,000), and the other sterile salt solution. During the operation she constantly dips her hands first in the one and then in the other. When the final skin stitch has been in-

* Gauze is wasteful of the iodine in spirit solution, which is very expensive. A large brush, sterilized, will do equally well.

† If the surgeon requires a second assistant, a dresser or one of the theatre nurses usually sterilizes herself and stands by his side ready to hold a retractor or assist in any way desired.

serted and the dressing is about to be applied, she leaves her table, and, with the assistance of the theatre nurse, proceeds to prepare for the next operation.

5. **The Theatre Nurses.**—The theatre nurses have been frequently alluded to in the previous pages. Three are required for the expeditious and smooth working of a series of operations in hospital—the theatre nurse and two assistant theatre nurses. The theatre nurse is a senior nurse, who should hold office for not less than three or four months in the theatre. She is the theatre sister's chief assistant, and takes charge in the absence of the former. Hers should be a special appointment open to those who have shown in their previous training capacity and liking for surgical work. Nothing is so detrimental to aseptic work in the theatre as constant change, and it is disheartening and annoying to both surgeon and theatre sister for a nurse to be removed just as she has become efficient. On the other hand, it is recognized that hospitals are the training-schools for nurses, and that it is impossible to provide permanent billets in them for some, however able, to the exclusion of others, who may be just as desirous and capable of attaining efficiency. A compromise must be struck somewhere, and as the result of this the theatre nurse should hold office for not less than three months, and should be one who has shown special capacity for the work. This involves no hardship on others. It must be remembered that all nurses are not fitted for surgical work, and whatever length of training they had, would never make suitable theatre nurses. Some do not like it, prefer general medical work, midwifery, fever work, and so on. Although all should receive a surgical training up to a certain point, a stage in their career is reached when they may specialize, both with advantage to themselves

and the work of the hospital. I make these few remarks because I have heard the argument used that, as all must have theatre training, constant changes are inevitable, without regard to the efficiency of the work in the theatre. This is sheer nonsense, and the authorities in charge of these matters, if they keep themselves abreast of modern surgical work, cannot fail to realize it.

The assistant theatre nurse is a more junior nurse. She should either hold office in the theatre for three months—in which case she is under the immediate supervision and training of the theatre sister, and this is the best arrangement—or, she may be a ward nurse, who attends the theatre on operation days. If the latter, arrangement should be made for the same nurse to attend *all* the operations of some particular surgeon during her term of office. In some hospitals each ward nurse accompanies her own case to the theatre, so that three or four different nurses may come down to the theatre on the same afternoon. This is unsatisfactory from the point of view of the work in the theatre, as well as of the nurse's theatre training. If three or four different nurses come into the theatre during an afternoon's operations, and the theatre sister does not even know who are coming, they are all practically of no value, are only in the way, and become mere spectators of the operation. They leave the theatre, perhaps do not enter it again for a week or two, and learn nothing. If, on the other hand, the same nurse attends the theatre from one of the wards once or twice a week for three months, and remains throughout an afternoon's operations, she soon begins to fall in with the routine of theatre work, and it is possible to give her a good preliminary training and make her really useful.

In addition to this, assistant theatre nurses who are

really assistants and not mere "passengers," are required for the smooth conduct of a series of operations. By an arrangement of this kind all nurses get theatre training up to a certain point, and from those who have shown special capacity for work of this kind the senior theatre nurses are chosen. If the assistant theatre nurse, according to this plan, attends the theatre from one of the wards, she is under the charge of her ward sister, who should take one or two necessary precautions with regard to her. The first is to see that on operation days she dresses no septic case and is engaged in no septic work in the ward. The second is to make sure (as the nurse is a junior, and may not have yet grasped the requirements of aseptic surgery) that her hands are in an irreproachable state and her nails short and clean before she sends her to the theatre. With these few general remarks on the selection of theatre nurses, I pass on to their duties. These include everything that does not come within the province of the participators in the operation already mentioned, and the theatre nurses share them in some such way as the following:

(1) *Duties of the Theatre Nurse.*—The theatre nurse is the theatre sister's chief assistant, and helps her in various ways in the preparation for operation (*cf.* Preparation of Theatre). On the morning of the operation she should look to her nails, and see that they are cut short and clean. In the conduct of the operation her first duty is to thoroughly disinfect her hands and put on a sterilized gown. She does not wear gloves or mask, because she does not actually come within the operation field. Her duties are nevertheless very important—in fact, perhaps the most difficult, and requiring the most care—because, though not completely sterile herself, and being obliged to work outside the operation field, she has

to keep in constant view *that nothing which is not sterile comes within that field.* In all her operations she has to bear in mind this cardinal fact. If called upon, for instance, to get an instrument during an operation, she hands it into the field in the tray or with a pair of sterilized forceps—does not touch it with her fingers. After disinfecting her hands and putting on her sterilized gown, her first duty is to assist the surgeon, house-surgeon, and theatre sister in their "toilet" for the operation. She, in the order given here, helps them into their mackintosh aprons and sleeves, pinning up the latter; fills the bowls with the chemicals used in the preparation of the hands; opens the outer lid of the tin from which the sterile lint is taken for the preparation of the hands; fills the gloves which the surgeon holds open from a jug of sterile water, if wet sterilization of gloves is the method employed; fills the lotion-bowls containing biniodide of mercury lotion and sterilized water, used in the preparation of the hands; opens the outer lid of the tin from which the gloved surgeon removes his coat; takes the coat from behind and inside, pulls it on for him, and ties it behind his back; and finally opens the outer lid of the tin containing the cap and mask, and after the surgeon has slipped it over his head, she ties the string, fastening it behind his neck. She does this in turn for surgeon, house-surgeon or assistant, and theatre sister. She then goes to the instrument sterilizer, takes out the tray of instruments by the handles, and, bringing it to the sister's table, she tips the instruments into the basin for their reception, or the sister takes them out of the tray with her gloved hands. She next takes the glass jars containing ligatures, sutures, drain-tubes, etc., to the sister's table, and lifts the cover. With sterilized forceps the sister extracts from them

what she requires, and the jars are replaced. She lifts the outer cover of the tin containing the swabs and packs, enabling the sister to help herself to these. Finally, she lifts the outer cover of the tin containing the towels to surround the operation area, the sister, as before, taking them out and handing them to the surgeon. During the operation she is at the beck and call of the theatre sister, and assists her in any way she may require outside the field of operation. She takes from the cabinet and sterilizes any instrument that may have been overlooked; sterilizes any instrument that may have become septic during an operation and may be required again; sees that the lotion-bowls are replenished as the lotion in them becomes soiled, being careful to place her hands on the outside of the bowls in removing them. She may occasionally have to fill in a gap in the operation, and to come within the field. If called upon to do any duty of this kind, she is to remember that her naked hands are not sterile, and to see that they touch nothing that comes within the sterile operation field. For example, an electric hand-light may require holding; if so, she must see that the hood of this and her hands holding it are covered with a sterile towel. At the termination of an operation, her entire duty is to assist the theatre sister to complete her preparations for the next, after which, as before, she is engaged in helping in the "toilet" of the several participators in that operation.

(2) *Duties of Assistant Theatre Nurses.*—The first thing the assistant theatre nurse does when she enters the theatre is to scrub up and get into a sterilized gown. When the operating-table is moved into the theatre from the anæsthetic room, she wheels in the anæsthetist's table, and places it at his side. She then assists the ward sister to place the patient in any position required

for the operation. During this time, as will be seen by referring to her duties, the theatre nurse proper is otherwise engaged. During the operation she stands by for any emergency duty that may be required of her. She should keep her eyes open, and try to master the principles and routine of an aseptic operation, and she will thereby get a good insight into the details of aseptic surgery. At the termination of the operation she hands the tin containing the dressing, and opens the outer cover; the surgeon then lifts the inner cover, and helps himself to the dressing from the tin. She hands the block for raising the pelvis, if required; flexes the thigh when a hernia dressing, etc., is being applied, and generally makes herself useful in the little details at the end of the operation. During this time, again, it will be seen that the ward sister is in attendance on the patient, and the theatre nurse proper is engaged in assisting the theatre sister in the preparation for the next operation. As soon as the patient has been wheeled from the theatre, she cleans the floor of any blood, etc.; removes soiled swabs, towels, and gowns, and generally gets things shipshape in the theatre for the reception of the next patient. During all this time the senior theatre nurse is otherwise engaged (*cf.* Duties of Theatre Nurse). It is best in major operations to have a second assistant theatre nurse, who takes charge of the tins containing the swabs and packs. She is, of course, thoroughly prepared herself, has a bowel of sterilized salt solution on a stand next her, takes the swabs and packs out of the tins as they are required, rinses them in the saline solution, and hands them to the surgeon. If a nurse cannot be spared for this purpose, the theatre sister can, of course, do it, but she is usually fully occupied in managing the instrument department of the operation.

6. **Duties of Porters.**—The porters, who should be clothed in clean linen coats or overalls, lift the patient from his bed in the ward on to the ambulance, under the superintendance of the ward sister, wheel him into the anæsthetic room, and place him on to the operation-table. One or both of them may be required at this juncture, in case a strong man becomes unmanageable during the early stages of the anæsthesia. They afterwards wait in the lobby for the previous patient to be brought out of the theatre, lift him from the table on to the ambulance, and wheel him back to the ward. The porters never enter the theatre.

I have endeavoured in the previous pages to define the duties of the various participators in an aseptic operation. Conducted in this routine manner, a series of operations works perfectly smoothly. Very few directions are required, and very little speaking takes place. Everybody thoroughly understands his or her duty, and does it and nothing else. This is the only road to success and safety in the conduct of aseptic work.

Before closing the present chapter a few remarks may be made on two other classes of operations, which are necessarily constantly taking place in surgery—viz., septic operations, and combined aseptic and septic operations.

I. Septic Operations.

The technique described in the previous section is that of an aseptic operation. Although, as has been previously explained, no operation is probably absolutely aseptic, on account of the impossibility of excluding every source of wound infection (*e.g.*, the atmosphere, the patient's skin, etc.), still we know, as a matter of

practical experience, that we can, by the exercise of sufficient care, render such sources harmless in far the majority of cases; in other words, when we have only these to deal with, we expect the wound to heal by first intention, and it generally does so. Such operations are called aseptic. For instance, the operations for the radical cure of hernia and varicocele, or that for the removal of an uncomplicated ovarian cyst, are regarded as aseptic operations; and if the technique described in the previous pages is followed, it is expected that the wound will heal without inflammation or suppuration; and this is all we require.

Other operations are manifestly septic. If, for instance, an extravasation of urine is opened, or an acute cellulitis or abscess, or an already accidentally infected wound is treated, we operate in the presence of infection that has already taken place; we know that the wound will be a septic one; we do not in many cases expect it to heal by first intention, and we make provision for draining away its septic contents. Such operations, many of them on tissues infected with very virulent germs, are best performed in a separate theatre, and, if they can be retained, the old theatres serve a useful purpose here. An effort should be especially made to retain them in the case of small hospitals which have only one modern theatre. If not, all the preparations for a series of aseptic operations may have been made, when a septic emergency case is perhaps suddenly admitted, has to be operated upon immediately in the theatre, and disorganizes the work there for some considerable time. In the conduct of septic operations, it is advisable to carry out the aseptic routine in its entirety. To begin with, the aseptic technique should become a second nature to both surgeon and nurses, and

it is easier for it to become so if it is invariably practised. Secondly, it is frequently unknown what particular germ or germs may have infected the patient, and there is no occasion to wittingly introduce others, and so add to his already overtaxed powers. For aught we know to the contrary, this may just turn the balance against him. The patient, for instance, may have a very unwelcome and unwholesome visitor in the guise of the colon bacillus or pneumococcus. There is no occasion to introduce to him at this somewhat unpropitious moment the streptococcus and staphylococcus as well. He may, with the aid of the surgeon, be able to deal with one, but possibly is not strong enough to turn out both. I make this remark, because I have often heard it said, "It is a septic case already, so it doesn't matter," when breaking one of the rules of aseptic surgery. We know enough of toxins and mixed infections to say that it is not a matter of no importance if, when a patient is being poisoned with the toxin of one bacillus, we supply him with that of another.

The wounds of the recent war were generally infected, and operations were performed on mostly virulently infected tissues. After prolonged attempts at disinfecting them, in the early periods, on the lines of wounds in civil practice—*e.g.*, washing them out with antiseptics ordinarily in use, irrigation, drainage, etc.—had resulted in dismal failure, with loss of life and limb, the consensus of surgical experience arrived at the advocacy of the earliest possible excision of wounds *in toto* whenever and wherever this was practicable, piecemeal when it was for anatomical or other reasons impracticable. After complete excision, primary union was in many instances attainable; in others, preparation of the

wound for secondary suture by various methods, of which the Carrel-Dakin* treatment eventually held the field, had to be adopted. Now in all these procedures it was found that the strictest aseptic precautions were necessary if good results were to be obtained—*i.e.*, for the primary operation the shaving and thorough preparation of the skin; the surrounding of the operation area with sterile towels, the use of gowns, masks, and gloves, by the operators; the thorough sterilization of instruments, etc., was just as necessary as in a strictly aseptic operation. It was recognized that no fresh sources of infection must be introduced from the surroundings of the patient during the operation if the results were to be successful. In fact, these excisions were aseptic operations conducted in the presence of virulent infection, and the most rigid aseptic precautions were necessary to insure primary union where that was attempted. Where, after excision, preparation of the wound for secondary suture by the Carrel-Dakin or other methods was adopted, it was likewise found that in all subsequent dressings the strictest aseptic precautions were necessary to insure successful results. This primary excision, and attempt at primary union or preparation for secondary suture, will most certainly become the practice in the accidental wounds of civil life, and for many reasons even better results may be anticipated than those obtained in the wounds of war. The injuries of civil life are not as a rule so serious, the infection is less virulent, the haste is less

* For the details of the Carrel-Dakin, Bipp, or salt-pack treatment of wounds, the reader must consult books and articles dealing with the subject. They do not come within the scope of this work.

urgent, the accommodation is better, methodical treatment more accessible. The point to urge here is the necessity of just as strict an aseptic technique in the treatment of these wounds as in the ordinary aseptic operation outlined in this book. Undoubtedly the greatest surgical triumph of the late war was the control eventually obtained over the most virulent organisms and the scientific methods which were gradually elaborated for combating the most deadly infections. In this a strict aseptic technique played a vital rôle.

The hands should therefore be carefully disinfected, and the costume worn, including gloves. Gloves in these cases serve a double purpose. Not only do they prevent the surgeon infecting the patient, but they likewise prevent the patient infecting the surgeon; and some surgeons—Kocher, for instance—who have never been able to master the gloves always use them in septic cases with this object, keeping their hands thus as far as possible free from infection. If the surgeon or assistant has any breach in the surface of the skin, they are also manifestly a great source of safety to him. After septic operations, more than ordinary care is required in the disinfection of the theatre, instruments, and other materials used in the operation. It is doubly necessary to cleanse all instruments at once, so as not to permit pus to dry in their crevices and joints; and they should be boiled, as previously stated (*cf.* Instruments), for double the time occupied in the disinfection of aseptic instruments before being replaced in the cabinet.

II. Combined Aseptic and Septic Operations.

The conduct of aseptic and septic operations, as has been explained, is definite. There is yet another class of operations which claims consideration. These take place almost exclusively within the abdomen, and are very common. They are combined aseptic and septic operations. By this is understood that, though the general conduct of the operation is aseptic in its minutest details—and it is of the utmost consequence that it should be so—a septic stage is introduced into it owing to the necessities of the case. An example or two will illustrate this. As has previously been explained, the alimentary canal is loaded with dangerous bacteria. Before undertaking operations which involve the opening of this canal, attempts are made by attention to the mouth, the administration of purgatives, etc. (*cf.* Preparation for Operation), to reduce the numbers of these. Yet it is not possible to get rid of them altogether, and in the course of an operation involving the opening of the alimentary canal—such, for instance, as an anastomosis or enterectomy—a septic stage, and with it a possible source of infection, is introduced, and we have to exercise the greatest care that all our efforts in the aseptic preparation for, and conduct of, the operation are not thereby nullified, and a septic peritonitis or suppuration of the abdominal wound induced. Exactly the same remarks apply to operations on the bile-passages. In cases of surgical disease here the contents of these passages are generally, if not invariably, infected. We have to recognize, therefore, and guard against the contingency of infection of the peritoneum or wound

from their contents when they are opened. Take, again, the case of an appendicectomy during the quiescent stage. When the mucous membrane of the appendix is cut across, a source of infection occurs. Lastly, in many cases of suppuration within the abdomen a localized abscess forms. Though a virulent infection exists within part of the peritoneum, it is so shut off by Nature's protective adhesions that the main portion of the peritoneum is not involved. It is of the utmost importance during the stage of the operation which consists in opening the abscess that none of the infective material should escape into the general peritoneum. Various operations of this kind are constantly taking place within the abdomen, and require great care on the part of the three immediate participators in them—viz., the surgeon, his assistant, and the theatre sister.

The first step, it will be noticed, in the performance of any abdominal operation is to wall off all the abdominal contents, except those actually involved in the operation. For this purpose the large thick packs, furnished with tapes having Spencer Wells forceps attached to them, and which have been already described, are nsed. The objects of this walling-off are threefold:

1. To prevent unnecessary exposure of the contents of the abdomen.

2. To keep them out of the way of the operator.

3. To prevent their infection, should a septic stage come into the operation.

If such a septic stage is about to be introduced, its immediate environment is surrounded by additional gauze packs. The theatre sister is then told that the operation is about to become septic. She immediately places a sterilized bowl close to the surgeon's right hand.

Into this all swabs and instruments are at once put which are used during this stage. For instance, the scissors or knife used in opening the gut is at once placed there, never given back into the sister's hands, or placed on the towels surrounding the operation area. The dissecting forceps used in the anastomosis, and the needles when done with, are placed there; any swabs used go there likewise. When the septic stage is completed, the neighbourhood of the incision is cleaned of all blood, is lightly gone over with a swab soaked in sterilized salt solution, and dried. The swabs used for this purpose likewise go into the bowl. Finally, the packs immediately surrounding the septic wound are removed and placed in the bowl. The theatre sister then takes a piece of sterile gauze from her table, and, removing the bowl with it, hands it to the theatre nurse, who, in turn, removes it from the field of operation. The theatre sister thus is clearly not infected at all. During the septic stage the surgeon and his assistants frequently dip their hands in biniodide lotion (1 in 4,000), and then in sterile salt solution. At the termination of it the gloves of the surgeon and his assistants may be changed, or the gloved hands thoroughly soaked in 1 in 500 spirit lotion, and this washed off with normal saline solution. If they are in any doubt as regards their infection, their coats should, of course, be changed. If, also, there is any suspicion of the towels surrounding the operation field, they should be changed; but this is not, as a rule, necessary if the precautions above detailed are observed. The operation may then be proceeded with. Similarly, in an appendicectomy in the quiescent stage, after turning down the peritoneal cuff, and just as the mucous membrane

is about to be cut, if this method of dealing with it is adopted, the wound becomes septic. An extra pack surrounds the appendix; the scissors divide it, and are placed in the bowl; the needle stitching the peritoneum over the stump is placed in the bowl, the stump washed with sterile salt solution, and dried; the pack mentioned above removed, and placed in the bowl. The bowl is then removed, and after the surgeon and his assistants have attended to their hands, the operation is proceeded with.

Lastly, when an intraperitoneal abscess is about to be opened, or a suppurating Fallopian tube to be removed, etc., great care is necessary in thoroughly walling-off the immediate surroundings with an extra layer of packs, placing all instruments and swabs used in the bowl provided, and insuring a thorough disinfection of the hands at the completion of the septic stage, and before the rest of the operation is proceeded with. Enough has been said to emphasize the importance of the septic stage in some aseptic operations. It is not within the scope of this book to go into the surgical technique of all of these operations, which belongs to the surgeon; but it *is* within its scope to draw attention to the matter, so that assistants and nurses may be aware of their responsibilities, and recognize the kind of precautions they have to take when a septic stage occurs in an aseptic operation.

ADDENDUM TO CHAPTER IV

Results obtained by the Operative Technique advocated in the Previous Chapters.

A study of the previous pages will apprise the reader that great care and attention to detail are advocated both in the preparation of the patient for operation and in the conduct of the operation itself, with the view of reducing the dangers attendant thereon to a minimum, and of securing primary union of the wound in those cases which admit of its possibility. It would, therefore, I think, be instructive and would lend support to the argument if the results of a test of the methods advocated here were submitted. In elaborating and perfecting the technique the skins of patient, surgeon, and assistants, ligatures, sutures, swabs, dressings, etc., were frequently submitted to culture tests, the only scientific criteria of sterility. But in everyday work such tests are not always available, and the criterion of sterility of the cases quoted below has been the practical one of primary union or absence of suppuration. This, after all, is the aim of the surgeon in performing a modern surgical operation. The tables include every operation performed on my regular operation day (Monday) at the Royal Portsmouth Hospital from July 1 to December 21, 1908—the adjournment for the Christmas holidays—*i.e.*, a period of six months. Emergency operations are excluded, as they cannot of necessity be submitted to the same careful preparation, and would not, therefore, be a fair test of the technique. Tables A and B, quoted below, have been arrived at in the following manner: The whole list of operations was written down by myself before each operation day, and a mark

placed against those in which an ideal preparation and operative technique were possible, and in which, therefore, it was anticipated that primary union would occur. These are the selected cases in Table A. Table B contains the remainder, and is only given to enable the reader to judge of the impartiality of the selection. Some of the cases in Table B healed by first intention, but they were excluded from the list of aseptic cases, because in none of them could a typical preparation or technique be carried out, and it was considered that a failure to secure primary union in any of them could not of necessity be attributed to a fault in the methods adopted.

TABLE A.—SELECTED CASES.

Description of Operation.	*No.*
Radical cure of hernia	20
Excision of glands (not suppurating)	10
Excision of varicose veins of the leg	10
Excision of varicocele	5
Osteotomy	5
Exploratory laparotomy	5
Appendicectomy (quiescent, and not suppurating)	4
Gastro-jejunostomy	4
Supravaginal hysterectomy for fibro-myoma	3
Halstead's excision of breast (not ulcerating)	2
Operation for undescended testis	2
Ovariotomy	2
Wiring fractured patella	2
Inguinal colotomy	2
Excision of bursa patellæ	2
Removal of needle from thigh	2
Nephropexy	1
Entero-enterostomy	1
Excision of tubercular abdominal glands	1
Radical cure of hydrocele	1
Thyroidectomy	1
Cholecystotomy and choledochotomy	1
Cholecystectomy	1
Salpingo-oöphorectomy (without abscess)	2
Omentopexy	1
Excision of tumour of thigh	1
Excision of external carotid for sarcoma of tonsil	1
Total	92

TABLE B.—UNSELECTED CASES.

Description of Operation.	*No.*
For tubercular abscess	6
For hæmorrhoids	5
For intra-oral epithelioma	5
For stricture of urethra	4
Staphylorrhaphy	3
Wertheim's abdominal panhysterectomy for carcinoma uteri	2
Curettage	2
Trachelorrhaphy	2
For vesico-vaginal fistula	2
Excision of eyeball	1
Halstead's excision of breast (ulcerating)	1
For villous tumour of bladder	1
Excision of broken-down malignant gland	1
Excision of suppurating sebaceous cyst	1
Excision of epithelioma of face	1
Excision of epithelioma over sacrum	1
For appendicular abscess	1
Tarsectomy for tubercular disease with sinuses	1
Excision of intestine adherent to septic abdominal wound	1
For hare-lip	1
Colporrhaphy and perineorrhaphy	1
Salpingo-oöphorectomy (with abscess)	1
For fissure of the anus	1
Total	45

The results of the operations included in Table A will now be submitted to the reader. As explained above, all of the cases included in it were selected previously to operation as those in which primary union was to be anticipated. Nine days after operation the wound was inspected by myself in the presence of the house-surgeon and ward sister, and the result as regards primary union or the reverse was recorded. The highest temperature reached in each case was also recorded. Cases that were drained, notwithstanding their being clean cases, were noted. So-called stitch abscesses or catgut working out were also to be recorded. Table A contains 92 cases. Of these, one, a child in whom radical cure of hernia had

been performed, developed diphtheria two days after operation, and was transferred to the Infectious Diseases Hospital, where he unfortunately died; a second, an old lady in whom the double operation of cholecystotomy and choledochotomy had been performed, succumbed to cerebral hæmorrhage on the fifth day after operation; a third died of exhaustion in forty-eight hours after a simple exploratory laparotomy, in which malignant disease of the common bile-duct was demonstrated. A post-mortem examination showed a perfectly healthy wound and abdominal cavity. These three cases are excluded, because, dying as they did from unpreventable causes shortly after operation, no conclusion was possible as to the ultimate fate of their wounds. Eighty-nine cases remain. Of these, 3 were drained—1 case of thyroidectomy, 1 case of excision of the glands of the anterior and submaxillary triangles for malignant disease of the mouth, and 1 case of excision of the glands of the submaxillary anterior and posterior triangles for similar disease. In each of these cases a drainage-tube was inserted, and removed in twenty-four hours. It is noteworthy that we have been able almost entirely to dispense with drainage. In 89 cases, only 3 were drained, all of them extensive operation wounds in the neck, and in each case the drainage-tube was removed in twenty-four hours. This exclusion of drainage adds very materially to the safety of the wound, the drainage-track being manifestly a potential source of after-infection. Of the 3 cases drained, all healed by first intention, except that from the drainage-track of one of them I squeezed on the third day a small quantity of dead tissue. The highest post-operative temperature in this case was 100°, and there was no attempt at suppuration. In the remaining 86 cases the edges of the skin were

closed throughout—the ideal aseptic operation wound. Of these 86 cases, 82 healed absolutely by first intention. In 2 cases a small piece of skin did not unite, owing to want of perfect apposition of the edges, and in 2 cases a hæmatoma developed beneath the scar, owing no doubt to faulty hæmostasis, and separated the edges of the wound at one spot, where it evacuated itself. In neither of these cases was there any inflammation of the wound. There was, therefore, in this series of 89 consecutive cases no instance of post-operative inflammation or suppuration. There was no case of so-called stitch abscess. No piece of catgut or silk worked out during the time the patient was under observation in hospital. The highest post-operative temperature was recorded in every case. The highest point reached was 101·4° in 1 case five days after operation, with a sore throat. The wound ran a perfectly normal course. In 1 of the cases noted above with a hæmatoma the highest temperature reached was 101°, and in 6 others a temperature between 100° and 100·4° was recorded. The average high-water mark of all the temperatures of all the cases was 99·09°.

Such results bear testimony to the efficiency and reliability of the methods advocated in these pages. It must be emphasized that the credit does not lie wholly or even mainly with the surgeon who performs the operation, but with house-surgeons, theatre and ward sisters and nurses, who superintend the many details which combine to insure success, and their share is gratefully, and should always be gratefully, recognized by the surgeon. In conclusion, I think it is a good plan for a surgeon to adopt some such record as this of his operative work. It stimulates a certain competition and rivalry in the various wards as to who are going to show the best results, and rivalry in its turn conduces to efficiency.

CHAPTER V

THE PATIENT IN THE WARD AFTER OPERATION—DUTIES OF WARD SISTER, NURSES, ETC.

AFTER operation the patient is wheeled back to the ward, and transferred to bed by the porter, under the supervision of the ward sister, who is responsible for its being done gently and in accordance with the requirements of the case. Provided that the conditions laid down in Chapters III. and IV. have been complied with—in other words, if the preparation of the patient for operation and the conduct of the operation itself have been in accordance with the principles and practice of aseptic surgery—there will be little anxiety as regards the wound or any complications arising therefrom. Still, it is not invariably plain sailing, even after an aseptic operation; and if a flaw has occurred anywhere in the asepsis, there may be added many consequences, demanding prompt recognition and ready treatment. It behoves the nurse, therefore, to have a sound knowledge of the after-treatment of the patient, even if the wound, as happily usually occurs nowadays, pursues a normal course. It is also necessary for her to acquaint herself with the various complications that may arise, together with their treatment, in so far as it comes within her province, should there be any deviation from the normal.

The present subject will be treated under the four following headings:

1. General directions, provided no complications arise.

2. Complications and sequelæ of operations generally.

Corollary.—Points to note after all operations.

3. Additional complications and sequelæ of abdominal sections.

Corollary.—Additional points to note after abdominal sections.

4. After-dressing of the wound.

I. General Directions, provided no Complications arise.

If no complications arise after a surgical operation, there is not much to do beyond the ordinary routine of nursing and making the patient comfortable. His after-illness becomes a mere convalescence, and it is astonishing to see, after severe operations, the patient in a day or two frequently looking quite himself, and expressing himself as feeling so. It is satisfactory to all concerned: to the surgeon, who has been careful to take the measure of his patient, and has skilfully performed the operation; no less so to all the participators in the preparation for, and the conduct of, the operation, who may legitimately claim an equal share in the surgical triumph. The following are the chief points to attend to:

1. **Position.**—Until the anæsthetic sickness has passed off, the patient is laid flat on his back, with a low pillow under the head. Subsequently, unless the situation of the wound or some other circumstance, such as shock, contra-indicate it, the best position for the patient is sitting up in bed. To insure this, a firm, very thick cylindrical sand-bag is placed transversely just below the buttocks, and an inclined plane of pillows made for

the back. This is comfortable, and prevents all slipping.* The advantages of this position are:

(1) It is comfortable to the patient, and relieves the backache which is often a source of acute distress after operation. Anything which makes for a patient's comfort after operation is, generally speaking, right. But there are other and more important advantages to follow.

(2) It lessens the liability to hypostatic pneumonia in old and feeble patients.

(3) In septic conditions within the abdomen it has special advantages, and should always be adopted from the very beginning. It tends to keep any septic matter towards the lower abdomen and pelvis, which are the regions of safety. It is therefore specially indicated in operations for septic conditions here—*e.g.*, operations on the gall-bladder, perforated duodenal or gastric ulcers, suppurative appendicitis, operations for suppurating tubes, etc.†

The general contra-indications to the erect position after operation are persistence of anæsthetic sickness and of shock, and if these are present, directions should be sought from the surgeon; but after operations for septic conditions within the abdomen, only urgent necessity should lead to its relinquishment.

2. **Provision against Shock.**—Provision against shock is made—

(1) By keeping the patient flat on his back, and tilting the foot of the bed with blocks.

* The same effect is obtained by raising the head of the bed on blocks.

† In all cases of suspected infection of the peritoneal cavity (*e.g.*, perforation of a gastric ulcer or appendix) the patient should be placed in this position as soon as the condition has been diagnosed; operated upon, if possible, in this position; carried back to the ward in this position; and subsequently maintained in this position till its relinquishment is sanctioned by the surgeon.

(2) By the application of warmth. With this object in view, the cotton-wool coverings in which the parts of the body not involved in the operation are wrapped (*cf. ante*, p. 59) should not be removed till all danger of shock has passed. The patient is covered with warm clothing, and hot-water bottles are placed in the bed, care being taken that they are wrapped in thick blanketing, so that they do not come in contact with the skin and cause a hot-water burn.

N.B.—A hot-water burn is very slow to heal, is very painful, is not without danger, and a patient never forgives it.

(3) By the early resumption of feeding (*cf.* Feeding) and stimulation, if necessary.

(4) By the assumption of an encouraging and hopeful attitude towards the patient.

3. **Feeding.**—After all operations (unless otherwise ordered*) feeding by the mouth should be commenced as soon as possible—*i.e.*, as soon as the anæsthetic sickness, if present, has passed off. Five or six hours generally suffice for this, though the time varies in different patients, and the sickness which occurs during the first twenty-four hours after operation may generally be attributed to the anæsthetic. Exceptionally it lasts even longer than this (*cf.* Persistence of Anæsthetic Sickness, p. 137). Previous to the commencement of feeding, thirst, if present, is relieved by frequently washing out

* In operations involving the intestinal tract (*e.g.*, gastro-jejunostomy) the nurse should take special directions as to feeding. After these operations surgeons differ in their routine; some advocating early feeding by mouth, others some delay. In gastro-jejunostomy, for instance, my own practice is not to feed by the mouth for twenty-four hours unless the patient requires it, having a preference for giving the anastomotic wound complete rest for this period. I do not, however, hesitate to feed much earlier if the patient's condition seems to require it, and I cannot say I have seen any harm result from this practice.

the mouth with hot water. When the anæsthetic sickness has stopped, feeding should be commenced with one or two teaspoonfuls of water every half-hour. If this is retained, it should be followed with milk and water, beef-tea, weak tea, in small quantities. If no sickness or nausea follows, the amount may be quickly increased to 1 ounce every hour. Sucking an orange or grape may be allowed during the first twenty-four hours, and is frequently very grateful to the patient. Also, women frequently long for their cup of tea, and this may be likewise permitted—weak. After many operations, the patient must not be stinted of fluid food, and the starvation methods formerly in vogue have rightly given way to a more rational practice. Experience and care count for a good deal in feeding patients after operation. When to withhold nourishment and when to press on with it are matters derived from experience. No definite rule can be laid down, but the principle to act upon after severe operations is that of getting the patient on to food by the mouth as soon as possible without prolonging the anæsthetic sickness. Meantime, feeding by the rectum should never be neglected. After all severe operations rectal feeding should be adopted from the commencement, and continued till the patient is taking nourishment freely by mouth. Abundance of fluid is the chief indication. A pint of normal saline solution (with 1 ounce of brandy, if directed, or glucose or bicarbonate of soda; *cf.* Treatment of Shock, p. 137) should be given as soon as the patient is back in bed (or sometimes on the operating-table), and every hour or two till mouth-feeding is well borne. After this it should be discontinued, as, if persevered with too long, it is apt to cause irritation of the bowel and diarrhœa.

After operations for septic conditions within the ab-

dominal cavity (*e.g.*, perforative peritonitis), in which symptoms of severe toxæmia are frequently present, the continuous method of rectal administration of fluid (proctoclysis) is that recommended by the highest surgical authorities, and should always be adopted. It is known as the "Murphy treatment," from its distinguished originator. The following description of it is in the words of J. B. Murphy, of Chicago: "As soon as the patient is returned to bed, proctoclysis is instituted, and maintained until the serious symptoms of intoxication cease. The continuous method is by far the most scientific and successful. *Moderate distension* is the normal condition of the large intestine. If it is *hyperdistended*, it causes spasm and expulsion of material. The mucosa of the large intestine absorbs water with great rapidity. We have administered 30 pints of normal salt solution in twenty-four hours to a patient eleven years old, and it was all retained. *The retention of fluid in the colon depends entirely upon the method of administration.* We have visited hospitals numbers of times, and have been shown patients who were receiving the 'Murphy treatment.' We should not have recognized it without the label. It is difficult to impress doctors and nurses with the importance of details, notwithstanding that the best results are secured only by close attention to detail. The fluid should be administered through a fountain syringe to which is attached a ⅜-inch rubber hose, fitted with a hard rubber or glass vaginal douche tip, with multiple openings. This tube should be flexed almost to right angles 3 inches from its tip. A straight tube must not be used, as the tip produces pressure on the posterior wall of the rectum when the patient is in the Fowler position. The tube is inserted into the rectum to the flexion angle, and secured

in place by adhesive strips binding it to the side of the thigh, so that it cannot come out; the rubber tubing is passed under the bedding to the head or foot of the bed, to which the fountain is attached. It should be suspended from 6 to 14 inches above the level of the buttocks, and raised or lowered to just overbalance hydrostatically the intra-abdominal pressure—*i.e.*, it must be just high enough to require from forty to sixty minutes for 1½ pints to flow in, the usual quantity given every two hours. *The flow must be controlled by gravity alone, and never by a forceps or constriction on the tube,* so that when the patient endeavours to void flatus or strain, the fluid can rapidly flow back into the can; otherwise it will be discharged in the bed. *It is this ease of flow to and from the bowel that insures against overdistension and expulsion on to the linen.* The fountain had better be a glass or graded can, so that the flow can be estimated. The temperature of the water in the fountain can be maintained at 100° F. by encasement in hot-water bags. The fountain is refilled every two hours with 1½ to 2 pints of solution. The tube should not be removed from the rectum for two or three days. When the nurse complains that the solution is not being retained, *it is certain it is not being properly given;* even children tolerate proctoclysis surprisingly well. We believe that, next to the conservative technique of the operative procedure proctoclysis is second in importance as a life-saver. It rapidly restores blood-pressure; it improves the capillary circulation; it quiets the thirst; it eliminates the septic products, and increases the excretions. All of the details are simple, but they *must be carried out with precision to secure the best results.*"*

* "Perforative Peritonitis," by John B. Murphy, M.D., Chicago, Illinois (*Magazine of Surgery, Gynæcology, and Obstetrics.* June, 1905).

Beef-tea, milk, brandy, etc., may likewise be administered per rectum. If it is deemed necessary for any reason to prolong rectal feeding, the rectum should be washed out once in twenty-four hours. It is after abdominal operations that rectal feeding finds its most useful application, because vomiting, as a rule, is a more troublesome sequel in these cases; but it is required after any severe operation. In operations within the abdomen, before administering the rectal feed, the tube should be passed into the rectum, and left *in situ* for ten or fifteen minutes. This frequently enables the patient to pass flatus, to his own great relief and that of the surgeon as well.

In operations within the mouth, of which excision of the tongue, etc., for malignant disease is the most frequent, the patient should be got accustomed to the passage of the nasal tube a few days beforehand, as has been previously insisted upon (*cf.* p. 45). A Jacques catheter is very suitable for administering nasal feeds, and by its means milk, beaten-up eggs, beef-tea, brandy, etc., may be liberally administered every two or three hours; for patients require free nourishment and stimulation after operations in this region, which are frequently very severe. If all goes well, the patient will usually begin to take light solid food on the second or third day after operation outside the abdomen, and in abdominal operations a day or two later. The rule to administer an aperient on the second night after operation, and when this has acted to commence light solid food, such as fish, chicken, etc., is a sound one, and may generally be adopted. No hard-and-fast rule is applicable to all cases, and the surgeon or house-surgeon will give direction in the matter.

4. **Attention to the Mouth.**—In Chapter III. the importance of getting the mouth into a thoroughly clean

condition previous to operation was insisted upon. The same care, and for similar reasons, should be bestowed upon the mouth after operation, the teeth being brushed two or three times a day, and the mouth washed out with an antiseptic solution (Sanitas or Listerine and water). Formamint lozenges have been shown by F. Levy to be capable of rendering the mouth temporarily sterile, and two or three of these per diem may be advantageously given to the patient for a few days both before and after operation. Special attention should be bestowed on the mouth after operations within that cavity itself (*e.g.*, excision of the tongue). Wounds here, unless very carefully and constantly attended to by constant washing out with antiseptic solutions (*i.e.*, every hour or two), become very foul, and are apt to be followed by septic pneumonia and parotitis, both very fatal complications. Once or twice a day a little iodoform or Whitehead's varnish should be brushed over these wounds, and has a great cleansing effect.

N.B.—Cleft-palate operations in young children are not included in these directions. Although the indication is to keep the wound clean here as elsewhere, indiscriminate meddling with it, and the struggling and crying it involves, are likely to be attended with more harm than good. How much antiseptic attention can be given to the wound depends on the intelligence and confidence of the little patient, and in each case direction from the surgeon should be sought.

5. After **vaginal operations,** tepid vaginal douches of biniodide of mercury (1 in 4,000) are frequently given night and morning. In many cases they are unnecessary, and in others—*e.g.*, panhysterectomy—they are contra-indicated. Directions as to this should be taken from the surgeon or house-surgeon.

If no complications arise, the instructions given above are all that are necessary to follow. Attention to the position of the patient, preventive measures against shock, the gradual resumption of feeding by the mouth as soon as the anæsthetic sickness has ceased, the administration of nourishment per rectum meanwhile in cases requiring it, heed to the cleanliness of the mouth and action of the bowels, constitute the important points in the after-treatment of a case of this kind. In a few days the patient will be convalescent, and only awaiting the removal of his stitches before being pronounced well.

II. Complications and Sequelæ of Operations Generally, with their Signs and Treatment.

1. **Shock.**—The Great War provided all too abundant material for the study of shock following wounds and the operations necessitated by wounds. A large amount of research work was done in the laboratory in connection with this important condition; clinically it was constantly and anxiously studied, and every means that suggested itself for its treatment was adopted. The experience thus gained should be of great value in the treatment of post-operative shock in civil practice, and in that following the accidents of civil life.

During the war wound shock, as might be anticipated, was frequently accompanied by severe hæmorrhage, but not by any means invariably so, and the condition, when present, was identical, whether wounds were attended with great loss of blood or not. The essential clinical condition present in all shock, whatever its cause (and the probability is that the causes are many), is a fall of blood-pressure, due to a diminished quantity of blood in circulation, and most recent investigations

render it probable that the blood, if not lost externally, is held up in the capillaries in certain areas of the body. As the blood carries oxygen to the tissues, the result of this diminished quantity of blood in circulation is that insufficient oxygen is carried to vital nerve centres to keep them functioning, and death results. Now, many factors were found to be associated with and to produce shock in wounded men, most if not all of which have a direct bearing on the accidents and operations of civil life. First of all was hæmorrhage, and an obvious indication here is that in operative work all unnecessary loss of blood should be scrupulously avoided, and care taken to secure perfect hæmostasis before the wound is closed. Again, it was found that men exhausted by fatigue and hardship suffered more severely from shock than fresher troops. An indication here is that patients, before undergoing a severe operation, should be brought into as good a state of health as time and circumstances permit. Other causes of shock were found to be pain and mental worry and anxiety, even in the presence of trivial wounds—the psychic shock on which Crile has laid so much stress; and indications here are to relieve pain and discomfort in every possible way after operation, and to be encouraging and cheerful to patients about to submit to operation, especially if they themselves be nervous and fearful of the result. Every surgeon probably feels not quite comfortable with a patient who he knows dreads very much the operation he is about to undergo. Again, cold and exposure were found invariably to increase shock in wounded men: shivering and feeling cold were their most insistent complaints, and the application of warmth externally and hot drinks internally were found to be of the utmost value in preventing shock and

overcoming it when present. Therefore, to clothe patients warmly during operation, to avoid all unnecessary bodily exposure, to keep the theatre warm and the operation-table warm, to apply warmth externally to the body surface and internally by hot drinks after operation, are indications of the utmost importance. Another insistent demand of wounded men during shock was thirst. Plenty of hot drinks were supplied to satisfy the want, and were found to be of the greatest value. Thirst is an equally insistent complaint of those who have undergone a severe operation. To satisfy the cry of the tissues starved of fluids by giving drinks, by rectal, intravenous, or subcutaneous injection, is as important in post-operative shock as it was found to be in that of the wounded. Information will be given as to the best fluids to use in the paragraphs on treatment.

Shock in civil operative work is generally proportional to the length and severity of the operation. On the other hand, severe shock may occasionally follow trifling surgical procedures. The essential condition, as stated above, is a fall of blood-pressure. This is measured by an instrument known as the sphygmomanometer. Shock, if it supervenes, usually does so during or within the first few hours of an operation, and is generally recovered from within twenty-four hours. Clinically it may appear in two forms:

(1) *Usual form,* the characteristic signs of which are:

(*a*) Pallor and coldness of the body surface, which is usually bathed in a clammy sweat, especially the forehead.

(*b*) Low temperature. A severe fall (96° or 95° F.) is a bad sign, and indicates profound shock.

(*c*) A pulse sometimes accelerated, sometimes slow, always feeble, sometimes imperceptible.

(*d*) Feeble, rapid, and shallow respirations.

(*e*) General apathy and listlessness.

(2) *Unusual Form.* — Occasionally the restless or maniacal form is present, the patient tossing about and screaming, while the temperature is falling and the pulse weakening. The sign of recovery from shock is a rise of blood-pressure, which, if maintained, results in a disappearance of the clinical symptoms. Thus:

(*a*) The cold sweat disappears and warmth returns to the body.

(*b*) The temperature rises.

(*c*) The rate and quality of the pulse improves.

(*d*) The shallow and feeble respirations give place to those of a normal character.

Treatment is preventive and curative.

(1) *Preventive.*—(*a*) Careful preparation of the patient, as directed in Chapter III., including wrapping all parts of the body not involved in the operation area in cotton-wool.

(*b*) The assumption of a cheery manner toward the patient both before and after operation. Fear and shock are closely allied, and the nurse should do everything possible to encourage her patient and diminish the dread of the operation and of its consequences.

(*c*) Warming the surroundings of the patient during operation. The temperature of the operating-theatre should be at least 65° F., and many modern operating-tables are provided with an apparatus for supplying heat to the body surface during operation.

(*d*) *Method of Operating.*—This of course mainly rests with the surgeon and his anæsthetist, and includes many important items, such, for instance, as the avoidance

of rough handling of tissues, experience and speed in operating, avoidance of all unnecessary loss of blood during operation and securing perfect hæmostasis, the employment of scientific measures to prevent shock (*cf.* Anoci-association, p. 64), the amount and kind of anæsthetic employed, and the experience in its use, etc. At the same time the efficient organization of an operation, in which sisters and nurses take part, also assists, and no patient should be on the table one minute longer than is necessary. If a patient die of shock, there has been somewhere during the operation a dividing-line which he has passed, and which his powers have not enabled him to recross. It is impossible to know in any given case where this dividing-line is. Our obvious duty is, therefore, to do all in our power to give it a wide margin, to keep the patient well within it.

(2) *Curative.*—The preventive* treatment described in the last section provides some of the means of dealing with shock, when present. Restoring warmth to the body supplies one of the most important requirements, and of itself suffices in many cases. With this object the cotton-wool wrappings in which the patient is clothed previous to operation should be maintained, he should be well supplied with warm blankets, hot bottles adequately protected should be placed next to the body, hot mustard poultices should be applied to the præcordial region, and hot drinks should be given, or warm enemata of brandy and water administered per rectum. If the above do not suffice, other means must be adopted, and these have two main objectives:

(*a*) To raise the blood-pressure.

* The prevention of shock during operations by Crile's method has been previously described (*cf.* p. 64).

(*b*) To remove toxic substances from the system which may be the cause of the shock.

The blood-pressure may be raised by the administration of drugs which constrict the arterioles, and for this purpose adrenalin and pituitrin have been the chief drugs advocated. Of these, pituitrin is the better, as its effects are less transitory than those of adrenalin. But the weight of recent medical opinion is that it is better to raise the blood-pressure by increasing the volume of blood in circulation, thereby insuring a larger supply of blood to the tissues.

With this end in view, various substances have been employed, either intravenously, subcutaneously, or per rectum. It has been found that if the blood-pressure can be raised and maintained, meaning an increased amount of blood in circulation, a consequent increased supply of oxygen to vital nerve centres, and lastly elimination of toxic products from the blood, the symptoms of shock are recovered from. In the late war, where shock so often followed hæmorrhage, blood from a donor was generally considered the best fluid to use, if available; and in severe shock following an operation in civil practice, especially if the operation has been accompanied by much loss of blood, the same treatment holds good. Failing a supply of blood, various other substances have been advocated.

1. Recently Professor W. M. Bayliss has, as the result of experiment and observation in wound shock, advocated very strongly the claims of a gum solution used intravenously. Previously salt solution intravenously, subcutaneously, or per rectum has been extensively used, but clinical experience has shown that, while the blood-pressure may be temporarily raised by it, it very soon falls again owing to the fact that the solution leaves

the vessels and is collected in the tissues. This has been confirmed experimentally. By increasing the viscosity of the fluid injected by the addition of gum acacia, this is prevented, and according to Bayliss and some other observers, the results of the injection of gum are very little inferior to those of human blood. The injection recommended is a 6 per cent. solution of gum acacia in 0·9 per cent. of sodium chloride. A pint of this may be run in intravenously, the time occupied in doing so being about a quarter of an hour. If improvement does not follow, a second pint may be administered in half an hour or so. Many cases of recovery from severe wound shock have been reported to follow this line of treatment.

2. On the assumption that in shock acidosis, due to the acid products of toxins and fatigue—in other words, a diminution of the alkali reserve in the blood—is present or threatening, bicarbonate of soda with saline subcutaneously, intravenously, or by the mouth or rectum, is strongly recommended, and has the advocacy of many surgeons experienced in the treatment of wound shock during the war.

3. On the theory that there may be carbohydrate starvation in shock, glucose has been recommended as an addition to saline in its treatment.

All of these methods had extensive trials during the war; all or any may be used in shock following severe operations or accidents in civil practice.

N.B.—If shock is present, the nurse in charge should constantly examine the dressings, to exclude or confirm external hæmorrhage as the cause of it.

2. **Persistence of Anæsthetic Sickness.**—Sickness, if due to the anæsthetic, usually passes off in five or six hours, but sometimes lasts longer, and that occurring

within the first twenty-four hours of an operation may usually be attributed to this cause. Vomiting persisting longer than this has generally some other significance, and is chiefly met with after abdominal operations (*cf.* Section III., p. 151). Rarely, however, anæsthetic sickness may persist and be very troublesome. If so, the indications are:

(1) The supine position.*

(2) Withholding food by mouth, and feeding exclusively per rectum.

(3) Mustard poultices to the epigastric region, ice to suck, and any other treatment the surgeon may order.

(4) It may sometimes be necessary to wash out the stomach, but this of course will be done by the surgeon. The patient may frequently be enabled to wash out his own stomach by giving him copious draughts of water by mouth.

The chief indication, if anæsthetic sickness seems likely to be troublesome, is for the nurse to feel her way very carefully with the initial feeding by mouth after the operation, and not to prolong the complication by injudiciously pushing the nourishment.

It should be a rule admitting of no exception that a patient should never be left by the nurse till he has thoroughly recovered from the anæsthetic. If he coughs or vomits during recovery, the head should be turned to one side, so that there is a free escape of the contents from the mouth; otherwise the patient in his half-conscious condition may easily draw the same into his respiratory passages.

3. **Hæmorrhage.**—Hæmorrhage occurring within the first twenty-four hours of an operation is usually due

* Sometimes propping the patient up in bed will arrest post-operative vomiting.

either to the slipping of a ligature from some vessel that has been insecurely tied, or to a renewed outbreak during recovery from vessels in which bleeding has been arrested temporarily owing to shock. Such hæmorrhage of itself will renew the shock, and in all cases of shock the nurse should constantly examine the dressings or neighbourhood of the wound—*e.g.*, the bed after hysterectomy—to make sure that this is not the cause of it. It must be remembered also that the hæmorrhage may be internal, and this is especially apt to occur after removal of tumours in the abdomen, such as ovarian, fibroid, and others. Hæmorrhage, as above described, and occurring soon after operation, is termed "reactionary."

True secondary hæmorrhage is that which occurs later and may happen at any time up to the closing of the wound. It is as rare nowadays as it was formerly common, owing to the organization of the blood-clot in the vessels that takes place during the healing of an aseptic wound, as distinct from the ulceration and breaking down of the same that was the necessary accompaniment of a septic suppurating wound. Still, some wounds suppurate owing to failure in the aseptic technique; others are septic from their nature, and in any of these secondary hæmorrhage may occur up to the time of their healing. But even in septic wounds nowadays we are generally able by drainage and the liberal use of antiseptics and cleanliness to prevent much ulceration of the deeper parts, and to quickly get them into a healthy granulating state. Secondary hæmorrhage, therefore, has become a rare event in surgery.*

* Secondary hæmorrhage was not infrequent in the wounds which accompanied various injuries during the late war. This resulted almost entirely from the unavoidable sepsis which occurred, owing to the circumstances in which the wound was

Treatment.—(1) The nurse in charge should summon the surgeon *at once* in every case. The surgeon has no less an obligation *to attend at once.*

(2) If the case is urgent, and the nurse has to act on her own initiative, the first thing to do is to rapidly remove the dressing over the wound. It is no use covering it up with more wool to hide the hæmorrhage and the fear to face it. After the dressing has been removed, it will very likely be found that by firm pressure on the wound either with fingers or sponge the bleeding will be arrested, and, if so, the pressure should be maintained till the arrival of the surgeon. In applying this pressure, if there is any bone in the neighbourhood —and there frequently is—the nurse should endeavour to direct the pressure against this, and she must not be afraid of applying it firmly. If the hæmorrhage come from a limb, this should always be raised. Arterial hæmorrhage will be diminished by this simple manœuvre, and venous almost or quite arrested. In addition, digital compression should be applied to the main artery of the limb.* This is all the nurse would be expected to do. She should bear in mind not to give the patient stimulants till the bleeding is under control, as the syncope caused by the latter is Nature's means of arresting the same.

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inflicted. The surest means of preventing this dangerous complication was by close attention to the elimination of sepsis from the wound—*e.g.*, by the Carrel-Dakin treatment. The author witnessed many cases, which had had one or more attacks of secondary hæmorrhage, and which, after the Carrel-Dakin treatment was adopted, never had another.

* In the lectures on surgical nursing the nurse will learn the various sites at which the main arteries can be controlled and practically the method of applying the pressure. She should, if engaged in operative surgical nursing, know these.

4. **Retention of Urine.**—Retention of urine may occur after any surgical operation. It is specially apt to follow operations on the pelvic organs—*e.g.*, that for hæmorrhoids, hysterectomy, etc.

The symptoms and signs are:

(1) Inability to pass any urine at all.

(2) The frequent passage of small quantities of urine. This is the dribbling from an over-full bladder, and should always be reported by the nurse. It is an almost certain indication of retention.

It is extraordinary how difficult it is to get nurses to grasp the fact that when the patient is constantly passing small quantities of water, he almost certainly has retention of urine, and that this sign is simply the dribbling over of a full bladder. It is, in my experience, one of the most difficult facts to get them to realize, although so simple and of such certain significance.

(3) A feeling of discomfort and distress in the lower abdomen.

(4) The presence of a median rounded tumour (the distended bladder) in the lower abdomen.

Treatment.—As for some hours after operation the quantity of urine secreted is diminished, and after severe operations very materially so, there is no reason to worry if no urine is passed till the next morning after operation, provided the patient evinces no distress. The nurse should be careful not to let the patient know that he or she may not be able to pass water naturally, lest the nervous apprehension of this contribute to its occurrence. If distress is felt in the lower abdomen, hot fomentations should be applied over the bladder, and the patient should be encouraged to try and void urine. Frequently, allowing patients to sit up will enable them to pass water, though unable to do so in the supine position.

If all means fail, there is nothing for it but the passage of the catheter, with the precautions described on p. 63; but it should be avoided if possible, and is rarely necessary within the first eighteen or twenty-four hours. If the patient is a male, the surgeon will pass the catheter; if a female, the nurse. **Suppression of urine** occasionally follows operations. Its treatment will be under the direction of the surgeon. The fact of the patient not passing water after operation should always be reported, as also the fact that a patient is passing water frequently and in small quantity (*cf.* above).

5. **Catheter Cystitis.**—Catheter cystitis is due to infection of the bladder from a faulty aseptic technique in passing the catheter, and the reason an instrument should be avoided after operation if possible is the fear of inducing this, often a very troublesome and sometimes a dangerous complication. Its symptoms and signs are:

(1) Increased frequency and pain in passing water.

(2) Rise of temperature, usually to 100° to 101° F.

(3) The presence soon of mucus and pus in the urine.

Treatment—(1) *Preventive.*—Delay in passing the catheter until it is absolutely necessary, and the rigid adoption of the precautions insisted upon previously (*cf.* p. 63), should its passage become inevitable.

(2) *Curative.*—This will be under the direction of the surgeon.

N.B.—If the preventive treatment is very carefully followed, the curative should never be required. The importance of catheter cystitis and its prevention cannot be too forcibly insisted upon.

6. **Fæcal Impaction.**—Occasionally patients lying in bed, especially if they have been on a liberal milk diet, are apt to get accumulations of hard fæces in the rectum,

which are a source of great inconvenience and suffering. These cases are deceptive unless the nurse is conversant with the condition. The bowels may be acting every day, due to loose evacuation past the hard fæcal mass which remains in the rectum, and the nurse may be consequently misled into supposing that nothing is amiss. It will be perfectly clear, however, from the patient's symptoms, that the condition named is present. Although the bowels may have acted, either naturally or in response to an enema, the patient does not obtain the relief which follows a normal evacuation. There is a sense of discomfort and straining, and a feeling of something he has not got rid of. A finger introduced into the rectum will at once reveal the hardened accumulation. An enema containing oil may get rid of it. Failing this, the hardened mass has to be removed with finger or spoon, after which frequently an enormous collection escapes from above it with the aid of an enema, to the complete relief of the patient.

This condition is strictly comparable to retention of urine. Just as in the latter urine frequently dribbles from an over-full bladder, so here small quantities of fæces are frequently passed from an over-full rectum. The point to make sure about in both cases is that the discharge of these functions is normal, and not irregular, as is the case in either retention of urine or fæces.

7. **Chest Complications.**—Bronchitis and pneumonia sometimes follow operations, and if they occur, add a complication always anxious and frequently very serious. The exciting cause is the infection of the air-passages by a micrococcus. A variety of circumstances may, however, predispose to this infection by lowering the patient's resistance or in other ways. For instance, certain climatic conditions existing especially in the

winter and spring months are favourable to the activity and invasion of the pneumococcus. Further, patients may be predisposed to such invasion by some constitutional defect, such as a weak heart. In some cases bronchitis and pneumonia are favoured by the irritant effects of ether on the mucous membrane of the air-passages where this anæsthetic is employed; in others, by exposure during operation—a cold theatre or the chilling effects of wet cloths, etc. Again, many cases of pneumonia following operation are no doubt due to inhalation of micrococci from a dirty mouth or a dirty inhaler; and that following operations within the mouth —*e.g.*, excision of the tongue—commonly arises from inhaling the septic contents of the wound there. Lastly, old people, during convalescence from operations, are liable to hypostatic pneumonia or œdema of the lungs, owing to the recumbent position, added to the weakening effects of their disease, plus that of the operation undertaken for its relief. It will be seen that many causes are at work in predisposing to this complication, and two or more may act conjointly in producing the effect.

It will be evident that the trouble is in the chest. The symptoms and signs are:

(1) Increased frequency and difficulty in breathing.

(2) Cough.

(3) Pain in the chest or back.

(4) Rise of temperature (absent in the hypostatic pneumonia of old people).

(5) Increase in the rate of the pulse.

(6) Later on expectoration, which may be blood-stained.

The curative treatment for these affections belongs to the surgeon; the preventive, and more important,

mainly to the nurse. It comprises points already emphasized in other parts of this book—viz.:

(1) Reporting to the surgeon or house-surgeon if the patient has a cough before operation, so that, except in cases of urgency, it may be postponed.

(2) Seeing that patients are adequately clothed when they go to the bath-room.

(3) Clothing of patients warmly for operation.

(4) Preventing undue exposure during operation.

(5) Seeing that the theatre or other operating-room is adequately heated.

(6) Thorough attention to the mouth and teeth both before and after operation.

(7) Propping up patients in bed as soon as may be after operation, and getting old people out of bed with as little delay as possible.

8. **Suppuration of the Wound.**—Infection and suppuration of the wound are generally due to a faulty technique in the preparation for, or conduct of, the operation, provided that the case falls within the category of aseptic operations. For instance, the operations for radical cure of hernia or varicocele are aseptic; the removal of a pyosalpinx is not; and though the abdominal wound may be closed in an endeavour to obtain healing by first intention, suppuration may occur in it without any fault in the technique. The infection of the wound almost invariably takes place at the time of the operation, rarely afterwards. The symptoms and signs of infection of the wound are:

(1) Rise of temperature and pulse, generally on the second or third day after operation, together with the constitutional symptoms of fever, such as headache, thirst, etc.

(2) Pain and tenderness in the wound.

Treatment.—This will be entirely under the direction of the surgeon. A rise of temperature persisting after operation is a paramount indication for removing the dressing and inspecting the wound.

9. **Septicæmia, Pyæmia, Erysipelas, etc.**—Septicæmia, pyæmia, erysipelas, hospital gangrene, etc., following surgical operations, are practically unknown nowadays in civil hospitals, and should they occur, their recognition and treatment do not come within the province of the nurse. She has, however, an all-important duty in preventing their recurrence by a rigid adherence to aseptic principles in all her dealings with wounds.

Sign.—A sudden rise of temperature, accompanied very probably by a rigor, will be the note of warning here, and should be reported at once.

10. **Parotitis.**—Post-operative parotitis usually supervenes about the end of the first week after operation, and is due to an ascending septic inflammation from the mouth along the parotid duct. Its symptoms and signs are fever, swelling, and redness in the parotid region, frequently followed by fluctuation (an abscess).

Treatment, as far as the nurse is concerned, is preventive, and consists in careful attention to the *toilette* of the mouth both before and after operation. The curative treatment will be in the hands of the surgeon.

The above are the complications usually met with after operations. Most of them may be obviated by careful preparation of the patient and a rigid compliance with the principles of aseptic surgery. As a corollary of them, the points for the nurse to note after operation will be briefly summarized, and in connection with these will be mentioned the complication or complications which any deviation from the normal should suggest to her mind. This does not mean that any one symptom

or sign is diagnostic, but that it should arouse her suspicion, make her look for further evidence in confirmation, and induce her to make a report of it to the surgeon.

(1) Whether or not the patient is suffering from shock. and, if so, whether any signs of hæmorrhage are present.

(2) Whether anæsthetic sickness is present, and, if so, whether it is excessive or unduly prolonged.

(3) Whether there is any hæmorrhage. For this purpose the dressing should be frequently inspected.

(4) Whether the patient is passing water naturally, or whether there is inability to pass it at all (retention or suppression), or whether it is constantly dribbling away in small quantities (retention).

N.B.—The amount passed for the first two or three days after operation should be recorded on the chart.

(5) Whether, after passage of a catheter, if this has been necessary, the patient has increased frequency and pain in passing water, and whether the water contains muco-pus (catheter cystitis).

(6) Whether the bowels are acting naturally, or whether the patient has a sense of discomfort, straining, and want of relief after their action (fæcal impaction).

N.B.—A record of the number of evacuations should be kept on the chart.

(7) Whether the temperature is normal, subnormal (shock during the first twenty-four hours), or above the normal (infection of the wound, inflammatory chest affections, cystitis, etc.).

N.B.—The temperature should always be recorded on the chart morning and evening. If there is any material rise, a four-hourly chart should be kept. Also, if the temperature is unduly depressed, as in shock, it should be frequently taken and recorded.

(8) Whether the pulse is normal or increased in frequency (infection chiefly, occasionally of nervous origin). The pulse-rate should be recorded morning and evening, and more frequently if required.

(9) Whether the respiration is normal or hurried, and, if the latter, whether there is any cough, pain in the chest, or expectoration (bronchitis, pneumonia, pleurisy).

N.B.—The respirations should be recorded on the chart morning and evening, and more frequently if required.

(10) Whether the patient is taking his food well or not.

(11) Whether the patient is sleeping well.

(12) Whether there is any complaint of pain or tenderness in the wound (infection of the wound).

(13) If a rigor occurs (infection of the wound, septicæmia, pyæmia, erysipelas, etc.).

(14) If any pain and swelling occur in the parotid region (parotitis).

III. Additional Complications and Sequelæ of Abdominal Sections.

It must be understood that any of the complications detailed in Section II. may attend abdominal sections, and some of them are not uncommon. The nurse has therefore the same points to note and report in these cases as in operations generally. The additional complications of abdominal sections are chiefly due to infection of the peritoneum, causing peritonitis. This is not different, and its causes are not different, from infection and suppuration of wounds generally, but many of its symptoms are so distinct and have such a special significance that they warrant separate consideration. In addition, complications follow abdominal sections which are not met with in operations elsewhere, and the causes

of some of these have not been finally determined. They will be included here.

1. **Peritonitis.**—Peritonitis following abdominal sections is due to infection of the peritoneum at the time of operation, and is strictly comparable to infection and suppuration in wounds generally. The infection may take place from without, owing to some fault in the technique—as, for instance, the use of dirty hands or dirty instruments—or it may arise from infective areas which have frequently to be exposed in these operations. As has been elsewhere explained (*cf.* Combined Aseptic and Septic Operations, p. 113), a septic stage is frequently unavoidably present in operations within the abdomen. The intestine, for instance, is teeming with dangerous micro-organisms, and any operation which involves the opening of this structure provides a channel for the infection of the peritoneum. In surgical diseases of the biliary tracts likewise the bile is infected, and operations opening these tracts render the peritoneum liable to infection. Operations for acute limited appendicitis, appendix abscesses, pyosalpinx, suppurating or gangrenous ovarian tumours, etc., fall into the same category, and are attended by the same dangers. In fact, it may be said that in most operations within the abdomen not only have we to contend with the sources of infection which attend operations generally, but an additional and very real element of danger is unavoidably introduced owing to the nature of the case.

Fortunately the peritoneum, in company with other serous cavities—*e.g.*, the meningeal cavity, the pleural cavity, and the synovial cavities of joints—possesses very highly specialized resistance powers to infection. It is very rich in serum and leucocytes, the two chief constituents of the body which in nature deal with

infection, and these are poured out in abundance on any infection occurring or threatening. Again, its surfaces become quickly covered with lymph, which glue them together, thus shutting off the infection and limiting its spread. All this is to the good, and a great help to both patient and surgeon. On the other hand, there is very little mechanical resistance to the spread of infection in this large space, once this becomes established. In this respect it is at a disadvantage as compared with denser structures, such as muscular and connective tissue. So that, although fortunately the peritoneal cavity is naturally very resistant to and has great powers of destroying infection, yet if the latter gains the upper hand, it very readily spreads within it, affords a large surface for the absorption of its toxic products, and thus becomes a great source of danger to the patient. The practical upshot of these considerations is that if, for instance, a large wound elsewhere, such as that after excision of the breast or an amputation, becomes infected and suppurates, it is rare, with our improved means of treating such wounds, for the patient to suffer anything worse than a more or less severe illness, combined with delay in the healing of his wound; whereas, if the peritoneum becomes so seriously infected that its natural defensive powers are overcome, the patient will be lucky if he escapes with his life.

The greatest care is necessary, therefore, in the technique, both of the operation generally, and especially of that part of it in which a septic stage arises (*cf.* Combined Aseptic and Septic Operations, p. 113).

The symptoms and signs of peritonitis following operation are not always characteristic. It behoves the nurse, therefore, to be wide awake, and to watch her

patient closely. The symptoms and signs are the following:

(1) *Vomiting* has a special significance after abdominal sections, and, if it persists, should always excite the suspicion of peritonitis. As has been previously stated, post-anæsthetic sickness usually ceases in five or six hours, but lasts not uncommonly twelve or twenty-four hours, and, generally speaking, that occurring within this period may be attributed to the anæsthetic.* If, however, it extends beyond this time, or is becoming more frequent about this time, or if, after having ceased on the day following the operation, it returns on the second or third day, it is always an anxious sign, and frequently means the onset of peritonitis.

(2) *Increase of the Pulse-Rate,* with diminution in its quality—in other words, a pulse becoming progressively quicker and weaker. This is another very important sign. If the pulse remains under 100, it is almost certain that there is no serious peritonitis. On the other hand, a progressively increasing pulse-rate generally points to some complication, and frequently to peritonitis.

(3) The *Temperature* may rise two or three degrees. On the other hand, it may remain normal or even subnormal. It is not of very important significance one way or the other after abdominal sections, for the following reasons: After severe operations, and subsequent to the initial shock, the temperature frequently rises a degree or two above the normal, and remains there several days, and yet the case in other respects may be doing well, and may run an apparently perfectly aseptic course. On the other hand, the case may be manifestly doing badly yet the chart may show a normal or subnormal tempera-

* Very occasionally it even lasts longer (*cf.* Persistence of Anæsthetic Sickness, p. 137).

ture. Still, other things being equal, the normal temperature is the reassuring one after abdominal, as after other, operations.

(4) *Thirst.*—The patient always complains of extreme thirst, and asks constantly for something to drink.

(5) *Inability to Sleep.*—If a patient is sleeping well, it is a pretty sure indication that matters are progressing favourably. On the other hand, restlessness and sleeplessness should always arouse suspicion.

(6) *An Anxious Expression.*—At first all that may be noticed is that the patient does not look contented and comfortable; subsequently the face becomes pinched and anxious, with sunken eyes. This is a very bad sign, indicative of profound toxæmia.

(7) *Inability to pass Flatus or Fæces.*—This is due to the paralysis of the bowel that takes place with the onset of peritonitis.

(8) *Abdominal Pain or Discomfort,* with the complaint of distension (the patient usually draws his legs up), combined with tenderness and swelling of the abdomen,

The above are the most important symptoms and signs. All of them may not be present in every case, and this is especially so if the peritonitis begins in the pelvis, and is at first confined there. The onset may be in these cases very insidious, and doubt may exist for a day or two. Still, as a rule, a short time suffices to indicate the nature of the complication. The most characteristic signs are the constant vomiting; the inability to pass flatus; the quick, weak pulse; the anxious and sunken face; and the distension of the abdomen. When fully developed, the illness proceeds rapidly to a fatal termination. Vomiting becomes constant, and consists in an effortless regurgitation of the stomach contents, and subsequently of those of the bowel into

the mouth. All the above symptoms progress, and the patient succumbs in a few days to a profound toxæmia, frequently retaining his consciousness to the end.

Treatment—(1) *Preventive.*—As far as the nurse is concerned, the treatment is almost entirely preventive, and consists in a scrupulous and conscientious preparation of the patient for operation, as indicated in previous pages of this book, and in a faithful observance of the rules of asepsis during its conduct. A responsibility of the gravest and of equal character in this connection rests on all concerned in the performance of any abdominal section. In addition to this, attention to the position of the patient subsequently to the operation (*cf. ante*, p. 123) is an important preventive measure, and should be always adopted in septic conditions within the abdomen.

(2) *Curative.*—The curative treatment rests almost entirely with the surgeon. Hot poultices or an ice coil applied to the abdomen are often comforting. The chief indication is to re-establish peristalsis of the bowel, with the consequent passage of flatus and fæces. On the first appearance of any of the symptoms suggestive of peritonitis, which the nurse in charge should detect and report at once, a full dose of calomel (gr. v.) should be administered and repeated; high enemata of soap and water (each containing an ounce of turpentine) should follow. If these do not act, an enema containing ℥ii. of Epsom salts should be given. As has been previously stated, the rectal tube is always introduced periodically after abdominal sections, and left *in situ* for ten or fifteen minutes. This frequently promotes the discharge of flatus. If flatus can be induced to pass, the most unpromising symptoms rapidly subside, and a patient with all the indications of commencing peritonitis will

become rapidly convalescent. Should these measures fail, operative treatment may be considered advisable in certain cases. It is not hopeful, and does not come within the scope of this book. The important points for the nurse to know are the possibility of the onset of peritonitis after abdominal sections, its causes and prevention, its great importance and dangers, its frequent insidiousness in its beginnings, its most characteristic symptoms, the urgency of reporting to the medical attendant at once any suspicion of its onset, and the paramount necessity of getting flatus to pass at the earliest possible moment.

2. **Gas Pains or Meteorism.**—By meteorism is understood a combination of symptoms commonly the sequel of abdominal sections, consisting of eructation of gas, sometimes vomiting, inability to pass flatus, and distension. The patient's complaint is: "If I could only pass the wind downwards! It keeps coming up." Whatever the cause of gas pains may be, it is certain that careful preparation for operation, strict attention to the aseptic technique, and speed and gentleness in operating, go far in abolishing or reducing this combination of symptoms to a minimum.*

Treatment.—The indication is to get flatus to pass, after which the symptoms rapidly subside, and a patient whose condition was giving rise to considerable anxiety, and who appeared to be going the wrong way, becomes rapidly convalescent. With the view of anticipating meteorism, the passage of the rectal tube at intervals is recommended after all abdominal sections. The Fowler position, by relieving pressure on the heart and

* Crile claims that if his method of conducting abdominal operations (*cf.* p. 64) is adopted, gas pains are almost entirely excluded.

diaphragm, and by enabling the abdominal muscles to better contract and expel the gas, is indicated. On the first suspicion of its onset the administration of enemata of soap-suds and turpentine, and, if necessary, Epsom salts, and the prompt exhibition of purgatives by mouth, should be adopted, and the same measures constitute its treatment if present. Its prevention is the aim after abdominal sections, and the nurse should hold fast to the fact that *the passage of flatus, not fæces*, is the most important of all considerations following these operations.

3. **Obstruction from Mechanical Causes** (such as twists, bands, adhesions).—This is an occasional sequel of abdominal section, whose symptoms simulate peritonitis—*i.e.*, it is attended with vomiting, inability to pass flatus and fæces, and distension. It usually occurs some days after operation in a case that has been progressing favourably.

Treatment.—This rests entirely with the surgeon.

4. **Hæmatemesis ("Black Vomit").**—Though hæmatemesis has been recorded after operations outside the abdomen, it is so much more frequent after abdominal sections that it is rightly included in the present section. The cause of this complication is not definitely determined, though its resemblance to a profound toxæmia, such as occurs in septic peritonitis, makes it probable that it is an acute infection. It generally supervenes within forty-eight hours of the operation.

Symptoms.—(1) Repeated gulping up of small quantities of black blood.

(2) Collapse, with failing pulse.

(3) The patient looks, feels, and is evidently very ill.

Treatment.—If the view of its infective origin is correct, the importance of preventive treatment is evident, as in all abdominal operations. The indications, when

it occurs, are to give calomel by mouth, high enemata of soap and water containing turpentine, and to wash out the stomach.

5. **Acute Dilatation of the Stomach.**—Acute dilatation of the stomach is rare after abdominal sections. Its cause has not been finally determined, and is possibly not the same in all cases.

Symptoms.—(1) Vomiting in gulps without straining, the vomited matter consisting of greyish or greenish fluid.

(2) Increase of pulse-rate, with diminution in its quality.

(3) Pain and distension of the upper abdomen, the contour of the enlarged stomach being sometimes visible.

(4) The patient appears very ill and collapsed.

Treatment.—The local indication is frequently to wash out the stomach and empty it of gas by the stomach-tube. The patient should be put in the prone position, and his general condition will require treatment.

6. **Thirst.**—Thirst, more or less distressing, with dry tongue, follows all abdominal sections. It is, perhaps, the symptom the patient most frequently complains of.

Treatment.—There is no special treatment for this. It may be relieved by washing out the mouth frequently with warm water. The liberal supply of fluids per rectum usually adopted at the present day, and recommended in previous pages of this book, and the administration of fluids early by mouth, in place of the starvation methods formerly in vogue after abdominal sections, generally result in a speedy disappearance of this distressing symptom.

7. **Thrombo-phlebitis.**—The precise cause of post-operative thrombo-phlebitis has not been determined, the opinion of surgeons as to its infective or non-infective

origin being about equally divided. Contributory causes are probably traumatism, exposure, hæmorrhage, dorsal decubitus, weak circulation, etc. It follows chiefly on cœliotomies, especially abdominal gynæcological operations, and of these most commonly on hysterectomy. The left leg is far the most frequently affected, the thrombus occurring in the left iliac and femoral veins. This has been usually attributed to pressure on the left iliac vein by an overloaded or distended ileo-pelvic colon, more or less obstructing and slowing the circulation in that vein; by others to the pressure exerted by the iliac artery on the vein. Its onset is usually slow—from ten days to a fortnight after the operation.

Symptoms.—(1) Pain in the thigh and leg, often coming on quite acutely and very severe.

(2) Rise of temperature and pulse-rate.

(3) Acute tenderness along the vein affected, which can be frequently felt as a hard cord.

(4) Swelling and œdema of the limb soon supervening.

Treatment.—If its cause is sepsis, treatment is foremost preventive, and consists in an aseptic technique. When it occurs, the limb should be placed at perfect rest on pillows and elevated, and warm compresses should be applied to it. More important still, no attempt should be made to move or massage the limb, as this may result in the separation of the clot, its lodgment in the pulmonary artery, and the immediate death of the patient. An instance of this occurrence happened within the cognizance of the writer, though not in a surgical case, and fortunately without fatal results. The patient was suffering from acute pleuro-pneumonia. She woke up in the middle of the night, saying she had acute cramp in her left leg. The nurse rubbed it for her, and she immediately fell back, apparently dying.

When the author saw her a few minutes afterwards, she was on the point of death, with all the symptoms of a clot in the pulmonary artery. This patient eventually recovered. In another instance within the cognizance of the writer a patient who had had an operation performed on the kidney was sitting propped up in bed about a fortnight afterwards, writing a letter, having apparently made an uninterrupted recovery from the operation, and without any untoward symptom whatever. She was found by her sister, who had come to visit her, dead in this position. Post mortem it was ascertained that a clot had formed in the renal vein, and a fragment of it had been carried to the pulmonary artery, causing immediate death. The nurse should remember never to move roughly or massage a patient affected with thrombosis.

It must be thoroughly understood, as has been remarked before, that all the complications described in Section II. may follow abdominal sections, and the points to note are the same up to a certain point, whether the operation be on the abdomen or elsewhere. As a corollary of Section III., the additional points to note and lay particular stress upon after abdominal sections are the following. In parentheses, as before, will be placed the complication they should suggest to the nurse's mind.

(1) Whether the anæsthetic sickness is passing off satisfactorily, or whether it appears to be prolonged, or whether vomiting is increasing in frequency on the day after the operation instead of disappearing, or whether, after having ceased for a time, vomiting appears to be returning (peritonitis and meteorism chiefly; acute dilatation of stomach, and mechanical obstruction rarely).

(2) The character of the vomiting—*i.e.*, whether an ordinary attack, with straining and retching (anæsthetic sickness and early vomiting of peritonitis, obstruction, etc.), or whether simply an effortless regurgitation into the mouth (later stages of peritonitis, acute dilatation of stomach, obstruction).

(3) The character of the vomited matter, whether of the stomach contents, bilious, greyish or greenish fluid (acute dilatation of stomach), dark blood (hæmatemesis), fæculent (later stages of peritonitis, obstruction, etc.).

N.B.—The vomited matter should always be preserved for inspection by the surgeon.

(4) Whether flatus escapes frequently per mouth (peritonitis, meteorism, obstruction).

(5) Whether the patient is passing flatus per rectum, either naturally or through the rectal tube (if not, paralysis of bowel, probably from commencing peritonitis, meteorism, obstruction).

(6) Whether the bowels have acted well after aperient or enema.

(7) Whether the pulse is fairly normal (*i.e.*, within 100 per minute), or whether it is increasing in frequency and at the same time diminishing in quality (peritonitis or some other infection [*cf. ante*] chiefly; hæmatemesis and acute dilatation of stomach rarely).

(8) Whether the patient looks comfortable and cheerful or pinched and anxious, and with sunken eyes (peritonitis).

(9) Whether the patient is sleeping fairly well, or appears restless (suspicion of peritonitis or some other infection).

(10) Whether there is any complaint of abdominal distension, and whether the abdomen appears distended

beneath the dressing (peritonitis, acute dilatation of stomach, obstruction).

(11) Whether there is any complaint of abdominal pain (intestinal peristalsis, colic of obstruction, peritonitis).

(12) Whether abdominal tenderness is present (peritonitis).

(13) Whether there is any complaint of pain or tenderness in the thigh or leg, generally the left (phlebitis and thrombosis).

IV. After-Dressing of the Wound.

In an aseptic case the after-dressing of the wound will play a very insignificant part if the patient leaves the table without any flaw in the technique. Sealing of its edges takes place in a few hours. An effective barrier is thus offered to the entrance into it of micro-organisms, and it very seldom becomes infected subsequently. Nevertheless, it must be understood that the wound *may* become infected at any time before it is soundly healed. Until this has taken place, therefore, care should be taken that nothing septic comes in contact with it.

In the Carrel-Dakin treatment of the infected wounds of war, the rationale of which was the submission of surgically prepared wounds to a continuous process of sterilization by the Carrel-Dakin solution until they were sufficiently free of germs to render their secondary closure safe, it was found to be absolutely essential to success that all dressings of these wounds should be done under the very strictest aseptic precautions as to hands, instruments, surroundings of the wound, etc., so as to insure that no germs were introduced from outside during the proceeding, and it was only by dressing such wounds

with as strict an attention to technique as the clean surgical wounds of civil practice that the maximum of success was secured.

First of all the requirements will be described for securing the aseptic dressing of wounds in the wards, which in many hospitals are very imperfect.

1. In the annex to each ward should be a large gas-burner and a copper, so that bowls, jugs, basins, and other ward utensils can be efficiently sterilized; also a second smaller gas-burner and fish-kettle for sterilizing the instruments, drainage-tubes, etc., used in dressing cases.

2. **Mackintoshes,** which are frequently soiled with discharges, should be of the Battist variety. These can be washed after use, packed in an ordinary sterilizing-tin, sent to the theatre, sterilized, and returned to the ward.

3. **Towels** should be arranged in the ward in an enveloping towel in packets of three, sent to the theatre, and sterilized. They are used for surrounding the wound area in dressing cases.

4. **Dressings,** gauze, wicks, etc., for redressing wounds should be packed in tins or towels in the wards, labelled with the patient's name, and sterilized in the theatre. They are then returned ready for use.

5. The requirements for sterilizing the hands of the dresser are frequently very imperfect. Go into many hospital wards, and what do we find? An ordinary earthenware jug and basin, a piece of soap in a soap-dish, some nail-brushes (perhaps sterilized, perhaps not), and a bowl of some antiseptic lotion, which everybody uses in turn. Such crude arrangements can easily be improved upon. First of all, earthenware jugs and basins get broken; their use is undesirable on that score alone. Jugs and basins of enamelled iron should

be used. Half a dozen such basins should be provided for each ward. These can be sterilized in the copper, and a separate one used for each case. In this way the contamination likely to ensue from people following one another to the same basin is easily insured against. The jugs containing water can, of course, also be boiled, and sterilized water can be used if desired. On the table close to the basin should stand a jar of soft-soap, and a bowl containing a spatula and a pair of sterilized forceps lying in lotio acidi carbolici (1 in 20). In another bowl, also containing lotio acidi carbolici (1 in 20), are placed some sterilized nail-brushes.

With these provisions, which are simple enough, a satisfactory washing is insured. A clean basin is at hand for each person. The dresser takes a nail-brush from the jar with the forceps, and replaces the latter in the lotion. He next with the spatula extracts a lump of soft-soap, replacing the spatula in the lotion. With clean, or, preferably, sterilized, water in an enamelled iron basin, which has been boiled and not previously used (perhaps for a septic case), he can now with confidence wash his hands. After a thorough washing, they should be soaked in a lotion of biniodide of mercury (1 in 1,000) before dressing the case. The more perfect technique would be to put on sterilized rubber gloves. This, though, is hardly necessary. Rubber gloves are already a very large item of expense in hospitals, and it seems unnecessary to further burden their exchequers by generally using them in the wards. It must be remembered that in dressing a case it is seldom necessary to touch the wound at all with the fingers. With sterilized dissecting and dressing forceps and scissors all the necessary manipulations—removing the gauze next the wound, removing and reinserting drainage-tubes where used, re-

moving stitches, etc.—can be readily accomplished; in fact, forceps should be the fingers for the dressing of cases. On the other hand, thick rubber gloves should be used in the dressing of septic cases, which are happily now a small minority, for the protection of the hands of the dresser. With these materials at hand—and they are very easily provided—the dressing of wounds becomes very perfect. Take an ordinary abdominal section, for instance, not drained. It rarely requires dressing till the eighth or ninth day, when the stitches are taken out. The bandage is cut and removed by the nurse, and the wound area is surrounded with Battist mackintosh. The nurse next removes the outer cover of the sterilized towels (*cf.* p. 161), being careful not to touch the towels within it in so doing, and the dresser, having prepared his hands as previously described, surrounds the wound with these. The dressings are then taken off with sterilized forceps, and the stitches removed. If a redressing is required, it is applied with the forceps. There is no necessity to finger the wound at all. Almost all wounds requiring redressing can be treated in this way, and if these simple precautions be observed, the after-dressing of cases becomes a very simple, easy, and safe proceeding.

In connection with the after-dressing of wounds, the following directions should be followed:

1. The nurse should frequently examine the dressing during the first twenty-four hours, for it is the period during which hæmorrhage, should it occur, may be expected; also the serous oozing from a wound takes place almost entirely during this period, and if it percolate the dressing, the latter may require changing. The fact of hæmorrhage or discharge coming through the dressing should always be reported without delay.

2. When the discharge has come through the dressing, the sooner the latter is changed the better, for the outer layers soon become infected, and septic matter will ascend through them to the wound. Pending the redressing of the wound, a layer of wool soaked in lotio hydrag. biniod. (1 in 1,000) should be applied, and bandaged over the dressing, with the view of preventing the infection of its outer layers.

3. At every dressing of the wound, until it is soundly healed, strict aseptic precautions, as described in detail above, should be adopted, including the sterilization of all instruments, drainage-tubes, irrigators, bowls, etc.—in fact, everything coming within the wound area.

4. All aseptic cases in the ward should be dressed first, the septic ones being left till the former have been attended to.

5. In the dressing of septic cases thick rubber gloves should be used for the protection of the hands of the dresser against infection. If they are not used, the hands should be most thoroughly disinfected *immediately* after dressing a septic case. Such disinfection should include a thorough soaking in 1 in 500 lotion of biniodide of mercury in spirit. Septic matter should on no account be given time to dry in the crevices of the skin and beneath the nails. This immediate disinfection is even more important in the case of the hands than in that of instruments, for the skin cannot be subjected to the only reliable method of sterilization—heat.

6. Before giving a hypodermic injection, both the injector's hands and the patient's skin should be thoroughly disinfected, and the needle should be boiled; otherwise, sooner or later, an abscess, if nothing worse, appears, and tells the tale of imperfect asepsis.

CHAPTER VI

THE SELECTION OF INSTRUMENTS, ETC., FOR OPERATION

THE selection of instruments for operation is not a very difficult matter if method is adopted by the nurse. It is not intended in the present chapter to name all the operations in surgery or samples of them, and in an opposite column the instruments required for each. To begin with, it is the wrong way to learn to select instruments. Intelligence and reasoning, not reliance on a retentive memory, which is very likely to fail at a critical moment, should be the guiding factors. Only experience and constant practice, such as is gained in theatre work and acquaintance with the fads of the surgeon under whom she is working, will enable the nurse to have everything right every time. Yet if she keeps a certain method in view, she will not, as a rule, make many mistakes. Of course, if she has to get ready for a surgeon who uses special patterns of instruments of his own for everything, and has special ways of doing things only known to himself, general hints are not likely to be very useful; but most good surgeons work with simple tools, and endeavour to adapt what manipulative skill they possess to them, instead of sacrificing such skill to the employment of instruments endowed with powers only known to their inventor. Still, as in most things, a little latitude must be given. The

surgeon who does not consider his own way of doing things the best is still unborn, and every surgeon derives satisfaction from the display of his own little crotchets. Why not ? The nurse will do well to ascertain his little weaknesses, and keep him in good humour by indulging them. Such foibles do not affect the main contention that most good surgeons work with as simple and as generally useful tools as possible, and it is in selecting instruments for such as these that the following hints may be useful.

The first thing the nurse will have to do is to learn the names of the various instruments, and instruction is given for this purpose in all training-schools by the only useful method—practical demonstration. For instance, she must be able to distinguish a pair of dissecting forceps from pressure forceps, to select a prostatic catheter, a trephine, and so on. When she has mastered the names of the instruments, and knows (a matter which the demonstrator will always point out) the kind of purpose they serve, she will very soon realize that certain of them are in common use and are required in almost every operation. She has then only to learn, in addition, the particular use to which certain special instruments are put. For example, she will soon realize that knives, scissors, needles, Spencer Wells forceps, etc., are required for almost every operation, and she will acquire the habit of getting them ready in almost all cases. Then, if the operation is some special one, she has only to provide in addition the special instrument or instruments used in that operation. She should first, therefore, know thoroughly and get ready, as a rule, the instruments in general use in operations, and then concentrate her attention on the special operation in view. After a little experience any special instrument required

will come instinctively to her mind. If, on the other hand, she endeavours to recollect each operation separately, and exactly what she saw used in the last case of the kind, she puts such a tax on her memory that she is very likely to forget the most important item of all. Thus, I have known the most elaborate preparations made for an operation, but when the surgeon asked for the knife it was not there. Similarly, in an operation within the mouth I have more than once known the gag for opening the mouth to be forgotten.

In selecting the apparatus, instruments, etc., for operation the following considerations should be kept in view:

1. The requisites for the anæsthesia.

2. The requisites for rendering the operation area visible and accessible.

3. The general requisites for operations involving the soft parts. These include:

(*a*) Provision for making the wound and conducting the operation.

(*b*) Provision against hæmorrhage.

(*c*) Provision for drainage.

(*d*) Provision for closing the wound.

(*e*) Provision for swabs, packs, dressings, etc.

4. Special additional requisites for operations on soft parts in special regions.

5. The general requisites for operations involving bone.

6. Special additional requisites for operations on bone in special regions.

The subject will be treated under these headings in the following pages.

I. THE REQUISITES FOR THE ANÆSTHESIA.

If the anæsthetic is to be a *general* one, the particular apparatus (such as the gas and ether apparatus, the nitrous oxide apparatus, Clover's inhaler, chloroform mask), gauze or lint and vaseline, a measure-glass, and the anæsthetic or anæsthetics to be used (*e.g.*, nitrous oxide, ether, chloroform, etc.), must be got ready.* Provision against vomiting is made by a clean towel and receiver, and provision for dealing with respiratory obstruction by a mouth gag (whose blades are shielded with indiarubber), tongue forceps, swab-holders, and swabs (*cf.* Operations within the Mouth or in its Neighbourhood, p. 174).

For dealing with cardiac failure a hypodermic needle-liquor strychninæ, brandy, amyl nitrite capsules, and pituitrin must be at hand. If the anæsthesia is to be *local*, novocain or other solution to be used and a hypodermic needle will be required. If infiltration anæsthesia is to be employed, the special needles and solutions (novocain, etc.) used will be required. Lastly, if *spinal analgesia* is required, the special syringe and solution for this purpose.

II. THE REQUISITES FOR RENDERING THE OPERATION AREA VISIBLE AND ACCESSIBLE.

These should next be carefully considered. If the operation involves *the skull*, such as a trephining or mastoid operation, a firm flat sand-bag will be required

* The open ether method, on account of its safety, is that most usually adopted at the present time. In this the ether is administered on an open mask.

Fig. 15.—Position in Operations upon the Gall-Bladder or Bile-Ducts.

Fig. 16.—Position in Operation upon the Kidney by the Lumbar Route.

To face p. 169.

beneath the head. In operations upon *the eye*, the eye speculum; in those on *the nose*, a nasal speculum; in those on *the ear*, aural specula of different sizes; and in those within *the larynx*, a laryngoscope, will generally be wanted.

In operations within *the mouth*, a mouth-gag will be required to open the mouth. In operations *on the neck* —*e.g.*, thyrotomy, tracheotomy, excision of tumours, etc.—a flat sand-bag is frequently required beneath the shoulders, to enable the head to be thrown back over it and the neck to be thereby extended. In operations upon the *gall-bladder* or *bile-ducts*, a firm, thick, square sand-bag is required beneath the liver region to arch forward the upper abdomen. In operations upon *the kidney* by the lumbar route, the patient should lie somewhat across the table, with thighs and knees well flexed, and a thick round sand-bag should be placed beneath the opposite loin to widen the distance between the lower ribs and the iliac crest on the side of operation. In operations *within the pelvis* or the lower abdomen, the Trendelenburg position will frequently be required, and should always be provided for. This is generally secured by a mechanism in the table itself, and the nurse should see that she understands its working. In an emergency it may be secured by placing a chair in such a position that the top of the back and the front edge of the seat rest on an ordinary table. In some operations upon the upper abdomen the reversed Trendelenburg position is recommended. In certain operations in the pelvis, such as excision of the rectum by the abdominal route, an exaggerated Trendelenburg position, with the patient almost vertical, may be necessary.

If the lithotomy position is likely to be required, as in operations attacking the *bladder* by the perineal

route and in vaginal, rectal operations, etc., the vertical stays at the end of the table or Clover's crutch should be in readiness.

When the patient is put in the lithotomy position, it should be looked to that he is lying squarely, with the stays the same height and the buttocks well over the edge of the table. Nurses often fail in these particulars.

In transacral or perineal *excision of the rectum* the exaggerated lithotomy position, with the pelvis raised by means of a very thick sand-bag to such an extent that the perineum is almost horizontal, and with the thighs fully flexed and separated, is far the best. Some surgeons prefer the prone position, the patient being in a kneeling position over the end of the table, with a sand-bag beneath the front of the pelvis, or the lateral position; but these are inferior from the point of view of affording access, and are very inconvenient for the anæsthetist.

In operations on the *vagina or rectum* the various specula used for rendering these cavities visible and accessible will be required.

The most common in use are Sims's duckbill speculum, Fergusson's speculum, and the bivalve rectal speculum.

The nurse should next consider the light and the position of the table to best secure this, and any artificial light—*e.g.*, forehead-mirror, hand-light, etc.—that may be required.

Fig. 17.—Trendelenburg Position.

To face p. 170.

Fig. 18.—Lithotomy Position.

To face p. 171.

II. THE GENERAL REQUISITES FOR OPERATIONS INVOLVING THE SOFT PARTS.

These include:

1. Provision for making the Wound and Conducting the Operation.

Two scalpels should always be provided. In a long peration a knife sometimes becomes blunt; a second hould be in readiness. The size of the scalpel should ary with the delicacy of the operation. In a dissection

FIG. 19.—AUTHOR'S LIGATURE FORCEPS.

the neck, for instance, a smaller knife is required than amputation of the breast. In addition, a pair of issecting forceps, a probe, a blunt dissector, a director ot often required), aneurism needle, or pair of ligature rceps of the author's pattern, blunt-pointed straight issors, and similar scissors curved on the flat, a pair sinus forceps, small and medium-sized retractors, a olkmann's spoon, and needle-holder (seldom required), nstitute the instruments in ordinary use in operations the soft parts.

In regard to retractors, their size should be in pro-

portion to the size and depth of the wound. Outside the abdomen small and medium-sized single- or double-hook retractors will meet almost any case.

2. Provision against Hæmorrhage.

In every operation provision should be made against hæmorrhage. In all but quite exceptional cases this is accomplished by getting ready Spencer Wells forceps (of which the patterns are legion) to seize the vessels, and ligatures to tie them.

These will, therefore, be required in almost every operation. The nurse will have to ascertain what ligatures the surgeon is in the habit of using, whether silk or catgut, and also what thickness he fancies. Thin ligatures suffice in all but exceptional cases—the thinner the better.

If the operation is to be on a limb—*e.g.*, an amputation, excision, etc.—the question of the control of the main artery will have to be considered. For this purpose various tourniquets have been invented, the most generally used being a round indiarubber band, with a catch of some sort, known as Esmarch's tourniquet. Esmarch's rubber bandage is also sometimes employed to empty the limb of blood before applying the tourniquet, but raising it for a short time is sufficient for this purpose.

3. Provision for Drainage.

Provision should be made for drainage in case this may be required. Rubber drainage-tubes of various sizes, according to the dimensions of the cavity to be drained, are generally used, and should be in readiness.

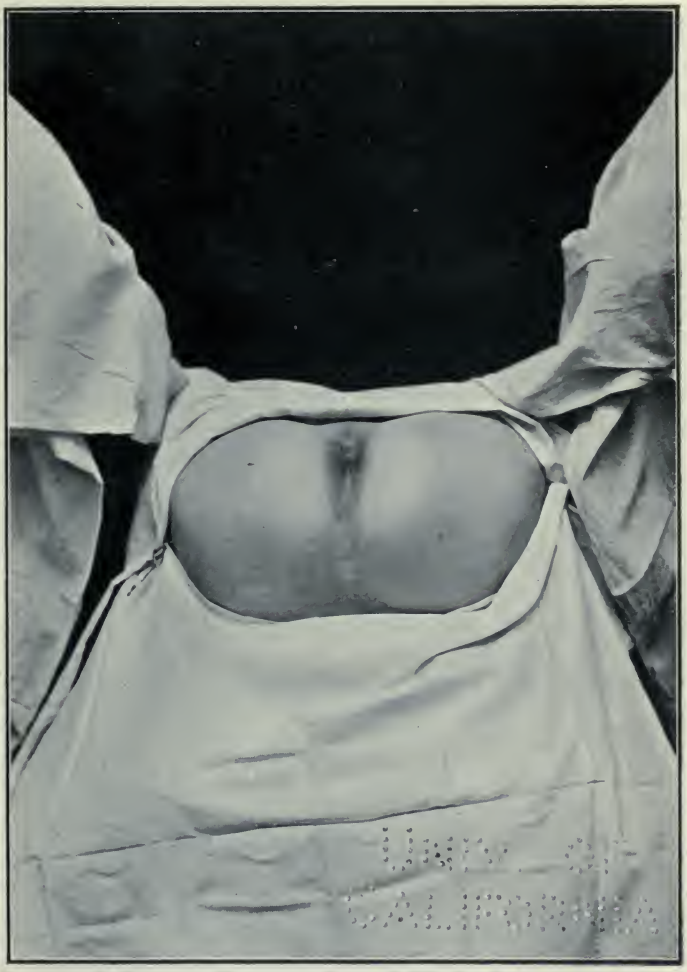


Fig. 20.—Exaggerated Lithotomy Position.

To face p. 172.

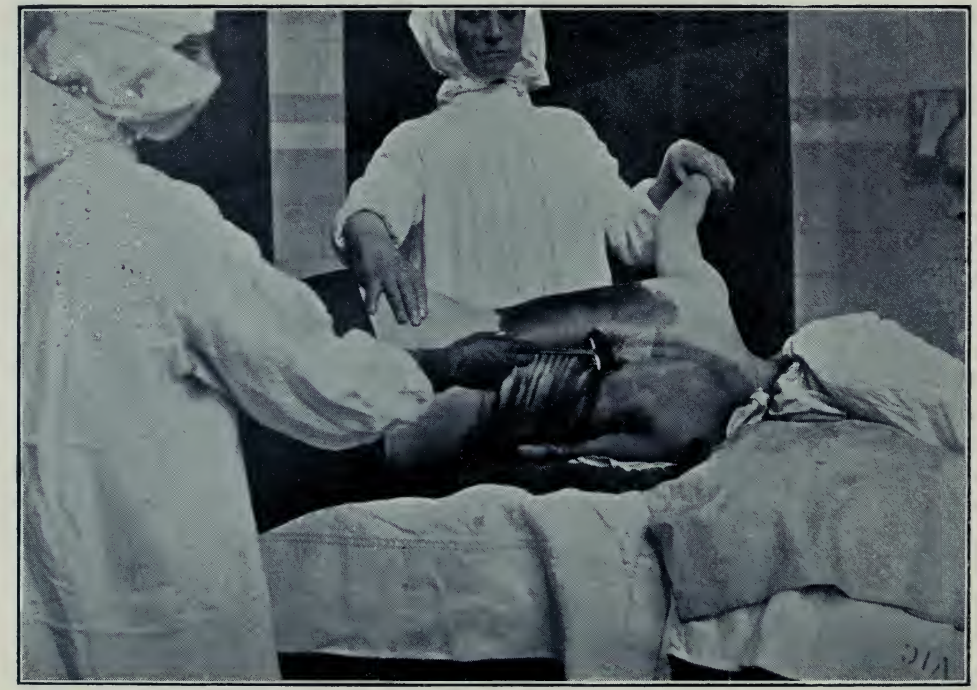


Fig. 21.—To illustrate Method of Turning a Patient over on his side.

To face p. 173.

4. Provision for Closing the Wound.

The requisites for closing the wound in its deep and superficial layers (the skin) must next be provided. In this connection the nurse will have to ascertain whether the surgeon is in the habit of using silk or catgut for his buried sutures, and silk or silkworm gut or Michel's clips for the skin; also whether his sutures are continuous, in which case they should be long; or interrupted, in which case they should be short (about 12 inches). She will also have to ascertain what size and shape of needles the surgeon prefers, for operators vary in their preferences in this respect; but sutures (catgut, silk, and silkworm gut) and needles (curved and straight) are the general requisites for closing the wound. Peritoneal needles are round-bodied; others have a cutting edge.

5. Provision for Swabs, Packs, Dressings, etc.

Lastly, these will have to be provided. They and their method of preparation have been fully described in Chapter III.

The above are the general requisites for operations involving the soft parts, and whether the operation be on the head, trunk, or limbs; whether it contemplate the cranial, thoracic, or abdominal cavity; whether it be a major or minor operation, the same general principles should be kept in view in providing for it, and the nurse will not go far wrong if she adheres to them.

IV. SPECIAL ADDITIONAL REQUISITES FOR OPERATIONS ON SOFT PARTS IN SPECIAL REGIONS.

The general principles in selecting instruments for these operations will be precisely the same as in the previous section. Special indications and special instruments will only be given here.

1. Operations within the Mouth or in its Neighbourhood,

Operations about the mouth are, generally speaking, attended with a good deal of bleeding, and bleeding in this situation involves some special inconvenience and dangers. One or two precautions are therefore required to meet these.

Firstly, the blood is apt to get into the patient's hair, coagulate there, and make a great mess. In all cases.

FIG. 22.—TRACHEAL HOOK.

therefore, where the head is not completely shaved, it should be covered with a mackintosh cap, fitting tightly round the forehead and occiput. Secondly, blood is apt to run down into the back of the pharynx and interfere with respiration, or to cause dangerous obstruction to breathing by its entrance into the larynx, etc. To

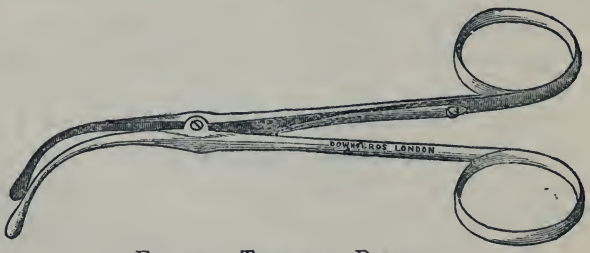


FIG. 23.—TRACHEAL DILATOR.

meet these contingencies two precautions are necessary—firstly, a mouth-gag should always be at hand, and swabs on swab-holders to clear the throat of blood; secondly, tracheotomy instruments should be got ready in case this operation is perchance demanded. Though

happily not often required, the necessity for its performance will probably arise when least expected, and will be urgent, and that is not the time to be hunting about in the instrument cupboard for the tracheotomy instruments. The nurse should, therefore, in all operations about the mouth, jaws, and neck consider this important contingency, and make timely provision against it.

The special tracheotomy instruments consist of a sharp hook for transfixing the trachea, a tracheal dilator, and tracheotomy-tubes of various sizes, according to the size of the trachea, with tapes affixed.

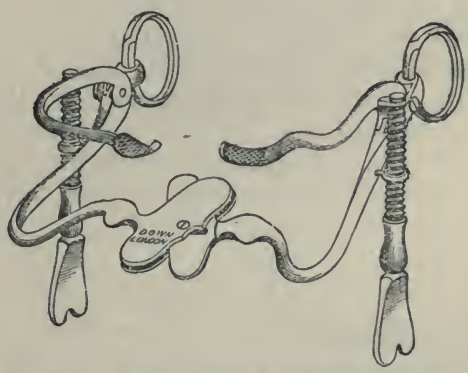


FIG. 24.—SMITH'S GAG FOR CLEFT PALATE.

Operation for Hare-Lip.—A pair of fine-pointed toothed forceps with spring catch (the old artery forceps) are useful for holding the lip on the stretch during the paring. A sharp narrow-bladed scalpel, curved needles, and silkworm gut (medium and very fine), and a pair of blunt-pointed scissors curved on the flat, should also be provided. If hare-lip pins are used, a pair of pin-cutting forceps will be required. Gauze cut to the shape of a butterfly's wings and collodion constitute the dressing.

Operation for Cleft-Palate.—Many special instruments have been devised for this operation. Smith's gag, or some modification of it, with tongue-plate for keeping the tongue down in the floor of the mouth, is undoubtedly the best, though the operation can be done with an ordinary gag. A small scalpel; a cleft-palate knife; a curved periosteal elevator for raising the covering of the

FIG. 25.—CURVED PERIOSTEAL ELEVATOR.

hard palate; a pair of blunt-pointed scissors, curved well on the flat, to sever the attachment of the palate to the palate-bone; long-handled forceps, with serrated and tenaculum points; cleft-palate needles, with the eye at the point, set at right angles and other angles to the shaft (according to the preference of the surgeon); silver wire or silkworm gut, medium and very fine, will be

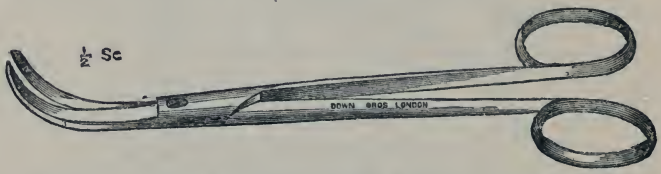


FIG. 26.—CLEFT-PALATE SCISSORS CURVED ON THE FLAT.

required. Personally, I use very small half-circle Hagedorn's needles and a needle-holder for passing the sutures, as described by me in the *British Medical Journal*, and they answer perfectly well. In addition, very small swabs or Spencer Wells forceps for lightly cleansing the edges of the incision should be got ready.

Brophy's Operation for Cleft-Palate.—If Brophy's operation is performed, a scalpel, a strong needle on a

handle, a thick silk pilot suture, some thick silver wire, and two small oblong leaden plates will be required, in addition to the instruments for paring the cleft and bringing it together.

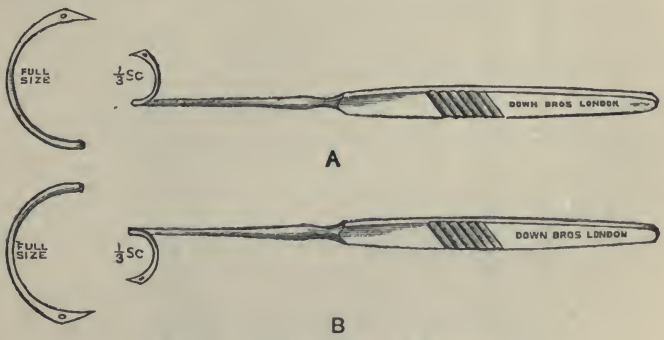


FIG. 27.—CLEFT-PALATE NEEDLES.

Excision of the Tongue.—Handled needles, with the eye at the point, for threading a piece of stout silk through each half of the tongue, are required. The tongue is usually excised with a pair of straight blunt-pointed scissors.

2. Abdominal and Pelvic Operations.

The nurse should provide here, as explained previously, for the position required, which is often very important (*cf.* p. 169). Few special instruments are needed in operations within the abdomen and pelvis. For making the wound in the abdominal wall, the same instruments are required as in operations on soft parts generally (*cf. ante*, p. 171); and for closing it in layers, silk or catgut, according to the practice of the surgeon; and needles, the most generally used being half curved.

The needle for the peritoneum should be round-bodied. Also provision should be made for closing the abdomen with through-and-through sutures in case this is de-

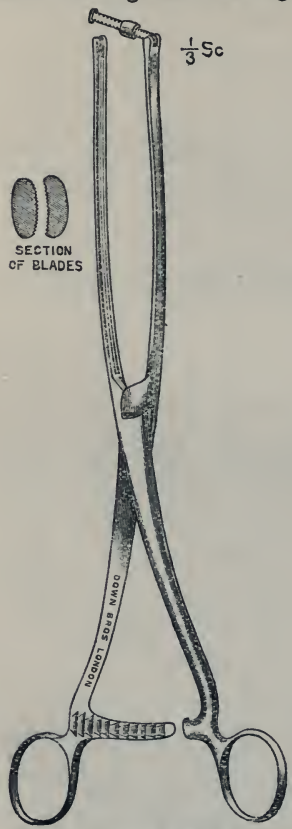


FIG. 28.—AUTHOR'S STOMACH CLAMP.

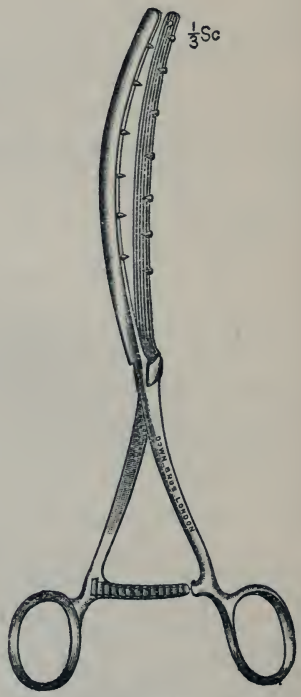


FIG. 29.—STOMACH CLAMP WITH HOOKS.

manded for any reason—*e.g.*, the necessity for expedition. For this purpose large fully curved needles and stout silkworm gut are the requisites. Within the

abdomen, large double-hooked retractors and kidney retractors are those generally used. Large Spencer Wells forceps should always be provided. They are useful for clamping almost anything but intestine, for temporarily taking hold of tissues, and for securing a bleeding vessel at the bottom of a deep wound. A needle-holder should also be included, for although it is not often required, its employment every now and then is indispensable. An aneurism needle, pedicle needle, or ligature forceps of the author's pattern, for use in tying omentum, mesentery, adhesions, broad ligament, etc., in sections, is a *sine qua non* in intra-abdominal work.

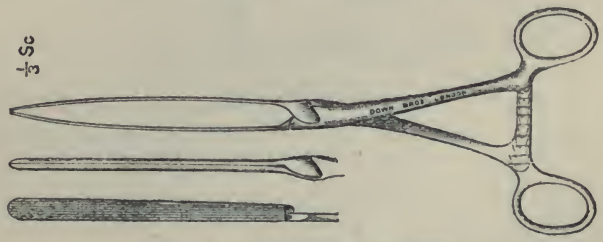


FIG. 30.—INTESTINAL CLAMPS.

Also swab-holders with long handles, for sponging out at the bottom of a deep wound, should be in readiness.

In operations involving the *gastro-intestinal tract* (anastomosis, or excision of part of the tract with subsequent anastomosis), the only special instruments required are the clamps (stomach and intestinal) for clamping the part before division, whose blades should be covered with rubber tubing, or clamps may be used as depicted on p. 178; a pair of sharp-pointed straight scissors for opening the stomach or bowel; intestinal needles; and intestinal silk or Pagenstecher's thread. Intestinal needles are round-bodied, and are straight or curved, the latter being the more handy.

N.B.—In gastrostomy a soft rubber catheter will be wanted to fix in the stomach.

In every abdominal operation, whether intended to be performed on intestine or not, provision should be made on the above lines for dealing with the gut. For

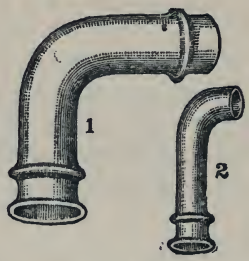


FIG. 31.—PAUL'S GLASS TUBE.

instance, in the removal of an abdominal tumour arising from some other viscus, intestine may be found involved and require resection and anastomosis, or it may be accidentally or unavoidably opened and require closing. It should, therefore, be the rule to make ready for dealing with divided intestine in all intra-abdominal operations.

FIG. 32.—GALL-STONE FORCEPS.

In cases of intestinal obstruction, Paul's glass tubes should be at hand for insertion in the intestine, with india-rubber tubing attached.

In operations on the **gall-bladder or bile-ducts,** the only special apparatus required are a gall-stone scoop or forceps, or both, a piece of long medium-sized rubber

tubing for draining the gall-bladder or bile-ducts, and possibly the aspirator or a trocar. The operation of cholecystenterostomy is identical with that of anastomosis of the intestine, but a clamp with a deep curve is used for securing the gall-bladder and intestine.

In **Appendicectomy** no extraordinary instruments are required, though some surgeons use a special clamp for

FIG. 33.—GALL-STONE SCOOP.

crushing its base. A pair of large Spencer Wells forceps answers the purpose.

In **Ovariotomy** the only special instruments required are the ovarian trocar, with rubber tubing attached to empty the cyst, and a pair of cyst forceps for taking hold of the cyst wall. Large Spencer Wells forceps will do for this.

FIG. 34.—BROAD-LIGAMENT CLAMPS.

In **Abdominal Hysterectomy,** a vulsellum forceps for taking hold of the uterus, and strong broad-ligament clamps for securing the uterine side of the broad ligament, are commonly used. Large Spencer Wells forceps are preferred by some surgeons. Also broad-ligament or pedicle needles, with the eye at the point, are used for tying the broad ligament in sections. The author's ligature forceps answer perfectly for this. In salpingo-

oöphorectomy the same instruments are required for securing the pedicle.

Although a very large variety of operations is performed at the present day within the abdomen, it will be seen that the special instruments required are comparatively few, and their selection is not a difficult matter unless it is made so by the idiosyncrasies of the surgeon. It is to be remembered that the Spencer Wells forceps (both large and small) must be counted before intra-abdominal operations, and their number written down on a slate, as well as the swabs and packs—a matter which has already been emphasized.

3. Operations on the Genito-Urinary Tract.

The Kidney.—The instruments required will be those for operations on soft parts generally. Kidney retractors, as their name implies, may be needed to retract, and large Spencer Wells forceps for use in the deep wound; stilettoes for exploring the kidney; a long gum-elastic thin bougie for passage down the ureter; forceps and scoops for extracting a stone from the kidney; and some form of pedicle needle or ligature forceps for securing the pedicle in nephrectomy.

The Urethra and Bladder.—Many special instruments are indispensable in operative work on the urethra and bladder. First of all, a certain preliminary preparation of the urethra and bladder may be required previous to the passage of a catheter or other instrument. If a general anæsthetic is not used, a solution of cocaine (10 per cent.) and syringe to inject this into should be provided. Frequently, the bladder needs emptying and washing out with boracic lotion or sterile water previous to its examination or any operation upon it. Again, it may require a preliminary distension,

as in suprapubic cystotomy and lithotomy. For these purposes catheters of various sizes and shapes, double-

FIG. 35.—URETER BOUGIE.

FIG. 36.—MALE BLADDER-SOUND.

FIG. 37.—FEMALE BLADDER-SOUND.

current catheters, and bladder syringes should be got ready, or some siphonage apparatus, such as a 4-ounce

glass syringe with the piston removed or a glass funnel with a long piece of rubber tubing attached to it.

FIG. 38.—COUDÉ CATHETER.

FIG. 39.—BICOUDÉ CATHETER.

In all operative procedures involving the bladder the nurse must bear these indications in mind. The dis-

tinction between the various forms of catheters and sounds in general use must be mastered. The chief metal instruments are ordinary silver catheters, the prostatic catheter with its large curve, Lister's graduated steel bougies for the dilatation of strictures, and bladder-sounds (male and female) for sounding the bladder.

In addition, there are the various forms of soft catheters and bougies; flexible olive-headed bougies; fine flexible bougies of whalebone, catgut, or silk, and fine flexible catheters for very narrow strictures; ordinary gum-elastic or silk web catheters; coudé and bicoudé catheters of gum-elastic or silk web for use in

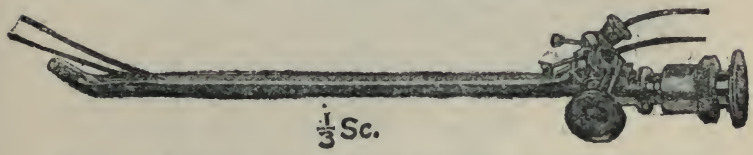


FIG. 40.—CYSTOSCOPE FOR EXAMINATION AND IRRIGATION OF THE BLADDER AND CATHETERIZATION OF THE URETERS.

enlargement of the prostate; lastly, Jacques' india-rubber catheter.

The names of these various instruments must be known, and what purposes they generally serve. With experience and the assistance of the surgeon the nurse will soon get to know those likely to be wanted in a given case.

The bladder may require:

1. Examination without opening.

2. Opening for examination or for operative work within it.

In examination of the bladder and its contents without opening it, catheters to estimate its capacity, bladder-sounds (male or female), the cystoscope, and segregator

are the instruments ordinarily used. If the ureter is to be catheterized, a ureteral catheter will be required.

N.B.—In all operative work connected with the

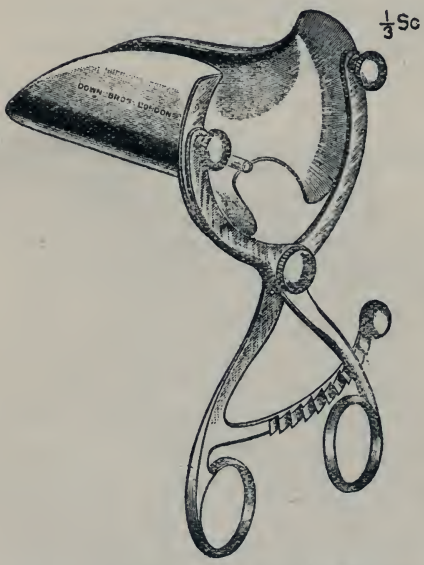


FIG. 41.—CAWARDINE'S DILATING BLADDER SPECULUM.

FIG. 42.—URETERAL CATHETER.

bladder provision should be made for emptying, distending, and examining the bladder and its contents on the lines mentioned above.

If the bladder is opened, this may be done eith r above

the pubes (suprapubic cystotomy) or through the perineum (perineal cystotomy).

1. **Suprapubic Cystotomy.**—The apparatus for washing out the bladder and subsequently distending it will be required (*cf. ante*, p. 170). The instruments necessary for opening the bladder, and subsequently closing it wholly or in part, will be those for operation on soft parts generally. A forehead electric lamp and speculum (Fergusson's vaginal speculum or a special bladder speculum) may be needed for inspection of the interior of the bladder.

If a stone is to be extracted (suprapubic lithotomy), a pair of lithotomy forceps and scoop for seizing the stone; if a growth, forceps for removing the growth.

Lastly, a full-sized rubber tube for draining the bladder must be got ready.

2. **Perineal Cystotomy.**—If the bladder is to be opened through the perineum for the removal of a stone (median or lateral lithotomy, operations seldom performed at the present day), the Clover's crutch or stays at the end of the table to insure the lithotomy position, a median or lateral grooved staff, a lithotomy knife (in lateral lithotomy), lithotomy forceps, scoops and crushers for dealing with the stone, and a rubber tube to drain the bladder, will be required, in addition to the ordinary instruments for operations upon the soft parts.

If the bladder is to be opened only (*e.g.*, for exploration or drainage), the instruments for dealing with a stone or growth, etc., will, of course, not be needed.

Lithotrity.—Provision must be made for emptying and subsequently distending the bladder with sterile water. The naturally distended bladder is sometimes made use of. The special instruments required are lithotrites of different sizes, varying generally with the

size of the urethra and size and density of the stone; and Bigelow's apparatus, or some modification of it (con-

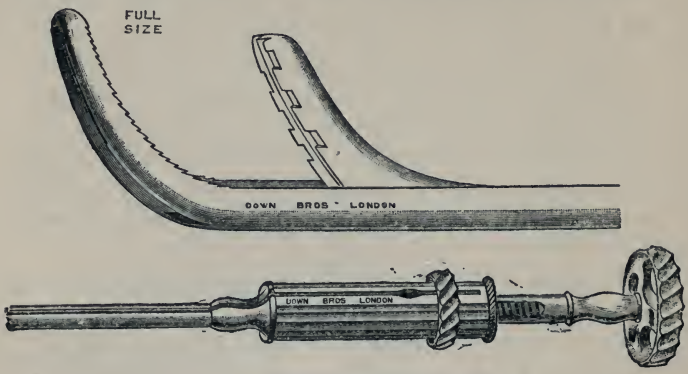


FIG. 43.—MILTON'S LITHOTRITE.

sisting of evacuators and evacuating tubes), for extracting the fragments of stone.

Two evacuators should be in use to save time during operation.

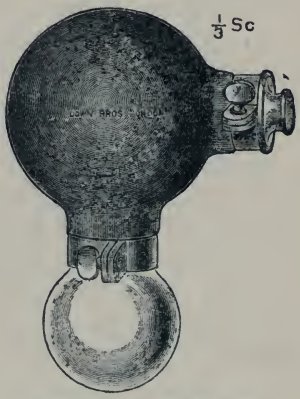


FIG. 44.—EVACUATOR.

Prostatectomy.—In suprapubic prostatectomy the instruments for opening the bladder above the pubes are

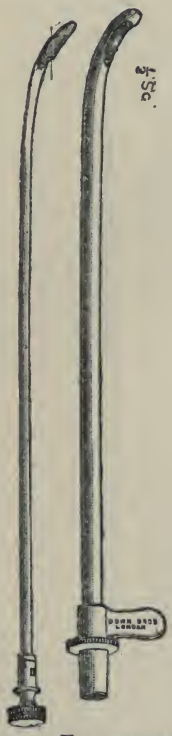


FIG. 45.—EVACUATING TUBE.

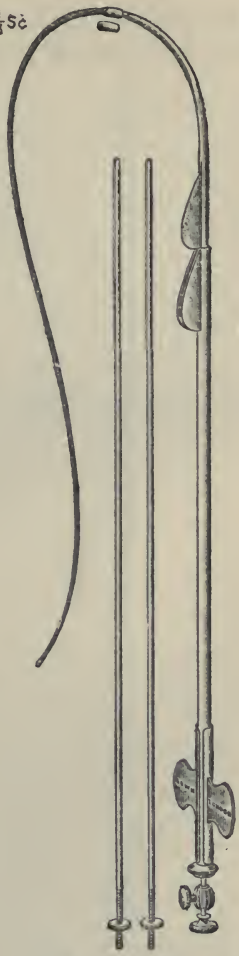


FIG. 46.—TEEVAN'S URETHROTOME.

those required, and large rubber tubing for subsequently draining it; in perineal prostatectomy, the instruments

FIG. 47.—WHEELHOUSE'S STAFF.

FIG. 48.—WHEELHOUSE'S DIRECTOR.

for opening the bladder in the median line through the perineum—median grooved staff (*cf.* Perineal Cystotomy).

Strictures of the urethra are usually dealt with by dilatation (rapid or gradual), and by internal or external urethrotomy.

(*a*) *Dilatation.*—For this purpose Lister's graduated steel sounds, various bougies (including filiform bougies), and catheters are used.

(*b*) *Internal urethrotomy* requires one of the special internal urethrotomes for dividing the stricture, and bougies or catheters to pass subsequently.

(*c*) *External urethrotomy* (Wheelhouse's operation) requires as special instruments Wheelhouse's staff and director, and Teale's gorget.

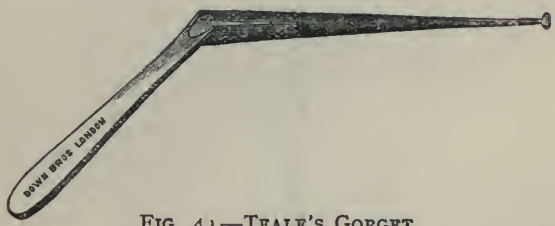


FIG. 49.—TEALE'S GORGET.

It will be realized that in operations upon the male bladder and urethra a great variety of special instruments is in use, and there are numberless patterns of these. A general idea of what is likely to be required has been given above; for further assistance the nurse must consult with the surgeon.

In the operations for *varicocele, removal of testis* (castration), and radical cure of *hydrocele,* the instruments for operations on soft parts generally are all that are needed; in *tapping a hydrocele,* the hydrocele trocar and cannula must be got ready.

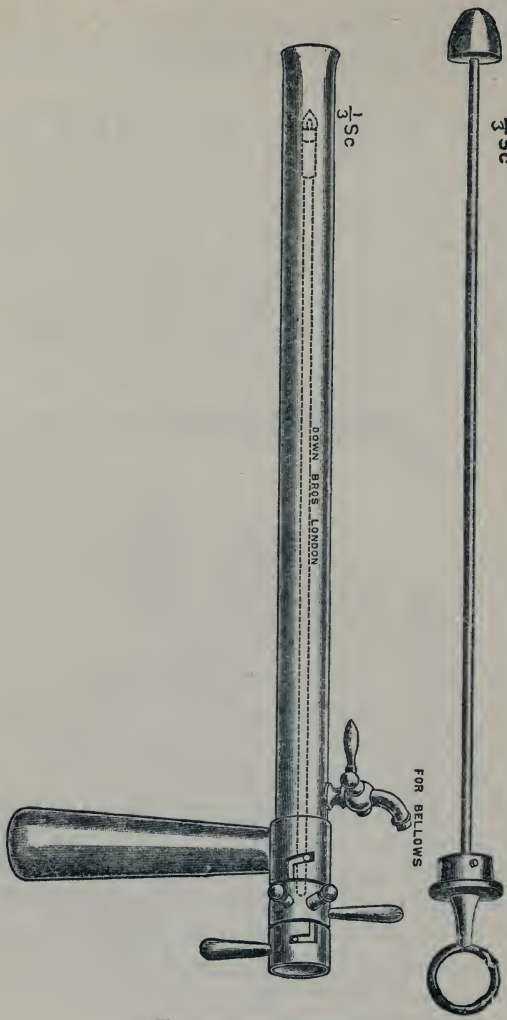


FIG. 50.—SIGMOIDOSCOPE.

4. Operations upon the Rectum and Anus.

For most operations on the rectum and anus the lithotomy position is required, and this is secured either by stays at the end of the table or by Clover's crutch. The general instruments are those employed in operations on the soft parts. A morphia suppository is frequently administered after operations in this region to lessen subsequent pain or prevent an action of the bowels, and should always be provided. The special instruments likely to be wanted are rectal specula (bivalve or three-bladed), proctoscopes, and sigmoidoscopes.

In the *operation for hæmorrhoids* by ligature, ring or toothed pile forceps to secure the piles, and stout ligatures of silk or whipcord to tie them must be got ready.

If the clamp and cautery or crushing operations are adopted, the special instruments for these will be required—viz., clamp, Paquelin's cautery, crushing clamp.

In operating on fistula sharp- and blunt-pointed bistouries may be required to slit up the fistulæ.

For dividing *non-malignant strictures* a blunt-pointed straight bistoury should be provided and rectal bougies to pass subsequently through the stricture.

In *transacral or perineal or abdomino-perineal excision of the rectum* a very thick flat sand-bag for raising the pelvis is necessary (*cf. ante*, p. 170). The coccyx, and part of the sacrum may require removal, and the instruments for the division of bone must therefore be got ready. Also, inasmuch as this operation involves division and may involve reunion of intestine, provision for enterectomy and anastomosis of bowel must be made (*cf. ante*, p. 179).

Lastly, if the patient is a male, a full-sized metal catheter or sound, to locate the urethra and bladder while the anterior connections of the rectum are being separated, will be wanted.

5. Operations on the Uterus, etc., by the Vaginal Route.

The lithotomy position is almost invariably required, and provision must be made for this (*cf. ante*, p. 169). In operations on the uterus or its adnexa by the vaginal route the following apparatus and instruments (all or some of them) will usually be needed, and should be in readiness. They are the special instruments employed in operations in this region, whether on the vagina itself, or on the uterus through the vagina.

1. Vaginal specula and retractors, of which Sims's duck-bill speculum in various sizes, Fergusson's speculum, and copper spatulæ, which can be bent to any angle, are the most generally useful; but surgeons have their individual preferences.

2. An irrigator with vaginal tube and uterine tube for washing out the vagina and uterus. Budin's and Bozeman Fritsch's uterine tubes are in common use.

3. Vulsella for taking hold of the cervix. All have long shanks, and Teale's answer very well.

4. Uterine sound.

5. Uterine dilators, of which Hegar's graduated metal dilators are the most generally used. Others are on the principle of expanding blades.

6. Curettes, sharp, blunt, and flushing, for scraping the interior of the uterus.

7. Playfair's probe, for the application of various

medicaments (carbolic acid, iodized phenol, etc.) to the cervix or interior of the uterus.

FIG. 51.—BUDIN'S UTERINE TUBE.

FIG. 52.—FLUSHING CURETTE.

8. Sponge-holders, the best having oval ring-blades, with a Spencer Wells catch.

9. Uterine forceps for gripping tumours, etc., with

variously fashioned blades, and long handles to enable them to reach through the vagina to the interior of the uterus.

Some of these (Doyen's) are punch or cutting forceps for piecemeal removal of tumours.

10. Uterine scissors of various patterns, which are nothing but ordinary scissors, straight and curved, provided with long handles to enable them to reach through the vagina to the interior of the uterus.

11. *Écraseurs*, wire or chain, occasionally used for the removal of polypoid tumours.

12. Female bladder-sound and catheter.

FIG. 53.—TRACHELORRHAPHY KNIVES.

In *vaginal hysterectomy* or *salpingo-oöphorectomy* no special instruments are needed; an aneurism or pedicle needle, or ligature forceps, and fairly stout silk for securing the broad ligament in sections, and straight, blunt-pointed scissors for dividing it, are included in the requirements for operations on soft parts generally. In *trachelorrhaphy* special knives are useful for paring the edges of the rent in the cervix.

In *amputation of the cervix* the instruments for operations on soft parts are those required.

6. Operations on the Perineum and Vagina.

The special operations on the perineum and vaginal walls are chiefly plastic, consisting of perineorrhaphy, anterior and posterior colporrhaphy, and the closure of vaginal fistulæ. For the first three, beyond the instru-

ments for exposing the field of operation and securing the cervix if necessary—*i.e.*, specula and vulsella—nothing special is required. The instruments for operating generally on soft parts are those to be got ready. In perineorrhaphy Lawson Tait's perineorrhaphy scissors are useful, and some surgeons employ special perineor-

FIG. 54.—LAWSON TAIT'S PERINEORRHAPHY SCISSORS.

rhaphy needles, with the eye at the point, but ordinary curved needles answer every purpose.

In these operations, as in others in this region, a female bladder-sound should always be provided, and an indiarubber finger-stall, with guard for the rest of the hand, in case the surgeon wishes to introduce his finger into the rectum. The closure of *recto-vaginal or vesico-vaginal fistulæ* is a very similar operation to closing a

FIG. 55.—AUTHOR'S WINGED HERNIA DIRECTOR.

cleft in the palate, and the same kinds of instruments will be required. Thus, long-handled forceps, with serrated and tenaculum points; ordinary scalpels, and knives with long handles and long thin blades, like cleft-palate knives; handled needles, with the eyes at the point, or a needle-holder, with ordinary needles of

various curves; and silk, silkworm gut and silver wire for sutures, should be got ready, in addition to the instruments for exposing the field of operation, and those for operations on the soft parts generally.

7. Miscellaneous.

Herniotomy and Radical Cure of Hernia.—In addition to the instruments required for operations on soft parts generally, there are only the broad hernia director for passing beneath the stricture, and the hernia knife, with its limited cutting edge.

The nurse should always be prepared here for an enterectomy and anastomosis (intestinal clamps, needles, and silk or Pagenstecher's thread) to meet the contingency of excision of gangrenous gut. In the *radical cure of hernia,* which usually follows herniotomy, or may be undertaken independently of it, special hernia needles are used by some surgeons, but ordinary fully-curved needles answer every purpose.

Tenotomy.—In tenotomy sharp- and blunt-pointed tenotomy knives will be required — the former for puncturing the skin, and the latter for dividing the tendon.

Ligature of Arteries in their Continuity.—The requisites are those for operations on soft parts generally, with the addition of the material (*e.g.*, silk, catgut, reindeer, or kangaroo tendon) with which the surgeon intends to ligature the vessel.

In **skin grafting** by Thiersch's method a razor will be needed to shave off the large flakes of skin; by Reverdin's a pair of skin-grafting or ordinary scissors curved on the flat.

Extraction of Bullet.—The special instruments required are bullet probes and bullet forceps.

Exploration of any cavity by needle—*e.g.*, chest, abdomen, abscess, etc. An exploring syringe is the special instrument employed.

FIG. 56.—BULLET PROBE.

In paracentesis thoracis (emptying the pleural cavity of fluid) an aspirator is used; in paracentesis abdominis (emptying the abdominal cavity of fluid) a fine trocar and cannula, with indiarubber tubing to fit on the latter.

FIG. 57.—BULLET FORCEPS.

Operation for Spina Bifida.—If the tumour is to be tapped and injected, a fine exploring needle will be required; if excised, the instruments for operations on soft parts generally.

8. Operations on the Eye.

The same general principles must be kept in view in operations here as elsewhere. Thus the field of operation will require exposure, and for this purpose an eye speculum is needed. In addition to the disinfection of the surrounding skin, the eye will require cleansing, hence an eye irrigator for washing it out with sterile water or a saturated solution of boric acid, or bichloride of mercury solution (1 in 8,000), and rendering it as far

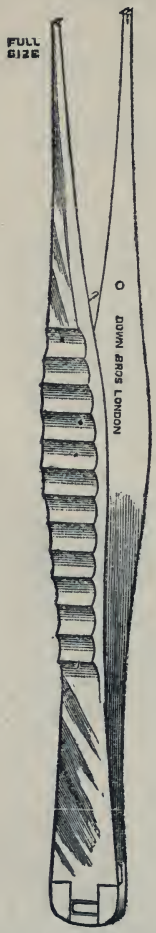


FIG. 58.—FIXATION FORCEPS.

FIG. 59.—STRABISMUS SCISSORS.

FIG. 60.—CANALICULUS KNIFE.

as possible aseptic, will have to be provided; the question of anæsthesia will have to be considered, and if it is to be local, which is usually the case in these

FIG. 61.—IRIDECTOMY KNIFE.

FIG. 62.—IRIDECTOMY FORCEPS.

FIG. 64.—IRIS REPOSITOR.

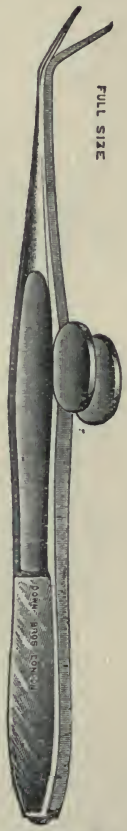


FIG. 63.—IRIDECTOMY SCISSORS.

operations, cocaine in tabloids or solution must be got ready; lastly, the eyeball will require steadying during the operation, and for this purpose a pair of fixation forceps will be wanted.

A waterproof cap to cover the head is also advisable in eye operations.

FIG. 65.—CATARACT NEEDLES.

FIG. 66. CATARACT KNIFE.

FIG. 67. CYSTOTOME AND CURETTE.

FIG. 68. CATARACT SPOONS.

FIG. 69. VECTIS.

The following are the standard operations upon the eye, though there are variations of these and others, which a nurse working specially in this department will become acquainted with.

Operations for Squint.—The special instruments required are the strabismus hook to secure the tendon and strabismus scissors to divide it.

In addition, fine curved needles and needle-holder should be provided.

Excision of Eyeball.—The special instruments are a strabismus hook for securing and strabismus scissors for dividing the tendons supporting the eyeball, and a pair of small blunt-pointed scissors curved on the flat to sever the optic nerve.

Stricture of Nasal Duct.—The special instruments are a canaliculus knife to slit the canaliculus, a set of lacrymal probes to dilate the duct, a lacrymal syringe, and lacrymal styles.

Operation for Tarsal Cyst.—A small scalpel and small curette or probe.

Removal of Metal from Eye.—A cataract knife, scissors, battery, and electro-magnet, fine dissecting forceps, needles, needle-holder, and fine silk should be got ready.

Iridectomy.—The special instruments are a cataract or iridectomy knife, iridectomy forceps, iridectomy scissors, and an iris repositer.

Operations for Cataract—(1) *Needling.*—A fine cataract needle is the special instrument required.

(2) *Extraction.*—The special instruments are those for iridectomy (*cf. ante*)—a cataract knife, cystotome and curette, cataract spoon, and vectis.

9. Operations on the Ear.

In operations on the ear aural specula are required to inspect the meatus, drum, or middle ear (if the drum

FIG. 70.—PARACENTESIS KNIFE.

be absent), a forehead mirror and electric light frequently, and a syringe for washing out the ear. A waterproof cap should also be provided.

Removal of Impacted Wax.—An ear syringe.

Removal of Aural Polypi.—A polypus snare and polypus forceps, a curette and probe.

Paracentesis of the Drum.—A paracentesis knife is the special instrument required.

Politzerization.—An inflator and Eustachian catheter.

Mastoidectomy.—The instruments required for this operation are given under the heading "Special Operations on Bone" (*cf.* p. 214).

10. **Operations on the Nose, Throat, and Œsophagus.**

For examination of or operations on the nose and throat a waterproof cap, nasal specula, mouth-gag, forehead mirror, tongue depressor, rhinoscopic mirror, swab-holders, and swabs should generally be got ready.

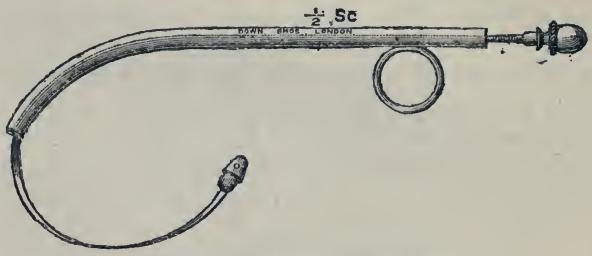


FIG. 71.—BELLOCQ'S SOUND.

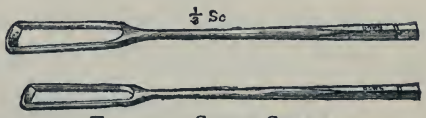


FIG. 72.—SPOKE-SHAVE.

Plugging the Posterior Nares for Epistaxis.—For this operation Bellocq's sound, or a small gum-elastic catheter, scissors, a pair of forceps, stout silk, and lint are required.

Removal of Tonsils and Adenoids.—The tonsil guillotine and adenoid curette are the special instruments.

Removal of Nasal Polypi.—Polypus forceps or a wire snare.

Removal of Turbinal Bone.—A spoke-shave or ring-knife.

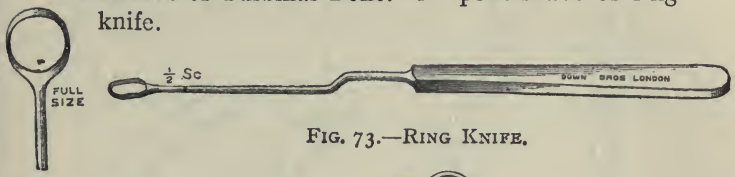


FIG. 73.—RING KNIFE.

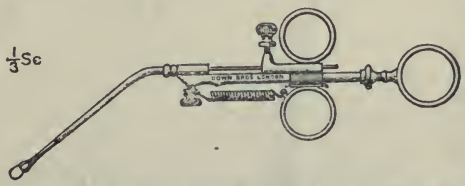


FIG. 74.—BALLANCE'S IMPROVED AURAL SNARE WITH THOMAS'S END.

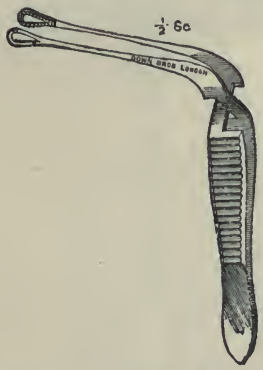


FIG. 75.—WYATT WINGRAVE'S AURAL POLYPUS FORCEPS.

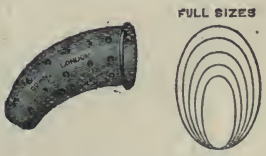


FIG. 76.—ASCH'S NASAL SPLINT.

Straightening Septum.—Special scissors for dividing the septum, septum forceps for straightening it,* and splints for keeping it in position, are the special instruments.

* Submucous resection of the septum is now usually adopted.

Fig. 77.—Coin-Catcher.

Fig. 78.—Œsophageal Probang.

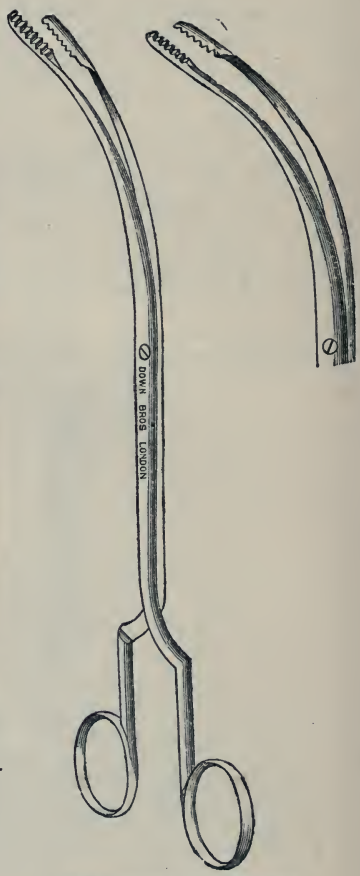


Fig. 79.—Œsophageal Forceps.

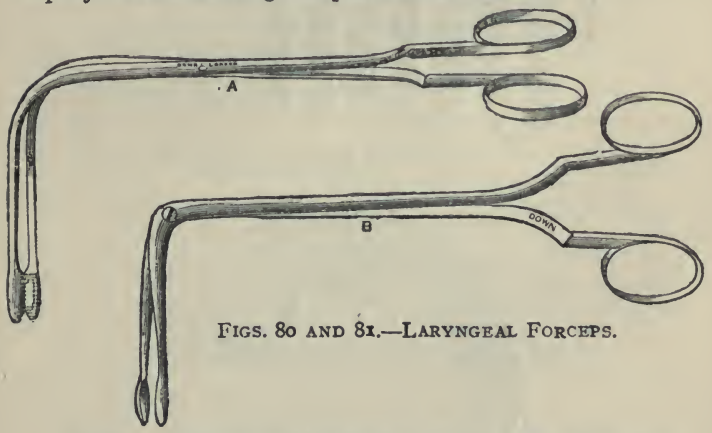
Removal of Foreign Bodies from Œsophagus.—Various forms of coin-catchers, probangs, and forceps are used for this purpose.

Œsophagotomy.—The ordinary instruments for operation on soft parts will be required, and in addition œsophageal bougies.

Examination or Dilatation of Œsophageal Stricture.—Graduated œsophageal bougies will be required.*

11. Operations upon the Larynx.

In intralaryngeal examinations and operations the laryngoscope for exposing the field will be required; also generally cocaine (4 per cent. solution), and a cocaine-sprayer for rendering the parts anæsthetic.



FIGS. 80 AND 81.—LARYNGEAL FORCEPS.

In all operations in this region, as in those about the mouth and throat, tracheotomy instruments should be at hand, and for a similar reason (*cf. ante*, p. 174).

For removing a **foreign body or piece of growth** from

* The œsophagoscope is now extensively used in the examination of the œsophagus.

the upper compartment of the larynx a pair of laryngeal forceps or laryngeal punch must be got ready. If the foreign body be below the vocal cords or in the

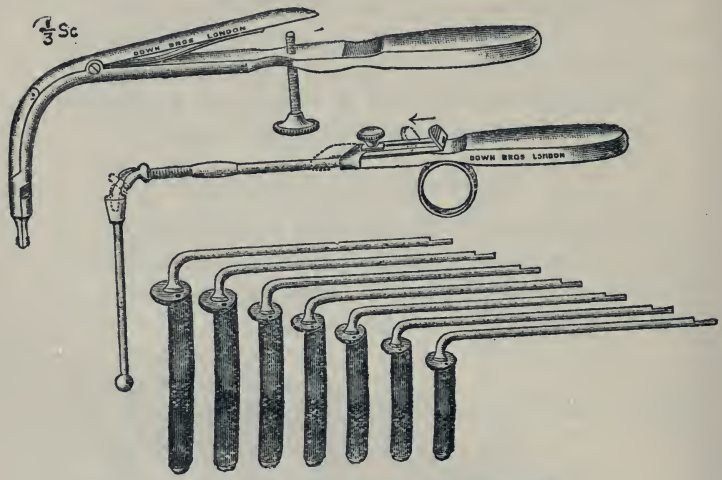


FIG. 82.—INTUBATION INSTRUMENTS.

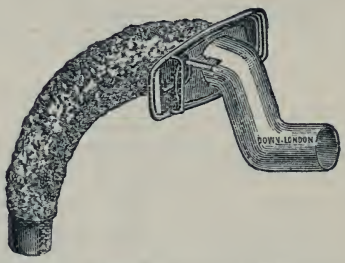


FIG. 83.—HAHN'S SPONGE CANNULA.

trachea, or a bronchus, tracheotomy may be required previous to its extraction.

In **Intubation of the Larynx** the special instruments for this operation will be required.

Thyrotomy.—In thyrotomy, in addition to the ordinary tracheotomy instruments, Hahn's sponge cannula may be wanted for plugging the trachea, and so preventing the entry of blood into the respiratory passages.

Also a small saw (Hey's) or straight bone forceps for dividing the thyroid cartilage if ossified, and a fine bradawl for puncturing it, as well as a 4 per cent. solution of cocaine and adrenalin, to render the interior of the larynx insensitive and bloodless, should be provided. Otherwise, no special instruments are needful.

Laryngectomy.—In this operation similar instruments will be required to those for thyrotomy, in addition to those for operation on soft parts generally.

N.B.—It must be understood that some of these operations in special regions—*e.g.*, on the eye, ear, nose, and larynx—fall mostly to specialists to perform, and there are numberless modifications of many of the instruments given above. A general idea only has been attempted of what will be required. If a nurse is working under a specialist in any of these departments of surgery, she must take more precise directions from him.

V. THE GENERAL REQUISITES FOR OPERATIONS INVOLVING BONE.

If the operation implicate a bone, the surgeon will first of all have to expose it, and this will involve an operation upon the soft parts. The instruments given in Section III. will, therefore, be required for this part of the operation, and in addition there will be those for dealing with the bone itself. Operations on bone are strictly comparable to those upon the soft parts, the only difference being that suitable instruments have to be provided for securing, dividing, uniting, or scraping,

as the scale may be, the hard structures of which bone is composed.

If the bone requires **division,** instruments may be needed for taking hold of it and steadying it. Those

FIG. 84.—HEY'S SAW.

commonly used for the purpose are known as lion and sequestrum forceps. They all have strong blades and claws or deeply serrated edges, so as to give a good hold on the bone.

FIG. 85.—WOOD'S JAW SAW.

Then, an instrument is used called a periosteal elevator in very many operations upon bone to raise up the enveloping periosteum, with the view of preserving it. It should always be got ready.

FIG. 86.—ADAM'S SAW.

Lastly, there are the instruments for dividing the bone —viz., saws, bone forceps, chisels, and osteotomes. Saws are of various shapes and sizes, the most common

in use being the ordinary amputation saw, with its wide business-like blade; Butcher's saw, which can be set at any angle; and various small saws (Hey's skull saw.

FIG. 87.—OSTEOTOME.

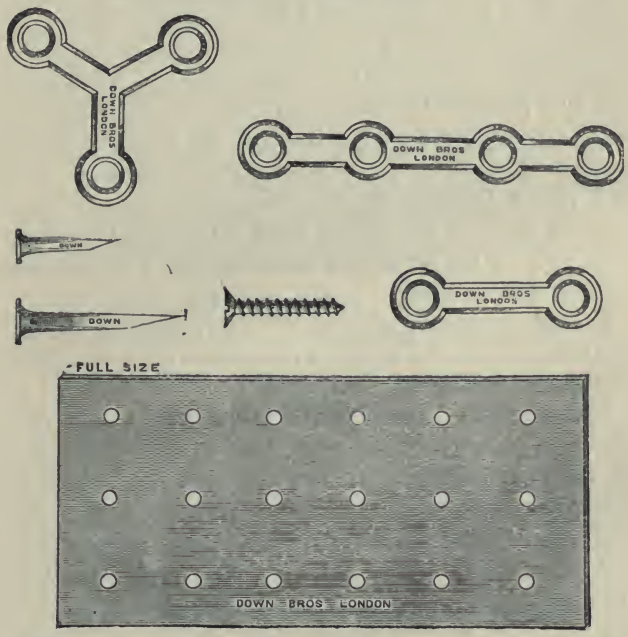


FIG. 88.—SCREWS, NAILS, AND PLATES FOR UNITING BONE.

Wood's jaw saw, Adam's saw, etc.) for dividing smaller bones—*e.g.*, those of the face and head.

Bone forceps for cutting bone are likewise of various shapes and sizes, according to the requirements of the

case, some having straight blades, others curved, and yet others bent at an angle.

Chisels and osteotomes are also frequently required in dividing bone, as in mastoidectomy, osteotomy, etc., and if these are to be used, the mallet to go with them must not be forgotten.

If the bone after division requires **reunion**—as, for instance, in excision of the knee—or if the operation is not for division, but for union of bone, as in the joining of fractures, additional instruments will be needed. For this purpose bradawls and drills (electric or otherwise) are in use for boring holes in the bone, and silver wire, catgut, etc., and various forms of screws, nails, and plates for uniting the fragments. Or the more modern practice of uniting bone fragments by a bone graft may be the operation, in which case a circular saw is of the greatest use.

Lastly, the bone may require simply **gouging** out and scraping, as in some cases of tubercular disease, and for this purpose gouges are required.

It will be seen that in operations involving bone exactly the same principles have to be kept in view as in those on the soft parts. Just as dissecting and tenaculum forceps are required for steadying soft parts, lion forceps and sequestrum forceps are required for steadying bone; just as knives are used for dividing soft parts, saws, bone orceps, chisels, and osteotomes are employed for dividing bone; as needles are used for piercing soft parts, bradawls and drills are used for piercing bone; as silk, silkworm gut, catgut, etc., are used for uniting soft parts, silver wire, nails, screws, and plates are used for uniting bone; as sharp spoons are used for scraping soft parts, gouges are used for scraping bone; as scissors are used for cutting silk, etc., wire nippers are required for cutting silver wire.

VI. SPECIAL ADDITIONAL REQUISITES FOR OPERATIONS ON BONE IN SPECIAL REGIONS.

Amputations.—In the larger amputations—*e.g.*, of the leg or arm—a torniquet is frequently required to control the main artery of the limb. An indiarubber band, known as Esmarch's torniquet, with some form of catch to secure it, is generally employed for this purpose. In amputation at the hip-joint, Lynn Thomas's tourniquet or Wyeth's pins are useful.

If flaps are formed by transfixion, amputating knives varying in size with the site of operation will be needed.

In most amputations nowadays the flaps are fashioned by dissection from the skin towards the bone, and a

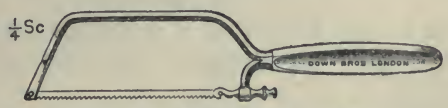


FIG. 89.—METACARPAL SAW.

scalpel varying in size with the site of operation is used for this purpose. Thus, in amputating the fingers or toes, a small scalpel is the only knife required; in amputating at the knee-joint, a larger scalpel.

In other respects the instruments for amputations are the same as those for operations involving the soft parts and division of bone generally.

Excisions.—The instruments required for excision of bones or joints are those for operations on bones generally (*cf. ante*, p. 209).

If, as in excision of the elbow-joint or of a rib, resection completes the operation as far as the bone is concerned, no instruments will be required for reuniting it;

if, on the other hand, the bones have to be reunited after excision, as in the case of the knee-joint, the instruments for uniting bone will have to be got ready.

FIG. 90.—MASTOID CHISEL.

In excision of the jaws, tooth forceps for removing teeth that may be in the way are required if they have not been previously extracted; also, as these operations are within the mouth, tracheotomy instruments should

FIG. 91.—MASTOID GOUGE.

be at hand. Small saws, such as Wood's jaw saw and metacarpal saws, are commonly used here, and should be in readiness.

Mastoidectomy.—The special instruments required are small trephines, mastoid chisels and gouges, which are

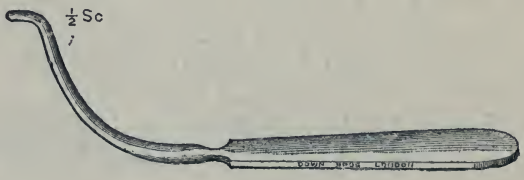


FIG. 92.—STACKE'S GUIDE.

made of a size to fit the delicacy of the operation, a mallet, Stacke's guide, and small curette.

Various forms of drills, burrs, and osteotribes are used by some surgeons.

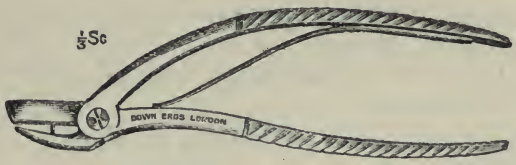


FIG. 93.—HOFFMAN'S GOUGE FORCEPS.

FIG. 94.—HORSLEY'S SKULL SAW.

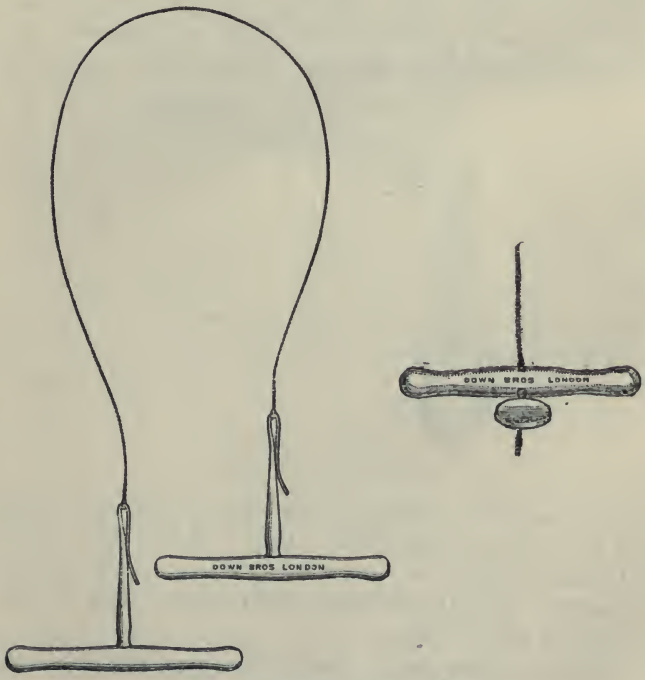


FIG. 95.—GIGLI'S THREAD SAW.

Trephining the Frontal Sinus.—The usual instruments for operations on bone are needed here, except that small trephines are sometimes used for making the opening in the bone.

Laminectomy.—The instruments are those for operation on bone generally.

FIG. 96.—SKULL ELEVATOR.

Trephining and Operations upon the Brain. — The special instruments required for these operations are different sized crown trephines, gouges, forceps for nibbling away pieces of the skull or enlarging the opening made by the trephine, saws (of which there are

FIG. 97.—PUS SEEKER.

many varieties—ordinary large saws, small saws, such as Hey's and Horsley's, and Gigli's thread saw), skull elevators, trocar for puncturing abscess, pus seekers or sinus forceps, brain knife, and Horsley's wax for the arrest of hæmorrhage.

I have endeavoured in the previous pages to mark the

general lines and general principles which should be kept in view selecting the apparatus necessary for the various operations of surgery, to give the reasons why certain things should be got ready in certain cases, and to indicate the special instruments required in particular operations and what purposes they serve. It is not a chapter of reference in the sense that the nurse can turn up any operation and crib exactly the instruments

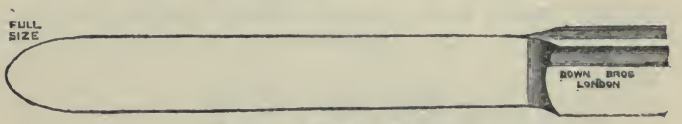


FIG. 98.—BRAIN-KNIFE.

required for it. If she adopts a method of that sort, she will probably never improve herself.

It is intended to show her the right method of learning to select instruments, to teach her the considerations which should guide her in so doing, to be an aid to her in working the matter out for herself, so that she may learn to prepare for operation intelligently, knowing the reason why she is choosing one instrument and discarding another, and may not rely solely for her guidance on what she thinks she remembers was used in the last similar case.

CHAPTER VII

OPERATIONS IN SURGICAL HOMES AND PRIVATE HOUSES

I. SURGICAL HOMES.

THE public is becoming educated to the value—indeed, the necessity—of surgical homes for the performance of modern operations of any magnitude, and it is safe to say that in a very few years any prejudice against them that may still exist will have disappeared. It takes time to upset old traditions and reverse long-established customs. Until comparatively recent years the private house was the usual rendezvous for an operation—a locality better adapted to it than any surgical home or hospital, which necessitated the congregation of patients suffering from various infective conditions under one roof. A little patience has been, and still will be, necessary to educate the public to the fact that the aseptic revolution in surgery has knocked the bottom out of this argument, as well as to convince them of the difficulty of fulfilling the conditions of modern surgery in private houses, and of the increased risk involved. Frequently I have questioned patients on this point, who were not easily persuaded to enter a surgical home for an operation. The answer has been invariably the same: "I had no idea so many preparations were necessary. I see it would have been next to impossible to

carry them out in the same way in my own house. I am very glad I came into the home."

Confidence and security in his surroundings are nowadays the first consideration in the surgeon's operative work. They are only to be obtained by his knowing in what sort of company and in what sort of place he is working. The efficient surgical nurse has become an expert, who has mastered the principles of a complicated technique, which, however, differs somewhat in its details with different surgeons, and she cannot be replaced at a moment's notice by another, however well trained and capable. Again, a room in a private house cannot adequately take the place of the theatre in a surgical home, specially furnished and specially fitted for operative surgery. Surgical homes may therefore be considered a necessary adjunct to modern private surgical work, and in them, if the necessary conditions are fulfilled, operations may be undertaken almost, if not quite, as safely as in the theatre of a hospital. The number of surgical homes that has sprung up in all large centres during the last few years is sufficient testimony to their necessity in modern surgery. I shall now make a few general remarks on the surgical home.

A private house is usually requisitioned for a surgical home. The ideal would be a house specially built for the purpose. Such a house would contain a modern theatre, with its annexes, and a lift. It would, in fact, be a private hospital, containing private rooms in place of wards, and additional up-to-date requirements for the operation itself. Such buildings would be costly and would add to the expense of surgical operations, already "apparently" expensive enough. I say "apparently," because when we contrast the suppurating

wound of pre-aseptic days, taking weeks to heal, involving its daily dressings and daily attendances, with the smooth and rapid convalescence after most surgical operations nowadays, necessitating in all but exceptional cases a very brief stay in a home, to say nothing of the untold saving of human life and alleviation of human suffering which modern surgery is capable of effecting, there can be little doubt which is the credit side of the account as far as the public is concerned. Still, the latter does not, and perhaps cannot, be expected altogether to realize and appreciate these benefits, so evident to the medical profession; and a modern operation appears quite an expensive affair enough, involving not only the surgeon's fees, but those of the surgical home as well. The fees of these homes should therefore be made as reasonable as possible.

As things are at present, a private house usually fulfils the purpose of a surgical home. In selecting a house, it should, if possible, not be in a main thoroughfare, in order that patients may be spared the noise inseparable from such a locality. The rooms should be of good size and well lighted. The drainage should be in perfect order, and modern bath-rooms and water-closets are indispensable. The house should be painted white inside, as this looks clean, and, moreover, shows up dirt if present. The walls and ceilings of the rooms should be colour-washed or painted, not papered. There should be no superabundance of furniture, and nothing elaborate, no pictures or unnecessary ornaments. At the same time, for patients of the upper classes rooms must be made to look comfortable. A narrow iron bedstead with wire spring mattress, a washstand, a toilet-table, a wardrobe, and two or three chairs, constitute the furniture. Curtains should be of white muslin, and should be changed for each occupant

of the room. The floor should be covered with linoleum, which can be scrubbed with soap and water.

Furnished in this way, a room looks neat, clean, and business-like, and affords the minimum receptacle for dirt. In addition, each room should be provided with electric light and an electric bell at the bedside.

The description of the preparation of such a room for the reception of the patient had best be begun, like that of the preparation of instruments, at the far end—*i.e.*, after a patient who has been operated upon in it has left it. The windows are opened, and the room is first thoroughly aired. The bed-clothes are then removed from the bedstead, and hung up in various parts of the room. All drawers and cupboards, if present, are opened. The window and fireplace are then closed down, and the room and everything in it is fumigated for several hours with formalin. After this, all blankets, sheets, etc., are sent to the laundry; the floors and skirting boards are scrubbed; furniture, ceiling, and walls are gone over with a damp cloth; the bedstead, electric light, washstand, etc., with 1 in 20 carbolic acid lotion; finally, clean sheets and blankets are provided. The room is now considered surgically clean and fit to receive a patient. Dressings removed from patients are put straight on to the fire in the bedroom; no soiled dressings leave the patient's room.

In the surgical home one room should be set apart as an operating theatre, and should be furnished on the same lines as the theatre in a hospital. The top light, so essential for many operations, is difficult to provide in a private house, but if a room can be selected with a bay-window in it, and if glass is substituted for the roof of the bay, a very good top light is provided. The ceiling and walls should be whitewashed or painted

white. The floor should be covered with linoleum. There should be two lavatory basins provided with hot and cold water, with foot or elbow apparatus to control the flow. An operating table, anæsthetic table, instrument table, dresser, two stands containing basins for dipping the hands in antiseptic lotions and sterile water, a table containing the lotions, etc., for preparing the hands. A powerful electric overhead light in the centre of the room, and wall connections for electric light and cautery, complete the equipment. Communicating with the theatre, if possible, should be a small room to be used as a sterilizing room. This should contain a steam sterilizer for dressings, etc.; a large copper, with suitable gas-burner, for sterilizing bowls, basins, jugs, and other utensils; an instrument-sterilizer, with gas-burner of suitable size; a sink, with a running supply of hot and cold water for washing instruments and various other articles; lastly, a boiler. With this apparatus, which is very much the same as that used in a hospital theatre, and is easily provided at no great expense, the requirements of aseptic surgery can be fulfilled, and the nurse can proceed very much on the same lines as in hospital. Thus, the preparation of her own and the patient's skin, the preparation of the costume, of instruments, ligatures, sutures, drainage-tubes, swabs, packs, towels, dressings, nail-brushes, and utensils, is exactly the same, and has already been described. Ordinary tables are sometimes used for the reception of bowls, instrument trays, etc. If so, they must be scrubbed with soap and water, washed with carbolic lotion (1 in 20), and covered with sterilized towels. If lavatories are not provided for washing the hands, enamelled iron jugs and basins which are sterilized in the copper—a separate basin being provided for each person—can be substituted.

The details of the preparation for operation have been fully given in Chapters III. and IV., and the conduct of an aseptic operation has been fully described, each participator in it having his or her duty definitely allotted, and doing this and nothing else. As a rule, one nurse who takes the part of the theatre sister, and another that of the theatre nurse, are sufficient. There is no necessity to repeat the respective parts played by each in the operation. They are carried out in exactly the same way in a surgical home as in a hospital, and the subsequent treatment of the patient is the same (*cf.* Chapter V.). It is hardly necessary to insist that every surgical home should have its permanent nurse or nurses responsible for the operations performed there. To turn on different nurses at different times to prepare for and conduct operations heavily handicaps success.

II. PRIVATE HOUSES.

Private houses are not suitable for modern surgical operations, but in cases of emergency, or owing to determination on the part of the patient, or lack of a suitable home, they have sometimes to be used for this purpose. The removal of a patient to a well-equipped surgical home, which can usually be done, is far preferable. To render this object attainable, every town should be provided with an ambulance, accessible at all times to all practitioners. If an operation has to be performed in a private house, the best way to secure its efficient conduct is to take as much as possible ready prepared, and to leave as little as possible to be prepared in the house. If the nurse relies on finding means of preparation in private houses which she is accustomed to find in hospital, she will frequently be disappointed. In addition,

she will be more at home and less likely to make mistakes if conducting her preparations under conditions which are familiar to her. The surgeon will generally have access to a surgical home or hospital, where he can have most of his necessary preparations carried out. Establishments, too, are now in existence in some towns where nurses have the necessary apparatus (sterilizers, etc.) wherewith to provide for operations. This is a great convenience for the surgeon who cannot make use of a surgical home or hospital. If he personally conducts the preparation, he must think the matter out for himself, but no busy surgeon could often afford the time which such a proceeding entails, nor would he be likely to do it as efficiently as the trained expert. I shall assume, therefore, that he has at his command some such means as mentioned above for securing an efficient preparation. For an operation of any magnitude he will require a nurse whom he knows and who knows his methods to accompany him, or preferably to be sent in advance (the day before, if possible), to carry out what will be required at the house. This nurse, as already emphasized, should take with her everything that it is possible to take ready prepared. The requirements for the operation, therefore, naturally divide themselves into two sections: (1) those to be provided before arrival at the house; and (2) those to be provided at the house itself. They will now be described in detail.

1. The Requirements before Arrival at the House.

(1) The first thing to be thought of is the **operating-table.** Portable operating-tables giving the necessary positions are in common use nowadays, and are very convenient. If one is not available, a table will have to be provided at the house, and this can usually be done. In

an emergency the Trendelenburg position can be secured by fixing a wooden chair on an ordinary table in such a way that the top of the back and the edge of the seat rest upon it, and any other position, such as the kidney, gall-bladder, or lithotomy position, will have to be considered and provided for, as described in Chapter VI., p. 168.

(2) **The Light.**—Portable electric lights with a battery are almost indispensable, and every surgeon liable to be called to an emergency operation, which he may have to perform in the middle of the night, should have access to one. The light provided in private houses is often deplorable, and no surgeon can do an operation properly if he cannot see.*

(3) **Requisites for the Preparation of Skin** (both Nurse's and Patient's), **the Costume** (excluding Gloves), **Towels, Swabs, Packs, and Dressings.**—These should all be sterilized at the home, and taken ready in separate tins, labelled. The use of separate tins insures that the various materials are kept apart to avoid confusion, and that nothing is exposed until it is actually wanted. Thus:

(*a*) A tin will be packed and prepared as described in Chapter III., p. 53, for the preparation of the nurse's own and the patient's skin previous to operation.

(*b*) A tin containing squares of lint or swabs for the preparation of the hands of the participators in the operation.

(*c*) A tin containing the costume—*i.e.*, coats, caps, masks, and gloves—of the surgeon and his assistants. In a major operation there should be three of each of these for the three immediate participators in the opera-

* Of course, whether an artificial light is required will depend on the operation and the light available.

tion, and an additional coat for the second nurse, alluded to hereafter.

(*d*) A tin containing Battist mackintosh and towels to surround the field of operation, and to cover the tables used.

(*e*) A tin containing the swabs and packs and a roll or two of ribbon gauze.

(*f*) A tin containing the dressing packed as described in Chapter IV., p. 83. These tins are labelled, sterilized in the steam sterilizer, and closed down.

(4) **Instruments, Sutures, Ligatures, Drainage-Tubes.**—All of these are sterilized at the surgical home or hospital. A sterilized Battist mackintosh is then laid out on a table, and upon this a sterilized towel. Into this the instruments, sutures, and drainage-tubes are tipped from the sterilizer. Ligatures of catgut (if this material is used for ligatures) are taken with sterilized forceps from the jar, and are also placed in the towel. The nurse then, with hands disinfected and with gloves on, rolls up the towels, and over them the mackintosh. These parcels are then tied up with tape. They are not taken by the nurse the day before, else the instruments would, of course, be found to be rusty. If prepared on the morning of the operation and taken by the surgeon himself, and used within a few hours of the preparation, no rust will have formed upon them. If preferred, the instruments can be boiled at the house, but I have found the above plan answer well.

(5) Nail-brushes, and a sufficient supply of enamelled iron jugs, bowls, and instrument trays. These may conveniently be sterilized at the patient's house, as hereafter described.

(6) The only remaining items the nurse will have to take with her are a razor, a pair of dressing forceps, a

spatula, and a pair of rubber gloves, for use in the preparation of the patient's skin, and four Battist mackintosh covers for the mouths of the jugs containing sterile water or salt solution.

2. **The Requirements to be provided at the House.**

What remains to be provided at the house comprises:

(1) **The Chemicals.**—These may be ordered from a neighbouring chemist, and consist, according to the technique advised in this book, of soft-soap, turpentine, ether, spirit lotion (1 in 500), carbolic acid lotion (1 in 20), and biniodide of mercury lotion (1 in 4,000), in stoppered bottles.

(2) **A copper** or **fish-kettle** large enough to sterilize bowls, trays, and jugs for sterile salt solution.

(3) **Kettles** for boiling water.

(4) **A saucepan** or **fish-kettle** to sterilize any instrument that may perchance require sterilizing during the operation. Provision having been made on these lines, the preparation for an operation and its conduct in a private house become a comparatively simple proceeding. How this is accomplished may now be briefly described.

PREPARATION FOR, AND CONDUCT OF, AN OPERATION IN A PRIVATE HOUSE.

1. **Preparation of the Room.**—Except the case be an emergency one, this will be the same as in a surgical home (*cf.* p. 218). All superfluous furniture, ornaments, curtains, carpet, etc., are removed. The floor and skirting boards are well scrubbed, and everything is

gone over with a damp cloth or carbolic lotion the day before.*

2. **Furniture required for the Operation.**—This consists of:

(1) The operation-table, either brought to or provided at the house.

(2) A chair and small table for the anæsthetist.

(3) A table on the operator's side to hold his instruments, etc., and lotion for his hands.

(4) A table on the assistant's side to hold the swabs and packs and lotion for his hands.

(5) A pail for the reception of used swabs or any soiled material.

(6) A washstand containing jugs and basins and lotions for preparing the hands.

(7) A side-table of fair size, upon which to stand jugs, lotion-bowls, and the various other utensils required.

All of these are first scrubbed with soap and water, wiped over with a cloth damp with carbolic lotion (1 in 20), and then covered with clean sheets.

3. **The Light.**—The next thing to be considered is the light, the position of the table to best secure this, and any provision for artificial light. The portable electric lights have been already alluded to. This completes the preliminary preparation of the operation-room. Some hours before the operation the window is shut, a large enough fire lighted to bring the temperature of the room up to at least 65° F., and shortly before the opera-

* If the case be an emergency one, the preparation of the room should be somewhat modified. There would not be time to take up carpets, scrub floors, remove furniture, etc.; in addition, such manœuvres shortly before operation would be liable to stir up dust. It is better, therefore, to leave the room as it is, and cover everything, including the floor, with clean sheets.

tion the sheets covering the various articles of furniture mentioned above are removed.

4. **Preparation of Bowls, Trays, and Sterilized Salt Solution.**—The nurse now separates from her stock three bowls and a nail-brush, to be used in the preparation of her own hands. The rest of the bowls and instrument trays are pinned up in a piece of sheeting and sterilized in the copper or fish-kettle. They are then removed to the operating-room in the sheeting, which is not opened till they are to be placed in position, just before the operation.

The jugs are likewise boiled in the copper. They are taken out by the nurse, she handling them with a sterilized towel. The sterilized water or sterilized salt solution prepared in the kettle is poured into the jugs, and their mouths are covered with a piece (*cf.* p. 227) of boiled Battist mackintosh tied on behind. They are then left to cool. Shortly before the operation some hot salt solution is prepared in the same way. There should be two jugs of each.

5. **The nail-brushes are boiled** in a bowl covered with a sterilized towel, and removed to the operation-room just as they are.

6. **Preparation of the Patient's Skin.**—This is done exactly as in hospital cases (*cf. ante*, Chapter III.).

The nurse will have separated, as mentioned above, some small bowls for her chemicals, and a nail-brush and pair of gloves for herself. She boils these, as well as a pair of forceps, and a spatula, which are placed in carbolic lotion (1 in 20). She has her chemicals for preparation of her own and the patient's skin in stoppered bottles. The necks of these are wiped over with lint soaked in carbolic lotion (1 in 20) before their contents are poured out. She is now ready to prepare

her own and the patient's skin just as in hospital, and she has the tin containing the requisite material for these already sterilized. If it has been properly packed everything will be found in the order required. There is no necessity to give the description again. It will be found in Chapter III., p. 48.

Up to the time of the operation the preparations are now complete.

Conduct of the Operation.

Very little description is needed for this, as it is practically the same as in the hospital theatre (*cf.* Conduct of an Aseptic Operation, Chapter, IV. p. 91).

There will generally be two nurses, corresponding to the theatre sister and theatre nurse, and they will be distinguished by these names in the following few remarks:

A fish-kettle or portable sterilizer should be kept on the boil during the operation in case any instrument requires immediate sterilization. Shortly before the time fixed for the operation the sister thoroughly disinfects her hands, and puts on gloves, gown, and mask. She has all the materials ready for this, the same as were used for her hands in the preparation of the patient's skin, gloves, etc., having, of course, been reboiled and a gown and mask removed from the costume-tin. The nurse washes up and puts on a sterile gown, but does not wear gloves, as she is not one of the immediate participators in the operation. The tin containing the towels having then been opened by the nurse, the sister takes out sufficient towels to cover the tables to be used at the operation. The sheeting containing the bowls and trays is now unfastened by the nurse, and these are placed in their required positions by the sister. They are then filled

with their solutions by the nurse. The tin containing the swabs and packs is placed unopened on the assistant's table by the nurse. During the operation it is opened, and the assistant helps himself out of it to what is required. The Battist mackintosh coverings of the instruments, ligatures, etc., are next undone by the nurse, who is careful not to touch the sterile towel inside; the towel is then unfolded by the sister, and its contents are placed by her in their respective trays and bowls.* The sister superintends the instrument department during the operation, and is ready to hold a retractor, etc., if required. The nurse assists the surgeon and his assistant in their preparation for operation, cuts the bandage, and removes the dressing on the patient. The surgeon having rendered himself sterile, and painted the operation area over with iodine, the tin containing the mackintoshes and towels to surround the operation area is opened by the nurse, and the surgeon, taking them out, places them in position, and the operation is proceeded with. During the operation the nurse is at the beck and call of the sister, and procures anything required, being careful that nothing comes from her into the operation field that has not been sterilized. When the operation is finished, the nurse hands and opens the dressing-tin, and the surgeon helps himself to everything in order (dressings, bandages, and pins) out of it.

The above may seem complicated in description, but if the details are strictly carried out, in practice it will be found to work out very simply. The chief essential is to have at command a reliable surgical nurse, who is acquainted with the methods of the surgeon, and it will

* It is assumed that the anæsthetist will bring his own requirements for the operation (*cf.* p. 84); otherwise they must be provided and placed on his table.

be evident how important a part the surgical nurse plays in present-day surgery. The technique of an operation in a private house is not different from that in a hospital, but the details are more difficult to carry out, and the sources of error are greater. For these reasons as little as possible should be prepared in the house itself, and what is required to be done there should be as simple and easy of attainment as possible. Equipped on the above lines the nurse will go to the house confident that she can make a satisfactory aseptic preparation for the operation, and that it can be performed aseptically, the only things required being a copper or large fish-kettle, water, and a fire, which are procurable everywhere. If the surgeon is unable to arrange for the preparation in some such manner as this, he had better use antiseptics freely (except in the abdomen), and he will very likely find his wound will heal by first intention, which is all he and the patient require.

In conclusion, it is hoped that in this small volume will be found the information and assistance required in the preparation for, and conduct of, a modern surgical operation. It is not contended that the technique here described is better than others, but whatever the details adopted by any particular surgeon, the principles are the same, and it has been the author's endeavour, while describing a technique familiar to himself, to emphasize and inculcate general principles.

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