General and local anaesthesia / by Aimé Paul Heineck.

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HEINECK.

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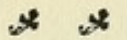
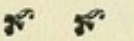
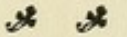


By AIMÉ PAUL HEINECK.



"The medical man cannot acquire more than a mere rudimentary knowledge of anaesthetizing from any book, but he may obtain undoubted service therefrom, enabling him to appreciate the dangers incident to, the caution necessary in anaesthetizing and grasp the rationale of the various methods of procedure in the administration of anaesthetics."—Dudley Buxton.



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THIS MONOGRAPH

Is dedicated to

Dr. Chauncey W. Courtright,

As a token of gratitude and esteem.

CHAPTER I.

GENERAL ANAESTHESIA.

Ether and chloroform are the most serviceable, the most widely used agents for the induction of general surgical anaesthesia. General surgical anaesthesia has its dangers. No powerful general anesthetic agent is free from risk. Ether and chloroform are highly toxic substances, the inhalation of which is capable of producing death. The mortality, however, that attends the use of these substances, is largely the mortality of carelessness and of incompetency. When death occurs from the administration of an anaesthetic, very frequently it is due to lack of watchfulness, to ignorance, and had proper precautions been taken, it would not have taken place.

Upon the usefulness of general surgical anaesthesia, all are agreed. Its advantages to the surgeon are thus summarized by Dr. D. W. Cheever: "He need not hurry; he need not worry; he need not sympathize; he can calmly dissect, heedful only that the anaesthetist is competent, the operation not prolonged beyond the verge of exhaustion; he can do better work; he can pause and consider; he can choose his steps; he can be deliberate, if not dextrous."

For the surgeon to derive all the forenamed advantages from the use of anaesthetics, the anaes-

thetist must be competent. He, the anaesthetist, must know the physiological action of the agent which he is administering. He must know the danger signals of surgical anaesthesia. He must also know all the procedures by the aid of which the grave accidents of anaesthesia can be forestalled and combated.

As the success and progress of surgery depend in a large measure upon the safety of anaesthesia, it is evident that too much study can not be given to this subject. Though much has been written on this subject, though the subject is old, Dr. McBurney speaks truly when he says: "Very few medical men administer ether well." As to chloroform, many physicians, conscious that they don't know how to administer it, and not possessing the necessary ambition and energy to learn how to administer it, never make use of it. Many that use it, use it faultily. Lord Lister says: "Death from chloroform is almost always due to faulty administration." It is easy to become a competent anaesthetist, and it is the duty of every medical practitioner to become one. Anaesthetics being used in all the different departments of medicine, it is imperative that all physicians should know how to skilfully administer ether and chloroform.

Knowledge is only acquired by observation and by study. To become a good anaesthetist one

must be taught, and must learn how to induce and maintain surgical anaesthesia. Theoretical and practical knowledge are both required. The value of theoretical knowledge lies greatly in the fact that more attention is paid to useful practical details, if the philosophy underlying their utility is evident or is known.

The giving of an anaesthetic should never be delegated to a nurse, much less to a layman. Nurses, owing to their incomplete medical education, of necessity, are irresponsible anaesthetists. They should not undertake, and should not be asked, to discharge the duties of a medical practitioner. The giving of an anaesthetic requires the undivided attention of an educated and watchful physician. The surgeon must not "start the anaesthetic" and then entrust the maintenance of the anaesthesia to an unqualified bystander. Accidents occur during all the different stages of anaesthesia, and must be immediately met by appropriate measures, so as not to prove fatal.

Never should the surgeon administer chloroform or ether, and operate at the same time. It is false economy. There is no scarcity of physicians. It is unsafe. Deaths have been caused by this practice. By attempting to do two things at once, the surgeon does neither well. The anaesthetic is not watched as it should be watched. The anaesthetist's eye should never be off his patient during the

entire duration of the anesthesia. Asepsis, of necessity, will be deficient. The neglect of aseptic teachings invites suppuration with its train of annoyances. His mind will not be concentrated upon the technique of the operation, hence the surgical methods employed will be at fault and results will not be ideal.

Indications for the use of ether or chloroform anaesthesia are:

1. For Diagnostic Purposes; (a) in complete exploration of rectum, or genitourinary organs; (b) in children, in exploring the bladder for stone since in children the bladder is so sensitive that it empties itself when an instrument is introduced; (c) in obscure abdominal and pelvic conditions, a precise diagnosis not being otherwise obtainable, as in carcinoma ventriculi, as in gynaecological conditions, pus-tubes, etc. "Examinations under anaesthesia can be conducted with a thoroughness which is impossible without it; the uterus can be drawn down, adhesions pulled upon, perineum deeply invaginated and inflamed, tubes and ovaries handled in a way which is impossible so long as the patient remains conscious." (Kelly, Baltimore); (d) it may be used to exclude hysterical conditions—hysterical joint, pseudocyesis, etc.; (e) to exclude simulation.

Rotterstein reports the case of a military officer who simulated aphonia, so as to secure his dis-

charge from the army. While being anaesthetized, in the stage of excitement, he began to sing. He was not discharged from the army. (f) In many cases, it is only by means of narcosis, that we can obtain a sufficiently satisfactory view of the eyes. In blepharospasm, especially in children, by proceeding with violence, there is danger of abrading the eyeballs. This is especially to be feared in purulent ophthalmia and in corneal ulceration. In adults, cocaine anaesthesia is often sufficient. Anaesthesia is of value as an aid to diagnosis, because by it, insensibility to pain on the part of the patient is secured, and through it, also, complete muscular relaxation is obtained. Examinations under it can therefore be more prolonged, more deliberate, more accurate. All resistance, voluntary and involuntary, on part of the patient is done away with.

2. For Therapeutic Purposes; in spasm, convulsions (puerperal eclampsia, tetanus), very painful neuralgias (tic douloureux, visceralgia of neurasthenia), renal coloc, hepatic colic, intestinal colic.

The anaesthesia is used to abort the spasms or convulsions. In the other conditions, we have recourse to anaesthesia when the suffering is beyond the influence of safe doses of morphine. In these conditions, we only administer chloroform till relief of pain occurs.

3. In Obstetrics. (A) In labor, we employ anaesthetics to mitigate the suffering of natural labor, to secure a semianaesthesia, that is an analgesia, a marked diminution of pain in the uterine and the periuterine regions. Winckel states that general anaesthetics render great service when the cervix is almost dilated and when the presenting part begins to pass through the vulva. We use them in natural labors in primiparae who are nervous and excitable and in whom the pain may even cause delirium; in all cases in which there is a spasmodic contraction or rigidity of the neck or body of the uterus.

The following conditions contraindicate their use: Opposition of the patient to their use; absence of severe suffering; placenta praevia: alcoholism; marked disease of circulatory or respiratory apparatus.

ANAESTHETICS IN CHILDBIRTH.

The following facts as to the use of anaesthetics in childbirth are established:

a. Chloroform is the agent sanctioned by almost all the authorities. It is pleasant to take. It acts quickly. Ether is disagreeable to take, is slow of action. Ethyl bromide has irritating properties, a disagreeable odor and interferes with the pains. It should not be used in obstetrics. Chloroform, unlike ether, is not inflammable. Hence, it can

be used at night, without any danger from light or fire. And certainly, it is at night, that the largest number of obstetrical cases occur.

b. Chloroform should be administered at the beginning of each pain, and discontinued as soon as the pain has passed, then resumed at beginning of next pain, discontinued at close of pain and so on. Never should complete insensibility be obtained. The object sought in natural labor, is a mitigation of the pain, a semianaesthesia. Complete anaesthesia would interfere with the progress of labor.

c. Anaesthetics are not harmful to the child. Anaesthesia of the child is not produced. They are not harmful to the mother. ["Lactation is not injuriously affected, nor is the child in any way injured." Buxton.] The almost complete immunity enjoyed by the woman in childbirth, from the accidents of anaesthesia, is partly due to the following conditions: Marked hypertrophy of the left ventricle during pregnancy; recumbent posture which patient naturally assumes during delivery; action of the heart is aided by the alternate relaxations and contractions of the uterus; the tendency of anaesthetics is to produce anaemia of the brain. This anaemia is counteracted by the labor-pains which give rise to an engorgement of that organ.

Anaesthetics do not, provided the narcosis is not too profound, interfere with the uterine contractions. They do not interfere with the contractions of the abdominal muscles. They weaken the resistance of the perineal muscles. They are of distinct advantage to the mother because by their attenuation of pain the progress of labor is hastened [this fact is especially demonstrable in women that fear pain]; because they calm the extreme agitation and cerebral excitement that labor often produces in very nervous women, and because, by shortening labor, they lessen its traumatisms, greatly diminish the parturient's prostration, and make her recovery more rapid.

After profound anaesthesia during delivery, increased watchfulness against hemorrhage is enjoined by most teachers. Playfair believes that the use of anaesthetics increases the tendency to hemorrhage. This tendency to hemorrhage is disputed by many good authorities. Fordyce Barker, of New York, says: "Through a long number of years I have rarely attended labors without ether. I have never seen from it any ill effects. Especially has it not caused a tendency to hemorrhage."

(B) In eclampsia (puerperal) to abort the convulsions.

(C) In all obstetrical operations as: version, application of forceps, embryotomy, etc., etc.

In all obstetrical operations the anaesthesia must be complete, must be surgical, not obstetrical.

ANAESTHETICS IN SURGERY.

In all cases in which there is an indication for surgical anaesthesia and the condition of the tissues or the nature of the operation do not admit of the employment of local anaesthetics, we have recourse to general anaesthetics. We use ether or chloroform for all operations requiring a longer and deeper anaesthesia than can be obtained by nitrous oxide gas or bromide of ethyl.

There are no absolute contraindications to the induction of general surgical anaesthesia. When the physical condition of the patient permits the performance of an operation, it permits of the giving of an anaesthetic. The question to be decided is whether the disadvantages attending the use of the anaesthetic more than counterbalance the advantages of its employment.

There are, however, unfavorable conditions. No age, no sex, no climate confers immunity from the dangers of ether and chloroform anaesthesia. Pregnancy and menstruation do not contraindicate ether or chloroform anaesthesia. They may, however, contraindicate the operation. I have not found a single case reported in which the induction of surgical anaesthesia has caused abortion.

In the following conditions the giving of an anaesthetic is hazardous, because experience has taught us that patients suffering from these conditions are subject to the grave dangers and accidents of anaesthesia:

In patients having severe organic lesions of the central nervous system, of the pulmonary system, of the circulatory system; in delirium tremens, the different neuroses as epilepsy, hysteria, etc.; in aneurisms of arch of aorta or of innominate artery, because there is danger of vascular rupture or because death frequently occurs from its administration in this condition; in surgical shock; in cachexia from any cause, fever, prolonged suppuration, suffering from intense and constant pain. "These conditions bring such changes in tissue nutrition and tissue vigor as to render the action of ether and chloroform for the time being abnormal." Gill, St. Barthol. Hosp. Rep., London, 1895.

SELECTION OF THE ANAESTHETIC.

The following statistics, being the combined statistics of Gurtl of Berlin and of Juillard of Geneva, show that chloroform and ether have each their mortality:

Anaesthetic Used.	Adm.	Deaths.
Chloroform ...	691,319	224, or 1 in 3,082
Ether	341,058	23, or 1 in 14,828

Despite the unfavorable showing made in the above figures by chloroform, from the standpoint of safety as compared to ether, chloroform maintains its popularity, its advocates declaring that in competent hands it is preferable to ether, because it is less disagreeable to take, less irritating to the lungs, its stage of excitement is shorter, and its after-effects, such as nausea and vomiting, less annoying, less prolonged than those of ether. "Nausea and general depressison are more pronounced after the use of ether than after the use of chloroform." (Hare.) Ether and chloroform have each their individual contraindications. Clinical experience teaches us that the mortality from anaesthesia can be much diminished by the careful selection of the anaesthetic in each individual case. This selection is to be arrived at by a consideration of the age of patient, of the climate, of the environments, of the physical condition of the patient, of the nature of the operation, of the posture of patient, of his idiosyncrasies, and of the skill of the anaesthetist.

This is the only scientific method of procedure. Failure to do this will at times be followed by fatal accidents. In the absence of indications (which are to be later enumerated) for the use of chloroform, ether is the anaesthetic to use. The following quotations from eminent experimental thera-

peutists and from well-known surgeons uphold this view:

"Ether is by far the safest anaesthetic substance for use during prolonged surgical operations." (Hare.) "Chloroform is seven times as dangerous as ether." (Waller.) H. C. Wood urges the general use of ether, and adds: "In the selection of an anaesthetic the question of safety is paramount." "I am certain that ether is infinitely safer than chloroform." (Frederick Treves.)

AGE OF PATIENT.

In children, previous to the age of seven years, chloroform is the safest anaesthetic. The relative immunity of children to chloroform narcosis is due to the great vascularity of their nervous system. The percentage of chloroform mortality in children is much below that of older patients. In children ether causes a great outflow of bronchial mucus. This mucus can asphyxiate patient. The bronchial mucous membrane of children is delicate and predisposed to inflammatory processes. Ether is a direct irritant to these mucous surfaces and can, and often does, excite inflammation of the air passages.

As a general rule, ether should not be administered to patients over sixty years of age, because these patients, as a class, either suffer from or are on the verge of renal and of pulmonary degenera-

tive changes. Ether is contraindicated in renal and in pulmonary affections.

CLIMATE.

In warm climates use chloroform. Lawrie records 45,000 chloroformizations without a death. A warm climate renders chloroform vapor more diffusible and so lessens its noxious effects. The respiratory functions are not so paramount, owing to the great activity of the hepatic and cutaneous functions in warm climates. Ether is obtained and preserved with difficulty in tropical countries.

ENVIRONMENTS.

On the battlefield and in the navy chloroform is the anaesthetic to use. It is less bulky. The quantity of chloroform needed to anaesthetize a patient is less voluminous than the quantity of ether required for the same purpose. Ether is inflammable, chloroform is not. It produces anaesthesia in less time than ether. The amount of work to be performed being great, time is an important factor.

When the thermo-cautery is to be used about the face, use chloroform.

In operations by gaslight use chloroform. Ether is inflammable. The danger of using ether near a lighted gas-jet is shown by numerous news items.

PHYSICAL CONDITION OF PATIENT.

(a) In atheromatous condition of vessels use chloroform, because ether produces a more violent, a more prolonged stage of excitement, thereby increasing the liability to vascular rupture and its consequences.

(b) In organic cardiac lesions always select ether. In this connection we must always remember that the integrity of the muscular structure of the heart is of far greater importance than the integrity of the valves. We select ether because chloroform is a powerful cardiac depressant and paralyzant; because chloroform acts upon the heart; it causes a marked depression of the cardiac muscle, involving a reduction of its tone, a relaxation of the cardiac walls, and an impairment of its functional activity. (McWilliam, British Med. J., 1890); because ether is a cardiac stimulant; because experiments and clinical observation show that chloroform kills generally by syncope (Verneuil), and organic cardiac lesions by their very nature predispose to this accident. "Sudden arrest of heart's action, from structural disease, may take place during the first few minutes of anaesthesia; and because failure to select ether is liable to result in accidents." Should, however, the cardiac lesion be accompanied by marked bronchial or pulmonary congestion, use chloroform.

If a fluidram of ether be injected directly into the jugular vein of a dog there is no fall in arterial pressure; if twenty drops of chloroform be injected, it will immediately cause a fatal paralysis of heart.

In renal affections use chloroform, because quantity for quantity ether is, of course, less irritating to the kidneys, but as a very much larger quantity of ether than of chloroform is needed to produce anaesthesia, chloroform is to be preferred. "Effect of chloroform anaesthesia on kidneys is practically nil."

In an examination of fifty cases before and after etherization (urine filtered and nitric acid test used), thirty-six cases showed that ether either produced albumen or increased its quantity when it was present before. (Blake.) Ether can cause oliguria anuria, or nephritis.

OTHER CONDITIONS.

In diabetes mellitus, use chloroform. The use of ether has been followed by diabetic coma. (Hare, Da Costa.)

In inflammatory conditions of the upper and the lower respiratory organs, as rhinitis, laryngitis, tracheitis, bronchitis, pneumonia, asthma, emphysema, use chloroform, because ether is a distinct irritant to mucous membranes and because unto-

ward effects of ether are mainly exercised upon the respiratory system. (Sajous.)

When there is a susceptibility to pulmonary inflammations use chloroform.

In phthisis pulmonalis, use chloroform.

In collapse, especially that following the loss of blood in shock, as characterized by low temperature, in asthenia, cachexia and in anaemia, use ether, but use it sparingly, because ether has stimulating properties, and because a comparatively small dose of chloroform may produce alarming or fatal cardiac depression.

In alcoholics, if the condition of the heart permits, use chloroform. Alcoholics are so steeped in stimulants that ether is inefficient.

When the liver function is impaired use ether.

In obese and plethoric individuals use chloroform. Ether, by causing marked engorgement of upper air passages, and increased secretion of saliva and mucus, renders respiration difficult.

In goitre, and in all conditions tending to reduce the caliber of larynx, trachea or bronchi, as malignant disease of throat and neck, deep cervical cellulitis, foreign bodies in air passages, foreign bodies in esophagus, asthma, etc., etc., use chloroform.

In empyema, chronic pleural disease, with or without marked secondary pulmonary changes, use chloroform.

In all conditions causing such narrowness of upper air passages as to produce temporary or abiding difficulty in breathing, as tumors of soft palate, larnygeal disease, aneurism pressing on trachea, use chloroform.

NATURE OF OPERATION.

A. Use chloroform in prolonged operations about mouth, nose and pharynx, when mouth and nose must frequently be uncovered; because, owing to the fact that consciousness rapidly returns when the supply of ether is discontinued, its (ether's) intermittent use does not give enough time for prolonged surgical procedure.

B. Always give chloroform when the anaesthetic is to be given through a tracheal canula.

C. In ophthamology use chloroform. Ether, by causing struggling and venous congestion, increases the risk of hemorrhage. Its after-effects, as vomiting, etc., also disqualify its use in ophthalmic work.

D. Use chloroform for tracheotomy, also esophagotomy and in laryngeal operations.

E. Use chloroform in operations in which venous engorgement constitutes a serious difficulty, as in removal of glands at root of neck; tracheotomy; operations on brain and membrane, etc.; with ether the venous system is engorged and incised parts bleed freely. (Hewitt.)

F. In cranial operations, in functional or organic diseases of the brain, use chloroform. Ether produces engorgement of the cerebral vessels, and general engorgement of the venous circulation. By using chloroform we shorten the stage of excitement and lessen the tendency to hemorrhage.

G. In abdominal operations use chloroform. "In abdominal surgery chloroform is better than ether." (Kelly, Baltimore.) Respiration is much quieter under chloroform than under ether. Engorgement of part is considerably less, hence less hemorrhage. Muscular relaxation is more complete. Relaxation of the abdominal parietes is very important in abdominal operations. In some cases, ether fails to secure this. The tendency of patient to cough and strain is considerably less after chloroform than after ether. Chloroform is less frequently followed by vomiting. Ether increases the bronchial secretions. The stagnation of these in the bronchi can excite pathological conditions. After abdominal operation the expelling power by which the bronchi are emptied is lessened, owing to the inhibition by pain and by the incision of the abdominal muscles. Chloroform does not increase the bronchial secretions, and hence is comparatively free from bronchial or pulmonary after-effects.

H. Chloroform is used in obstetrics, and in hep-

atic and renal colic. Its action is quick. It is less disagreeable to take.

I. In operating upon the neck use chloroform. There is less movement of the parts. Ether, by provoking copious salivary and bronchial secretions, hampers respiration and renders it jerky.

J. Chloroform should never be used for extracting teeth. Nitrous-oxide gas is a safe and convenient anaesthetic, and fulfills, with very few exceptions, all the requirements of the dentist. In Lyman's collection of deaths from chloroform anaesthesia (393 in number) there are thirty deaths that occurred under chloroform anaesthesia induced for removal of teeth.

K. Chloroform should not be used for minor operations, such as removal of ingrowing toe-nail, opening of superficial abscess, or when local anaesthesia fulfills the requirements. "A very large proportion of deaths from chloroform anaesthesia have occurred with minor operations." (Hewitt.)

L. In the operation for removal of naso-pharyngeal adenoids use ether, if local anaesthesia is unsuitable. Hinckel has collected eighteen cases of death under chloroform in this operation as occurring within the last five years. During this same period there was only one case of death from ether administered for throat operation. This operation was a tonsillotomy. Dr. Paltauf says: "As a result of enlargement of the thymus gland, and

other lymphoid structures, there is a particular predisposition of the individual to cardiac syncope." Syncope is a common mode of death under chloroform anaesthesia. Brickner says: "In anaesthetizing patients of the lymphatic temperament, or in whom lymphatic enlargements or adenoid vegetations exist, chloroform should be rigidly interdicted." The posture usually given to the patient in this operation, sitting or semi-recumbent posture, render the use of chloroform inadmissible. For the removal of naso-pharyngeal adenoids, Coulter, Hawley and many other laryngologists make use of bromide of ethyl anaesthesia.

M. In rectal surgery give ether. Deep narcosis is here required. The rectal reflex is a late reflex to depart. Deep ether narcosis is less dangerous than deep chloroform narcosis.

POSTURE OF PATIENT.

Chloroform is the safest anaesthetic for laparotomy in Trendelenburg's posture. (Garrigues, Cleveland, Goodell, Sutton.) This position tends to produce congestion of brain. Ether has this same property. Both causes combined may cause rupture of cerebral vessels.

Any operation that must be performed in the upright, sitting or semirecumbent posture, forbids the use of chloroform anaesthesia. As to the knee-chest posture, it is not a position for anaesthesia.

In the prone posture give ether. In this position the face, the eyeballs, the pupils are more or less concealed from observation, the pulse is not as easily watched as in the dorsal position, therefore the respirations are our main guide as to the condition of the patient. The breathing under ether is strong and audible, hence the value of ether when this posture must be maintained during the course of the operation.

If in a previous anaesthesia the patient has taken ether very poorly the selection of chloroform is proper. The same also applies to chloroform.

If the anaesthetist is inexperienced ether is the anaesthetic to be chosen. Ether kills slowly, gives plenty of warning. Chloroform gives no warning whatever, and kills quickly.

PREPARATION OF PATIENT.

1. Ascertain condition of heart, lungs and kidneys of patient. It will guide you in your selection of the anaesthetic agent. Knowing the physical condition of your patient, you will be on the alert for possible accidents and be better prepared to meet them. By carefully preparing your patient for the ordeal of anaesthesia, you greatly minimize the dangers incident to this condition. "It is far better to err on the side of an unnecessarily cautious investigation than to overlook symptoms which if recognized would be of ser-

vice in conducting the administration of the anaesthetic." (Wm. S. Deutsch.) An existing bronchitis should be palliated or cured. If the operation is one of a certain duration, and the examination of the urine reveals the presence of albumin and casts, place patient on a milk diet for a few days previous to the operation. Especially is this indicated if the daily passage of urine is much below the normal.

2. Toilet of naso-pharyngeal passages. Cleansing of naso-pharyngeal mucosa. Ether promotes separation of foreign substances from naso-pharynx. The aspiration of these irritating morbid products (dessicated secretions), with their lurking micro-organisms, from the higher to the lower respiratory passages, can set up bronchial or pulmonary inflammation. An existing rhinitis should be palliated or cured. If a nasal obstruction to free breathing exists, it must be attended to.

3. Mouth wash of some efficient and pleasant antiseptic solution, as listerine or borolyptol.

4. Examine the eyes. If patient has a glass eye remember it. Note the degree of dilation, the regularity and the mobility of the pupils.

5. Examine joints for anchylosis. "An anchylosed elbow not previously noticed may lead you to believe the patient is not relaxed, and in your endeavor to secure complete muscular relaxation the anaesthesia will be pushed too far."

6. Order a hot bath, when practicable, on the day before the operation. It assists the emunctory function of the skin.

7. Bowels should be evacuated on the night before operation by a laxative. An enema should be given on the morning of the operation. This lessens the nausea and vomiting. (Buxton.)

8. On the night before the operation give patient a hypnotic, so as to secure a restful night.

9. Patient's bladder to be voided on morning of the operation. In abdominal operations the patient is to be catheterized before beginning the administration of the anaesthetic.

10. In women, hair should be tied in towel or cap.

11. All head jewelry, such as earrings, combs, etc., to be removed.

12. In cases of intestinal obstruction attended with fecal vomiting, as strangulated hernia, etc., lavage of stomach before administering the anaesthetic lessens the danger of emesis during the course of the operation. The entrance of fecal vomit into the trachea causes either pneumonia or death.

13. The best time for an operation of election is early in the morning or early in the afternoon. These are the periods of greatest vitality. Late in the day the body is fatigued. "Individuals are more liable to after-effects of an unpleasant char-

acter when their bodily condition is one of nervous exhaustion and lowered vitality." (Willard and Adler.)

RULES APPLYING TO BOTH ETHER AND CHLOROFORM.

1. The temperature of the room in which ether or chloroform are to be used, should not be below 70 deg. F.; when the trachea or abdomen are to be opened not below 85 deg. F.

2. The anaesthetist should be provided with a clean apron and clean towels; pledgets of gauze (plain); Allis inhaler; Esmarch's inhaler; two long artery forceps, to serve as gauze-sponge holders; mouth-gag; tongue forceps; hypodermic syringes—one with strych. sulph. gr. 1-20, the other with tr. digitalis, m x-xx; cosmoline or other bland fatty substance; rubber catheters; tracheal canula. Strychnine, digitalis and ammonia are the most serviceable drugs in the accidents of anaesthesia. Nitrite of amyl, caffeine and atropine are of little or no use in chloroform poisoning. (H. C. Wood.)

3. Anaesthetics must not be self-administered. Up to 1880, there were 20 deaths on record from self-administration of chloroform. (Lyman.)

4. Before beginning to give the anaesthetic, scrub hands with soap and water and put on a clean apron. It is cleanly. It makes a good impression.

5. Always clean cone or mask, sterilization is preferable, before each anaesthesia. This will promote the comfort of patient, cleanliness and non-conveyance of infection.

6. Always satisfy yourself of the purity of the drug that you are going to administer. Enydahl attributes his great success with anaesthesia to the absolute purity of the ether which he uses. "Impure chloroform is very dangerous to life." (Hare.) Perrin cites fatalities due to impure chloroform. The impurities of chloroform, such as chlorine and hydrochloric acid, lengthen and intensify the stage of excitement, aggravate the irritating action of chloroform upon mucous membranes, and increase the liability to sickness during and after anaesthesia. They are said to favor the production of cardiac and respiratory syncope. Tasse says, "Impure chloroform is capable of poisoning the nervous system, producing paralysis, and transient or permanent albuminuria." The purity of ether may be tested by adding to it a small amount of oil of copaiba. Clearness of solution indicates purity of ether; any cloudiness or emulsion indicates impurities. Ether readily develops impurities. It should not be exposed to light. Can should be kept closed. To ascertain purity of chloroform, dip pure absorbent paper into chloroform, and allow to evaporate. Pure chloroform leaves no odor. If the chloroform tested is impure, a more or less

irritating, unpleasant smell remains. Chloroform should be kept in glass-stoppered, dark-colored bottles. The addition to chloroform of a small quantity of ethylic alcohol 1-1000, prevents its decomposition.

7. Win the patients' confidence, reassure them as to the outcome of the operation; tell them that there is no cause for alarm, that anaesthesia has no dangers. Heart can be made functionally incompetent by fright. "The element of fear can easily lead to heart failure." (Richardson.) Fatal result taking place within a few minutes after the commencement of the inhalation of the anaesthetic can be caused by syncope, the effect of fear. Anxiety and fear are heart depressants, and may produce dangerous, and even fatal, symptoms. Examples: Desault was about to perform a lithotomy; to demonstrate the line of incision, he drew his finger-nail over the patient's perineum. The patient uttered a loud cry and suddenly died. Cazenave was about to operate on a very nervous patient. He did not give chloroform, but made a pretense by putting a towel over patient's nose. The respiration and heart stopped. The patient was dead.

8. Always give the anaesthetic upon an empty stomach. The patient should not, however, be kept too long without food. If the patient is kept too long without food, bile is apt to flow in

stomach and induce vomiting during anaesthesia. Five to six hours should have elapsed since food was last taken. By taking this precaution the tendency to vomiting is lessened. "Vomiting is almost a constant sequel in those who have inhaled the drug upon a full stomach." (Hare.) In operations upon stomach and intestines, Dr. McBurney washes out stomach previous to anaesthetizing patient. Vomiting is annoying to the anaesthetist; it retards the production of anaesthesia; it can produce harm by disturbing the relation of wound flaps, by giving rise to hemorrhage from cut vessels imperfectly blocked, by disturbing and soiling dressings. In abdominal operations it causes a protrusion of intestines; aspiration of vomited matter can cause: aspiration pneumonia and asphyxia; a distended stomach impedes the heart's action; vomited matter may lodge in the esophagus, and from there compress trachea and cause asphyxia.

9. The anaesthetist should be behind the patient's head, or at side of head.

10. Always, when the nature of the operation allows it (and there are very few operations that do not), anaesthetize patient in the recumbent posture. The giving of chloroform to a patient in the sitting posture is an unjustifiable error. The Hyderabad commission insists that chloroform be given in recumbent position. The recumbent pos-

ture is to be selected because it facilitates the circulation between the heart and the brain, thereby lessening the tendency to syncope. Failure of respiration in chloroform narcosis is due to anaemia of the respiratory center. The horizontal posture does not favor this anaemia; the sitting posture does.

Force of gravity has a marked influence upon the circulation. The sitting and vertical postures cause a fall of blood pressure in the carotid arteries, the horizontal posture restores the blood-pressure in these vessels to its normal state. Chloroform lowers the blood pressure by its depressing action on the vaso-motor apparatus, and on the heart and its contained ganglia. The upright, sitting, and semirecumbent postures lower the blood pressure in the cranial and cervical vessels. Chloroform and faulty position acting together produce an anaemia of the medulla oblongata. From this anaemia, if it be sufficiently marked, results syncope.

The splanchnic vaso-motor mechanism controls the abdominal vascular area. Chloroform paralyzes this mechanism. This paralysis allows dilatation of the abdominal veins, and in the sitting and similar postures, the force of gravity aiding, the blood drains into these veins, the right heart is emptied and the cerebral circulation fails.

It is the most convenient position for the anaesthetist. It gives him a better view of the face, of the pupils, of the respiratory movements of the patient and enables him to easily palpate the facial or temporal artery. These arteries keep him informed of the patient's heart action. In this position, he can easily prevent tongue from falling backward by pressing and keeping forward, with little and ring finger, the rami of jaw. He can easily feel the expiratory current of air, by putting thumb occasionally over the patient's mouth, thereby ascertaining that the patient is breathing. This is important because the epigastric region may rise and fall, and still no air enter the lungs. He can easily hear the respiratory murmur. He can better watch action of the diaphragm.

The position admits of better expansion of chest. For the safe administration of chloroform and ether, expiration must not be impeded. This condition is only obtained in positions that permit the lungs to expand and contract freely. To secure this full expansion and contraction of the lungs, in addition to suitable position, the air passages must be straightened out, the glottis must be free, and the tongue prevented from falling back. The side position impedes respiration, and especially is this marked when a pleural effusion is present. When the heart's action is interfered with, by old adhesions, by tumors, etc., the side position greatly

increases the tendency to heart-failure or syncope.

The prone position hampers respiration, (a) by preventing free expansion of chest, (b) by preventing descent of diaphragm, owing to the pressure exerted in this position on abdominal wall and viscera. "Knee-chest posture must never be used in anaesthesia." (Hewitt.) In obstetrics, semi-lateral position can be used.

In laryngeal and abdominal operations the Trendelenburg position is very satisfactory. The anaesthesia, however, must be started in recumbent posture, and when patient is under the anaesthetic, position is changed. If in the Trendelenburg position, the cyanosis of face becomes marked, patient must temporarily be returned to horizontal position.

In operations upon naso-pharyngeal adenoids, if the operator insists upon sitting posture, begin administering the anaesthetic in the recumbent position, then, once patient is anaesthetized, slowly raise him to sitting posture and have head and shoulder well thrown forward. (Hewitt.) This position is favorable for the escape of blood. Never use chloroform in this position. Henry Davis, in the British Med. Journal, for the removal of naso-pharyngeal adenoids, advises having patient on back, with head drawn over the table, as in the method now so frequently employed for staphylorrhaphy. He says that in this position, blood can-

not trickle downward in the larynx, but that it collects in the roof of the pharnyx, which in this position forms, as it were, a cup from which the blood and fragments of adenoid tissue can be easily removed.

PRECAUTIONS BEFORE AND DURING ANAESTHESIA.

11. In operations upon throat, elevate shoulders and keep head pendent so that blood will not gravitate into the trachea.

12. Always have patient's mouth free from false teeth, chewing gum, or other foreign bodies, before starting to administer the anaesthetic. Foreign bodies interfere with respiration. If an emergency arises demanding the rhythmic traction of the tongue they are in the way. They may slip into the trachea, and cause pneumonia or asphyxia. Case 242. Lyman's collection: "A patient was passing into stage of insensibility, her respiration became laborious, her countenance livid, her pulse weak, and all symptoms of suffocation appeared. She coughed up some bloody mucus and died. The tongue was pulled forward and with the finger a metallic plate of artificial teeth was drawn out of pharnyx. Death from suffocation." In children look for loose temporary teeth, so as to be on guard, in case the use of the tongue forceps becomes necessary. Rough handling can dislodge a tooth, and its intrusion into the trachea can cause suffocation.

13. Always see that all articles of dress are loosened and that there are no constrictions about waist or neck, because such constrictions impede the circulation and the respiratory movements. The Hyderabad Commission found that tight lacing greatly increased the risks of chloroform administration, on account of the imperfect respiration and the consequent tendency to asphyxia to which it gave rise.

14. Always smear nose, chin and lips with vaseline or cold cream, or oil, or glycerine. Ether and chloroform irritate the skin and the mucous membranes. By taking this precaution, the patient is protected from an annoying postoperative erythema or dermatitis. "Applied to the skin, chloroform is a powerful irritant, and if the contact be prolonged and evaporation be prevented, vesication will ensue." (Willard and Adler.)

15. Always cover the eyes of the patient with a folded towel or piece of gauze. This is to prevent the irritation of the conjunctiva that follows its exposure to the fumes of ether or chloroform. It also protects the eyes from any ether or chloroform that might accidentally be spilled on the face. Once complete anaesthesia has been induced, this can be removed so as to enable you to watch the pupils.

16. Keep the patient's arms to side of body, and feel pulse at facial or temporal arteries. See that

arms do not hang over sharp edges of operating table. See that they do not lie between the border of the operating table and the body of the operator or any of his assistants.

Among the cases of postanaesthesia paralysis reported, some of them have been due to compression, others to traction of brachial plexus or some of its branches by the arm having been pulled over head of patient. Others have been due to the arm having been caught as in a wedge between the operator and the operating table. The elevation of the arms lessens the costo-clavicular interspace, and thus can cause compression of the brachial plexus or of some of its branches.

17. Let there be no unnecessary exposure of patient's body to cold. Maintain his body-temperature before, during and after the operation. Have his bed warmed by hot bricks and hot-water bottles. See that he does not lie in a puddle of cold water during the course of anaesthesia. Object: To prevent chilling of body and consequent bronchitis and pneumonia. In discussing after-ether pneumonia, Buxton says: "That removal of the patient to a cold ward after he has been in a warm operating room and subjected to severe surgical shock, has been the true cause of the lung trouble in many cases." Chilling of the surface of the body, produces congestion of the internal organs. Hyperaemia of an organ predisposes it to

inflammation. If to the hyperaemic condition of the renal and pulmonary parenchyma is added the irritating action which attends the inhalation of ether and of chloroform (not as marked with chloroform) by the lung, as well as their elimination by the kidneys and the lungs, inflammation can easily be excited in these organs. Prevention is more certain than cure.

18. Remember that all methods that employ a large quantity of anaesthetics are faulty. All methods involving marked asphyxial symptoms are subject to grave objections.

19. Never crowd the anaesthetic. It is the large dose inhaled at once that causes death. If the operator asks of you to push the anaesthetic, bear in mind, that though his time may be very valuable, the patient's life is much more so. During my interneship at Cook County Hospital, I witnessed two deaths that were caused by crowding the anaesthetic. "The pushing of the anaesthetic vapor so as to get a rapid anaesthesia at all risks, is as dangerous a plan as could be possibly devised." (Sir B. W. Richardson.) "Hasty saturation of tissues with a powerful anaesthetic, may cause speedy death." (Hare.) Pushing the inhalation of a poison from the start overwhelms the vital centers, while its slow administration habituates them to it.

20. Never give an anaesthetic to a woman unless

a third person be present. This is suggested for the comfort of the patient and for your protection. There are cases on record where the patient has accused her medical attendant of assault while he had her under the effects of the drug. These accusations were brought forth either for the purpose of blackmail, or because the patient had experienced, during the anaesthetic sleep, an orgasm of which the anaesthetizer appeared to be the cause.

21. In giving an anaesthetic, do not relax your vigilance from the beginning to the end. Deaths have occurred in all stages of anaesthesia. Accidents are sudden, and, not to be fatal, must be detected at their inception. The anaesthetist should not watch the operation. (Phocas, le Nord Médical.)

22. Do not, as a routine measure, complicate anaesthesia by the use of such agents as morphine, atropine, etc. By their action on the respiration, on the pulse and on the pupils, they mask the patient's real condition. There are exceptional instances where these agents can be properly used. Morphia, given previous to beginning the administration of the anaesthetic, increases the liability to vomiting during anaesthesia. Analysis of 15,000 anaesthesias collected by the Society of Scandinavian Surgeons (March 1, 1894, March 1, 1895) showed that vomiting occurred in ether anaes-

thesia without injection of morphine in 14 per cent; with morphine, in 25 per cent. Chloroform, without injection of morphine, in 10½ per cent; with morphine, in 14 8-10 per cent. Morphine is a respiratory depressant. Morphine interferes with the motility of the iris. Those agents, such as morphine and atropine, interfere with means employed for resuscitation if the patient gets into a dangerous condition. For instance, the effects of morphia would last longer than the effects of the anaesthetic, and the morphia could not be counteracted by any other drugs than those that would be employed to resuscitate the patient from the anaesthesia-narcosis.

23. During anaesthesia, from time to time, turn patient's head to either side so as to allow the escape of loosened secretions from mouth and nose. Rotation of head on trunk has little or no influence upon respiration. This procedure facilitates the outflow of mucus and saliva from mouth. These, during anaesthesia, tend to induce cough, and if swallowed, favor retching and vomiting. Coughing, retching and vomiting, when caused by swallowed saliva, and mucus, mislead us into thinking that patient is recovering consciousness, and incite us to give him more of the anaesthetic than he needs.

24. Should the patient to be anaesthetized suffer from partial or complete nasal obstruction, place a

small gag between his teeth, before commencing the administration of the anaesthetic. Partial nasal occlusion is liable to become complete during anaesthesia, by reason of the increased vascularity of the parts. In all operations about mouth, pharynx and lower jaw, it is a good rule to introduce gag, at an early period during the induction of anaesthesia. When the tongue is the seat of the growth, pass a thread through its tip before muscular relaxation sets in. This thread will give you a better control of tongue. Should the tongue fall backward, thereby mechanically preventing the entrance of air into the lungs, by pulling thread, you can easily pull tongue forward. In operations about face, Souchon's apparatus is very serviceable.

25. Sudden change from recumbent to vertical posture during anaesthesia must be avoided. Danger of syncope.

26. Room, in which the anaesthetic is administered, must be quiet. Conversations and noises excite the patient's attention and retard the production of anaesthesia. If there is a burning gas-jet in the room, see that ventilation is assured. Chloroform, in being decomposed by the gas-flame, liberates free chlorine. This gas is a respiratory irritant, and can cause bronchial irritation in operator and assistants, and asphyxia in patient.

27. Have patient's head on level with body.

"Keep patient's head in extension, but not dropped backward over end of table." (Hare.) Flexion of head on neck, lessens the caliber of air way and favors stertor and respiratory embarrassment. "Extension and projection forward and backward, both pull epiglottis away from glottic opening, but in the latter posture, the soft palate is strapped over dorsum of tongue and the patient is forced to breathe through his nose, which is often partly or entirely occluded by mucus, by hypertrophies, whereas, when the head is extended and projected forward, the patient can readily breathe through both mouth and nasal chambers." (Hare.) If patient insists upon having pillow below head, remove it as soon as he is asleep.

28. Keep jaw forward and upward. Falling down of jaw is attended by falling backward of the tongue. The tongue in falling back carries with it the epiglottis, and this by falling back prevents entrance of air into lungs.

29. Operators must minimize the duration of operations to time consistent with their proper and thorough execution. Because, the longer the operation, the more anaesthetic required. Anaesthetics are dangerous per se. Chloroform is a virulent protoplasmic poison. Ether produces a marked diminution in the amount of hemoglobin. The shorter the anaesthesia, the less liability there is to after-vomiting and other disagreeable after-

effects. The danger of death is present as long as the anaesthesia continues.

30. Warn patient, especially if he be an adult, that at first a sensation of choking will be experienced, but that it will soon pass off. When that feeling of suffocation comes, he will feel less alarmed, knowing that he is experiencing the expected. Tell patient that he must not struggle.

31. Patient's struggles should be quietly but resolutely restrained. When a patient struggles, he holds his breath. This is disadvantageous, because any obstruction to breathing is very likely to impede the heart's action. If breath is held for any length of time, pulmonary circulation and right side of heart become engorged. With ether, the cause of struggling is generally too strong a vapor being administered from the commencement. Give patient a breath or two of fresh air. During struggling, pushing of ether is dangerous.

32. Struggling in chloroform or ether anaesthesia may be due to fright, which may lead to resistance. Avoid fright by calming patient's fears; to choking or asphyxia, generally due to cap being held too close to patient's face and to non-sufficient admixture of fresh air with the anaesthetic. Avoid it, by holding mask not too close to patient's face at beginning of anaesthesia. Give patient a breath or two of fresh air to relieve symptoms; to intoxication:—overdose of chloro-

form or ether. Give patient a breath or two of air. If patient struggles violently, and the breathing becomes abnormally deep, give patient fresh air and do not reapply cap till the breathing becomes normal again.

To summarize, the objections to struggling are based on the facts that it interferes with the circulation and unduly taxes the heart, and that it fixes the thorax and embarrasses and often renders respiration impossible.

33. Encourage patient to take deep breaths. They help to overcome the sensation of suffocation. He must also be told not to hold his breath. By holding his breath, he debilitates his respiratory center, owing to lack of oxygen furnished to it. Then when the necessity of breathing overcomes all other impulses, a gasping inspiration is taken, the center is flooded with the anaesthetic agent, and death may supervene; this is especially liable to occur with chloroform. "Deaths which take place comparatively early in chloroform anaesthesia are due primarily to rigidity, struggling and holding of breath." (Hill, Barnard.) If patient complains of suffocation, and struggles or breathes irregularly, remove mask and allow a few breaths of fresh air. Prof. Jno. Ashhurst recommends the following procedure: "Request patient to blow out. The vapor of ether is so irritating to the throat that it is very difficult to vol-

untarily draw it by deep inhalation, but it is perfectly easy to blow into the cone, and as a full expiration is inevitably followed by a deep inspiration, the surgeon's purpose is most readily accomplished; contrary to what happens when the patient is directed, as is usually the case, to draw in his breath."

34. Encourage patient to expectorate mucus, and during the anaesthesia, if mucus accumulates in pharynx, remove it with gauze sponges held by long artery forceps. Mucus, mechanically, obstructs the entrance of air into the lungs. The swallowing of mucus causes retching and vomiting, both during and after the administration of the anaesthetic.

35. Should, during the course of the anaesthesia, patient begin to vomit, immediately turn his head to one side. By the aid of this measure, the vomited matter will be ejected from the mouth, instead of being sucked into the larynx. Neglect of this precaution has been followed by fatalities. These have, principally, occurred in cases of fecal vomiting due to intestinal obstruction. It is the anaesthetist's duty to see that the vomited matter is removed from the pharynx. Swab out pharynx with a gauze sponge held by long forceps.

36. Remember that in cases where there has been a severe hemorrhage, the amount of anaes-

thetic necessary to maintain safe anaesthesia is small.

37. Should tongue fall backward and embarrass breathing, it is rare that one needs the aid of a tongue forceps to bring it forward. Tongue-forceps often lacerate tongue, and the lesions which they inflict cause suffering for a few days. Use the following method to bring tongue forward. I have often used it, and it has never disappointed me: "With fingers (ring and little finger) push forwards and upwards angles of lower jaw; by this procedure the condyles of lower jaw are thrown, so to speak, on the eminentia articularis. This movement will invariably bring forward the tongue."

INCOMPLETE ANAESTHESIA.

38. Under no circumstances should incomplete anaesthesia be deemed sufficient for even the most trivial operation. See that anaesthesia is complete before the operation is begun. If the operator begins operating before the anaesthesia is complete, it becomes harder and requires more anaesthetic than would otherwise be required to obtain complete surgical anaesthesia. The patient being subjected to traumatic irritation, such as cutting and pulling of nerves, the anaesthetics act more slowly. Another, and still more valid objection to operating under incomplete anaesthesia, is that pain may inhibit the heart's action. Therefore see that there

is complete muscular relaxation, abolition of masseter, palpebral and buccal reflexes, and contraction of the pupils (the latter is not required in ether narcosis, but is indispensable in chloroform narcosis) before an incision is made. The conjunctival reflex, when abolished, does not always indicate a corresponding abolition of reflex action generally. I quote from Brunton: "Sudden stoppage of heart is usually ascribed to chloroform, and, no doubt, concentrated chloroform vapor inhaled into the lungs may arrest the heart. Very commonly, though, it is reflex, and when death occurs in such a case it is due to the want of chloroform and not to its excess. In the great majority of cases recorded, as deaths from chloroform, the statement is made that the quantity used was very small and the anaesthesia incomplete; that these operations, though trivial, were dangerous under imperfect anaesthesia and not at all dangerous when either no anaesthesia was used or when narcosis was complete. The reason for this is probably that when no anaesthetic was given irritation of sensory nerves during operation caused two effects—slowing or stoppage of heart and reflex contraction of vessels. This contraction of vessels neutralizes cardiac weakness, maintains blood pressure and thus prevents syncope. During imperfected chloroform anaesthesia the reflex effect on the heart persists, so that irritation

of a sensory nerve may produce syncope by stopping the supply of arterial blood from the heart. In its weakened state it will not pump enough into the arteries, while the blood still flows rapidly into the dilated capillaries and veins." As Hare says, "The man is suddenly bled into his own vessels as effectively as into a bowl." "Danger of partial anaesthesia lies particularly in not keeping reflex action in abeyance. It is essential that both sensation and reflex action be abolished." (A. R. Edwards.) Imperfect anaesthesia renders patient peculiarly liable to cardiac failure through afference of sensory impressions conveyed from cutaneous or visceral nerves.

39. If operator notices that the patient's blood is becoming dark, he should tell the anaesthetist. Patient is either getting an overdose of the anaesthetic or respiration is obstructed. Withdraw the cap and remove any impediment to the respiration that may be present.

RESPIRATION OF THE PATIENT.

40. See that operator's arms, or those of his assistant, do not rest on chest or abdomen of patient. All things that embarrass the respiratory movements must be avoided.

Watch the rate, the depth, the audibility of the breathing and the degree of stertor. "Throughout chloroformization the respirations must be

constantly watched." (Buxton.) The respirations must be regular, deep and of normal frequency. Throughout the inhalation of the anaesthetic, the breathing must be free and not impeded in any way. The respirations are watched in ether and chloroform anaesthesia, because (a) the character of the respirations gives us information as to the depth of anaesthesia. (b) The rapidity and the depth of breathing govern the amount of the drug inhaled. An amount of anaesthetic which can be given with safety during easy breathing may aggerated respiration. The respirations of the etherized patient are usually deeper, quicker and noisier than those of the chloroform patient.

Movement of the chest wall, or of the diaphragm, is not sufficient evidence that the respiratory function is being carried on properly. The sounds of respiration must be heard, the breath must be felt. If costal respiration becomes feeble, or is replaced by purely diaphragmatical breathing, death will speedily follow if artificial breathing be not immediately resorted to. The value of artificial breathing lies in its property of furnishing oxygen to the blood, of clearing the lungs of anaesthetic vapors and of helping on the circulation of the blood.

Marked quickening of respiration means an overdose of the anaesthetic, unless it is accounted for by reflex action, such as stretching of the

sphincter and working with the mucosa of the rectum, or by some mechanical interference with the breathing, as the presence of mucus in the air-passages. Snoring and stertorous breathing are evidences of profound narcosis. Deep, stertorous breathing is due to paresis of the muscles of the palate. With ether they are not necessarily dangerous. In fleshy individuals, and in patients suffering from nasal obstruction, as hypertrophied tonsils, naso-pharyngeal adenoids, etc., snoring and stertorous breathing will persist during entire anaesthesia. When breathing becomes stertorous, if chloroform is the anaesthetic you are using, cease administration. Then watch for some slight indication of returning reflex action, as a dilating and active pupil, etc. Then give chloroform and reinduce stertor. If ether is the anaesthetic agent used, continue its administration, but in doses just sufficient to maintain the anaesthesia.

If respiration is embarrassed, see that no obstruction to the entrance of air into the lungs is present, as regards improper position of head; foreign body in mouth, pharynx or larynx; falling backward of tongue and with it of the epiglottis; accumulation of saliva and mucus in pharynx. See that patient gets more fresh air. In the stage of excitement breathing is labored. In the stage of surgical anaesthesia, it becomes regular as soon as the muscles are completely relaxed. The slowing

of the respiration is due to the depressing action of the anaesthetic on the pneumo-gastric nerve. In the stage of paralysis or collapse, the respirations are slow, sighing, shallow and finally cease.

There are certain reflexes present during full surgical anaesthesia, such as those excited by dilating the sphincter ani, by the rough handling of the peritoneum, especially the breaking down of peritoneal adhesions, by the compression or rough handling of the ovaries or testes. These reflexes manifest themselves by an increase in the rate and in the depth of the respiration. During their occurrence the amount of chloroform or ether, being inhaled, should be temporarily diminished; as the increased frequency and increased depth of respiration would, were this precaution not taken, lead to the inhaling of an overdose, and to consequent ill effects.

Give chloroform drop by drop; you thereby give it in its most diluted form with air, and lessen the liability of any reflex action on the vagus. An unduly strong dose of chloroform can cause closeure of the glottis. "Sudden arrest of the heart or of respiration in the initial stage of chloroform narcosis has been, experimentally, proved by European observers to be often due to reflex action from the filaments of the trigeminus in the Schneiderian membrane to the vagus." The possibility of this reflex action is much lessened by

giving the chloroform in diluted form, and increasing the strength of the vapor very gradually. To counteract this reflex action, some surgeons spray patient's nasal chambers with cocaine previous to beginning the administration of the anaesthetic.

Direct cause of primary arrest of respiration when ether is given is due to one of the following factors:

a. Irritation of peripheral filaments of trifacial, which reflexly causes spasm of glottis. (Kretzschmar.) This is avoided by giving vapor in diluted form to begin with. If, despite this precaution, it occurs, continuing the administration of the anaesthetic will benumb the peripheral filaments of trifacial, and in that way cause relaxation of glottis.

b. Irritation of the peripheral vagi in the lungs. This inhibits respiratory movements, and momentarily impedes the action of the heart. Here the pushing of the anaesthetic benumbs the peripheral ends of the vagi in lungs and thus puts a stop to the irritation.

c. Spasm of muscular fibres of smaller bronchial tubes induced by the irritant vapor of ether. Continue to administer the anaesthetic, and the muscular fibres of bronchial tubes will soon relax, and breathing will take place. By gradually giving the anaesthetic, that is, gradually increasing the strength of the vapor, the feeling of suffocation and spasm of glottis are rarely produced, and ster-

torous breathing and lividity of face are not frequently seen. In the respiratory forgetfulness which, at times, occurs at the beginning of ether anaesthesia, pour some ether on patient's abdomen. The sensation of cold which attends the evaporation of this substance will reflexly excite respiration.

CONDITION OF THE CIRCULATORY SYSTEM DURING ANAESTHESIA:

41. The condition of the circulation during anaesthesia. Before beginning to administer the anaesthetic, locate the facial or temporal artery. During the course of anaesthesia these arteries are to keep you informed of the strength and of the rate of the heart's action. The color of the face, lips and ears will also give you information as to the heart's condition. The fall of blood pressure, which is the normal condition of anaesthesia with chloroform, is due to the action of chloroform on the vasomotor center in the medulla oblongata. During the stage of excitement the pulse is accelerated, a frequency of 144 pulsations to the minute has been reported. Usually the more marked the excitement the greater the frequency of the pulse.

In the stage of surgical anaesthesia, the pulse loses in frequency, and acquires fullness and compressibility. If the administration is now contin-

ued with care, the pulse will not lose these qualities during the entire duration of the anaesthesia. In the stage of paralysis the pulse is rapid, feeble, fluttering, finally ceasing or stopping suddenly without warning. When pulse becomes rapid, 130 to 160 in children, 120 to 140 in adults, resort to stimulation; use strychnine sulph. gr. 1-20; may speedily lead to fatal collapse, if given during ex- use Tr. Digitalis, m. xv. to xxv. If the pulse seems feeble, slow, irregular, intermittent, the anaesthetic must be withdrawn and fresh air freely admitted till improvement occurs. Respiration and circulation may cease simultaneously on section of a nerve.

There is an increased frequency of the pulse. When, though the thorax is rising and falling regularly, no air is entering the lungs; when patient is about to vomit (pulse also becomes irregular previous to vomiting); after considerable loss of blood; during stage of excitement; during manipulation of considerable portion of intestines; during dilation of anal sphincter; during operations in cervical regions, when cardiac accelerating branches of pneumogastric may be irritated; at the beginning of anaesthesia, pulse may be rapid from fear.

There is a decreased frequency of the pulse in cranial operations; in operations in the cervical regions, when cardiac inhibitory branches of pneu-

mogastric nerve may be irritated; in case of pressure or traction on the diaphragm, during gastric operations.

Sudden stoppage may appear, momentarily, from any of the following causes:

(a) Severing a nerve in amputation.

(b) Sudden escape of the contents of a cystic tumor.

(c) Upon removal of a large abdominal tumor. (In frogs exposure and irritation of the intestines will stop the heart.)

(d) Pressure on testicle or spermatic cord, during hernial operation.

(e) Ligation of an ovarian pedicle.

(f) Spasmodic contraction of diaphragm preceding vomiting.

(g) Dilation of anal sphincter.

42. Condition of the muscular system during anaesthesia. Muscular movements during stage of excitement are violent, purposeless and most always independent of the will. The voluntary muscles are the first to be influenced by anaesthetics. It is important to note that the involuntary muscles are, so to speak, refractory to the influence of anaesthetics. It is extremely rare for patients during anaesthesia to pass urine or to void feces.

The usefulness of obstetrical anaesthesia is based

upon this nonpredisposition of the involuntary muscles to the action of anaesthetics.

In the period of rigidity which precedes that of relaxation, if the breathing stops for more than a moment, practice artificial respiration.

Anaesthesia is not complete before complete muscular relaxation has set in. Perfect relaxation of limbs is an indication that the patient is ready for the operation. During the stage of excitement, patient struggles because he believes himself asphyxiated. Jaws are more or less fixed. Excitement and struggling gradually subside. Buccal paralysis accompanying respiration indicates that patient is going under. A little later snoring and stertorous breathing indicate faucial and pharyngeal paralysis and stage of surgical anaesthesia has been reached.

In the stage of surgical anaesthesia the muscles are relaxed (if the arm is raised it falls back of its own weight); jaws are relaxed. In the stage of paralysis muscles are in the same condition as in the preceding stage. All patients in going under with ether pass through a stage in which there is more or less rigidity. Pushing the ether does not overcome, but prolongs, the rigidity, whereas withdrawing the ether brings relaxation of muscles without return to consciousness.

CONDITION OF CENTRAL NERVOUS SYSTEM.

43. Condition of Central Nervous System: In the stage of excitement, patient seems intoxicated. There is a quick succession of ideas, of strange sensations, of hallucinations. Ideas become incoherent. Patient becomes drowsy. Cerebral torpor overtakes him. Delirium may be mild, may be violent. Excitement and delirium are due to marked hyperaemia of brain. Sensibility is impaired. Stage of surgical anaesthesia: Patient is calm. Brain is anaemic. Sensation is abolished. This is due to suppression of the function of the sensory nerves. State of paraylsis same as the preceding. "Ether," says Hare, "depresses first the perceptive and intellectual cerebral centers, next the sensory side of the spinal cord, then the sensory and motor portions of the medulla oblongata; and with this depression, death ensues." This applies also to chloroform, both drugs acting similarly on the nervous system.

44. Watch the color of the face, lips and lobes of ear. Cyanosis, though more marked in ether narcosis, is of less importance than in chloroform anaesthesia. If patient's face becomes dusky, give him fresh air. In the stage of excitement, follow patient in his efforts to get away from cone or mask and keep it applied to his face.

45. Stage of Excitement: Face is congested.

This congestion is due to the turgescence of the superficial vessels. Stage of surgical anaesthesia, face resumes a more normal color, and may become covered with a viscous perspiration. Stage of paralysis or collapse; face deeply cyanosed and veins distended or face is suddenly blanched. This blanched appearance indicates impending trouble. At slight indication of blanching of the face remove the mask, allow the patient a few breaths of fresh air. Pallor indicates that circulation is depressed either by surgical shock, insufficient breathing, or an overdose of the anaesthetic. A certain degree of pallor and a slow, rather feeble pulse are not necessarily indicative of danger. They often precede vomiting, and, when so caused, need occasion no alarm; they often precede respiratory failure, and by putting the anaesthetist on his guard enable him to avoid this serious condition.

Cyanosis means embarrassed respiration. A turgid condition of veins of head and neck, associated with a dusky color of surface, especially if there be muscular rigidity, with a rapid and irregular pulse and an excited state of the respiration, should always lead to a temporary suspension of the inhalations.

REFLEX ACTION.

46. Coughing and swallowing, in the very early stages of anaesthesia, point to too strong a vapor

and should be met by a diminution in its strength. Should they tend to arise after surgical anaesthesia has become established, they should be met by increasing the strength of the vapor, because they then indicate that the patient is recovering from the effects of the anaesthetic. The function of deglutition during profound anaesthesia is suspended. The presence of the pharyngeal reflex (the act of deglutition excited by the presence of the anaesthetic vapor or mucus) indicates that more of the anaesthetic is required. In the stage of excitement, the cornea is sensitive, reflex action continues, pupil dilates and reacts to light.

Stage of Surgical Anaesthesia: All the reflexes except those of the involuntary muscles are abolished. By keeping these reflexes barely abolished, a patient may be kept in this state for hours. The abolition of reflex action denotes that the operation can begin. By carefully watching the pharyngeal reflex, and keeping it abolished, coughing, retching and vomiting can, with very few exceptions, be prevented during the course of the operation. This is a fact of no small importance, in abdominal, rectal and perineal surgery.

Patient may cough at first; this is due to direct irritation by anaesthetic vapors of the superior laryngeal nerve filaments. This cough is, usually, slight and transitory; however, should it persist

and be associated with dyspnea, suspend the inhalations till quiet is restored.

When stomachic disturbance is evidenced by the rapid dilatation of the pupils, by the spasmodic contractions of the diaphragm, by short, convulsive movements of the abdominal muscles, by rapid, short, jerky respirations, with a pulse of increased rapidity and by repeated efforts at deglutition, vomiting will soon take place, in almost all instances. Pushing of the anaesthetic if it succeeds in abolishing these reflexes, will prevent vomiting. As soon as it is apparent that the patient will certainly vomit, remove mask, turn the head quickly to one side, always to the side away from the field of operation, catch vomit on towel, and clean mouth and pharynx. As soon as vomiting has ceased, resume anaesthesia.

Under ether, the pupils contract at first, and then remain moderately dilated during surgical anaesthesia.

The observation of the pupil is of great importance during chloroform anaesthesia. Its behavior while the patient is under the influence of this anaesthetic, furnishes us invaluable information concerning the stage and the depth of anaesthesia, and the condition of the patient.

The third nerve center which governs the pupil, unlike the respiratory center, is not a vital center. In this stage, the corneal reflex is present, and the

pupil is dilated and reacts. When the patient is going under or coming around, the dilatation and the activity of the pupil that are present are thus explained. The dilatation occurs because mental, sensory and sympathetic impulses affect the half narcotized cerebrum and cause reflex inhibition of the third nerve center. The activity of pupil is due to the fact that the center itself has not been reached by the anaesthetic. A same dilatation of pupil is produced, under ordinary circumstances, by fright, pain or a blow on the abdomen.

As long as the pupil dilates in response to sensory stimuli, such as the pinching of the skin, etc., anaesthesia is not sufficiently deep to allow the commencement of the operation. Vomiting causes dilatation of pupil similar to that which occurs when patient emerges from the anaesthetic state.

State of Surgical Anaesthesia: Corneal reflex is abolished; pupil is contracted; myosis. A contracted pupil is a sign of complete and safe narcosis. We must endeavor to keep the pupil contracted. Operator may now begin. This contraction of the pupil occurs because all the cerebral reflexes are barred and the third nerve center is consequently unimpeded. The center of third nerve is now only inhibited by the light reflex. The same condition occurs in deep sleep.

Stage of Paralysis or Collapse: Corneal reflex is always abolished. Narcotic has reached nerve

center and has gradually overwhelmed it, consequently nerve control has ceased. The pupil dilates widely and the light reflex is abolished. Withdraw chloroform till contraction of pupil occurs as a result of the recovery of the third nerve center. Dilated and fixed pupil denotes danger of imminent narcosis of respiratory center. Respiratory syncope is the most common cause of death from chloroform anaesthesia. Use restorative measures.

During the course of the anaesthesia the pupil may dilate gradually, may dilate suddenly. The gradual dilatation of the pupil denotes that patient is recovering from the anaesthetic. Resume the administration of the chloroform and continue it drop by drop until the pupils again become myotic. Then suspend the administration. In a few moments, when the pupils again show a tendency to dilate gradually, administer some more chloroform, and keep on in this way, always maintaining the pupils contracted. The sudden dilation of the pupils denotes that the third nerve center has been overwhelmed by the anaesthetic. It is a serious condition. It must at all hazards be avoided. This sudden relaxation of the iris, under chloroform, is a part of the relaxation of death. Upon its occurrence, immediately cease the administration of the chloroform, invert the patient, practice artificial respiration, and resort to stimu-

lation. The first three measures are by far the most valuable.

When with symptoms of asphyxia, pupil is contracted and remains contracted (it suddenly dilates in this condition when cause being uncounteracted verges on a fatal result), the asphyxia is due to some mechanical obstruction to breathing and not to an overdose of chloroform. This condition can easily be remedied, and should never prove fatal.

Per contra, if the chloroform be present in an overdose, the pupils are always dilated. The dilating and active pupil of the stage of excitement and of insufficient narcosis can be distinguished from the dilated pupil of deep narcosis or collapse by the greater freedom of the light reflex, by the supervention of other reflexes such as cough, vomiting, irregular breathing and by the absence of the glassy fixation of the eyes so characteristic of profound narcosis.

A FEW POINTS CONCERNING CHLOROFORM ANAESTHESIA.

1. Always reduce to the minimum consistent with full and complete anaesthesia, the amount of chloroform vapor inhaled. It is impossible to find a dosage that will do for all patients. The individual must be studied, and the only person that can do this is the educated anaesthetizer. Do not administer chloroform from a towel. An overdose is too easily given this way. By autopsies and

experiments Heintz (Journ. de Med. et Chir. Prat., October 9, 1898) has proven that chloroform inhaled for long periods produces, through a slow secondary action, pathological changes in the organs, capable of causing death, one or several days after the anaesthesia. By lessening the dose of chloroform, the liability to undesirable after-effects is lessened.

2. Avoid the continuous action of chloroform on the organs by allowing at least one week to elapse between two chloroformizations in the same individual. The elimination of chloroform inhaled is only completely effected in about a week. The secondary action of chloroform exhausts itself also in about a week. Both elimination of the chloroform inhaled and its secondary action must be at an end before more chloroform is introduced in the system. Schenck objects forcibly to the practice common in gynaecological clinics of narcotizing individual patients frequently at short intervals for the purpose of establishing a positive diagnosis.

3. Always be very watchful while administering chloroform to individuals suffering from renal or hepatic insufficiency. These subjects offer to chloroform, as they also do to other intoxicants, as, for instance, sepsis, an impaired resistance.

4. Use an Esmarch inhaler in administering chloroform. Give this agent well diluted with air.

Give it drop by drop. Danger of an overdose is thereby lessened. "Quantity is the all important factor in chloroform anaesthesia. I am convinced that death is nearly always due to unskilful administration, and that unskilful administration is the administration of an overdose." (Waller.) Chloroform should always be given with about 95 per cent of air.

At beginning of anaesthesia, hold inhaler some inches from mouth and nose, so that chloroform will be diluted with air. By doing this the sense of suffocation which is so trying to the patient, and so provocative of struggling, will often be prevented. Asphyxia taking place within a few minutes from the commencement of the anaesthesia can be caused by a too highly concentrated vapor of chloroform. It patient struggles violently, breathes irregularly, or holds his breath, remove cap and have patient take a breath of fresh air before administration is proceeded with.

5. The following conditions, occurring under chloroform anaesthesia, are signs of impending danger:

(a) Sudden dilatation of the pupil.
(b) Shallow, sighing respirations.
(c) Absence of pulse, rapid, irregular or intermittent pulse.
(d) Sudden paleness or sudden lividity of countenance.

A FEW POINTS CONCERNING ETHER ANAESTHESIA.

To administer ether you can use a cone, in the apex of which you stuff some gauze sponges. The Allis* inhaler is a good apparatus.

With it the amount of air can be easily and quickly regulated. With it anaesthesia is begun by a free administration of air and drop by drop administration of ether upon parallel bandages. Drops are rapidly increased in number, so that by the end of the first half minute a tiny stream, resembling a bead-like chain, will be going into the inhaler. At same time, top of the latter is gradually closed in and the administration of air is thus shut off.

If ordinary cone is used, the ether is poured on the sponges and distributed as evenly as possible. Ether should be given so that air is present in the proportion of about 5 per cent while patient is

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* The advantages claimed for this inhaler by Dr. Allis are:—It gives the patient the freest access of air. It is a mistake to suppose that air must be excluded. All that is necessary is that the air should be saturated with the vapor of ether. The inhaler affords a series of thin surfaces upon which the ether can be poured, and from which it will almost instantly evaporate. By leaving the instrument open at the top, the supply can be kept up constantly, if desired; and, as ether vapor is heavier than air, there is no loss by not covering it. The top should never be covered. The inhaler does not cover the patient's eyes, does not terrify him; and he often passes under the influence of the anesthetic without a struggle.

struggling. Always begin administering ether slowly, increasing the amount gradually. Air slightly impregnated with ether the first rule, and ether impregnated with air the second. In using ether do not drench patient with the anaesthetic. In giving ether, it is the safest way to give with the first few inspirations vapor much over-diluted with air and gradually and systematically increase the strength of vapor at each following inspiration. Ether, being irritating to mucous membranes, can, if given too strong, cause spasm of glottis and other serious reflex acts. Once patient is under the influence of ether, decrease the dose inhaled and maintain patient anaesthetic and docile with as small a quantity as possible. On the average, 8-15 minutes are consumed in producing ether anaesthesia. In ether anaesthesia the variations of the pupil do not possess the significance that they do in chloroform anaesthesia. Hence the giving of atropine, though it dilates the pupil does not complicate the anaesthesia as much as it would if chloroform were the agent inhaled. In one hundred cases in which C. L. Gibson gave atropine previous to the etherization, he noticed that it did not prevent vomiting, that it lessened the bronchorrhea, that it acted as an efficient stimulant. The administration of atropine can be serviceable as an aid in preventing bronchial complications. When ether is given in abdominal oper-

ations, atropine, by preventing an hypersecretion of mucus, and that which often results from an hypersecretion of mucus, plugging of the bronchi, will lessen the liability to pulmonary complications. These conditions are serious after abdominal operations, owing to the want of expelling power from inhibition of the abdominal muscles. When giving ether, avoid proximity of lighted gas-jets, candles, etc.

POST-ANAESTHETIC TREATMENT.

1. After patient is returned to his bed, the anaesthetist or an attendant must remain with him until he recovers consciousness, in order to guard against his choking by vomiting, to guard against dropping backward of the tongue, and to detect and control hemorrhage should it occur. No pillow should be placed under his head before he recovers full consciousness. This lessens the caliber of the air-passages, embarrasses respiration, thereby retarding recovery from the effects of the anaesthetic. Have the bed warmed, using hot bricks or hot water-bottles. If the operation has been very bloody, elevate the foot of the bed.

Immediately after discontinuance of the anaesthetic, if the nature of the operation permits it, turn patient on the side, or if this cannot be done, turn the face to one side. Through this procedure, the mucus tends to flow out of the mouth, the

tongue will gravitate into the cheek of dependent side, the respiration will be unobstructed and the stertor will cease. No food should be given until the patient calls for it. The taste of ether is best overcome by moistening the lips with lemon juice.

ACCIDENTS.

The accidents of anaesthesia admit of the following classification: immediate and late. Immediate accidents are those that occur during the inhalation of the anaesthetic or before the patient has recovered consciousness. In meeting these accidents promptitude of action is imperative. For example, in cessation of breathing, artificial respiration must be practiced immediately, as chloroform can kill the patient between the suspension of respiration and its attempted respiration by artificial means.

1. Ether, being explosive, if administered near a lighted candle or other flame, an explosion can occur. If it does,

   (a) Instantly cover patient's face with towel or pillow to prevent burning.

   (b) Remove ether and ether cone from vicinity of flame.

2. During the period of muscular rigidity which precedes that of relaxation, the breathing sometimes ceases. Dash some ether on abdomen. Practice artificial respiration, if condition persists.

3. Asphyxia.—It is a grave condition. If it be due to falling back of tongue, foreign body, or other mechanical obstruction, remove the impediment. These conditions will not occur, if proper precautions have been taken. If asphyxia be due to a mechanical obstruction, it must be removed, otherwise artificial respiration will be ineffective.

b. Tetanic fixation or relaxation of respiratory muscles. Practice artificial respiration. Sylvester's method is the method I have always used. Most authorities prefer it to the other methods.

4. Syncope.

a. Initial.

b. Secondary.

(a) Initial syncope, due to a sudden arrest of the heart's action. This has only been observed in chloroform anaesthesia. It occurs at beginning of anaesthesia, and is attributed by some authors to a pathological condition of the nervous system, favoring an abnormal and rapid saturation of the whole or of one of the most important parts of the nervous system.

(b) Secondary syncope, occurring more or less rapidly during the course of anaesthesia, and usually during the surgical period when the patient is subjected to the depressing effects of the operation, to hemorrhage, etc.

Immediately ascertain if the air passages are patent (as long as the glottis is closed, no air can

enter the lungs). Protect wound by covering it with sterile gauze-dressing, invert patient, and practice artificial respiration.

Inversion of patient is the most efficient measure to reestablish the circulation of the blood in the brain. It is the most efficient procedure to combat syncope. It should always be resorted to.

Artificial respiration exercises great influence upon the circulation and the respiration. "In Sylvester's method of artificial respiration, it is important that the assistant should grasp the feet and keep them motionless. If this is done, extension and upward traction of arms above the head, elevate and dilate the chest. This holding of feet is especially indicated in children as the lower segment of the body readily follows the chest in its upward movements." Always begin artificial respiration by the act of expiration. By beginning by inspiration, you would promote further absorption into the blood of the anaesthetic vapor present in the bronchi, the bronchioles and the air-vesicles. Bring arms down close to body, compress firmly the thorax, and then elevate the arms.

OTHER MEASURES TO COMBAT SYNCOPE.

1. Medicinal measures may be used. You must not rely on them exclusively. Strychninae sulphas is the best agent, it raises arterial tension, and deepens the respirations. Digitalis, ammonia.

2. Excitation of skin by various agents.
Heat, cold, flaggellations, electricity.

3. Stretching of sphincter ani. Value is greatly exaggerated. Anal dilatation does effect the respiratory function. Its action, however, in very deep narcosis is doubtful. For discussion on this procedure, see Transactions American Inst. of Homœopathy—1896, 1897.

4. Insufflation of air into lungs through trachea. Introduce catheter or similar body into trachea and insufflate air either with mouth or with bellows. An excellent method.

5. Laborde's method of rhythmical traction of tongue. Tip of tongue being grasped, it is drawn out of mouth regularly sixteen times a minute and by reflexly stimulating the respiratory center, it renews respiratory movements in apparently hopeless cases.

6. Massage and compression of heart. If the above methods fail to restore respiratory action, the patient must not be abandoned until tracheotomy followed, if necessary, by prolonged artificial respiration or insufflation has been resorted to. Tracheotomy facilitates the access of air to the lower respiratory regions. The accumulation of mucus, the falling backward of the tongue, the constriction of the jaws and other causes contributing to the obstruction or closure of the glottic orifice, render the passage of air to the lungs

through the upper respiratory passages difficult, if not impossible. This operation, supplying a new route, meets an important indication. The operation is benign. Being practiced upon sound tissues, the canula can soon be removed after recovery of patient from anaesthesia and healing by first intention results early.

VOMITING AFTER ANAESTHESIA.

"There is no specific to prevent vomiting after anaesthesia." (Cheever.)

1. The following procedure is often very serviceable and effective: Saturate a towel with fresh strong vinegar, and hold it a few inches above patient's face. It should be used directly after the administration of the anaesthetic has been discontinued, and kept up as long as indicated. It is free from toxic effects and can occasion no harmful conditions. The theoretical explanation of its action is that, free chlorine, one of the products of chloroform, is neutralized by the acetic acid. (Lewin.) Chlorine acts as a marked irritant to the pharyngeal mucous membrane and induces vomiting, but the acetic acid soothes the irritated parts and neutralizes the chlorine at the same time.

It has also been claimed that vinegar by its pungency stimulates the respiratory mucous membrane, promotes normal secretion and by its soothing action on peripheral nerve filaments of part,

lessens the irritability of the pneumo-gastric and of its centers and thereby controls reflex condition of vomiting.

2. Application of mustard plaster to hypogastrium.

3. Acetanilid.

Caffeinae cit.

Camphor monobr. aa grj. every hour till vomitting ceases.

4. Cerium oxalate.

5. Gastric lavage, with lukewarm solution.

6. Hot water with sodium carbonate. (Parmenter.)

7. Wine of ipecac—one drop on tongue every hour for two or three hours.

Late:

Headache. Usually requires a night's rest for its removal. Coal tar products are of service.

Anaesthetic chill (rare).—In many cases the chill is chiefly due to the operation. Warm bricks, hot water bottles, rubbing of body with alcohol, rubbing with warm camphorated oil.

Anaesthetic stupor.—If this state is prolonged, patient must be stimulated, rubbed with alcohol, made to inhale plenty of fresh air, gentle flagellation of thorax resorted to.

Persistent singultus.—Dram doses of Hoffman's anodyne. Musk, chloral.

Jaundice.—No special treatment.

Post-anaesthetic paralysis.—That of similar paralysis due to other causes. Treatment of post-anaesthesia paralysis should be preventive as avoiding forced elevation of arm, watching to see that the arm or member is not compressed against edge of table, etc., etc. "Local faradization is indicated in paralysis from compression, and passive movement of the articulation to prevent stiffness. If the electric tests disclose degenerative atrophy or severe reflex paralyses, localized electric treatment is contraindicated. In the latter case, the reflex medullary irritability should be soothed with static electricity, and possibly revulsion on the spine with spark friction." (Mally, Revue de Chirurgie.)

LOCAL ANAESTHESIA.

CHAPTER II.

"To perform operations under general anaesthesia when they are certainly practicable with one or another form of local anaesthesia, I must, from the standpoint of humanity, denounce as absolutely unjustifiable."—Schleich.

Local anaesthetics are employed to abolish, by their topical application, the sensibility of a part for more or less prolonged periods, during diagnostic, therapeutic and operative procedures of various kinds. The number of substances that have been proposed and used as local anaesthetic agents is great. Very few have found wide acceptance. Very few have remained popular for any length of time.

Among the discarded agents can be mentioned:

(a) Brucine in five per cent solution. This agent was abandoned because it did not give uniform results; it was not readily absorbed, and had none of the advantages of cocaine.

(b) Eucaine, which has been and is still used by some as a local anaesthetic. It is less toxic than cocaine; it is irritating to the tissues; its injection into the tissues causing pain; it causes a hyperaemia of the tissues, the increased hemorrhage attending its use obscuring to a certain extent the field of operation. The anaesthesia

produced by it is of shorter duration than that induced by cocaine. Though it is less toxic than cocaine, it possesses disadvantages that make the latter far superior to it for general use.

(c) Guaiacol dissolved in olive oil has been used as a local anaesthetic. It has not met with general favor. It is still used in selected cases by its introducer, Lucas-Championniere, and his personal admirers; it does not produce anaesthesia as rapidly as cocaine or the infiltration method; it can, by its vaso-constrictive action, cause sphacelus; it does not always procure anaesthesia; there is much smarting at the periphery of the area into which the fluid is injected and this smarting lasts longer than the anaesthesia.

(d) Carbolic acid is employed as a local anaesthetic. It exerts a destructive and caustic action on the tissues. It does not penetrate deeply.

Antipyrin is valuable to obtain anaesthesia of the urinary bladder. Its anaesthetic power is less than that of cocaine, but it has the advantage of being less toxic. Surgical local anaesthesia can be induced by the aforenamed and other less valuable agents. It is neither necessary nor practical for the medical practitioner to have a thorough and complete knowledge of every agent that can induce local anaesthesia. It is far wiser and of far more utility for him to confine himself to the use of those local anaesthetic agents, the value of which

is universally acknowledged and to master thoroughly the technique of their administration. Experimentation is legitimate and commendable when carried on in laboratories and in large public hospitals by experienced men. Private patients, however, pay to be healed, not to be immolated on the altar of science, hence the busy general practitioner must accept the teachings of, and adopt the methods sanctioned and employed by the specialist.

Local anaesthesia is nowadays generally induced by one of the following methods:

(1) Refrigeration—(a) cold; (b) evaporation of ether; (c) ethyl chloride, etc., etc.

(2) The use of Cocaine—(a) applied superficially; (b) injected subcutaneously; (c) with the cataphoric action of the galvanic current.

(3) The infiltration method.

The principle being to infiltrate the entire field of operation with fluid as indifferent as possible to the organism.

Local anaesthetics in the present state of our knowledge can not entirely displace general anaesthetics. General surgical anaesthesia and local surgical anaesthesia have each their respective indications and limitations, each their respective advantages and disadvantages.

ADVANTAGES OF LOCAL OVER GENERAL ANAESTHETICS.

The advantages which local anaesthetics possess over general anaesthetics are:

1. Minor operations with local anaesthesia can be performed without assistants. This is a matter of importance to the country practitioner who can not as easily obtain skilled assistants as his city brethren. This is also important when there are no means with which to compensate an assistant.

2. Greater rapidity of action. Their use does not entail the loss of time incident to putting patient under the influence of a general anaesthetic.

3. Headache, nausea, vomiting, etc., do not follow their use.

4. Their use does not give rise to any serious after effects. Nephritis, pulmonary inflammations, paralyses and other pathological states have occurred consequent to the inhalation of general anaesthetics.

5. General anaesthesia is always accompanied by more or less depression or shock. After minor operations, under general anaesthesia, the shock or depression is often due to the ether or chloroform administered.

6. There is a mortality inherent to the use of general surgical anaesthesia. The dangers of gen-

eral anaesthesia are, however, dependent more on the experience of the anaesthetist than on the drug itself. Skilled anaesthetists rarely have fatalities. Lawrie of India reports 45,000 chloroformizations with no death. The mortality of local anaesthetics, when cautiously used, is practically nil. They can be used when the patient is too ill to take a general anaesthetic with safety. In cases where there are grave objections to the employment of general anaesthesia, major operations can be performed under local anaesthesia. Amputation of the thigh has been successfully done under cocaine anaesthesia.

With general anaesthesia the operator has to work in a constrained position. This is not the case with local anaesthesia.

8. Local anaesthetics do away with the apprehension and fear which most people have against being put to sleep with a general anaesthetic. Hence, surgical interventions can be more timely, more opportune. Patients are not so afraid of local anaesthesia as they are of general anaesthesia. While they are thinking over the advisability of taking a general anaesthetic, the pathological processes progress.

9. The technique of their administration is comparatively simple. No previous preparation of the patient is required. In operations about the face, throat and nose, any apparatus used

(Souchon's excepted) to produce general anaesthesia embarrasses the operator, interferes with his operative manipulations.

10. Operator does not lose patient's cooperation and guidance. Patient remaining conscious, operations about the oral cavity under local anaesthesia are not attended with the danger of deglutition of blood, of aspiration of blood and foreign bodies as teeth, etc., in respiratory passages. The patient can be of aid to the surgeon by opening his mouth, thus doing away with the use of the mouth gag to maintain jaws apart, can expectorate any blood accumulating in mouth. The patient being conscious, there is no danger of tongue falling backward, occluding the glottis and causing asphyxia, no danger of tooth or foreign body being swallowed. In operations on hands or feet in which cut tendons have been sutured, when one wishes to find out whether the ends have been correctly adjusted, voluntary motion supplies at once the physiological test.

11. Local anaesthetics do away with the retching and vomiting that so often accompany the induction of general anaesthesia. This retching and vomiting are especially objectionable in operations about the face, mouth, throat and eyes.

12. Local anaesthetics are more agreeable to the patient, are safer than general anaesthetics. The comfort and safety of the patient should ever

be present to the physician's mind. Hence, we always employ local anaesthetics instead of general anaesthetics when the temperament of the patient and the nature of the operation render their use practicable.

WHEN NOT TO BE USED.

Local anaesthetics must not be resorted to in the presence of an insurmountable fear of patient; of hysteria; or against the personally expressed wish of patient to take a general anaesthetic; when they would fail to secure a sufficiently deep anaesthesia; when, in operations requiring exposure, a general anaesthetic might be preferred on sentimental grounds; where muscular relaxation is required, as in the reduction of fractures and of dislocations, as in intra-abdominal operations; when very extensive dissection is necessary, as in the separation of abdominal adhesions in surgery. (Abbe.)

Neither should they be resorted to in the case of very nervous individuals or in children, because they are liable to become unruly on seeing the knife, making local anaesthesia often insufficient and very unsatisfactory; nor in major operations attended by much hemorrhage, the consciousness of the patient in these conditions is annoying to the operator; nor when the employment of a local anaesthetic would impair the vitality of the tissues.

Local anaesthetics will be found very serviceable and preferable to general narcosis in all operations which do not take up much time and where every step is well known. Operations such as the following come within the domain of local anaesthesia:

Abdominal and thoracic puncture; incision and evacuation of abscesses when located near the surface; operations on felons, carbuncles, naevi, sebaceous cysts; lipomata; adenomata of breast when near surface; circumcisions; castrations; and many operations in ophthalmology, laryngology and rhinology.

HOW TO PROCEED.

It is well, however, to bear in mind that the anaesthesia obtained by the use of local anaesthetics is not as complete as that obtained by the use of general anaesthetics. Consciousness being present, the perception of pain is not as completely abolished as with general anaesthetics. Most individuals, however, will prefer to endure a slight amount of pain rather than be put to sleep.

The induction of local surgical anaesthesia should only be practiced by qualified and responsible persons, that is, by dentists and by physicians. Irrational employment of local anaesthetics leads to deleterious results. The toxicity of the agents employed and the serious consequences that can

follow their unscientific use, amply justify the dictum at the beginning of this paragraph.

When about to induce local anaesthesia, and to operate under it, whatever may be the agent used, cover the patient's face with a light fabric so as to completely close off the field of operation from his observation. The sight of surgical instruments, of the operator's movements, of blood, will in some patients induce syncope. The patient seeing or being aware that an operation is being done upon him, the apprehension which is so commonly felt that pain will be experienced, in many cases, produce faintness and in some instances, fatal syncope.

Always tell the patient that there will be a slight amount of pain; he will then not be surprised if he experiences a little pain and, being forewarned, will not become alarmed. Section or rough manipulation of muscle tissue causes dull pain of an aching character which can easily be endured. (Lilienthal.) Section or manipulation of tendons is not felt. Manipulation of nerves causes a pain which is acute, if nerve is grasped with clamp or caught in a ligature (Lilienthal). Ligature of arteries is painful. Vaso-motor nerves are sensitive (Wyeth).

ANAESTHESIA BY REFRIGERATION.

Cold benumbs the nerve-endings or trunks. The freezing methods are of limited application be-

cause (a) cold not penetrating beyond a very shallow depth, this method of anaesthesia suffices only for short surface operations; (b) they can be applied only to limited areas; there is danger of gangrene of the frozen tissues; (c) freezing retards healing; (d) anaesthesia produced by the refrigerating methods is evanescent; its induction is attended with pain, especially in inflamed parts; the pain following its disappearance is at times very severe; (e) freezing substances harden the tissue and alter the appearances of cut surfaces, making it difficult to differentiate between normal and pathological states of tissues. (Lilienthal.)

Chopped ice and salt are used. Dr. Lemke uses these to anaesthetize site of insertion of canula, previous to injecting nitrogen gas in tubercular pulmonary cavities.

Sprays of solutions, of which the following is a fair example, are extensively employed:

Chloroform .....parts 10.
Ether .....parts 15.
Menthol .....parts 1.

This solution quite freezes part in about a minute. The skin becomes white and hard. The freezing process must not be carried too far, otherwise a slough is apt to ensue. The anaesthesia produced by this spray lasts from 2 to 6 minutes. This solution and all others containing ether, must

not be used in operations about the eye. Ether vapour irritates the cornea and conjunctiva.

Ethyl Chloride (that of French manufacture is the best) is of use to anaesthetize very superficial parts, as when a mere incision is to be made in the skin. It is usually dispensed in large glass tubes. The heat of the hand causes the liquefied gas to issue in spray form. Hold tube at a distance of from 6 to 10 inches from the part to be anaesthetized. The part soon becomes frozen and ready for operation. It is a good local anaesthetic, having no influence on the sensory nerve centers in the brain. This substance is highly inflammable and when it is used operations must be done at a good distance from gas or other flame. The exact limits of the operations must be determined beforehand, because the ethyl chloride hardens the skin.

COCAINE.

Cocaine is to the rhinologist, laryngologist and ophthalmologist what chloroform and ether are to the general surgeon. It has caused a few deaths. So has opium, so has belladonna and so have many other valuable medicinal agents. These few fatalities should not lead us to abandon the use of cocaine, but should stimulate us to discover and observe methods of administration that do away with some of the uncertainties attending its use. Careful attention to the teachings of experimental

therapeutists and close observation of the methods practiced by eminent clinicians, minimize the dangers incident to therapeutic procedures and enhance their value to humanity. Cocaine is an agent of great power and usefulness, but it must be used with caution. In the absence of positive contra-indications to the use of general anaesthesia, it should not be used in irregular and prolonged operations, as in abdominal sugery. The quantity required to maintain prolonged anaesthesia is toxic. Neither should it be used in individuals showing organic disease of the brain, heart, lungs or kidneys, when local anaesthesia by refrigeration, by infiltration or by the use of such agents as antipyrin, orthoform or strophantheine meets the indications.

PROPERTIES OF COCAINE.

Cocaine paralyses the terminal filaments of the peripheral sensory nerves when brought in contact with them. Its use as a local anaesthetic is based upon this property. The less vascular the part the more intense its action. It possesses remarkable anaesthetic properties upon mucous membranes. All mucous membranes are amenable to its anaesthetic properties. The conjunctival, the labial, the nasal, the pharyngeal, the gastric, the urethral, the vesical, the rectal, the vaginal and the uterus mucous membranes are all anaesthetized by the application of cocaine to them.

The application to any of these membranes of swabs of cotton saturated with a solution of cocaine is followed by insensibility in from 3 to 5 minutes. This loss of sensation continues for from 15 to 20 minutes. The influence of cocaine solutions on mucous membranes depends entirely upon the strength of the solution, the frequency of the applications and the time that has elapsed from the time of first application. A 2 per cent solution is almost always sufficiently strong to obtain anaesthesia of mucous membranes for minor operations. The statement made by some that a 2 per cent solution is more effective than a stronger solution is erroneous.

Applied to the unbroken skin, cocaine does not anaesthetize it. To anaesthetize the skin the cocaine solution must be injected in the dermal tissues; that is, in the skin and not beneath it. Injections must be intradermic and not hypodermic. There is a difference in the susceptibility of patients to cocaine, also a difference in the susceptibility of the same patient on different occasions. There are individual idiosyncrasies. Children appear to come more quickly under the influence of the drug than adults. The application of cocaine to the conjunctival, vaginal and rectal mucous membranes is almost never followed by alarming symptoms. Serious accidents have followed, however, application to the urethral mucous membrane. Its

subcutaneous use has given rise to a few accidents. Reclus collected from the medical literature, and analysed, 16 deaths due to cocaine anaesthesia. He says that all these deaths were due to one or more of the following conditions:

(1) The use of too strong solutions.

(2) Sudden emptying of large quantities of the drug into the general circulation, either by puncture of a vein or injection into areas vascular, by virtue of the presence of an inflammation or naturally so, as is the case with the head.

(3) Operating in the erect position was a factor in all the cases.

"The healing process is not impaired by the use of cocaine."—(Ludwig Pernice.) "In my experience wounds made under the influence of cocaine have invariably healed well." (W. Moore.)

These opinions are in accord with the experience of all those that have used cocaine extensively.

The application of cocaine to mucous surfaces is attended by a weakening of the reflexes, so that parts can be handled that without the influence of cocaine could not be handled.

For cocaine anaesthesia use the hydrochlorate of cocaine, the alkaloid itself is very insoluble in water; other preparations do not possess the same anaesthetic properties (Franz Fux). Cocaine phenate, being insoluble in water, is unsuited for hypodermic use. In making ointments, cocaine, the

alkaloid is used, as it is soluble in fats, whereas its salts are not.

Cocaine is of especial service to the ophthalmologist, as it does not cause phenomena of irritation. (Koller.)

COCAINE IN OPHTHALMOLOGY.

In ophthalmology it is used to control pain in the eye, in the removal of foreign bodies present in the conjunctival sac or imbedded in the cornea, and in such operations as iridectomy, cataract removal, sclerotomy, extirpation of eyeball, cure of strabismus, etc. Slitting of canaliculi and other operations on lachrymal ducts are, with its use, done painlessly. The same applies to ablation of small tumors, as cysts, to removal of pterygium, etc. Cocaine does not possess the disadvantage of producing the enormous engorgement of the ocular vessels that ether does. An objection to the use of general anaesthesia in ophthalmology is the possibility of vomiting which may occur during or after the administration of a general anaesthetic. This is always dangerous after a cataract operation. Vomiting by causing a too rapid escape of the aqueous humor may cause extensive prolapse of iris, subluxation of lens, prolapse of the vitreous humor, intraocular hemorrhage. The use of cocaine anaesthesia eliminates the danger of vomiting. Under local anaesthesia, the patient can direct the movements of his eyes according to the

necessities of the operation. This is impossible under general anaesthesia.

Holtz (Chicago) uses a 2 per cent cocaine solution to anaesthetize corneal ulcers previous to cauterizing them. For most operations, ophthalmologists employ solutions varying from 3 to 5 per cent in strength. A few drops of this solution are injected several times into the conjunctival sac, at intervals of few minutes. For enucleation of the eyeball, J. A. White says: "A solution of from 10 per cent to 20 per cent is required to deaden the sensibility of deep tissues surrounding the optic and ciliary nerves." About five minutes before the division of these deep tissues inject in them, by means of a syringe with a long canula five Mm of the cocaine solution. Cocaine solutions can be injected into the substance of the eyeball if necessary. If the performance of the operation is delayed 10 or 15 minutes after the first instillation, for the drug to pass through the cornea, the iris will be completely anaesthetized and iridectomy can be performed without pain." (A. Duane.) Solutions of atropine, eserine, or cocaine, when applied to the surface of the conjunctiva, by a process of endosmosis, soak through the cornea and become diffused in the aqueous humor; they are thus brought in actual contact with the iris.

In making subconjunctival injections of cocaine, the episclera must not be wounded. A one

per cent solution is a safe solution for that purpose.

COCAINE IN OPERATIONS ABOUT THE MOUTH, NOSE, ETC.

An objection to the use of general anaesthetics in operations about the mouth, nose, larynx is that voluntary cough can not take place until the patient has recovered from the effect of the general anaesthetic. During this period accumulation of blood in main air-passages may cause asphyxia. This danger is not present when local anaesthesia is used.

The use of cocaine spray to produce nasal pharyngeal or laryngeal anaesthesia is to be condemned because too much unnecessary surface is anaesthetized and too much cocaine is absorbed, it being not possible to regulate the dose. To anaesthetize pharyngeal, laryngeal and nasal mucous membranes many operators use strong solutions ranging from 10 per cent to 20 per cent; most operators, however, use 4 per cent to 5 per cent solution first. The saliva and mucus are wiped off from the surface, as they dilute and retard the production of the anaesthesia. Should, during any operations under cocaine anaesthesia, sensibility of part anaesthetized return, more cocaine solution must be applied to the tissues, it being remembered that, once a tissue has been brought under the influence of cocaine, it is very quick to respond to subsequent applications dur-

ing the entire duration of the operation. Use cocaine in tonsilotomy, especially if both tonsils are to be cut. The patient not experiencing any pain when the first tonsil is cut, willingly submits to the excision of the second. By the application of cocaine to the surface of the tonsils, anaesthesia of the deeper parts is not obtained. This, however, is not a great drawback, as the chief seat of pain, in section of the tonsils, is the mucosa.

For the removal of naso-pharyngeal adenoids in adolescents and in adults for the removal of polypi and of multiple papillomata of larynx, cocaine anaesthesia is serviceable. When cauterizing or applying caustics to diseased portions of larynx see that cocainization is complete; have cotton wad firmly wound around end of probe so that it won't detach itself, and after moistening in cocaine solution, under guidance of mirror, rub vigorously against laryngeal mucosa.

COCAINE IN NASAL SURGERY.

In nasal surgery, cocaine is a favorite anaesthetic. When used the head can be kept in proper position for illumination of part. Every step of the operation can be seen. Under general anaesthesia this can not be done. It is useful to the rhinologist for the removal of deep as well as superficial tissue abnormalities, by promoting quiet, by lessening hemorrhage, by preventing se-

cretion and sneezing. By its contractile effect on the erectile tissues, the employment of cutting instruments in the nares is facilitated and the operator is enabled to examine the field of operation easily. The removal of pedunculated growths, of excrescences of the nasal septum and other similar operations come within the province of cocaine anaesthesia.

In order to anaesthetize the nasal mucous membrane put in the nostril to be anaesthetized a pledget of cotton saturated with cocaine solution. The pledget must be large enough to occlude the nostrils; every two or three minutes until the part is fully anaesthetized instill a few drops of solution on cotton in situ. The pledget of cotton must be in contact with the area to be anaesthetized for about five minutes. Joseph S. Gibb recommends general anaesthesia in the following intranasal operations:

(1) Major operations involving considerable dissection.

(2) Large bony deflections requiring breaking the septum at its base.

(3) Removal of large bony spurs.

(4) Congenital or acquired stenosis.

(5) Plastic operations.

COCAINE IN OTOLOGY.

Cocaine is of service to the otologist in the following conditions:

(1) Application of painful remedies, such as nitrate of silver, alcohol, etc., in case of chronic purulent otitis, can be made to the ear after cocainization, with little, if any, pain being experienced by the patient. (2) Operations on the walls of ear canal, auricle and its surroundings, such as removal of small tumors, incisions into the skin, can be rendered painless by injections of cocaine. (3) Manipulations, such as scraping, torsion, avulsion, ecrasement, etc., in tympanic cavity can be performed painlessly under local anaesthesia when the drumhead is perforated. (4) The following otological operations can be performed under local anaesthesia: Paracentesis of tympanum, incision of its anterior and posterior flods; tenotomy of the tensor muscle, section of the handle of the malleus, and many others.

GENERAL SURGERY.

Removal of cutaneous tumors, as sebaceous cysts, rodent ulcers; excision of single ganglia about wrist and ankles, opening of abscesses, perineal, ischio-rectal and others; tenotomies; operations on hydrocele, serous cyst of neck, tracheotomy, tapping of abdominal and thoracic cavities; all these operations can be done and should be done under cocaine anaesthesia.

GENITO-URINARY SURGERY.

Use only a 2 per cent solution in urethra. (a) To induce cocaine anaesthesia of penile prepuce for circumcision: Retract prepuce, place constriction band around base of penis; inject by means of a fine hypodermic needle 10 or 12 drops of 2 per cent cocaine solution into the internal layer of the prepuce about one-half inch from its attachment to the glans penis; make blebs until cervix is completely encircled by them. Now draw prepuce forward, and at that point elected for incision, make a similar line of blebs on the external preputial layer. (b) For enlarging meatus urinarius painlessly, to anaesthetize area, place a tablet of cocaine just within the meatus and let it dissolve there. (c) Previous to cauterizing chancroids and ulcers of other nature, have the patient wash them thoroughly and then apply your cocaine solution vigorously; another method is to powder a few cocaine tablets and dust them on the ulcers, they will dissolve in the secretions and anaesthetize the surface. (d) In the removal of vulvar, urethral and anal vegetations; in the cauterization and scarification of the uterine cervix; when it is desired to cauterize vulvar vaginal mucous membrane in gonorrheal inflammations, cocaine is the anaesthetic to resort to. Though curettage of uterine cavity has been successfully performed under co-

caine anaesthesia, I prefer in that operation the aid of general anesthesia.

In rectal surgery, when six injections are made equidistant around the anus, the forcible dilatation of the orifice is not painful. The ligation of small hemorrhoidal tumors can be performed under cocaine anaesthesia; if the hemorrhoids are to be cauterized, the infiltration method of anasthesia is preferable to cocaine anaesthesia, as incandescent heat destroys the drug. In anal work, the rich lymphatic and vascular supply of the part increases the liability to cocaine intoxication.

Cocaine anaesthesia is of service as an aid to diagnosis: (a) To differentiate the glans penis pain from renal pain. (b) To examine the eyeball and conjunctival sac. Anaesthesia of the eyeball abrogates that reflex movement of the lids. This is of value, in trying to locate a foreign body in conjunctival sac or imbedded in cornea, in blepharospasm, etc. (3) Applications of cocaine to the palate, to the uvula and to the posterior pharyngeal wall greatly facilitate, especially in sensitive patients, laryngoscopic and posterior rhinoscopical examinations. It does this by abolishing reflex phenomena and by diminishing, or abolishing, temporarily, tactile hyper-sensibility. (4) In anterior and posterior rhinoscopy, by abolishing reflex excitability, by diminishing or abolishing dolorous sensibility, by contracting the ves-

sels of the congested nasal mucous membrane, it facilitates the use of instruments in the nasal cavities. Cocaine, owing to its contractile effect on erectile tissues, enables the operator to examine the nares more closely. In nasal polypus, by diminishing the swelling around it, it makes the polypus more prominent. (5) For rectal examinations, especially when it is desired to palpate the prostatic gland, also in examining for anal fissure. (6) In sounding, and in examining the bladder by cystoscopy. In case of alarming symptoms appearing, rapidly empty the bladder and then wash it out. Very little absorption takes place from the vesical mucous membrane. However, it is unsafe to use cocaine solution in the bladder if any dissolution in the continuity of the lining membrane of the bladder is present. The anaesthetization by cocaine of the urinary vesical mucous membrane having been attended in some cases by the production of alarming symptoms, many genito-urinary surgeons now use antipyrin to anaesthetize the vesical mucous membrane. (7) For the vaginal examination of highly nervous and hyperaesthetic women, cocaine may be applied to the vaginal orifice.

COCAINE AS A THERAPEUTIC AGENT.

As a therapeutic agent, the anaesthetic properties of cocaine are made use of: (a) To lessen

the pain associated with superficial inflammation of the eyeball, especially those of the cornea. (b) To reduce the sensibility of a painful membranum tympani. (c) To lessen the pain incident to fissured nipples, it must always be washed off before putting child to the breast. Orthoform, being non-toxic, is for this purpose preferable to cocaine. Another objection to cocaine in this condition is that it unfavorably influences the secretion of milk. (d) To combat dysphagia, in cases of pharyngeal stenosis produced by tumors, in pharyngeal or laryngeal phthisis and syphilis, in tonsillitis, in ulcers of pharynx, or of epiglottis or of larynx, the pain produced by swallowing is at times so severe that patients either refuse or are unable to take nourishment. By cocainizing the painful parts, the pain incident to the partaking of food in these conditions is mitigated or stopped. Patients can then take nourishment. This, the taking of nourishment, in all diseases, is an important adjuvant to medicinal measures. (e) To facilitate the introduction of the stomach-tube when lavage or gavage of the stomach are indicated. Before introducing the stomach-tube paint vigorously the posterior buccal and pharyngeal mucous membrane with a 10 per cent cocaine solution. This abolishes the sensitiveness of the parts and spares the patient the pain and nausea incident to this procedure, when anaesthesia of the

fauces has not been previously secured. If in the absence of cocainization, swallowing of the stomach-tube causes patient little or no discomfort, the use of cocaine is not indicated and should not be resorted to. (f) In hyperemesis gravidarum, Lutaud recommends cocaine, 10 drops of 1 or 2 per cent repeated at one or two hours' intervals. In the gastric crises of tabes, the introduction into the stomach of 5 ounces of water containing from one-half to one grain of cocaine, is most always followed by a palliation if not by a cessation of the pain. In stomatitis, in gastralgia, in boulimia, owing to its benumbing influence on the mucous membranes, it is a valuable palliative agent. (g) In catheterization of the Eustachian tubes through the nose, this procedure is greatly facilitated by previously applying, by means of an atomizer, a brush, or cotton at end of probe, cocaine to the nasal passages and to the pharyngeal orifice of tubes. Under the influence of the cocaine, the mucous membrane becomes insensible, and then the catheter glides over the parts without causing any pain owing to the greater patulousness of the nasal passages. In many individuals, catheterization of the eustachian tubes, introduction of the stomach tube, catheterization of urethra and examination of rectum can easily be performed without the aid of cocaine anaesthesia. When the employment of a toxic agent is not required, its

use should not be resorted to. (h) After operation for hemorrhoids, under general anaesthesia, a cocaine suppository is comforting to the patient. In painful hemorrhoids, cocaine suppositories can be used with advantage. (i) In anal fissure to obtain painless stools, so as to operate without general anaesthesia (anal dilatation can be performed under cocaine anaesthesia); in spasm of sphincter ani, to relieve anal itching of hemorrhoids; in all these conditions, cocaine, owing to its paralyzing action on the peripheral sensory nerve filaments, is of service. Use a tampon soaked in 5 per cent solution and apply to fissure or insert in the rectum as indicated. (j) In vulvar and preputial pruritus, avail yourself of the action of cocaine on peripheral sensory nerve filaments. Also on eczema of the anus and of the genital organs.

(k) The employment of such agents as chromic acid, the galvanocautery, etc., etc., is by the use of cocaine made comparatively painless. The efficacy of the destructive agent is not affected by cocaine. The ulcerated surface is to be swabbed vigorously with 10 per cent solution. If the cauterization or curettage is to be deep, some of the cocaine must be injected in the tissues. (l) When a few drops of a solution of cocaine, 2 per cent to 5 per cent, are injected into the urethra, a catheter can be introduced without pain, pro-

vided there is no stricture. Be cautious as to its use here. Most of the cases of cocaine poisoning have followed its use about the urinary organs. (m) In vaginismus the swabbing of the vaginal walls with a cocaine solution, then following this with a vaginal injection of a weak cocaine solution, though it will not cure the condition, will, however, suppress one of its annoying inconveniences. Coitus is made possible and painless to the woman. Conception is thus facilitated. In this condition, I have found the local use of the following mixture valuable:

Cocaine hydrochlorate.....	.30
Distilled water	20.00
Alcohol	10.00

(n) Localized neuritis, catapheric use of cocaine is valuable. Place the positive pole over the affected nerve; it is the sedative pole. You get the analgesic action of the electricity and the analgesic action of the cocaine.

1. Observe the same aseptic and antiseptic precautions in operations done under local anaesthesia that you do, or should do, in operations performed under general anaesthesia. (a) Rigid surgical cleanliness of field of operation and irrigation with antiseptic solutions. (b) Thorough sterilization of all instruments and of all objects that are to come in contact with the field of operation. (c) Strict observance by surgeon and his

assistants of modern surgical antiseptic teachings. Needle and syringe used should be aseptic. Needle can be boiled and a syringe full of alcohol passed through it previous to using.

2. Solutions used should be freshly prepared. Solutions of cocaine with age lose their anaesthetic properties, they decompose and become septic, moulds form in them. Only distilled or filtered sterilized water should be used for these solutions. The sterilization of solution by heat after the cocaine is dissolved in the water, decomposes the cocaine, moreover, it is superfluous, as unadulterated cocaine is sterile.

Non-sterile solutions give rise to suppuration of wound. The humors of the eye, the body juices are good culture media for germs.

3. The cocaine employed should be absolutely pure. Laborde has pointed out that its mixture with other alkaloids forms highly poisonous compounds.

4. According to Reclus, who has a record of 3,500 successful cocainizations, the dose should not exceed one-fifth grain for small operations, one to three grains in large operations. When the latter amount is used, great watchfulness must be exercised. The dose of cocaine should be appropriate to the extent of surface desired to render insensitive. A large dose should never be used at one time, but fragmented, given at intervals.

The slow administration of cocaine renders it the slow administration of cocaine rendering it possible to guard against the production of sudden symptoms of poisoning. Injections can be made as the operation progresses. Concentrated solutions should never be employed, the danger from their use is too great rapidity of absorption.

A weak solution permits a minimal amount of cocaine to reach a maximal extent of surface. The danger of cocaine anaesthesia is proportional to the actual quantity of the alkaloid used and not to the amount of solution used. Reclus, when he uses cocaine subcutaneously, confines himself to a one per cent solution.

5. The use of constricting band or tourniquet, when practicable, as in operations on extremities, as in circumcision, should never be omitted. In performing castration under cocaine anaesthesia, surround base of scrotum with an elastic ligature. By the use of the constricting band or tourniquet, the action of the drug is limited to desired area. Before applying tourniquet, elevate part to expel blood from same. "When we shut off the blood from a portion of the body previously injected with a comparatively weak solution of hydrochlorate of cocaine, we maintain the latter for a protracted period of time in contact with the filaments of the sensory nerves; and are con-

sequently enabled to prolong in the sensory filaments, those chemical changes which are necessary for the suspension of their functional activity, for the maintenance of the condition of anaesthesia."—Leonard Corning.

This constriction prevents the rapid absorption of the drug into the general circulation and the dangers of intoxication incident to this rapid absorption. Owing to lessened tendency to absorption, more latitude for the use of the drug is obtained. When this elastic ligature is removed, the bleeding from the stump washes out the excess of the drug.

6. In some cases, the constricting band is useful, because it secures a wound unobscured by blood. Anaemia facilitates the production of anaesthesia. In operating on a limb, after the completion of the operation, the tourniquet is loosened for three or four sections and then re-applied for several minutes; this procedure is repeated two or three times. In this way only a small quantity of cocaine is admitted into the circulation at one time and this small quantity distributed over a large area produces no ill results.

7. Extreme caution in the use of cocaine is to be employed, when the circulation cannot be controlled. First inject one centigramme of the drug; if no untoward symptoms occur there is no idiosyncrasy. You can then inject more.

8. Injections should always be practiced with patient in recumbent posture, and he should only be raised when the operation is to be performed upon the mouth or throat, and then only when the anaesthesia is complete. (Magitot, Reclus.) The recumbent posture is imperative in cocaine anaesthesia. (Dujardin-Beaumetz.) Reclus insists upon the patient being kept in the recumbent posture, and adds that syncope in cocainization is the fault of the administrator and not of the cocaine. He makes patients keep recumbent posture for from two to three hours after the completion of the operation, and does not permit them to arise until they have eaten something.

9. When the operation involves the skin, the injection should be made into the derma itself and not into the subcutaneous cellular tissue. Anaesthesia of the skin by cocaine, is obtained only through endermatic injections. Cocaine cannot be absorbed through the unbroken skin. Hypodermatic injections secure subcutaneous anaesthesia, but not cutaneous.

You will know that you are injecting the solution in the cutaneous tissues by experiencing the resistance which the dermal tissues offer to the advance of the hypodermic needle and by noting the formation of bleb-like swellings along the

line of injection. Introduce the needle about parallel to the skin.

10. Do not inject the solution in a vein. Many of the accidents that have occurred under cocainization, and that have been attributed to idiosyncrasy, were, in reality, due to the injection of the drug directly into the veins. With proper precautions, even in regions rich in veins, this should not occur. This is avoided by gradually expelling solution from the syringe at the same time that the needle is gradually withdrawn from the tissues.

Leonard Corning advises the following, to avoid injecting cocaine solutions in veins: Pass a piece of ordinary elastic webbing around the central portion of the limb; draw it sufficiently tight to cause swelling of the superficial veins. It is now an easy matter to trace out the course of the distended vessels with an ordinary colored pencil, so that when the ligature is removed, these topographical reminders remain upon the surface.

11. Expel the solution of cocaine from the syringe drop by drop, while the needle is passing through the tissues. The object of this is to control the largest possible field with a single injection; that is obtaining the maximal effect with the minimal dose. Make cocaine injections in an orderly manner. Inject the sub-epidermal tissues first and subsequently the deeper tissues. If

the operation to be done requires deep dissection, injections must be both superficial and deep. Swab, if needed, field of operations with cocaine solution, every few minutes.

12. Let at least five minutes elapse after the first application or injection before applying the knife.

13. In inducing local anaesthesia for the enucleation of a small tumor located near the surface of body, inject solution beneath and around tumor so as to bathe neoplasm in the anaesthetic fluid. Its dissection will then not be attended with any suffering.

When giving cocaine always have some aromatic spirits of ammonia, some nitrite of amyl and some ether at hand. These are useful agents with which to combat cocaine intoxication. Upon the first appearance of symptoms of poisoning, have (a) patient immediately assume the recumbent posture. Recovery takes place more rapidly in this posture. (b) Give hypodermic injections of ether.

ACCIDENTS AND THEIR REMEDIES.

Accidents are often due to the faulty technique of the physician, such as the use of an overdose, failure to have patient maintain the recumbent posture, non-employment of means that prevent too rapid absorption, as the constricting band or tourniquet, the use of an adulterated product, etc. Among the symptoms of poisoning may be men-

tioned loquacity, cold perspiration, shallow respirations, rapid, feeble pulse, unconsciousness and convulsions. Cocaine can cause death by causing paralysis of the respiratory center or tetanic fixation of respiratory muscles.

In paralysis of respiratory center:

a. Elevate trunk and lower head.
b. Practise artificial respiration.
c. Give strychninae sulph. gr. 1-20 hypodermically. It is the best respiratory stimulant that we have.
d. Give amyl. nitrite, or hypodermics of nitroglycerine.

In tetanic fixation of muscle, give:

a. Inhalations of amyl. nitrite.
b. Chloral and bromide in the form of enemata.
c. Morphine sulph.

Morphine, though not an absolute antidote, is most valuable in counter-acting the toxicity of cocaine. "There exists a marked antagonism between cocaine and morphine, also between cocaine and chloroform or ether."—Willard and Adler.

In all forms of cocaine poisoning, empty the bladder and activate urinary secretion. Meet sleeplessness by hypnotics or narcotics.

INFILTRATION ANAESTHESIA.

The technique of this method was first elaborated, and introduced to the medical world by Dr. C. L. Schleich of Berlin. It is based upon the

fact that endermatic injections or infiltration of the various tissues of the body with water, or watery solutions of indifferent substances will produce local anaesthesia of the tissues infiltrated. Previous to the introduction of Schleich's infiltration method of local anaesthesia deep injections of cold water along the course of the sciatic nerve were made with alleged benefit. If the production of the anaesthesia is preceded by the production of pain, we have the condition which is called anaesthesia dolorosa (Liebrich) ".02 parts to 100 parts of distilled water is the weakest cocaine solution which can produce local anaesthesia without prodromal hyperaesthesia." (Schleich.)

Infiltration causes anaesthesia by

a. Causing an anaemia of the part. This anaemia is due to the compressing action exerted by the injected fluid on the bloodvessels.
b. Low temperature of the injected solution. Its temperature must always be lower than that of the body. If both are of the same temperature, the anaesthetic effect is greatly diminished; whereas if the solution is ice-cold, anaesthetic action is augmented.
c. The mechanical pressure exerted on tissues, notably on nerve filaments.
d. Direct specific but not destructive effect of injected sol. on the nerves.
e. Destructive chemical action on the nerves.

f. The maintenance of complete oedema of the tissues to be operated on.

The anaesthesia produced by this method is instantaneous. As soon as the tissues have been oedematized, they are anaesthetic. This differs from other methods of local anaesthesia, and is a distinct advantage. "Every tissue is anaesthetic that can be artificially oedematized by our solutions." (Schleich.) This holds good for skin and mucous membrane, periosteum, synovial membrane, fascia, muscle, lymph, glands, nerves, viscera, and even bone.

The infiltration method of anaesthesia is unsuited for use.

a. In most abdominal and pelvic operations.

b. In ophthalmic surgery, as relating to the eyeball. Cocaine is the ophthalmologist's most serviceable anaesthetic.

c. In nasal, naso-pharyngeal and intra-laryngeal manipulations and surgery. Dr. Coulter, however, uses infiltration anaesthesia when performing tonsillectomy.

d. In plastic surgery, the artificial oedema which is the basis of the modus operandi of "the infiltration method" interferes with the nicety of surgical operations. Infiltration produces an extensive artificial oedema which masks anatomical details considerably. In-

filtration by distorting the flaps increases the difficulties of the operation.

e. In skin grafting operations. Infiltration impairs the vitality of the flaps. (Lieberthal.)

f. Whenever the limits of the disease are not readily definable as in malignant tumors. The presence of much fluid in the tissues changes their appearance and renders difficult the demarcation of sound from diseased tissues.

g. In diffuse cellulitis, requiring free incisions.

h. In cases of malignant new growths, of diffuse tuberculosis, etc. The increased hyper tension of part makes possible the forcing of the materies morbi into the lymph channels. "In the removal of large neoplasms or large purulent collections, the infiltration method is not suitable." (Braun, Leipsig.)

i. In all cases where local anaesthesia is contra-indicated as in very nervous patients who dread watching the surgeon's manipulations.

With this method, anaesthesia occurs at the moment of completion of artificial oedema and not before. It lasts from 10 to 15 minutes and can be prolonged by further addition of the fluid. No part is to be operated on before the artificial oedema is complete.

The quantity of toxic agents present in the solutions employed is so small that the use of

comparatively large quantities of the solutions is attended with no risks of drug-poisoning. Different solutions have been used. Arthur E. Barker (London) uses the following which he says can be used practically in any amount without danger of producing poisonous effects.

BARKER'S FORMULA.

Eucaine .....1 part by weight.
Chloride of sodium...8 " "
Water .....1000 " "

Most operators, however, use Schleich's formulae. They are the following:

SCHLEICH'S FORMULAE.

No. 1. Strong—for operations on highly hyperaesthetic areas. Inflammation, suppuration, neuralgia. The more sensitive the parts are that you operate on, the greater must be the concentration of the cocaine.

Cocaine hydrdochlor 2
Morphine hydrochlor 025
Sodium chloride (ster.)..... .225
Distilled water (ster.) .....100.
M et adde 5 per cent acid carbol.gtt. 2

One ounce of this solution contains about 1 gr. of cocaine.

No. 2. Normal—for operations on moderately hyperaesthetic areas.

Cocaine hydrochl 0.100
Morphine hydrochl ..... .025
Sodium chl. (ster.) 2
Distilled water (ster.).....100.
M et adde 5 per cent acid carbol.gtt. 2

One ounce of this solution contains about ½ gr. of cocaine.

No. 3. Weak—the weakest possible solution for extensive operations to be used alternately with stronger solutions.

Cocaine hydrochlor ..... .01
Morphine hydrochlor ..... .005
Sodium chloride (ster.)..... .2
Distilled water (ster.).....100.
M et adde 5 per cent acid carbol.gtt. 2

These solutions must be kept absolutely sterile.

These ingredients can easily be prescribed in the form of a powder to be dissolved in sterilized water just previous to using. Every practitioner should always have in his satchel a few of these powders, kept in a sterilized flask.

Only sterilized water must be used in the preparation of the solutions. The sodium chloride is roasted in a small pan. It is added to the solutions to attenuate the irritating action of the water. The one-fifth per cent solution of sodium chloride is a practical anaesthetic when the skin is healthy. It will not suppress pain in hyper-

aesthetic inflamed areas. (Schleich.) To do this, cocaine is added to the solution.

Morphine does not need to be sterilized. Like cocaine in the pure state, it is bacteriologically sterile. Heat decomposes these alkaloids. Morphine was incorporated in Schleich's solutions for the purpose of allaying the paraesthesia incident to the wearing off of the anaesthesia.

An ordinary hypodermic needle may be made to serve for injecting the solution in many cases. It is better, however, to have a larger syringe with several needles, some straight, some curved. "The Brausford Lewis Infiltration Syringe" is very serviceable. The barrel of the syringe is large, the needles have a rounded end, or probe point, which prevents their piercing such structures as veins, arteries or nerves.

Such operations as enucleation of buboes, circumcisions, castration, colotomy, cholecystotomy, drainage of empyema of thorax, have been successfully performed under infiltration anaesthesia. August McLean says "The infiltration does not appear to have any deleterious effect upon the healing of the tissues." In many of his cases, there was primary union.

In 3,500 cases, Schleich did not once convey infection by means of the injected fluid.

In beginning to use the infiltration method, select easy cases such as ablation of small tumors,

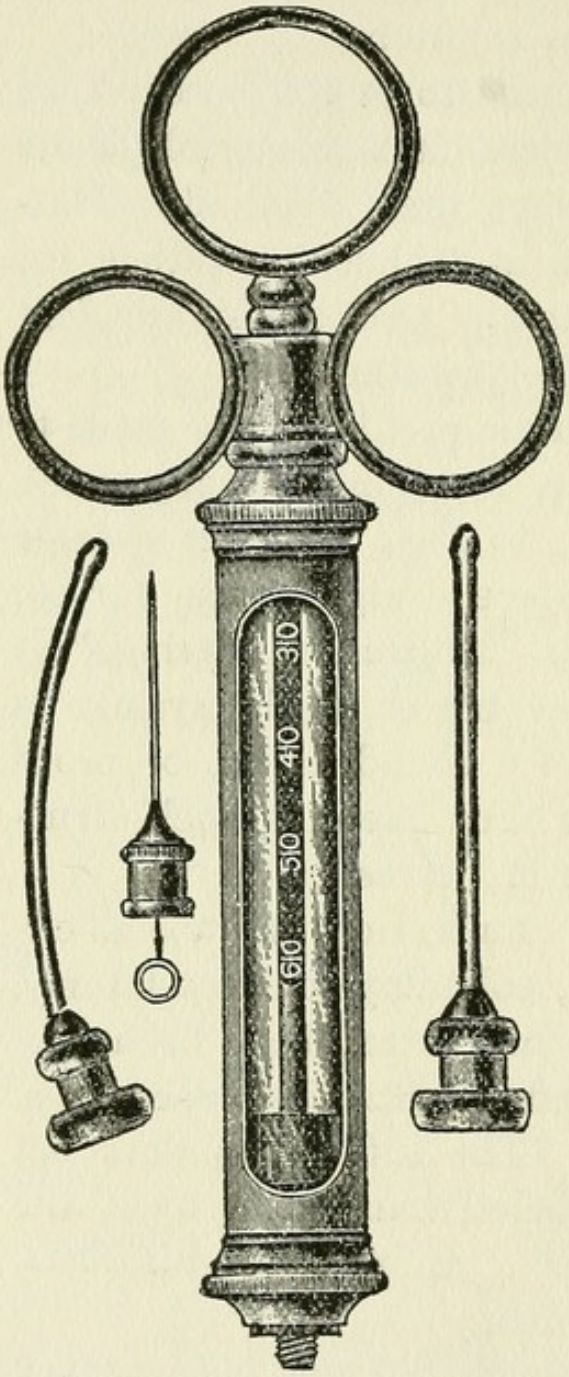

Fig. 1.

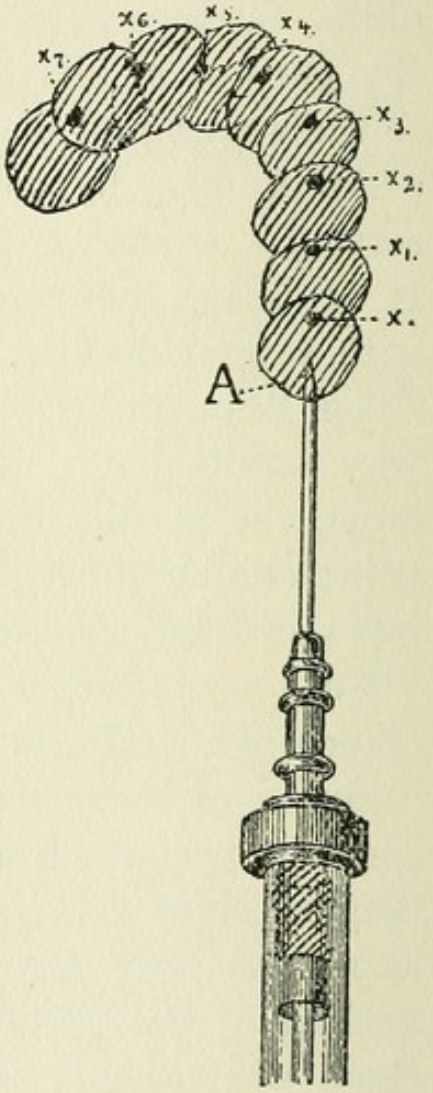

Fig. 2.

FIG. 1.—Bransford Lewis Infiltration Syringe.

FIG. 2.—Formation of the cutaneous wheals. A. Spot made anesthetic by ether spray for the first injection.

suture of wounds. As your experience with the method increases, you can use it in more difficult cases. Experience will perfect your technique.

TECHNIQUE OF METHOD.

1. Scrub, shave, and otherwise prepare field of operation.

2. Observe, and have your assistants observe, modern antiseptic teachings.

3. Needle, syringe and anaesthetic solution must be sterile.

4. Place the bottle containing the solution on ice. It must be kept on ice during the entire duration of the operation. The anaesthetic properties of the solutions are intensified by cold. Warm solutions are unfit for anaesthetic use. The syringe should also be cooled.

5. To make the first puncture, by needle, painless, a spray of chloride of ethyl can be directed against the skin; a pledget of cotton dipped in cocaine solution placed upon the mucous membrane.

6. Insert needle in skin, inject sufficient of solution to produce a wheal about the size of a dime. Remove needle, reintroduce at the periphery but still within the wheal, inject enough of solution to form a new wheal and repeat this process as often as indicated. In this way the line of incision is anaesthetized. When solution is thrown into skin, the end organs of the sensory

nerves situated there immediately absorb the solution and are temporarily paralyzed. (Barker, London.) Anaesthetize skin broadly, so that the suture line will be infiltrated.

Now an incision can be made through the skin, and infiltration of the deeper tissues proceeded with, or the subcutaneous tissues can be squeezed full of fluid through the anaesthetized skin. The important fact being that all tissues that come within the field of operation must be oedematized to be anaesthetic. Spots which have not been infiltrated retain their sensibility. If the tissues to be operated on are not very deep, it is better to infiltrate through the skin. Infiltration in the open wound is more difficult, as the fluid escapes. Do not infiltrate through the skin deeper than the superficial muscles except in cases where the tissues to be anaesthetized are superficially located, as over the skull, over the clavicle, over the sternum. When tissues are dense, considerable pressure is necessary to infiltrate them.

7. The field of operation must be tensely filled with the solution before beginning to operate. If, during operation, a large nerve trunk is met, it may be anaesthetized, for a short time only, by touching it with a five per cent carbolic acid solution. If nerve is to be cut, it must be infiltrated separately. If patient during operation complains of the

slightest pain, the part must immediately be re-infiltrated.

Pain is a sign of insufficient anaesthesia, insufficient oedematization. As soon as infiltration is complete, pain is absent. "Tissues not thoroughly infiltrated must not be cut or manipulated." (Lund.) The surgeon must lay down the knife and take up the syringe on the slightest expression of pain on the part of the patient. Should it become necessary to extend the field of operation beyond the infiltrated area, injections must be made in the direction required, starting from within the anaesthetic area.

8. Never begin the infiltration in inflamed area. Surround it and advance upon it from all sides, via sound skin. Inflamed tissues owing to their hypersensitiveness are not to be infiltrated until the adjacent normal tissues are infiltrated. Primary injection into an abscess, phegmon or pathological focus is to be avoided as it increases the tension and does not lessen the pain.

9. Do not inject contents of syringe in a blood vessel. If operation has lasted more than 15 or 20 minutes, it will be necessary to anaesthetize points of entrance and of exit of suture before closing the wound.

Spray is applied to one side of furuncle and the first wheal is set up within healthy skin. Push a long needle in an oblique direction through skin,

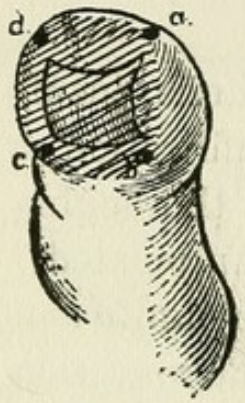

Fig. 4.

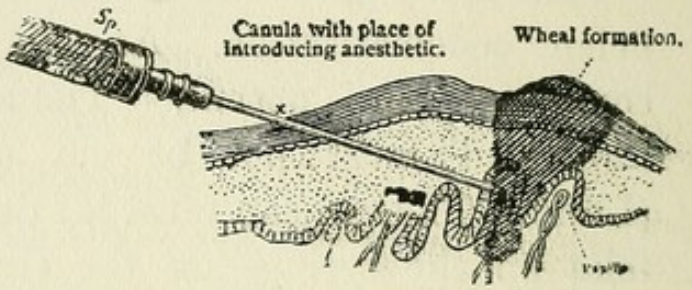

Fig. 3.

FIG. 3.—Diagram of a section of the skin, showing formation of the first wheal.

FIG. 4.—Infiltration of ingrowing toe-nail.

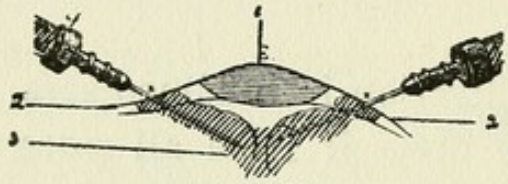

Fig. 5.

Fig. 6.

1, Furuncle; 2, Anesthetized skin; 3, Infiltration of subjacent tissue; 4 and 5, First and second position of syringe. Fig. 6.—Infiltratton of abscess.

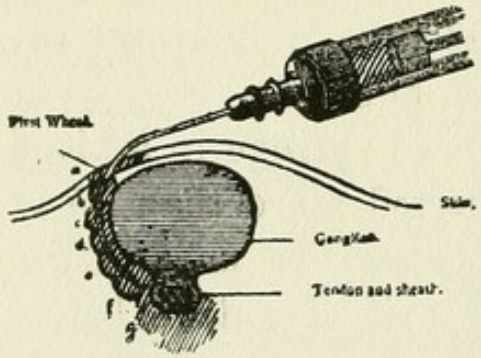

Fig. 7.

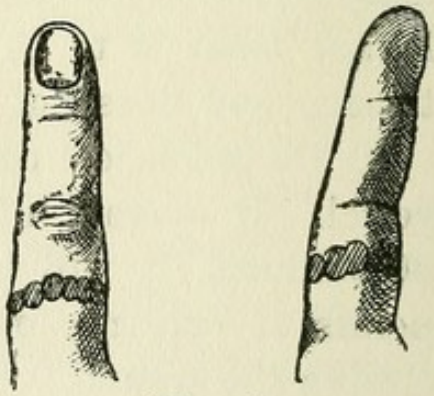

Fig. 8.

FIG. 7.—Tumors.

FIG. 8.—Infiltration around finger going down to periosteum.

expelling the solution all the time as you advance and deposit an anaesthetic focus beneath the furuncle. (Fig. 5.)

Repeat this process on opposite side of boil. Use solution freely. Once the furuncle is completely cut off from the surrounding tissues by an anaesthetic zone, anaesthetize the skin covering it, beginning within the infiltrated area and advancing towards it. Now incise and evacuate and curette the furuncle.

For removal of sebaceous cyst, or small tumor, cut skin along line of wheals, severing only the skin. Adapt now a curved needle to syringe. Raising by aid of forceps the cut edge of the skin, insert needle gently and gradually, push it around underneath the cyst, steadily expelling solution from syringe all this while. The tissue beneath the cyst is thus anaesthetized. Now draw out needle, and repeat the same injecting procedure on the other side, always expelling fluid from syringe as needle advances. The cyst is thus wholly enveloped by oedematous and anaesthetized tissue.

Abscess. Never inject solution in abscess. It increases pressure on all sides. It intensifies the pain. Begin at one side in healthy skin and proceeding towards abscess anaesthetize by the formation of intracutaneous wheals, the skin overlying the abscess. (Fig. 6.) The skin being infiltrated, infiltrate subjacent and surrounding tissues.

The accompanying illustrations portray the technique better than words.

For amputations or in operations upon bone, the periosteum must be infiltrated in its whole circumference. When this has been done, bone may be divided by saw or forceps without any pain being caused. The medulla of bone can be infiltrated through an opening made in corlex of the bone.