

of a patient with varicose veins. The introduction of air is a danger that may be avoided by care. 2. The action of a drug when put directly into the blood may be different, qualitatively and quantitatively, from its action when it is given by the mouth or by the skin, because it reaches the blood and is carried to the heart and other organs in such concentrated form—an objection which may be partly overcome by using dilute solutions and giving them slowly. 3. The more difficult technique is often spoken of as the greatest objection. It is sometimes hard, especially in women, to put a needle through the skin directly into a vein. Even after the vein is exposed it may be an exasperatingly delicate operation to get a cannula into it.

The amount of care and skill needed to avoid the dangers and difficulties, then, is so great as to forbid the use of intravenous injections as a routine measure. The procedure is to be reserved for those cases in which other methods have failed, or in which an emergency demands great haste.

The following are some of the special instances in which intravenous injections have been used:

In syphilis the intravenous use of mercurials has been especially advocated by Baccelli. The solution used is as follows:

Corrosive sublimate	1
Sodium chloride	3
Distilled water	1,000

One cubic centimetre of this (1 mgm. of mercury) is the usual dose, but in urgent cases it may be increased. The cyanide has also been used. This procedure may be of value in those few cases in which mercury does not appear to produce its usual good effect when given in the ordinary ways or in which rapid advance of the disease makes it essential to get the patient mercurialized at the earliest possible moment. Besides the dangers already mentioned, the intravenous use of mercury has been followed by severe ptialism even after small doses. For ordinary cases the method has no advantages over the simpler ones in common use.

Baccelli has also urged the intravenous administration of quinine in pernicious malaria. The following solution is used, acid solutions not being permissible:

Quinine hydrochlorate	gr. xv.
Sodium chloride	gr. xij.
Distilled water	3 iiss.

This is to be boiled and filtered. Symptoms of cinchonism, ephemeral in duration, may appear soon after the use of gr. xv. of quinine in this way. As in the case of mercury this method is to be reserved for the treatment of pernicious cases when quinine given in the ordinary ways has proved of no avail, or when great haste is demanded.

For the purpose of introducing into the circulation large quantities of artificial serum in surgical shock or hemorrhage or for "washing the blood" in uræmia, septicæmia or other toxæmic states, and in collapse from cholera—for these purposes intravenous injections are of the greatest value. In such cases only will the average practitioner ever be called upon to use them. In general we may say that the indications for the intravenous injection of salt solution are the same as for hypodermoclysis, and the reader is referred to the article with that title. And the hypodermic method, by reason of superior convenience and safety, will almost always be chosen. But in certain cases of extreme shock, absorption from the subcutaneous tissue is slow and uncertain. Thus Jones reports two cases in which, owing to failure of absorption from the skin, hypodermoclysis was ineffectual; on using the veins, however, both patients speedily improved. Again, when hemorrhage has been profuse and every moment is of value, the intravenous route is the best. Ringer's solution (see *Hypodermoclysis*) or 0.6-per-cent. salt solution may be employed. Milk or distilled water—

both of which have been employed with fatal results—are mentioned only to be condemned.

Intravenous injections have been recently used in diabetes mellitus, especially in coma, and in accordance with the theory that the coma is due to an acid intoxication, large quantities of sodium bicarbonate are given in this manner. Three per cent. of sodium bicarbonate is added to decinormal salt solution and upward of a quart given. A discussion of the value of this procedure would be out of place here. It need only be said that the improvement is often striking, but if coma is well developed it is usually temporary. The intravenous route is the one usually selected in urgent cases—*i. e.*, in cases in which time is of importance.

Gelatin solutions have been used intravenously in aneurism, internal hemorrhages, hæmophilia, and other hemorrhagic conditions. The subcutaneous route is the one ordinarily chosen, the mouth and rectum being used at the same time. The intravenous route is hardly justifiable, and indeed the whole matter is still *sub judice*.

Intravenous feeding has been tried but is too dangerous to be of practical value.

Technique.—This varies with the substance to be introduced or, more properly, with the amount of fluid used. Small quantities, as in the case of mercury or of quinine, are best inserted directly into the vein. The arm is constricted by a bandage above the elbow so as to shut off the return of blood and distend the veins. The largest vein near the bend of the elbow is selected, and the field is rendered sterile by scrubbing with soap and then with corrosive sublimate solution. The sterilized needle is then introduced directly into the vein through the skin. It must point upward in the direction of the circulation. The bandage is then removed and the injection is slowly made. If the needle has not entered the vessel a small tumor will be formed and the attempt must be repeated. The solution should always be warm when introduced. Any syringe may be used which has a capacity of several drachms and which may be sterilized by boiling. The ordinary antitoxin syringe, made wholly of glass and packed with string, is as good as any. The only difficulty is in getting the needle into the vein. This is much lessened if care be taken to use a new and very sharp needle. The writer has easily inserted a needle into one of the comparatively small veins of the wrist. The vein is not injured and many injections may be made at the same point without producing any appreciable change in the walls of the vessel.

For the introduction of large quantities of fluid it is probably better to insert a cannula. After applying a bandage and rendering the field of operation sterile, as before, the vein is exposed by an incision and a double ligature is passed. The lower ligature is tied and the vein is partly opened by snipping with scissors. Into the opening thus made a glass cannula is inserted, or if this be not at hand a dulled hollow needle. The other ligature is now tightened about the cannula and the fluid is allowed to flow in from a height of one or two feet. Before starting the flow every precaution must be taken to see that the fluid contains no air. The injection is to be made slowly, at least fifteen minutes being taken for the introduction of a quart. The best temperature is about 110° F. After the operation is over the cannula is removed and the incision is closed and dressed. Every precaution should be taken to have the fluid and its container, all instruments and tubes, and the hands of the operator sterile. A glass irrigating apparatus with rubber tubing may be used, or in an emergency a rubber fountain syringe, sterilized by boiling. But the best apparatus consists of a large flask with a rubber stopper arranged like a wash bottle. Through two holes in the stopper glass tubes are passed. One, for the purpose of admitting air when the flask is inverted, leads to the bottom, and the other to which the rubber tube is attached leads just through the stopper. The whole apparatus filled with fluid may be sterilized in the steam sterilizer, or if an ordinary chemical flask is used it may be boiled over a tripod.

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INTUBATION.—In 1856 Bouchut suggested and actually practised a crude method of intubation, which, however, the ridicule of his confrères soon forced him to abandon. Before this time, catheterization of the larynx had been practised to a certain extent for the temporary relief of urgent symptoms of stenosis, but with little success. In 1880 Dr. Joseph O'Dwyer, of New York, with no previous knowledge of the experiments of Bouchut, began to study the subject of intubation. This work extended over a period of three years and was performed at the New York Foundling Hospital, where the operation of tracheotomy had given such fatal results that it had

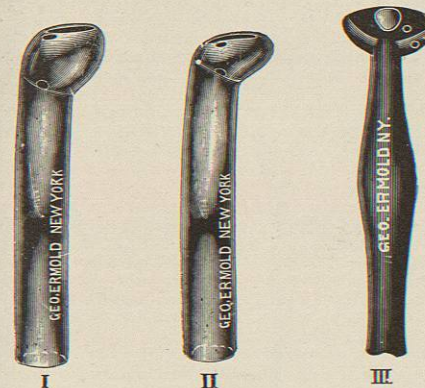


FIG. 2940.—Intubation Tubes. No. I., Granulation tube; No. II., lateral view of ordinary tube; No. III., anterior view of the same.

long since been abandoned. After many failures and a few partial successes, Dr. O'Dwyer gave to the world the perfected instruments as they are made to-day.

Intubation Instruments.—The tubes are made of hard rubber (the older metal tubes were found to promote the deposit of lime salts about the lumen and caused damage to the larynx if worn for more than a few days), in seven or more sizes suited to the various ages of childhood. A

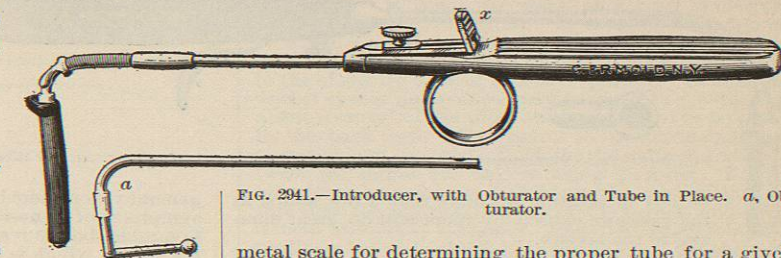


FIG. 2941.—Introducer, with Obturator and Tube in Place. a, Obturator.

metal scale for determining the proper tube for a given age accompanies each set of instruments. The tubes (Fig. 2940, Nos. II. and III.) are long enough to reach nearly to the bifurcation of the trachea, thus lessening the chance of obstruction by loose membrane. The retaining swell is sufficiently full to keep the tube in place and yet small enough to allow of ready expulsion when the lumen is blocked. The neck is narrow and adapted to the grip of the vocal cords.

Ulcerations were found to be caused by the earlier tubes at three points: 1. In the cricoid division of the larynx (the narrowest part); this is obviated by using the smallest possible tube for a given age. 2. At the base of the epiglottis; this is avoided in the modern tubes by giving the head a backward sweep and leaving a good deal of material at its anterior part, thus distributing the

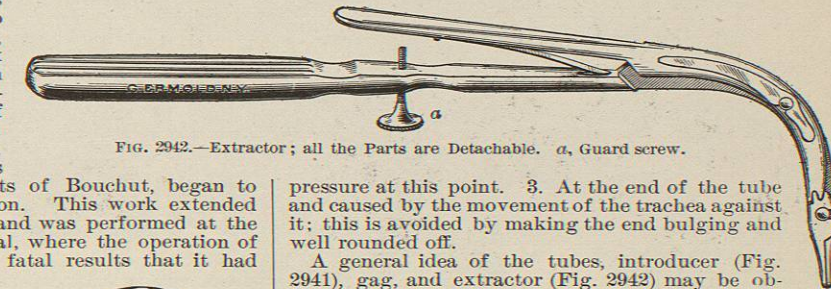


FIG. 2942.—Extractor; all the Parts are Detachable. a, Guard screw.

pressure at this point. 3. At the end of the tube and caused by the movement of the trachea against it; this is avoided by making the end bulging and well rounded off.

A general idea of the tubes, introducer (Fig. 2941), gag, and extractor (Fig. 2942) may be obtained from the accompanying illustrations. The obturator (Fig. 2941, a), one for each tube, fits into the introducer and is released from the tube by the thumb of the operator pushing forward the button at x. The mouth

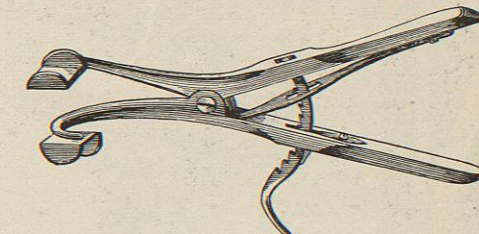


FIG. 2943.—Mouth Gag.

gag (Fig. 2943) is a powerful instrument and need not be used in young infants as it has the undesirable property of lacerating toothless gums.

In addition to the regular tubes there are tubes especially adapted to getting rid of loose pseudo-membrane. These are hollow cylinders of different sizes and of large calibre (Fig. 2944), short enough not to push down the membrane and long enough to reach below the cricoid

constriction. They have no retaining swell and it is therefore necessary to use the largest size possible, wedging it into the larynx. On no account should these tubes

ments, many of which have been discarded as useless and all are totally unnecessary. The O'Dwyer instruments as made by a reliable manufacturer, meet all the requirements for which they were intended.

The vast majority of cases requiring intubation are due to laryngeal diphtheria. Other conditions rarely requiring the operation are pseudo-diphtheria (streptococcus) of the larynx, catarrhal laryngitis, and laryngismus stridulus.

When to Intubate.—With the use of antitoxin it is generally considered better practice to wait for marked symptoms of stenosis, provided the patient's condition is favorable, before resorting to operation, in the hope that the serum, which is to be given in large doses at the first suspicion of laryngeal diphtheria, may do away with the necessity for operative interference.

The symptoms calling for operation are progressive dyspnoea, labored breathing and cyanosis, retraction of the tissues about the epigastrium and clavicles, diminished respiratory murmur over the lung bases, physical depression, and a failing pulse.

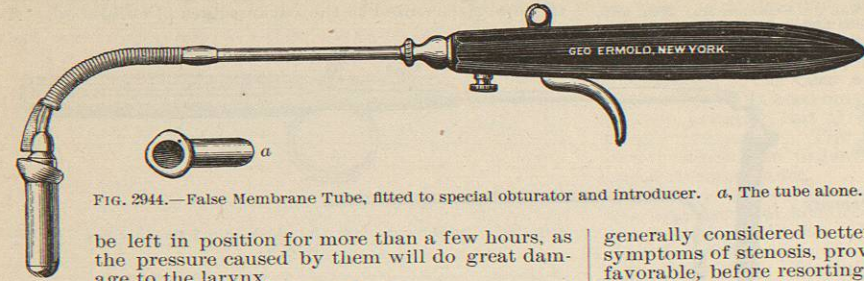


FIG. 2944.—False Membrane Tube, fitted to special obturator and introducer. a, The tube alone.

be left in position for more than a few hours, as the pressure caused by them will do great damage to the larynx.

Granulation tubes (Fig. 2940, No. 1.) are constructed for cases in which previous intubation has caused the formation of granulation tissue about the larynx. They differ from the ordinary tubes in having a large built-up head, which rides above the granulations and by pressure tends to hasten their absorption.

With the exception of the short tube of Bayeux, which possesses the sole advantage of being better adapted to

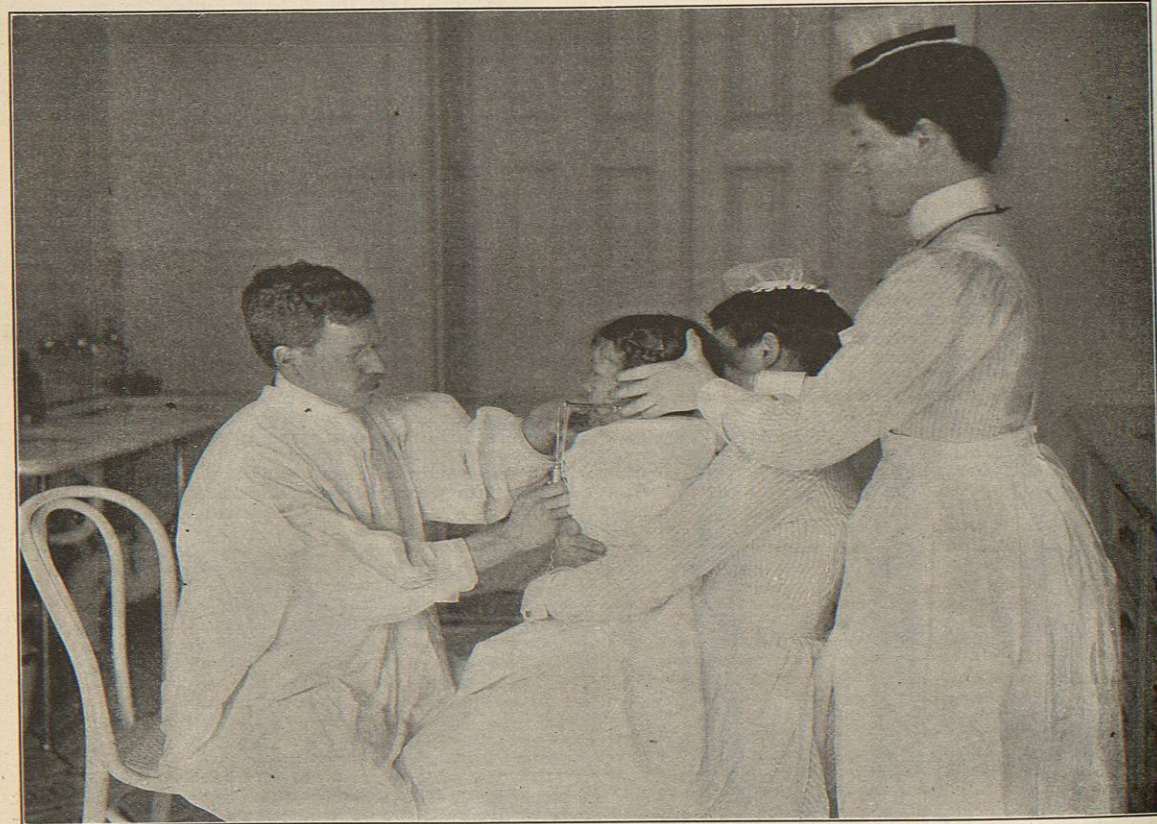


FIG. 2945.—Intubation. Correct position of operator, patient, and assistants. First position of the tube.

the operation of enucleation or removal by pressure through the trachea, it is unnecessary to mention here any of the so-called modifications of O'Dwyer's instru-

Technique of the Operation.—Intubation may be performed with the patient in either the upright or the dorsal position, the former being generally preferred. In either

case the patient is wrapped from the neck downward in a sheet or light blanket which includes the shoulders, arms, and hands, care being taken to avoid a bulky roll in front of the neck, which interferes with the handle of the introducer at the beginning of the operation. The nurse sits upright in a straight-back chair, holding the child firmly against her left breast and shoulder, by crossing the arms in front of the child's body outside of

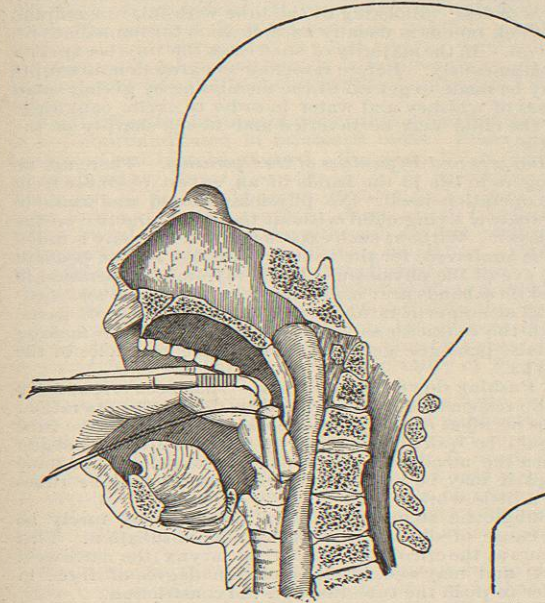


FIG. 2946.—The Tube Just Engaged in the Larynx.

the wrapper. The legs of the patient are gripped firmly between the knees of the nurse, the assisting physician standing behind the chair grasps the patient's head between his hands and holds it perfectly straight in a position as though the child hung from the top of its head.

The operator, seated or standing directly in front of the patient, inserts the mouth gag well back between the jaws of the left side, opens the mouth widely and gives the handle of the instrument to the assistant who includes it between his left hand and the patient's cheek. A tube of the proper size having been selected and its eye threaded, preferably with braided silk, care is taken to see that it slips easily from the obturator, which has been previously fitted to the introducer. The operator then inserts his left index finger into the patient's mouth, hooks back the epiglottis, crowds the finger as much as possible to the left and passes the tube, in the middle line along it, and just under its edge until the tip of the tube engages in the glottis (Fig. 2946). The handle of the introducer is at first depressed and nearly parallel to the patient's body; as the tube approaches the larynx, the handle is gradually raised until the tube actually engages in the chink of the glottis, when the elevation of the introducer should be abrupt so that the tube points directly down the trachea. By gentle pressure it is passed downward until the introducer lies crowded against the tongue (Fig. 2947). The left forefinger is then taken from the epiglottis and placed on the head of the tube, which with a gentle thrust it pushes home at the same time that the obturator is released and withdrawn from the mouth (Fig. 2948). The left forefinger and gag are then removed.

The characteristic respiratory sound, cough, and expectoration, together with immediate relief from the dyspnoea, indicate that the tube is in position. The string is left in for fifteen or twenty minutes to make cer-

tain that the calibre of the tube is free from obstruction by loose membrane or thick mucus, after which one end of it is severed close to the angle of the mouth, and while the left forefinger holds the tube in place it is quickly pulled out. It is not necessary, as a rule, to insert the mouth gag for this purpose. In infants, the string may be left in place during the entire period of intubation. In such a case it is to be hooked up behind the ear and fastened to the cheek by a bit of adhesive plaster. In older children it causes annoyance, may be pulled on with consequent removal of the tube, and is very apt to be severed by the back teeth. The points to be emphasized in the operation are, in brief: Hold the introducer lightly between the thumb and fingers, using no force. Keep the introducer as nearly as possible in the median line. Be sure that the position of the child is correct and that it is held absolutely immobile. See that everything is in readiness before beginning the operation. If not successful in introducing the tube at the first trial, begin all over, making, if necessary, repeated short attempts rather than a single prolonged one.

Dr. Bryant of the Willard Parker Hospital prefers to intubate with the patient in the dorsal position. Here the same rules apply as those given for the upright position. The dorsal position has the advantage of making the operation possible without the aid of assistants. For this purpose the child is wrapped up as above described and placed on a table. The operator's knee is pressed between the patient's thighs, the gag is introduced and allowed to hang in place, and the tube is passed in the usual way. It need not be said that this method of operation necessitates great skill on the operator's part, and should never be attempted unless assistance is absolutely unattainable.

EXTUBATION.—In the removal of the tube, the patient's position should be the same as that adopted for its intro-

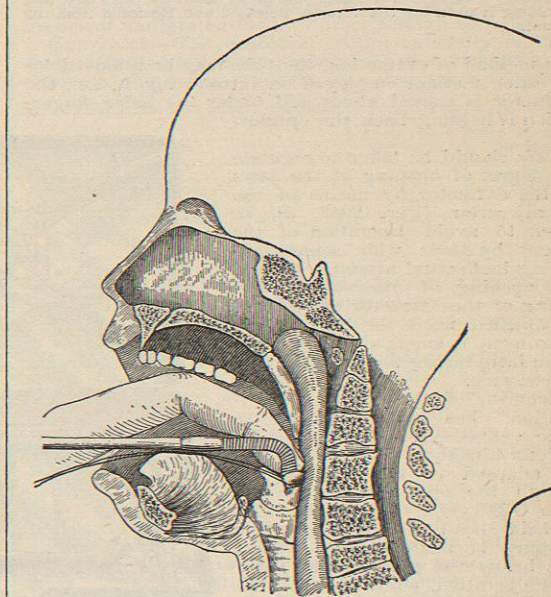


FIG. 2947.—The Tube Passed well into the Larynx. The introducer flat on the tongue.

duction; the left forefinger is placed on the arytenoid cartilages, the epiglottis is hooked up as the finger passes over it, the beak of the extractor is passed to the centre of the pulp of the finger and then to its extreme end, which marks the posterior boundary of the glottis in the median line, and then the handle of the extractor is

abruptly elevated, with the result that the beak of the instrument is pried forward from the finger tip into the opening of the tube. If difficulty is experienced with

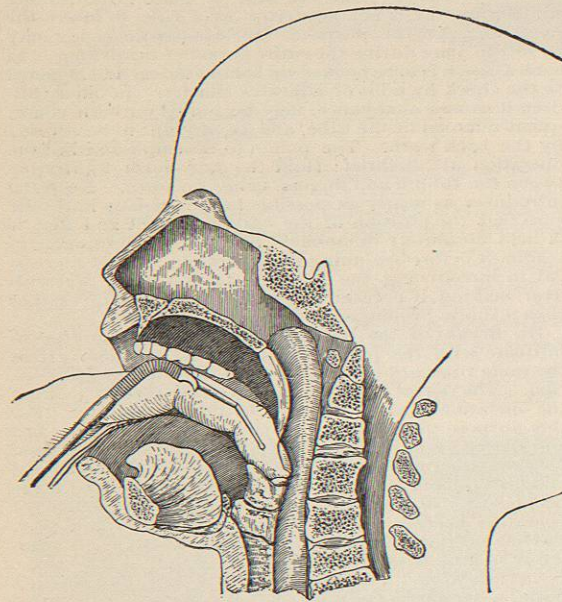


FIG. 2948.—The Left Forefinger Thrusting the Tube in Place and Holding it until the Obturator is Released and Removed from the Mouth.

this method of extraction, the tube may be removed by the same method employed in introducing it, *i.e.*, the extractor is passed along and under the index finger, which is holding back the epiglottis.

Care should be taken to regulate the degree of opening of the jaws of the extractor by means of the guard screw (Fig. 2942, *a*), in order to avoid laceration of the tissues by their wide separation, during ineffectual attempts to find the opening of the tube. The spring of the extractor should not be touched until the beak of the instrument is engaged in the tube. As in introducing the tube, no force is necessary.

Removal of the tube by "enucleation" has been practised to some extent. The short tubes of Bayeux already referred to are better adapted to this method, although the operation is possible with O'Dwyer's tubes. The child is held head downward, while pressure is made on the trachea just below the point of the tube. This operation, while it is not to be relied upon, especially with the O'Dwyer tubes, is certainly worthy of a trial in an emergency, as for instance when there is a sudden blocking of the tube which is not followed by expulsion. In cases also in which the tube has slipped below its proper position, it is perhaps better to try this method rather than risk pushing the tube farther down with the extractor.

When to Extubate.—With the use of antitoxin, the time during which a tube need be retained has been materially shortened and reintubation is much less frequently required. The retention of the tube is dependent on the general condition of the patient, the amount of toxæmia present, the condition of the pulse and temperature, the presence of membrane in the pharynx, and the age of the patient. Children under two years of age usually require the tube for from one to two weeks, older children for five days or less. Blocking of the tube with false membrane or thick mucus is usually an indication for immediate removal. In the majority of such cases the tube is expelled spontaneously. Before resorting to extraction, attempts may be made to get rid of the membrane by giving small doses of whiskey and water in order to excite coughing, or the child may be inverted and struck sharply on the back.

Dangers and Difficulties of the Operation.—There are no dangers to life at the hands of an expert operator from the operation itself. No physician should undertake to intubate a living child without thorough practice on the cadaver. Without such experience, tracheotomy is much to be preferred, for the field of operation is then beneath the eye of the physician. Dangers from the operation in unskilled hands are: asphyxia from prolonged and awkward attempts at intubation, laceration of the soft parts, with the extractor as well as the tube, and the making of false passages, generally through the ventricles of the larynx.

"Pushing down false membrane" has been erroneously made responsible for many deaths during the operation. This accident occasionally occurs, in which case the tube should be quickly removed by the still attached string when the membrane will usually be expelled. In some cases it may be necessary to use false membrane tubes for a little while.

Subglottic stenosis (so-called œdema) may rarely be the cause of difficulty in performing intubation. This occurs at the cricoid division of the larynx (the narrowest part) and may necessitate a certain degree of force in order to push the tube through the constriction.

Retained Tube.—Conditions requiring frequent re-intubations are: persistence of the laryngeal membrane, œde-

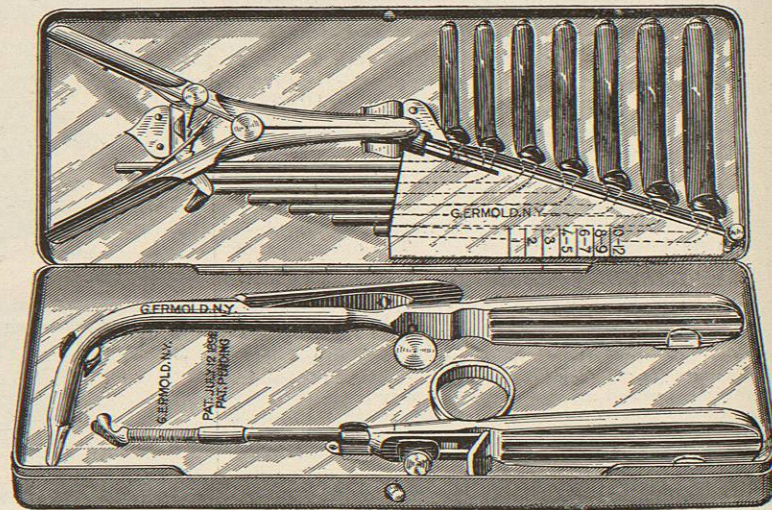


FIG. 2949.—Latest Design of Case Containing a Set of O'Dwyer's Instruments.

ma, ulcerations about the cricoid cartilage, leading occasionally to collapse of the cartilaginous framework of the larynx, cicatricial contractions, granulations, and abductor paralysis.

Care and Feeding of Intubated Children.—In the majority of cases of intubation the children soon learn to take food in the ordinary way. If, however, this is not possible, Casselberry's position may be necessary at least for a short time. In this method the patient's head hangs back over the lap of the nurse at an angle of forty-five degrees, the feet are elevated on a chair, and food is given with a spoon or from a bottle.

Gavage is preferred by some physicians during the entire time of intubation. It is certainly contraindicated when the pharynx is congested and painful. Rectal feeding should be regarded as a last resort. Semi-solids are more easily taken than liquids. Food should be given at short intervals and in such quantities as the child will take.

Nasal irrigation in cases of concurrent nasal diphtheria, is not contraindicated in intubated cases. Pharyngeal irrigation had best be omitted. To avoid the necessity of reintubation Dover's powder, gr. i., or morphine sulphate, gr. $\frac{1}{10}$ – $\frac{1}{2}$, may be given a short time before the tube is removed, and repeated afterward if necessary. Other useful measures to the same end are hot poultices over the throat, hot baths, and steam inhalation. Calming and amusing the child are also of great service.

The more recent statistics of intubation show that with the early use and proper dosage of antitoxin the operation detracts but little if at all from the chances of recovery from laryngeal diphtheria. Thus Waxham has reported forty intubations, with a mortality of five per cent.

The advantages of intubation over tracheotomy are in brief: That the former is bloodless, requires no anæsthetic or the help of trained assistants, is performed in a few seconds, and the after-care of the patient is much less than in tracheotomized cases. Finally, it would seem to be very poor judgment on the physician's part to inflict an open wound in order to tide a patient over a difficulty often (with the use of antitoxin) of only a few hours' duration.

Intubation for the relief of chronic stenosis due to cicatrices from wounds, syphilitic lesions, etc., as well as for the removal of a retained tracheotomy cannula, was suggested and practised by Dr. O'Dwyer with excellent results. The details of the operation cannot here be entered into. Suffice it to say that its success depends largely on the ingenuity and skill of the operator in having tubes fashioned to the various conditions encountered.

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Matthias Nicoll, Jr.

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INTUSSUSCEPTION.—The prolapse of one part of the intestine into the lumen of the adjoining part is called an intussusception. The included portion is called the intussusceptum, the receiving portion the intussusciptens. The condition is uncommon, and many physicians of large experience have never seen a single case. Among 12,641 cases of disease of which the diagnosis is recorded in recent hospital reports in New York City, there are only two such cases. Much attention, however, has recently been called to the condition, and the increasing number of reports suggests that when the possibility of

this condition is in the mind of the examiner the diagnosis will be made more frequently.

CAUSE.—Little is definitely known of the cause of intussusception. In peristalsis there are temporary contractions of the circular muscle fibres of the intestine. It

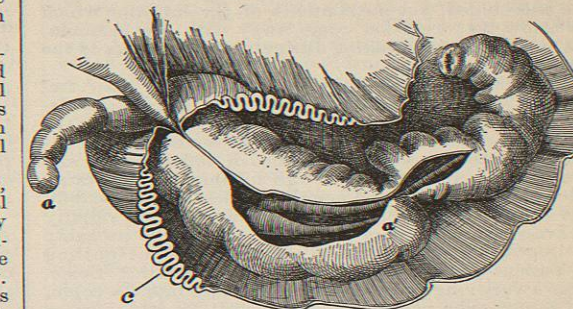


FIG. 2950.—Intussusception. (After Braun.) The lower end of the ileum, the caecum, and a part of the colon have prolapsed into the colon. *a*, Appendix vermiformis; *a'*, caecum; *c*, wrinkling of sheath which permits much mobility.

is easily conceivable that in rare instances, under certain irritations, this contraction should be prolonged and that the contracted part, with or without the action of the longitudinal fibres, should slip into the lumen of the adjacent part of the intestine and thus form an intussusception; and it is generally believed that most intussusceptions are formed in this way. A polypus or other new growth or a foreign body may also drag on the intestine and thus invaginate it. Leichtenstern,¹ in studying the records of 320 cases, found that polypi were present in 30 and that in 34 others there were cancers, strictures, masses of undigested food, or other foreign bodies.

Occurrence.—The condition occurs generally in children. Curtis,² in his comprehensive article in the former edition of this work, gives the following table of ages:

Age.	Acute cases. Per cent.	Chronic cases. Per cent.
Before 11 years	53	28
Between 11 and 20 years	12	10
Between 21 and 40 years	20	47
Between 41 and 60 years	11	12
Over 60 years	4	4

He found that children not over one year of age furnish 29 per cent. of the cases of intussusception.

The location of the intussusception is most commonly at the ileo-cæcal opening.

Leichtenstern found the following distribution: Ileo-cæcal, 44 per cent.; enteric, 30 per cent.; colic, 18 per cent.; ileo-colic, 8 per cent. The cases of intussusception in the small intestine were almost entirely confined to the ileum and the lower part of the jejunum. There are, however, records of a very few rare cases of intussusception of the duodenum.

Curtis noted that three-fourths of the cases in children under one year of age were ileo-cæcal, the mobility of the caecum and entire colon being greater in early life.

SYMPTOMS.—The symptoms which are most commonly present are the following: 1. Abdominal pain. 2. Vomiting. 3. Constipation. 4. The presence of a tumor within the abdomen. 5. The passage of blood and mucus from the rectum. 6. The presence of the intussusceptum so near the rectum that it can be felt by the finger. 7. Shock.

Pain usually comes on suddenly, often without any preceding illness or injury. The patient usually twists and turns until he has reached the position which is least uncomfortable, possibly flexing the thighs on the body.

Vomiting is usually persistent, first of the stomach