

tional symptoms, 2,000 to 4,000 units, according to severity. Cases seen after the disease has progressed so far that its probable local extent can be guessed, mild cases, 1,000 to 2,000 units, according to the size of the patient; moderate cases, 2,000 to 3,000 units; severe cases, showing necrotic membrane, swollen glands, or laryngeal stenosis, 3,000 to 4,000 units.

The effects to be expected from the antitoxin are, that the local disease should not extend, that the swelling and hyperemia should lessen and the constitutional symptoms abate. If twelve hours after the injection these changes have not begun clearly to manifest themselves, the injection of antitoxin should be repeated. If in twelve hours more no decided improvement occurs (which rarely happens, excepting in cases already very severe when first injected, and in some of the laryngeal cases complicated by bronchial or lung involvement), still a third dose should be given; some even advise a fourth. The extent of the disease, rather than the size of the patient, guides the dose; still size should be considered somewhat, and I should not advise, in a child under one year, more than 3,000 units in a single injection, and in one under six months not over 2,000 units. If the cases are severe, injections should be repeated just as in larger children. In adults attacked with malignant diphtheria the largest doses mentioned should be used and fearlessly repeated. With the serums as now used, these large doses have produced in a small percentage very disagreeable results, namely, rashes, fever, and in a few joint inflammation.

Whether some samples of serum may or may not cause, along with their beneficial effects, really serious deleterious effects, is still undetermined; but we do know that many samples of serum produce practically not even disagreeable effects. Thus, I have seen sixty cases treated, with only one rash. I have also seen, with serum obtained from another bleeding, twenty treated, with ten rashes. To select good serum only and throw away the most irritating, is only a matter of testing in trial cases. At present I see no other way of eliminating from sera the substances which produce rashes and other deleterious effects. The precipitate of antitoxin and globulin thrown down by magnesium sulphate is just as liable to produce rashes as the entire serum, and at present we know of no way to separate antitoxins from globulins.

**THE PRODUCTION OF DIPHTHERIA ANTITOXIN FOR THERAPEUTIC PURPOSES.**—As a result of the work of years in the laboratories of the Health Department of New York City the following may be laid down as a practical method:

The strongest diphtheria toxin possible should be obtained by taking a very virulent culture and growing it in slightly alkaline two-per-cent. peptone bouillon. The culture, after a week's growth, is to be removed, and, after it has been tested for purity by microscopical and culture tests, is then to be rendered sterile by the addition of ten per cent. of a five-per-cent. solution of carbolic acid. On the following day the sterile culture is filtered through ordinary sterile filter paper and stored in full bottles in a cold place until needed. Its strength is then tested by giving a series of guinea-pigs carefully measured amounts.

The horses used should be young, vigorous, of fair size, and absolutely healthy. A number of such horses are severally injected with an amount of toxin sufficient to kill ten thousand guinea-pigs of 250 gm. weight. After from three to five days, so soon as the fever reaction has subsided, a second subcutaneous injection of a slightly larger dose is given. With the first three injections of toxin about 10,000 units of antitoxin are given. If antitoxin is not mixed with the first doses of toxin, only one-tenth of the doses advised is to be given. At intervals of from five to eight days increasing injections of pure toxin are made, until, at the end of two months, from ten to twenty times the original amount is given. There is absolutely no way of judging which horses will produce the highest grades of antitoxin. Upon a very rough estimate I may say that those horses which are extremely sensitive and those which react hardly at all are

the poorest, but even here there are exceptions. The only way, therefore, is at the end of six weeks or two months to bleed the horses and test their serum. If only high-grade serum is wanted, all horses that give less than 150 units per cubic centimetre are discarded. If moderate grades only are desired, all that yield 100 units may be retained. The retained horses receive steadily increasing doses, the rapidity of the increase and the interval of time between the doses (three days to one week) depending somewhat on the reaction following the injection, an elevation of temperature of more than 3° F. being undesirable. At the end of three months the antitoxic serum of all the horses should contain over 200 units, and, in about ten per cent., as much as 600 units, in each cubic centimetre. Very few horses ever give above 1,000 units, and none so far has given as much as 2,000 units per cubic centimetre. The very best horses continue to furnish blood containing a large amount of antitoxin for several months, and then, in spite of increasing doses of toxin, the amount of antitoxin gradually decreases. If every nine months an interval of three months' freedom from inoculations is given, the best horses furnish high-grade serum for from two to four years.

**THE PRODUCTION OF TETANUS ANTITOXIN.**—The tetanus antitoxin is developed in the same manner as the diphtheria antitoxin—by inoculating the tetanus toxin in increasing doses into horses. The toxin is produced in bouillon cultures grown anaerobically. After ten or fifteen days the culture fluid is filtered through porcelain, and the germ-free filtrate is used for the inoculations. The horses receive 0.5 c.c. as the initial dose of a toxin of which 1 c.c. kills 250,000 gm. of guinea-pigs, and along with this a sufficient amount of antitoxin to neutralize it. The antitoxin is added to the first few doses. In five days this dose is doubled, and then every five to seven days larger amounts are given. The dose is increased as rapidly as the horses can stand it, until they support 700 to 800 c.c. or more at a single injection. After some months of this treatment the blood of the horse contains the antitoxin in sufficient amount for therapeutic use. When the animals' temperatures are normal and they have recovered from the dose of toxin last given, they are bled into sterile flasks and the serum collected.

**TECHNIQUE OF TESTING TETANUS ANTITOXIC SERUM FOR VALUE IN ANTITOXIN.**—Tetanus antitoxin is tested exactly in the same manner as diphtheria antitoxin, except that the unit of measure is different. A unit in the German standard is the amount of antitoxin needed to neutralize 4,500,000 fatal doses of toxin for 1 gm. of white mouse. In the French method the amount of antitoxin which is required to protect a mouse from a dose of toxin sufficient to kill in four days is determined, and the strength of the antitoxin is stated by determining the amount of serum required to protect 1 gm. of animal. If 0.001 c.c. protected a 10-gm. mouse, the strength of that serum would be 1 to 10,000. Guinea-pigs are frequently used in place of mice. Knorr's method of preserving toxin is by precipitating it with saturated ammonium sulphate and drying and preserving the precipitate in sealed tubes. As required, it is dissolved in ten-per-cent. salt solution, as above stated. For small testing stations the best way is to obtain some freshly standardized antitoxin and compare serums with this.

**THE DOSAGE OF TETANUS ANTITOXIN.**—For immunization, one dose of from 5 to 10 c.c. of a serum of a good strength, such as 1 to 100,000,000, will suffice unless the danger seems great, when the injection is repeated at the end of a week. For treatment, it is well to begin with from 30 to 50 c.c., and then, according to the severity of the case, give from 20 to 50 c.c. every six to twenty-four hours until the symptoms abate. In the gravest cases no curative effect will be noticed from the use of the serum. It is sometimes injected into the lateral ventricles or even into the brain substance. Both the theoretical reasons for, and the actual results obtained from, this method of treatment, are open to criticism. The first dose, in severe cases, may be given intravenously. *William H. Park.*

**ANTITUSSIN.**—Difluor diphenyl (C<sub>6</sub>H<sub>4</sub>F)<sub>2</sub>. This is a white crystalline powder with a pleasant aromatic odor suggestive of dill seed. It is insoluble in water and soluble in alcohol, ether, chloroform, and fixed and volatile oils.

Originally introduced as an antispasmodic and sedative in whooping-cough, it was reported by the early observers to be of little value in that condition. Recently, however, Max Heim has published observations on sixteen cases in which he found speedy and surprisingly complete relief following its use. His conclusions were that it lessens the acuteness of the attack, that it markedly loosens the phlegm and mucus, and that the duration of the disease is reduced from several weeks to a few days, or at most two weeks. His formula is difluor diphenyl 5, vaseline 10, adeps lanae hydrosus 85, and this he uses by inunction over the neck or interscapular region after thoroughly cleansing the skin and rubbing it with a rough towel. Antitussin is not administered internally, as it deranges the stomach. The dose by inunction is from 5 ij. to 5 iij.

Besides its use as above it has been found valuable as an antiseptic, and for this purpose is applied as a five to twenty per-cent. ointment or dusting powder. Thimm uses it in venereal ulcerations, after cauterizing the ulcer with carbolic acid.

*W. A. Bastedo.*

**ANUS AND RECTUM. (SURGICAL.)**—No rectal examination in women can be considered at all complete which does not include bimanual exploration of the pelvis, and the examiner must acquire the same skill in this as the gynaecologist, though he will more frequently explore with one finger in the rectum than in the vagina. It is also true that many obscure cases both in men and in women will at once become clear under anesthesia. So little does diagnosis depend upon any specula that we need not stop to consider these instruments.

This does not apply to the Kelly long tubes for high rectal and sigmoid exploration. These may in certain cases be of great value both for diagnosis and for treatment. I have modified his original design so as to make the long tube resemble the ordinary valve speculum except in its length. The instruments are difficult to use and not devoid of danger, but in expert hands they occasionally yield excellent results.

**HEMORRHOIDS.**—These may be divided into external and internal. External hemorrhoids present themselves in two perfectly distinct forms. The first is shown in Fig. 220, and is a venous tumor, produced by the rupture of an external hemorrhoidal vein and the extravasation of its contents. Such a tumor forms suddenly, is

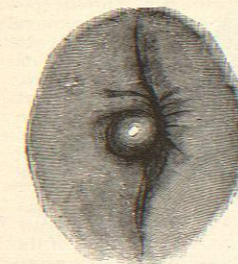


FIG. 220.—External Venous Hemorrhoid. (Smith.)

exquisitely painful, and sometimes looks and feels like a large black grape; it will slowly subside and disappear when treated by rest in bed and applications of powdered ice in a rubber *baudruche*, with the internal administration of a saline cathartic. The most appropriate treatment, however, is a free incision with a small, sharp-pointed, curved bistoury, the tumor being transfixed and incised in the direction of the radiating folds of the anus. As a result of the incision, a small, round clot—the pressure of which has caused all the suffering—may be turned out of its bed.

The other form of external hemorrhoid is a cutaneous and not a venous tumor, and is well shown in Fig. 221. This is often spoken of as a condyloma, but that name is better applied to another condition. Such a tumor as this is composed of skin and connective tissue. It often results directly from the irritation caused by the first variety, and is, in fact, the remains of the venous tumor;

or it may be caused by the irritation of some ulcerative disease within the rectum. It is not painful unless it happens to become acutely inflamed, and is generally best left alone. When operating for more serious trouble, with the patient under ether, I occasionally snip them off with a pair of scissors, but when a patient applies for relief from them alone, I usually advise non-interference. The wound made by removing them is painful and they generally do little harm.

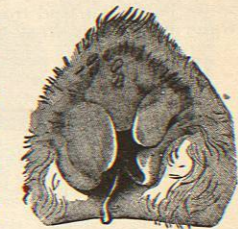


FIG. 221.—External Cutaneous Hemorrhoids. (Esmarch.)

Internal hemorrhoids are those which arise, within the sphincter muscle, from the internal hemorrhoidal vessels. They present many variations in structure. One perfectly distinct variety is known as the capillary. This is in reality an erectile tumor composed of the terminal branches of the arteries and veins, and of the dilated capillaries which unite them. This form of tumor is never of large size, and never projects far into the cavity of the rectum. It is, in fact, much like a nevus of the scalp. It may be situated high up in the rectum, but is generally near the anus; the surface is granular, and the membrane covering the vessels is so thin that it may be broken by each act of defecation. Such a tumor never appears outside the anus unless the protrusion is caused by some other affection, but it may be seen by carefully pulling open the parts with the fingers, and from some part of its mulberry-like surface there is apt to be a jet of arterial blood, coming *per saltum*. This is, above all others, what is most properly called the "bleeding pile."

This form of hemorrhoid may be cured by a single thorough application of fuming nitric acid, and it is the only form in which this plan of treatment is likely to be of permanent benefit.

In the other forms of hemorrhoids there is a distinct tumor, sometimes of considerable size, made up of mucous membrane more or less eroded, of connective tissue, and of blood-vessels. These tumors may cause decided symptoms before they are sufficiently large to protrude from the anus. One of the first is an unsatisfied feeling after defecation, as though the rectum were not fully emptied; and this is explained by the increase in size of the tumors caused by defecation. This feeling passes away after a few moments, when the circulation has again become natural. Other symptoms are pain, more or less obscure, and referred to the loins and thighs; difficulty in micturition; diminished sexual appetite and power; hemorrhage; and sometimes a peculiar train of nervous symptoms referred to the legs—symptoms which will deceive both patient and physician into the belief that an ataxia is developing. After the tumors reach a stage which causes them to protrude beyond the sphincter in defecation, the resulting symptoms are well known. In ordinary cases the patient will reduce the tumors himself after each protrusion. They may, however, become strangulated and be entirely beyond the patient's power of manipulation. In such a case, after a period of rest, and after the relief which may follow a spontaneous escape of blood, the hemorrhoids may return of themselves or be put back by the patient.

If the strangulation be more intense, gangrene may set in and a part of the mass may slough, or a portion may suppurate. Under such circumstances there will be great pain, and more or less constitutional disturbance, with fever. The gangrene is very evident, both to the eye and the sense of smell, from the greenish or blackish color and fetid odor of the part, and is rather a favorable termination to the trouble, as it generally results in a radical cure.

**TREATMENT.**—The treatment of internal hemorrhoids is both palliative and curative, and it is a great advantage to the surgeon to know what can be done for a timid pa-

tient without having recourse to anything which may properly be called an operation. The first thing is to secure a daily natural evacuation of the bowels, and this without medicine if possible. The diet should be plain. Highly seasoned dishes, gravies, salads, old cheese, etc., all alcoholic drinks, and any excess in tobacco should be strictly interdicted. If necessary, a laxative may be added to the daily diet, and this may be either a glass of mineral water before breakfast, or a drachm of compound licorice



FIG. 222.

powder at night. The local treatment consists mainly in the use of astringents and cold water. A cold sitz bath every morning after stool is one of the best of all methods of preventing and relieving hemorrhoids, and cold, or even ice water should be freely applied after each passage. The best astringent is the subsulphate of iron in the form of ointment or suppository (3i. to ʒi. for ointment, and two or three grains in a suppository). By these means, when followed with care and patience, the worst case may be greatly improved. Although they are given simply as palliative measures, they will sometimes be followed by such relief as to convince the patient that he is radically cured.

Of all the different methods of radically curing hemorrhoids I shall describe but two. These are the ones which have given the best results, and from them each may choose. By either of them every case may be cured.

(a) The treatment by the ligature, as practised by most surgeons at present, consists in cutting through the greater part of the base of the tumor with the scissors, and tying a strong ligature around the remainder, which is supposed to contain the larger blood-vessels. As in all operations on the rectum, the bowels should be thoroughly cleared by a cathartic on the previous day and by an enema just before operating. The patient should be etherized and placed in the lithotomy position, and the sphincter gently but forcibly dilated till it loses its contractile power. A speculum may or may not be used, as the operator prefers. Each tumor is seized with a long toothed forceps, such as is shown in the cut (Fig. 222), and is then drawn out of the anus. Holding the forceps in his left hand, the operator separates the tumor from its attachments by cutting with a strong pair of scissors in the line of junction of the skin and mucous membrane from below upward until only a pedicle remains. The forceps are then transferred to an assistant, and a strong silk ligature tightly tied around what remains of the tumor, and the hemorrhoid itself may then be cut off at a short distance from the ligature, in order that as much dead tissue as possible shall be removed from the rectum. Each hemorrhoid is thus treated in succession, and after all are removed and the ligatures cut off close, a suppository of opium and belladonna is introduced and a T-bandage tightly applied over a compress of lint and a napkin.

The after-treatment is a matter of a good deal of importance. It is not well to allow the bowels to be confined more than three days, and the first passage should be assisted by a laxative. Much less pain will be caused by a soft passage on the third day after the operation than will result from confining the bowels for ten days or a fortnight, as is usually done. Under the latter circumstances the suffering caused by the first passage is often atrocious. It is not a good plan to try to introduce suppositories into the painful rectum after the operation. The ligatures will generally come away at the end of a week or ten days, and the patient should be kept in the bed or on the lounge for a week longer till

the ulcer caused by the separation of the slough has had time to heal. Nothing has been said about primary hemorrhage. It is sometimes considerable, and much that is theoretical in character has been said about the chief vascular supply of a hemorrhoid being at the upper end. The incision made with the scissors before the ligature is applied sometimes bleeds very freely, and requires the free use of lint within the bowel after the operation is completed. The removal of this wad, in those cases in which it has been found necessary to introduce it, is an additional source of pain.

This operation, though generally very satisfactory, is open to certain objections. These are: occasional severe constitutional disturbance with nervous excitement, frequent pulse, loss of sleep, pain sufficient to demand the use of morphine for days, and obstinate retention of urine, which may render catheterism necessary for a fortnight; and, finally, undue contraction after the operation, which will entail the use of the bougie.

(b) The other operation, which gives the best results, is done with the clamp and cautery, and consists in drawing down the tumor, embracing its base tightly in the clamp, cutting off such an amount that a good-sized stump shall be left, and cauterizing this thoroughly with the hot iron. It is important to isolate the tumors well, so as to compress them easily and completely; and, in cases in which the hemorrhoid joins abruptly the hypertrophied skin, a groove may first be made with the scissors, so that the compression of the neck of the tumor may be more effectual. After the cautery has been very thoroughly applied, at a black heat, the blades of the clamp should be gradually released by the screw. Should any bleeding occur the clamp must be again screwed up, and the cautery applied more thoroughly. This may be necessary several times. The advantages claimed for this operation over that with the ligature are: greater safety to life, greater freedom from suffering, more rapid recovery, less danger of pyæmia, of ulceration, and of embolus, and less constitutional disturbance after the operation. The operation is equally applicable to cases of prolapsus.

*Treatment by Minor Surgical Methods.*—Many methods have been devised by which hemorrhoids may be radically cured by office treatment, without general anesthesia or confinement to bed. Perhaps the one best known at the present day is that which requires the injection of a solution of carbolic acid into the tumor—an uncertain and dangerous plan, which has been generally abandoned by the regular surgeons because of the impossibility of limiting its effects. If a patient prefers this office treatment without what he or she considers a surgical operation, hemorrhoids may be gradually destroyed exactly

as the nose and throat specialists remove polypi and obstructions from the air passages. The treatment will require time, but it is perfectly efficient and gives great satisfaction to those who can avail themselves of its advantages.

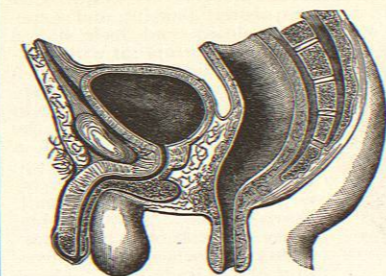


FIG. 223.—First Variety of Prolapse. (Mollière.)

other affections also—fissures, pruritus, small fistula, etc. **PROLAPSE.**—There are four distinct varieties of prolapse, which must be carefully distinguished from one another as regards the plan of treating them, for the same operation which will cure one variety may lead to a fatal result in another which to the eye closely resembles it. The first consists of a protrusion of the mucous membrane alone, and is sometimes spoken of as partial prolapse, because only a part of the coat of the bowel comes

out of the body. It is shown in Fig. 223. It is a mere eversion of the mucous membrane of the lowest portion of the rectum, rendered possible by the laxity of the sub-mucous connective tissue. It is the most common of all the forms, and is most frequently found in children between the years of two and four. It always comes on gradually, and it may be partial or complete as regards the entire circumference of the anus. It appears as a scarlet or livid mass (depending upon the degree of contraction of the sphincter) covered with the natural secretion of the bowel, directly continuous with the skin on one side and with the mucous membrane on the other, and arranged in folds which radiate from the central aperture toward the circumference. It is at first spontaneously reducible, or at least may easily be replaced by slight pressure, and remains reduced till the next defecation; but as the amount of prolapsed membrane increases, the difficulty in reduction becomes greater, and finally the mass may be out of the body most of the time from distention and loss of power of the sphincter. In this condition the tumor is liable to become inflamed, oedematous, and irreducible, and the patient is in a very unhappy plight.

The first step in the treatment of this form of prolapse is generally the reduction of the mass. If the patient be in the condition last named all operative interference should be postponed; no attempt at reduction need be made, the patient should be confined to his bed, cold applications should be used freely, and the tumor should be smeared with an ointment of equal parts of the extracts of opium and belladonna. After a week of this treatment the tumor will probably be in a condition in which it may either be replaced or be removed, and the surgeon will then be able to judge something of the amount of tissue to be removed, which is not possible when all the parts are oedematous. In ordinary cases the tumor may be reduced by gentle taxis. If this does not succeed, ether should be given at once and a radical operation performed. In adults, when the taxis has failed and both ether and operation are declined, there is nothing to do but keep the patient on his face in bed with a pillow under the pelvis, apply warm poultices with the ointment mentioned, and trust to time to relieve the condition.

The palliative treatment is directed entirely toward diminishing the frequency and amount of the prolapse, and a cure may sometimes, especially in children, be obtained by these means without operation. They consist briefly in directing the act of defecation to be performed in the recumbent posture, and in advising the use of laxatives to prevent straining, the avoidance of any source of irritation which will cause frequent passages, and the use of astringent washes each time the bowel protrudes. The best astringent is cold water or a cold solution of alum (ʒi. to ʒviij.). An astringent injection may also



FIG. 224.—Prolapse Composed of All the Coats of the Rectum. (Bushe.)

be given every night with advantage, the fluid being allowed to remain in all night. In children a very effectual means of cure is the application of fuming nitric acid to the prolapsed part. The bowel should be thoroughly dried with a towel, and the acid applied with a small stick all over the mucous membrane. The bowel should then be replaced, a pad of lint should be firmly applied, by means of a broad strip of adhesive plaster, over the nates, sufficient opium should be given to confine the bowels, and the child should be kept in bed. In a large proportion of cases the cure will be complete after a single application, unless a polypus be the exciting cause of the trouble. This treatment is not equally successful in adults, and in old persons deep and dangerous sloughs may result, which may lead to serious hemorrhage. In them the treatment by

linear cauterization is much preferable. It consists in making several deep cauterizations in lines radiating from the centre of the prolapse toward the circumference. Paquelin's cautery with the fine-pointed bent tip is the proper instrument to employ, and after several such cuts have been made it is a good plan to burn through the sphincter on each side, to allow of contraction. This operation must be done with judgment, and the amount of cauterization must correspond with the amount of prolapse. In old and inveterate cases the fault is generally, however, in not making the cauterizations sufficiently extensive. A portion of the mucous membrane is burned off, but the cuts do not extend into the connective tissue around the anus, as they should.

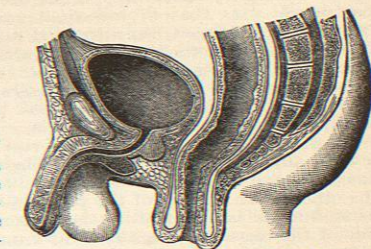


FIG. 225.—Second Variety of Prolapse. (Mollière.)

The second variety of prolapse is that composed of all the coats of the rectum—mucous, submucous, and muscular—and is shown in Fig. 224. The essential point in the consideration of this form of the disease is to remember that the prolapse may contain peritoneum; and it follows, from the anatomy of the parts, that the peritoneal pouch will be larger in front than behind. In the pouch thus formed may be located coils of small intestine, or even the uterus or an ovary. In this form of prolapse there is no groove or sulcus, and its absence is therefore no proof of the absence of peritoneum. Its anatomical characters are well shown in Fig. 225. This variety of the disease generally follows the first, though it may come on suddenly from violent straining. It is distinguished from the first by its size, by greater firmness and thickness

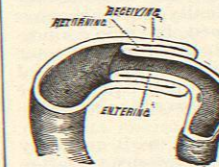


FIG. 226.—Third Form of Prolapse. (Bryant.)

as ascertained by the touch, possibly by resonance on percussion, or by the gurgling of gas in a contained loop of small intestine, by its conical shape, and by the slit-like orifice which is generally drawn to one side by the attachment to the vagina, or by the binding down of the meso-rectum.

It is evident that an operation which might cure the first variety might easily end fatally in this one, by reason of the presence of peritoneum, and that the possibility of this complication must always be borne in mind. The treatment by linear cauterization is the safest, and the cuts should be made into the substance of the sphincter after the tumor has been reduced, and not into the tumor itself. Should this fail, the tumor must be amputated with subsequent circular enterorrhaphy above the external sphincter. The palliative treatment is the same as for the other variety.

The third and fourth varieties will be described together, because they do not differ from each other in their nature, but simply in their extent and location. To both the term invagination is properly applied, because of the ensheathing of one part of the bowel within another, which is shown in Fig. 226. In the third variety the telescoping occurs near the anus, the intruded portion appears at the anus, and the sulcus between the extruded portion and the lower part of the rectum may be felt with the finger. Its depth forms an indication of the length of the contained part. When a portion of the bowel still further removed from the anus has become invaginated into that immediately below, the included portion may or may not descend sufficiently near to the