ing the inflow to continue, and then by arresting the latter and allowing the fluid to escape through the carry-off tube, one can irrigate the intestine in a satisfactory manner.

FIG. 1914.—Enteroclysis with Single Tube. Case of an infant.

Still another method is to allow the injected fluid to be ejected by the patient alongside the tube, immediately after which a fresh supply of the fluid is again injected. This operation can be repeated as often as may be desired. It will be found useful not only for cleansing purposes but also for the relief of such conditions as shock, uræmia, hemorrhage, etc. The mode of procedure, in the case of an infant, is thus described by Dr. L. Emmett Holt, who places the ileo-cæcal valve as the limit which the fluid may reach: "The child is placed on the back, thighs flexed, buttocks brought to the edge of the table, clothing protected. The fountain syringe at a height of four to five feet; a flexible rectal tube, or soft catheter, No. 18–20 American scale, is employed; an extra eye may be cut near the tip. The catheter is oiled and just after the tip is inserted into the anus the water is turned on. This renders it stiffer, and it passes more readily. It is pushed

FIG. 1915.—Bodenhamer's Rectal Irrigator. *A*, inflowing stream; *B*, outflowing stream; *C*, points at which the escaping fluid enters the irrigator.

in twelve to fourteen inches. Usually a pint and often a quart will be introduced before any water returns. The water is evacuated from time to time alongside the catheter and often with considerable force; hence a towel should be spread to fall like a screen over the anus to protect the operator. The washing should be continued until the water returns quite clean. Gentle kneading of the abdomen should be employed during the early part of the irrigation to facilitate the passage of water into the upper part of the colon. The temperature, in most cases, should average 101° F. At the end of the irrigation, the tube of the fountain syringe is detached and the fluid which remains allowed to escape through the catheter before removal of the latter. The colon of a six-months' infant holds a pint without distention, and, at the age of two years, two to three pints."

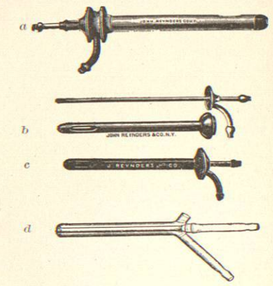

FIG. 1916.—Author's Irrigating Tubes. *a*, Flexible irrigator; *b* and *c*, more recent models; *d*, glass irrigator, with side opening (closed by a cork) for cleansing purposes.

A convenient modification of the operation is shown in the accompanying illustration (Fig. 1917).

ENTEROCLYSIS WITH A DOUBLE CONTINUOUS CURRENT.—The principle of double-current irrigation is quite old; the instrument of Bodenhamer was probably the first double-current rectal irrigator devised (see Fig. 1915). Many other irrigators have been employed, such as two tubes or catheters, or a large double-current catheter, etc.

When it is necessary to improvise a double-current irrigator, this may be accomplished in the following manner: Take two catheters—the smaller one for the entering current, the larger for the outflow—and pass them

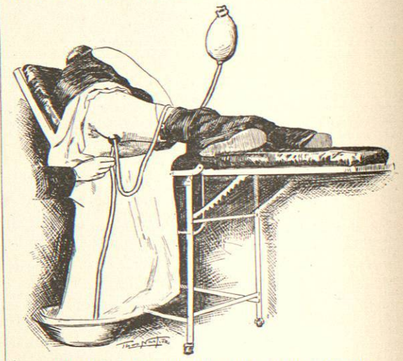

FIG. 1917.—Enteroclysis in the Semi-recumbent Position.

through a perineal pad of gauze and cotton, covered with oiled silk, or through a dress-shield, or a piece of oil cloth, marble cloth, or rubber sheeting.

In the accompanying figures are shown several of the author's latest patterns of irrigating tubes (see Fig. 1916, *a*, *b*, *c*, *d*).

Precautions to be Observed before Inserting the Tube.—Allow the irrigating fluid to flow from the tube until all

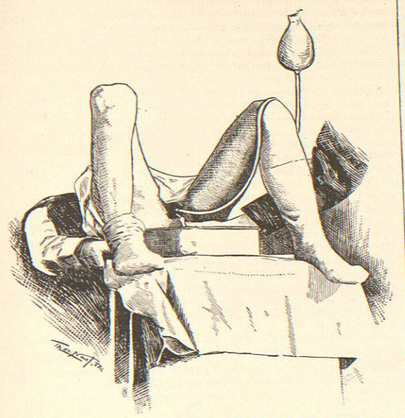

FIG. 1918.—Enteroclysis in Dorsal Position on the Bed Pan.

the air has been expelled; then check the flow. As the tip of the instrument passes through the sphincter, start the flow in order to force the mucous membrane away from the irrigator and from its fenestræ. Attach the fountain syringe to the central tube and the carry-off tube to the larger curved lateral tube. By alternately pinching this and the tube of the fountain syringe, the quantity of fluid entering and escaping can be regulated. As the outflow is larger than the inflow, unless the outflow is checked no fluid will pass up the bowel.

Insertion of the Instrument.—The tube should be well lubricated and inserted with a gentle rotary motion, and not forced in. The tip of the instrument should be directed slightly backward toward the sacrum, and the fluid allowed to flow at the moment when the tip passes the sphincter. If the flow ceases, rotate the tube slightly or withdraw it slightly while rotating, and push it back. If the outflow seems to be obstructed, stop the inflow and then force fluid back through the outflow tube with a small hand syringe, or detach the fountain syringe and force the flow back through the outflow tube for an instant. Sometimes "milking" the outflow tube with the fingers will start the flow. Avoid pressing the tip of the instrument against the wall of the bowel, or directing the current against it, as either of these procedures is irritating.

Distance to which the Irrigator should be Pushed up into the Bowel.—The rectal tube should be inserted for a distance of from one-third to one-half its length in prostatic cases, etc., and in its entire length when high irrigation is to be carried out. In actual practice it is found that the introduction of the short tube to its full length, provided the patient's hips are elevated, gives as good results in high irrigation as does the colon tube.

Withdrawal of the Instrument.—Do not withdraw the instrument like an ordinary tip, lest the mucous membrane catch in the fenestræ, but rotate it slightly, first in one direction and then in the other, as it is being withdrawn. By observing this precaution the physician will not be likely to experience the accident just described.

Cleansing the Irrigators.—To clean the stiff tubes, unscrew the central tube and withdraw it. To clean the flexible tube, unscrew the accessory cap and loosen the main cap, meanwhile holding the rubber fitting of the central tube firmly, to prevent twisting the central linen catheter; push the caps along the central tube to nearly the end, then withdraw the hard-rubber tip from the main outer tube and with it about half an inch of the central linen tube; next unscrew the tip, holding the catheter firmly just below it; and finally withdraw the central tube, as in the hard-rubber instrument. If the attempt were made to unscrew the flexible tube, it would readily tear. The flexible tubes should not be allowed to remain in any solution except for a moment, as the central tube readily softens and collapses. Should this occur, a wire passed through it generally remedies the difficulty. The central tube is often made of a linen catheter. The flexible English catheter (such as has the stylet) is much more durable; the ends do not fray so readily, nor does it crack so easily, and it is cheap. No. 7 is a good size; it can be cut in lengths to suit, and the hard-rubber fittings will cut their own thread on it. A fresh central tube can thus be used in every case, and the outer tube and fittings can be disinfected.

Enteroclysis in the Semi-oblique (Half-Sitting) Posture.—Dr. William H. Thomson's method. This has been employed in pulmonary œdema and in pleurisy with effusion, when, because of respiratory difficulty, the patient was unable to lie down (see Fig. 1917).

The Different Positions of the Body in which High Irrigation may be Practised.—The first position is that in which the patient lies upon his back, with his hips elevated and his shoulders at a lower level. A bed pan, preferably a douche pan, is placed beneath his buttocks (see Fig. 1918). This receptacle, however, may be dispensed with, as a rubber sheet, if properly adjusted, will answer sufficiently well (see Fig. 1919). The patient may also lie on either side, with the hips elevated and the shoulders at a lower level (see Fig. 1920). Instead of a rubber sheet, a Kelly's pad may be employed.

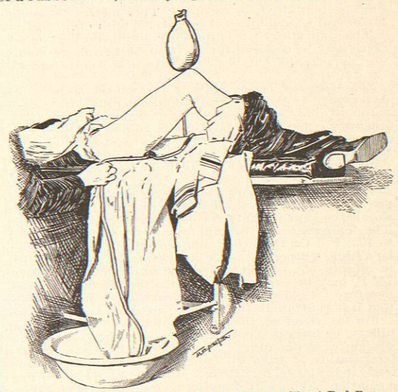

FIG. 1919.—Enteroclysis in Dorsal Position without Bed Pan.

What is known as the *method by rotation* (see New York *Medical Journal*, March 13th, 1897) may be described as follows: The patient is placed on the left side, with the hips elevated, and about a pint and a half of the solu-

tion is allowed to flow into the descending colon; the outflow tube is then pinched and the patient is gradually rotated first to the dorsal position and then to the right side. As the next step in the procedure the shoulders are elevated above the level of the hips (the patient still

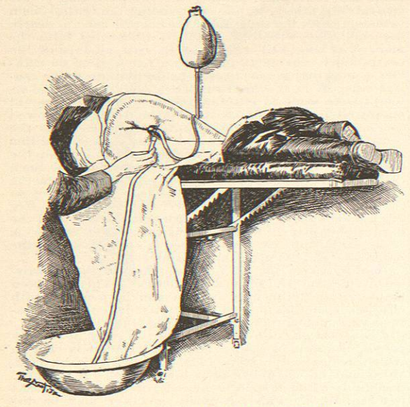

Fig. 1920.—Enteroclysis in the Sims Position.

being on the right side), in order that the fluid may gravitate into the caput coli. Then the steps just described are reversed, the outflow tube is released, and the fluid is permitted to escape. This method resembles Kussmaul's technique for irrigations with oil.

The indications for employing double-current enteroclysis may be deduced for the most part from the following paragraphs on the "Quantity and Temperature of the Solution."

Quantity and Temperature of the Solution.—In colitis, dysentery, typhoid, intestinal dyspepsia, the various forms of diarrhœa, constipation, fæcal impaction, etc., a quantity equal to from six ounces to one pint and a half may be allowed to flow into the bowel before escape is permitted. Enteroclysis may be employed once or twice daily, and the total amount of fluid used at each sitting should not be less than two quarts. In some cases as much as several gallons has thus been utilized. If there are no special contraindicating circumstances the flow should be kept up until the escaping fluid is quite clear. The temperature of the fluid used should be from 101° to 105° F. On the other hand, in sthenic cases, if there be a high temperature—as in dysentery, gastro-enteritis in infants, etc.—irrigation with a solution at from 90° to 75° F. may be employed, to aid in the reduction of temperature. Cold should be used cautiously, and I believe that it is contraindicated if there are renal complications.

For the relief of the spasm which accompanies renal, biliary, or intestinal colic, it is a good plan to allow from six ounces to one pint of a hot fluid (saline solution at a temperature of from 101° to 103° F.) to remain continuously in the bowel for fifteen minutes or longer. At times a solution having a still higher temperature (from 110° to 120° F.) acts better. This is often the case in intestinal colic, in which condition the hot solution aids in expelling flatus.

In all conditions in which it is desirable to stimulate the circulation, to increase renal secretion when insufficient, or to eliminate toxins through promotion of diuresis, etc., the quantity of the solution to be kept continuously in the bowel should average from a pint to a quart; and the enteroclysis should be kept up for from half an hour to an hour. If we wish to secure the best results under the conditions referred to, we should employ normal salt solution at a temperature somewhere between 110° F. and 120° F. In addition to the conditions last named and to those enumerated in the earlier part of the article, the following may be named: sepsis due to any cause, as from peritonitis, septic endocarditis, cholera, typhoid, diphtheria, etc.; malarial poisoning (to check or abort a chill); the various dropsical conditions, etc.

Enteroclysis, as may readily be supposed, has proved to be of use in gynæcology. Thus, for example, its usefulness in the case of an unmarried woman, as a substitute for vaginal douching, deserves special mention. It may be employed, in the form of hot enemata of normal saline solution (at a temperature of from 110° to 120° F.), for promoting the absorption of pelvic exudations, for the relief of leucorrhœas, of ovaritis, of shock, etc., and in many other conditions (C. Reginald Hyde).

In genito-urinary and rectal affections—such as inflammation of the prostate or bladder, retention of urine, spasmodic stricture of the urethra, chronic or acute inflammation of the urethra, internal hemorrhoids, etc.—enteroclysis often affords great relief. In cases of intestinal paresis and of intestinal obstruction injections of oxygen have been found useful by Dr. Clement Cleveland, of New York. (See New York *Medical Record*, January 5th, 1901.)

Solutions that may be Used in Enteroclysis.

Flaxseed tea, made thin and oily, of value in catarrhal conditions of the intestine, especially if accompanied by constipation; also aids absorption of exudations.

Fig. 1921.—Enteroclysis with Double Tube. Case of an infant.

Normal salt solution, a drachm of salt to a pint of water; useful for cleansing purposes; bland and especially safe for children; useful as a circulatory stimulant; as a diuretic, and to eliminate toxins.

Oil of peppermint or cinnamon (five to fifteen minims to the pint) may be added to the salt solution for cleansing purposes (William H. Thomson).

Boiled water, with boric acid (from half a drachm to a drachm to the quart, or even stronger), or with permanganate of potassium (from three to ten grains or more to two quarts of water); useful when there is marked fermentation or foul odor. A similar solution of bichloride of mercury (1 to 10,000) has been successfully employed (two quarts at each irrigation daily) in membranous (croupous) colitis of a septic type. In dysentery it is also of service. Stronger solutions do not appear to be necessary. Solutions of carbolic acid and of camphor have been found to be irritating. Rovacs and others employ quinine solutions (1 to 1,000) in amœbic dysentery. Solutions of tannin (one to two per cent.) are valuable in cholera. Tannic acid, tannin, witch hazel, and other astringents, are useful in dysentery. In chronic conditions injections of silver-nitrate solutions (gr. x.–xx. to the quart or even the pint), to be followed by normal saline solution to prevent overaction, are of service. Finally, solutions containing listerine, borolyptol, borax, bicarbonate of soda, or powdered alum (a drachm of the latter to the quart of water, or even a stronger solution), are of service.

Robert C. Kemp.

ENTEROL is a mixture of three isomeric creosols said to represent three bodies from the intestinal tract in normal proportion. It is slightly soluble in water, has an unpleasant odor, and is used as an intestinal antiseptic. It is given in pill or capsule, or in a solution of one grain to an ounce of water, usually combined with a laxative.

W. A. Bastedo.

ENTODERM, also called entoblast, and occasionally hypoblast, is the innermost layer of cells in the embryo; it is an epithelium which, in the adult, lines the digestive canal and its appendages, lungs, liver, pancreas, etc. (See *Germ Layers*.)

C. S. M.

ENURESIS (ἐν = in, and οὖρον = urine) is a condition in which the urine is passed involuntarily or unconsciously. It is not so much a disease as a symptom common to many diseases and disorders. In childhood, however, it may be considered a separate malady, since it is often found at this age without any other accompanying symptom or lesion; in infants, up to about three years of age, it is physiological.

Mechanism.—The bladder is a fibromuscular sac which acts as a temporary reservoir for the urine. The urine does not normally escape as it falls into the bladder, and without the knowledge of the individual; but, slowly and constantly secreted, it gradually accumulates in the bladder until it can be expelled. It is retained in the bladder by the sphincter vesicæ; it is expelled by the muscular contraction of the coats of the bladder and the detrusor urinæ, assisted by the diaphragm and abdominal muscles. Normal micturition is a reflex act. As the urine gradually flows into the bladder the intravesical pressure increases, until, on a sufficient quantity being present, afferent impulses are sent from the bladder to the centre for micturition in the lumbar enlargement of the spinal cord; from this efferent impulses are sent down strengthening the inhibitory force at the neck of the bladder, and thus causing delay in the act of urination. Further, there exist a motor tract and an inhibitory tract from the brain to the centre in the cord; and, as the intravesical tension continues to rise, impulses are sent to the brain, and other impulses, now conscious, are remitted to the neck of the bladder, causing either relaxation or further tightening till a suitable time and place present themselves. The act of urination is then brought about by the relaxation of the sphincter and the combined action of the detrusor urinæ and the abdominal muscles. Any interference with this mechanism may cause enuresis.

Etiology is frequently obscure, and many conditions that are considered causes are often probably only co-existing and not causal.

Any interference with the normal mechanism of micturition, as given above, will cause enuresis; such interference can take place at the lumbar centre, or in the afferent or efferent nerve tracts, or in the brain. Other causes are: 1. In the *urine:* increase in quantity or acidity. 2. In the *bladder:* malformation, increased irritability, muscular spasm of the detrusor urinæ, non-development or imperfect innervation of sphincter vesicæ, calculus. 3. In the *penis:* phimosis, paraphimosis, elongated or adherent prepuce, balanitis. 4. Stricture of urethra and enlarged prostate in advanced age. 5. Fissure or eczema of *anus*, and worms. 6. Lesions of the nervous system—shock, hysteria, locomotor ataxia, apoplexy.

In children this distressing condition is generally due to want of development of the muscles of the bladder, chiefly the sphincter vesicæ, and to lack of proper training. It must be remembered that up to about three years of age enuresis is physiological, and that after that age proper education can do much toward inculcating good habits. Often, too, there may be a diminished sensibility of the nerves of the bladder, when the sensations are not sufficiently strong to awaken the patient, or else the sleep is abnormally deep and prolonged. Children with a neurotic tendency are often afflicted with enuresis. The trouble generally disappears at or about puberty.

Symptoms.—Enuresis may be mistaken for the "overflow" or retention of urine common in enlarged prostate, but a catheter will settle the diagnosis. Otherwise the diagnosis is clear from the statement of the patient or parent.

In children the disease is classified as (1) enuresis nocturna, (2) enuresis diurna, and (3) enuresis continua. Of these the commonest is the nocturnal variety, in which the patient is troubled only at night, but regularly every night, and this in spite of the fact that he has emptied his bladder before being put to bed. The child is apt to be gloomy and downcast, and apparently much troubled about this sad condition which is indeed his misfortune and not his fault. In some cases the trouble continues even when the patient is aroused every few hours.

The diurnal variety is caused by muscular contraction, chiefly in laughing and coughing, and is apt to persist longer than enuresis nocturna; when found after the age of puberty it is more common in the female.

Prognosis.—In children the trouble generally disappears at puberty. In any case it is well to make a thorough examination and if possible remove the cause.

Treatment.—Whenever possible remove the cause or apparent cause. Look after the general condition of the patient. In the case of children punishment and reproaches are reprehensible; the little patient probably suffers considerably from the knowledge of his affliction. Many remedies have been tried, some with a little success. Raising the foot of the bed, so that the urine does not rest on the base of the bladder, has been recommended; so, too, has electricity—the faradic current,—one electrode in the rectum, the other on the perineum.

Drug medication is largely empirical, but cures have been reported from the use of strychnine, fluid extract of ergot, iron, atropine; also nitrate of silver applied locally.

In the *Medical and Surgical Reporter* for March, 1898, is reported the case of a boy who by mistake took, four times a day, a pill of extr. cannabis indica, gr. ¼; hyoscyamine, gr. $\frac{1}{150}$; zinc phosphide, gr. ¼; and was "cured," in three days, of enuresis.

R. J. E. Scott.

ENZYMES.—Enzyme (Gr. ἐν, in, and ζύμη, leaven), a name given to a class of chemically active substances widely distributed through the animal and vegetable kingdoms. They are chiefly of interest in medicine from the part they play in digestion, most of the chemical changes in this process being due to their agency.

In their action, enzymes present many points of striking resemblance to ordinary ferments, such as bacteria, yeast, moulds, etc. For example, both classes work best