

as simply "external urethrotomy." When no guide can be introduced the term "external urethrotomy without a guide," or perineal section, is generally adopted.

External Urethrotomy with a Guide.—All the precautions above mentioned with regard to the preparation of the patient and location of the stricture should be observed. Full surgical anesthesia is necessary. The operation most generally done is that modelled after the operation originally described by Syme. It is briefly as follows:

The patient is placed in the lithotomy

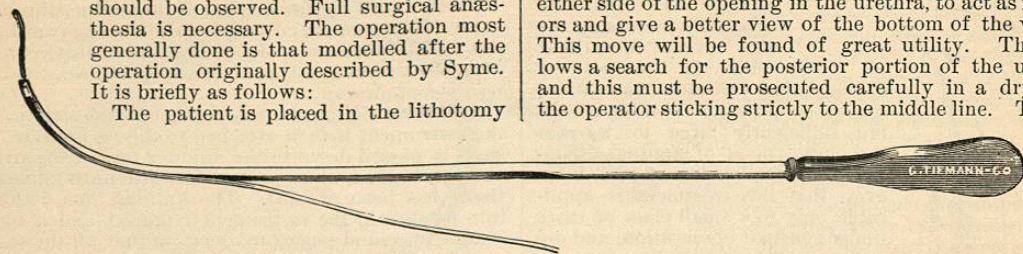


FIG. 4848.—Gouley Tunnelled, Grooved Guide.

position. A grooved guide is passed, care being taken to ascertain that it has entered the bladder, and is held strictly in the middle line. The knife is then introduced in the middle line of the perineum, about half or three-quarters of an inch in front of the anus or behind the stricture. With the blade of the knife turned upward, it is pushed rapidly forward until it strikes the groove of the guide, when the cut is continued upward, completely dividing all stricture tissue from behind forward. The guide is then withdrawn and a full-sized sound passed to make sure that the stricture is completely divided. This is withdrawn and a catheter is tied in place in order to drain the bladder and form a smooth surface around which the wound may heal. In regard to the length of time during which this catheter should



FIG. 4849.—Wheelhouse Staff.

remain in place much difference of opinion exists. Many of the best authorities advise that it should be removed after two or three days, long before the wound is healed and while urinary leakage will still occur freely. It has seemed wiser to me to leave the catheter in place for a week or ten days, or even two weeks, until the wound is nearly closed. It may be necessary to remove the first catheter and replace it by another, but I believe that smooth healing without complication is more likely to be obtained by the adoption of this course than when the catheter is removed in a few days and the urinary fistula allowed to close as best it can.

External Urethrotomy without a Guide.—Perineal Section.—This operation is among the most difficult and tedious of the operations of surgery. It should never be undertaken except by a surgeon who is prepared for a major operation. The best light, the best assistance, and the best surroundings should always be secured. Before deciding to do the operation without a guide a painstaking attempt should be made to pass a filiform bougie through the stricture, for, if this can be done, the operation is converted instantly from one of great difficulty to one of perfect simplicity. Attempts to pass an instrument having failed, two courses are open, one by far the best: to open the urethra in front of the stricture and attempt to find the opening in the stricture (Wheelhouse operation), or the knife may be boldly plunged into the apex of the prostate behind the stricture and the urethra opened at this point (Cock's operation).

Wheelhouse Operation.—For this operation a special straight grooved staff terminating in a hook, invented by Mr. Wheelhouse, is frequently used (Fig. 4849).

With the patient in the lithotomy position, this staff, with its groove upon the floor of the urethra, should be passed down to the face of the stricture. It is then in-

trusted to an assistant, to be held strictly in the middle line, and the urethra is opened at the point where the staff shows the face of the stricture to be. The staff is then turned so that its hooked extremity catches the upper angle of the wound and draws it upward. Mr. Wheelhouse advises the placing of guide stitches in either side of the opening in the urethra, to act as retractors and give a better view of the bottom of the wound. This move will be found of great utility. Then follows a search for the posterior portion of the urethra, and this must be prosecuted carefully in a dry field, the operator sticking strictly to the middle line. The ori-

fice will frequently be found nearer the roof than the floor and every likely pocket should be searched with a probe until the right one be found. If the bladder be distended with urine, pressure with the hand above the pubes may force a few drops of urine out at the opening, thus giving the key to the situation. Time, patience, and a good light are the prime requisites to success, but in the most skilful hands hours may be consumed in the search. In case of failure, after prolonged search, the bladder may be opened above the pubes and an instrument passed through the urethra from behind forward, or Cock's operation may be done. I am inclined to believe that suprapubic cystotomy and retrograde catheterization is an operation which has been too much dreaded, and that it may frequently be done without running a risk so great as that taken by a prolonged and fruitless search for the urethra. When the orifice has been found, a probe-pointed gorget or grooved director should be passed to the bladder and the stricture divided along the floor or dilated with a proper dilator. After this a full-sized steel sound should be passed to the bladder, it being made to turn the corner at the urethral opening with the assistance of the gorget. This having been done, the bladder should be washed out and a catheter tied in place to secure permanent drainage. Some authorities advise the drainage of the bladder with a perineal tube brought out at the perineal wound and left in position for a few days. I believe that, except in cases complicated with abscess formation or enlarged prostate, an in-lying catheter will secure sufficiently good drainage and promote a more rapid healing of the wound.

Cock's Operation.—This operation may be dismissed with the comment that to plunge a knife blindly into the tissues in order to open a urethra, the position of which is uncertain, is not to-day a sound surgical procedure.

MISCELLANEOUS METHODS OF OPERATION.—Divulsion.—The operation of divulsion, though still practised by some of the best genito-urinary surgeons, hardly comes

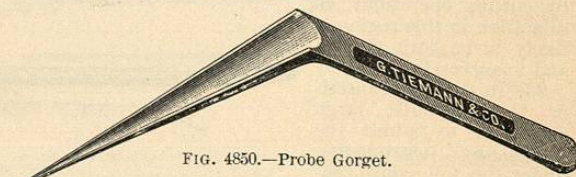


FIG. 4850.—Probe Gorget.

up to the standard of modern accuracy. It is impossible to tell in exactly what direction the splitting force will be exerted, and the rent may occur in an undesirable place. It seems to have no obvious advantages over a carefully practised internal urethrotomy, and is capable of giving bad results through the formation of excessive scar tissue.

Excision.—A considerable number of surgeons have

practised the operation of excising well-localized strictures through a perineal opening. These have been treated by an attempt to bring the ends of the urethra together, by grafting, and by plastic operations. In some of the best cases, however, the ends of the urethra have been left separated and allowed to granulate up over an in-lying catheter. The operation appears to have given excellent results in properly selected cases.

Electrolysis.—The application of electricity to the absorption of strictures has been enthusiastically advocated from time to time. Its advocates have, however, generally been enthusiasts whose results have not been verified by general experience, and it may be confidently asserted that electricity cannot be expected to cure organic stricture of the urethra.

PROGNOSIS OF OPERATIVE TREATMENT OF STRICTURE.—Internal urethrotomy is frequently referred to as a trivial operation, devoid of danger. This statement, however, cannot be allowed to stand in the face of statistics, and a practitioner advising the operation must reckon with a mortality in the vicinity of two per cent., when all cases are taken into consideration. While this is not a large mortality, it is sufficiently important to emphasize the necessity of doing the operation only when it is distinctly indicated.

Uncomplicated cases of external urethrotomy should not have a mortality higher than that of internal urethrotomy. The possibility of complications is, however, considerable, as the strictures of the deep urethra, to which this operation is applicable, are more likely to have affected the other urinary organs, thereby increasing the risk of any surgical operation.

Perineal section is an operation of considerable mortality, which cannot be accurately stated, but is probably in the vicinity of fifteen per cent. This is due to the fact that the cases are much less favorable for operation on account of the frequency of pyelitis and pyelonephritis, and the mortality is not directly due to the operation itself, but to conditions antedating the operation. It must, however, be considered as a distinctly dangerous operation, but the mortality should never deter a properly qualified surgeon, as the conditions which call for it are certain either to prove fatal or to leave the patient in a condition less favorable for operation.

RESULTS OF TREATMENT.—The ultimate results in the treatment of stricture of the urethra may be considered from two points of view:

- 1st. As affected by the position of the stricture, and
- 2d. By the method of treatment.

Position of the Stricture.—In general it may be said that the outlook for radical cure decreases with the distance the stricture is situated from the meatus. Stricture at or near the meatus, if treated by a proper cutting operation, is practically always entirely relieved. Strictures of the pendulous urethra can generally be radically cured. Strictures of the bulbous and membranous urethra generally require the more or less continuous use of instruments in order to maintain a full calibre.

Method of Treatment.—Gradual dilatation will radically cure a certain number of cases of stricture of the anterior urethra. The exact proportion cannot be accurately stated, but in the majority of cases the full calibre of the urethra is maintained only by the occasional passage of instruments.

Internal urethrotomy is more likely to produce radical cure in properly selected cases of stricture of the anterior urethra. The percentage of cures cannot with certainty be stated at over fifty per cent., and in extensive or narrow strictures it is not notably more successful than gradual dilatation.

External Urethrotomy and Perineal Section.—Strictures of the deep urethra requiring external urethrotomy or perineal section are rarely, if ever, radically cured by operation. A certain amount of recontraction is to be expected, and permanent cure should never be promised to the patient, though it may occasionally result. The old saying, "Once a stricture always a stricture," is nowhere more applicable than to the deep urethra.

Complications of Stricture of the Urethra.—The most serious complication requiring surgical treatment is abscess formation and infiltration of urine. The direction which the septic processes will take has been already described under the section on rupture of the urethra. Where the rupture takes place owing to an organic stricture of the urethra, the process is likely to be more insidious in its onset, but none the less disastrous in its consequences. Extreme destruction of tissue in the region of the bulbous and membranous urethra and in the loose tissue of the scrotum occasionally takes place. The treatment should consist in free incision and drainage of all accessible infected areas, together with relief of the stricture.

Hemorrhage.—Hemorrhage in operations for stricture of the urethra, either internal or external, is rarely serious. When occurring in internal urethrotomy it can be efficiently controlled by the passage of a full-sized catheter to the bladder, followed by pressure along the urethra against the catheter. This can sometimes be exerted by a T-bandage, pressing the parts snugly against the pubes, or by winding a narrow bandage or strip of adhesive plaster about the penis.

Hemorrhage following external urethrotomy can be controlled by pressure or by packing the wound. Care should be taken to ascertain that leakage is not going on backward into the bladder, as evidenced by the occurrence of clots in the urine coming through the catheter, or by failure of the catheter to drain. Should the hemorrhage taking place in this direction be alarming, it may be controlled by the distention of the deep urethra with a perineal tube, combined with packing the wound. These hemorrhages may be primary or secondary, and are rarely of serious note.

Septicæmia.—It is extremely rare to-day that serious general infection follows operations upon the urethra except where rupture of the urethra or abscess formation has already occurred. Much of the improvement is probably due to the use of urinary antiseptics, of which urotropin is at present the most valuable. However, in isolated cases extremely virulent streptococcus infections occur, which are as a rule rapidly fatal. Treatment should be addressed to supporting the patient's condition, and will probably have little effect upon the result.

Hugh Cabot.

URICIDIN is a granular salt containing the sulphate, chloride and citrate of sodium, the citrate of lithium, and other salts. It is made by adding 20 parts of sulphuric acid and 4 parts of hydrochloric acid to sufficient clarified lemon juice to represent 50 parts of citric acid. This is then nearly neutralized with sodium bicarbonate, 1 part of lithium carbonate is added, and it is evaporated down and granulated. It is employed in teaspoonful doses in gout and rheumatism.

W. A. Bastedo.

URINARY BLADDER, EXTIRPATION OF.—HISTORY.—The first operation for removal of the bladder was made by Bardenheuer, in 1887, in the male. The first operation in the female was made by Pawlik, in 1888. Since that time more than a hundred cases have been operated upon. In this country the operation has been done by many different surgeons, both in the male and in the female. In the female, Martin, of Chicago, was the first to operate, his first operation being in 1892. The bladder was removed with a uterine fibroid. He has also operated on several other cases. Mann,* of Buffalo, has operated on three cases, the first one in 1900. C. C. Frederick, of Buffalo, E. Reynolds, of Boston, and A. Laphorn Smith, of Montreal, have each operated once. The operations upon the male for exstrophy have been quite numerous.

INDICATIONS.—The indications for the performance of this operation are: first, incurable disease of the bladder, such as cancer and tuberculosis; second, exstrophy; third, incurable disease of surrounding organs which has begun

* Trans. Amer. Gyn. Soc., 1901.

to involve the bladder, such as cancer of the uterus in the female.

MANAGEMENT OF THE URETERS.—In the male the method generally proposed has been the grafting of the ureters into the bowel. In 100 cases collected by Bovée the ureter was grafted into the bowel separately 31 times; by the Maydl and Pozza method, 44 times; into the urethra, 13 times; into the vagina, 8 times; and into the skin, 4 times. This is the most important question connected with the operation, and must be clearly understood. As the conditions in the male and the female vary very much, different methods may be used in the two sexes. I will, therefore, first consider the methods in the male.

The first plan used by Bardenheuer was to insert the cut ends of the ureters directly into the rectum. Experimentation upon the lower animals, by Peterson and

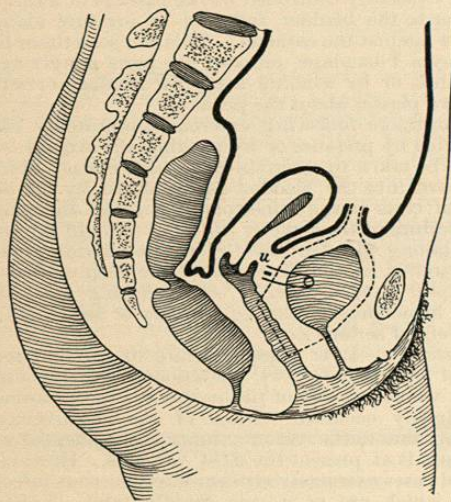


FIG. 4851.—Extirpation of the Bladder. The dotted line shows line of incision. The ureter (u) is roughly shown entering the bladder.

others, shows conclusively that this is an exceedingly dangerous method, as in almost every case, within a comparatively short time, infection travelled from the bowel to the kidney, and the animal died of this complication. The same thing has been noted in man, and the method is now considered so dangerous as to be practically given up.

Maydl proposed the removal of the trigone of the bladder with the ureters, and the transplantation of this piece of the mucous membrane of the bladder directly into the intestine. The results of this have been very much better, as the natural valvular action at the end of the ureters seems to prevent the ingress of infecting germs; so that many cases in which this has been performed have been permanently successful. This can only be done in cases in which the trigone is healthy, so that in exstrophy of the bladder it is the only recognized method. In the case of malignant disease and of tuberculous disease, which are most apt to affect the posterior wall of the bladder, it may be impossible to dissect out the trigone; in which case it will be necessary to put the cut ends of the ureters into the intestine. But, as this is almost certainly fatal, it would seem to rule out operations for removal of the bladder for these indications in the male in a large proportion of cases.

In the female we have the choice of two methods, both of which have been proved to be successful. We may either open the ureters into the vagina by a previous operation, as was done by Pawlik, or we may leave the cut ends of the ureters opening into the vagina after the removal of the bladder—methods which really amount to the same; or we may perform the operation of Maydl, or, better still, its modification by Pozza.

Pozza's operation differs from Maydl's in that more of the mucous membrane of the bladder is removed, and the trigone is not retained in one piece, but is divided by making a longitudinal median incision before separation. The results of both the Maydl and Pozza operations have been most satisfactory. Out of forty-four cases only two died of infection.

The grafting of the ureter to the skin has been done ten times, but the results are not encouraging. Sonnenberg implanted the exposed ureter of an ectopic bladder into the urethra of the glans penis. In all, more than twelve cases have been done by this method. It leaves dribbling of urine, but this is more easily taken care of than is grafting to the skin.

In the female, when the bladder is removed, by removing at the same time a portion of the anterior wall of the bladder the cut ends of the ureters may be left entirely alone; and, when cicatrization has taken place, they will be found to empty into the vagina. This gives an opportunity of making a receptacle for the urine out of the vagina by simply closing the vaginal entrance. As the urethra must also necessarily be cut in removing the bladder, it also will open into the vagina, and the patient will be able to empty the vagina through the urethra, either by the catheter or by voluntary effort, as was done in Pawlik's case. If the vagina is maintained in an aseptic condition during healing, ascending infection will be prevented. After complete healing of all the parts the danger of infection will be very greatly diminished.

In exstrophy of the bladder, in the female, the Maydl or the Pozza operation may be done on the vagina, thus obviating the necessity of opening the abdomen.

The Mauclaire-Gersuny operation consists in implanting the ureters into the rectum, which is cut off from the bowel above after an artificial anus has been made. Gersuny modified the original operation by bringing the bowel exit into the sphincter ani, thus doing away with the artificial anus and maintaining a separate receptacle for the urine.

TECHNIQUE.—Exstrophy in Men.—The trigone is first dissected out with the ureters. The abdomen is then opened and the trigone carried into the rectum through an incision and sewed in place. After this the bladder is removed and the opening closed. The incision may be made curved, with its concavity downward from one inguinal canal to the other; a vertical incision may be made which can be enlarged by a transverse incision crossing the lower end of the vertical one.

In women the Pozza operation will be necessary, in order to get around the uterus. If it is desired to transplant the ureters into the vagina, a transverse incision may be made down to the peritoneum. After the trigone has been dissected out, the vagina can be pushed up by an assistant and opened and the trigone inserted. It will be necessary to dissect off the mucous membrane of the vagina on the anterior wall beforehand, so as to make a raw surface to which the trigone can adhere. The closure of the vagina can be left to a later date.

Cancer or Tuberculosis in the Male.—Although the indication may seem to be urgent, so far the technique of the operation is not complete enough to warrant its performance unless the parts around the bladder are healthy. This can be satisfactorily ascertained only after the bladder is opened. Suprapubic cystotomy must first be performed, and the bladder carefully examined. If the trigone be healthy, the abdomen must then be opened by a free longitudinal incision, the bladder thoroughly disinfected and laid open, and the trigone may then be dissected out (the patient being in the Trendelenburg position), with the ureters, and put into the rectum; after which the bladder may be easily removed, mostly by blunt dissection.

Cancer or Tuberculosis in the Female.—Owing to the fact that the ureters may be left undisturbed in the female, the operation is much easier than in the male. After the bladder has been carefully washed out, a median abdominal incision is made, and the patient put

in the Trendelenburg position, self-retaining retractors being introduced. The peritoneal covering is then incised over the bladder from side to side. The bladder is afterward loosened with the finger down to the attachments of the base, so that it is held only by the urethra, ureters, and attachments to the anterior wall. These are then cut with strong scissors, so as to remove a portion of the anterior wall of the vagina as big as a fifty-cent piece. Any bleeding vessels are tied and the peritoneum closed over the seat of the bladder with catgut suture. If the patient be in good condition, and no previous infection of the bladder exists, the vaginal entrance may then be closed by a plastic operation.

AFTER-TREATMENT.—In order to keep the urine aseptic, and thus prevent ascending infection of the ureters, in all these operations it is well to give the patient large doses of benzoate of ammonium, beginning a few days before the operation. In women the vagina must be kept well cleansed out and drained. If the vagina be closed at the time of the operation, a self-retaining catheter should be passed through the urethra and left, the vagina being washed out through the catheter at least twice a day.

RESULTS.—Bovée has collected 100 operations. Of these the operation was done 21 times for malignant disease, 3 times for tuberculosis, once for epispatias, once for fibroid of the uterus, and 5 times for conditions not noted.

In exstrophy Maydl's operation was done 38 times, with 8 deaths; Pozza's operation, 4 times—no deaths; anastomosis of the ureters into the rectum, 10 times, with 3 deaths; and separate anastomosis into sigmoid, twice, both patients dying. Sonnenberg's operation was done 13 times—no deaths.

For malignant disease 21 operations were done, with 11 deaths.

In 7 the ureters were grafted into the vagina, with 1 death from collapse, and 1 from peritonitis on the ninth day.

For tuberculosis, 3 cases, with 2 deaths, are reported. Altogether there were 26 deaths in 100 cases. Sixty-nine operations for exstrophy gave 19 per cent. mortality, and 31 operations for other conditions gave 42 per cent. mortality. *Matthiew D. Mann.*

URINARY SEDATIVES.—The conditions which require the use of urinary sedatives may be dependent upon some state of the urine itself or upon something entirely independent of it.

1. Certain drugs may cause intense irritability of the whole urinary tract—as, for example, cantharides and turpentine. A very acid urine or one containing crystals of uric acid or of calcic oxalate may give rise to symptoms of irritation. Again, a decomposing urine may produce similar effects. An alkaline urine, especially when associated with phosphaturia, may also give rise to discomfort.

2. We may begin at the kidney and find an occasional exciting factor outside of the urine itself, even as far down as the meatus. Pyelitis is a frequent cause, as are cystitis and vesical calculus. In women a uterus which is anteverted pushes into the bladder, while a retroverted uterus may pull upon that same viscus. Pelvic tumor, either prostatic in men or of the various kinds to which women are liable, may diminish the size of the bladder by direct pressure, or by traction, to such an extent that the desire to empty it is very frequent. Tumors of the bladder have a similar effect at times, though in these cases the sense of a foreign body in the bladder seems very often to furnish the stimulus. Stricture of the urethra seldom gives signs of urinary irritability until, in the process of contraction, it has reached such a small calibre that there is back pressure in the bladder. Finally, an adherent and tight foreskin is a well-known cause of occasional nocturnal, or even diurnal, incontinence, in children. We have thus very briefly suggested the more frequent causes of urinary irritability, as we can only hope for relief in a given case by carefully studying out

the exciting factor. No good can be gained and much harm may be done by trying to cure all cases with any one remedy.

3. To the two classes of irritability mentioned we must add a third, in which we can find no tangible stimulus, and have to fall back upon a purely nervous origin for the affection.

Many remedies which have in the past been considered valuable in these cases have in recent years fallen into disuse; some deservedly as of little value, others through having been supplanted by more powerful drugs, acting in the same manner and more convenient to use.

As regards the cases which are due to some condition of the urine itself, an excessively acid urine can be rendered less irritating either by increasing the ingestion of liquids, and so diluting it, or by giving one of the alkalies. The citrate or acetate of potassium is most useful in these cases. Few patients will drink enough water unless given specific directions. Each of the salts named, when given in fairly large doses, has the effect of producing thirst and thereby making it easier for the patient to take enough water, while at the same time it renders the urine alkaline. Care should be taken not to make the urine too alkaline, lest we get a deposit of phosphates. If we are confronted by an excessively alkaline condition of the urine, it can be corrected by giving a drug that will change the reaction. The mineral acids are of little or no value for this purpose. Benzoic acid is useful.

Given as benzoate of sodium, by the mouth, it is excreted in the urine as benzoic acid, which, besides the effect of rendering the excretion acid, also exerts an antiseptic effect. Ten grains given in a glass of water three times a day is usually enough. Urotropin makes the urine acid, and causes rapid disappearance of the phosphates in cases in which they are deposited in alkaline, neutral, or slightly acid urine. Five grains, given well diluted twice a day, is an ordinary dose. It is particularly valuable in the cases in which the urine is alkaline from decomposition, as it is broken up in its passage through the body, and the formalin which is set free is eliminated by the kidneys. In these cases the dose may have to be considerably increased. The bactericidal action of this remedy is marked. Boric acid in sufficient doses will render the urine acid, but it is less well borne by the stomach than are the remedies mentioned. Salol will give an acid urine, and is often of value, especially in cystitis.

In cases in which the irritability is due to crystals of uric acid or of oxalate of lime, measures looking to the elimination of the source of the crystals are needed. The usual antirheumatic remedies will remove the excess of uric acid. At times there is much difficulty in preventing the formation of oxalate-of-lime crystals. In the obstinate cases, in which other methods fail, one or two drops of strong nitro-muriatic acid, taken after meals in a full glass of water, will relieve the difficulty.

A careful regulation of the diet is of great importance in these cases. The amount of meat should be restricted when the uric acid is in excess. It should be borne in mind that fruit at times, and rhubarb often, cause an excess of calcic oxalate in the urine. Hæmaturia has been known to follow after eating rhubarb, so great was the irritation caused by the calcic oxalate crystals.

In case the discomfort comes from the use of certain drugs, as cantharides or turpentine, the omission of the medicine would at once suggest itself.

Alcohol is always contraindicated in any inflammation of the genito-urinary tract, and we often see the first serious symptoms, in a prostatic or stricture case, follow the ingestion of even a moderate amount of alcohol. A source of irritation which is often not considered is ginger ale. This is especially harmful in gonorrhœa, and I have seen a severe exacerbation follow its use. Under the same conditions highly spiced foods, such as curries, Welsh rarebit, etc., should be carefully avoided.

Pyelitis, whether of tuberculous or of some other origin, must needs be treated by drugs; some medicine must be used which is eliminated by the kidneys. Of these, prob-

ably all owe their value almost entirely to their antiseptic action. The remedies promising most are urotropin, buchu, uva ursi, pareira brava, and chimaphila. Urotropin is best given in doses of five grains three times a day. The dose of the fluid extract of each of the other drugs mentioned is a teaspoonful, well diluted, three or four times a day. These all have a slight antiseptic action, as shown by the diminished tendency to decomposition when the urine is left standing. This is particularly true of urotropin, but in very large doses it may cause some frequency of urination by rendering the urine too acid. Uva ursi has some diuretic action, as has also chimaphila. Buchu does not increase the amount of urine appreciably. In the very chronic form the stigmata of Zea Mays will be found a more effective remedy, as they stimulate the renal epithelium directly. A teaspoonful of the fluid extract may be given every four hours. In rare cases, in which something stimulating is required, small doses of turpentine may be of value. If the pyelitis be associated with renal calculus, a surgical operation, with removal of the stones and temporary drainage of the kidney, offers the best hope of permanent relief. By correcting the reaction of the urine we may prevent any increase in the size of the stones, but the chance of causing them to dissolve is remote. Hyoscyamus, phenacetin, belladonna, and opium in its various preparations, afford temporary relief. Sweet spirits of nitre at times helps and may relieve the vesical tenesmus, which is often associated with this disease. In tuberculous cases there is little hope of permanent relief except through nephrectomy or through the breaking down and complete disappearance of the organ, in consequence of which it will cease altogether to secrete any urine. In these cases the pain is often referred to parts of the urinary tract which are situated lower down and which are not involved in the disease.

In the cases due to diminution of the size of the bladder from extraneous causes the removal of those causes at once suggests itself. In prostatic hypertrophy the flow from an overdistended bladder may easily be mistaken for abnormal frequency of urination. This possibility should be investigated before seeking for a further cause. Overdistention may also occur in connection with a stricture of small calibre. Drawing off the residual urine under the strictest aseptic precautions one or more times daily may entirely relieve the symptoms. The administration of five grains of urotropin three times a day diminishes the danger of cystitis. In cystitis an antiseptic which will be eliminated in the urine is indicated. In many cases washing out the bladder once or twice a day with an antiseptic solution, such as a four-per-cent. solution of boric acid, is necessary. When stronger antiseptic washes are needed, one of permanganate of potassium or of citrate of silver will be found serviceable. Nitrate of silver is more stimulating and should seldom be used in solutions of more than one grain to the ounce. Pareira brava is said to be useful in chronic catarrh of the bladder. It checks bleeding in these cases and diminishes the muco-purulent secretion. Cubebs, copaiba, and sandal-wood, though more effective in irritation of the urethra, exert their influence through the medium of the urine and are of use in bladder affections. This is especially so of the oil of sandal-wood. All of these drugs resemble each other closely. It should be borne in mind that while they are being taken the urine is somewhat irritating. When they are given in large doses, they give rise to a constant desire to urinate, and the pain and difficulty in doing so are great. In some cases, in which the bladder and urethra are much inflamed, the pain may be so great as to lead to complete retention. The ordinary dose of each of these drugs is ten minims three times a day. They are best given in capsules, as the taste is disagreeable. Even in doses of ten minims twice a day the oil of sandal-wood at times gives so much backache that it has to be discontinued.

For the relief of the pain and frequency of urination associated with the presence of a calculus in the bladder, operation alone is of any avail. Morphine or belladonna

or a combination of the two may afford great temporary relief.

At times we are forced to abandon our search for a tangible cause and fall back upon a neurosis as an explanation of the trouble. Here we may expect relief from the use of nervous sedatives, such as one of the bromides or hyoscyamus. Treatment of the condition through the urine proves as a rule unsuccessful, and washing out the bladder often only aggravates the patient's suffering. In the tenesmus of tuberculosis washing the bladder is generally worse than useless, especially if we have to pass a catheter for this purpose.

In the cases in which we need urinary sedatives, when the cause lies in the urethra itself, copaiba, sandal-wood oil, and cubebs give great relief. In the intense burning which accompanies micturition and which does not yield to internal medication or local treatment, the injection into the urethra of a two-per-cent. solution of cocaine alleviates the distress temporarily. In men, urination with the penis submerged in water as hot as can be borne, often gives relief.

Finally, in those cases of incontinence in children in which the trouble does not yield to belladonna in full doses, and appears to be caused by an irritable bladder, circumcision at times effects a cure.

Franklin G. Balch.

URINE.—PHYSICAL PROPERTIES. QUANTITY.—The amount of urine voided is dependent (1) on the state of the renal epithelium; (2) on the rapidity of the blood flow through the kidneys. It is independent of the blood pressure.

A normal healthy adult of the average weight of 75 kgm. passes from 1,500 to 2,000 c.c. of urine in twenty-four hours. Infants pass absolutely less, but, in proportion to their body weight, relatively more urine; this is largely due to the liquid diet. Abundant ingestion of fluids increases diuresis (*urina potus*); sweating (violent exercise, hot weather) decreases it. Less urine is normally passed at night than during the day; in chronic nephritis this ratio may be reversed.

Pathology.—Destructive renal lesions or local circulatory disturbances, in order to influence the flow of urine, must be bilateral; unilateral interference with diuresis is compensated by the healthy organ.

(a) *Polyuria.* The more chronic the nephritis the greater the tendency to polyuria (contracted kidney, amyloid). This is chiefly due to the contraction of the renal tissues and the resulting acceleration of the blood flow. During convalescence from acute nephritis; in heart and lung disease as soon as the circulatory disturbances begin to be compensated; in diabetes mellitus, and insipidus; after psychic shocks, and in various neuroses (*urina spastica*); after the exhibition of certain drugs (see *Diuretics*), and after the ingestion of certain articles of food (tea, coffee, alcohol, etc.)—the flow of urine is increased.

(b) *Oliguria.* In acute nephritis, in acute exacerbations of chronic nephritis, and in heart and lung diseases leading to stasis the flow of urine is decreased.

(c) *Anuria.* In uræmia (occasionally), in diseases causing great loss of fluids through other emunctories than the kidneys (acute gastritis and intestinal catarrh, with profuse vomiting and diarrhoea, cholera, dysentery), in rapidly progressive forms of anæmia, and in hysteria, the urine may be altogether suppressed.

Determination.—The urine should preferably be collected from morning to morning before eating; the bladder should be emptied before the collection is begun; the patients should urinate before going to stool, as, particularly in old women, much urine may be lost during the act of defecation. The total quantity may be measured or determined by weighing; the weight multiplied by the specific gravity yielding the volume. For clinical purposes the former method is best; for exact determinations the latter is to be preferred.

THE SPECIFIC GRAVITY.—The specific gravity of the urine is, as a rule, high when little urine is voided and

low when the flow of urine is abundant. The same factors, therefore, that determine physiological fluctuations in the amount of urine also determine corresponding fluctuations in its specific gravity. As the normal total quantity varies from 1,500 to 2,000 c.c., so the normal specific gravity varies correspondingly from 1.025 to 1.015.

The specific gravity of the urine is an index of the excretion of urinary solids. If the latter were all heavier than water, the last two figures of the specific gravity (expressed in four figures) would directly indicate the quantity by weight of urinary solids contained in one litre of urine. As some of the excreta are, however, heavier than water, or of the same specific gravity, their weight is greater than indicated by these two figures. It has been found empirically that the last two figures of the specific gravity multiplied by 2.2337 give the weight in grains of the solids in one litre of the urine. [Example: Specific gravity = 1.018; 18 multiplied by 2.2337 = 40.2066 grains of solids in one litre of urine.] This calculation, while not absolutely accurate, is useful for comparative studies.

Pathology.—In severe febrile diseases the specific gravity is usually low without a corresponding increase of urine as soon as the patient's vitality begins to flag and general metabolism is reduced.

In acute and subacute nephritis the specific gravity is usually high, the water excretion correspondingly reduced. In the healing stage of acute nephritis the flow often increases, whereas the specific gravity remains low; this indicates that the kidneys are regaining their power to excrete water, but not as yet to eliminate solids. In acute exacerbations of chronic nephritis and in the terminal stages of destructive inflammation and degeneration of the kidneys the specific gravity is reduced; when it occurs suddenly, this is a bad prognostic omen, and often indicates threatening uræmia. In contracted kidney the specific gravity is low and the flow abundant. In diabetes mellitus the flow is great and the specific gravity very high, whereas in diabetes insipidus the flow is also great, but the specific gravity very low.

Determination.—The specific gravity may be determined (a) by weighing with a hydrostatic balance, (b) with a pycnometer, and (c) with an aerometer. The first method is useful only in very exact work, and requires a complicated balance; it will not be described here. The second and third methods are useful for clinical work. In ordinary comparative studies the aerometer is quite sufficient.

The *pycnometer* is a flask with a long neck that is drawn out in one place (see Fig. 4852); at the narrowest point is a mark; the flask is closed with a ground-glass stopper. The flask is first filled with distilled water to the mark and weighed; it is then filled with the filtered urine to the mark and weighed again. The weight of the urine divided by the weight of the water gives the specific gravity. It is very important that the temperature of the water and that of the urine should be exactly alike when the pycnometer is filled and when it is weighed. For other forms of pycnometers than the one shown in Fig. 4852, see text-books.

The *aerometer* (urometer). This instrument consists of a glass cylinder and a float (see Fig. 4853). The latter should be graduated from 1.000 to 1.040. It is better to have two floats, the one reading from 1.000 to 1.020 and the other from 1.020 to 1.040.

The urine is poured into the cylinder, the float introduced into the urine, and the specific gravity read off directly from the aerometer scale. Here, too, the temperature is important; it should be about 17.5° C., for the aerometers are graduated at this temperature. If the urine is

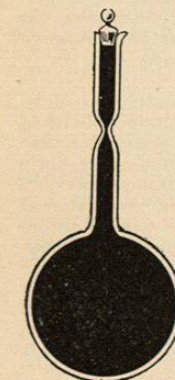


FIG. 4852.—Pycnometer.

warmer than 17.5° C., one-third of a urometer degree should be added for each degree of temperature; if the urine is colder than 17.5° C., the reading should be corrected by subtraction—one-third urometer degree for each degree of temperature. [Example: Urine 20.5° C., specific gravity 1.017. Corrected, $1.017 + 3 \times \frac{1}{3} = 1.018$.] A temperature scale is found on many urometers.

REACTION.—Normal urine is never neutral to litmus; it is either acid, amphoteric, or alkaline. The acidity is never due to the presence of free acid, but to the excess of acid salts (monobasic phosphates and urates) over alkaline salts (dibasic phosphates and urates). When the two are mixed in certain definite proportions the reaction becomes amphoteric. The urine becomes alkaline after eating (HCl—secretion) and after the ingestion of certain salts of vegetable origin (citrate, tartrate, etc.), as the latter are excreted as carbonates. Old urine is usually alkaline as the micrococcus ureæ generates ammonium carbonate.

Pathologically the acidity of the urine is always increased in febrile processes, for here increased katabolism of proteid with liberation of sulphuric and phosphoric acids from proteid-sulphur and proteid-phosphorus occurs. In leukæmia, scurvy, and diabetes the urine is also in general acid.

Increased alkalinity is a valuable sign only if the above-named physiological factors can all be excluded. It is important to determine whether the urinary alkalinity is due to the liberation of ammonia or to the presence in solution of fixed alkali. Free ammonia signifies fermentation of the urine and points to cystitis. Fixed alkali appearing in excess in fresh urine may be due to the withdrawal of acid from the body (vomiting and frequent lavage), to the admixture of alkaline secretions from the urinary passages, or to the rapid absorption of exudates and transudates.

Determination.—For clinical purposes the litmus test is sufficient; blue litmus paper turning red in acid urine, and red litmus paper turning blue in alkaline urine. If the blue color remains after the paper dries, the alkalinity is due to fixed alkali; if it vanishes, to free ammonia.

Optical Properties.—(a) *Color.* The color of the urine is dependent on its concentration, its reaction, and the pigments it contains. Normal urine may be from pale yellow to reddish-brown. The greater the concentration the darker the color. Acid urine becomes more pale when it is alkalized, and alkaline urine darker when it is acidified.

Certain pathologic pigments change the color of the urine. Bile pigment colors it green or brown, blood pigment red to brown red, urobilin dark brown, and melanin brown to black. Certain aromatic decomposition products that are found in the body (indican, phenols) cause the urine to turn dark on standing. Certain fruits (cherries, raspberries, etc.) and certain medicaments impart a characteristic color to the urine (see carbolic acid, coal-tar preparations, resorcin, naphthol, salol, chrysarobin, rheum, senna, santonin, etc.).

(b) *Fluorescence.* Pale yellow normal urine shows a bluish, yellowish-red urine, a greenish or yellow fluorescence. Urine containing albumin shows more fluorescence than normal urine, and ammoniacal urine more than urine that is not decomposed.

(c) *Behavior toward Polarized Light.* Normal urine is almost always slightly levorotatory; it is never dextrorotatory, and hardly ever optically inactive. The presence of certain abnormal constituents (dextrose, levulose, glycuronic acid, etc.) produces typical polarimetric phenomena that will be described below.

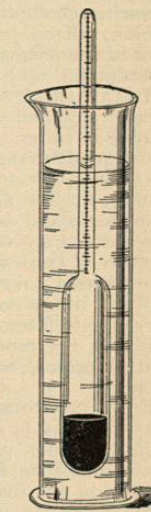


FIG. 4853.—Aerometer.