

"3. It may burrow inside of Buck's fascia, but outside of the corpus spongiosum, forming a fistula opening behind the glans penis near its root, a hard ridge marking the course of the fistula within Buck's fascia.

"4. It may escape behind the triangular ligament into the cavity of the pelvis.

"5. It may escape outside of the common fascia of the penis, in front of the triangular ligament, in which case it rapidly distends the perineum, the scrotum, and the connective subcutaneous tissue of the penis, and mounts up over the abdomen, and may also, more rarely, perforate the deeper layer of the superficial perineal fascia, and descend upon the thighs.

"When extensive infiltration of this sort occurs, all the parts affected becomes œdematous; gases form in the connective tissue, causing emphysema and making the tissues crackle when pressed by the finger. Dark spots soon appear, indicating gangrene, and extensive portions of tissue may slough unless relief be promptly afforded.

"The constitutional symptoms are those of shock. A chill usually occurs, followed by great depression, a cold clammy skin, feeble, quick, irregular pulse, hurried respiration, furred tongue, complete anorexia, symptoms of septicæmia, and death.

"When urine escapes behind the triangular ligament—which it does more rarely—it infiltrates deeply around the prostate and rectum well back in the perineum, around the bladder and up behind the pubes, forming abscesses in the cellular tissue of the hypogastrium, or perhaps deep pelvic abscesses."

Keyes reports his own experiments and quotes those of Mengel to show that normal urine injected in small

quantities into healthy tissues is absorbed without injuring them, and believes that if urine is evacuated by operation as soon as it has extravasated, serious gangrene may often be averted. If the urine be decomposed before its escape, as is often the case, or if infectious matter from the urethra be carried into the tissues with the urine, gangrene is certain to follow.

In very rare instances some portion of the bladder, instead of the urethra, may rupture. This accident is followed by an extravasation of urine that almost invariably terminates fatally.

Fistula and extravasation occur only in old and neglected cases of stricture, and are almost never found outside of dispensary and hospital practice.

INSTRUMENTATION OF THE URETHRA.

Before attempting the use of instruments in the urethra, the student should become thoroughly familiar with the anatomy of the urethra and the perineum and with the landmarks of these regions. The following characteristics of the urethra should also be borne in mind:

The meatus, as a rule, is the narrowest point in a normal urethra, while the membranous portion is nearly as narrow. In addition to these two points of decided narrowing in the urethra, the pendulous portion may contain one or more points of slight constriction, usually situated in the second or third inch from the meatus, which points are recognized only when the urethra is fully dilated. The urethra also contains three decided enlargements. The first is the fossa navicularis, in the roof of which, about half an inch from the meatus, is a mucous flap forming the lacuna magna, which often

catches the points of fine instruments that have been improperly directed, in this region, to the upper wall. The second enlargement is in the bulb, which, of all portions of the urethra, is the most distensible and elastic, and therefore most liable to damage from the unskilful use of steel instruments. The third enlargement is in the prostatic portion (Fig. 27).

The pendulous urethra is freely movable, and its curvature depends on the position of the penis, but the portion of the urethra extending from a little in front

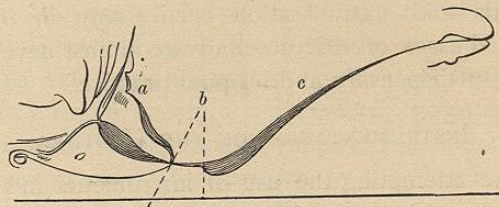


FIG. 27.—The prostatic (a), membranous (b), and spongy portions (c) of the normal urethra (Thompson).

of the triangular ligament to the neck of the bladder has normally a fixed curve. This portion of the urethra, and especially its floor, is not wholly immovable, and usually the curve may be nearly obliterated by the forcible introduction of straight instruments. Such a procedure is always painful, and usually is attended by danger of rupturing the urethra. It is of great importance, therefore, that all inflexible instruments intended for use in the deep urethra should be made with a curve corresponding closely with the fixed (subpubic) curve of this portion of the urethra. In the large majority of cases this curve is an arc of a circle three and one-fourth inches in diameter, the cord of this arc being two

and three-fourths inches long (Fig. 28). An instrument made with a curve of this shape and length (generally known as "the Thompson curve") will pass readily through the normal deep urethra, while an instrument with any other curve will pass with difficulty and is

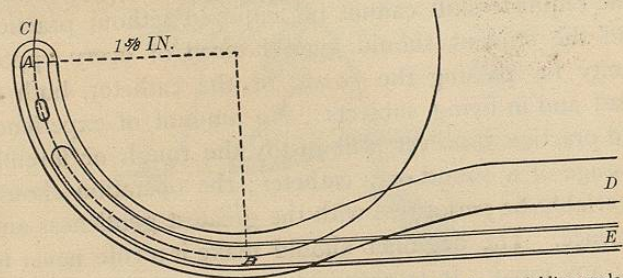


FIG. 28.—A B E shows the proper curve (reduced in size) for unyielding male urethral instruments. C B D shows an improper curve (Tiemann).

liable to injure the urethra. In old men and in those in whom the prostate is enlarged or the bladder is distended the curve may be a little longer than the one described above.

Guyon called attention to the fact that the fixed curve is found in the roof only of the urethra, since the floor is elastic, extensible, and soft, yields readily before instruments, which it therefore cannot support or guide, is lacerated or ruptured with comparative ease, and is less regular in formation than the upper wall. The latter is shorter, less movable, more regular and constant in its curve, smoother and firmer, less easily damaged, less vascular, and less intimately connected with important structures than the lower wall. The practical deduction is obvious: in passing instruments through the urethra, after the fossa navicularis is

passed the point should be kept closely against the upper wall.

Catheterism or Sounding of the Urethra.—The steel sound plays a most important part in the treatment of urethral disease, and the ability to introduce it properly and skilfully is one of the first requirements. The requisite skill cannot be acquired without practice, and the student should avail himself of every opportunity for passing the sound or the catheter, both in dead and in living subjects. No amount of experience and practice, however, will justify the rough or forcible passage of a sound or a catheter; the operation should invariably be performed with the greatest gentleness and patience. The beginner should make it a rule never to use any force. It is always best to know how to pass the sound with either hand, but in the following description, as a matter of convenience, the use of the right hand is implied:

The patient, with his thighs separated, should lie on his back on a firm table or couch. He should be made as comfortable as possible, both physically and mentally, in order to secure complete relaxation of all the muscles. To this end his fears should be removed by assuring him that if the instrumentation proves painful it will be stopped at once. The surgeon, standing at the patient's left, gently holds the penis just back of the corona with the left hand, while in the right hand he holds the sound, which has been properly cleaned, warmed, and anointed. With the sound held lightly, the shaft parallel with the patient's groin and near the skin, and with the handle well depressed (Fig. 29), the tip of the instrument is inserted in the meatus, and the penis is gently slipped up over the sound, which may be allowed to drop into the ure-

thra by its own weight. The penis should gently be put on the stretch to efface the folds of the urethral

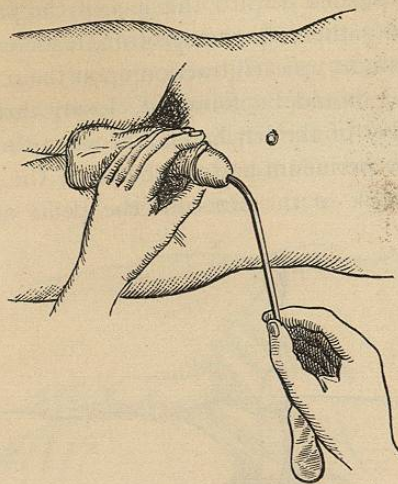


FIG. 29.—Sounding of the urethra (Keyes).

mucous membrane and to enable the point of the sound to gravitate as far as possible toward the bulb. With

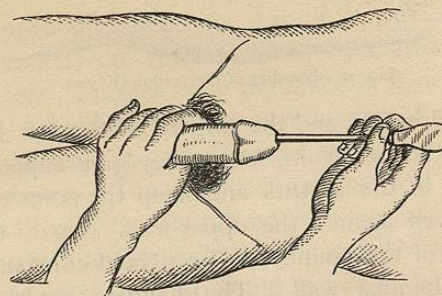


FIG. 30.—Sounding of the urethra (Keyes).

the left hand still holding the penis, the handle of the instrument is steadily carried over the surface of the

abdomen to the exact median line of the body (Fig. 30). Without elevating the handle of the sound, the latter is then gently pushed toward the feet of the patient, while the left hand gathers up the scrotum, testicles, and penis and makes slight upward traction upon them. The point of the sound should be followed closely throughout by the little finger of the left hand, and when the point has passed to the perineum and the curve of the instrument can be felt back of the scrotum, the penis and the tes-

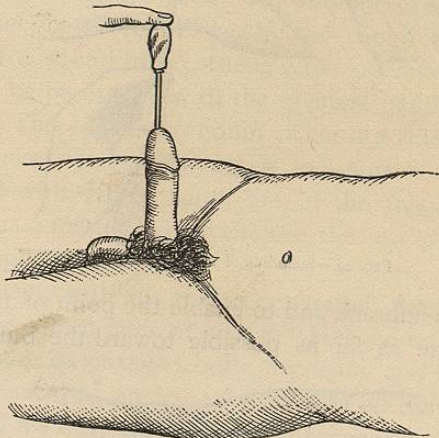


FIG. 31.—Sounding of the urethra (Keyes).

ticles are dropped and the fingers of the left hand are placed on the perineum, where they give support to the lower wall of the urethra and keep the point of the instrument well against the upper wall. Up to this time the handle of the sound has been held constantly close to the abdominal wall. The handle should now be lifted and gently carried toward the feet, thus describing an arc of a circle exactly in the median line of the body. When the handle of the sound has reached and

passed the perpendicular (Fig. 31), the left hand leaves the perineum and supports the handle of the sound, while the right hand presses upon the pubes and relaxes the triangular ligament, allowing the sound by its own weight to slip through the membranous and prostatic portions of the urethra into the bladder (Fig. 32). That the sound has entered the bladder may be demonstrated by partially rotating the handle, showing that the tip of the instrument is free.

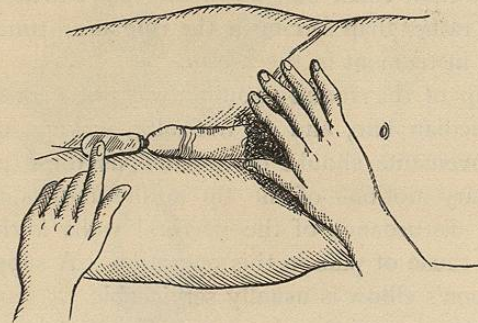


FIG. 32.—Sounding of the urethra (Keyes).

To remove the sound the handle is carried through motions exactly the reverse of those pursued during its introduction. Neither force nor traction is necessary.

Force is required for the introduction of a sound in exceptional cases only, and should never be used by any but the expert. The sound should be held lightly between the tips of the thumb and the fingers, as a firmer grasp would interfere with the sense of touch, which is of great importance, and would increase the danger of unconsciously using force. It should never be forgotten that the sound is a lever of the first class, the tip forming its short and the handle its long arm, and that the

pressure produced by the point upon the urethral wall is many times greater than that exerted by the hand of the operator upon the handle. Even in a normal urethra the progress of the sound may be arrested by urethral spasm, which occurs most frequently at the beginning of the membranous urethra. The gripping of the sound by the muscle-fibres produces a sensation readily recognized by the experienced hand holding the instrument. If the sound be held quietly against the contracted muscles, they soon relax and allow the instrument to pass. Coaxing rather than forcing is the rule at all times when using an instrument in the urethra.

The tip of the sound should always be kept steadily in the median line, and all irregular, jerking, or wobbling movements should be avoided, as these produce unnecessary motions of the tip in the urethra, and the resulting disturbance of the urethral walls is the most frequent cause of pain in this operation. A support for the surgeon's elbow is usually serviceable.

Beginners experience the most difficulty when the tip of the sound is passing from the large, distensible, and movable bulbous urethra to the narrower membranous portion. If the handle be raised from the abdomen too soon, the tip catches above in the subpubic ligament; while if the tip is not held well up against the upper wall by the fingers on the perineum, it may bury itself in the loose and movable floor below the orifice. Figure 33 shows the bulbous urethra greatly distended by the tip of a sound that has been allowed to fall and turn over. When the tip of the sound is arrested at this point, the curve of the instrument bulges out in the perineum as the shaft is depressed between the thighs, and if the handle be released, it springs back toward the perpendicular.

In such a case the sound should be withdrawn an inch or two and reintroduced, care being taken not to raise the handle too soon and to keep the tip against the upper

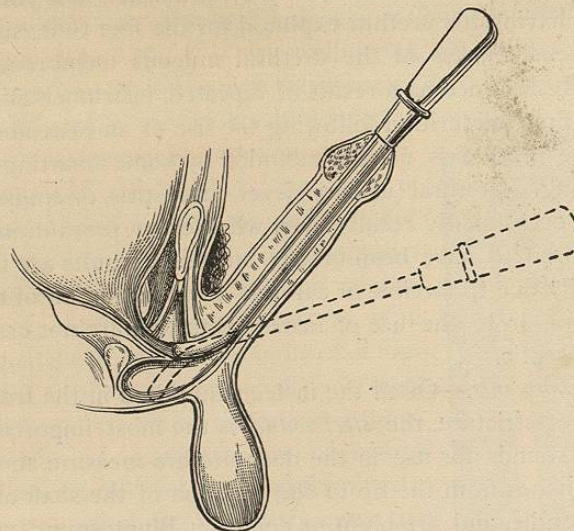


FIG. 33.—Relative positions of triangular ligament and bulb of urethra (diagrammatic, from Culver and Hayden).

wall. A few gentle manœuvres should succeed in passing the instrument into the bladder, unless there be stricture or unless the sound is too large for the urethra.

While decided pain should not be produced by the passage of a sound or a catheter as described above, even a normal urethra shows some resentment at the introduction of a foreign body. Slight pricking, stinging, or tickling sensations are usually felt by the patient as the tip of the sound comes in contact with the mucous membrane, and as the instrument dilates the membranous and prostatic portions the desire to urinate may become

so strong that the patient declares he cannot retain his urine another moment. In sensitive patients the operation may produce nausea or even complete syncope. These disturbances are usually most marked in a young man having his urethra explored for the first time, since the sensitiveness of the urethral mucous membrane is rapidly lessened as a result of repeated instrumentation. The first micturition following the use of an instrument in the urethra is usually attended by some smarting or burning. Urethral (urinary) fever, prostatitis, or epididymitis occasionally results even when every precaution is supposed to have been taken; but these results are frequently due to forcible or careless instrumentation of the urethra, or to the use of instruments that are not clean and aseptic.

Instruments.—Of all the instruments used in the treatment of stricture, the *steel sound* is the most important. Steel sounds for use in the deep urethra measure about nine inches from the tip to the junction of the shaft and the handle, and are blunt or conical. Blunt sounds are of a uniform diameter throughout their entire length; conical sounds are several sizes (from 3 to 7 sizes French) smaller at the tip than in the shaft, the conicity extending from the tip to about the beginning of the curve. The blunt sound is chiefly valuable for exploration and for the treatment of urethral lesions other than stricture. The slightly conical sound is the most generally useful and the most economical, as fewer sizes are needed. All steel sounds for use in the deep urethra should possess the curve already described, should be polished perfectly smooth, should be nickle-plated, and should have the size of the shaft plainly stamped on the handle.

The scale used for determining the size of urethral in-

struments varies greatly in different countries and, unfortunately, with different instrument-makers. The French scale furnishes a definitely fixed standard, and is that to which all numbers in these pages refer. By this scale the number on a sound indicates its circumference in millimeters. No. 1 is one millimeter, No. 2 two millimeters, and so on through the entire scale. The divisions on this scale are so small that it is rarely necessary to have sounds representing all the numbers, especially in conical and in flexible instruments. In making a set every other number may be omitted, so that ten conical steel sounds ranging from 15 to 33 in sizes (the tip of each being three or four sizes smaller than the shaft) will meet the requirements of all but exceptional cases. As manufacturers of instruments do not yet use a uniform scale, and as most flexible instruments are neither accurately nor plainly marked, the surgeon should own an accurate scale-plate (Fig. 34), on the two faces of which are marked French, English, and American scales, as well as inches and millimeters.

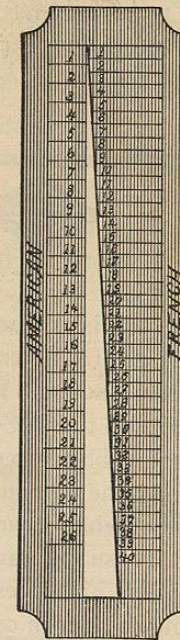


FIG. 34.—Handerson's gauge (Tiemann).

Short steel sounds, made straight or with a very short curve at the tip, are convenient for use in the anterior urethra; they are, however, not necessary, since the long sound need be passed into the urethra no further than is desired.

The *bulbous bougie* (*bougie à boule*) is the instrument

most used for determining definitely the location and calibre of strictures (Fig. 35). The head should be short,

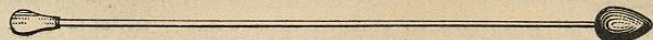


FIG. 35.—Bulbous bougie (Tiemann).

and the shoulder should join the much smaller shaft at almost a right angle. These instruments made of metal are to be preferred when large sizes are to be used in the anterior urethra only, but for general use the flexible gum *bougies à boule* are better. Otis's urethrometer

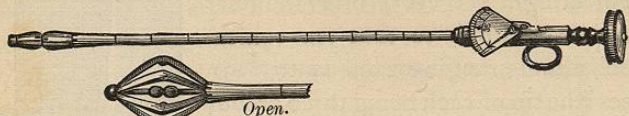


FIG. 36.—Otis's urethrometer (Tiemann).

(Fig. 36) is intended to serve the purpose of bulbous bougies of different sizes. After introduction into the urethra the bulb may be made larger or smaller as desired, and the size is indicated on the scale at the handle. A soft-rubber cap covers the bulb, to keep the wires from tearing the mucous membrane. This instrument is convenient when it works well and is carefully manipulated, but it usually causes more pain than do the bulbous bougies, and even in careful hands the rubber cap is liable to be torn or to be left in the urethra.

Silver catheters should correspond in shape and size with the blunt steel sounds. They are of occasional service in the large sizes, and should be introduced in the same manner as the steel sound.

Flexible bougies (Fig. 37) are necessary in the treatment of stricture of small calibre; in the larger sizes

they are often valuable, especially for beginners. As a rule, even the expert should use flexible bougies for all sizes below 15 or 18, in order to avoid the danger of



FIG. 37.—Olivary gum bougie (Tiemann).

making a false passage. Of these bougies, the conical are the best and most serviceable, though for the larger sizes the olive-tip bougie, if connected with the shaft by a slender, perfectly flexible neck, is preferable. They are made in all sizes from the filiform up.

Flexible catheters are made of the same size and shape as bougies. Some of these catheters are furnished with a metal stylet which stiffens them during introduction. This stylet is of only occasional value. The Mercier catheter (Fig. 38) is an excellent instrument in difficult



FIG. 38.—Mercier elbowed catheter (Tiemann).

cases, and especially if the prostate be enlarged. The tip should not be too stiff, as it often is in those of English manufacture.

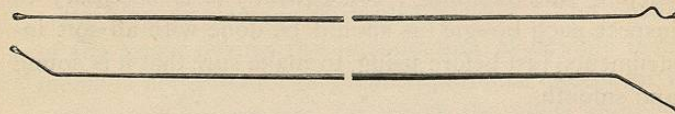


FIG. 39.—Gouley's whalebone bougies (Tiemann).

Filiform bougies (Fig. 39) are necessary in the treatment of all strictures of very small calibre—tight strictures. The best filiforms are made of whalebone with fine bulbous

tips. By placing them in hot water for a few minutes the ends may be so bent or twisted that the point will enter an eccentric opening in a stricture which a straight instrument would be unable to penetrate. If the two ends of a filiform bougie are thus bent in the same direction, when the tip engages in the stricture the outer end will serve as an index to the exact location of the opening, which can thus be found with much less difficulty at the next sitting. A filiform bougie, when it has been passed through a small and difficult opening in a stricture, may be used as a guide for a larger instrument. For this purpose the bougie should be at least eighteen inches long. Dr. E. A. Banks has devised a whalebone bougie which is filiform at its tip and throughout its first two or three inches, and then increases in size to form a larger shaft which can be pushed on into the stricture to dilate it. Filiforms are also made with caps on the outer end that can be screwed on to larger instruments which may thus be conducted through the stricture. These bougies are dangerous, as the caps may become loose and the filiform bougie may be left in the stricture or in the bladder; besides, they offer no advantage over either of the two preceding methods. Whalebone bougies frequently become cracked, rough, or frayed as a result of keeping and handling; consequently it is necessary to inspect each bougie (as should be done with all soft instruments) just before using, to make sure that it is sound and smooth.

Tunnelled sounds and catheters (Fig. 40) are so made that they can be threaded over a filiform bougie and thus be guided safely into the bladder. They should have a short curve, and the short tunnel should be large enough to allow the guide to slip through it easily, with

edges smooth and rounded to prevent cutting the guide. To use the tunnelled sound safely and to advantage, at least five or six inches of a long filiform bougie should be passed into the bladder. The tunnelled sound is

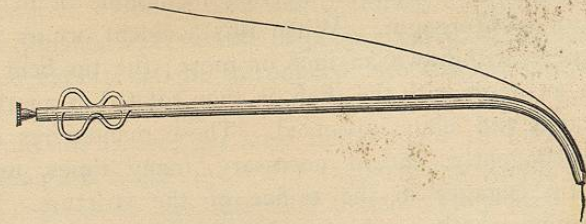


FIG. 40.—Gouley's catheter-staff (Tiemann).

then threaded over the guide and slipped down to the point of the stricture. Here it is gently pressed forward through the stricture as the guide is slowly and gently drawn out. If the guide becomes fast in the larger instrument, both guide and sound should be withdrawn until the former is again freely movable. Failure to observe these precautions may result in a false passage or in cutting the guide in two and leaving one end of it in the stricture.

Introduction of Flexible Instruments.—In the use of soft and flexible instruments slight pressure or force is allowable, though some of the rubber bougies are stiff enough to do damage if carelessly used. The position of the penis during the introduction of flexible instruments is not a matter of great importance except for the small-sized instruments, for which the penis should be held parallel with the thighs and should be put lightly on the stretch, to make the canal as straight as possible and to efface the folds of mucous membrane in which the fine points of small instruments are frequently caught.