by any plan of fornication, escape the evil consequences to which stimulated but ungratified desire exposes him. Marriage with a pure woman may right him—rarely anything short of this. Hence, when a case presents itself where marriage is impossible, or if the patient be already unhappily married, there is but one course left to advise, and that is absolute continence and an effort at purity of thought, with a strict avoidance of all possible temptations to erotic thought or act, whether entering through the mind, the eye, or the ear—whether actual or implied, direct or remote. Could such a patient imitate the heroic example of St. Augustine—a record of which that honest father of the Church has left behind—he would control the hygiene of his urethra. and doubtless save himself much distress in life.

CHAPTER II

MALFORMATIONS OF THE URETHRA

The urethra is subject to arrest and error of development, but is not often seriously deformed. Among curiosities of deformity may be mentioned abnormal position of the meatus on the side of the glans penis; termination of the ejaculatory ducts in a separate canal, running along the dorsum of the penis and opening behind the glans[1] (gonorrhea of this canal has been noted); and termination of the urethra in the groin.[2] Perkowsky[3] found in a well-formed penis, besides the healthy urethra, a second canal opening at the base of the glans above the meatus, and affected with gonorrhea. He split this subcutaneous canal to the symphysis, where it terminated in a blind pouch. Luxardo[4] describes a gonorrheal patient who had three openings at the end of the penis. One gave exit to semen only. The two lower ones appeared to communicate, and both had gonorrhea. E. B. Ward[5] reports three brothers, each with three openings to the urethra, but he does not state whether they communicated, or that one was not a seminal duct. Englisch[6] has reported several cases similar to Perkowsky's. Le Fort[7] has collected and classified the different varieties of fistula of the penis and the so-called double urethra, and shows that the second urethra is always a blind pouch, usually a prolongation of the lacuna magna. In fact, double urethra does not exist, except with double penis.

All these deformities, dependent upon excessive and unnatural development, are exceedingly rare. Deformities caused by a defect of development are more common. Either the canal is obstructed or it is not closed in. In the former case the junctions among the

[1] Cruveilhier, Traité d'anatomie descriptive, Paris, 1865, vol. ii, fasc. 1.
[2] Haller, quoted by Pitha, Krankheiten der männlichen Geschlechtsorgane, 1864.
[3] Centralbl. f. Chir., Nr. 50, 1883, 816.
[4] L'Union médicale, No. 54, 1883, 663.
[5] New York Med. Record, September 1, 1883, 251.
[6] Internat. Centralbl. f. d. Phys. u. Path. d. Harn. u. Sex. Org., 1892, iii, 327.
[7] Guyon's Annales, 1896, xiv, 624, 792, 912, and 1095.

various parts of which the canal is formed are incomplete (atresia—congenital stricture); in the latter the closure of the walls is defective (hypospadias—epispadias).

Atresia.—Atresia, commonest at the meatus, may occur at any part of the canal. Indeed, the entire urethra may be replaced by a fibrous cord. The prostatic urethra is never obstructed.[1]

The obstruction is usually but a thin membrane which may be punctured and the orifice kept patent until it heals, after which no further trouble need be anticipated. If, however, the urethra is imperforate for some distance, it may be punctured with a small trocar, but only after the internal segment has been accurately located by external urethrotomy, or, if the membranous urethra is also involved, by suprapubic cystotomy. In these cases the urachus often remains patent, and the patient urinates through it. Removal of the urethral obstruction is soon followed by closure of the urachus. Englisch[2] has furnished a contribution to this subject. The stricture liable to ensue upon puncture of a diaphragm or of a band must be combated by the usual methods. Major surgical procedures are best delayed, if possible, until the patient has attained his sixth or eighth year. Guyon[3] and Demarquay[4] have collated interesting cases. Demarquay's puncture through a band without preliminary perineal opening is too blind a proceeding to be approved.

Congenital Stricture.—Congenital stricture, usually of the meatus, is so common, and has such a direct bearing upon the treatment of the so-called organic stricture, that it will be considered in that connection.

Dilatation of the Urethra.—Bokay[5] has collected 14 cases of congenital urethral diverticula, only 3 of which were due to stricture.

HYPOSPADIAS

Hypospadias is that form of imperfect development of the urethra in which the canal terminates in an opening in its lower wall instead of extending to its normal termination in the end of

[1] Mercier's *valvule de la vessie*, which he claimed to be a common cause of obstruction at the neck of the bladder, appears to have been either contracture of the vesical neck or hypertrophy of the prostate. Guyon, once a stanch supporter of the *valvule* theory, has so far modified his opinion as to admit that he has seen the valve demonstrated post mortem only six times, and has known it to cause symptoms but once. (*Op. cit.*, iii, 151.)

[2] Arch. f. Kinderheilk., 1881, ii, 85 and 291.

[3] Des vices de conformation de l'urêtre chez l'homme, etc. Thèse de Paris, 1863.

[4] Maladies chirurgicales du pénis, 1877, p. 581.

[5] Dermatolog. Zeitschr., 1900, vii, 721.

the glans penis. There are three degrees of hypospadias: 1. *balanitic hypospadias*, in which the urethra opens on the lower surface of the glans or at the peno-balanitic junction; 2, *penile hypospadias* (peno-scrotal and scrotal hypospadias), in which the canal opens on the under surface of the penile urethra, or more often at the peno-scrotal angle; and (3) *perineal hypospadias*, in which the urethra terminates in front of the triangular ligament and opens in the perineum. Thus hypospadias always occurs in front of the cut-off muscle, and, no matter how extensive it may be, the patient always has control over the escape of urine.

Hypospadias at the peno-scrotal angle is more common than the perineal variety, and most frequent of all is hypospadias confined to the glans penis or to its immediate vicinity. That part of the urethra lying between a hypospadial opening and the meatus is usually absent or impervious, but may be patulous for a short distance in front of the opening on the floor of the urethra, or even up to the meatus. Hypospadias, as commonly encountered in practice, consists in an absence of the frenum preputii and a flaring open of the meatus inferiorly, or an opening in the floor of the canal within a few lines of the natural meatus, the position of which latter is usually marked more or less perfectly in its usual site. The glans penis may be bifid. The urethral orifice in hypospadias is small as a rule. With penile hypospadias there is usually some downward curvature of the penis, and not infrequently adhesion of the penis to the scrotum. The under surfaces of the corpora cavernosa are not developed, the fibrous sheath of the penis is thickened and too short beneath, so that the condition may be called one of permanent physiological chordee. The penis, freed of all cutaneous and urethral attachments, cannot be straightened until the fibrous sheaths of both corpora have been transversely incised beneath, and sometimes not then until the fibrous septum has been incised. The penis, usually small, is sometimes completely buried in the scrotum. With perineal (sometimes called scrotal) hypospadias the scrotum is bifid, and the penis is usually very imperfectly developed, imperforate, and looks like a large clitoris. The bifid scrotum passes very well for a vulva, and in this way some of the so-called hermaphrodites are formed, the true sex perhaps only being discovered after adult age is reached.

Etiology.—Hypospadias is usually regarded as a simple arrest of development in a portion of the lower wall of the urethra, its lateral halves failing to unite in the median line. In favour of this view are the manifest hereditary tendency to this deformity seen in some cases, and the fact that at two months the embryo has hypospadias

normally. The scrotum has not yet united, and if natural development ceases here the last degree of hypospadias results. It may be urged that this theory does not explain the incurvation of the penis, nor its adhesion to the scrotum, nor the scar-like contracted appearance of the orifice. To explain these facts Kaufmann[1] advances the theory that hypospadias and epispadias are examples of congenital fistula dependent upon imperfect union of the penile and the balanitic urethra. These two portions of the canal, it is known, are developed separately, and if imperfectly approximated atresia at the peno-balanitic junction may result. Now Kaufmann supposes that the urine secreted by the fetus may break either through the obstruction, leaving congenital fistula, or through the floor of the canal, producing hypospadias, or through its roof, thus causing epispadias. Even supposing that this theory explains incurvation and adhesion (which it does after a fashion), it can scarcely explain malposition of the urethra in epispadias, or exstrophy of the bladder, with non-union of the symphysis pubis—phenomena so closely related to epispadias that no theory which does not elucidate them can be invoked to account for the urethral deformity. And why, moreover, does not the urine find a free vent through the urachus as it does when the urethra remains closed? In short, Kaufmann's theory, though ingenious, is insufficient.

Symptoms.—Balanitic hypospadias is unimportant; many patients have it without being aware of the fact, while the greatest inconvenience it produces is a slight imperfection in erection and a dribbling at the end of urination. With penile or perineal hypospadias, however, the patient may be forced to urinate in a squatting posture to keep from wetting himself, erection may be very imperfect, and there may be impotence from inability to throw the semen into the vagina. An associated inconvenience is the necessity of enlarging the contracted meatus, in order to introduce dilating instruments, in case of stricture.

Treatment.—For *balanitic hypospadias* no treatment is actually necessary unless a meatotomy to permit the introduction of instruments into the urethra. Kaufmann suggests that a triangular skin-flap be sutured into the orifice to maintain its calibre, but I have found this unnecessary. If, however, the patient demands that his urethral orifice be brought forward to its natural position, one of two operations may be selected. The accepted method is that of Duplay:[2] if the glans is deeply furrowed the edges of the furrow are simply denuded of epithelium and sutured together. Usually,

[1] Deutsche Chirurgie, L. a., 60.

[2] Arch. gén. de méd., 1874, mai et juin.

though, the groove must be deepened by one vertical or two lateral diverging incisions. The edges are sutured over a small (12 French) soft-rubber catheter, and both the sutures and the instrument removed at the end of the week. After the wound has healed firmly, the new balanitic urethra is united to the penile portion of the canal

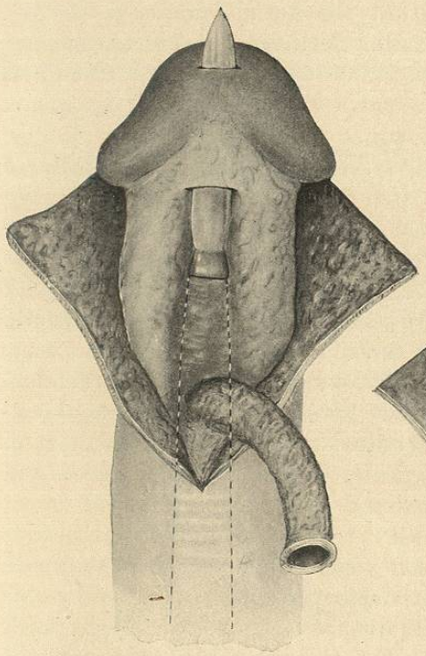

Fig. 9.—Beck's Operation for Balanitic Hypospadias.
Liberation of the urethra—puncture of the glans.

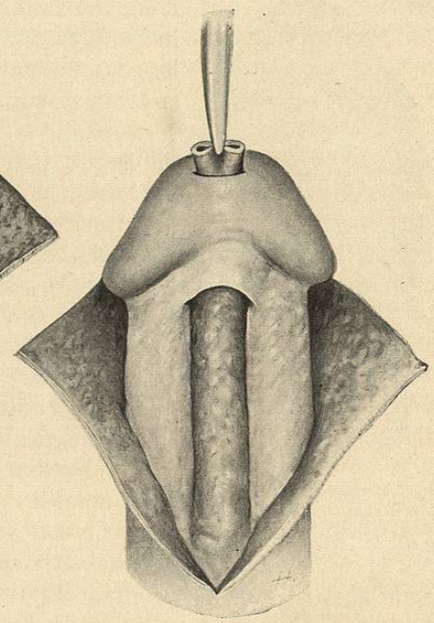

Fig. 10.—Beck's Operation for Balanitic Hypospadias.
The urethra drawn through the glans.

by freshening the edges and by direct suture, preferably over a retained catheter, or after an external perineal urethrotomy to divert the stream of urine from the wound. Recently Beck[1] has cured three cases by freeing the urethra, bringing it forward and suturing it to an orifice punched through the glans (Fig. 9). The urethra must be freed well back and sutured to the apex of the glans to prevent incurvation (Figs. 9, 10, and 11). This is a much simpler expedient than Duplay's, and is commendable, since the formation of a fistula—which is the bane of the older operation—is avoided, and the sutures usually hold.

[1] N. Y. Med. J., 1898, lxvii, 148; *ibid.*, 1900, lxxii, 969.

For *penile hypospadias* the operations are many and various. Certain preliminary steps are necessary in almost all cases.

First, the penis must be freed from its scrotal adhesions. If these are slight, a transverse incision through the peno-scrotal frenum will, when sutured in a longitudinal direction, suffice to free the organ. But if the penis is deeply buried in the scrotum the integument of the former must be derived from the latter with regard only to covering in the penis; the scrotum will, by virtue of its looseness, adapt itself to the loss of almost any amount of skin.

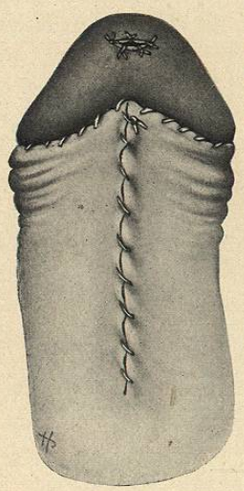

Fig. 11.—Beck's Operation for Balanitic Hypospadias. Suture.

Secondly, the incurvation of the body of the penis often demands attention. This may be corrected through the liberating incision. A transverse incision is carefully made through the whole thickness of the sheath of the corpora cavernosa on its under surface, care being taken to avoid the erectile tissue. This is usually sufficient to permit straightening the penis. If not, the intercavernous septum may require division down to the dorsum. Then the penis is forcibly straightened and snugly bandaged about a slight splint in an overextended position to prevent recontracture. I can vouch from personal experience for the satisfactory results obtainable by this somewhat violent procedure. If the penis is kept straight until entirely healed it may be anticipated that subsequent erections will be complete and direct.

Finally comes the most delicate part of the treatment—the extension, namely, of the urethra to its proper length. This is done in two stages: First, the new urethra is built, and then it is joined to the old canal. Great ingenuity has been displayed in the formation of the new canal. The operation of Duplay is preferred by most surgeons, though the methods of Thiersch[1] (an adaptation of his operation for epispadias), Dieffenbach,[2] Dolbeau,[3] Laurent,[4] and Van Hook[5] also deserve mention. In each of these the lining membrane of the new canal is derived, in one way or another, by flaps turned in

[1] Arch. für Heilk., 1868, x, 20.
[2] Gaz. méd. de Paris, 1837, 156.
[3] De l'épispadias . . . et son traitement, Paris, 1861.
[4] Bull. de l'acad. de méd. belg., 1895, iv, ix, 685.
[5] *Cf.* Mayo, J. Am. Med. Ass'n, 1901, xxxvi, 1157.

from the adjoining regions. That each has been devised to supplement the older ones is an evidence—to which the surgeon who has tried any will certainly testify—of how rarely they succeed and how utterly baffling they all are. A more recent operation, based upon an entirely different principle, promises so well that I venture to refer the reader seeking for details of the earlier operations to the original monographs or to any of the current text-books, while I describe only this one of Nové-Josserand,[1] prefacing that the restoration of the urethra, whatever the method employed, should not be attempted until the wounds made in straightening the penis have entirely healed.

Through a transverse incision 2 cm. long and just in front of the hypospadic meatus, a stout probe is introduced and passed forward along the under surface of the penis, in the subcutaneous connective tissue, until it reaches the base of the glans, elevating the skin from the entire under surface of the penis. The anterior orifice of the canal is then formed by slitting up the under surface of the glans, or by puncturing it with a trocar. To obtain an epithelial lining for this canal—and herein consists the originality of the operation—an Ollier[2] skin-graft, 4 cm. wide and considerably longer than the intended canal, is taken from the inner side of the thigh, where there are no hairs, and wrapped, inside out, around a woven catheter, 21 French in size, and held in place by a ligature at each end and one or two sutures, all of 00 catgut. (Rochet[3] has improved the operation by employing, instead of the Ollier graft, a flap taken from the scrotum, with its base at the abnormal urethral orifice. This device eliminates the fistula between the old urethra and the new (Figs. 12, 13).) The catheter thus covered is then inserted into the canal, and when the graft is in place the anterior ligature is cut and removed, and the edge of the graft sutured to the glans penis. The catheter is then cut off short so that each end barely protrudes from the canal, and a snug dressing is applied with the penis held in the erect position. A retained catheter is used to draw off the urine. (In the Rochet operation the catheter around which the graft is wrapped is used as a retained catheter.) On the eighth day the posterior ligature is cut and the sound removed. Five days later the daily passage of sounds is

[1] Lyon méd., 1897, lxxxiv, 237, and Revue de chir., 1898, xviii, 333.
[2] The Ollier graft, the only one, as far as I know, yet used for this operation, differs from the Thiersch graft only in that it is made as thick as possible without including any of the subcutaneous tissue, instead of—as in the Thiersch method—as thin as possible.
[3] Guyon's Annales, 1900, xviii, 648.

begun, and this is continued for two or three weeks to prevent contracture of the graft.

This operation has been performed three times, twice by Nové-Josserand and upon one patient after Duplay's method had been tried and had failed. The first operation was a success, but a 15

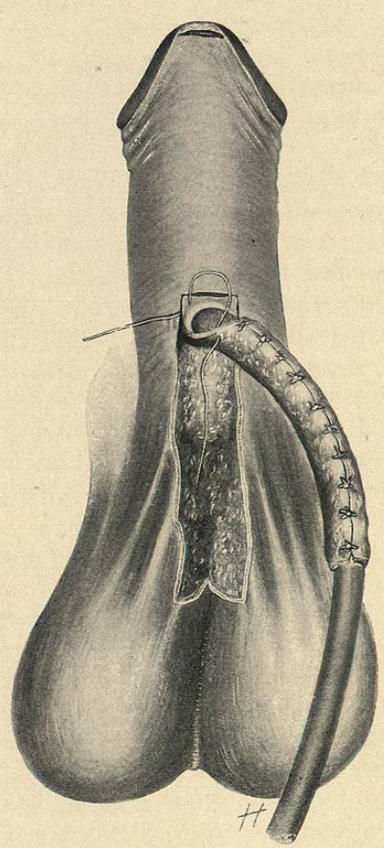

Fig. 12.—Rochet's Modified Nové-Josserand Operation for Hypospadias.

The flaps are cut, the catheter introduced, the scrotal flap sutured around it.

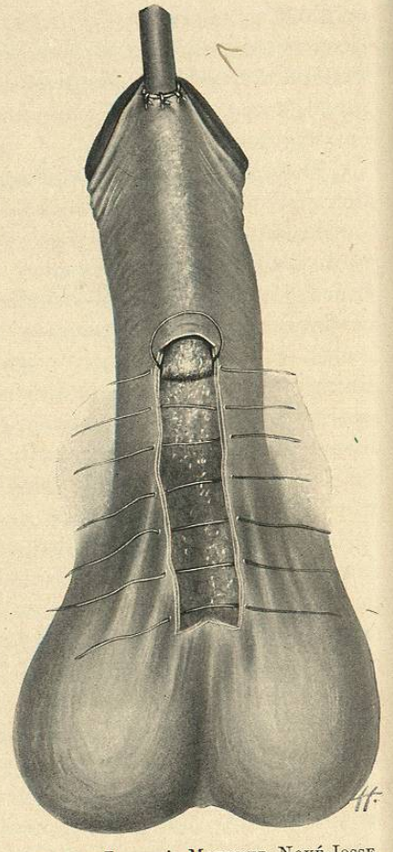

Fig. 13.—Rochet's Modified Nové-Josserand Operation for Hypospadias.

The final sutures.

French catheter had been used, and the surgeon, being dissatisfied with the calibre of the resultant canal, simply repeated the operation, using a larger catheter. Tuffier [1] has also operated successfully. No failure has been reported.

[1] Guyon's Annales, 1899, xvii, 370.

The canal produced by this operation is devoid of a corpus spongiosum, and will therefore always allow some dribbling after ejaculation or emission; but this annoyance is slight compared to that of a peno-scrotal hypospadias.

After the formation of the new canal there still remains the most difficult task of all—namely, the junction of the natural and the artificial portions of the urethra. (This is not required in the Rochet operation.) This, the simplest in the chain of operations, is the one most likely to fail, for the urine tends to infiltrate the suture line and thus to perpetuate the fistula. The operative steps are simple. The adjoining extremities of the new and the old canal are denuded and sutured together over a small soft-rubber catheter (12 French) with silver wire or silk. The catheter is retained in place —with the usual precautions (p. 210)—and all the urine drawn through it until union is complete, after which both catheter and sutures are removed. If union is incomplete because of urinary infiltration, the fistula must be allowed to heal perfectly before it is again attacked by the same method, or, if small, its complete occlusion may be encouraged by injections of peroxid of hydrogen (p. 130).

For *perineal hypospadias* the same treatment is indicated as for the penile or peno-scrotal deformities.

EPISPADIAS

Epispadias (*επι, above*; *σπαζω, I separate*) is a fissure of the superior wall of the urethra with ectopia of the canal (Guyon). It is extremely rare. According to Baron [1] epispadias occurs once for 150 cases of hypospadias, but Marshall did not find a single case of epispadias in examining 60,000 conscripts.[2] The epispadias may be balanitic or penile, or the urethra may be entirely laid open. This complete epispadias is almost always accompanied by exstrophy of the bladder, and will be considered in that connection. A case of complete epispadias, without exstrophy, is figured by Dolbeau.[3] The epispadiac orifice is large, and sometimes the finger may even be passed through it into the bladder. The prepuce forms a knob of loose tissue below the glans. The penis is short and thick, or small and more or less deviated. It is usually adherent to the

[1] Dolbeau, *op. cit.*, p. 11.

[2] Englisch (Bull. méd., Paris, 1895, ix, 153) has reported a case of complete separation of the penis into lateral halves, each corpus cavernosum forming a penis by itself, and the urethra opening between them.

[3] *Op. cit.*, Plate III.

scrotum, sometimes practically buried in it. The pubic bones may be separated even when there is no exstrophy of the bladder, and there may be hernia of that organ without exstrophy.

Etiology.—The observations made upon the etiology of hypospadias apply equally well to this condition. Epispadias is certainly an arrest of development in the upper wall of the urethra, but it is still a matter of hypothesis how the urethra gets above the united corpora cavernosa; for even when the genital buds which are to form the corpora cavernosa are still separate at the fortieth day of fetal life, the urethra is beneath them. However, the fact remains that the urethra gets above the corpora cavernosa and fails to unite in its upper wall, the corpora cavernosa effecting their faulty union none the less. With exstrophy of the bladder, where the lower portion of the abdominal wall is lacking and the pubic bones do not come together, it is easier to understand how the roof of the urethra may be wanting throughout.

Symptoms.—The symptoms consist in the functional derangement of micturition, erection, and emission, as in hypospadias; but it is to be noted that incontinence of urine, which never complicates hypospadias, is usually the main feature of severe cases of epispadias, and this cries out for operation more loudly and incessantly than even the most aggravated symptoms of hypospadias. Unfortunately, it is precisely here where operations are most in demand that they are most difficult.

Treatment.—For the milder cases, uncomplicated by the loss of sphincter power, the counsel to bear their woes patiently is a good one. The methods hitherto employed to relieve this condition—even the favoured procedures of Thiersch and Duplay—are tedious and fraught with failures. Thiersch estimates the minimum of time required for the different stages of his operation at three months and a half—a sufficiently dreary prospect. In view, however, of the success of the Nové-Josserand operation for hypospadias, I should be tempted to try it for simple penile epispadias. In addition to the changes obviously necessary to adapt the operation to epispadias it would be necessary to divert the stream of urine by ureteral catheterism, and it might seem advisable to connect the new and the old urethra by continuing the graft into the outer extremity of the epispadic urethra previously denuded. I see no reason why the Nové-Josserand operation should not succeed when thus applied to the upper surface of the penis as well as it has undoubtedly succeeded on the opposite side of that organ. The unsatisfactory plastic operations of Thiersch and Duplay need not delay us.

When the sphincter is lost it cannot be replaced. If there is

exstrophy of the bladder, that deformity requires attention (p. 336). Without exstrophy the Nové-Josserand operation might succeed; but probably a modification of one of the urinals adapted to the more severe deformity will give the patient greater comfort than any operation, unless it be Maydl's (p. 498).

The complicating adhesions, torsion or flexion of the penis, must be dealt with here, as in hypospadias, by liberating incisions of the skin and the sheaths of the cavernous bodies.

CHAPTER III

CATHETERS AND CATHETERIZATION

Catheterization, broadly speaking, is the introduction of an instrument through the urethra into the bladder; strictly speaking, however, catheterization is the introduction of a *catheter*—viz., that particular kind of a hollow instrument which, having an opening at each end, is used to introduce fluids into, or evacuate them from, the bladder or upper urinary organs.

A *sound*, on the contrary, is an imperforate urethral instrument, and has no connection with the introduction or evacuation of fluids.[1] A *bougie* is a flexible sound.

Scales.—The scale for grading the calibre of urethral instruments was first accurately fixed in France, where two scales are at present in use—the Charrière (commonly known as the French scale) and the Béniqué. Other scales are the English and the American.

Of late years the tendency in this country, as well as in England, has been to adopt the French scale as the most convenient, while in France itself there is a tendency to replace the old French (Charrière) by the new Béniqué scale. Although Dr. Van Buren, senior author of the first edition of this work, was very tenacious of the American scale—which indeed was born in his office—the almost universal adoption of the French scale since his time has led me, in subsequent editions, to drop the American in favour of the French scale.

The French (Charrière) scale indicates diameters in $\frac{1}{3}$ mm. No. 1 has a diameter of $\frac{1}{3}$ mm., No. 2 a diameter of $\frac{2}{3}$ mm., and so on. From this scale, therefore, the diameter of an instrument may be determined by dividing its number by 3. A No. 30 sound has a diameter of 30 mm. $\div 3 = 10$ mm.

The Béniqué scale indicates diameters in $\frac{1}{6}$ mm. It numbers instruments twice as high, therefore, as the Charrière. A No. 30 French sound is a No. 60 Béniqué. B. + F. × 2.

[1] To the French all urethral instruments are *sondes*, and the verb *sonder* means to catheterize in the broadest sense.

The American scale indicates diameters in $\frac{1}{2}$ mm. Thus its numbers are $\frac{2}{3}$ as high as the French. 30 F. = 60 B. = 20 A. A. = F. $(1 - \frac{1}{3}) = \frac{2}{3}$ F.

The English scale follows no rule, but its numbers are generally about 2 less than the American. Thus, 30 F. = 60 B. = 20 A. = 18 E. E. = A. − 2 = $\frac{2}{3}$ F. − 2.

The best scale-plate I know of is the one furnished with a triangular slot so marked as to give the sizes in the English, American, and French numbers for any instrument, and also marked off in inches and millimetres upon one edge (Fig. 14). It is essential to the surgeon's armamentarium in the state of confusion in numbering urethral instruments which still prevails in this country.

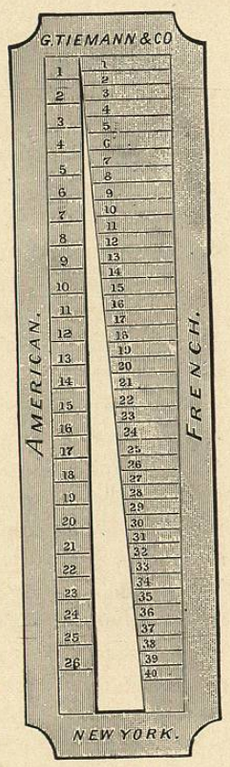

Fig. 14.

The Instrument.—Rigid urethral instruments are made of silver or of nickeled steel. Flexible ones are of rubber or of woven silk coated with wax or varnish: these woven instruments are less flexible than the rubber ones. There are also small whalebone instruments, which on account of their tenuity are called filiform.

The *qualities* essential to a good urethral instrument are:

1. Smoothness,
2. Sterilizability, and
3. Durability.

For sounds external smoothness suffices. For catheters the eye should be depressed so as not to scrape the mucous membrane, and the interior must be smooth and free from pockets so as to submit readily to mechanical cleansing. Not only, therefore, should it be as smooth inside as outside, but also its lumen should terminate in the eye and not in a pocket beyond the eye, wherefore the ordinary catheter, with its eye a little distance from the tip, should have a solid end.

The sterilization of catheters is most effectively and conveniently accomplished by boiling. Metal, rubber, and whalebone instruments all may be boiled satisfactorily. The only instrument that rebels is the woven one. This is the one point of inferiority in that excel-