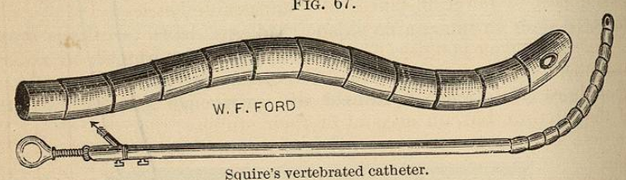
side finish, and which is commonly known as Jaque's catheter. It is also made in this country by George Tiemann & Co., who claim to have improved the eye of the instrument so that it cannot excite irritation in its passage (Fig. 64).

In some instances it is desirable to impart to this instrument increased firmness without impairing its elasticity, in which case the stylet or guide of Professor Otis, consisting of a light steel rod (A), eight inches in length, upon which is screwed a spiral riband (B), five inches in length, will be found of value (Fig. 65).

A silver prostatic catheter, with more than the usual curve, and a long beak, should always be at hand. Fig. 66 represents the size and shape of one which has never yet failed me in cases of retention of urine from enlargement of the prostate.

Squire's vertebrated catheter (Fig. 67) is also highly esteemed by many of our best authorities in cases of prostatic obstruction, but

Fig. 67.



Squire's vertebrated catheter.

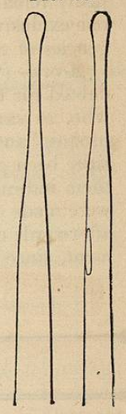
many accidents have occurred from the separation and detachment of its links, owing to imperfect construction, and it may well be supplanted by the Jaque's catheter, with or without a stylet, already mentioned.

Sounds.—The best sounds are made of "Stubb's steel," and are either highly "polished in oil," or, more frequently at the present day, nickel-plated, both to avoid rust and to present a smooth surface to the urethral walls. For reasons already given, I prefer to have in my office two full sets, one of Thompson's, the other of Béniqué's curve. The former, however, may be made to answer every purpose, and are quite sufficient for a case of instruments to take to an operation or for the use of a general practitioner. They should range in size from number 12 to 36, or even 40. In cases of stricture so tight as not to admit No. 12, it is better to employ bougies, since the stiffness of a small metallic instrument exposes to the danger of making a false passage. Their handles should be broad and roughened, so as to afford a secure hold to the hand and indicate any deviation in the direction of the point. It is well to have the points gradually tapering to two sizes smaller than the shaft, and the same arrangement enables us in making up an out-door case of urethral instruments to economize space by dispensing with every other number of the scale.

Bougies.—Bougies are made of wax, gum-elastic, whalebone, and other materials, and are furnished with variously shaped points.

The English mahogany-colored bougies, which, on account of their durability, are so commonly found in surgical cases in hospitals and private offices, are objectionable, *except in certain cases of prostatic obstruction*, in which considerable stiffness of the instrument is called for, because of their not readily following the natural curve of the urethra. They are the source of much of the pain and even injury so often inflicted upon patients in catheterization. No other bougies can equal those made by the French, which are black in color, highly flexible, conical towards the extremity, and furnished with an olive-shaped point, which prevents their catching in the lacunæ of the canal.

Fig. 68.



French flexible bougie and catheter.

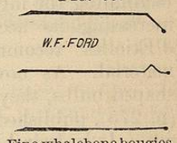
"Filiform bougies," of the same material, are indispensable in the treatment of tight strictures, and should be in the hands of every surgeon who attempts to treat such cases. If their value were better known, we should hear of fewer instances of "impassable" strictures.

Fine whalebone bougies (Fig. 69), some with straight and others wih eccentric and twisted points, are also of value in cases of tight strictures in the anterior portion of the urethra, but, on account of their stiffness, they are less adapted to strictures in the sub-pubic curvature.

The desired shape and stiffness may be imparted to the points of fine flexible bougies by first soaking them in hot water, then twisting them as required, and finally plunging them into cold water. Or, again, the twisted points may be covered with several coats of collodion, which will retain their form even when exposed to the secretions of the urethra and the urine.

The employment of gum-elastic and whalebone filiform bougies as guides in internal urethrotomy and in the rupture of strictures, will be mentioned hereafter.

Fig. 69.



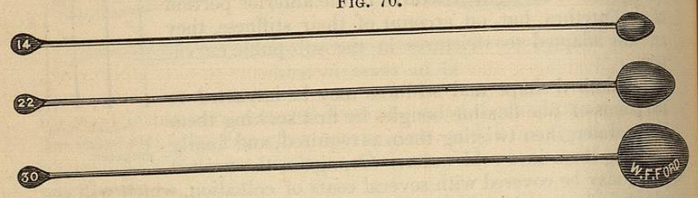
Fine whalebone bougies twisted points.

All bougies should be carefully examined from time to time, and if found impaired in the slightest degree should at once be destroyed, lest they be incautiously used, and a portion break off in the canal. Bougies of elastic gum become rough with use, whereby they irritate the mucous membrane, and should in this case also be discarded. After using them, they should be wiped quite dry and free from oil, which acts on the rubber, and then be dusted over with powdered soapstone, and be kept, in warm weather, in a cool place, as in an ice-chest. But no rubber material can be long kept in our climate, hence it is desirable for the surgeon to replenish his drawers sparingly at any one time. Whalebone bougies must be oiled occasionally, or they become brittle and unsafe.

The question has arisen, which is the less painful to the patient, the introduction of a metallic or flexible instrument? My own preference, except in somewhat tight strictures, is decidedly in favor of the former, and this preference is founded on the statements of my patients when I have had occasion to use both. I would certainly, however, recommend one who was not in the habit of using instruments, to employ the latter (flexible), but as my friend Dr. Ashhurst[1] justly remarks, "the practitioner will do wisely not blindly to follow one exclusive method, but to vary his remedies according to the exigencies of each particular case."

Acorn- ("bulbous") *pointed Sounds and Bougies.*—We are indebted for the original conception of these instruments to Chas. Bell,[2] who, as early as 1807, described them under the name of "ball-probes," and claimed for them all the advantages which they have since been proved to possess. Bell's instruments, as the name he gave them indicates, were ball-shaped or spherical at their extremity; they were made of metal, both ball and shaft. The ball-shaped head was afterwards changed to one of an olive form. This was no improvement, since a sphere will better detect a slight contraction than any

FIG. 70.



Acorn-pointed sounds.

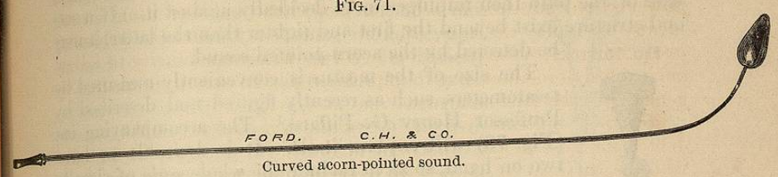
bulb of an olive-shape. An actual gain was acquired in making the terminal bulb like an acorn with a somewhat abrupt shoulder, thereby facilitating the introduction of the instrument and at the same time increasing its accuracy of diagnosis upon withdrawal. Leroy d'Etiolles[3] recommended the same instruments made of flexible material. As now chiefly used, made of metal and with acorn-shaped bulbs, they were described in the first edition of this work (p. 275), published in 1861, when they had long been in common use. It is desirable to have them in sets, like sounds, ranging in size from 12 upwards, nickel-plated, their shafts straight and about six and a half inches long, with a disk upon the distal end upon which the number is marked (Fig. 68.)

This form is the most generally useful, but it should be distinctly understood that it is adapted only for exploration of that portion of

[1] The Principles and Practice of Surgery, 2d ed., 1878, p. 913.
[2] Chas. Bell, Operative Surgery, Am. reprint, Phil., 1812, vol. i., p. 72.
[3] Traité d. angusties d. l'urètre, Paris, 1845, p. 122.

the urethra anterior to the triangular ligament. If it be desired to explore beyond this point, we must either use a similar instrument, which I have had constructed curved like an ordinary sound (Fig. 71), or employ the acorn-pointed bougie, made of flexible mate-

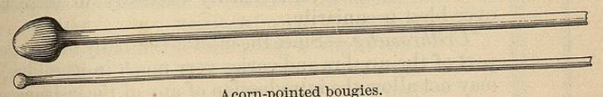
FIG. 71.



Curved acorn-pointed sound.

rial (Fig. 72). In practice, however, bulbous sounds or bougies are rarely resorted to for exploration of the deeper portion of the canal.

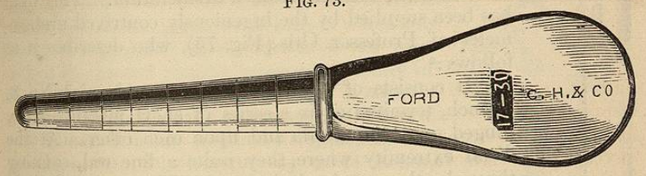
FIG. 72.



Acorn-pointed bougies.

The advantages offered by these instruments are the following: They enable us to detect and locate points of tenderness in the canal, where a chronic gonorrhœa or gleet very likely has its seat. They are

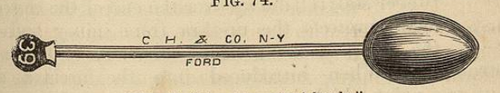
FIG. 73.



Meatometer.

a valuable means for determining the presence of slight contractions or the so-called "strictures of large calibre." It is commonly said

FIG. 74.

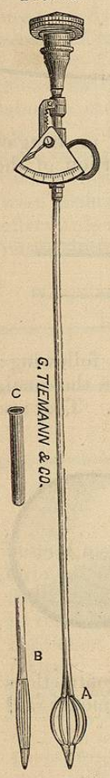


Piffard's "fossal bougies à boule."

that they enable us to determine the length of strictures, but this is evidently impossible, unless the stricture terminate abruptly at each

extremity, which is rarely the case. A stricture is usually shaped like an hour-glass, and more or less contraction exists before the obstruction is encountered by any sound that can be made to pass through it. The presence of a slight stricture is better detected on the withdrawal than on the insertion of the sound, since the abrupt base of the bulb then impinges more decidedly against it. If a second stricture exist beyond the first and tighter than the latter, it may be detected by the acorn-pointed sound.

Fig. 75.



Otis's urethrometer.

The size of the meatus is conveniently measured by meatometers, such as recently figured and described by Professor Henry G. Piffard.[1] The accompanying cut (Fig. 73) will explain itself. It is desirable to have two on hand, so as to include the whole scale of sizes to which the meatus is liable, each being marked with the numbers corresponding to its divisions. If the surgeon wishes to multiply his instruments in this direction he may do so with short *bougies à boule* (Fig. 74). This refinement, however, is hardly necessary to those not over-blest pecuniarily.

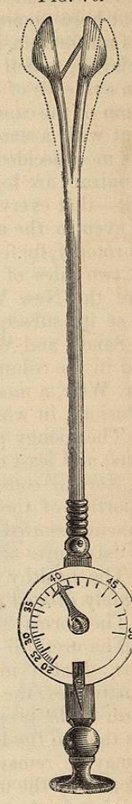
Urethrometer.—Since the meatus is usually the smallest part of the urethra and varies very much in its calibre, it may not allow the introduction of any of the instruments thus far mentioned of sufficient size to thoroughly explore the canal and especially to detect slight contractions. An instrument which could be inserted through a narrow meatus and then be dilated within the urethra, with an index at its distal extremity showing the amount of its dilatation, was therefore a desideratum. This want has been supplied by the ingeniously contrived urethrometer of Professor Otis (Fig. 75), who describes it as follows:[2]

"It consists of a small, straight canula, size No. 8, French, terminating in a series of short metallic arms, hinged upon the canula and upon each other. At the distal extremity where they unite a fine rod, running through the canula, is inserted. This rod (which is worked by a stationary screw at the handle of the instrument), when retracted, expands the arms into a bulb-like shape, 10 millimeters in circumference when closed, and capable of expansion up to 40 millimeters. A thin rubber stall (C) drawn over the end of the closed instrument, protects the urethra from injury and prevents the access of the urethral secretions to the interior of the instrument. When introduced into the urethra and expanded up to a point which is recognized by the patient as filling it

[1] Physician and Pharmac., N. Y., Jan. 1, 1879.
[2] Stricture of the Male Urethra, N. Y., 1868, p. 77.

completely—and yet easily moving back and forth—the index at the handle then shows the normal circumference of the urethra under examination. In withdrawing the instrument, contractions at any point may be exactly measured, and any want of correspondence between the calibre of the canal and the external orifice be readily appreciated. Among the advantages claimed for this instrument are: I. Its capacity to measure the size of the urethra, and to ascertain the locality and size of any strictures present, *without reference to the size of the meatus.* II. It enables the surgeon to complete the examination of several strictures by a single introduction of the instrument."

Fig. 76.



Dr. Weir's urethrometer. The rings on the shaft locate the points of arrest, and permit subsequent accurate measurement.

While admitting the great advance made by Dr. Otis, in enabling us to determine more accurately the size of the urethra at its various points, yet his instrument possesses this defect: its extremity is of an elongated olive shape, and hence is less capable of indicating a slight contraction than if it were of an acorn form—the same objection that is made to Bell's original ball-probes, only still greater. This defect is remedied in B. Wills Richardson's urethrometer,[1] and also in one invented by Professor Robert F. Weir, of New York (Fig. 76).

Dr. Otis believes that a constant relative proportion exists between the calibre of the urethra and the size of the penis, as follows: When the flaccid penis, about three-fourths of an inch back of the corona glandis, measures 3 inches in circumference, the size of the urethra is 30 millimeters in circumference, or more.[2] When it is $3\frac{1}{4}$ inches, it is 32, or more; $3\frac{1}{2}$, inches, 34; $3\frac{3}{4}$ inches, 36; 4 inches, 38; $4\frac{1}{4}$ to $4\frac{1}{2}$ inches, 40 or more millimeters. The constancy of this relationship is denied by Dr. R. F. Weir,[3] but seems to have been received generally as at least approximatively correct, and hence of considerable practical value. The urethrometer is commonly introduced as far as the bulbous portion of the urethra, that is to say, about $4\frac{1}{2}$ to 5 inches, before being dilated. Upon withdrawing it, it will usually be found necessary to screw it down 2 or 3 millimeters, when it ar-

[1] Dublin Q. J. M. Sc., Nov., 1873.
[2] Dr. Otis's scale in millimeters of *circumference* differs somewhat from the *Charrière-filière*, or French scale. (See p. 306.)
[3] New York M. J., April, 1876.

rives at 3½ or 3 inches from the meatus even in perfectly healthy urethræ. Thus diminished in size, it ought, according to the statement of its inventor, to traverse the remainder of the canal to the meatus without hindrance, unless some abnormal contraction be present.

But here comes up a question: Is a normal, healthy urethra always uniform in its calibre in its spongy portion, and must every irregularity, which can be detected by the urethrometer, be regarded as an evidence of disease, or are constrictions (or obstructions) in this portion of the canal to some extent independent of disease and consistent with a state of health, or, in a word, *normal?* My own opinion is most decidedly in favor of the latter view. Those who maintain the contrary are logically forced to the conclusion—which they readily admit—that every obstruction, that can be detected by the urethrometer, even in the absence of present inconvenience, requires internal urethrotomy, for fear of some eventual ill effect. Such is not my opinion. The two sides of this question were well presented in a discussion before the New York County Medical Society, January 24, 1876, and, at its subsequent meeting, by Dr. Otis on the one hand, and Drs. Sands and Weir on the other. A report of the same may be found in the columns of the *New York Med. Journ.* for April, 1876.

Dr. Weir, a most able and conscientious observer, formulates his conclusions, in which I fully concur, as follows:

1. The spongy portion of the urethra is the smallest (except the meatus) and least dilatable portion of the canal.

2. Normal constrictions (or obstructions) are to be met with in this portion of the canal as small certainly as No. 29, and the means at present resorted to are insufficient for the differentiation of such from "strictures of large calibre."

3. The healthy urethra in this portion can generally be readily and safely dilated up to an average size of 32 millimeters.

4. The normal size of the meatus is from No. 21 to 28.

5. The urethral canal is, in the words of Jarjavay,[1] "narrow at the meatus, dilated in the glans, and very slightly narrowed at the termination of the fossa navicularis; then it forms a cylinder nearly uniform to the prepubian angle, where a coarctation is found. It enlarges then to the bulb," etc.

It may be remarked that somewhat more pain and uneasiness are occasioned by the urethrometer than by the use of an ordinary sound or *bougie à boule*, and a few drops of blood are likely to follow the withdrawal of the instrument.

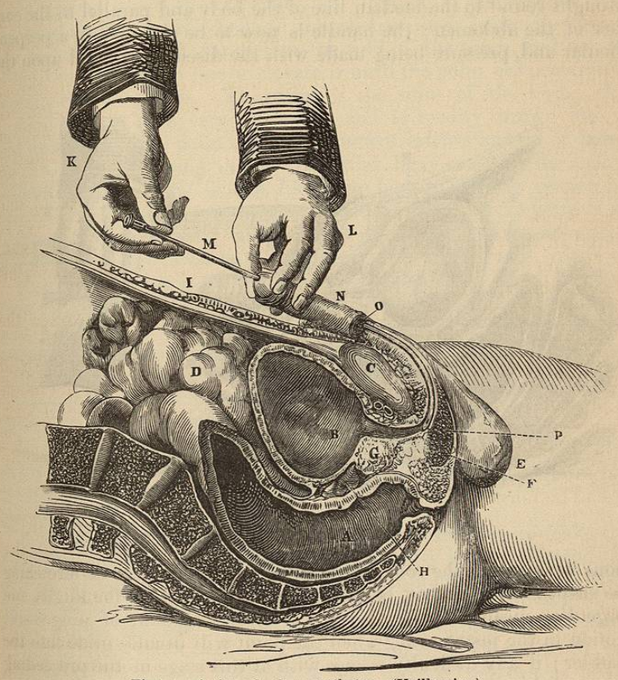
Introduction of the Catheter.—A catheter may be introduced while the patient is in the standing or sitting posture, but the recumbent position is on many accounts the best; the patient lying square on the back, with the shoulders elevated, the knees drawn up and somewhat separated, the genital organs entirely exposed, and the surgeon standing or sitting on his left.[2] The operator now raises the penis to

[1] Recherches anatomiques sur l'urèthre, 1856, p. 208.

[2] This is the position usually recommended, but much depends upon the habit of each surgeon. For myself, I prefer to be on the patient's right, and to introduce

an angle of about sixty degrees with the body, thereby effacing the anterior curve of the urethra, by means of the ring and middle finger of the left hand, its palm looking upwards; the thumb and forefinger are thus left free to retract the prepuce and separate the lips of the meatus. The catheter, previously warmed and oiled,[1] is held tightly between the thumb and fore and middle fingers of the right hand "like a pen," its shaft corresponding to the fold between the

FIG. 77.



First step in introducing a catheter. (Voillemier.)

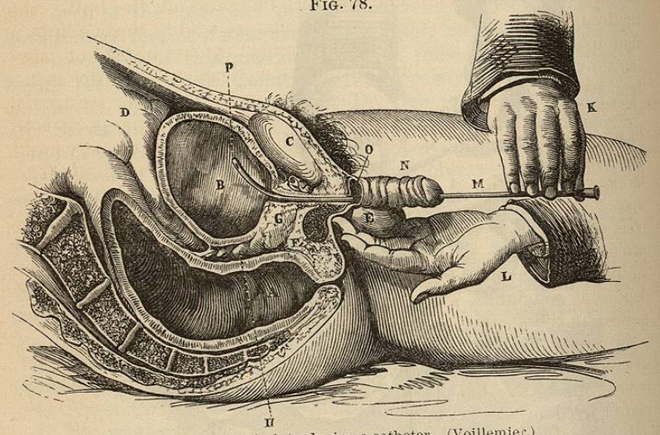
abdomen and the left thigh. The introduction of the instrument should be slow and with the exercise of little force; its own weight is almost sufficient to effect its passage if properly directed; if any

the instrument as far as the bulb with its *convexity* facing the pubes, when by rotating the shaft round towards the abdomen, the point readily slips into the membranous portion. This method, called the "*tour de maître*," has been said to be "dangerous," but on what grounds I have yet to learn.

[1] Vaseline, with the addition of ten grains of carbolic acid to each ounce, is one of the best and most convenient lubricants for this and other urethral instruments.

obstruction be met with, the instrument should be withdrawn for a short distance and again advanced with the direction of its point slightly varied, or if the obstacle be due to spasmodic contraction of the urethra, it may generally be overcome by gentle pressure continued for a moment or two; while passing through the first two inches of the urethra the point of the instrument is inclined to the lower surface in order to avoid the lacuna magna; beyond this it should be directed rather to the upper surface to escape the sinus of the bulb; when it has penetrated beneath the pubes the shaft is brought round to the median line of the body and parallel to the surface of the abdomen; the handle is now to be elevated to a perpendicular and, pressure being made with the disengaged hand upon the

FIG. 78.



Second step in introducing a catheter. (Voillemier.)

mons veneris and the root of the penis for the purpose of stretching the suspensory ligament, be gently depressed between the thighs, not forgetting meanwhile to maintain a certain amount of progressive motion in the instrument,[1] when the point will usually glide into the bladder; if any difficulty is met with at this stage of the proceeding it is probably because the point has caught in the extensible tissue of the bulb, and the instrument should be again raised to a perpendicular and slightly withdrawn, and the penis elongated by traction before the manœuvre is repeated; further assistance may be obtained, if necessary, during the latter part of the introduction, by gently pressing against the convexity of the instrument just back of the scrotum, or by introducing a finger into the rectum, ascertaining the exact position of the point and guiding it forwards and upwards against the

[1] "The great art in passing a sound consists in properly combining the motion of reversion with that of progression imparted to the instrument." (Voillemier.)

posterior surface of the symphysis; the passage of the extremity over the uvula vesicæ is often indicated by nausea or a slight tremor on the part of the patient, and its entrance into the bladder by a flow of urine.

Let us review these several steps and notice the chief natural obstacles which are to be avoided. The first is the lacuna magna, situated upon the upper surface of the urethra; this is to be shunned by directing the point of the instrument towards the lower surface during the first two inches of its passage. The second is the symphysis pubis, against which the extremity will impinge, if the abdomen be distended and the handle held in the median line; hence the direction to hold the shaft parallel to the fold of the thigh, and not to bring it to the median line or elevate it until the point has penetrated beneath the symphysis. The third is the sinus of the bulb; the urethral wall is here very extensible, and is readily thrown into a fold upon which the point of the instrument catches instead of passing through the opening in the triangular ligament into the membranous portion; this is less likely to happen if the tissues be stretched by traction upon the penis; and, if it occur, the point is to be disengaged by slightly withdrawing it, and afterwards advanced in a direction more towards the upper surface of the canal. It is to be observed that this is the only stage of the process in which traction upon the penis is desirable; after the point has entered the membranous portion, it is positively injurious. Again, hypertrophy of the prostate or abnormal development of the uvula vesicæ may oppose an instrument in the last part of its passage; this is to be avoided by depressing the handle and thus elevating the point towards the symphysis: in these cases a prostatic catheter is often required.

In using a flexible filiform bougie, the fact that it has passed the stricture and entered the bladder may be known by our ability to insert it up to the handle, and to give it a to-and-fro motion with perfect freedom.

It is a golden rule in every case of suspected stricture to make the first examination with an instrument sufficiently large to distend the urethra, whatever history of his previous symptoms may be furnished by the patient; in this manner many sources of error already indicated will be avoided. The difference in the impression conveyed to the hand of the operator by mere spasmodic contraction of the urethra and an organic stricture, is very marked, but can be better felt than described. In the former case, the tissues against which the point of the instrument impinges evidently preserve their natural suppleness, and the obstruction yields to gentle and continued pressure; while in the latter, a firm resilient obstacle is felt, which can be thrust backwards, imparting more or less motion to all the surrounding parts; and if after a trial of one or more smaller instruments, one be found which can be successfully introduced within the stricture, it is grasped or "held" by it in a very characteristic manner. This can be only very imperfectly simulated by any contraction of the voluntary and involuntary muscles surrounding the membranous