

floor are of interest far more from a practical than from a theoretical point of view.<sup>1</sup> His observations may be classified as follows:

I. The roof of the urethra (when the penis is erect) forms an uninterrupted curve from the fossa navicularis to the bladder.

II. All the variations of calibre, except the fossa navicularis, are produced at the expense of the floor, which is, in consequence, very irregular.<sup>2</sup>

III. The mucous membrane of the roof is more closely adherent to the subjacent structures than that of the floor.

IV. The mucous membrane of the floor of the urethra is much more elastic than that of the roof.

Therefore, not only is the floor of the urethra more irregular than the roof, but its irregularities may be increased with much greater facility by any object introduced into the canal, as well as by disease. In other words, instruments, especially if small and rigid, may, with their points, furrow the floor of the urethra until, finally, they become pocketed (usually in the bulb), and so are brought to a full stop, while an instrument whose point impinges always on the roof avoids these obstructions and glides easily into the bladder. Therefore this eminent French surgeon has termed the roof the surgical wall of the urethra—the wall, namely, which is the guide to the instrument in entering the bladder. That fistulae and false passages always occur in the floor and lateral walls, never (practically) in the roof, and that the orifice of a stricture is usually nearer the roof than the floor—these two facts make the roof the surgical wall in disease even more than in health.

#### THE CURVE OF URETHRAL INSTRUMENTS

From these considerations it follows that *the curve of the urethra is the curve of its roof*. Now the entire anterior urethra is freely movable with the penis, and can be made to assume any curve. Not so the posterior canal. The membranous urethra, bound tightly at its extremities by the two layers of the triangular ligament, is the real fixed point of the urethra, and runs at a distance of from 1 to 2 cm. ( $\frac{2}{8}$  to  $\frac{4}{8}$  inch) below the symphysis pubis. In front of this the bulbous urethra tends slightly upward because of the tension of the suspensory ligament and of the skin and fascia, while a similar elevation is given to the pros-

<sup>1</sup> *Op. cit.*, ii, 309 *et seq.*

<sup>2</sup> Though not absolutely accurate, these two observations are clinically correct.

tatic urethra behind by the pubo-prostatic ligaments and the anterior fibres of the levator ani muscles. Thus is formed the so-called fixed curve of the urethra—not a true fixed curve, for by depression of the bulbous and the prostatic urethra to the level of the membranous portion it can be, and often is, transformed into a straight line, as when a sound is pushed home until its shaft is in line with the patient's body, or when straight metal instruments are introduced. (This latter proceeding, sometimes difficult, often painful, is never absolutely necessary.) The curve varies slightly with different persons, and in the same person at different periods of life, being shorter and sharper in the child, longer in the old man. A distended bladder or an enlarged prostate lengthens the curve.

The proper average curve, as recognised by Sir Charles Bell and insisted on by Sir Henry Thompson—the one which will mathematically accord with the greatest number of urethrae—is that of a circle 8.125 cm. in diameter; and the proper length of arc of such a circle, to represent the subpubic curve, is that subtended by a chord 6.875 cm. long.<sup>1</sup> An instrument made with a short curve of this sort will readily

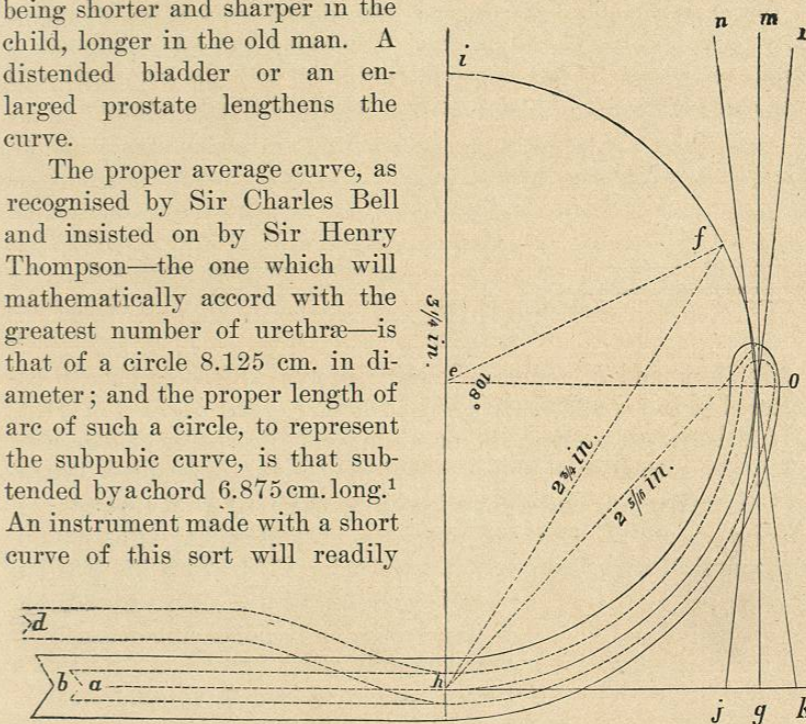


FIG. 6.—Instruments as ordinarily made, with faulty curve, *Oa, Od* (Béniqué). Correctly curved conical instrument, *Ob*. Length of natural curve of urethra, *fOh*. Length of chord of curve of sound, *hO*,  $2\frac{5}{8}$  inches (5.812 cm.).

find its way through the normal urethra into the bladder without the employment of any force. It is very desirable that instruments in-

<sup>1</sup> In the winter of 1852-53, assisted by the late Dr. Isaacs, I made a series of careful experiments upon sections of frozen subjects, as well as by injecting the urethra with numerous substances afterward carefully cutting out the casts. I found the average curve to be identical with the one given above.—VAN BUREN.

tended for habitual use should be so constructed,<sup>1</sup> inasmuch as many of the difficulties of catheterism are due to a defective curve in the instrument employed. The defect most frequently encountered is too great straightness of the last half inch—a deviation of the curve at its most important point. In an instrument properly made (Fig. 6) it will be found that a tangent to the axis of the curve at its extremity will intersect the projected axis of the shaft at a little less than a right angle ( $nkh$ ). If the curve comprised only a quarter of the circle, the tangent would meet the projected shaft at a right angle ( $mgh$ ); but instruments made a little longer, as they are usually found, invariably have the last part of the curve tilted off into a faulty direction, as shown in Fig. 6, making the angle between a tangent to the axis of the curve at this point and the projected axis of the shaft obtuse ( $ljh$ ), and falling within the right angle.

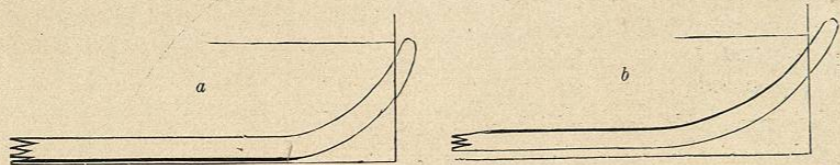


FIG. 7.—FAULTY CURVES.

Fig. 7, *a* and *b*, represent faulty curves, still occasionally encountered in instruments. Fig. 8 shows the correct curve.

It is better to prolong the curve around the circle, and even to slightly decrease that of the terminal quarter of an inch, as instruments so made cling more tenaciously to the roof of the canal, and the point is, for all practical purposes, still at right angles to the shaft, and 4.375 cm. from it. A knowledge of this relative position

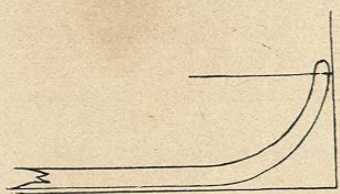


FIG. 8.—PROPER CURVE.

and direction of the point is of great importance in difficult catheterism. A moderately short curve is as good as a long one, provided it is accurate; indeed better, for when the instrument is made with the full length of curve,  $\frac{3}{10}$  of the circle, its point is so far from the shaft that it is sure to wobble when it encounters an obstruction. This objection is all the more applicable to the Béniqué instrument (Fig. 6, *dho*) on account of its having a posterior as well as an anterior curve. This wobbling is not of

<sup>1</sup> An instrument destined for habitual use by the patient is sometimes made half an inch short in the curve, on account of the greater facility of its introduction through the pendulous urethra.

serious importance in the healthy canal, but it is very distracting to the surgeon when a tight stricture is to be entered. Here the short conical point, at right angles to the shaft, is vastly superior on account of steadiness, and is equally certain to follow the urethral curve accurately.

### PHYSIOLOGY OF THE URETHRA

**Sensibility.**—Under normal conditions the sensibility of the anterior urethra is slight, although it is exquisitely sensitive when inflamed. The prostatic urethra is practically insensitive, while the membranous portion of the canal is always somewhat sensitive. Indeed, the first passage of an instrument through this part of the urethra of a nervous individual is attended not only by pain but also by a decided shock. He becomes pale and nauseated, may even faint, if not already in a recumbent position; while the recorded deaths ensuing upon this simple manœuvre, though few, attest its severity. This acute sensibility becomes rapidly deadened, unless the canal is inflamed by repeated soundings, so that after a few repetitions the operation is attended by no shock and but little, if any pain.

This urethral shock is an important element in many cases of so-called urinary fever, yet rarely the sole cause of death, but often contributory by its reflex action upon enfeebled kidneys, and usually tingeing the frankly septic cases with a neurotic element not otherwise to be explained. Moreover, it contributes to the elucidation of the mystery of urethral neuralgia and urethral spasm, and is doubtless concerned in the explanation of the fact that the form of septicemia known as urinary fever, so common after injury to the deeper portions of the canal—namely, the bulbous and the membranous urethra—becomes less and less to be feared the farther forward the injury, and is unheard of when the trauma affects only the balanitic portion of the canal.

**Mobility.**—The muscles of the penis and urethra are thrown into action only during urination or erection and emission, and their functions are therefore more fitly described under these titles. A few words concerning the cut-off muscle may not be amiss in this place. Besides its most important function of preventing the urine from escaping from the bladder by an effort of the will and of cutting off the stream, it presents several interesting physiological characteristics. It has been stated that the urethra in front of the cut-off muscle swarms with bacteria, while all beyond is germ-free. This is so not because the muscle presents an impassable barrier, for

it does not. When violently contracted it doubtless does form an insurmountable barrier to bacterial invasion, but its periods of contraction, like those of the external sphincter ani—to which it bears a close resemblance—are comparatively infrequent and of short duration. Its normal tone, however, is sufficient to make the channel a narrow and difficult one, readily cleansed of any chance invader by the periodical outflow of urine. This irrigation is only of secondary importance, for no infection occurs by this route when the stream of urine is diverted through a suprapubic fistula; but the rapid multiplication of bacteria in the anterior urethra under these circumstances demands an occasional flushing of the canal to check the increase of its prolific population. It is suggestive, moreover, that the cut-off muscle surrounds the most sensitive part of the urethra. Hence the cause of spasm in this muscle, whether acute from some local or general shock, or chronic as a specific evidence of a neurotic habit, is not far to seek.

#### URETHRAL AND SEXUAL HYGIENE

Before passing to the morbid conditions of the urethra its hygiene in health and in disease demands consideration.

In order that the urethra may be in a healthful state, able to get well if diseased, and then to remain well, two points must be observed. They comprise fully the hygiene of the canal. They are:

- (1) That the urine be non-irritating in character.
- (2) That sexual excitability be quieted.

(1) Urine, to be non-irritating, must be normal, faintly acid, or neutral, free from sharp crystals, and not too concentrated. Hence measures tending to bring the fluid to this state are hygienic. These include general hygiene of the skin, stomach, muscles, lungs, etc., but also in many cases (especially where the subject is of gouty habit) certain dietetic precautions. The latter consist in the avoidance of all alcoholic fluids, especially sweet fermented wines and malt liquors. New ale is particularly harmful. All of these substances tend to create sharp crystals of uric acid in the urine as well as to concentrate and acidify it. From this cause alone inflammation of the urethra may spring. Lemon-juice is also somewhat irritating to the urethra, as are, to a mild degree, all the condiments—salt, pepper, mustard—and, it is said, asparagus. In inflamed conditions of the canal, general hygiene prescribes rest.

(2) The quieting of sexual excitability is an object not less important, but far more difficult to accomplish. No part of the body can be in perfect health unless its function is being regularly

and satisfactorily performed. This is seen in stomach, brain, muscle, and excretory duct. For example, when all the urine escapes from the urethra, through a large fistula in the perineum, the fore part of the canal contracts and becomes hyperesthetic.

The urethra, however, only performs the function of a sexual canal at longer or shorter intervals. If there were no erotic fancies, the urethra would never be called upon to participate in the sexual function, and the latter would have no influence over its health or its disease. In the eunuch the hygiene of the urethra undoubtedly does not include the sexual problem.

If, then, the individual be absolutely pure in thought, word, and deed; if he never has or has had an erotic fancy, direct or remote, then his urethra would be a urinary canal, and its hygiene would be simple. But absolute purity is not a common attribute of man, as any one who has the honesty to accept facts must confess, and the rule that every male adult has more or less strong sexual longings and necessities must be admitted. Hence is established the rule, borne out daily and hourly by intelligent study of the parts concerned, both in health and disease, that the urethra is not in the best conditions for health unless the sexual needs are attended to. There is no possible means of accomplishing this result except marriage. Fornication is always irregular, unnatural, often excessive, and therefore is harmful and worse than nothing, looked at merely from a worldly point of view. Masturbation is degrading, and affects the general health of the individual by ruining his *morale*. Nature's safety-valve, involuntary ejaculation during sleep, is inefficient. Marriage only allows healthy, natural, unstimulated sexual relations, and accomplishes the first necessity of urethral hygiene—namely, sexual quietude. Hence the value of marriage as a curative agent in morbid conditions of the urethra, especially if there be any nervous element in the case—an element almost invariably present in some degree.

In all conditions of acute inflammation, sexual intercourse must be, of course, absolutely interdicted. Excessive indulgence is bad at any time, but worst of all is stimulation without relief. This state is, unhappily, a common one among the unmarried men of large cities. Such individuals, looking at suggestive pictures, reading exciting books, taking part in impure conversation, become ripe subjects for nervous disease of an obscure sort, not only of the urethra but of the whole body. In fact, this undue stimulation, without appropriate relief, is far more often the cause of hypochondria, melancholy, and functional perversion, than is the masturbation to which the public generally ascribe it. Nor can such an individual,

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<sup>1</sup> (gonorrhœa of this canal has been noted); and termination of the urethra in the groin.<sup>2</sup> Perkowsky<sup>3</sup> 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 gonorrhœa. He split this subcutaneous canal to the symphysis, where it terminated in a blind pouch. Luxardo<sup>4</sup> describes a gonorrhœal 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 gonorrhœa. E. B. Ward<sup>5</sup> 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<sup>6</sup> has reported several cases similar to Perkowsky's. Le Fort<sup>7</sup> 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

<sup>1</sup> Cruveilhier, *Traité d'anatomie descriptive*, Paris, 1865, vol. ii, fasc. 1.

<sup>2</sup> Haller, quoted by Pitha, *Krankheiten der männlichen Geschlechtsorgane*, 1864.

<sup>3</sup> *Centralbl. f. Chir.*, Nr. 50, 1883, 816.

<sup>4</sup> *L'Union médicale*, No. 54, 1883, 663.

<sup>5</sup> *New York Med. Record*, September 1, 1883, 251.

<sup>6</sup> *Internat. Centralbl. f. d. Phys. u. Path. d. Harn. u. Sex. Org.*, 1892, iii, 327.

<sup>7</sup> *Guyon's Annales*, 1896, xiv, 624, 792, 912, and 1095.