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ORIGINAL COMMUNICATIONS.

**TREATMENT OF CERTAIN VESICAL AFFECTIONS BY
MEANS OF HYDRAULIC DISTENTION.***

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(With six illustrations.)

(The experiments on animals were performed at the Laboratory for Surgical Research at the Harvard Medical School, Boston, Mass.)

THE object of this paper is to show the capacity of the bladder in certain vesical affections, to show the effect of the diminished capacity on symptomology, to show the effect of hydraulic distention in the treatment of diseased conditions. Incidentally, the anatomy of the lower end of the ureter will be discussed, and the results of experiments on animals and human cadavers, for the purpose of throwing light on the question of ureteral reflux will be detailed.

ANATOMY OF THE LOWER END OF THE URETER.

It is generally stated in books that the ureteral canal follows an oblique course through the bladder walls. In order to determine this point, I examined twenty-one cadavers. I found that the canal is not oblique through its entire course in every case. In my dissections I found that the ureteral canal, from

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its entrance at the posterior wall to its termination in the bladder, really consists of two distinct portions, which may be named the submucous or intravesical portion, and the vesical-wall portion. The submucous portion is situated well in the bladder proper. In many instances the submucous portion is decidedly straight, forming with the oblique or vesical-wall portion an obtuse angle, with the base or submucous portion parallel with the mucous membrane of the bladder cavity. The directions of the two portions of the canal are well shown in the accompanying photographs, which were taken from microscopic sections of recent human cadavers (Figs. 1, 2, 3, 4).

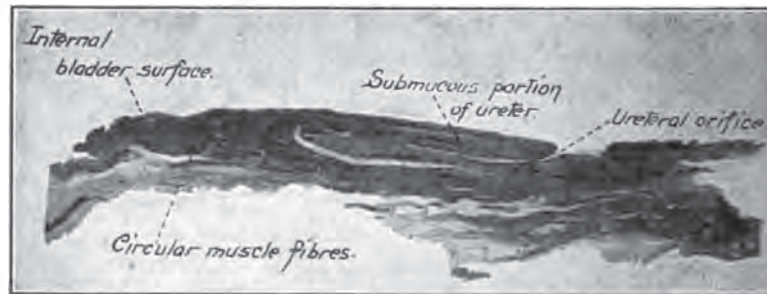


FIG. 1.—Photograph of microscopic slide. Recent cadaver. Showing submucous portion of ureter in the bladder. The canal is straight and parallel with the mucous membrane of the bladder.

In the forty-two ureters examined, the direction of the submucous portion of the canal was as follows:

No. 1	Straight.	No. 22	Straight.
" 2	Straight.	" 23	Straight.
" 3	Straight.	" 24	Straight.
" 4	Straight.	" 25	Straight.
" 5	Oblique.	" 26	Oblique.
" 6	Oblique.	" 27	Straight.
" 7	Oblique.	" 28	Straight.
" 8	Oblique.	" 29	Oblique.
" 9	Oblique.	" 30	Straight.
" 10	Oblique.	" 31	Straight.
" 11	Straight.	" 32	Straight.
" 12	Straight.	" 33	Straight.
" 13	Straight.	" 34	Straight.
" 14	Straight.	" 35	Straight.
" 15	Straight.	" 36	Straight.
" 16	Straight.	" 37	Straight.
" 17	Straight.	" 38	Straight.

No. 18.....Straight.	No. 39.....Straight.
" 19.....Straight.	" 40.....Straight.
" 20.....Straight.	" 41.....Straight.
" 21.....Straight.	" 42.....Straight.

Thus it will be seen that in thirty-four out of forty-two ureters the canal was straight. Only at the uppermost portion of the submucous part of the ureter, near the junction of the vesical-wall portion and the submucous portion, the tissue above the canal begins to get thicker (Fig. 3).

In the submucous portion of the ureter the canal is separated from the bladder cavity by a very thin septum of tissue, averaging, in all the recent cadavers which I examined, from one to two millimeters in thickness. This part is very yielding. In catheterizing the ureter in the living, this yielding character is some-



FIG. 2.—Photograph of microscopic slide. Recent cadaver. Showing submucous portion of ureteral canal. Enlarged.

times very manifest, for the catheter is frequently arrested at the point where the submucous portion and the vesical-wall portion join each other.

The length of the submucous portion of the forty-two ureters which I examined were as follows:

No. 1.....1.5 cm.	No. 22.....1 cm.
" 2.....1.5 cm.	" 23.....1 cm.
" 3.....1 cm.	" 24......75 cm.
" 4.....1 cm.	" 25......75 cm.
" 5.....1.25 cm.	" 26.....1 cm.
" 6.....1.25 cm.	" 27.....1.25 cm.
" 7.....1 cm.	" 28.....1.25 cm.
" 8.....1 cm.	" 29......25 cm.
" 9.....1.25 cm.	" 30.....2.50 cm.
" 10.....1.25 cm.	" 31.....1 cm.
" 11......25 cm.	" 32.....1 cm.

No. 12.....	.25 cm.	No. 33.....	2.25 cm.
" 13.....	1 cm.	" 34.....	2 cm.
" 14.....	1.75 cm.	" 35.....	1.50 cm.
" 15.....	1.25 cm.	" 36.....	.75 cm.
" 16.....	.25 cm.	" 37.....	1.50 cm.
" 17.....	1.50 cm.	" 38.....	2 cm.
" 18.....	1.50 cm.	" 39.....	1.50 cm.
" 19.....	1.50 cm.	" 40.....	.25 cm.
" 20.....	1.50 cm.	" 41.....	1.50 cm.
" 21.....	1 cm.	" 42.....	1.50 cm.

In the above table, the ureters are paired; thus Nos. 1 and 2 are in the same cadaver. It is interesting to observe the discrepancy that exists in the length of the separate ureters in the same cadaver. Thus, in Nos. 29 and 30 there is a marked difference, one being 0.25 cm. in length and the other 2.5 cm.

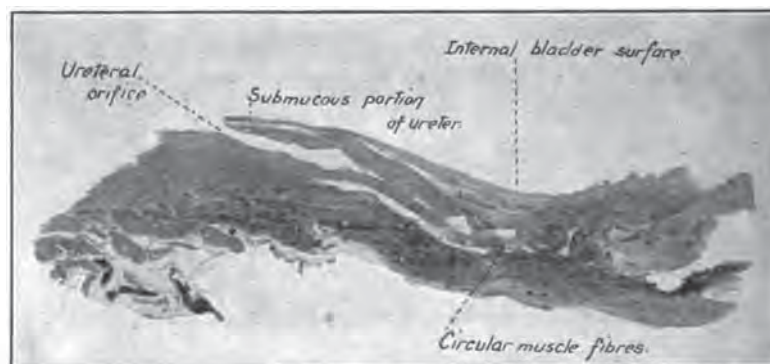


FIG. 3.—Photograph of microscopic slide. Recent cadaver. Submucous portion of ureter. In this case the canal begins to be somewhat oblique a short distance from the ureteral orifice.

The vesical wall portion of the canal is really the important part, both surgically and physiologically. This part of the ureter always courses through the bladder in an oblique direction. Its length was found in forty-two cases to be as follows:

No. 1.....	1 cm.	No. 22.....	1 cm.
" 2.....	1 cm.	" 23.....	1 cm.
" 3.....	1 cm.	" 24.....	1 cm.
" 4.....	1 cm.	" 25.....	.50 cm.
" 5.....	.75 cm.	" 26.....	.50 cm.
" 6.....	1.25 cm.	" 27.....	1.25 cm.
" 7.....	1.5 cm.	" 28.....	1.25 cm.
" 8.....	1.5 cm.	" 29.....	1 cm.
" 9.....	1.25 cm.	" 30.....	1 cm.

No. 10.....1.25 cm.	No. 31......50 cm.
" 11......75 cm.	" 32......50 cm.
" 12.....1 cm.	" 33.....1.25 cm.
" 13.....1.5 cm.	" 34.....1 cm.
" 14.....1.5 cm.	" 35......75 cm.
" 15.....1.5 cm.	" 36......50 cm.
" 16.....1.5 cm.	" 37......75 cm.
" 17.....1 cm.	" 38......75 cm.
" 18.....1 cm.	" 39.....1.50 cm.
" 19......75 cm.	" 40.....1.25 cm.
" 20......75 cm.	" 41......75 cm.
" 21.....1 cm.	" 42......75 cm.

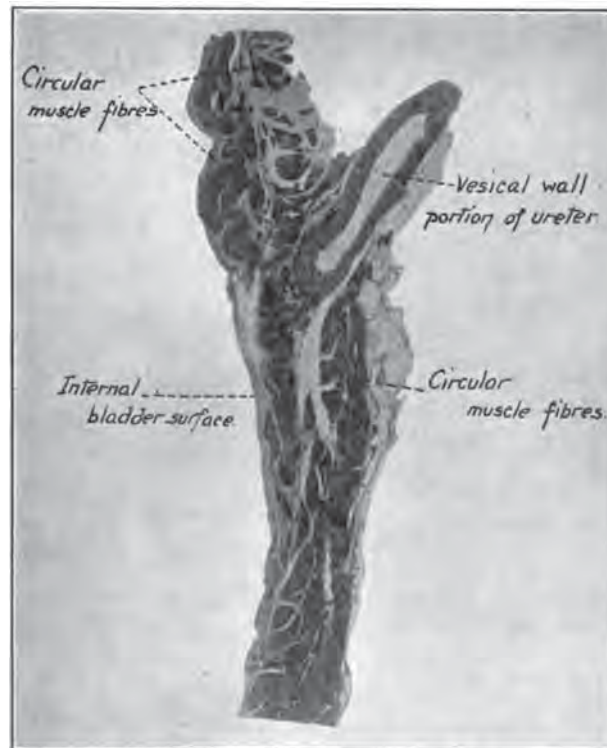


FIG. 4.—Photograph of microscopic slide. Recent cadaver. Showing the vesical wall portion of the ureter. Note the extremely oblique course through the muscular tissue. Note the well-developed circular fibers in front of and behind the ureter.

These measurements have an importance in a surgical sense for they show how dangerous an operation through the bladder on the lower part of the ureter might be, with a short ureteral

canal. In all the text-books on anatomy and genitourinary diseases which I have consulted, to the number of twenty, I find the course of the ureter given as "oblique through the bladder wall." There is one exception, however, and that is Testut (*Traité d'Anatomie Humaine*, Paris, 1901, p. 585) and in his book I was glad to find that his investigations on the ureter and mine agreed in every particular. Testut says: "The ureter traverses the muscular wall in an oblique direction, and it is intimately united to its fibers. When it arrives at the internal surface of the muscular coat, it slips for a short distance between this coat and the mucous membrane of the bladder and enters into the cavity. In its last portion, the ureter is constituted solely by a fold of mucous membrane."

DISSECTION CASES.

1.—Male, thirty. Well developed, 150 pounds. Twelve hours after death. Right ureter: length of submucous portion, 1.5 cm.; length of vesical-wall portion, 1 cm. Direction of canal in submucous portion, straight. Direction of canal in vesical-wall portion, oblique. Thickness of septum between submucous portion of canal and vesical cavity, 2 millimeters. Transverse thickness of bladder wall at exit of ureter, 7 millimeters. Left ureter the same.

2.—Female, forty-five. One hundred and eighty pounds. Twelve hours after death. Right ureter: length of submucous portion, 1 cm. Length of vesical-wall portion, 1 cm. Direction of canal in submucous portion is straight. Direction of canal in vesical-wall portion is oblique. Thickness of septum between submucous portion of canal and vesical cavity, 2 millimeters. Transverse thickness of bladder wall at exit of ureter is 5 millimeters. Left ureter the same.

3.—Male, thirty-four. One hundred and forty pounds. Twelve hours after death. Right ureter: length of submucous portion is 1.25 cm.; length of vesical-wall portion is .75 cm. Direction of canal in submucous portion is oblique. Direction of canal in vesical-wall portion is oblique. Thickness of septum between submucous portion of canal and vesical cavity is 3 millimeters. Transverse thickness of bladder wall at exit of ureter is 6 millimeters. Left ureter is the same except that the vesical-wall portion of the ureteral canal is 1.25 cm.

4.—Male, forty. Two hundred and twenty pounds. Twenty-four hours after death. Right ureter: length of submucous portion is 1 cm.; length of vesical-wall portion is 1.5 cm. Direction of the canal in submucous portion is oblique. Direction of canal in vesical-wall portion is oblique. Thickness of septum between submucous portion of canal and vesical cavity is 1.5 millimeters.

Transverse thickness of bladder wall at exit of ureter, 7 millimeters. Left ureter the same.

5.—Male, forty. One hundred and sixty pounds, well developed. Twenty-four hours after death. Right ureter: length of vesical-wall portion is 1.25 cm. Length of submucous portion is 1.25 cm. Direction of canal in submucous portion is oblique. Direction of canal in the vesical-wall portion is oblique. Thickness of septum between submucous portion of canal and vesical cavity is 2 millimeters. Transverse thickness of bladder wall at exit of ureter is 6 millimeters. Left ureter the same.

6.—Male, forty-five. One hundred and forty pounds. Twenty-four hours after death. Right ureter: length of submucous portion, .25 cm.; length of vesical-wall portion, .75 cm. Direction of canal in submucous portion is straight. Direction of canal in vesical-wall portion is oblique. Thickness of septum between submucous portion and vesical cavity is 2 millimeters. Transverse thickness of vesical wall at exit of ureter, 6 millimeters. Left ureter, the same, except that the length of the submucous portion of the ureter is .25 cm., and length of vesical-wall portion is 1 cm.

7.—Male. One hundred and thirty-five pounds. Twenty-four hours after death. Right ureter: length of submucous portion, 1 cm. Length of vesical-wall portion, 1.5 cm. Direction of canal in vesical-wall portion is oblique. Thickness of septum between submucous portion and vesical cavity is 2 millimeters. Transverse thickness of vesical wall at exit of ureter, 4 millimeters (bladder had been much stretched). Left ureter: length of submucous portion, 1.75 cm.; length of vesical-wall portion, 1.5 cm. Otherwise, the same.

8.—Male. One hundred and seventy pounds. Twelve hours after death. Right ureter: length of submucous portion, 1.25 cm.; length of vesical-wall portion, 1.50 cm. Direction of canal in submucous portion is straight. Direction of canal in vesical-wall portion is oblique. Thickness of septum between submucous portion and vesical cavity is 2 millimeters. Transverse thickness of vesical-wall at exit of ureter, 7 millimeters. Left ureter: length of submucous portion is .25 cm.; length of vesical-wall portion is 1.50 cm. Otherwise the same as right.

9.—Male, twenty-six. One hundred and forty pounds. Twelve hours after death. Right ureter, length of submucous portion, 1.5 cm. Length of vesical-wall portion, 1 cm. Direction of canal in submucous portion is straight. Direction of canal in vesical-wall portion is oblique. Thickness of septum between submucous portion and vesical cavity is 2 millimeters. Transverse thickness of vesical-wall at exit of ureter, 4 millimeters (bladder had been stretched). Left ureter: length of submucous portion, 1.5 cm.; length of vesical-wall portion, 1 cm. Otherwise the same.

10.—Female, sixty. One hundred and forty pounds. Acute myelitis. Right ureter: length of submucous portion, 1.5 cm.;

length of vesical-wall portion, .75 cm. Direction of canal in submucous portion is straight. Direction of canal in vesical-wall portion is oblique. Thickness of septum between submucous portion and vesical cavity is 2 millimeters. Transverse thickness of vesical wall at exit of ureter, .75 cm. Left ureter: length of submucous portion, 1.5 cm.; length of vesical-wall portion, .75 cm. Otherwise the same.

11.—Male, age (?). One hundred and eighty pounds. Recent subject. Right ureter: length of submucous portion, 1 cm.; length of vesical-wall portion, 1 cm. Direction of canal in submucous portion is straight. Direction of canal in vesical-wall portion is oblique. Thickness of septum between submucous portion and vesical cavity is 2 millimeters. Transverse thickness of vesical wall at exit of ureter is 1 cm. Left ureter: length of submucous portion, 1 cm.; length of vesical-wall portion, 1 cm. Otherwise the same.

12.—Male, thirty-five. One hundred and thirty-five pounds. Recent subject. Chronic interstitial nephritis. Right ureter: length of submucous portion, 1 cm. Length of vesical-wall portion, 1 cm. Direction of canal in submucous portion is straight. Direction of canal in vesical-wall portion is oblique. Thickness of septum between submucous portion and vesical cavity is 2 millimeters. Transverse thickness of vesical wall at exit of ureter is 1 cm. Left ureter: length of submucous portion is .75 cm.; length of vesical-wall portion, 1 cm. Otherwise the same.

13.—Female. One hundred and forty pounds. Age (?). Adult. Recent subject. Right ureter: length of submucous portion, .75 cm.; length of vesical-wall portion is .50 cm. Direction of canal in submucous portion is oblique. Direction of canal in vesical-wall portion is oblique. Thickness of septum between submucous portion and vesical cavity is 2 millimeters. Transverse thickness of vesical wall at exit of ureter is .75 cm. Left ureter: length of submucous portion, 1 cm.; length of vesical-wall portion, .50 cm. Otherwise the same.

14.—Female, sixty years. One hundred and sixty pounds. Cardiac. Recent case. Right ureter: length of submucous portion, 1.25 cm.; length of vesical-wall portion, 1.25 cm. Direction of canal in submucous portion is straight. Direction of canal in vesical-wall portion is oblique. Thickness of septum between submucous portion and vesical cavity is 2 millimeters. Transverse thickness of vesical wall at exit of ureter is 1 cm. Left ureter: length of submucous portion, 1.25 cm.; length of vesical-wall portion, 1.25 cm. Otherwise the same.

15.—Male, thirty-five. One hundred and thirty-five pounds. Pneumonia. Recent case. Right ureter: length of submucous portion, .25 cm.; length of vesical-wall portion, 1 cm. Direction of canal in submucous portion is oblique. Direction of canal in vesical-wall portion is oblique. Thickness of septum between submucous portion and vesical cavity is 2 millimeters. Transverse thickness of vesical wall at exit of ureter, 1 cm. Left ureter:

length of submucous portion, 2.50 cm.; length of vesical-wall portion, 1 cm. Direction of canal in submucous portion is straight; direction of canal in vesical-wall portion is oblique.

16.—Female, sixty. One hundred and forty-five pounds. Cardiac. Recent case. Right ureter: length of submucous portion, 1 cm.; length of vesical-wall portion, .50 cm. Direction of canal in submucous portion is straight. Direction of canal in vesical-wall portion is oblique. Thickness of septum between submucous portion and vesical cavity is 2 millimeters. Transverse thickness of vesical wall at exit of ureter is .50 cm. Left ureter: length of submucous portion, 1 cm.; length of vesical-wall portion is .50 cm. Otherwise the same.

17.—Female, forty-eight. One hundred and ten pounds. Exophthalmic goitre. Recent subject. Right ureter: length of submucous portion, 2.25 cm.; length of vesical-wall portion, 1.25 cm. Direction of canal in submucous portion is straight. Direction of canal in vesical-wall portion is oblique. Thickness of septum between submucous portion and vesical cavity is 2 millimeters. Transverse thickness of vesical wall at exit of ureter, 1 cm. Left ureter: length of submucous portion, 2 cm.; length of vesical-wall portion, 1 cm. Otherwise the same.

18.—Female, sixty-five. One hundred and seventy-five pounds. Apoplexy. Recent subject. Right ureter: length of submucous portion, 1.50 cm.; length of vesical-wall portion, .75 cm. Direction of canal in submucous portion is straight. Direction of canal in vesical-wall portion is oblique. Thickness of septum between submucous portion and vesical cavity is 2 millimeters. Transverse thickness of vesical wall at exit of ureter is 1.25 cm. Left ureter: length of submucous portion, .75 cm.; length of vesical-wall portion, .50 cm. Otherwise the same.

19.—Male, forty-five. One hundred and sixty pounds. Fracture of base of skull. Recent subject. Right ureter: length of submucous portion, 1.50 cm.; length of vesical-wall portion, .75 cm. Direction of canal in submucous portion is straight; direction of canal in vesical-wall portion is oblique. Thickness of septum between submucous portion and vesical cavity is 2 millimeters. Transverse thickness of vesical wall at exit of ureter, 1.25 cm. Left ureter: length of submucous portion, 2 cm. Length of vesical-wall portion, .75 cm. Otherwise the same.

20.—Female, sixty. One hundred and sixty pounds. Acute septicemia. Recent subject. Right ureter: length of submucous portion, 1.5 cm.; length of vesical-wall portion, 1.5 cm. Direction of canal in submucous portion is straight. Direction of canal in vesical-wall portion is oblique. Thickness of septum between submucous portion and vesical cavity is 2 millimeters. Transverse thickness of vesical wall at exit of ureter, 1.25 cm. Left ureter: length of submucous portion, .25 cm.; length of vesical-wall portion, 1.25 cm. Otherwise the same.

21.—Male, forty-five. One hundred and thirty pounds.

Cardiac. Recent Subject. Right ureter: length of submucous portion, 1.5 cm.; length of vesical-wall portion, .75 cm. Direction of canal in submucous portion is straight. Direction of canal in vesical-wall portion is oblique. Thickness of septum between submucous portion and vesical cavity is 2 millimeters. Transverse thickness of vesical wall at exit of ureter, 1.25 cm. Left ureter: length of submucous portion, 1.5 cm.; length of vesical-wall portion, .75 cm. Otherwise the same.



FIG. 5.—Photograph of microscopic slide. Recent cadaver. Showing middle or circular layer of muscles of the bladder. Note how the muscles coil around the ureter. Contraction of these muscles would tend to close the canal. From Sabotta (*Human Anatomy*, Phila., 1906. II. p. 122. Fig. 479).

THE MUSCLES OF THE URETER.

The musculature of the ureter, according to Sabotta (*Human Anatomy*, Phil., 1906, vol. ii, p. 123) is independent of that of the bladder. The muscles of the ureter extend down in a longitudinal direction and enter the muscular layers of the bladder and become lost in the muscles of the trigone. Accord-

ing to Kalischer (*Urogenital Muskulatur des Dammes*, Berlin, 1901, p. 151), the musculature of the trigone is not related with the transverse or middle layer of the muscles of the ureter and with the circular muscles of the urethra.

Hallé (*Uréterites et Pyélites*, Paris, 1887, p. 29) agrees in the main with Kalischer. Hallé states that the long ureteral muscle fibers are quite distinct from the muscle fibers of the bladder, and he maintains that they are separated from one another by connective tissue.

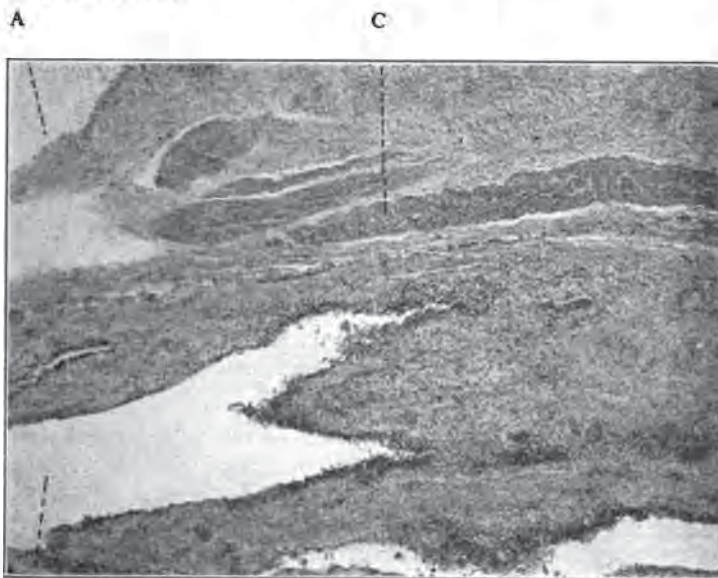


FIG. 6.—Photograph of microscopic slide. Recent cadaver. The longitudinal muscles of the ureter which help to open the orifice. A, Internal bladder surface. B, Ureteral orifice. C, Longitudinal muscle.

The muscles of the bladder wall proper are of three kinds: the longitudinal or external, poorly developed; the middle or circular which are well developed and strong; and there is likewise an internal longitudinal layer which is less developed than the other two.

I wish to call particular attention to the muscles of the bladder along the course of the vesical-wall portion of the ureter. A glance at Fig. 5, taken from Sabotta (*Human Anatomy*, Phila., 1906, p. 122, Fig. 479), shows very well how circular bands of muscle curl around the ureter just below the point of exit from the bladder. It is easy to understand how contraction of these

fibers would close the canal. I have found in my dissections somewhat similar circular fibers situated *directly in front of the ureter* as it courses through the vesical-wall portion. Both the posterior and the anterior circular fibers are well pictured in Figs. 3 and 4, which are photographs of mounted specimens of human bladders. It is easy to see how contraction of these two sets of muscles would firmly close the ureteral canal.

The muscles of the ureteral orifice are of two kinds, those which close the orifice and those which open it. The muscles which close the orifice are the longitudinal muscles which are continued from the sides of the ureter down into the trigone. Longitudinal fibers obliquely placed, running into the trigone, open the orifice. These are seen in Fig. 6.

MECHANISM OF CLOSURE OF THE CANAL.

Much stress has been laid upon the fact that distention of the bladder exerts pressure on the ureteral canal as it courses through the bladder walls, and so prevents reflux. The greater the pressure, the less the chance of reflux. This is undoubtedly the main factor in preventing reflux, because in experimenting with sixteen cadavers under conditions in which muscular contraction could be eliminated, reflux was, in my experiments, absent with but a single exception, and in this case the orifice of the ureter was diseased. Young (*Johns Hopkins Hospital Bulletin*, 1898, lxxxvii, 105) in two cadavers likewise failed to get reflux. Young's experiments were the only ones I could find in the literature. In both my own and in Young's experiments, fluid was forced into the bladder under great pressure.

I believe that the action of the circular muscles, already described, must also have a large part in preventing reflux, and this view is also taken by Guyon (*Mal. des Voies Urinaires*, Paris, 1896, p. 445) who called attention to the posterior circular muscles and commented on their action in preventing reflux. In his experiments on animals, reflux always occurred when these posterior fibers were cut.

As to which portion of the ureteral canal is of more importance with reference to reflux, the submucous or the vesical-wall portion, I cannot definitely say. In some of my dissections the submucous portion was very short (.25 cm.), and it is hard for me to see how such a short canal can be reckoned with in preventing fluids from regurgitating. Again, those who use the cystoscope can testify to the frequent patency, in life, of the ureteral orifice,

even with the bladder filled with liquid. The submucous portion is a lax canal, and this is sometimes plainly manifested on passing a ureteral catheter. On the other hand, with a long submucous portion it is easy to see how internal vesical pressure would approximate the two walls of the ureter and so prevent reflux. With the vesical-wall portion of the ureter it is different. Here we have a tube coursing obliquely in a wall which is fairly rigid, with muscular tissue in front and behind it. Internal vesical pressure must tend to close it. In some of the cadavers which I examined, I passed a probe into the ureter from above, the bladder having been removed from the body and greatly distended with fluid. In all the cadavers which I examined in this way, to the number of five, there was a definite obstacle to the passage of the probe exactly at the point where the ureter courses through the vesical wall. So that it was evident to my mind that the vesical-wall portion of the ureter played a very important part in preventing reflux, even in the cadaver. In life it is reasonable to suppose that the muscles aid toward this end, especially when the bladder is full and there is resulting spasm and presumably muscular action.

REFLUX OF FLUIDS FROM THE BLADDER INTO THE URETER AND RUPTURE OF THE BLADDER.

Reflux in Animals.

Under normal conditions, it is probable that reflux of fluids into the ureter never takes place. In conditions of disease, however, fluids enter with ease. We have at present to do with reflux in conditions of health.

In order to determine the question of ureteral reflux, I experimented upon sixteen dogs.

The technic was simple. The dogs were first etherized and the abdomen was opened by longitudinal and transverse incisions, thus exposing the field. The ureters were then dissected from beneath the peritoneum and cut close to the kidney and the free ends laid upon white gauze at the side of the animal. A catheter was then passed into the urethra and reflux from the bladder was prevented by ligaturing the urethra around the catheter. A solution of methylene blue was then injected into the bladder by means of a fountain syringe. Reflux was easy to observe for the blue at once stained the white gauze. The dogs were full grown and averaged from twelve to thirty pounds in weight.

The dogs were divided into two groups of eight each; in the first group the injection was made rapidly under great pressure at 14 feet elevation; in the second group the injection was made at a gradually increasing elevation of 2, 5, 9, and 14 feet, with a pause of three minutes at each elevation.

With rapid distention of the bladder in the first group of eight dogs, reflux was observed six times, on one side or the other, in the sixteen ureters at an elevation of 14 feet.

With gradual distention, that is, at 2, 5, 9, and 14 feet, respectively, progressing from the low elevation to the high, reflux was observed as follows:

One at 14 feet,
One at 9 feet,
Six at 5 feet,
Three at 2 feet.

In the remaining five ureters there was no reflux. The time elapsing from the beginning of the experiment until the reflux was observed varied from thirty seconds to twelve minutes. The fountain syringe was allowed to remain at each elevation for three minutes. There were thus eleven refluxes in sixteen ureters.

It is interesting to observe that in the sixteen ureters in which distention was gradual, there were only five in which no reflux occurred, while in the other sixteen ureters in which rapid distention was done, there were ten in which no reflux was observed.

Guyon and Coutade (*Bul. Méd.*, Paris, 1894, x, 651) found the following results: Experimenting with thirty-two rabbits they got reflux twenty times. They note that when the bladder was in a state of contraction, reflux was more apt to occur. When the bladder was inert and easily distended, this reflux was less apt to occur. In the dog they got reflux five times in thirty-two cases. They concluded that reflux *never* occurred when the bladder offered no resistance, even when very much distended, and they also concluded that when the bladder was in a state of contraction, reflux was possible. This contraction was measured by 1.5 cm. of mercury in the rabbit and 5 cm. in the dog. These same authors (quoted by F. Guyon, *Leçons Cliniques des Mal. des Voies Urin.*, Paris, 1894, ii, 447) speak of the well-developed muscles which are found behind the ureter as it courses through the bladder wall. They found these fibers well

developed in dogs, and they believe that the contraction of these muscles serves in a great measure to prevent reflux of fluid. They found that when these fibers were cut, reflux was constant,

F. Guyon (*Leçons Clin. sur les Mal. des Voies Urin.*, Paris, 1894, i, 83) injected antiseptically into the bladders of various animals, vegetable charcoal in suspension. The urethra was then occluded. Charcoal was always found in the pelvis of the kidney within 48 hours. Under these circumstances, however, a different mechanism is brought into play.

Sampson (*Johns Hopkins Hospital Bulletin*, 1903, xiv, 343) has experimented with sixteen dogs. He cut the ureter and implanted it in the bladder (seven dogs). Later he injected a colored solution into the bladder, and no reflux was found to occur, either in the ureter which had been implanted or into the opposite one.

H. H. Young (*Johns Hopkins Hospital Bulletin*, 1898, ix, 104) experimented on a small dog with an elevation of 14 feet of water. No reflux occurred.

Lewin and Goldschmidt (*Virch. Archiv.*, 1893, cxxxiv, 48) found reflux both by injecting under pressure and by artificial retention. It always occurred in bladders not greatly distended and still capable of contraction. The number of times is not stated in the article. The authors also found that when the pressure was exerted just after a peristaltic wave in the ureter had reached the bladder, reflux was apt to occur. They noticed this several times (*loc. cit.*, p. 54). The writers used forty animals, but no special statistics are given.

If we may generalize, we may say that reflux is not so apt to occur in animals when the bladder is distended rapidly as when it is distended gradually.

REFLUX IN HUMAN BEINGS.

I have experimented with sixteen cadavers for the purpose of investigating the question of reflux. The technic was simple. Milk or water was forced into the bladder with a Davidson's syringe at a pressure of 3 pounds to the square inch, measured by means of a simple water-gauge. This pressure was kept up for ten minutes in each case. In thirty-one of the ureters there was no reflux; in one only was there reflux, and in this case the ureteral canal from the entrance to the exit into the bladder was diseased. It was very easy to watch the ureters. They were cut a short distance above the entrance to the bladder

and carefully observed during the distention. After watching the ureter for ten minutes the bladder was forcibly distended at a pressure varying from 7 to 10 pounds until it burst. In none of the bladders, with the one exception, was there reflux even under this great pressure. In about half the cadavers the bladder and ureters were removed from the body before the experiment began. This made no difference in the results.

Young (*Johns Hopkins Hospital Bulletin*, 1898, ix, 104) experimented with a cadaver of a male adult. He injected 1,700 c.c. at an elevation of 14 feet. There was no reflux. In another cadaver a similar result was obtained. These experiments are the only ones besides my own that have been performed on human cadavers.

Judging from my experiments on cadavers and from my clinical work, I should say that reflux never occurs in life if the orifices are normal. I have performed dilatation of the bladder many times and I have never seen any ill effects following it, with but three exceptions. The first case was evidently unsuited for this treatment: the patient had a "golf-hole" ureter, and reflux was certain to occur. In this case the bladder was very much contracted and there was a stricture of the ureter. I thought I might, by dilating the bladder, do a ureteral resection later, and I was willing to take the risk of dilatation with this in view. She had a severe colic. In the other two cases there was a very slight hemorrhage following the dilatation, which soon subsided.

I do not believe that even if reflux did take place much harm would result, even if the fluid were germ-laden. The kidney is constantly secreting germs which do not prove to be harmful provided the mucous membrane of the urinary tract is intact. Reflux, of course, occurs sooner or later when there is retention of urine in the bladder due to obstruction. If the urine is germ-laden, infection of the upper passages is certain. But this is an entirely different problem, for here we have continued disturbances in circulation which favor easy infection. It seems to me that the evidence is in favor of the innocuousness of dilatation. If we dilate rapidly, the danger of reflux will be much lessened.

RUPTURE IN ANIMALS.

In order to determine the rupture-point of the bladder, I experimented on sixteen dogs.

The dogs were divided into two groups. In the first group of eight dogs, the bladder was distended gradually at a progressive elevation of 2, 5, 9, and 14 feet. The elevations were for three minutes each. Three bladders ruptured at an elevation of 5 feet, one at 9, three at 14, and in one remaining dog no rupture occurred at 14 feet elevation, but there was a general ooze which came through the peritoneal surface of the bladder. The internal coats were ruptured and the fluid oozed through the peritoneum.

In the other eight dogs, with an elevation of 14 feet from the outset, rupture occurred without exception at a time varying from thirty seconds to two minutes. Males held more than females. One male bladder ruptured at 14 feet with a capacity of 1,200 c.c. In most of the cases the bladder held from 300 to 350 c.c. before bursting. In every case the rent was on the posterior wall and was longitudinal, and from 1 to 4 inches in length.

James (*Edinburgh Medical Journal*, 1878 xxiv, 408) experimented with sixteen sheep. All these bladders were ruptured at an elevation varying from 3 1/2 to 9 feet. The time varied from one minute to eighty minutes. The amount of fluid contained varied from 900 c.c. to 2,000 c.c.

James, in commenting on these results, says that the greater the pressure, the more rapidly the bladder will burst and the smaller the amount of water required. In James' experiments, the bladder burst near the neck.

James' article was a very good one. He called attention (*loc. cit.*, p. 299) to the fact that the strength of the bladder is measured by the diameter. If this is doubled, the strength will be halved; that is, the more the bladder is stretched, the less the wall will be able to withstand internal pressure. James also called attention to the fact that there are really two points to be considered in determining the question of rupture. A bladder which is stretched at once bursts at a certain pressure, whereas one which is stretched gradually and slowly bursts at another pressure. The latter is called proof tenacity, and the former ultimate tenacity. For clinical purposes, the ultimate tenacity is the only one which need be considered.

RUPTURE IN HUMAN BEINGS.

In the sixteen human bladders with which I experimented there were seven females and nine males. The bladders were

injected at a pressure of from three to four pounds for a period of ten minutes. In no instance did rupture occur. The amounts held during this time varied from 500 c.c. to 1,500 c.c., females holding quite as much as males. Then the bladders were rapidly injected until they burst. The amounts held when the bursting took place is as follows:

Females.	Males.
1000 c.c.	1000 c.c.
1200 c.c.	1210 c.c.
1100 c.c.	1710 c.c.
1800 c.c.	1500 c.c.
750 c.c.	1200 c.c.
800 c.c.	1100 c.c.
1800 c.c.	900 c.c.
	1800 c.c.
	1000 c.c.

The point of rupture, its extent and nature, is indicated in the following table:

1. Anterior superior; pinhole; complete.
2. Anterior superior; pinhole; complete.
3. Anterior superior; large rent; complete.
4. Posterior superior, left; large rent; incomplete; inner and middle coats only. Ooze through peritoneum.
5. Anterior lateral, right; 2 cm. in length; complete.
6. Vertex, anteroposterior; 2 cm.; complete.
7. Anterior superior, right; pinhole; complete.
8. Left anterior wall, longitudinal; incomplete; middle and inner coats only. Ooze through peritoneum.
9. Anterior left lateral, longitudinal; incomplete. Middle and inner coats only, 2 cm. Ooze through peritoneum.
10. Anterior right lateral; incomplete. Middle and inner coats only, 2 cm. Ooze through peritoneum.
11. Anterior right lateral; incomplete. Middle and inner coats only, 2 cm. Ooze through peritoneum.
12. Midline posterior wall; middle and inner coats only, 1 cm. Rent below reflection of peritoneum. Ooze in cellular tissue.
13. Anterior upper left wall, 2 cm. Incomplete.
14. Anterior left wall; incomplete; middle and inner coats only, 2 cm. Ooze through peritoneum.
15. Anterior upper right wall, 2 cm.; complete.
16. Anterior lateral upper left wall, longitudinal, 2 cm.; complete.

It will thus be seen that complete rupture occurred nine times, and incomplete, seven times. The rents were, as a rule, small, not over 2 or 3 cm. long. The tear was always jagged and never clear cut.

James experimented with twenty human bladders, but his results are not well tabulated; his technic was also imperfect. Instead of injecting water directly into the bladder, he removed it and put into it a rubber balloon which was injected underneath the bladder walls. Nevertheless, his experiments are interesting: In one case (*loc. cit.*, p. 409) that of a strong boy, with a head of water of 6 feet, the bladder did not burst for seventy-two hours. At the end of that time it contained 480 c.c. It burst at once with a head of 10 feet of water with the same capacity. In another case, that of a strong male, thirty-four years old, the bladder took 1,500 c.c. at once. At a pressure of 4 1/2 feet of water it burst at the end of sixty hours, and its capacity was 2,040 c.c.

Delbet (*Anat. Chir. de la Vesie*, Paris, 1895, p. 7) quotes Bouley (*Thèse de Paris*, 1883, p. 101) who ruptured a human bladder in a cadaver at 1,300 c.c. The same author quotes Duchastelet (*Thèse de Paris*, 1886, p. 24) who ruptured bladders in cadavers with a capacity of from 1,000 to 1,600 c.c. Delbet himself (*loc. cit.*, p. 8) did experiments likewise on cadavers and ruptured the bladders with 1,400 to 2,200 c.c.

Kausch (*Arch. f. klin. Chir.*, Berlin, 1907, lxxxiii, 81), in commenting on the danger of rupturing the bladder, is able to state that no case has been found in literature of rupture of the bladder following dilatation.

Skene (*Diseases of Women*, New York, 1889, p. 752), however speaks of the case of a woman who had long-continued cystitis. She had a habit of wearing a catheter at night. After many years of suffering, dilatation was tried. After the first and only injection, severe pain, collapse, and death followed. At the autopsy a perforation was found at the site where the catheter had lain so many years. The catheter had eroded the bladder. This is the only case of rupture I have been able to find in literature.

I think that if care is used and if the elevation of the water is not too great, there is no danger of bursting the human bladder in life. A safe index of the amount of fluid the patient can stand is, I believe, the sensation of the patient.

Some prefer to use pressure of a head of water. This gives uniform results and the pressure can be regulated. A head of water from 4 to 6 feet is, I am convinced from my experiments, perfectly safe. Under these circumstances, the amount of pressure used is not more than from two to three pounds per square inch. I have exerted this amount of pressure on sixteen

cadavers without ill results. On a delicate boy, eighteen years, who died from progressive muscular atrophy, a pressure of three pounds per square inch, equal to a head of water 6 feet high, was successfully withstood. It required a pressure of ten pounds per square inch to rupture the bladder; this equals a head of water 20 feet high. Young (*Johns Hopkins Hospital Bulletin*, 1898, ix, 107) was also able to get excellent results in dilatation with a head of water 4 feet high. With this head of water, one can do all that is necessary.

EXPERIMENTS TO DETERMINE THE RUPTURE-POINT AND REFLUX IN ANIMALS.

(I think it is not reasonable to draw any positive conclusions from experiments on dogs, with reference to the rupture-point and reflux. The bladders in these little animals are very delicate, far more delicate than those in human beings, and it is astonishing that they could stand as much pressure as they did.)

Experiments to Determine Rupture and Reflux in Animals.

Dog No. 1.—Twenty-five pounds, well-built male. Gradually increasing pressure, 2, 5, 9, 14, feet. Ruptured in 7 minutes; posterior surface of the bladder, longitudinal, 3 inches, 1,200 c.c. No reflux on the left. Reflux on the right.

Dog No. 2.—Twenty-five pounds, female. Gradually increasing pressure, 2 feet. Rupture in six minutes. Rent in summit of the bladder, 550 c.c. Reflux on right side. Reflux on left side.

Dog No. 3.—Fifteen pounds, female. Gradually increasing pressure. General ooze at 5 feet, from the posterior wall of the bladder, 350 c.c. Reflux on right side at 2 feet in three minutes. Reflux on left at 5 feet in four minutes.

Dog No. 4.—Thirteen pounds, female. Gradually increasing pressure. General ooze from the posterior wall at 5 feet, 350 c.c. Reflux on the left at 5 feet. Reflux on the right at 5 feet.

Dog No. 5.—Twenty pounds, female. Gradually increasing pressure. General ooze at 5 feet. No rupture, 500 c.c. No reflux on left at 14 feet. No reflux on right at 14 feet.

Dog No. 6.—Twenty-two pounds, female. Gradually increasing pressure. General ooze at 5 feet. Ruptured at 14 feet, 700 c.c. Reflux on the right at 2 feet. Reflux on the left at 2 feet.

Dog No. 7.—Thirty pounds, female. Gradually increasing pressure. General ooze at 5 feet. Ruptured at 9 feet. Rent longitudinal on posterior wall, 2 inches, 600 c.c. No reflux on left. No reflux on right.

Dog No. 8.—Ten pounds, male. Gradually increasing pressure. Ruptured at 14 feet. Rent in the posterior wall, longitudinal,

3 inches, 300 c.c. Reflux on left at 5 feet. Reflux on right at 9 feet.

Dog No. 9.—Twelve pounds, female. Rapid pressure at 14 feet. Ruptured in 3 seconds. Posterior wall, longitudinal, 3 inches, 350 c.c. Reflux on right. Reflux on left.

Dog No. 10.—Fifteen pounds, female. Rapid pressure at 14 feet. Ruptured in 30 seconds. Posterior surface, longitudinal, 3 inches, 650 c.c. Reflux on the left. Reflux on the right.

Dog No. 11.—Twenty pounds, female. Rapid distention. Ruptured in 30 seconds. Posterior wall, longitudinal, 3 inches, 250 c.c. No reflux on right. No reflux on left.

Dog No. 12.—Twenty pounds, female. Rapid distention, 14 feet. Ruptured in thirty seconds, posterior wall, longitudinal, 3 inches, 400 c.c. Reflux on left. Reflux on right.

Dog No. 13.—Fifteen pounds, male. Rapid distention. Ruptured in ten seconds. Posterior wall, longitudinal, 2 inches, 300 c.c. No reflux on left. No reflux on right.

Dog No. 14.—Twelve pounds, male. Rapid distention at 14 feet. Ruptured in ten seconds. Posterior wall, longitudinal, 2 inches, 350 c.c. No reflux on left. No reflux on right.

Dog No. 15.—Twenty-two pounds, female. Rapid distention at 14 feet. Ooze at the end of 1 minute. Ruptured at the end of 2 minutes. Posterior wall, longitudinal, 2 inches, 850 c.c. No reflux on left. No reflux on right.

Dog No. 16.—Seven pounds, female. Rapid distention. Ruptured in 10 seconds, posterior wall, longitudinal, 3 inches, 200 c.c. No reflux on left. No reflux on right.

EXPERIMENTS TO DETERMINE RUPTURE AND REFLUX IN HUMAN BEINGS.

I performed the following experiments upon sixteen cadavers for the purpose of determining the rupture-point of the bladder:

1.—Male, eighteen. Emaciated. Progressive muscular atrophy. Three pounds' pressure for ten minutes; no rupture. Ten pounds' pressure (20 feet of water); rupture two minutes later. Pinhole opening in the anterior superior part of the bladder. Amount injected, 1,000 c.c. No reflux on either side.

2.—Male, thirty-four. Emaciated. Purulent meningitis. Three pounds' pressure for 10 minutes; no rupture. Eight pounds' pressure for two minutes; rupture. Pinhole opening in the anterior superior part of the bladder. Amount injected, 1,210 c.c. No reflux on either side.

3.—Male, twenty-eight. Robust. Accidental death. Three pounds' pressure for ten minutes; no rupture. Ten pounds' pressure; rupture three minutes later. Large rent in the anterior superior part of the bladder. Amount injected, 1,710 c.c. (600 c.c. injected without rupture at 3 pounds' pressure). No reflux on either side.

4.—Male, twenty-nine. Accidental death (broken neck). Two pounds' pressure ten minutes; no rupture. Eight pounds' pressure; rupture five minutes later. Large rent in posterior superior left part of bladder. Rupture involved inner and middle coats and not peritoneal at all. Ooze through peritoneal. Amount injected, 1,500 c.c. (Amount injected without rupture, 660 c.c., at three pounds' pressure.) No reflux either side at three and five pounds; reflux in left at eight pounds, one or two drops. On opening the bladder it was found that the left ureteral orifice was patulous and that the canal was also patulous. Much injection of eminence. Evidence of ureteritis. Remarks: left ureteral canal diseased, hence reflux.

5.—Female, sixty. Myelitis. Three pounds' pressure, ten minutes; no rupture. Ten pounds' pressure; rupture three minutes later. Rent in anterior lateral wall, 2 cm. Amount injected, 1,000 cm. Amount injected without rupture, 800 cm. at three pounds pressure. No reflux either side at three pounds. No reflux from either side at ten pounds.

6.—Male, age (?). One hundred and eighty pounds. Four pounds' pressure, ten minutes; no rupture. Ten pounds' pressure; rupture four minutes later. Rent in vertex, anteroposterior, 2 cm. Amount injected, 1,100 cm. Amount injected without rupture at four pounds, 900 c.c. No reflux either side at four pounds. No reflux either side at ten pounds.

7.—Male, thirty-five. Chronic interstitial nephritis. Three pounds' pressure, fifteen minutes; no rupture. Eight pounds' pressure; rupture three minutes later. Pinhole rent in anterior upper wall to the right. Amount injected, 1,200 c.c.; at three pounds, 1,050 c.c. No reflux either side at three pounds. No reflux either side at eight pounds.

8.—Female. Adult. Three pounds pressure, ten minutes; no rupture. Ten pounds' pressure; rupture one minute later. Rent in left anterior wall, involving middle and inner coats. No peritoneal rent. Ooze through peritoneum. Amount injected 1,200 c.c. Amount injected at three pounds, 1,110 c.c. No reflux at three pounds. No reflux at ten pounds.

9.—Female, sixty. Cardiac. Four pounds' pressure, ten minutes; no rupture. Ten pounds' pressure; rupture one minute later. Rent in anterior left lateral wall, middle and inner coats only, 2 cm. Ooze through peritoneum. Amount injected, 1,100 c.c. Amount injected at four pounds, 900 c.c. No reflux at four pounds. No reflux at ten pounds.

10.—Male, thirty-five. Pneumonia. Four pounds' pressure ten minutes; no rupture. Ten pounds' pressure, rupture two minutes later. Rent 2 cm. long in anterior right lateral wall. Incomplete. Ooze through peritoneum. Amount injected, 1,100 c.c. Amount injected at four pounds, 600 c.c. No reflux either side at four pounds. No reflux either side at ten pounds.

11.—Female, sixty. Cardiac. Four pounds' pressure; ten minutes; no rupture. Seven pounds' pressure; rupture three

minutes later. Rent in upper right lateral wall, small, incomplete. Ooze through peritoneum. Amount injected, 1,800 c.c. Amount injected without rupture, 1,500 c.c. at four pounds' pressure. No reflux either side at four pounds. No reflux either side at seven pounds.

12.—Female, forty-eight. Exophthalmic goitre. Four pounds' pressure, ten minutes; no rupture. Eight pounds' pressure; rupture a few seconds later. Rent in posterior wall, midline, 1 cm. Rent was below the peritoneal reflection and there was oozing in the cellular tissue. Amount injected, 750 c.c. Amount injected without rupture, 500 c.c. at four pounds. No reflux either side at four pounds. No reflux either side at eight pounds.

13.—Female, sixty-five. Apoplexy. Three pounds' pressure, ten minutes; no rupture. Eight pounds' pressure; rupture three minutes later. Rent in anterior wall to left, high up, 2 cm. Amount injected, 800 c.c. Amount injected without rupture, 600 c.c. at three pounds' pressure. No reflux either side at three pounds. No reflux either side at eight pounds.

14.—Male, forty-five. Fracture of base of skull. Three pounds' pressure, ten minutes; no rupture. Eight pounds' pressure; rupture two minutes later. Rent in anterior left wall high up, 2 cm. Incomplete. Ooze through peritoneum. Amount injected, 1,800 c.c. Amount injected without rupture, 1,500 c.c. at three pounds' pressure. No reflux at three pounds. No reflux at eight pounds.

15.—Female, sixty. Acute septicemia. Three pounds' pressure, ten minutes; no rupture. Eight pounds' pressure, rupture three minutes later. Rent anterior lateral wall, 2 cm. Amount injected, 1,800 c.c. Amount injected without rupture, 1,200 c.c. at three pounds' pressure. No reflux either side at three pounds. No reflux either side at eight pounds.

16.—Male, forty-five. Cardiac. Four pounds' pressure, ten minutes; no rupture. Eight pounds' pressure; rupture four minutes later. Rent anterior lateral wall, left, 2 cm. Longitudinal. Amount injected, 900 c.c. Amount injected without rupture, 700 c.c. at four pounds' pressure. No reflux either side at four pounds. No reflux either side at eight pounds.

THE TREATMENT OF CERTAIN VESICAL AFFECTIONS BY HYDRAULIC DISTENTION; AND CAPACITY OF THE BLADDER IN HEALTH AND DISEASE.

Technic.

As a preliminary to this treatment, cystoscopy should always be performed.

To dilate the bladder, the patient may be placed in the dorsal position or, as Sinclair (*Medical Chronicle*, Manchester, 1894, ii, N. S. 83) advises, the side position. I think the latter an excel-

lent one, because, by using it, the pressure of the abdominal contents is avoided. The bladder is first emptied and washed out with a 2 per cent. solution of boric acid; then about 3 drams of a 5 per cent. solution of cocaine are injected into the bladder and urethra and left there for three minutes. The cocaine is then washed out. A fairly firm rubber catheter of large bore is then passed into the bladder, and with a Davidson syringe a 2 per cent. solution of boric acid is forced into the bladder rather quickly. Reflux through the urethra along the catheter may be prevented by inserting the finger into the vagina at the side of the catheter in the vicinity of the vesical neck and making fairly firm pressure against it. When the patient begins to complain of pain, the injection should cease temporarily. When the bladder has accustomed itself to the fluid within it, the pain ceases and another syringeful may be forced in. This may be repeated at intervals of half a minute or so until the patient declares that she can stand no more. Usually she will endure the treatment five minutes.

Pressure with a syringe is intermittent, at least in cadavers, for I found that after a syringeful of liquid had been injected there was an immediate rise, as registered by a water gauge; after a brief pause, the pressure dropped almost to zero. I suppose this is due to the elasticity of the walls which allows of accommodation by expansion. With steady pressure by a column of water the pressure is continuous, and many prefer this method of dilating. The technic is simple, all that is required being a fountain syringe and a catheter. A head of water from 4 to 6 feet is safe.

A modification of the technic is proposed by Janet (*Ann. des Mal. des Org. Gén.-Urin.*, Paris, 1895, xiii, 138). Janet dilates the bladder to its utmost, and the patient is desired to hold the water as long as possible.

The treatment should be given at intervals of 3 or 4 days, but in a bad case it might be advisable to give the treatment every day at first. Dilatation should not be done in a bladder in which there is a "golf-hole" ureter, one in which there are deep ulcers or in which there are deep loculi. Frequent cystoscopic examination of the bladder should be made in order to see that no harm is being done. With this precaution, the treatment is devoid of danger. Occasionally, after long treatment of two or three months, there may be some tendency to loculation of the bladder between the muscle fasciculi. This takes place usually on the

sides of the bladder. In bladders contracted by disease this loculation does not occur. When it does happen it has no significance.

PERSONAL CASES.

Incontinence.

1.—Female, twenty-six. Duration ten years. Bladder normal in every way. Diagnosis: incontinence, retroflexion. Capacity without cocaine, 180 c.c.; with cocaine, 360 c.c. Dilated three times up to 360 c.c. Result, no benefit.

Neurasthenia.

2.—Female, twenty-five. Duration six months. Urination twelve times a day, twice at night. No bladder lesions. Diagnosis: neurasthenia. Capacity without cocaine, 480 c.c.; with cocaine, 660 c.c. Dilated six times at intervals of four days up to 810 c.c. At the end of this time she was perfectly well with reference to her bladder symptoms. Urination three times a day; none at night.

Vesical Hyperemia.

3.—Female, forty-two. Duration one year. Vesical neck and trigone very much reddened. Hyperemia of the vesical neck and trigone, also of the posterior wall of the bladder. Lacerated cervix and perineum and prolapse. Capacity without cocaine, 450 c.c.; with cocaine, 540 c.c. A recent case.

4.—Female, forty-six. Duration four years. Urination twelve times a day, two or three times at night. Intense redness of the vesical neck and trigone. Right floating kidney. Lacerated cervix and perineum, retroversion, endometritis. Separation of the recti. Capacity without cocaine, 240 c.c.; with cocaine, 480 c.c. Dilated seven times at intervals of four days up to 540 c.c. Patient very comfortable. Urination five or six times a day, not at all at night.

5.—Female, twenty-seven. Duration 4 years. Urination eight times a day, five times at night. Intense redness of the vesical neck and trigone. Diagnosis: hyperemia of the vesical neck and trigone, lacerated cervix and perineum, left salpingitis. Capacity without cocaine, 480 c.c.; with cocaine, 570 c.c. Dilated only once. Disappeared.

6.—Female, thirty-six. Duration six weeks. Intense redness of the vesical neck and trigone. Diagnosis: hyperemia of the vesical neck and trigone, lacerated cervix and perineum. Capacity without cocaine, 420 c.c. No dilatation. Disappeared.

7.—Female, forty-nine. Duration two years. Urination twenty to thirty times a day. Once at night. A few patches of redness on the posterior wall. Intense redness of the vesical neck and trigone. Diagnosis: hyperemia of the vesical neck and trigone and of the bladder, antelexion. Capacity without co-

caine, 300 c.c.; with cocainine, 360 c.c. Dated six times at intervals of four days up to 750 c.c. Result, well. Urinates four times a day; not at all at night. Great relief.

8.—Female, thirty-seven. Duration seven years. Urination six times a day, eight times at night. Intervals when she urinated less frequently. Intense congestion of the trigone and vesical neck. Diagnosis: hyperemia of the vesical neck and trigone and of the bladder, double salpingitis. Capacity without cocaine, 720 c.c.; with cocaine, 780 c.c. Dilated three times at intervals of four days up to 810 c.c. Great improvement. Urinates six times a day; not at all at night. Feels very much better.

7.—Female, forty-two. Always had irritable bladder from childhood. Urination twelve times a day, three times by night. Intense redness of the vesical neck and trigone. Diagnosis: hyperemia of the vesical neck and trigone, retroversion. Capacity without cocaine, 180 c.c. No dilatation. In this case the bladder was small from childhood. Never could hold urine very long.

10.—Female, thirty-nine. Duration one year. Urination six to twelve times a day, two to four times at night. Slight redness of the vesical neck and trigone. Double pyelitis, chronic metritis. Capacity without cocaine, 240 c.c.; with cocaine, 300 c.c. No dilatation.

11.—Female, forty-six. Duration six weeks. Urinates ten times by day, once at night. Redness of the vesical neck and trigone, and bladder wall. Diagnosis: hyperemia of the vesical neck and trigone, anteflexion. Capacity without cocaine, 360 c.c.; with cocaine, 480 c.c. Dilated four times at intervals of one week up to 500 c.c. Urination three or four times a day, not at all at night.

12.—Female, forty-three. Duration one year. Urination fifteen times a day, twice at night. Redness of the vesical neck and trigone. Diagnosis: hyperemia of the vesical neck and trigone. Capacity without cocaine, 400 c.c. Dilated twice up to 600 c.c. Much better, urination six times a day, twice at night. Less irritability.

13.—Female, twenty-three. Duration twenty years, at intervals. Urination twelve times by day, total incontinence by night. Redness of the vesical neck and trigone. Diagnosis: hyperemia of the vesical neck and trigone, incontinence, occasional retention (probably hysterical). Capacity without cocaine, 480 c.c.; with cocaine, 570 c.c. Recent case.

14.—Female, thirty-five. Duration one month. Urinates six times by day, twice by night. Redness of the vesical neck and trigone. Two large patches on the posterior wall. Diagnosis: hyperemia of the vesical neck and trigone and posterior wall, right salpingitis. Capacity without cocaine, 150 c.c.; with cocaine, 240 c.c. No dilatation. Disappeared.

15.—Female, forty. Frequent urination for fifteen years. Redness of the vesical neck and trigone. Diagnosis: hyperemia

of the vesical neck and trigone, lacerated cervix and perineum, rectocele, prolapse. Capacity without cocaine, 480 c.c.. Recent case.

Acute Cystitis.

16.—Female, sixty-five. Duration two months. Urinates twenty to thirty times a day, four times at night. (No cystoscopy). Diagnosis: acute cystitis. Capacity without cocaine, 240 c.c.

17.—Female, forty-one. Duration six weeks. Urination ten to twenty times a day, four or five times at night. (No cystoscopy.) Diagnosis: acute cystitis, appendiceal abscess, salpingitis. Capacity without cocaine, 270 c.c.; with cocaine, 330 c.c. Recent case.

Chronic Nontubercular Cystitis.

18.—Female, thirty-nine. Duration eight months. Urinates twelve times a day, once or twice at night. Patches of redness on the bladder wall. Diagnosis: chronic cystitis, right floating kidney. Capacity without cocaine, 480 c.c.; with cocaine, 490 c.c. No dilatation. Disappeared.

19.—Female, twenty-two. Duration four years. Urination forty times a day, twenty times at night. Capacity of bladder very small, 90 c.c. with ether. Diffuse redness, numerous ulcers, cicatrices of bladder. Diagnosis: chronic cystitis with thickening, right suppurative nephritis, ureteritis, nephrectomy. No dilatation. Two years later, urination six times a day and three times at night. This bladder dilated itself.

20.—Female, twenty-nine. Duration eight years. Urination ten to twelve times a day, the same at night. Intense congestion of the entire vesical mucous membrane. Scars, superficial ulcers. Diagnosis: chronic cystitis. Capacity without cocaine, 210 c.c.; with cocaine, 360 c.c. Cystotomy. Result unknown.

21.—Female, thirty. Duration four months. Intense congestion of the vesical neck and trigone. A few patches on the posterior wall. Diagnosis: cystitis. Capacity, without cocaine, 270 c.c.; with cocaine, 300 c.c. Dilated four times at intervals of four days up to 390 c.c. At the end of this time no bladder symptoms. Urination four times a day. Not at all at night.

22.—Female, fifty-two. Duration six years. Incontinence. Patches on the posterior wall. Diagnosis: left pyelitis, incontinence, cystitis. Capacity without cocaine, 300 c.c.; with cocaine, 350 c.c. No dilatation. Disappeared.

23.—Female, twenty-seven. Duration thirteen years. Urination twenty to thirty times a day, eight times at night. Intense congestion of the bladder wall. Diagnosis: stricture of the right ureter, suppurative nephritis on the right, pyelitis on left, cystitis. Capacity without cocaine, 150 c.c.; with cocaine, 200 c.c.

24.—Female, fifty. Duration three years. Urination eight

to ten times a day, once at night. Universal redness of the bladder wall, superficial ulcerations. Diagnosis: right pyelitis, cystitis. Capacity without cocaine, 390 c.c.; with cocaine, 450 c.c. No dilatation.

25.—Female, thirty-six. Duration two years. Urination eighteen times a day, three times at night. Redness of the bladder and trigone. Diagnosis: cystitis, right floating kidney. Capacity without cocaine, 315 c.c.; with cocaine, 325 c.c. Dilated twice at four days' intervals up to 450 c.c. Greatly relieved. Urinates ten times a day, once at night. Less irritability. Recent case.

26.—Female, sixty. Duration one year. Urination ten to twenty times a day, six times at night. Intense congestion of the whole bladder. Superficial ulcers. Patches, redness. Diagnosis: chronic cystitis. Capacity without cocaine, 180 c.c. Cystotomy. Result unknown.

27.—Female, thirty-one. Duration two years. Urination ten times a day, eight times at night. Intense redness of the trigone and vesical neck. Bladder wall hyperemic. Diagnosis: cystitis, left salpingitis. Capacity without cocaine, 360 c.c.; with cocaine, 420 c.c.

28.—Female, forty-two. Duration five years. Urination twenty times a day, ten times at night. Intense congestion of the vesical neck and trigone. Diffuse redness of the bladder wall. Slight superficial ulcers, bleeding easily. Diagnosis: cystitis. Capacity without cocaine, 150 c.c.; with cocaine, 210 c.c.

29.—Female, twenty-nine. Duration three years. Urination six times a day, seven times at night. Universal redness. Superficial ulcers. Left ureteral orifice shaggy and roughened. Diagnosis: cystitis, stricture of left ureter, double pyelitis, double ureteritis. Capacity without cocaine, 260 c.c.; with cocaine, 300 c.c. Dilated four times at intervals of a week up to 390 c.c. Stricture also dilated. Marked improvement at once. Urination three times a day and twice at night.

30.—Female, twenty-nine. Duration five years. Urination forty times a day, twenty times at night. Universal redness with patches of greater redness. Superficial ulcers. "Golf-hole" ureter, left. Diagnosis: cystitis (gonorrhea), stricture of the left ureter, right movable kidney, double salpingitis, retroversion. Capacity without cocaine, 45 c.c.; with cocaine, 90 c.c. Dilated once. Severe renal colic followed, lasting twenty-four hours. Now in hospital.

31.—Female, thirty-four. Duration six months. Urination twelve to twenty times a day, six times at night. Bladder universally injected. Diagnosis: cystitis, right pyelitis. Capacity without cocaine, 120 c.c. Dilated twelve times at intervals of a week up to 240 c.c. Much relief. Urination six times a day and the same number of times at night.

32.—Female, forty-five. Duration one year. Urination

twelve times a day, twelve times at night. Intense vesical congestion. Patches of bright redness. Superficial ulcers. "Golf-hole" left ureter. Diagnosis: chronic cystitis, suppurative nephritis. Capacity without cocaine, 90 c.c.; with cocaine, 90 c.c. Nephrectomy. Attempted dilatation once, but pain was severe. Still in hospital.

33.—Female, fifty-two. Duration thirty-four years. Constant irritability of the bladder. Urination twenty to thirty times by day, eight to ten times by night. Intervals of less frequency. General injection of the bladder, with superficial ulcers at first; later congestion only. Diagnosis: chronic cystitis, right floating kidney. Capacity without cocaine, 360 c.c. Cystotomy for five years. Closure of fistula. Still suffering.

34.—Female, twenty. Duration four years. Urination twenty times by day, twice by night. A large red patch upon the trigone on the right. Intense injection of trigone and vesical neck. Diagnosis: cystitis, retroversion. Capacity without cocaine, 150 c.c. Dilated three times at intervals of four days up to 450 c.c. Greatly relieved. Urination ten times by day, once at night. Disappeared.

35.—Female, forty-one. Duration seventeen years. Urination ten to fifteen times a day, three or four times at night. Intense congestion of the bladder with superficial ulcers. Diagnosis: chronic cystitis, stricture of both ureters. Capacity without cocaine, 240 c.c.; died after nephrectomy.

36.—Female, forty. Duration three years. Slight injection of the bladder. Diagnosis: chronic cystitis, double pyelitis, calculus of the right ureter, double pyonephrosis. Capacity one year after the second nephrectomy 720 c.c., notwithstanding chronic cystitis for two or three years.

37.—Female, forty-two. Duration eight years. Urination twelve to twenty times a day, once to three times at night. Intense congestion of the trigone, vesical neck and ulcers about the left ureteral orifice. Diagnosis: cystitis, stricture of the left ureter, ureteritis, left salpingitis. Capacity, without cocaine, 480 c.c., with cocaine, 480 c.c. Dilated seven times at intervals of a week up to 500 c.c. Stricture also dilated. Urination five times a day and once at night. Much improved.

38.—Female, forty-eight. Duration ten years. Urination twenty times a day, ten times at night. Universal injection, scars, ulcers. Diagnosis: cystitis, suppurative nephritis. Capacity without cocaine, 150 c.c. Cystotomy ten years ago.

39.—Female, fifty-five. Duration seven years. Urination thirty to forty times a day, twelve times at night. Intense congestion of the whole bladder, with patches of greater redness. No ulcers. Diagnosis: chronic cystitis, double pyelitis. Capacity, without ether, 90 c.c. With ether 390 c.c. Declines treatment. This case shows the effect of spasm in diminishing the size of the bladder.

40.—Female, thirty-three. Duration one year. Urination

twenty to thirty times a day. Small patch on the right wall of the bladder. Diagnosis: cystitis, right floating kidney. Capacity without cocaine, 330 c.c.; with cocaine, 570 c.c.

Exfoliative Cystitis.

41.—Female, thirty-three. Frequent urination, every fifteen minutes. Incontinence. These symptoms succeeded the passage of the entire mucous membrane. Capacity without cocaine, 90 c.c. Lost sight of.

Papilloma of the Bladder.

42.—Female, twenty-seven. Duration five years. Retention alternating with frequency. Rosetted papilloma around the vesical orifice in the bladder. Capacity, 300 c.c.

Carcinoma.

43.—Female, sixty-two. Frequent micturition, five months. Carcinoma of the bladder. Capacity, 90 c.c.

Inhibition of Vesical Contraction.

44.—Female, forty-six. Retention at times for eight months. Urination twice a day. Capacity without cocaine, 480 c.c.

Hysterical Retention.

45.—Female, twenty-nine. Retention, alternating with incontinence. Capacity, 1,200 c.c.

46.—Female, twenty-three. Duration four years. Retention at times, hysterical. Capacity, 1,800 without cocaine.

Normal Bladders.

47.—Female, sixty. Duration twelve years. Urination three or four times a day. Bladder normal. Capacity without cocaine, 270 c.c.

48.—Female, twenty-nine. Just after child-birth. Urination three or four times a day. Capacity, without cocaine, 600 c.c.; with cocaine, 870 c.c.

49.—Female, fifty-six. Normal bladder. Urination three or four times a day. Capacity without cocaine, 750 c.c.

50.—Female, forty-seven. Normal bladder. Urination three or four times a day. Capacity without cocaine, 330 c.c.; with cocaine, 390 c.c.

51.—Female, fifty-six. Normal bladder. Urination three or four times a day. Capacity without cocaine, 330 c.c.; with cocaine, 420 c.c.

52.—Female, thirty. Normal bladder. Urination three or four times a day. Capacity without cocaine, 240 c.c.; with cocaine, 300 c.c.

53.—Female, forty-seven. Normal bladder. Urination three or four times a day. Capacity without cocaine, 540 c.c.

54.—Female, sixty-four. Normal bladder, urination four or five times a day. Capacity, 330 c.c.

CASES IN LITERATURE.

Atony of the Bladder.

55.—H. H. Young (*Johns Hopkins Hospital Bulletin*, 1898, ix, 107). Male, forty-six. Urination every fifteen minutes. Syphilis of the cord; paraplegia, paralysis of the bladder with contraction. Capacity without anesthetic, 65 c.c. Dilated in two days to 120 c.c. Urination at the end of this time, four times a day. In one month dilated to 435 c.c., with daily dilatation. Several months later, capacity 435 c.c., and urination once in four hours.

Congenitally Small Bladders.

56.—Sinclair (*Medical Chronicle*, Manchester, 1894, ii, N. S. 82). Female, twenty-nine. Frequent micturition. Contracted bladder. No disease. No inflammation. Capacity, 60 c.c. Dilated daily and in a month capacity was 660 c.c. In six months there was a relapse and the treatment was resumed and cure followed.

Incontinence.

57.—Sims, H. M. (*AMER. JOUR. OBST.*, 1889, xxii, 918). Female, seventeen. Troubled from infancy. Urination forty to fifty times a day. Incontinence at night. Capacity 50 c.c. Daily distention with a Davidson syringe. In two months held 360 c.c. Incontinence ceased. Later held 540 c.c., with occasional incontinence at night. Three months later she was cured. Sims explains this case as follows: "There was infantile neglect to properly empty the bladder when nature demanded. This continued neglect of Nature's call resulted in the bladder becoming so reduced in size and capacity that it could scarcely contain any water at all."

58.—Sims, H. M. (*AMER. JOUR. OBST.*, 1889, xxii, 921). Female, eighteen. Suffered from infancy. Urine normal. Incontinence at night. Bladder capacity, 30 c.c. Dilated in a short time up to 180 c.c. In eight weeks capacity was 360 c.c., and later the bladder was stretched to 636 c.c. The patient was then pronounced well.

59.—Sims, H. M. (*AMER. JOUR. OBST.*, 1889, xxii, 921). Female, thirteen. Suffered from infancy. Incontinence. Bladder capacity 20 c.c. Dilated daily and in five months bladder held 540 c.c.

Spasm of Muscles of the Bladder.

60.—Janet (*Ann. des Mal. des Org. G'n.-Urin.*, 1895, xiii, 138). Female, forty-eight. Family history of nervous troubles. Incontinence up to six years of age. At thirty-three years began to urinate frequently. Urine clear. Capacity, 100 c.c. At the end of twenty-six treatments was well. Dilatation daily at first, then every two days, then twice a week, then every week.

Dilated up to 600 c.c. The fluid was retained a quarter of an hour at first, then half an hour, then two hours. At the end of treatment urinated four times a day and once at night. (This case appears to me to be one of hyperemia of the vesical neck with subsequent spasm of the muscles. Janet's technic deserves trial. The bladder is filled with liquid and it is allowed to remain there as long as the patient can hold it.)

61.—Strong (*Boston Medical and Surgical Journal*, 1890, cxxiii, 53). Female, twenty-two. Frequent urination for five years. Urination every twenty minutes day and night. No inflammatory disease of the bladder. Retroflexion. Capacity a few ounces. Gradual dilatation with instructions to retain. Seven months later much better. Urination three or four times a day and once at night. (Strong thought that the cause of this condition was continued irritation resulting in spasm of the muscles and hence contracted bladder. He also thought that the case showed the influence of habit.)

Chronic Cystitis.

62.—Brown (*Johns Hopkins Hospital Reports*, 1901, x, 74). Female, twenty-three. Duration two years. Cystitis. Ulcers. Bladder dilated. Some improvement after several months.

63.—Brown (*Johns Hopkins Hospital Reports*, 1901, x, 75). Female adult. Duration ten years. Contracted bladder with ulcers. Bladder dilated. In three months bladder held 400 c.c. Patient was cured. No recurrence in three months.

64.—Brown (*Johns Hopkins Hospital Reports*, 1901, x, 75). Female, fifty-five. Chronic cystitis. Contracted bladder with ulcers. Cured in two months' treatment. Dilatation. Capacity not stated.

65.—Mahé (*Occidental Medical Times*, Sacramento, 1890, iv, 359). Male, twenty-seven. Cystitis. Rapid distention tried with success. After the first treatment there was profuse hemorrhage from the neck of the bladder. The patient was cured at the end of ten treatments. Mild solutions used.

66.—Skene (*Diseases of Women*, New York, 1889, p. 752). Female adult. Chronic cystitis and contracted bladder. She was in the habit of wearing a catheter at night for years. At the end of this time the bladder was dilated once. Peritonitis and death followed. At the autopsy a hole was found in the bladder, evidently where the catheter had eroded the membrane. The muscle walls were over half an inch thick.

67.—Brown (*Johns Hopkins Hospital Reports*, 1901, x, 73). Female, sixty-five. Cystitis, eleven years. Ulcers. Capacity 60 c.c. at first. Dilated to 300 c.c. Many ulcers healed. Doing well.

68.—Brown (*Johns Hopkins Hospital Reports*, 1901, x, 73). Female, sixty-five. Cystitis four months. General inflammation, some ulcers. Bladder dilated daily. Treatment for thirty

days. Capacity at first, 200 c.c.; at the end of the treatment, 750 c.c.

69.—Brown (*Johns Hopkins Hospital Reports*, 1901, x, 74). Female. Duration two years. Cystitis. Capacity of bladder 100 c.c. Dilated up to 400 c.c. Marked improvement.

70.—Brown (*Johns Hopkins Hospital Reports*, 1901, x, 76). Female, cystitis. Capacity at first, 65 c.c. Later held 550 c.c. Treatment by dilatation. Cured.

71.—Robson (*British Gynecological Journal*, London, 1895-6, xi, 195). Female, thirty. Complete incontinence for twelve years. Examination showed no bladder cavity. Urine alkaline. Under ether the bladder was scraped of phosphates. Later ether was again given and the bladder was dilated to 60 c.c. She was then told to hold her water, and at the end of three months could hold 210 c.c. for six hours.

72.—Sims (*AMER. JOUR. OBST.*, 1889, xxii, 922). Female, sixty. Cystitis for several years. Urinates thirty times at night, every few minutes by day. Capacity 30 c.c. Dilated to 360 c.c. in six weeks by daily dilatation. At the end of three months held 660 c.c. Urination then was four times a day. Patient well.

73.—Stone (*Atlanta Medical and Surgical Journal*, 1889-90, N. S. vi, 657). Male, thirty-eight. Chronic cystitis, three years. Contracted bladder. Lumbar nephrotomy. Died. Bladder held 30 c.c.

74.—Stone (*Atlanta Medical and Surgical Journal*, 1889-90, N. S. vi, 658). Male, seventy-five. Dilated from 90 c.c. to 180 c.c.

75.—Young (*Johns Hopkins Hospital Bulletin*, 1898, ix, 104). Male, thirty-two. Duration ten months. Urination twenty times a day. Capacity 100 c.c. In one month daily dilatation raised capacity to 500 c.c. with urination every four hours.

76.—Young (*Johns Hopkins Hospital Bulletin*, 1898, ix, 103). Male, forty. Urination every ten or fifteen minutes. Duration two years. Capacity, 30 c.c. Bladder dilated with a head of 4 feet of water every four hours daily. Capacity raised to 365 c.c. in four months. At the end of this time urination every four to six hours at night. Comfortable during the day. Health good.

77.—Young (*Johns Hopkins Hospital Bulletin*, 1898, ix, 101). Male, sixty-five. Cystitis, twenty years. Capacity, 30 c.c. Daily dilatation. Dilated up to 290 c.c. Contractile power did not return. Had a residual of 60 to 100 c.c.

78.—Young (*Johns Hopkins Hospital Bulletin*, 1898, ix, 102). Male, forty-one. Cystitis ten years. Urination every ten or fifteen minutes. Capacity 40 c.c. Dilated four times a day. At the end of three weeks capacity was 130 c.c. and urination every two and one-half hours.

79.—Young (*Johns Hopkins Hospital Bulletin*, 1898, ix, 101). Adult male. Urination forty-eight times a day. Capacity, 40 c.c. In ten days capacity 150 c.c. Urination not so frequent.

80.—Rothschild (*Deutsch. med. Woch.*, 1901, xxvii, 86). Female, twenty-eight. In 1894, acute cystitis. In 1895, cystitis again. Sick until 1899. Incontinence. Bladder felt as a hard body behind the pubes. Capacity, 10 c.c. Daily dilatation. In two weeks, 50 c.c. At the end of several months capacity 90 c.c. Very much more comfortable.

81.—Cullen (*Johns Hopkins Hospital Bulletin*, 1898, ix, 110). Female, cystitis. Dilatation eight times. Dilated from 160 to 240 c.c. Result not stated.

I was surprised on looking over the cases in literature to find that there were several in which incontinence was associated with contracted condition of the bladder. Sims explains this on the assumption that in childhood there had been a neglect to properly train the bladder, and that as a consequence of this neglect the bladder had become reduced in size. This seems to me not to be the true cause. It is my belief that incontinence in childhood is always the result of disturbed innervation, for we never see this condition in any other than in neurotic, ill-developed children, usually with a neurotic family history. The trouble usually passes off at about puberty, or even before in some cases. I have, however, had two cases in which the affection was present in adult females about twenty-seven years of age. In both these cases there was a history of extremely nervous habit and in both there was a history of insanity in the family.

Neurasthenia of the bladder I have found to be very rare indeed. Janet (*Ann. des Mal. des Org. Gén.-Urin.*, 1895, xiii, 134) calls attention to this condition in an excellent article on the subject. He makes the point that in this disease one should always seek the predisposing cause. This cause may be irritation at a distance from the bladder, preoccupation, hypochondria, some lesion of the central nervous system, and, lastly, bad habit, that is, a habit of passing water frequently when there is really no need of it. Janet endeavors to suppress the cause, if possible.

In these cases, suggestion acts very well. The patient should be told that there is no serious disease, and that an endeavor should be made to hold the urine as long as possible. It is really surprising what good results may be obtained by this simple means. A peculiarity of this trouble is, as it was pointed out by Guiard (*Ann. des Mal. des Org. Gén.-Urin.*, 1891, xx, 231) that the calls to urinate occur especially during the daytime and that the patient at night is not usually disturbed. This is quite a diagnostic point. Another peculiarity in neurasthenics is that these bladders are usually of large capacity. Genouville,

(*Gaz. des Hôp.*, 1895, lxxviii, 260) was the first to point out that in neurasthenics the tonicity of the bladder muscles is very much reduced. In one of his cases, 1,200 c.c. of fluid were injected into a bladder under a pressure of 8 cm. of water without causing pain and without causing a desire to urinate. This large capacity in neurasthenic bladders is, of course, due to the weakness of the muscles—a peculiarity in neurasthenia.

These neurasthenic bladders are easily distinguished from hysteric bladders. In neurasthenia the only bladder symptom is a desire to urinate frequently. In hysteria we are more apt to get retention of urine, while other stigmata of hysteria will usually make the diagnosis perfectly clear. In some instances, however, in my experience, a diagnosis of hysteria may remain in doubt for a good while, the stigmata not being perfectly apparent.

Treatment of neurasthenic bladders by dilatation is well worth trying. On the one case which I had, the result was gratifying. The patient had instant relief.

I have been very much gratified with my results in the treatment of hyperemia of the vesical neck and trigone by dilatation. This affection is very annoying and gives the physician a great deal of trouble. These bladders are usually of fair capacity. In thirteen cases the average capacity without cocaine was about 345 c.c. The following table shows the capacities at a glance, with and without cocaine.

	Without cocaine.	With cocaine.
No. 3	450 c.c.	540 c.c.
" 4	240 c.c.	480 c.c.
" 5	480 c.c.	570 c.c.
" 6	.....	420 c.c.
" 7	300 c.c.	360 c.c.
" 8	720 c.c.	780 c.c.
" 9	180 c.c.	.....
" 10	240 c.c.	300 c.c.
" 11	360 c.c.	480 c.c.
" 12	400 c.c.	.....
" 13	480 c.c.	570 c.c.
" 14	150 c.c.	240 c.c.
" 15	480 c.c.	.....

I think that spasm of the muscles of the bladder in this affection is responsible in part for the symptoms. In a number of cases it will be seen that the capacity was greatly increased when the bladder was cocainized. This spasm is what one might ex-

pect in this trouble. Most of these patients are nervous and have become so in consequence of the suffering. Their nervous system is in a state of tension and the irritable bladder, causing as it does a frequent desire to urinate, increases the nervous tension. Brooding over the affection is likewise responsible for a great deal of the suffering. Not only is the bladder irritable, but this irritability reacts upon the nervous system. Thus a vicious circle is created.

My results in the treatment of this disease have always been satisfactory. Without exception the patients have said that they were better as soon as the treatment was begun. Of course, as it is well known, hyperemia of the vesical neck is at times transitory, and there are periods of remission, during which the patient may not suffer at all. I would not say that dilatation is the only method of treating this affection. I think it is suggestive, however, that in my experience, dilatation has always at once proved beneficial. Certainly, I have found it far more efficacious than any other method of treatment with which I am familiar.

I have had but two cases of acute cystitis in which the capacity of the bladder was measured. In both cases there was a diminution of the capacity. This is what one would expect because there must always be spasm of affected muscles.

I have dilated the bladder in a number of instances of chronic cystitis, and I think I may say that in every case in which I used it, the result was good.

A glance at the following table will show the capacities of the bladder in chronic cases.

	Without cocaine.	With cocaine.
No. 18	480 c.c.	.....
" 19	90 c.c.	.....
" 20	210 c.c.	360 c.c.
" 21	270 c.c.	300 c.c.
" 22	300 c.c.	360 c.c.
" 23	150 c.c.	200 c.c.
" 24	390 c.c.	450 c.c.
" 25	315 c.c.	325 c.c.
" 26	180 c.c.	.....
" 27	300 c.c.	420 c.c.
" 28	150 c.c.	210 c.c.
" 29	260 c.c.	300 c.c.
" 30	45 c.c.	90 c.c.
" 31	120 c.c.	240 c.c.
" 32	90 c.c.	90 c.c.

	Without cocaine.	With cocaine.
No. 33	360 c.c.	.....
" 34	150 c.c.	.....
" 35	240 c.c.	.....
" 36	720 c.c.	.....
" 37	480 c.c.	480 c.c.
" 38	150 c.c.	.....
" 39	90 c.c.	390 c.c.
" 40	330 c.c.	570 c.c.

Here again it is noticeable that the capacity of the bladder was considerably increased in a number of the instances after cocaine was applied to the mucous membrane. This, I think, shows the effect of spasm of the muscles. I must say that I was somewhat surprised in reviewing these figures to find that in so few instances of chronic cystitis was the bladder very much reduced in capacity. I am speaking now of my own personal cases. In a few of these, as it will be observed, the capacity was very small, but they were a very few. It was very striking, in reviewing the cases which I was able to find in a thorough review of the literature, to note that in almost every instance the capacity was exceedingly small, showing that the treatment was resorted to only because the capacity was so very small. There are only twenty in all. I am forced to conclude, therefore, that the capacity of the bladder in chronic cystitis of the nontubercular form is but seldom greatly diminished. In general, however, the smaller the bladder capacity, the more frequently the patient had to urinate; with very small bladders this symptom was pronounced. I believe that whether the capacity is reduced by interstitial changes or by spasm of the muscles, the result is the same, the patient under both these circumstances having to urinate frequently.

In one of my cases, in which the cystitis had lasted a good many years, the capacity was quite large (No. 36). This woman was of phlegmatic temperament, and I think there must have been less spasm of the muscles than usual in her case, though I cannot be positive of this. It is far different in the tubercular forms of cystitis with regard to capacity, and it will be shown later on that these bladders are almost invariably diminished in capacity.

The list of twenty nontubercular cases found in literature is as follows:

	Without cocaine.
No. 62.....	.....
" 63.....	.....
" 64.....	.....
" 65.....	.....
" 66.....	.....
" 67.....	60 c.c.
" 68.....	200 c.c.
" 69.....	100 c.c.
" 70.....	65 c.c.
" 71.....	less than 60 c.c.
" 72.....	30 c.c.
" 73.....	30 c.c.
" 74.....	90 c.c.
" 75.....	100 c.c.
" 76.....	30 c.c.
" 77.....	30 c.c.
" 78.....	40 c.c.
" 79.....	40 c.c.
" 80.....	10 c.c.
" 81.....	160 c.c.

I cannot determine very much in regard to the question of extent of lesions in diminishing the capacity of the bladder, and I think that the reason for this is that we have no method for determining just the amount of change going on in the wall of the bladder, that is, in the muscular and fibrous tissue. Judging from the cases as I have found them, I should say that a badly ulcerated bladder is more apt to be contracted than one which is not ulcerated. The presence of scars, cicatrices, and bands also was noted to be associated with a diminished capacity. In general, the longer the duration of the disease, the smaller the capacity, but this has its exceptions.

The influence of spasm of the muscles was very well illustrated in a number of instances. In one, in particular, that of a woman with chronic cystitis extending from many years (No. 39), the capacity was only 90 c.c. without ether, but with ether it was found to be 390 c.c. In this case there was double pyelitis, and the disease had been in progress for seven years. It is my belief that the treatment by dilatation is particularly efficacious in cases of this kind. The spasm is overcome, the tension is relieved, and the patient certainly feels very much better. On the other hand, I have seen cases in which the cystitis has lasted

for many years, and yet there was no spasm of the muscles at all. This was illustrated in No. 36. In this case the woman had been suffering for a number of years and had been through two nephrotomies; yet when the bladder was measured a year after the last nephrotomy, it was found that there was a capacity of 720 c.c. In No. 24 also there was a fairly large capacity of 450 c.c., and in this case the woman had been suffering for some years; there was pyelitis on the right side in this case. I think I may say that both of these women were of a very phlegmatic temperament, and this may have had something to do with the absence of spasm.

It has been definitely shown that in cystitis of long duration all the coats of the bladder are affected, from the mucous to the peritoneal. Hallé and Motz (*Ann. des Mal. des Org. Gén.-Urin.*, 1902, xx, 21) have done more than anybody else to show the pathological condition of the bladder in a state of inflammation. These authors found a diminished capacity in all. Some of their bladders were extremely small. There was usually a loss of suppleness, a loss of motion and the bladders were incapable of much distention. Thickness of the wall was particularly found. Mahé (*Occidental Medical Times*, Sacramento, 1890, iv, 359) reports a bladder whose walls were half an inch thick. The patient had had cystitis for many years. Otis (*Philadelphia Medical Times*, 1881-2, xii, 500) also mentions a case of a patient with long-standing cystitis, and here the walls were four times the normal in thickness. One of the most marked features in chronic cystitis is hypertrophy of the muscles. This has been noted by Hallé and Motz (*loc. cit.*, p. 170). This hypertrophy is due to the increased work which the bladder is called upon to do. The inflammation affects every portion, interstitial tissue and muscular tissue as well. There is inflammatory infiltration, and the end result is disappearance of muscles, due to granular degeneration and compression by the interstitial tissue, and the result is sclerosis and hardening. The serous coat is often underlaid with fat which tends, of course, to prevent the bladder from dilating. Samways (*British Medical Journal*, 1900, ii, 1771) has called attention to the hypertrophy which is seen in the subacute stage in cases of cystitis. This hypertrophy, of course, increases the strength of the bladder wall. Samways has called attention to the fact that this hypertrophy takes place quite regularly; as a result, all the individual fibers of which the coat is composed are very much increased in size. The result is that a sort of

network is formed which greatly adds to the strength of the bladder. If we dilate in the stage in which this hypertrophy occurs, there is, of course, but little danger of doing any harm from overdilatation.

Young (*Johns Hopkins Hospital Bulletin*, 1898, ix, 101) was the first to advise treatment by dilatation in cases of chronic cystitis, and his results were certainly remarkable. Before Young, Sims had advised dilatation, not for cystitis, but for incontinence with contracted bladder. Young commented on the excellent results obtained by this method. His explanation of the improvement is as follows: "The secretions are washed away, the individual bundles of muscular fiber are separated and loosened, folds or pockets are smoothed out, ulcers are stretched or cracked, the bladder muscle is exercised and its tonicity is improved, the mucous membrane is cleaned, stretched, and with increased vascularity is given a chance to throw off the inflammation."

I should consider that this treatment might well be compared to massage, and it is, in fact, a massage as applied to the bladder.

I do not think that there is any danger whatever in treating chronic cystitis by means of dilatation. I have never seen any bad results at all, and I consider the treatment to be absolutely innocuous. I think, however, we should be careful in our selection of cases. Certainly, no one would think of dilating a bladder unless that bladder had previously been cystoscoped.

Inhibition of Vesical Contractility.

This condition was formerly described as "spasm of the muscles of the vesical neck." The latest views are to the effect that the retention which characterized the condition is due to disturbed action of the nervous system. As a matter of fact, passage of the catheter in these cases is not difficult and there is no grasping of the instrument by muscles at the neck of the bladder. This subject was discussed at the first meeting of the International Congress of Urology held in Paris, 1908, by Albarran and Noguès (*Trans. Cong. Int. d'Urol.*, Paris, 1908, pp. 318 and 371). Bazy and Condamy in the discussion claimed priority in discovery.

I have seen but one case of this kind which I think was undoubted.

NORMAL BLADDERS.

In eight normal bladders I found the capacity to be, on an average, about 420 c.c. This was without cocaine. With cocaine the capacity could be increased about 60 to 150 c.c. In one instance, that of a woman who had just been delivered of a child, I found a very large bladder (No. 48) and it held 870 c.c. with cocaine. I suppose that this large capacity must have been due to softening of the walls under the influence of the congestion of pregnancy. James (*Edinburgh Medical Journal*, 1878, xxiv, 293) found the adult male bladder with two feet of water pressure to be 600 c.c. Genouville (*Arch. de Physiol.*, 1894, fifth series, vi) found as a result of his observations, that the normal adult experiences a desire to urinate when there are 250 c.c. of liquid in the bladder. The pressure under these circumstances, Genouville found to be about 15 cm. of water.

PERSONAL CASES OF TUBERCULOSIS OF THE BLADDER.

82.—Female, thirty-three. Duration one year. Micturition twenty to thirty times a day, twenty times at night. Bladder shows intense congestion, superficial ulcers, bleeding points. Diagnosis: tubercular cystitis, stricture of the left ureter. Capacity of bladder without ether, 75 c.c.; with ether, 90 c.c. Dilated once only. Severe pain and hematuria followed. Waiting for bladder to heal.

83.—Female, thirty. Duration one year. Urinates twenty times a day, four times at night. Bladder shows intense congestion, ulcers about the left ureteral orifice; "golf-hole" left ureter. Diagnosis: tubercular cystitis. Capacity without ether, 150 c.c.; with ether, 180 c.c. No dilatation. Died from the effects of calculus of right ureter two years after nephrotomy of the left kidney.

84.—Female, thirty-seven. Duration, many years. Bladder shows intense congestion, ulcers, tubercles. Diagnosis: tubercular cystitis. Capacity without ether, 100 c.c.; with ether, 120 c.c. No dilatation.

85.—Female, twenty-three. Duration, five years. Urinates ten to fifteen times a day, five times at night. Bladder shows intense congestion, tubercles. Diagnosis: tubercular cystitis. Capacity without ether, 120 c.c.; with ether, 150 c.c. No dilatation.

86.—Female, sixty. Duration four years. Urination ten to twenty times a day, twenty times at night. Bladder showed intense congestion with superficial ulcers. Diagnosis: tubercular cystitis. Capacity without ether, 120 c.c. No dilatation.

87.—Female, twenty-two. Duration one year. Urination forty times a day, six times at night. Bladder showed intense congestion, fibrin, scars, ulcers. Diagnosis: tubercular cystitis.

Capacity without ether, 120 c.c.; with ether, 150 c.c. Nephrotomy performed, and at the end of two years, from self-dilatation, capacity 210 c.c. No artificial dilatation done.

88.—Female, twenty-two. Duration seven years. Urination twelve times a day, eight times at night. Bladder showed ulcers, intense congestion, and tubercles. Diagnosis: tubercular cystitis. Capacity without ether, 90 c.c.; with ether, 90 c.c. No dilatation done.

89.—Female, thirty-eight. Duration one year. Urination twenty times a day, twelve times at night. Bladder showed intense congestion, ulcerations, and granulations. Diagnosis: tubercular cystitis. Capacity without ether, 90 c.c.; with ether, 90 c.c. No dilatation.

90.—Female, twenty-eight. Duration seven years. Urination forty times a day, twenty times at night. Bladder showed ulcers, intense congestion, tubercles. Diagnosis: tubercular cystitis. Capacity without ether 85 c.c.; with ether, 85 c.c. Cystotomy performed and bladder healed under Guyon treatment; then dilatation done. Bladder increased in capacity from 85 c.c. to 200 c.c. in twenty treatments at intervals of four days. Patient is now well and urinates once in three hours.

91.—Female, thirty-five. Duration two years. Urination twenty to thirty times by day, ten to fifteen times by night. Bladder shows intense congestion. Cystotomy; opening now present. Bladder thickened and ulcerated. Diagnosis: tubercular cystitis. Capacity of bladder as measured by sight, about 30 c.c.

92.—Female, thirty-two. Duration many years. Urination twenty times a day, ten times at night. Diagnosis: tubercular cystitis. Capacity without ether, 100 c.c.; with ether, 120 c.c. No dilatation.

93.—Female, thirty-nine. Duration two years. Urination thirty times a day, eight times by night. Bladder shows intense congestion, tubercles, and ulcers. Diagnosis: tubercular cystitis. Capacity without ether, 120 c.c.; with ether, 120 c.c. No dilatation.

94.—Female, thirty-five. Duration, two years. Urinates twenty to thirty times a day, four or five times at night. Bladder shows intense congestion, granulations, and ulcers. Diagnosis: tubercular cystitis. Capacity without ether, 60 c.c.; with ether, 75 c.c. No dilatation.

95.—Female, thirty. Duration five years. Urination twenty times a day, ten times at night. Bladder shows intense congestion and ulcers. Diagnosis: tubercular cystitis. Capacity without ether, 100 c.c.; with ether, 120 c.c. No dilatation.

96.—Female, twenty-two. Duration ten months. Urination forty times a day, twenty times at night. Bladder shows intense congestion, tubercles. Diagnosis: tubercular cystitis. Capacity without ether, 100 c.c.; with ether, 120 c.c. No dilatation.

97.—Female, thirty-five. Duration two years. Urination

twenty times a day and ten times by night. Bladder shows intense congestion, granulations and ulcers. Diagnosis: tubercular cystitis. Capacity without ether, 90 c.c.; with ether, 100 c.c. No dilatation.

98.—Female, thirty-one. Duration, two years. Urination thirty times a day, twenty times by night. Bladder shows intense congestion, ulcers, granulations. Diagnosis: tubercular cystitis. Capacity without ether, 40 c.c.; with ether, 60 c.c. Nephrectomy. Dilated once, two months after nephrectomy. Intolerably painful and bleeding followed immediately. Still in hospital.

99.—Female, twenty-two. Duration, three months. Urination twenty times by day, ten times by night. Bladder shows intense congestion and ulcers. Diagnosis: tubercular cystitis. Capacity without ether, 90 c.c.; with ether, 120 c.c. No dilatation.

100.—Female, thirty-two. Duration, three years. Urination twenty times by day, ten times by night. Bladder shows intense congestion, ulcers, and tubercles. Diagnosis: tubercular cystitis. Capacity without ether, 90 c.c. No dilatation.

101.—Female, seventeen. Duration, six months. Urinates thirty times by day, twenty times by night. Bladder shows intense congestion, tubercles, no ulcers. Diagnosis: tubercular cystitis. Capacity without ether, 120 c.c.; with ether, 140 c.c. No dilatation.

102.—Female, twenty-one. Duration seven years. Urination twenty to thirty times by day, twenty times by night. Intense congestion, ulcers, and tubercles. Diagnosis: tubercular cystitis. Capacity without ether, 65 c.c.; with ether, 90 c.c. Cystotomy. Fistula open five years, then closed. Capacity after cystotomy, 75 c.c. Dilated in fifteen sittings at intervals of four days up to 200 c.c. Urinates once in three hours.

103.—Female, forty-four. Duration fifteen months. Bladder shows intense congestion, ulcers, scars, and tubercles. Diagnosis: tubercular cystitis. Fecal fistula anterior to cervix. Capacity without ether, 360 c.c. No dilatation.

The first point which strikes our attention in looking over these cases is the relation that exists between the capacity of the bladder and the duration of the disease. The following table shows this at a glance:

No. 82	One year	75 c.c.
" 83	One year	150 c.c.
" 84	Seven years	100 c.c.
" 85	Five years	120 c.c.
" 86	Four years	120 c.c.
" 87	One year	120 c.c.
" 88	Seven years	90 c.c.
" 89	One year	90 c.c.
" 90	Seven years	85 c.c.

No. 91	Two years.....	30 c.c.
" 92	(?)	120 c.c.
" 93	Two years.....	120 c.c.
" 94	Two years	75 c.c.
" 95	Five years.....	120 c.c.
" 96	Ten months	120 c.c.
" 97	Two years.....	90 c.c.
" 98	Two years	60 c.c.
" 99	Three months	120 c.c.
" 100	Three years	90 c.c.
" 101	Six years.....	120 c.c.
" 102	Seven years	90 c.c.
" 103	One year 6 months	360 c.c.

It will be seen that the capacity in every instance, with one exception (103) is small, no matter what the stage of the disease. This would seem to show that other causes than organic changes in the bladder wall must be at work in determining the reduced size of the bladder in tuberculosis.

In a most excellent article on tuberculosis of the bladder by Hallé and Motz (*Ann. des Mal. des Org. Gén.-Urin.*, 1904, xxii, 163) the capacity of the bladder is carefully studied at various stages of the disease. It is greatly to be regretted, however, that no exact measuring was done. Rather vague terms, such as large, small, and moderate capacity, are made use of. However, the article as a whole is decidedly one of the best yet published. These authors insist that a large capacity is not infrequently met with in vesical tuberculosis, especially toward the final stages of the disease. In some instances they found postmortem bladders reaching even to the umbilicus. The only material was autopsy material. The thickness of the walls in the bladders studied by these authors varied from 1 millimeter to 2 centimeters.

Hallé and Motz (*loc. cit.*, xxii, p. 210) state that in the beginning of the disease the capacity is small or medium. As the disease progresses the bladder shows an increase in size, and toward the end they state (*loc. cit.*, p. 259) that the increase in size is almost the invariable rule. They have only one case (*loc. cit.*, p. 257) in which the bladder was small at the termination of the disease. In this case there had been a fistula during life. They likewise report five other cases of small bladders at the end of the disease in all of which, however, a cystotomy had previously been performed.

Their general conclusions in regard to the size of the bladder are as follows (*loc. cit.*, p. 260): "In the beginning of the disease

the lesions are limited to the membrane. The capacity is normal at this time, but the walls are already thickened; at the more advanced stage, when the tubercular lesions have affected the deeper structures of the bladder, the capacity is small; during the stage of ulceration, the muscle is destroyed in part, and in this stage the bladder begins to dilate, finally the walls are thinned, the muscle is totally destroyed, and the bladder begins to distend."

My criticism of these results would be this: that all these bladders were studied postmortem, at a time when the spasm of the muscles could be eliminated. It is my opinion that this spasm plays a large part in reducing the capacity of the tubercular bladders.

I have seen twenty-two cases of tuberculosis, some of them of very long duration, and I have never seen a bladder of very large capacity; in fact, I have found the majority were very much diminished, as will be readily seen on consulting the table. At the same time I would not be understood as saying that spasm alone is the invariable cause of reduced capacity in vesical tuberculosis. In cases 82 and 99 of my list, the capacity was not appreciably increased under ether; the same was true in certain other of my cases, but I particularly noted these two cases, for the bladder wall seemed to be hard and rigid and unyielding. In these cases the interstitial changes were undoubtedly responsible for reduced capacity. Even after the process has come to an end—we will say after cystotomy and after thorough treatment of the bladder—these walls are extremely unyielding and the cavity is only with great difficulty made larger by dilatation.

This spasm of the muscles is something which one would expect and is quite analogous to the spasm of the muscles in any part of the body which overlie an inflamed area. The effect of spasm is of course to hold the bladder fixed, and in this way undoubtedly the irritation is made less. I have never had an opportunity of studying tubercular bladders in the postmortem state, so that my views on the subject may be said to be purely clinical. I think, however, that it is significant that in practically all the cases under my observation the bladders were of small capacity.

The changes which take place in a tubercular bladder have been admirably described by Hallé and Motz (*Ann. des Mal. des Org. Gén.-Urin.*, 1904, xxii, 183). It may be said, in general terms, that in the beginning of the disease the inflammation is confined to the mucous membrane; later, the lesions penetrate

into the muscular walls, and these are destroyed in places. Ulceration may occur in various parts of the bladder and these ulcers may extend quite deeply. Caseation is also occasionally seen, but it is quite rare. In well advanced cases none of the muscular tissue is spared. The end-result is the formation of dense fibrous tissue. This tissue is not tubercular, and in fact has nothing of a tubercular character. The authors comment on the fact that this fibrous tissue is often quite invulnerable to tubercular change. When the end result has been reached, the authors state that the bladder begins to dilate. Perivesical changes are rare.

By way of comparison with my own cases, Hallé and Motz's (*loc. cit.*, p. 175) cases are herewith given in detail. These authors divide their cases into the following classes, beginning stage, active stage, and final stage.

HALLE AND MOTZ'S LIST OF CASES OF TUBERCULOSIS OF THE BLADDER.

Cases in the Beginning Stage.

- 104.—(Page 175.) Male, thirty. Small bladder; ulcers on the trigone.
- 105.—(Page 175.) Female child. Capacity not stated. Lesions on the trigone and lateral walls. Ulcers.
- 106.—(Page 176.) Male, thirty-four. Large bladder; walls slightly thickened. Lesions on the lower surface. Ulcerations.
- 107.—(Page 177.) Male adult. Moderate capacity. Thick walls, ulcerations on the lateral walls.
- 108.—(Page 178.) Male, forty-nine. Large bladder; walls slightly thickened. Lesions on the vesical neck, anterior wall and trigone.
- 109.—(Page 179.) Adult male. Large bladder; moderate capacity. Walls slightly thickened. Ulcerations on the base.

Cases in the Active Stage.

- 110.—(Page 180.) Adult. Small capacity; thick walls, ulcerations.
- 111.—(Page 180.) Adult. Moderate capacity; rather small. Ulceration near the left orifice.
- 112.—(Page 181.) Adult. Small capacity; thick walls, ulcerations.
- 113.—(Page 181.) Adult. Moderate capacity; rather small. Thick walls, ulcerations on the trigone and the right ureteral orifice.
- 114.—(Page 188.) Male, thirty-six. Small capacity; external walls fat-laden. Ulceration throughout. Hypertrophied muscles; connective tissue infiltrated.

115.—(Page 188.) Male, twenty-five. Moderate capacity; surface ulcerated; muscles hypertrophied.

116.—(Page 190.) Male, fifty-two. Large bladder; unequal thickness. Lesions on the lower surface.

117.—(Page 192.) Adult, thirty-seven. Medium capacity; thick walls. Ulcers around the orifice.

118.—(Page 192.) Male, forty-seven. Large bladder; unequal walls, ulcers throughout. Muscular coat preserved.

119.—(Page 192.) Female adult. Small capacity. Thick walls. Much fat externally. Deep ulceration of the whole bladder.

120.—(Page 201.) Adult. Large bladder. Thin walls, deep ulcers on trigone.

121.—(Page 204.) Adult. Small bladder. Thick walls, caseous masses. Muscle preserved.

122.—(Page 205.) Child's bladder. Large. Thin walls, irregular surface, internal surface smooth, with no trace of former structure.

123.—(Page 205.) Female, twelve. Large bladder. Caseation in the walls almost universal.

124.—(Page 207.) Adult, thirty-nine. Small bladder; thick walls. Internal surface irregular, caseation in walls, also hypertrophied. Muscular tissue hypertrophied.

125.—(Page 208.) Adult. Medium capacity; thick walls; fat externally; deep ulceration on trigone. Caseous walls; infiltrated intermuscular tissue.

End-result Cases.

126.—(Page 242.) Adult. Large bladder. Ulcerated, muscular tissue alone preserved, but damaged.

127.—(Page 243.) Adult. Moderate capacity; walls thickened, infiltrated, cicatricial tissue. Caseation.

128.—(Page 245.) Large bladder; thick walls, hard and rigid. Typical ulceration of the internal surface, muscles partially preserved, fat tissue externally.

129.—(Page 245.) Adult. Large bladder; thin walls, rigid, fibrous. Internal surface smooth, muscles atrophied and in part gone.

130.—(Page 246.) Adult. Large bladder; rigid walls. Dense fibrous tissue, muscle almost entirely gone; sclerosed and atrophied.

131.—(Page 247.) Adult. Four-fifths of the walls is fatty tissue; slight sclerosis.

132.—(Page 247.) Adult. Very little muscular tissue. Capacity not given.

133.—(Page 248.) Adult. Large bladder. Thin walls. Transparent and thin like paper at the summit. Caseous and no muscle tissue.

134.—(Page 249.) Male, thirty-five. Large bladder, extend-

ing up to umbilicus. Smooth surface. A little fibrous tissue, muscles invaded universally.

135.—(Page 250.) Adult. Large bladder, friable walls, smooth surface, fibrous tissue.

136.—(Page 251.) Adult. Large bladder, unequal thickness, fibrous walls, thin and smooth. Some muscle tissue remaining.

137.—(Page 252.) Adult. Adherent to certain organs. Lesions at base.

138.—(Page 253.) Very large bladder, ulcers near ureters.

139.—(Page 253.) Adult. Large bladder; unequal thickness. Lesions at the base. Thin on top.

140.—(Page 257.) Male, thirty-three. Small bladder. Very small capacity. Three cm. wide, 2 cm. high. Pericystitis. In this case there was a fistula which Hallé and Motz thought prevented the bladder from getting large.

141.—(Page 261.) Adult. Small capacity. Thick walls. Ulcers and caseation; adherent to surrounding organs.

This list of cases, when compared with mine, shows very clearly that in tuberculosis of the bladder it is largely the spasm of the muscles which reduces the capacity.

Analyzing these cases, we find that in the beginning stage there were six bladders, three of which were large, one moderate, one small, and one not stated. In the active stage there were sixteen bladders, five of which were large, four moderate, and seven small. The bladders in the final stage were sixteen. Among these ten were large, one moderate, two small, and in three the capacity was not given.

I do not think that we can say much in regard to the capacity of the bladder as dependent upon the seat and extent of the lesions. In my experience, bladders in which the disease was confined almost entirely to the bases were quite as likely to have a small capacity as those in which the lesions were more widely scattered.

It is my feeling that in the active stage it is unwise to attempt dilatation. I have tried it twice, but in both instances the pain was intolerable.

In the literature, however, two cases were found in which tubercular bladders were dilated during the active stage and with success. These cases were as follows:

142.—Young (*Johns Hopkins Hospital Bulletin*, 1898 ix, 103). Male, twenty-eight. Duration five years. Micturition every thirty to forty minutes. Capacity, 60 c.c. Daily dilatation. Later, capacity 180 c.c. Micturition once in three hours.

143.—Battle (*Lancet*, 1899, Dec. 9, 1587). Male, twenty-two. Duration two and one-half years. Dilated under ether with

a head of 4 feet of water. Then daily dilatations at 4 feet of water. In thirty-four days could hold urine three hours and had a capacity of 300 c.c. Two months later could hold urine four hours and urinated once at night. Before treatment, was urinating every ten minutes to one hour.

It would seem, from these two cases, that dilatation may sometimes be beneficial in the active stage. Perhaps it is worth trying. It is indicated in those long-standing cases of tubercular cystitis in which some degree of toleration has been attained. Certainly, no one would think of attempting the treatment in the presence of an acutely inflamed sensitive bladder.

Cases best suited for treatment by dilatation are those in which the tubercular process has been thoroughly eradicated by appropriate means, and when this has been done and the inflammation has entirely disappeared, such a bladder may be dilated with considerable prospect of relief. A cystotomy may have to be performed before this stage is reached, and a tubercular kidney and ureter will have to be removed.

I think that too much must not be expected from simple nephrectomy and ureterectomy. It is stated in many of the books that a bladder will get well if those operations have been performed.

This has not been my invariable experience. It is my custom, after nephrectomy, to wait for a considerable length of time before touching the bladder, say about two months. I then give the patient ether and cauterize the bladder thoroughly from top to bottom with solid nitrate of silver stick. This treatment is followed up, after a time, by constant applications of silver at intervals of a few days, and if it does not succeed I do a cystotomy and keep the patient under close observation until healing has taken place. When the bladder is healed and when the cystotomy wound has been closed, it is then time to try dilatation.

A contracted bladder will sometimes help to dilate itself. I had a case (No. 90) of this sort in a woman who had primary tuberculosis of the bladder. She had a cystotomy and she was treated for a long while by the Guyon method. After the fistula was closed she was treated by dilatation. She went away for a short time and she was told that during her absence she must try and hold water as long as possible. She did so, and on her return it was found that the bladder held 25 c.c. more than it did before her departure.