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SUCCESSFULLY TREATED BY KOLPO-URETERO-CYSTOTOMY. IRRIGATION OF THE PELVIS OF THE KIDNEY, AND INTRAVAGINAL DRAINAGE.

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FROM

THE AMERICAN JOURNAL OF THE MEDICAL SCIENCES.

MARCH AND APRIL, 1888.

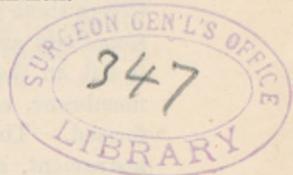
Dr. F. P. Foster with the Author's Compliments

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SUCCESSFULLY TREATED BY KOLPO-URETERO-CYSTOTOMY. IRRIGATION OF
THE PELVIS OF THE KIDNEY, AND INTRAVAGINAL DRAINAGE.¹

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I PRESENTED to the Ninth International Medical Congress a paper entitled "The Gradual Preparatory Treatment of the Complications of Urinary and Fecal Fistulæ in Women, including a Special Consideration of the Treatment of Pyelitis by a New Method and the Prevention of the Evils of Incontinence of Urine by a New System of Drainage." In this communication, I reported at length the history of a case of pyelitis which occurred as a complication of a large urinary fistula involving the urethra, uterus, and both ureters, and described its successful treatment by irrigation of the pelvis of the kidney. I also briefly alluded to the extension of the method to the treatment of a case of pyelitis not associated with a fistulous opening in the bladder, and stated that the orifice of the ureter was exposed by an operation which I ventured to name kolpo-uretero-cystotomy. My purpose is now to report more fully this latter case, to describe the operation, and to show the application of intravaginal drainage to the treatment of the resulting incontinence of urine. To this I will add an analysis of my first, as well as my second case, together with such observations on disease of the urinary organs in women as seem appropriate.

In the paper referred to, I showed that in the treatment of cases of urinary fistula by the use of intravaginal drainage, by means of an instrument which I had recently devised, I was able to conduct away the urine from the bladder, and to prevent its contact with the vaginal mucous membrane and the integument of the external genitals, and surrounding parts. But as this description of the method has not yet been published, a short account of the principle upon which the action of the instrument depends is necessary in order to understand its use in the case to be reported. The essential part of the instrument is a hard-rubber or metal drain which fits in the vagina and is connected by

¹ Read in substance before the New York State Medical Association, September 27, 1887. The publication of the paper has been delayed until the completion of the treatment of the case.

a soft-rubber tube to a bag or urinal attached to the thigh near the knee. Its upper surface, which corresponds with the vesico-vaginal septum, is grooved or made concave and perforated by a number of small openings in such a manner that one or more of them must come in apposition with the fistula. The efficiency of the instrument depends upon the adaptation of the vagina to the form of any rounded body placed in its interior. The vaginal mucous membrane clings closely to the instrument and blocks up all the openings on its upper surface except those opposite to the fistula. So intimate is this contact, that sometimes an imprint of the upper or cribriform surface of the drain is left on the anterior vaginal wall and teat-like processes of mucous membrane, corresponding in size and position with the openings, are formed. The margins of the fistula are accurately applied to the instrument, and the defect in the septum is supplied by its upper surface. All communication between the bladder and vagina and every other avenue of escape being in this way shut off, the urine passes through the perforations into the interior of the instrument and is conducted by the tube into the urinal. The urine is thus drained directly from the bladder and does not come in contact with the vaginal mucous membrane. The vagina, therefore, is not drained and the designation, intravaginal drainage, is intended merely to suggest the use of an instrument placed within the vagina in order to conduct away the urine from the bladder.

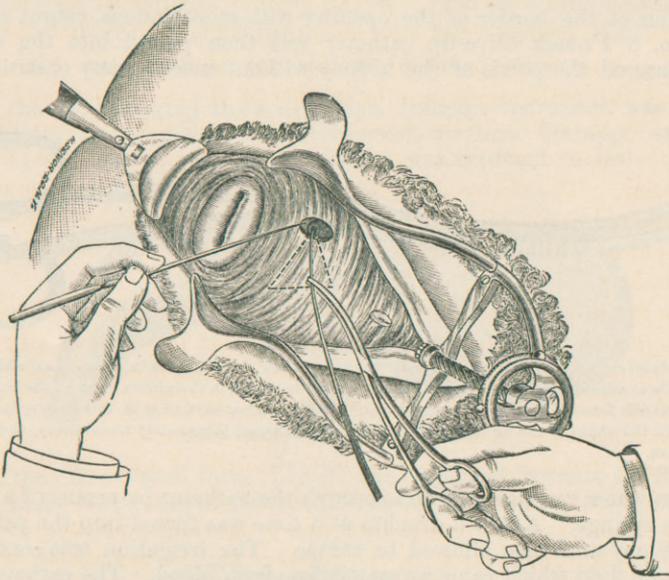
The drain may have various shapes to adapt it to the peculiarities of the vagina in individual instances, or in order to subserve other purposes in combination with drainage, as, for example, support of the uterus or dilatation of the vagina. I have described several forms of the instrument and endeavored to give them distinctive names. In the treatment of the case to be presently reported, I used, for the greater part of the time, what I call a utero-vesical drainage support (Fig. 5). It is a simple and convenient form and is especially applicable to cases where an opening is made in the bladder for the purpose of draining that organ or of exposing the orifice of one of the ureters.

CASE.—Mrs. B., aged thirty-four, was admitted into the Woman's Hospital on Feb. 27, 1887. She had borne five children and had had no miscarriages. Her labors were normal. Two years and a half ago, after having been married ten years, she became a widow. In the fourth month of her last pregnancy, about three years before I first saw her, she began to suffer from pain in the right lumbar region, and this symptom had continued and was growing worse at the time when she was admitted into the hospital. She described the pain as variable in character and aggravated by exercise; at times it was acute and radiated to the groin and down the thigh toward the knee; more frequently, the pain was dull and constant and confined to the lumbar region. Her urine had been for two and a half years and was still almost constantly

stained with blood, which was sometimes present in sufficient quantity to cause a thick deposit at the bottom of the vessel.

In the course of her illness, the patient also complained of frequent urination and vesical tenesmus, and suffered from dizziness, headache, cold hands and feet, loss of appetite, and nausea and vomiting; her general health depreciated, and she lost flesh and strength. She was confined to bed for six weeks by a severe illness, which began in November of last year. At this time she suffered from partial suppression of urine, severe paroxysms of pain, nausea and vomiting, and high fever. In the course of this attack she found two calculi in her urine; the first was an inch and a half long and about the size of a slate pencil; the second was broken into several pieces. The hæmaturia ceased before the passage of the second calculus, but at the end of five days the urine again became bloody.

FIG 1.¹



The opening at the right ureteral angle of the trigone of the bladder, the result of the operation of kolpo-uretero-cystotomy, and the method of catheterizing the ureter. (Left lateral position.) The advantages of transverse dilatation of the vagina, for work of this kind, are well shown in the figure. The folds of the anterior wall are obliterated, the septum is rendered tense, the fistula is perfectly displayed, and easy access to the orifice of the ureter secured.

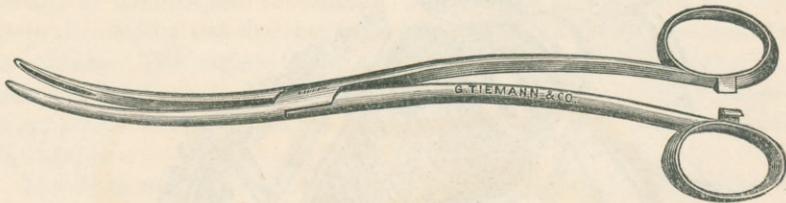
On admission she was much emaciated; her complexion was sallow, and her mucous membranes very pale. She was extremely weak, and suffering almost constant pain in the region of the right kidney. The urine was of a reddish color, acid in reaction, contained albumen, and deposited a thick sediment consisting of blood and pus. The uterus was

¹ Figures 1, 6, 7, and 9, are from drawings made by my friend Dr. John Aspell, a member of the house staff of the Woman's Hospital. I am greatly indebted to him for the skill and accuracy with which they were executed.

large, retroverted, and slightly prolapsed. During the month following, I made two examinations of the bladder, but discovered nothing of importance, and failed in two attempts to pass a probe into the ureter. The effect of the exploration of the bladder through the urethra in both instances was to cause an acute exacerbation of the chronic cystitis which was present.

On May 6th the patient was anæsthetized, placed on the left side, and the anterior wall of the vagina exposed and made tense by means of my dilating speculum and perineal elevator (Fig. 1). The point of a narrow-bladed scalpel, mounted in a long handle, was made to enter the mucous membrane on the right side, about one inch and a quarter below the cervix uteri, and three-quarters of an inch away from the median line and a circular piece of the septum was removed, forming an opening into the bladder sufficiently large to admit the index finger.¹ The orifice of the ureter was then discovered, and bloody urine was seen issuing from it. The vesical and vaginal mucous membranes were brought together at the border of the opening with a continuous catgut suture. A No. 8 French olive-tip catheter was then passed into the ureter and entered the pelvis of the kidney without meeting any obstruction.²

FIG. 2.



My uterine forceps.

The blades are shown partly open in order to display their short concave inner surfaces, which make it possible to seize the catheter longitudinally. The catheter lies in the groove between the blades, and its tip extends forward in nearly a straight line. This is a great advantage in introducing the instrument into the orifice of the ureter. Afterward it may be seized more nearly transversely, as shown in the figure.

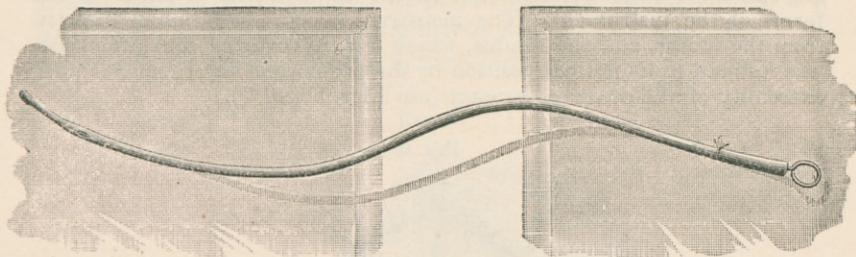
Warm water was now injected through the catheter by means of a small piston syringe. About a drachm at a time was forced into the pelvis of the kidney and then allowed to escape. The irrigation was continued until the fluid which came away was free from blood. The catheter was left in place for thirty-six hours, and the urine was collected as it flowed directly from the pelvis of the kidney. When examined by Dr. Coe, the pathologist of the hospital, it was found to be alkaline in reaction, and to contain a large proportion of blood, pus, and crystals of triple phosphates. Bacteria were also present in great numbers. A week later the catheter was again introduced, and allowed to remain twenty-four hours. Its continued presence in both instances occasioned nausea

¹ The orifice of the ureter is normally situated about one and a quarter inches below the cervix uteri, but in this case, in consequence of the retroversion of the uterus, there was an anterior displacement of the cervix, and an apparent shortening of the space.

² The best instruments are those made by Vernas, of Paris. I now explore the ureter with a filiform bougie before passing a catheter. Unless the symptoms are urgent, further experience leads me to advise a delay of ten days or two weeks after the opening in the bladder has been made before beginning the treatment of the pelvis of the kidney. Time is thus allowed for the swelling and tenderness about the orifice of the ureter to subside, and catheterization is more easy and less painful.

and vomiting, and a good deal of paroxysmal pain. After its removal, the catheter retained the peculiar form imparted to it by the course of the ureter. It presented two curves the convexities of which were in opposite directions and in different planes; in other words, it had assumed a spiral form. A stilet was shaped to fit the catheter in order to preserve its peculiar curvature (Fig. 3).

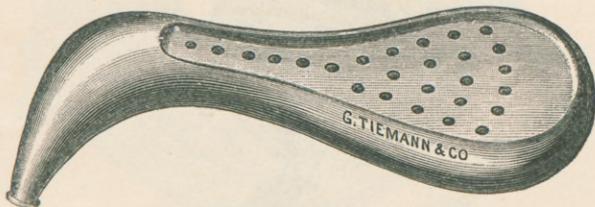
FIG. 3.



Spiral curve imparted to the catheter by the course of the ureter.

On the day following the operation a drainage instrument was introduced into the vagina. The utero-vesico-urethral drainage support (Fig. 4) was used as long as the patient was confined to bed. After-

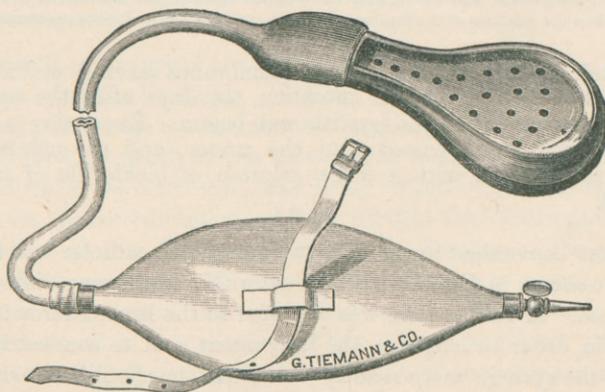
FIG. 4.



Utero-vesico-urethral drainage support.

ward, the utero-vesical form (Fig. 5) was employed, because the former, while being better suited for the recumbent position, in consequence of

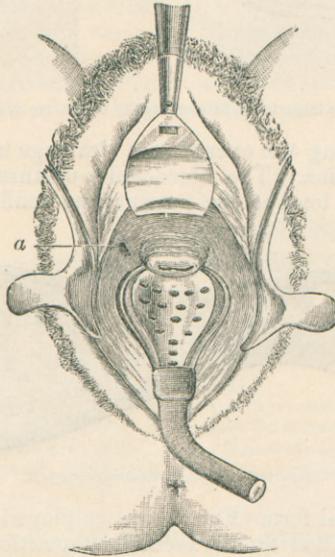
FIG. 5.



Utero-vesical drainage support.

its greater length extended beyond the vulva, and interfered with sitting. From the first, the drainage was satisfactory, and the presence of the instrument in the vagina caused no discomfort or inconvenience. When the patient was sitting or standing, all the urine was collected, and none escaped into the vagina; in the horizontal position a little was lost, but the quantity was not sufficient to cause discomfort or to excite vaginitis. In consequence of their relation to the cervix uteri and posterior *cul-de-sac*, two unexpected results followed the employment of either of the forms of the instrument. The menstrual blood was drained directly from the uterus, and the fundus, which was retroverted and prolapsed, was restored to its normal position by the presence of the rounded upper extremity of the drainage support (see Figs. 6 and 7).

FIG. 6.



The utero-vesical drainage support in place. (Front view dorsal position.)

The perineum is depressed, and the anterior wall is lifted up to expose the interior of the vagina, and to show the relations of the fistulous opening (*a*) and the cervix uteri to the instrument.

The vesical and vaginal mucous membranes having united at the border of the opening by first intention, ten days after the operation, systematic treatment of the pyelitis was begun. Every day a flexible olive-tip catheter was passed into the ureter, and the pelvis of the kidney was irrigated with a warm solution of bichloride of mercury, 1 : 20,000.

The most convenient mode of introducing the catheter was found to be the one shown in Fig. 1; when done in this manner no difficulty was experienced. A rubber tube was attached to the lower extremity of the catheter, in order to lengthen the instrument, and to connect it to the nozzle of the syringe more readily. A small hard-rubber syringe was

used. At first I injected only about one drachm at a time; afterward, I found that the best guide as to the quantity of fluid which should be injected, was the sensation of the patient. Whenever the pelvis of the kidney was distended, a peculiar and characteristic pain was felt; the fluid was then allowed to escape, and the injection repeated until the washings were colorless and free from sediment. As the treatment progressed, the size of the catheter employed was gradually increased to a No. 13, and, if any useful purpose would have been served, I believe I could have dilated the ureter to a much larger size.

FIG. 7.



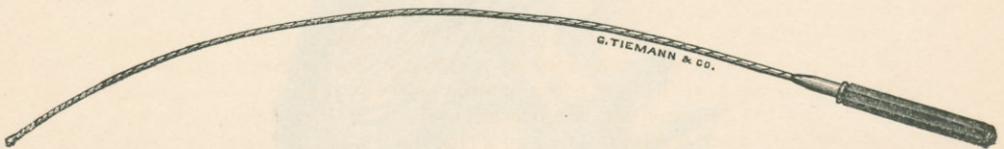
Diagrammatic section in the dorsal position, showing the relation of the utero-vesical drainage support to the fistula (*a*), the vesico-vaginal septum, cervix uteri, and posterior *cul-de-sac* of the vagina. The dotted triangle is introduced to show the upward inclination of the instrument when the patient is lying down. It makes an angle of about thirty-five degrees with the horizon. This fact explains the less perfect drainage secured in this position.

As a result of the spiral course of the ureter, the catheter as it entered rotated on a longitudinal axis. A given point on its surface, indicated by a mark, was seen to describe a complete circle. As the catheter passed toward the pelvis of the kidney, this point moved from right to left; and while the instrument was being withdrawn, the rotation took place in an opposite direction. I have verified this observation in other cases and found that in the left ureter the direction of the rotation of the catheter is reversed. Whenever the catheter was passed, the urine retained in the pelvis of the kidney flowed out. The quantity thus removed was found to be variable. If the patient had been standing or walking immediately before the introduction of the catheter in the left

lateral prone position, there was found little or no accumulation of urine in the pelvis of the kidney; if she had been lying down a considerable quantity was removed. At the beginning of the treatment, this was sometimes as much as fifteen drachms. I was also able to measure the capacity of the pelvis of the kidney. The injection of fluid was continued, as already described (but with a larger syringe), until the peculiar pain was felt. The fluid was then allowed to escape and measured. The capacity of the pelvis, determined in this manner, was at first twenty-one drachms, but was at last diminished to five drachms, which, from my observations in other cases, I believe to be about normal.

In the course of the treatment of the case, I had constructed a flexible renal sound (Fig. 8), made of a delicate ribbon of steel twisted into a

FIG. 8.



Renal sound.

cylindrical form of a suitable size and length. With this instrument, I was able to explore the ureter and pelvis more easily and thoroughly than with a catheter; a calculus would also be more easily detected by means of a metallic instrument; but no foreign body in the pelvis of the kidney was discovered by its use.

While the treatment was being carried out, the urine as it came from the pelvis of the kidney was frequently examined and the quantity of pus and blood which it contained was found to be gradually diminishing. At the end of three weeks, the urine was perfectly clear and deposited no sediment. On June 25th, about six weeks after irrigation of the pelvis of the kidney was begun, the following experiment was made: The bladder was douched. The catheter was then passed into the right ureter and a drainage instrument was placed in the vagina. The urine from the left kidney, as it was secreted, flowed into the bladder and was collected by the drain; that from the catheter was received in a vessel placed between the thighs. In this way it was possible to collect at the same time and in separate vessels the urine secreted by each kidney. At the end of two hours, three ounces of urine had been collected from the left kidney by the drainage instrument, and four ounces by catheter from the right. The result of the examination of the two specimens, made by Dr. Coe, shows that the pelvis had returned to a normal condition. It was as follows:

	Color.	Reaction.	Sp. gr.	Albumen.	Sediment.
Urine from left kidney . .	Straw.	Neutral.	1010	None.	None.
“ “ right “ . .	Amber.	Acid.	1020	None.	An occasional leucocyte.

As the urine returned to a normal condition, the symptoms improved. The distressing pain in the right lumbar region entirely ceased and the patient gained appetite, flesh, and strength. I believed haste in closing the opening in the bladder unnecessary, because by the use of the uterovesical drainage support all discomfort from incontinence of urine was prevented. She was, therefore, sent home and instructed to return for the operation when her health and strength were entirely restored. She wrote me, August 12th, the following account of her condition:

"The drainage works perfectly, there is no escape of urine except sometimes a little while lying down. I do not suffer from any irritation whatever. The instrument keeps the uterus in position. I have not suffered any pain in the kidney. I feel better than I have for years. I have just weighed, so will acquaint you with the numbers, 109 pounds, having gained 19 pounds in three months, that is, since the operation. I am able to attend church services. I can either ride or walk, neither gives me any uneasiness. My friends look at me and speak of my improvement with astonishment."

The patient returned to the hospital on November 8th for the closure of the artificial fistula. She had been entirely free from pain since her discharge, had gained twenty-five pounds in weight, and become strong and well. On examination, the vagina and vulva were found to be in a healthy condition. Almost all the urine had been drained from the bladder and the normal position of the uterus maintained by the drainage support.

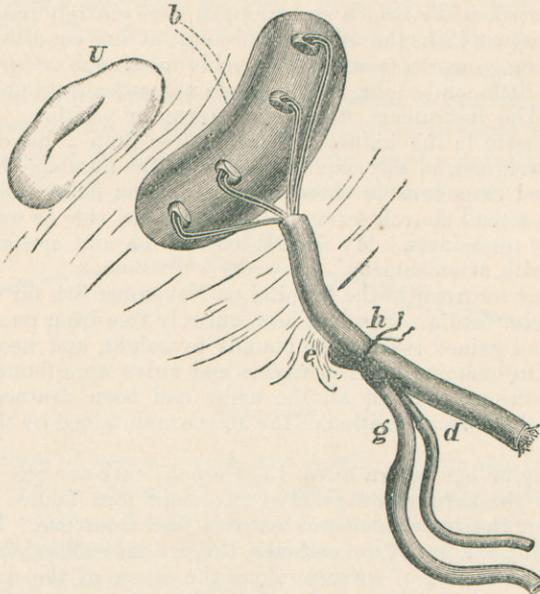
On the day of her return a No. 13 (French) catheter was passed into the pelvis of the kidney and allowed to remain four hours. The urine drawn off by the instrument was entirely free from pus. During the night following the use of the catheter, the patient suffered from pain in the loins and a feeling of soreness along the course of the ureter. The next day pus and blood were found in the urine. A mild attack of cystitis, ureteritis, and pyelitis had been set up by the use of the catheter. The mischief probably resulted from the retention of too large an instrument in the ureter for so long a time. I thoughtlessly used the same catheter which had been employed six months before. The ureter was then dilated, meanwhile it had contracted and the instrument had become too large. Moreover, I did not pay as much attention to the cleansing and disinfection of the catheter as I should have done. A smaller instrument (No. 8 French) was, therefore, used in the subsequent treatment and care was taken to wash it thoroughly and to disinfect it with a solution of bichloride of mercury (1 to 1000).

The pain soon ceased, and after a few irrigations of the pelvis of the kidney, the urine again became normal. The operation for the closure of the opening in the bladder was, however, delayed for four weeks, until observation of the patient gave complete assurance of the subsidence of the inflammation.

On December 4th, the fistula was closed with the button-interrupted suture (Fig. 9). The line of coaptation measured about one and a half inches and four silver sutures were used. The second and third wires were passed half an inch apart so as to avoid all danger of obstructing the orifice of the ureter. The sutures were left long and their ends were enclosed in a rubber tube as shown in the figure. A No. 4 soft English catheter was placed in the bladder and secured in place by tying it to the wires opposite the meatus urinarius. The operation was followed

during the first two or three days by a good deal of vesical tenesmus. The catheter was removed at the end of twelve hours. The urine was drawn and the bladder irrigated every six hours with a weak solution of boracic acid. Perfect union occurred. The sutures were removed

FIG. 9.



The fistula closed by the button-interrupted suture. (Left lateral position.)

a, ends of sutures inclosed in a rubber tube. *e*, meatus urinarius. *U*, cervix uteri. *b*, lower part of ureter shown in dotted lines. *g*, vesical catheter. *d*, ureteral catheter.¹

at the end of seven days and the patient was allowed to get out of bed a week later. Some vesical irritability followed the operation, but it has gradually subsided.

On December 12th, examination showed that during the week following the operation, the fundus of the uterus had returned to its original position against the rectum, and the cervix became displaced toward the right, causing some distortion of the vesico-vaginal septum, and possibly some obstruction of the ureter. I believed that correction of the displacement was important in order to guard against recurrence of the

¹ The ureteral catheter was not employed in this case. I have used it and advise its employment when the ureter forms a part of the border of the opening—*i. e.*, in uretero-vaginal fistulae after their conversion into uretero-vesico-vaginal fistulae. In these cases, in order to prevent obstruction of the duct, its lower extremity should first be slit up on the vesical side for about one-fourth of an inch so as to turn its orifice into the bladder; before the fistula is closed a No. 4 flexible English catheter should be introduced into the ureter for five or six inches, and afterward secured in place by tying it to the ends of the sutures as is shown in the figure. It may be removed at the end of twelve hours after the operation. Care should also be taken to straddle the ureter—that is, to leave a sufficient interval between the sutures which lie on either side of its lower end. This method of dealing with the ureter is introduced here because if, in the operation of kolpo-uretero-cystotomy, the opening were by accident made too high up, the ureter would be involved in the fistula, and might become everted, as is always the case in uretero-vaginal fistulae.

cystitis and pyelitis. The vagina was, therefore, columned with dry cotton. After a few applications of the column my utero-vaginal support was introduced. The instrument kept the uterus in place satisfactorily; but the idea afterward occurred to me, that the use of the drainage support, which had held the uterus in position while the fistula remained open, might be continued (see Fig. 7). The experiment was accordingly tried, and it was found that the instrument was as efficient as a uterine support as ever. It held the uterus in position perfectly. I also discovered that when the openings in its cribriform surface were closed, the instrument tended to slip down and was no longer useful for this purpose. The drainage support was worn through the patient's last menstrual period. All the menstrual blood was collected by the instrument and conveyed to the rubber bag attached to the thigh in the same manner as before the fistula was closed. A smaller and more convenient receptacle might be employed to collect the menstrual fluid in menorrhagia.

The patient (January 11th), five weeks after the closure of the fistula looks and feels perfectly well; the vesical and renal symptoms have all disappeared, and her urine is normal. She will, however, be kept under observation for a few days longer, in order to determine whether the correction of the uterine displacement by the use of the drainage support will be permanent.

I shall now present an analysis of the case which I have here reported, and of my previous case of pyelitis treated by the same method.

Etiology.—Chronic pyelitis is rarely idiopathic. The causes which lead to the disease are mainly narrowing of the ureter along its course or at its orifice, the presence of calculi in the pelvis of the kidney, cystitis, and obstruction of the outflow of the urine from the bladder.

Which of these causes was operative in my second case is, unfortunately, largely a subject of conjecture. The patient gave a history of cystitis, and inflammation of the bladder was undoubtedly present at the time when she was under observation. Whether it existed prior to the occurrence of the pyelitis, I do not know. The first symptoms of inflammation of the pelvis of the kidney appeared during pregnancy, and there was a similar history in other cases which I have seen. Whether the pressure of the pregnant uterus or the foetal head, by causing obstruction of the ureter, gave rise to the pyelitis, my experience is too limited to decide definitely; but recently I have treated a case in which dilatation and inflammation of the pelvis, and absorption of the kidney substance resulted from the pressure of a fibrocystic tumor of the uterus upon both ureters. Unfortunately, my attention was not directed to the urinary organs during life. Death occurred on the fifteenth day after I operated for the removal of the tumor, and at the autopsy the lesions of surgical kidney were found on both sides. Retroversion of the uterus in some cases, in consequence of the pressure of the cervix uteri upon the bladder and the formation of a pouch in the vesical wall, occasions

cystitis and may also cause obstruction of the lower extremity of one of the ureters. Retroversion and enlargement of the uterus, the result of engorgement of its bloodvessels, were present when I first saw the patient; but parturition had occurred since the first appearance of the symptoms of pyelitis.

The pressure of a peritoneal cicatrix is a cause of obstruction of the ureter in women. No evidence, however, of a previous pelvic inflammation was afforded by the history or by examination through the vagina. Exploration of the ureter, moreover, showed that there was no narrowing of the duct along its course and, although cystitis was present, the thickening of the vesical mucous membrane was not sufficient seriously to obstruct its orifice. A history of the passage of calculi was given by the patient; but these should be regarded as a result of the abnormal condition of the pelvis of the kidney, and not as its cause. They were phosphatic in composition and corresponded in form and size with the calibre of the ureter. The conditions present, as was afterward discovered in the course of the treatment, were favorable for their formation. The pelvis was dilated, the urine which it contained was alkaline, and detritus of blood, pus, and phosphatic salts was frequently washed away. The shape of the calculi indicates that they were formed, in part at least, in the ureter. If, as is probable, they originated in the pelvis, the concretions were then of small size and not sufficiently large to have occasioned by mechanical irritation the extensive inflammation which was present.

Taking all these facts into consideration, it is reasonable to infer that the inflammation of the pelvis of the kidney resulted from more than one cause; the morbid process was probably set up by the presence of the pregnant uterus, and the subsequent uterine displacement and cystitis caused its continuance.

The etiology of the pyelitis in my first case, when it occurred as a complication of a large urinary fistula, is more simple. The orifice of the ureter was contracted to a very small size by the pressure of the cicatricial tissue which formed the upper border of the fistulous opening into the bladder. The obstruction thus afforded to the outflow of the urine from the pelvis of the kidney no doubt gave rise to the disease.

Symptoms.—The subjective symptoms of chronic pyelitis are not always distinctive, and are frequently obscured by those of the cystitis with which the disease is commonly associated. This is especially true when cystitis, and at a later period pyelitis, follow obstruction of the flow of urine from the bladder. Dilatation of the ureter and pelvis of the kidney on both sides, and serious renal lesions occur in these cases so gradually as to occasion but little disturbance of sensation. No change in the symptoms or in the condition of the patient, except, perhaps, a more rapid depreciation of the general health, may, therefore,

be observed to indicate the extension of the inflammation from the bladder to the upper urinary passages.

When, however, as more frequently happens in the female, the obstruction occurs along the course of the ureter or at its orifice, the resulting pyelitis is unilateral, the dilatation of the pelvis more rapid, and cystitis a less prominent feature; besides the cachexia of chronic suppuration, nausea and vomiting may then occur and a characteristic pain is more frequently felt in the lumbar region. When, in addition, as happened in both of my cases, the presence of pus and ammoniacal urine in the pelvis of the kidney lead to the formation of phosphatic concretions, well-marked symptoms are produced. Attacks of renal colic occur from time to time and calculi are voided with the urine. During the temporary impaction of a calculus in the ureter, fetid pus and ammoniacal urine are pent up in the pelvis of the kidney. Septicæmia follows. Repeated rigors, high temperature, persistent nausea and vomiting, and great prostration resulted from this cause in my first case. In my second, these symptoms were not present while the patient was under observation, but she gave a clear history of a similar attack.

Urinary changes.—Pus, bacteria, and amorphous and crystalline phosphatic salts of lime were found in the urine in considerable quantity in both, and persistent hæmaturia was a marked feature of the second case. The difference in reaction of the mixed urine and that obtained directly from the pelvis of the kidney on the affected side, also observed in my second case, is interesting. The former was commonly acid, the latter alkaline. In the mixed urine, the acidity of the excretion of the kidney on the healthy side more than neutralized the alkalinity of the other. Characteristic cells from the pelvis of the kidney were not found; this was no doubt due to the solvent action of the ammoniacal urine.

Course and termination.—The natural course of a chronic inflammation of the pelvis of the kidney is to increase in gravity and extent, and to lead to disease of the kidney. The tubular structure forming the Malpighian pyramids may be to a greater or less extent absorbed in consequence of the increased pressure of urine in the dilated pelvis, and the function of the cortical portion gradually impaired as the result of a chronic interstitial nephritis. Complete obstruction of the ureter may occur and give rise to pyonephrosis, or the inflammation extending to the renal parenchyma result in acute or chronic suppuration in the kidney.

In my first case, when treatment was begun, renal calculi were being formed and discharged at frequent intervals; rigors were often repeated and the temperature was constantly high. The patient was evidently rapidly dying from septicæmia resulting from the absorption of pus confined in the pelvis of the kidney. After the pus was removed by irrigation and the obstruction at the orifice of the ureter overcome by dilata-

tion and incision, the inflammation of the pelvis subsided; but the injury, the result of pressure and the pyelitis, sustained by the kidney on the affected side was indicated by the diminished quantity of urine excreted and the small percentage of urea which it contained.

In my second case the disease was running a more protracted course; but the patient was suffering almost constant pain and was greatly enfeebled by the long-continued suppuration and hæmaturia. The pelvis of the kidney was already considerably dilated and the presence of alkaline and putrescent urine in the calices of the kidney was liable at any time to occasion suppurative nephritis.

The formation of phosphatic calculi in both cases as the result of pyelitis illustrates the causative relation of the disease to pyonephrosis. The passage of the calculi through the ureter was difficult and accompanied by paroxysms of renal colic. At any time, this temporary obstruction of the ureter might have become permanent and given rise to pyonephrosis.

Diagnosis.—The presence of pus in the urine in considerable quantity, when its origin can be traced directly to the pelvis of the kidney, is alone sufficient to establish the diagnosis of pyelitis; but the exact determination of its source is necessary, because it may proceed from the mucous membrane of the bladder. The formation of pus may be due to cystitis alone, or the inflammation of the bladder, as frequently happens, is associated with the pyelitis. When cystitis is excluded or its association with pyelitis is ascertained, accurate diagnosis requires that the extent and exact location of the latter disease should be determined, because one pelvis may be inflamed and the other healthy, or both may be involved. It is also important to detect the presence of calculi in the pelvis, to ascertain the existence of stenosis or obstruction of the ureter at its orifice or along its course, and to measure the extent of the injury sustained by the renal parenchyma.

In my first case the diagnosis was not difficult. The symptoms were well marked and characteristic. When my attention was directed by them to the investigation of the condition of the upper urinary passages, the orifice of the left ureter was discovered in a mass of inodular tissue situated around the corresponding angle of the fistula and fetid pus was seen exuding from it. Having demonstrated thirty years before and many times since, the facility with which the ureter can be explored when its orifice is exposed by a fistulous opening, I did not hesitate to pass a catheter into the pelvis of the kidney. When, in my second case, an opening had been made in the base of the bladder, all difficulty in the diagnosis and doubt concerning the nature of the lesions present also vanished. I was not only enabled to determine the presence of cystitis, but to estimate its extent by observing the amount of the thickening of the vesical wall. The origin of the pus and blood was

demonstrated by visual inspection and specimens of urine from the diseased pelvis were collected by catheterization of the ureter. The capacity of the organ was measured by filling it with water and in this way the extent of the dilatation of the pelvis was determined. The urine from each kidney was collected simultaneously and in separate vessels. The quantity secreted by each in a given time thus became a measure of its functional activity and the extent of the injury sustained by the kidney on the affected side was estimated. The use of the catheter in my first case demonstrated the narrowing of the orifice of the ureter and the existence of obstruction at different points along its course. In my second case the employment of my renal sound, an instrument better adapted to diagnostic purposes, showed that no foreign body was present in the pelvis of the kidney. In a word, all the requirements of accurate diagnosis set forth at the outset were satisfied.

Treatment.—The most important feature in the treatment of my two cases of pyelitis is the demonstration of the possibility of applying local measures to the treatment and cure of a grave disease of an organ situated in the interior of the body and communicating with the bladder only by a narrow and winding canal twelve inches long. I have shown that this is not only possible but easy. When the orifice of the ureter has been exposed by kolpo-uretero-cystotomy, which is not a dangerous operation, irrigation of the pelvis of the kidney is scarcely more difficult than washing out the bladder. It is almost painless. I have frequently irrigated the pelvis of the kidney in my private office and the patient walked home without inconvenience or evil consequences.

Almost equally important is the demonstration of the tolerance evinced by the ureter in respect to these surgical procedures. In my first case I left the catheter in the ureter and pelvis of the kidney twenty-four hours and it caused no pain or evil results whatsoever. The continued presence of the instrument in my second case, it will be remembered, gave rise to pain, nausea, and vomiting, but was followed by no serious or permanent consequences. Although these observations were important, in the treatment of diseases of the pelvis of the kidney it is unnecessary, and, therefore, unwise, to put the tolerance of the ureter to so extreme a test. It is sufficient to introduce the catheter and to remove it after the irrigation is finished. When this was done, not even the slight disturbance of function, above described, was occasioned.

Irrigation of the pelvis of the kidney in pyelitis as a therapeutic measure rests upon the basis of the rational treatment of disease. By it, pus, blood, ammoniacal urine, and calcareous deposits are removed. Dilatation of the ureter also allows the free escape of these irritating substances and prevents their accumulation. When complete obstruction of the ureter has occurred in consequence of the impaction of a

stone, the gradual dilatation of the duct below the seat of the obstruction by the passage of larger and larger catheters would favor the descent of the calculus. If contraction of the orifice exists, as in my first case, it can be overcome by dilatation and incision of the vesical extremity of the ureter.

For the treatment of chronic inflammation of the bladder, kolpo-uretero-cystotomy is as efficient as the operation of kolpo-cystotomy.¹ An opening at one of the ureteral angles of the trigone of the bladder drains its cavity as perfectly as one in the median line. The cystitis so commonly associated with pyelitis both as a cause and a complication, is by this means radically treated. Perfect drainage of the bladder, by removing pus and ammoniacal urine from contact with the vesical mucous membrane, allows the inflammation to subside and physiological rest of the organ brings atrophy of its thickened muscular and mucous coats.

A similar, but less obvious, result of the opening in the bladder is that by it physiological rest and perfect drainage of the ureters and pelves are also secured. Normally, when the bladder fills, the urine contained in its cavity exerts a pressure in every direction upon the vesical walls, varying in amount with the degree of distention of the organ. Continuous tension and reflux of urine into the pelves of the kidneys are prevented by the valvular arrangement of the lower extremities of the ureters and vesical mucous membrane; but in order to allow the flow of the urine into the bladder under these circumstances, the tension of the contents of the ureters and pelves must, at least, momentarily exceed that of the bladder. The pelvis of the kidney fills from time to time and by muscular contraction injects its contents into the already more or less distended bladder.

By the operation of kolpo-uretero-cystotomy the physiological relations of the upper urinary passages to the bladder are changed. The bladder being always empty, no obstacle to the flow of the urine from the

¹ Perineo-cystotomy was first proposed by Guthrie for the cure of cystitis, and, in 1850, the operation was performed in this country by Dr. Willard Parker, in order, as he said, "to open a channel by which the urine could be drained off as fast as secreted and thus afford rest to the bladder, the first essential indication in the treatment of inflammation" (New York Medical Journal, vol. vi., 1851). This was all that I knew concerning this method of treatment in the male, and nothing had been done in the female, when in January, 1861, I did the operation of kolpo-cystotomy. I made an opening about the size of half a dollar in the vesico-vaginal septum for the cure of cystitis, ulceration of the vesical mucous membrane, and concentric hypertrophy of the bladder. In consequence of the great thickening of the vesico-vaginal septum, the opening contracted to such a small size as to prevent drainage. It was, therefore, enlarged to nearly the size of a silver dollar. A permanent fistula was thus produced by this second operation. At the end of about fourteen months, when the thickness of the base of the bladder had diminished from three-quarters to about one-quarter of an inch, and the cystitis and ulceration had disappeared, the opening was closed. The cure was permanent. I was practising in New Orleans at this time, and, owing to the continuance of the Civil War and the suspension of all the medical journals of the South, the case could not be published. It, together with others, was, however, at length reported in 1871. (Urethrocele, Catarrh and Ulceration of the Bladder in Females. Trans. New York State Medical Society, 1871.)

ureters is afforded by the normal periodical distention of the organ. In the report of my second case, it will be remembered, the quantity of urine retained in the pelvis of the kidney depended upon the position of the body previous to the passage of the catheter. If the patient had been standing or sitting before the instrument was introduced, little or no urine was drained off; if she had been lying down, a considerable quantity was removed. It follows from these observations that, provided there is no obstruction in the duct itself, when the orifice of the ureter is exposed and the bladder drained, no obstacle is afforded to the flow of the urine from the pelvis of the kidney; in the upright position the organ is perfectly drained in obedience to the law of gravitation.

From physiological rest and drainage of the pelvis of the kidney, therefore, results analogous to those obtained by the same means in disease of the bladder may be expected to follow. Pus and ammoniacal urine are rapidly removed, and their prolonged contact with the mucous membrane prevented. The thickened lining membrane and muscular coat will atrophy from disuse, and the dilated cavity of the pelvis shrink to a normal size when the pressure of the urine is removed.

The use of intravaginal drainage constituted an essential part of the treatment. In my second case, the contact of the urine with the vagina and integument, in the enfeebled condition of the patient, might have led to disastrous results. Vaginitis would have been occasioned, and, owing to the impossibility of keeping the skin and bedclothes free from urine, ulceration of the buttocks, or even sloughing of the integument over the sacrum might have been produced. Freedom from these complications and the pain and mental distress which are caused by incontinence of urine was no doubt of great importance, and contributed much toward the rapidity of the recovery of the patient and the success of the treatment.

After the suppuration of the lining membrane of the pelvis of the kidney had ceased, and the symptoms subsided, the drainage instrument was still indispensable. During the time the opening has been [was] left open in order to secure the advantages of physiological rest and drainage of the whole urinary system, the patient has been free from the evils of incontinence of urine. As her letter shows, she has been enabled by the use of the drainage support to perform her daily duties and enjoy the pleasures of life.

The analysis of my two cases of pyelitis is now completed. In conclusion, I submit the following summary of what I conceive to be the most important results which follow the employment of this new method of treatment.

1. An artificial fistula at one of the ureteral angles of the trigone of the

bladder, the result of the operation of kolpo-uretero-cystotomy, furnishes an opportunity for the observation and clinical study of disease of the bladder, ureters, pelvis, and kidneys, afforded by no other means. Specimens of the urine have been obtained from the ureters by catheterization through the urethra; but the information to be obtained by this means is necessarily limited, and the procedure is open to various objections. The practice of forcibly dilating the urethra in order to facilitate the catheterization is unjustifiable, because it frequently results in incontinence of urine. Catheterization without dilatation of the urethra—"free handed," as it has been called—is a very difficult operation. I have made repeated attempts within the last few years to perform this surgical feat, but they were all failures. This method also involves an amount of probing which is injurious to the bladder, especially if cystitis is already present. It will be remembered that in the case reported my two attempts to pass a catheter into the ureter were each followed by an exacerbation of the chronic inflammation of the bladder. In order to be certain of the source of the pus, especially if it is present only in moderate quantity, the catheter must be passed along the whole length of the ureter to or into the pelvis of the kidney; otherwise it may come from the ureter, and ureteritis at the vesical portion of the duct is, I believe, a very frequent complication of cystitis. In consequence of the spiral course of the ureter (see Fig. 3), only a very flexible instrument can be safely passed into the pelvis of the kidney; and in order to discover the ureteral orifice by probing the bladder, a moderately stiff catheter must be employed. When an opening in the bladder has been made, the orifice of the ureter can be exposed to view, and the most flexible instrument guided into it.

2. The means of easy access to the bladder, ureter, and pelvis of the kidney, afforded by the operation of kolpo-uretero-cystotomy, are even more important for treatment than diagnosis. Irrigation of the pelvis of the kidney removes pus and ammoniacal urine from contact with its mucous membrane. Gradual dilatation of the ureter overcomes narrowing of the duct at its orifice or along its course; the escape of irritant substances from the pelvis is thus made more easy, and the descent of a calculus impacted in the ureter would be facilitated. Physiological rest and perfect drainage of the bladder, ureters, and pelvis, tend to cause the subsidence of inflammation of their lining membrane, and atrophy of their thickened muscular coats. In consequence of the removal of the pressure of the urine, an enlarged bladder or a dilated pelvis returns to its normal size.

3. By this new method of treatment, the patient is exposed to but little danger in comparison to that involved in the grave operations of nephrotomy and nephrectomy. These major operations are seldom done except at a late period, when extensive renal disease has occurred, and,

if the case does not terminate fatally, result in the partial or complete loss of one of two vital organs. The complicating cystitis is not treated by them, and causes which may afterward lead to disease of the remaining kidney are neglected. Congenital absence of one kidney, coincident disease of both, and pyelitis on both sides, are contraindications to the performance of the operation of nephrectomy, but not to the employment of this new method of treatment. Kolpo-uretero-cystotomy should be done early. By the operation, and the subsequent treatment, the associated lesions of the bladder will be cured, and in many cases all the urinary organs restored to a normal condition. In other cases, by the accurate means of diagnosis afforded by the opening in the bladder, allowing the use of the catheter and renal sound, a stone in the pelvis of the kidney too large to pass through the ureter, extensive suppuration of the kidney itself, or some other condition not susceptible of cure by this method of treatment, may be discovered. Nephrotomy or nephrectomy may then be resorted to with greater confidence, and an increased probability of success. The patient is meanwhile relieved from the distress resulting from the complicating cystitis and pyelitis. The vesical and pelvic irritability and tenesmus no longer causing loss of sleep, her general condition can be improved, and she is better prepared to undergo a serious operation.

4. Intravaginal drainage prevents the evil consequences of incontinence of urine, and perfects the method by removing the chief objection to its employment.

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