

LUYS'S INSTRUMENT FOR THE INTRAVESICAL SEPARATION OF THE TWO URINES.¹

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FROM the earliest times the urine has been studied with increasing success as an index of disease; but it is only in the last twenty-five years, since the development of renal surgery, that the necessity for an examination of the separate urine from each kidney has arisen, as an aid to a more exact diagnosis, and more accurate appreciation of the functional capacity of each organ. The older methods of meeting this requirement are of interest, and aid in a better understanding of our subject.

Tuehmann, a German physician practising in London in 1874, was apparently the first to emphasize the value of thus separating the urines and the insufficiency of the methods theretofore in vogue in differentiating various surgical affections of the kidney; for example, he said, in determining the source of a hæmaturia or a pyuria, or distinguishing between kidney colic and impaction of a stone. He employed a modified lithotrite with a short right-angled beak, between the blades of which he compressed one ureteral orifice; the bladder urine collected during the time of compression representing the secretion of the opposite kidney. In its use he was guided to the mouth of the ureter by the smooth surface of the trigone, which could not be pinched up, and by the ligamentum interuretericum, which he had found, after a study of the bladder in fifty cadavers, was so prominent as to be felt like a cord when the instrument passed over it, even imparting to the hand a slight vibration. In his first paper he reported the use of the instrument in eight

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patients, mostly males, and also experiments with it on himself.¹

Gustav Simon a few months later criticised this method of Tuchmann, and demonstrated it was quite possible to directly catheterize the ureters. This he had accomplished seventeen times on fifteen patients, and was convinced the procedure was easy in the majority. He dilated the urethra under chloroform narcosis, introduced the index-finger, and was guided to the ureteral orifices, which themselves cannot be felt, by the inter-ureteric ligament and the lateral elevations formed by the muscle fasciculi of the ureters which are prolonged towards the bladder, which he said he could readily recognize. Later, Simon took as a guide the orifice of the uterus, which was readily distinguishable through the vesical wall, the mouth of the ureter being found three-fourths to one centimetre outside the commissure of the lips of the cervix and one-fourth of a centimetre in front of it.² He objected to the method of Tuchmann, first, because of the difficult orientation of the bladder at the end of such a long instrument, and, second, because of the short time the ureter could be compressed. His clinic in Heidelberg was visited by Tuchmann, and each demonstrated to the other his method.

Thus in the very beginning of urinary separation a discussion was precipitated as to the relative value of direct ureteral catheterization and indirect intravesical separation. The difficulty of the former was the first objection urged against it. It was out of the question, except in females. Winkler found it impossible either on the living or cadaver.³ Tuchmann objected to it because chloroform narcosis was necessary, and he regarded the separation as incomplete on account of the flow of urine alongside the catheter and into the bladder, if the bladder urine was accepted as the secretion of the other kidney.

Following Tuchmann and Simon, the subject was taken up the next year by Grünfeld.⁴ One of his assistants, Stein, had employed two years before the endoscopic tubes of Desormeaux in examining the bladder in both males and females.⁵ Grünfeld was the first to catheterize the ureters by the aid of

vision. He filled the bladder with water and employed straight, short, endoscopic tubes with a glass window at the distal extremity, the source of light being outside the bladder. He described minutely at what angle to turn the endoscope with reference to the median line of the subject and the depth to which it was to be pushed into the bladder to find the ureteral orifices, thus anticipating Kelly nearly twenty years.

Pawlik⁶ improved the method of Simon by introducing the metal ureteral catheter through the undilated urethra. With the woman in the knee-chest position and posterior vaginal wall retracted, the position of the catheter could be noted through the anterior vaginal wall, and was guided to the ureteral orifices by the prominence, there to be noted, of the interureteric ligament and the cord-like elevation of the ureters. He had thus sounded thirteen patients at the time of his first paper. "It is natural," he writes, "that in an opening so small one does not succeed at once; ordinarily, however, one succeeds quite rapidly." Later, he catheterized simply by means of the finger in the vagina to guide the catheter.

Warnots⁷ seems to have been the only other surgeon to succeed with the method of Pawlik. His efforts on the cadaver in imitating Simon were so discouraging he did not attempt it on the living. Following Pawlik, however, he was more successful, and in each of two women catheterized one ureter in about twenty minutes.

The work of Newmann seems to have been generally overlooked, probably because it is buried in a thesis on malpositions of the kidney submitted to the University of Glasgow in 1883 for the degree of M. D.⁸ He dilated the bladder in the female with eight ounces of boracic acid solution, and took a step in advance of Grünfeld by introducing into the bladder a small electric light, on a long stem. The ureteral catheter was next introduced, and then a cone-shaped speculum with a glass end. He evidently used this method successfully in his practice.

Recognizing the difficulties of ureteral catheterization, which was confined to the hands of a very few, and even with them limited in use to the female, Silbermann⁹ reverted to the

method of Tuelmann, and devised a very clever instrument for compressing the ureteral orifice, which, however, like its prototype, was seemingly never used except by its originator. His idea was to imitate nature and close the ureteral orifice as by an artificial tumor, having had a patient with a fibroid tumor of the bladder set squarely in front of one ureteral orifice. To this end he concealed in a No. 18 (Charrière) catheter a small rubber balloon, which was made to protrude, when within the bladder, by filling with mercury, the weight of which compressed the ureteral orifice when directed over it. He had used the instrument twenty-seven times in fifteen patients, but could not attest the accuracy of the separation because none of the patients suffered from a unilateral affection of the kidneys.

Thus far efforts at catheterization of the ureters had been confined to the female. In anticipation of a case in the male which might imperatively demand catheterization, Harrison¹⁰ in 1884 investigated its possibility, on the cadaver, through the lateral lithotomy incision, but found it necessary in addition, in order to bring the ureteral orifices into view, to open the abdomen in the median line and make pressure on the fundus of the bladder.

With the mention of Hurry Fenwick's "Urinary Aspirator,"¹¹ I have about completed an enumeration of the earlier steps which have led up to our present methods in separating the two urines. "The aspirator consisted of an elastic ball and an oval glass bottle, which could be affixed to the end of a specially curved catheter, which latter was furnished with an elongated laterally placed eye. Later, the catheter was double channelled so that the urine from the disengaged ureter might enter and drain into a different receptacle." Apparently only very small quantities were thus secured, for the urine rarely ran into the bottle, but had to be collected from the catheter channel.

A reflection in the United States of these efforts in Europe at separation of the two urines is found in a discussion before the New York Practitioners' Society in 1883.¹² In the report of a case of hip-joint amputation with the aid of a Davy's level

to control hæmorrhage, Weir called attention to the fact that the ureters were within the area pressed upon by the lever, and suggested it might be used "to determine the comparative condition of the two kidneys," in place of the hand which Sands had employed in at least one case. In the discussion, Polk described a double-curved catheter he had devised and used on the cadaver to compress the ureter through the bladder against the pelvic wall.

How successfully ureteral catheterization was taken up in this country in 1892 by Kelly is familiar to all. But this method of separating the urines was not equally applicable in the male until the perfection of the catheterizing cystoscope by Albarran in 1897,¹³ since which time intravesical separation has been all but abandoned.

It is the object of this paper to call attention to a new intravesical separator, which again brings this method into prominence, and which is certainly destined to fill an important place in our armamentarium. My prophecy for it is not as sanguine as that of its originator; it cannot supersede ureteral catheterization in all cases, but it will surely be a valuable adjunct to that method,—one supplementing the other, each having its own field of usefulness. Further, it will make urinary separation possible in the hands of many who have not the time or inclination to learn ureteral catheterization. Luys's instrument is now widely used in France, and more recently in Germany, but as yet is scarcely known in the United States, only a few cursory references having been made to it. In England it has been discussed by Bickersteth.¹⁴ Before describing it, it is necessary to briefly refer to three instruments which immediately preceded it, and which constituted a new departure in urinary separation not yet referred to.

It was Lambotte, in 1890,¹⁵ who described the first instrument for partitioning the bladder. This consisted of a double sound provided at its distal extremity with two straight, parallel steel springs covered by a small rubber balloon. The springs when relaxed extended themselves and formed a con-

tinuation of the shaft of the catheter (Fig. 1), but when traction was made at the proximal end of the instrument on a rod

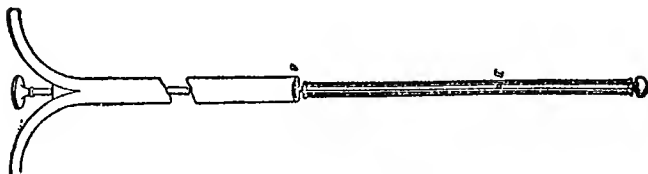


FIG. 1.—After Lambotte. Closed.

running between the springs, they outlined a circle or an ellipse according to the amount of traction, and with the rubber made taut, formed a vertical partition in the bladder (Fig. 2); when the springs were released they again became extended, and did not interfere with its removal. Lambotte seems to have employed the instrument with some success in both the male and female, and occasional reference is made to it by others;¹⁶ but apparently it was unknown to Neumann, who seven years later

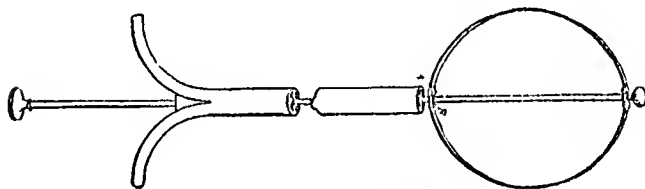


FIG. 2.—After Lambotte. Opened.

briefly described the second instrument for partitioning the bladder, this one only applicable in the female, however.¹⁷

Neumann's instrument (Fig. 3) consisted of a double catheter, provided with a median ridge which formed the septum between the ureteral orifices when pressed against the base of the bladder, supported by a finger in the vagina. This instrument attracted considerable attention. Kelly¹⁸ said that at first it looked as if it would limit the use of the ureteral catheter.

A year later, Harris¹⁹ described his urinary segregator, which is still used successfully by many, and is now so well known as to hardly need description. The principle involved was a new one and entirely original with him. By means of a lever introduced into the vagina, or into the rectum in the male, and pressed up against the base of the bladder, a sort of watershed was raised between the ureteral orifices, each side

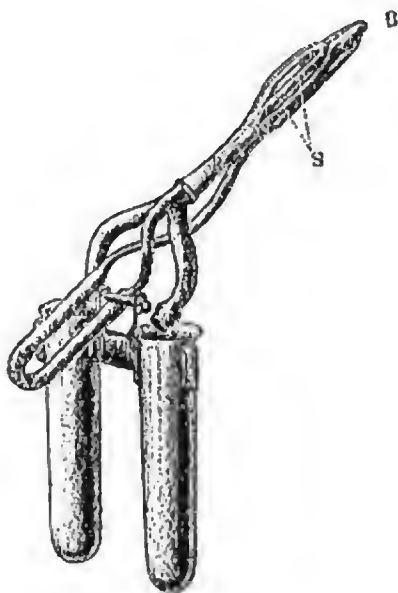


FIG. 3.—After Neumann.

being drained by an ingenious double catheter. This instrument I have used from time to time since its introduction, but never with a feeling of absolute security as to the results obtained. The lever and aspirating bulb complicated the instrument considerably. Downs's modification aimed at the elimination of the latter objection, and was successfully used in

Germany by Freudenberg and in France by Nicolich and others.

In France, the Harris instrument was first employed by Hartmann at the Lariboisière Hospital, Paris;²⁰ but it did not prove satisfactory in his hands. Early in 1901, his assistant, Luys, showed him a new instrument the latter had devised for intravesical separation of the two urines, and from the first trials of it, which were made in his clinic, its superiority to the Harris instrument was apparent, and, slightly modified, has been in constant use there since. "In all," Hartmann says, "over 400 applications of the instrument have been made in 210 males and females, without accidents and with perfect results, establishing in an irrefutable manner the accuracy of the method; the question being settled for all those who have seen it used, and further discussion impossible. Its simplicity and facility of manipulation, which puts it at the door of all practitioners, explains how, in a short time, intravesical separation of the urines, until this moment almost abandoned, has made, so to speak, the tour of the world. Very rapidly it has been accepted, and has taken the place of catheterization of the ureters, which until now has reigned supreme in Paris. The Necker Clinic, where ureteral catheterization originated, and where it was vulgarized, seems actually to abandon it, as the successive publications of Cathlin and Legue indicate."

Luys states²¹ he began to study the subject immediately after the termination of his "Internat" in 1890. In the course of his dissections, he was struck by the fact, so simple and so well known, that when one has the opened bladder before him, and places the extended finger between the ureteral orifices, one can depress the base of the bladder, and thus create two pockets, entirely distinct, in which will collect the separate secretion from each kidney. It was manifest that, to obtain a good intravesical separation of the urines, it was not necessary to partition the upper part of the bladder, but only necessary to thus depress its base to prevent all mixing of the two urines, if one insured the drainage of each pocket to prevent too great an accumulation of urine in them. He therefore simply substituted for his

finger an instrument which could be readily introduced through the urethra, intended to thus depress the base of the bladder, and provided with a median partition to be extended at will.

The essential principle, then, to which he directed his efforts, was the elevation of a water-tight septum, in the small triangle lying between the ureteral orifices and that of the urethra, in such a manner as to collect on each side the secretion from the corresponding kidney, and providing free drainage for each side so as to prevent accumulation of urine within the bladder. He points out that the three elements of the trigone, *i.e.*, the urethral and right and left ureteral orifices, have a fixed relation to each other, quite independent of the dimensions of

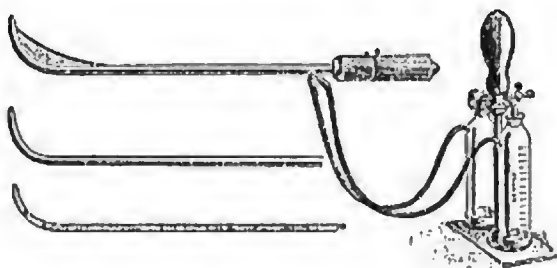


FIG. 4.—After Luys. Earlier model.

the bladder itself. The distance between the ureteral orifices varies always between twenty and thirty millimetres, while that from the apex of the triangle (the urethral orifice) to the base of the triangle (a line connecting the two ureteral orifices) is equally constant, between twenty-five and thirty millimetres.

To these fixed relations he adapted his instrument of fixed and uniform dimensions. It consisted of three parts,—two removable hollow metallic sounds of the ordinary Guyon curve, flattened on their inner surfaces to accommodate between them the third piece, a flattened metallic stem of the same curve (Fig. 4). This intermediate piece carries the handle of the instrument, and, projecting a little beyond the convex surfaces of the two laterally placed hollow sounds, forms the metallic

septum when pressed against the base of the bladder; in its concavity lies a small chain, like that of an *éraseur*, which forms a chord to the arc of the extremity of the instrument when made taut by a screw in its handle. A *gutta-percha* "chemise" covers this intermediate part like a finger-stall, and when raised by tightening the chain forms a rubber septum in the bladder three centimetres high, above which the urines cannot mix, as constantly drained from each side by the hollow metallic sounds. When slackened, the resiliency of the rubber "chemise" carries the chain back into place in the concavity of the curve of the metal stem. The two hollow metallic sounds fit into the handle on each side of the stem, and are attached to the latter at its distal extremity by a small screw cap; the instrument thus assembled has a circumference of about twenty-four millimetres. The openings in the lateral catheter channels for draining the urine from each side of the septum are on the inner and upper surfaces, to avoid their occlusion by the mucous membrane of the bladder.

The simple Guyon curve of the original instrument (Fig. 4) exposed it to three objections. Considerable pain was often caused by dilating the neck of the bladder in extending the rubber septum, if the entire chain and arc subtended by it were not within the bladder, or if the full introduction was prevented by an anteroposterior diameter of the bladder of less than seven centimetres. Second, there existed sometimes, below the convex surface of the metallic septum, a small retroprostatic cul-de-sac (Fig. 5), permitting a partial admixture of the urines, to avoid which it was necessary to lift that part of the bladder wall against the instrument with the finger in the rectum. And, third, by reason of the elevated position of the handle of the instrument, an aspirating bulb was necessary. (Fig. 5.)

The subject of the best catheter curve for drainage of the bladder, especially in cases of prostatic hypertrophy, had recently been studied in France by Eseat.²² By adopting what is known as the Eseat curve (Fig. 6), all three of the above difficulties incident to the simple Guyon curve were at once overcome.

Later, Luys had constructed a smaller model, No. 15, to be used on children, and, at the invitation of Albarran, success-

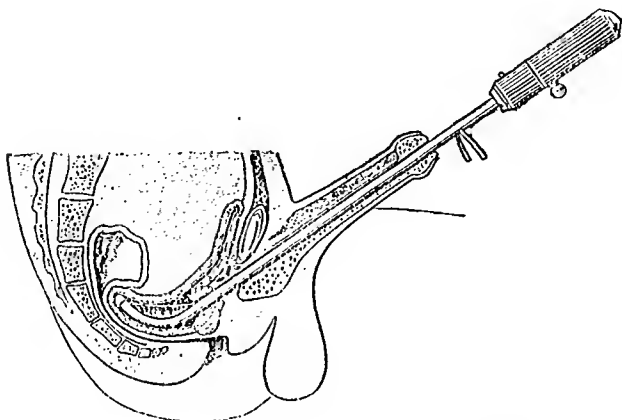


FIG. 5.—After Luys. Showing retroprostatic cul-de-sac with earlier model of instrument.

fully separated the urines in the case of a little girl of six and a half years, in which this skilful operator was unable to catheterize the ureters,—on the left side because the ureteral orifice

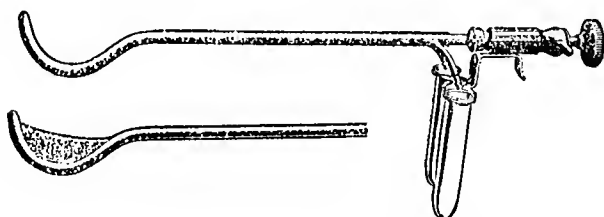


FIG. 6.—After Luys. Later model assembled.

could not be found, and on the right side because of numerous fungosities arising within the ureter and encircling the orifice.²³ The character of the urine obtained by the separator from the

left side pointed to disease of that kidney, which was corroborated a few days later by nephrectomy performed by Albarran.

As the instrument has a fixed curve, it is necessary to adapt the posterior wall of the bladder to it by bringing the patient into a sitting position after its introduction. Luys has found on the cadaver, as long as this position is maintained, the septum is perfectly stanch. If the patient had to be anæsthetized, a necessity hardly liable to arise, the upright position might constitute an objection to the use of the instrument. Luys mentions one case, with a very painful secondary tubercular cystitis, in which a few whiffs of chloroform were required. At first sight this unusual curve for a urethral instrument suggests difficulty and pain in its introduction; and, indeed, these

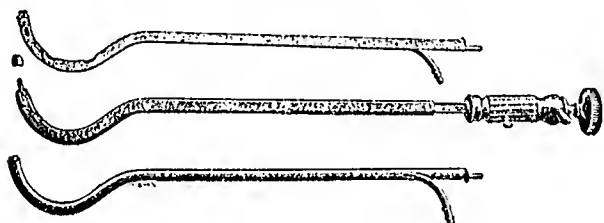


FIG. 7.—After Luys. Later model, showing parts.

are the chief objections raised against the instrument. If one attempts to remove it from the bladder with the same upward motion of the handle appropriate with the simple Guyon curve, this can only be accomplished by brute force, which will be most painful. The handle must be first depressed and then elevated, and if any difficulty is experienced, a slight elevation of the pelvis with a support under the buttocks will give room for still greater depression of the handle. The same movement of alternate depression and elevation of the handle also secures the introduction of the instrument without pain. In its present form with the Escat curve, the development of the rubber septum is absolutely painless, once the instrument is within the bladder, and if properly maintained in position is not more

than uncomfortable, as apprehensive patients have informed me. I have several times permitted it to remain an hour in place, though sufficient urine is usually obtained in twenty or thirty minutes.

The handle is very slightly raised, and forward traction made so as to apply the convexity of the instrument snugly against the base of the bladder. Luys says that if one is careful to combine gently these two movements, *i.e.*, slight traction and then elevation of the handle, one can be certain the septum is

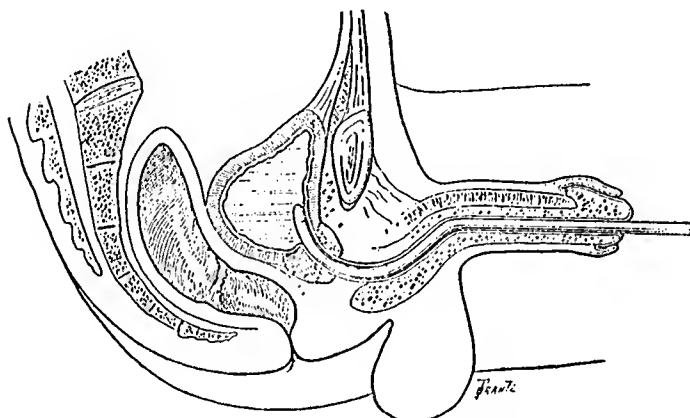


FIG. 8.—After Luys. Instrument partially introduced.

perfect and that the urines do not mix. No force is used; it simply being necessary to bring the elasticity of the tissues into play and feel slightly the resistance of the neck of the bladder and its base. If the handle is too vigorously elevated, the patient complains a great deal. A rectal examination will assure the operator the instrument is accurately placed, and the patient is instructed how to so keep it; it is inadvisable to use the support, as Luys himself states, because the patient may accidentally move and change his position with reference to the instrument, and thus jeopardize the separation.

Before introducing the instrument, the bladder is first thoroughly washed out, forty or fifty cubic centimetres of boracic acid solution being allowed to remain to start the siphon. If the patient secretes less than a litre of urine a day, Luys suggests a diuretic or a copious drink of water a quarter of an hour before the separation. The lower bowel should be empty and a previous examination demonstrate no obstruction exists in the urethra.

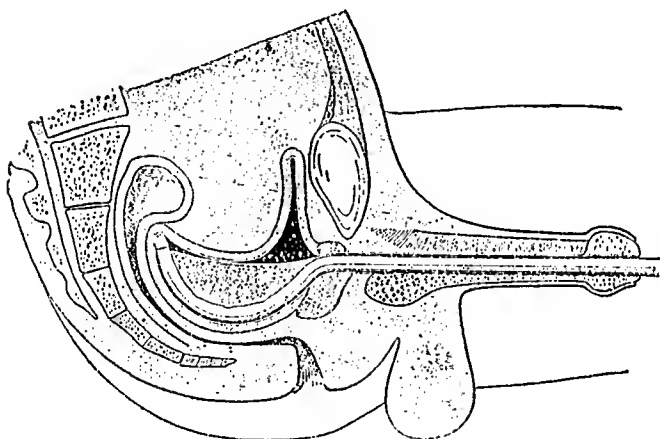


FIG. 9.—After Luys. Instrument fully introduced.

The accuracy of the separation, if the instrument is properly used, in suitable patients cannot be questioned in view of over 200 case histories reported by Luys, which include nephrectomized patients with not a drop of urine flowing from the catheter corresponding to the side operated upon, and patients with a hæmaturia or pyuria with absolutely clear urine on the sound side.

There is another instrument for the intravescical separation of the urines much used in France, devised by one of Guyon's assistants at the Necker Hospital, Cathlin, whose name was already well known as the author of the epidural route for

spinal injections. The central idea in this instrument seems to have been to overcome the fixed dimensions of Luys's instrument and adapt it to the varying capacity of different bladders. This he accomplished in a very clever manner by means of a thin pear-shaped rubber septum attached to and supported at its periphery by a thin ribbon of watch-spring steel. The septum is concealed in the shaft of the instrument and pushed out into the bladder to a distance, as indicated by a scale on the shaft, corresponding to the previously determined capacity of the bladder. The one great advantage of the instrument is in bladders of very small capacity; Legue²⁴ reports a successful application in which the bladder would only hold eighteen cubic centimetres.

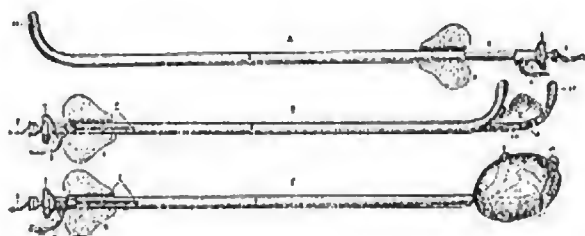


FIG. 10.—After Rochet and Pallenda.

But this feature is outweighed by several objections,—greater cost, larger caliber (No. 28), smaller catheter channels, and an increased liability therefore to their occlusion; but more than all, an uncertainty as to the stanchness of the septum, which is jeopardized if the membrane is developed too far or not far enough, when a fold of the rubber tissue of the diaphragm, and not the metallic periphery, is applied to the bladder wall. In a bladder which contracted strongly, the delicate membrane would be doubled up, or, if the bladder wall is relaxed, as in chloroform narcosis, the instrument cannot be employed, as Cathlin himself states.²⁵ The success of the separation is consequently subordinate to the contractility of the bladder, which, as Luys points out, it is absolutely impossible to

regulate, and further urges against the instrument that the idea of vesical graduation is entirely foreign to the principle of intravesical separation of the urines. The Cathlin instrument has been used in this country by Keen and Valentine. It might be successful in the presence of a fibroid uterus or carcinoma of the cervix in which the depression of the base of the bladder necessary for the Luys instrument could not be obtained.

In the rare cases of vesical fistulæ where the bladder could not be distended with either air or water, a new instrument (Fig. 10), described by Rochet and Pallenda,²⁰ for compressing the ureteral orifice, and almost identical in principle with the instrument of Silbermann, may find a field of usefulness.

Before indicating wherein intravesical separation is to be preferred to ureteral catheterization, let us consider briefly what legitimate objections can be entertained against this latter procedure, for theoretically one acknowledges it is the ideal method of urinary separation.

First, its difficulty is urged by a large number who either have not the time or inclination to acquire the necessary ability; but for those who use the cystoscope this objection does not hold in the majority of cases, though in the hands of the most expert in some cases ureteral catheterization is impossible. To those whose first efforts have been made with the indirect lens system, as were my own, the comparative facility of the operation with the direct cystoscope, which has been perfected in this country by Tilden Brown, will come as an agreeable surprise.

A second and serious objection is our knowledge that there is a danger which, though small, actually exists. Two or three deaths at least have been reported from simple exploratory catheterization, as that cited by Tuffier.²⁷ Sampson, the Resident Gynecologist at Johns Hopkins Hospital, recently had a death from an ascending ureteral infection as the result of employing the catheter as a guide to the ureter during a hysterectomy for cancer of the uterus. Israël²⁸ reported the case of a physician with an old urethritis and a slight cystitis. One ureter was catheterized by Casper because of lumbar pain on that side; the urine collected through the ureteral catheter was clear, and the

patient rejoiced that his kidney was normal. That night he was seized with lumbar pains, chills, fever, vomiting, and later passed a cloudy urine containing pus. This condition still persisted at the end of three years, with fever and pyuria. Hartmann²⁰ points out that a slight pyonephritis set up by the ureteral catheter would not attract immediate attention, but would require a certain time to develop, and perhaps not be traced to its true cause. Krotoszyne³⁰ says that Nitze, in a personal conversation, stated that in his opinion catheterization of the ureters had done a great deal of harm because performed without strict indications. Nearly all operators regard a severely infected bladder as a dangerous circumstance in the use of the ureteral sound; in the presence of a tubercular kidney, the catheterization of the supposedly normal side is absolutely impermissible.

Albarran,³¹ however, regards ureteral catheterization as entirely innocuous, and in support of this contention cites the 1000 cases of Casper, a like number of his own, the hundreds of Nitze, those of Pasteau, more than 500; of Kolischer, more than 500; Bierhof, 475, and many others. The dangers are probably overrated by the majority of antagonists of ureteral catheterization, but they are great enough to demand most careful attention to asepsis, and a regard for legitimate contraindications.

A third difficulty is encountered, if but one ureter is catheterized, and it is not entirely occluded by the sound; a part or all of the bladder urine, which is regarded as the secretion from the uncatheterized kidney, may come from the catheterized side by reason of the urine on that side trickling between the wall of the ureter and the catheter. Albarran has endeavored to overcome this with a specially devised catheter with open end and a slight swelling immediately behind. This source of error is, of course, entirely avoided by simultaneous catheterization of both ureters.

The following points of superiority, then, can be advanced for the Luys instrument: its simplicity and freedom from all danger reduces urinary separation from the dignity of an oper-

ation to a procedure, and gives it a certain medical interest; in fact, last year a Paris Thesis³² was devoted to the medical aspects of the subject; tuberculosis of one kidney or an infected bladder do not constitute contraindications to urinary separation with this instrument. In children, in prostatics, and in patients with a reduced bladder capacity, it is successful where catheterization may be impossible. Among Luys's cases of prostatic hypertrophy, however, I find one in which the separation could not be effected, because the use of any instrument caused bleeding in passing the prostate and the blood-clots plugged the mouths of the catheters.

The following advantages of ureteral catheterization over intravesical separation are urged by Albarran:

First. Absence of bladder contamination. This I admit as far as bacterial contamination is concerned; but as to histological elements, if the bladder is first thoroughly washed out, even in a severe cystitis the small area over which the urine flows could not furnish enough pus to give rise to an erroneous interpretation, a point always made by Harris with regard to his instrument; in the presence of a hæmaturia, an examination of the bladder would naturally first be made.

Second. Greater security as to actual separation would seem to be absolutely refuted by Luys's 210 cases. The only possible error with the Luys instrument, properly used in suitable cases, comes from an atypical implantation of the ureteral orifices. The authors who have devoted themselves to a study of anomalies of the trigone are very few; but it is well known that such anomalies are very rare. If the examination furnishes two identical urines, this would necessitate a cystoscopic examination to demonstrate whether the ureteral orifices were normally placed; usually, however, the accuracy of the separation is attested by at least slight differences in the specimens. In the very rare cases in which there is a double ureter on one or both sides, the Luys instrument might give more reliable information than catheterization.

Third. Simultaneous cystoscopy is an undeniable advantage, but only in a first examination.

Fourth. Simultaneous exploration of the ureter is also an undeniable advantage, but only at the first examination. Luys describes a method of Berger, which he has made use of a number of times successfully in dilatation of the pelvis, intermittent retentions, kinking of the ureter due to displaced kidney, etc.; the manœuvre consists simply of elevating slightly the diseased kidney towards the diaphragm, which will empty the pelvis of its tell-tale contents, when otherwise little or no urine would be secured from that side.

Fifth. If the contention of Albarran that a correct estimate of the functional capacity of the kidneys can only be arrived at by a study of the separated urines collected during at least four to six hours, or better twenty-four hours, proved to be true, the usefulness of Luys's instrument would be greatly restricted, for the ureteral catheter has been allowed to remain *in situ* twenty-four hours, anything approaching which would be impossible with Luys's instrument. But Albarran is alone in this contention, others, including Casper, maintaining that a better conception of the functional capacity of the kidneys is obtained by several examinations on successive days, or fifteen to twenty minutes' duration.

Albarran's fifth and final claim is that the catheterizing cystoscope is easier to introduce than the Luys instrument.

It is now apparent that each of these two methods of separation has a field of usefulness of its own, one supplementing the other. There are certain well-defined indications for the ureteral catheter, but in a large majority of cases the instrument of Luys will be found sufficient "to permit a rigorously precise diagnosis of the functional state of the kidneys and lay down the indications for operation." (Hartmann.) The ureteral sound will be used in locating stone and stricture; and in connection with the X-rays, after the suggestion of Illyès,³³ to outline the ureter and locate the kidney; to collect urine for bacteriological examination; to exclude the ureter as the source of pus or blood, and of course for therapeutic purposes.

Separation of the two urines has extended far beyond its

original indications. It is demanded in all cases of hæmaturia; in the early diagnosis of renal tuberculosis; in all obscure abdominal tumors as an aid in differentiating between involvement of the kidney and surrounding organs. In view of the work of Edebohls and his followers in decapsulating the kidneys, urinary separation should be resorted to early in all cases of nephritis. Edebohls³⁴ in 1901 reported eight instances of unilateral nephritis among nineteen cases of chronic Bright's disease on which he had operated, and recently added three more out of a total of seventy-two cases. "This feature of my work," he says, "evoked, perhaps, more comment than any other, and met dissent and incredulity in not a few quarters." The further necessity of urinary separation as a preliminary to all operations on the kidneys is shown by the statistics of v. Sehmedien;³⁵ in a series of 1118 nephrectomies he found that of 301 deaths following the operation, fifty-six times it was due to anuria, or uræmia, in consequence of disease, or entire absence, of the other kidney.

The present lowered mortality in kidney surgery is for the most part due to a preliminary study of the separated urines. While the efforts of the last few years towards an exact appreciation of the functional capacity of each kidney have been unsuccessful, a comparison of the two urines, as to freezing-point, phloridzin elimination, chemical and microscopical characteristics gives us an approximate idea, and at the same time most valuable surgical indications. A consideration of this aspect of urinary separation, however, would lead us beyond the limits of this paper.

In conclusion, I will briefly detail several case histories illustrative of the use and accuracy of Luys's instrument:

CASE I.—Mr. S. came to me complaining of rheumatic pains in arms, legs, and especially in the back, which latter were exaggerated by the muscular exertion of stooping, for instance, just as in an ordinary lumbago. A rather large amount of amorphous urates from a freshly passed and centrifugalized specimen of bladder urine, containing also a few granular casts, many pus-cells but no albumen, immediately directed attention to his kidneys.

The next day I separated the urines with Luy's instrument, believing, however, that I was dealing with a medical affection of the kidneys.

Instrument permitted to remain fifty-five minutes. Preliminary injection of five milligrammes of phloridzin half-hour before.

	RIGHT.	LEFT.	BLADDER.
Amount. Color.	28 cubic centimetres. Cloudy and very high colored.	12 cubic centimetres. Clear and straw-colored.	Cloudy.
Amount of deposit with centrifuge.	.2 cubic centimetre, composed mainly of amorphous urates, few pus- cells.	No deposit.	.2 cubic centimetre, composed of amor- phous urates and many pus-cells.
Phloridzins. Urea.	Phloridzin negative. 12 grammes per litre.	Negative. Same.	14 grammes per litre.

The large deposit of amorphous urates on one side only, from freshly passed urine, suggested a renal calculus. Next day took two radiographs; both showed a stone in pelvis of the right kidney.

CASE II.—Mrs. R. Husband brought specimen of wife's urine for examination; she had been sick several months, and nature of illness had not been determined by her physicians in the neighboring village where they lived. Urine contained a large amount of pus but no kidney elements. Centrifugalized a large amount of urine and stained the pus for tubercle bacilli with positive results. I gave the husband an unqualified diagnosis of a tubercular lesion some place in the genito-urinary tract. A week later I was requested to see patient for the purpose of determining, if possible, the exact seat of the trouble. I found the right side of the abdomen in the kidney region very sensitive, and the muscles so rigid I could not palpate the kidney, but on percussion it was easy to make out what was apparently that organ, very much enlarged. Cystoscopic examination showed the seat of the trouble was not in the bladder. I separated the urines with Luy's instrument.

	RIGHT.	LEFT.
Amount.	7 cubic centimetres.	4 cubic centimetres.
Urea.	Urea, 25 grammes per litre.	10 grammes per litre.
Pus.	Large amount of pus containing tubercle bacilli.	Few pus-cells, no tubercle bacilli.

I made an unconditional diagnosis of tuberculosis of right kidney. The small urea output on opposite side suggested a further study of the secretion from that kidney before a final decision as to operation. I so explained to the husband. I tried to get other bladder specimens to watch the urea excretion, but was informed "they were out of specimens," which rather amusing statement was explained later by the husband frankly acknowledging he had endeavored in every way to disprove my diagnosis, sending specimens to the State Laboratory, to Mulford's in Philadelphia, also, I believe, and in many other directions. Nephrectomy by a confrère without further separation of urines; diagnosis confirmed. Death on third day with uræmic symptoms.

CASE III.—Mr. L. had an asthenia of undetermined cause. Because of a peculiar bronzing of the skin, the possibility of Addison's disease had been entertained by one of my professional friends. History of a hæmaturia about six months before, however, suggested a separation of the urines.

	RIGHT.	LEFT.	BLADDER.
Amount.	8 cubic centimetres.	10 cubic centimetres.	
Appearance.	Clear.	Clear.	
Urea.	Urea, 14 grammes per litre.	Same.	20 grammes per litre.
Chemical examination.	Quantitative comparison of chlorides, phosphate, and total purins with the centrifuge gave same amounts on both sides.		

Asthenia, bronzing of skin, and the hæmaturia explained by eliciting a history of chronic malarial poisoning.

CASE IV.—Mr. S., thirty-five years old, two years ago suffered from a depression in health, the cause of which I could not determine. I went over his chest most carefully because of a slight cough, but found nothing even suggestive of tuberculosis. I gave him an injection of tuberculin with negative results. Several examinations of the urine were likewise negative. A couple of months in the country restored his health sufficiently to keep him

out of my hands for two years, though he has not been perfectly well. This spring he began to lose flesh, and again consulted me. My suspicions as to a tubercular lesion in the lungs were again excited. I had him take his temperature daily. It was found that he was running a temperature between 99.5° and 100.5° F., which continues to date. Pulse has been constantly around 100. An X-ray examination of chest being negative as to any evidence of tuberculosis, I repeated the injection of tuberculin of two years before, giving ten milligrammes at the first dose; no reaction. It was at this time I elicited the history of a venereal sore five years before. I conferred with the physician who treated him, who told me there were no secondaries, but that the patient was so worried about the affair he gave him a course of mercury by the mouth. This was most unfortunate, for there was no way to exclude syphilis as the cause of his present depression in health except to try the effects of specific treatment. Took mercury three months by the mouth without effect on symptoms. Was not materially improved by about two months in the country.

Several examinations of the urine were negative before my vacation. On my return I was greatly surprised on again examining a specimen to find a distinct ring of albumen. Previous failures to detect albumen were explained by daily examinations of the urine, a distinct ring being present one day and entirely absent for the next two or three, perhaps. Attention having thus been directed to the kidneys, I separated the two urines with the Luys instrument with the following result:

	RIGHT.	LEFT.	BLADDER.
Amount.	17 cubic centimetres in 45 minutes.	15 cubic centimetres.	
Urea.	15 grammes per litre.	Same.	23 grammes per litre.
Specific gravity.	1025.	1020.	1030.
Casts.	Few, hyaline and waxy.	None.	
Mucus.	Considerable mucus.	Same.	
Pus-cells.	Large number of pus-cells. Number of large, round, and caudate cells, with degenerated nuclei on right side, but many more on the left side.	Few.	

In referring to large amounts of mucus, cells, etc., I refer to all that could be obtained in the tip of the tubes of the centrifuge. The total amount was about .4 cubic centimetre, and macroscopically simply had the appearance of a cloud of mucus.

A low blood-pressure of 110 enables me to exclude contracted kidneys; the blood examination showing only a slight anæmia excludes any malignant disease of the kidneys. (Hæmoglobin, 100; reds, 4,750,000; Sp. gr. 1063; slight leucocytosis.) Diagnosis apparently lies between syphilis of the kidneys and slight pyelonephritis due to colon or other infection, with weight of evidence in favor of latter because of negative results from mercury. In view of the statement of Israël that mercury does not agree with the syphilitic kidney, and that, on the contrary, potassium iodide does act favorably in those cases, I have recently begun pushing the latter without yet having had time to know what the result will be. An X-ray examination excluded kidney calculus.

A second separation with Luys's instrument gave the following result:

	RIGHT.	LEFT.	BLADDER.
Amount, end of one hour.	12 cubic centimetres.	8 cubic centimetres.	
Specific gravity.	1021.	1027.	1032.
Urea.	11 grammes per litre.	13 grammes per litre.	21 grammes per litre.
Bacteria.	Few.	Abundant.	Abundant.
Casts.	3 or 4 hyalines.	Large number granular.	
Mucus.	Large amount.	Little.	Large amount.
Amorphous urates.	Large amount.	But little.	Large amount.
Fus-cells.	Goodly number.	Few.	Few.
Albumen.	Heavy ring.	Same.	Same.
Caudate and large round cells.	Few.	Abundant.	Few.

A week later I catheterized both ureters. The bladder urine was almost free from any deposit when centrifugalized, and there was the merest trace of albumen; catheters were pushed to pelvis on each side:

	RIGHT.	LEFT.	BLADDER.
Amount.	7 cubic centimetres.	5 cubic centimetres.	
Amount of deposit when centrifugalized.	.4 cubic centimetre of solids.	.2 cubic centimetre, mere cloud.	
Appearance.	Cloudy.	Perfectly clear.	Clear.
Bacteria.	Large number; also cells looking like yeast.	None.	None.
Large, round, and caudate cells, with granular protoplasm and nucleus gone.	Great quantities.	None.	None.
Casts.	Few hyaline.	None.	None.
Specific gravity.	1015.	1020.	Not taken.
Urea.	12 grammes per litre.	Same.	Not taken.
Albumen.	Tracc.	Same.	Same.

It will be seen from this last separation that the ureteral catheter emptied a slight retention in the right pelvis, and still further upholds the diagnosis of a pyelonephritis.

[NOTE (two months later).—A bacteriological examination of the catheterized specimens did not demonstrate a pathogenic organism. The patient has gained twelve pounds in two months since the administration of strontium iodide was begun, and for the first time in six months is without fever.]

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