Demonstrations

ON

THE CYSTOSCOPE

AND A METHOD OF ILLUSTRATING DISEASES OF THE BLADDER
AND THE APPEARANCES IN RENAL DISEASE
BY THE OPAQUE PROJECTOR.*

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PART I.—THE CYSTOSCOPE.

GENTLEMEN,—In the name of my colleagues and on my own behalf I welcome you very cordially to join us in our endeavour to establish post-graduate medical classes in this city. The very large, practically unlimited clinical material at your disposal affords abundant opportunities of studying disease in all its phases, and it will be our object to present it to you by demonstrations in as practical a form as possible.

The medical and surgical staff of the hospital, with the hearty co-operation of the managers, have arranged three terms, one during February and March, the second in May and June, and the third during October and November. We recognize that success depends upon ourselves.

This demonstration is the first of the winter term, and the series includes in all seventy-five meetings, details of which you will find in the syllabus. The subject I have selected is surgical diseases of the urinary organs, and I intend to make the teaching as far as possible practical and clinical.

In studying diseases of the bladder and kidneys, it is very necessary in the first place to know the technique of the modern cystoscope, and in the second place to become familiar with the appearances presented by it to our view. The former is quickly and easily acquired, the latter in all its details demands many years' experience.

In relationship to diseases of the kidney, examination of the bladder with the cystoscope has proved of great practical value, not only in a negative way by eliminating lesions of the bladder from the diagnosis, but also by giving positive evidence of the presence of disease in one or both kidneys. When nephrectomy is contemplated on one kidney, a knowledge of the presence and functional activity of the other is of primary importance. From ocular inspection, if carefully carried out by an educated eye, exact conclusions may be drawn which cannot be arrived at by other means, and the course of treatment can be decided upon early in the course of the disease. By so employing this method, most valuable time may be utilized which would otherwise be wasted waiting for other evidence to prove the nature of the renal lesion. Too often, when we wait until the symptoms are sufficiently significant to form a basis for diagnosis, the disease has advanced beyond our power to remedy.

Cystoscopy, when conducted with aseptic precautions, is unattended with danger, and is comparatively easily carried out in both sexes, but for obvious reasons with greater facility in the female.

After over twenty years' work with the electric cystoscope in its various forms, I feel that I have much still to learn. It must be admitted that while in many instances the cystoscope is not a difficult instrument to use, in others the greatest caution and care is required in order to accurately appreciate what is seen. This I will fully explain later on. It may, however, be encouraging to you to know that although necessarily self-taught, I found that in my early experience many of the grosser lesions of the bladder were easily recognized at first sight, and doubtless in using the instrument you will have the same experience, but with the advantage that you will have some initiation to the work. As in disease of other organs so also in those of the kidney. It is the more obscure diseases that demand experience in their detection. However, the great majority of the lesions of the bladder and of the ureter orifices, after having been once demonstrated to you, you will easily recognize when seen again.

In many diseases of the kidney the symptoms simply

* The first of a series of Post-graduate Demonstrations given at the Royal Infirmary, Glasgow.

point the direction in which information may be obtained, nothing more. For example, pain and bleeding may originate in any portion of the urinary tract; but, while in many instances the character of the hæmorrhage and the situation of the pain correctly indicate the nature and site of the lesion, in others they seriously mislead, unless resort is had to physical proofs to guide and correct the conclusions deduced from the subjective symptoms.

One of the methods employed to eliminate the difficulties in the diagnosis between bladder and kidney diseases is a cystoscopic examination of the bladder, including the appearances of the orifices of the ureters and the nature of the fluid escaping from them. The facts revealed by the cystoscope, combined with the information that may be obtained from bacteriological research, inoculation of animals, chemical examination, radioscopy, and segregation of the urine, added to ordinary clinical inquiry, enable us to advise operation or to refuse it, knowing that we have employed all the methods to our hand.

The majority of surgeons recognize the use of the cystoscope in its application to vesical disease, even although they may not practise its use, but few fully appreciate its value in gaining information regarding renal lesions. It has been my routine practice to make an examination of the bladder of all renal cases prior to operation, almost as regularly as I examine the urine, and I am convinced that by so doing I have been saved from many fallacies in diagnosis and errors in treatment.

In describing the apparatus I shall limit your attention only to the appliances which I have personally found most useful and successful.

For cystoscopic examination a reliable battery is of the first importance, one that will be ready for use at all times, and one which does not deteriorate by lying unused. Primary batteries and dry cells do not fulfil the requirements of men who are using them only occasionally. They are irregular in their action, rapidly deteriorate when not in regular use, and are constantly going out of repair. An arrangement of secondary wet cells, which I devised and have used for over seven years, answers admirably, and during that time the battery has not failed me on a single occasion, whereas, prior to finding out the way of working cells by the method I am about to describe, constant trouble was given even by the best primary and secondary batteries procurable.

The battery* consists of four secondary cells (Fig. 1), the glass or celluloid baths of these measuring 9 in. × 5 in. × 1½ in. These are mounted in a teak box open at the

Fig. 1.

sides, so that the condition of the plates and the solution can be seen, and, if required, a fresh supply of the latter can be made up without dismantling anything or interfering with the connexions.

This accumulator is suitable for most surgical purposes where electricity of modern voltage and ampérage is required. By means of a switchboard consisting of taper plugs the cells can be coupled up so as to give two volts,

* Made by Mr. Trotter, Optician, 40, Gordon Street, Glasgow.

four volts, or eight volts as required. The electrodes of the individual cells are conveyed to a switchboard, and the terminals of the cells when combined are carried to two rheostats, one at each end of the box, one rheostat of low resistance for the low-tension currents, two and four volts, the other a higher-resistance rheostat for the eight-volt discharge. The former is used for cautery work, the latter for the light. The power of the accumulator is an eight-volt current of 20 ampère-hours, four-volt current of 40 ampère-hours, or two-volt current of 80 ampère-hours. It will be understood that at two volts the cells are coupled in what is known as parallel—that is, all the positives and all the negatives together (Fig. 2 *a*). For the four-volt current four negatives are coupled, two at each end of the

Fig. 2.—*a*, plugs placed connecting all the positive cells together and all the negative cells together = 2 volts for 80 ampère-hours. *b*, plugs placed so as to give a 4-volt current of 40 ampère-hours. *c*, plugs placed so as to give 8-volt current for 20 ampère-hours.

battery, while in the centre one negative and one positive are connected (Fig. 2 *b*). For the eight-volt current the negatives and the positives are coupled together (Fig. 2 *c*). This arrangement of a switchboard enables the voltage to be carefully regulated, and prevents wastage of electricity, but in its use care is required. Care must be taken not to short circuit by placing plugs making three connexions between two cells—that is to say, both diagonal and parallel connexions between two cells. The safest

plan is to remove all the plugs, and put them in as marked on the diagram on the box. Should only one change in voltage and ampère be required—the one eight volts of 20-ampère hours, the other two volts of 80-ampère hours—then a switchboard, as shown in Fig. 1, may be employed in place of the one just described.

The cystoscope has now gained for itself a hardly-earned and well-deserved place as an instrument of precision. Only those who have closely followed the literature of the subject are fully aware of the strong opposition offered against its use. In the past this has been largely due to the difficulties experienced in teaching the subject and in demonstrating the appearances observed. Hitherto it has been found very difficult to show others what one sees, unless the lesion is of a gross nature. The slightest movement of the cystoscope in the passing of it from the hands of one observer to another changes the field of observation. Consequently the student may not see what his instructor desires him to observe. He is apt, in receiving the cystoscope, either to push it further into the bladder or to withdraw it slightly. This is the strong objection to the use of the ordinary cystoscope for teaching purposes. Now, however, the difficulty has been overcome. The instructor and the student may examine the object under review simultaneously. Mr. Trotter now makes for me a wash-out cystoscope with a double objective by which two observers can see the same object at one time.

Over those of last generation, in taking up the study of the cystoscope for the first time, the practitioner of to-day has many advantages. Having been trained by experts he is familiar with physical methods, and is well acquainted with the use of the microscope, the ophthalmoscope, and the laryngoscope. His predecessors had no experience in their use. I feel, therefore, that to teach you the elements of cystoscopy is not a heavy task, although I may warn you at the onset that the instrument is not only a difficult one to use, but experience is required in order properly to appreciate its full value and to justly judge what is presented by it to your view.

To narrate the history and development of the electric cystoscope is unnecessary in a course of clinical instruction, but it may interest you to see my first cystoscope

Fig. 3.—To the end of the hollow stem A a cold lamp B (Löwenstein's) is fixed, and immediately behind the lamp is a window C, $\frac{3}{4}$ in. long. At the other end of the stem is a pack box D, and passing from it at right angles a tube E, into which a movable handle F may be fixed. At D a metal drum may be fixed, divided into the degrees of a circle, and an indicator. The drum is coloured red on one semicircle, green on the other, and a jamb-screw is fitted to fix the stem in a position desired. Before the cystoscope is introduced the tube G is passed into the stem A, so that the part H acts as a shutter to the window C. After the cystoscope has entered the bladder, the tube G is withdrawn $\frac{1}{4}$ in. or is rotated half a circle, and the cystoscope is converted into a wash-out catheter. The double-action stopcock H should then be fixed to the tube at I, so as to regulate the direction of the flow of fluid. A rubber tube leading to the limb K should contain solution under fluid pressure of a 2-ft. column, while a rubber tube leading from L should contain fluid having suction of a 2-ft. fall—the former for ingress, the latter for exit of solution from the bladder. This part of the apparatus practically affords a wash-out catheter by which the bladder is cleared before the introduction of the telescope M.

before I demonstrate the construction and use of my latest one. My original electric cystoscope (January 18th, 1883), which is still armed with the first electric lamp introduced into a human bladder, I now pass round for your inspection. Edison's incandescent lamp had just been patented, and one or two were sent to Glasgow for Sir William Thomson (Lord Kelvin). The late Mr. White showed them to me. At the time I was struggling with the difficulties of cystoscopy by reflected light, and at once appreciated the value of direct illumination.¹

Since 1883 great changes have taken place. The cystoscope I now show you is the one I use, and it fulfils all the following requirements.

(1) Comparatively small lumen of the stem, so that the instrument may be introduced without injury to the urethra or to the neck of the bladder; (2) large field of vision and a clear view; (3) good view of the neck of the bladder; (4) good illumination without danger of scalding the mucous membrane of the bladder; (5) ease in sterilizing the instrument; (6) facility in emptying the bladder should there be clamant call to urinate, without necessitating the removal of the cystoscope; (7) ability to demonstrate to a second observer the object seen; (8) easy means of clearing the field should it become obscure, without removing the stem of the instrument from the bladder; (9) means of steadying the instrument while an examination is being made, of fixing the cystoscope prism at any particular point, and of defining clearly the position of the lesion. The cystoscope (Fig. 3) fulfils all these requirements.

Prior to introducing the cystoscope the lamp must be tested and the rheostat adjusted. When the bladder has been washed out, and is distended to the required extent, the tube *g* is withdrawn and replaced by the telescope *M*, so that the prism *n* comes to be immediately opposite the window *c*.^{*} The electrodes are introduced into the openings *o* and *p*, the circuit completed by pressing the switch *r* against the body of the cystoscope, the lamp is lighted, and the observation made. Should the fluid become opaque before the examination of the bladder is completed, the bladder may be rewashed by withdrawing the telescope and reintroducing the tube *g* without moving the stem of the instrument. This instrument differs from the ordinary cystoscope also, in that two eyepieces may be screwed on to the telescope (*M*), one a single (*s*), the other a double eyepiece (*t*). In the latter the image is refracted into a second eyepiece at right angles to the shaft of the cystoscope, so that a student can look through this second eyepiece (*x*) while his instructor is making observations through the first eyepiece (*y*). This invention greatly facilitates instruction in cystoscopy. The surgeon seats himself in front of the patient in the usual way, and while he is making an inspection of the bladder and describing it to the student, each feature presented is as clearly seen by the second party as by the first.

Now you understand the construction of the cystoscope, I desire to point out its advantages. Divided into two distinct parts, the wash-out catheter and the telescope with the prism attached, the instrument is constructed so as to enable the examination to be completed from beginning to end without the stem being withdrawn. Practically only one instrument is introduced through the urethra. The optical arrangements are such that 90° of the sphere of the bladder can be seen at one time. One of the great faults of the Leiter cystoscope is that the bladder is first washed out by means of a catheter, and when the cystoscope is introduced the prism is liable to be soiled, so that when the lamp is lighted in many cases no clear view can be obtained. In order to cleanse the prism the whole instrument requires to be withdrawn, and may be again soiled on reintroduction. With the cystoscope I have shown you the telescope is not in the stem while it is introduced, it is only after the cystoscope has been in the bladder that the wash-out catheter is withdrawn, and the telescope with the prism attached introduced; therefore it cannot be soiled during introduction. Should it be soiled after introduction, then it can be easily withdrawn and cleansed without removing the stem of the cystoscope from the bladder. Then, again, should there be, as is frequently the case, a clamant call to

urinate the telescope can be withdrawn and the bladder emptied, and after an interval redistended with clear fluid. By using lamps embedded in asbestos the conduction of heat is reduced, and consequently the danger of scalding the mucous membrane greatly diminished. The optical portion of the instrument being separate from the wash-out catheter the latter can be thoroughly sterilized without the danger of injuring the instrument. The double eyepiece facilitates the demonstration of objects to the student while they simultaneously pass before the instructor, and by employing a prism placed at an obtuse angle to the stem the neck of the bladder can be easily seen. This is impossible to observe by means of the ordinary prism.

In certain works and articles on cystoscopy diagrams are given showing the incandescent lamp shining and illuminating limited areas only. Such representations are misleading. A good lamp lights up the whole bladder. In young persons examined in a darkened room the light can be seen shining through the perineum and the anterior wall of the abdomen in front. The light is not limited, but the range of vision through the rectangular prism is usually restricted to about 60 degrees. By it the neck of the bladder cannot be seen. To see the neck a second telescope is required, with an obtuse-angled prism, as shown in Fig. 4*a*. Fig. 4*b* shows the direction of refraction of the ordinary right angle prism.

To describe the method of conducting an examination will take some time, and at first sight it may appear complicated, but when you see me employ it you will

Fig. 4*a*.—The telescope *A*, with a short-focus lens *D*, for examining the neck of the bladder, which is close to the obtuse angle prism *c*. The angle of refraction is shown at *c*, and the direction of the central line of light is indicated by arrows.

Fig. 4*b*.—The telescope *A* is provided with a long-focus lens *D* for examining the surface of the bladder. The angle of refraction of the rectangular prism is shown at *c*, and the direction of the central line of light is indicated by arrows.

admit the simplicity of the whole procedure. My purpose is to enable you to make an examination with the greatest safety and the least discomfort to the patient. The cystoscope is constructed with the object of getting a complete view with the least possible movement of the stem of the instrument. The movements are a combination of rotation of the stem and an outward and inward sliding of the telescope. The window (Fig. 3, *c*) is an elongated one, so that while the stem remains stationary in the urethra, the telescope may be moved along the stem and the observer may look through the window from different points of view.

Prior to a cystoscopic examination careful inquiry should be made into all the circumstances of the patient. In those suffering from serious disease, and in whom the introduction of an instrument is likely to be followed by aggravation of the symptoms, cystoscopy should not be resorted to unless the patient is prepared to submit to an immediate operation should it be deemed necessary; for example, in advanced tuberculous disease, in chronic retention in persons of advanced years, and in chronic cystitis with sacculcation of the bladder, instrumentation is liable to do harm.

The evening before an aperient should be administered, and on the morning of the examination an enema. The meatus and urethra should be washed from above downwards with a mild antiseptic solution. The cystoscope should be sterilized by careful cleansing and steeping in a 1 to 40 carbolic acid solution. Half an hour before the inspection the patient should partake of one pint of hot fluid, such as milk or weak tea, so that the kidneys may be moderately active at the time of the examination, and to ensure that the bladder contains a quantity of freshly secreted urine. It is not desirable that the excretion be very active, for if so, small quantities of blood escaping from a ureter may evade observation. To lessen pain during the examination, 2 or 3 drachms of a 10 per cent. solution of cocaine may be injected into the urethra, and retained for four to five minutes and then allowed to

^{*} The telescope usually employed has a rectangular prism, but a second telescope is required to obtain a good view of the neck of the bladder.

Figs. 5 and 6.—For washing out purposes I use a graduated cylinder irrigator (a), capable of holding 2 litres of boracic acid dissolved in sterilized water (half full strength). A rubber tube, with fluid pressure of about 2 ft., leads from the irrigator to the limb k (Fig. 3) of the double action stopcock H, while a second tube leading from I contains fluid with suction of a 2 ft. fall. When the stopcock is turned to the left fluid flows into the bladder, when turned to the right the fluid flows out, and when the stopcock is placed midway between both k and I are closed. The temperature of the solution should be 100° F. With the stopcock H fixed in it, the tube G (Fig. 3) is inserted into the stem of the cystoscope, and the solution is allowed to flow freely through the window c until the metal is heated to the temperature of the fluid.

escape externally, not into the bladder. Only when there is considerable irritation is it advisable to introduce cocaine into the bladder, for while it serves to deaden the sensitiveness of the mucous membrane it also alters the colour considerably. If carefully and gently conducted, the pain during an examination should not be greater than that induced by passing a full-sized catheter, and certainly much less than that caused by sounding. By keeping the handle perfectly steady, and simply rotating the cystoscope and moving the telescope out and in the stem, a complete view may be obtained with very little pain. A general anaesthetic may be exhibited to females from motives of delicacy, to nervous patients who dread the examination, and to those with a very sensitive bladder or when it is necessary from any cause to make a protracted examination—as, for example, in observing shoots from the ureters, catheterizing the ureters, determining the exact relationship of a tumour, discovering the nature of an obscure lesion, or in demonstrating the condition to other observers. General as well as local anaesthetics influence the colour of the mucous membrane. I therefore prefer, where colour is an important factor, to avoid their use. Immediately before the patient is brought in, all the apparatus should be thoroughly tested. By not attending to this simple rule, much trouble may be caused, and the instrument may be blamed for what is really the fault of the observer. The prism and the lenses should be carefully examined and if necessary cleansed. The battery being in good working order, with the rheostat at the point of greatest resistance, the wires should be connected with the cystoscope with the switch drawn back. The lamp should then be placed under water and the circuit closed. With the full resistance in circuit, the lamp will merely show a red glow, but by turning the rheostat to the left the resistance will be gradually diminished until the filament becomes incandescent. The amount of current required varies greatly with different lamps. Half a dozen taken at random shows the following: the lamps generally are 7 or 8 volts, and the amount of current required varies from $\frac{1}{2}$ to $1\frac{1}{2}$ ampères. The rheostat regulates the current so exactly that a $\frac{1}{2}$ ampère lamp may be simply heated to redness on the one hand, or a $1\frac{1}{2}$ ampère lamp may be rendered incandescent according to the resistance used.

With the battery I described to you, sufficient current is supplied for any of these lamps with about one-third of the rheostat still in circuit. The advantage of this amount of power is that there is always plenty of electricity in reserve for any emergency. Hence lamps of various capacities may be used, but in each case the current required must be tested before the cystoscope is introduced.

The patient is placed on his back with the buttocks resting a little above the edge of the table and the feet

supported upon rests (Fig. 5), which can be fixed at a height suitable to the individual patient. The legs are wrapped in sterilized towels. The surgeon then takes a sheet of jaconet 18 in. square, with a small hole cut in the centre, passes the cystoscope through this opening, lubricates the instrument with glycerine, and, standing on the left side of the patient, introduces the cystoscope into the bladder. At the triangular ligament a little resistance may be offered to the passage of the beak, but by gentle and steady pressure while the handle of the cystoscope is brought well down between the thighs the elbow turns the corner and the beak suddenly glides into the bladder. An assistant steadies the cystoscope by holding the handle, as shown in Fig. 5, or by resting the loop on the end of the table. The operator, now seating himself on a low chair at the end of the table, withdraws the tube G (Fig. 3) about $\frac{1}{4}$ in., turns the stopcock to the right and allows the bladder to empty itself into the receptacle x, y (Fig. 5). This receptacle is constructed on the principle of a wash-out cistern. It holds 6 oz. of fluid, and as soon as filled it quickly empties itself into a bucket, so that each succeeding flow from the bladder can be clearly seen. When the fluid flowing into the receptacle becomes quite clear and translucent the height of the solution in the graduated cylinder is noted and the quantity which readily flows into the bladder is measured so that the examination may be made under various degrees of distension.

Suppose the bladder capable of holding without discomfort 300 c.cm., the catheter tube is now withdrawn and replaced by the telescope. The observer looking through the eyepiece (Fig. 6) presses the switch home and completes the circuit. The prism of the cystoscope being directed towards the anterior wall, when the lamp is lighted nearly always an air bubble which has found its way into the viscus with the fluid is the first object which attracts attention. If small, it appears as a shining spherule which sways with every movement of the patient or of the instrument. If large, it resembles a vibrating mirror which reflects brightly the image of the cystoscope. With the patient on his back, the air bubble occupies the apex of the concavity of the bladder, and, marking the meridian of the sphere, it acts as a polar star, and so serves as a useful guide in locating lesions. The indicator w (Fig. 3) of the cystoscope is made to coincide with the position of the centre of the air bubble. With the telescope pushed fully home the stem of the instrument is slightly rotated to the right of the observer, a systematic search is made, a general view of the bladder is obtained, and, should any abnormalities be seen, their position is noted. A general inspection having been made, special attention should be directed to the area of the trigone, as it is at the base that evidence of disease is most likely to be found, such as ulceration, tuberculous disease, sacculation, tumours, calculi, and foreign bodies. The orifices of both ureters

should be seen and their appearances carefully noted. The power of detecting them can be easily developed with a little practice; I can usually find them in a few seconds.

Viewed during life the appearance of the mucous membrane of the bladder is seen to vary greatly both in form and colour. These variations depend upon many circumstances, but one only shall I refer to now—namely, the degree of distension of the viscus. When well filled—say to the extent of 16 oz.—its mucous membrane is of a pale yellowish-pink colour, is attenuated and free from folds, the blood vessels are hardly perceptible, the lips of the ureters become almost obliterated, and the orifices flattened, but, if by slow degrees the contents be permitted to escape, the colour brightens, and the mucous membrane gradually appears more bulky. The folding of the mucous membrane first becomes visible immediately above the trigone on the posterior surface, and gradually fold after fold appears like small waves extending from above downwards, and gradually assume larger dimensions. The blood vessels slowly become more and more dilated, the lips of the ureters pronounced, and the orifices distinct. A fully-filled bladder is anaemic, one moderately distended is well supplied with blood, an empty one is congested. These conditions must be considered in making observations. In a partly distended bladder the folds of mucous membrane may hide lesions, consequently never be satisfied by one examination or one degree of distension only. The appearances presented by the trigone and by the ridges corresponding to the lines of the ureters also vary in different individuals, and according to the degree of distension. In many instances, when the bladder is well distended, the ridges of the trigone are hardly apparent, and the orifice of the ureter appears to lie upon a flat surface. In other cases the ridges limiting the trigone are pronounced, the interureteric ligament appears as if a cord was placed transversely under the mucous membrane, and the openings of the ureters are situated upon distinct eminences. Between these two extremes there may be innumerable gradations. The mucous membrane of the trigone is smooth and more deeply coloured than that of the rest of the bladder, and, when the viscus is only moderately distended, the limits of the trigone are clearly defined. In disease other aspects present themselves, changes in colour, in size, in shape, and in the appearance of the surrounding parts. Sometimes the mouths of the ureters seem to be pushed out towards the lumen of the bladder, in others they seem to be drawn in. These conditions must be studied in the living subject, as after death the appearances lose most of their characteristic features.

In health the urine collects slowly above the closed sphincters at the orifices of the ureters, and at intervals is thrown by squirts with considerable force into the bladder. The length of the intromissions depends upon the activity of the kidney. Under favourable circumstances, about 10 to 15 drops are ejected, alternately, from each ureter every 30 or 40 seconds. By carefully watching the line of the ureter, the portion coursing through the wall of the bladder, the part immediately above the sphincter, will be seen gradually to distend. Immediately before the urinary squirt appears, the expanded duct, looking in form not unlike a miniature engorged leech, is drawn slowly upwards and outwards. It gives a sudden wriggle, its muscular fibres contract, the sphincter is forced open, and the contents are ejected. The urine, as it is thrown into the bladder, forms a distinct jet which shoots downwards and inwards. The spurt occupies about two seconds. The form of the spout can be seen most easily in cases of renal haematuria. The aspect of the orifices of the ureters individually, and in relation to each other, is important to observe. It may be stated as a general observation, that when the appearance of the orifice of one ureter is altered, while that of the other is normal, the renal lesion is on the side of the morbid ureter. And, again, if the number of urinary shoots be counted within a given time, as they occur from each side, and a marked difference is observed, the side on which most shoots are seen is either the site of considerable local irritation or is the most active organ functionally. When due to morbid irritation, the shoots not only succeed one another rapidly, but they are of short duration, and the urine which escapes is small in quantity; whereas in increased functional activity the shoots, in

addition to being frequent, are prolonged, and the amount of the urine is large. Instead of coming in regular and distinct jets every 20 or 30 seconds, the force of the shoots may be diminished. The manner in which the urine enters the bladder may be so slow as to be hardly perceptible. In stricture of the ureter, or when its lumen is obstructed by a stone, the urine may dribble into the bladder, just as it dribbles out of it in enlarged prostate or in stricture of the urethra. In describing the orifices of the ureters we may speak of the inner and outer lips and the upper and lower angles. In many cases the orifice of a ureter may not be visible, but it is not necessarily to be concluded that the orifice is absent or displaced; it may be merely hidden—at one examination easily seen, at another not to be found.

In some cases certain facts can be ascertained regarding surgical renal lesions by an examination with the cystoscope. For example, in many cases of renal haematuria, and in some cases of pyuria, the escape of blood or of pus from a ureter can be readily seen by the cystoscope. When the amount of blood present is small, but still sufficient to perceptibly stain the urine, the cystoscope is, in the male, more reliable than the ureter catheter, the introduction of which into the inflamed ureter may cause a little bleeding and so vitiate the value of the observation. When we come to consider the question of effluxes from the ureters, I shall point out to you the importance of their various characteristics. Pus may escape in different ways, according to the consistency of the fluid. In many cases the quantity of pus discharged from the kidneys is small and its escape so irregular that the cystoscope fails to establish from which kidney the purulent urine flows. When, however, the diseased kidney is secreting little urine, and the quantity of pus is considerable, the discharge may be readily seen escaping from the ureteral orifice. In some instances it is forced out of the ureter in form and appearance not unlike a cheese maggot, and little masses of purulent discharge may be seen on the floor of the bladder curled up like dead maggots, unmixed with the solution introduced for the cystoscopic examination, but when the bladder contracts to expel its contents, the force required to drive them out causes the purulent masses to lose their form and become intimately mixed with the fluid. In this way they are deprived of their characteristic form, which can be observed only while they are within the bladder. The appearance of more or less slight effluxes indicates that the kidney from which they come has ceased to be functionally active. On the other hand, when the pus is seen to escape in distinct shoots, the kidney may be presumed to be still secreting a considerable quantity of urine.

A very important area of the bladder still remains to be examined—namely, the neck. The first telescope is now withdrawn and the second one inserted. With it the neck of the bladder is clearly seen, and the telescope lens being one of short focus it is necessary to make certain allowances as regards the size of the objects seen according to the power of the individual lens.

In making our systematic examination, suppose that we have seen the lesion, say an ulcer covered by a white slough. How are we to locate the position of the lesion? It is clearly not on the floor of the bladder, and it is not on the anterior wall. It first came into view when the cystoscope had been rotated some distance to the right of the perpendicular. As the view obtained by my cystoscope includes 75 per cent. of a circle or sphere, it is impossible to define for descriptive purposes the limits of the ulcer unless an exact method be followed. I have had considerable difficulty in selecting a method for recording the situation and extent of lesions. The sphere of the bladder might be divided as the face of a clock, and we might speak of an ulcer occupying a space corresponding to 4 o'clock, or a circle might be made similar to the mariner's compass, and we might regard the ulcer as being SE by E, but I fear to a landsman that would not convey a very clear idea. The plan I have adopted I shall explain in a few words. Immediately opposite the handle (Fig. 3) and fixed to the metal collar (b) within which the cystoscope (A) rotates, there is a small pointer (z) which corresponds in position to a hair line in the telescope. In making the examination the handle is allowed to rest upon the operating table, and is maintained in a perpen-

dicular position, so that the pointer corresponds exactly with the middle line in front. This point we fix as the meridian. The circumference of the drum (Fig. 3, v) is graded 180 degrees to the right and left of the meridian, and in order to avoid mistakes in recording (the observer's right being liable to be substituted for that of the patient), one semicircle is coloured green (star-board) and the other red (port), indicating that the prism is pointing to the patient's right or left as the case may be. Let us take an example, and note that in making comparative observations the distension of the bladder must be always the same. The cystoscope has been passed, the air bubble seen; the line on the prism is made to correspond with the centre of the air bubble, the pointer is at 0, the stem is now rotated to the observer's right—the patient's left—and a search is made. I show you on the screen with the projector exactly what is observed with the cystoscope. You see a small white slough, the centre of which nearly corresponds with the thread line on the disc of the telescope. On looking at the register on the drum we find by the pointer that the cystoscope has been rotated 110° to the left of the meridian, and on measuring from edge to edge of the ulcer, that the lesion extends between 105° and 115° to the left of the middle line in front. The pointer (Fig. 3) is covering the red hemisphere. Now, in order to find the degrees from the middle line posteriorly we make the following calculation:

$$180^\circ - 115^\circ = 65^\circ \quad 180^\circ - 105^\circ = 75^\circ$$

that is to say, the ulcer extends from 65° to 75° from the middle line behind. We are therefore able clearly to

Fig. 7.

define the longitude of a lesion, and approximately measure the degrees of the sphere of the bladder occupied

by it. To define the latitude is more difficult, and although I have tried several methods I have not been able to hit upon a reliable one.

Now, having shown you the method of using the cystoscope, I may say a few words as to the method I employ in recording the appearances seen and in illustrating them by means of an opaque projector.

To accurately portray the appearances presented by the cystoscope is difficult for several reasons:—(1) The field is small, and to represent the whole picture a number of separate drawings may be necessary; (2) the slightest movement of the cystoscope or of the patient may suddenly alter the relationship of parts; (3) the field of vision may become obscure before the artist has time to complete his picture; and (4) the artist requires considerable experience and instruction in the use of the cystoscope before he can appreciate and reproduce in colour the morbid changes presented to view. I am fortunate in having obtained the services of Mr. Alexander K. Maxwell, who has shown much aptitude in appreciating what has

to be seen by the cystoscope, and in transferring his impressions to paper. It seems to me that the easiest and most perfect method of teaching men to observe by the eye is to teach them through the eye, not through the ear, therefore during this course I shall have several opportunities of showing you his productions, which are specially drawn to illustrate lesions by means of the opaque projector. The projector is a very simple and inexpensive apparatus.* It consists of two lanterns (Fig. 7, A and B), which through condensing lenses (c and d) throw on the image (a) placed at the back of projector (Fig. 7, K) the full light of two large lime lamps (F and F'). To limit the extent of the surface illuminated, blackened diaphragms (L, L) of various sizes are employed according to the size of the object to be shown. For my present purpose a disc (L) having an opening (H) 3 in. in diameter is used. When the object (a) to be shown is placed behind the opening (H) in the diaphragm, its image is reflected through a series of lenses (I) and focussed on a translucent screen (Fig. 7 K and Fig. 8 A). Only a small portion of the large diagram of the bladder G is illuminated at one time. By moving it I can show you the mucous membrane bit by bit, just as it is seen in making an inspection with the cystoscope.

In order to demonstrate the appearances of "shoots" of healthy urine or of morbid fluids escaping from the ureter I have constructed small cells made of block tin. The cell measures 6 in. by 6 in. by 1 in., and on the inside a diagram of the bladder wall and of the orifice of the ureter is painted. Corresponding to the ureter orifice in the picture there is an opening through the back of the cell,

and from it a tin tube leads to a 2-oz. syringe, also to a hypodermic syringe. The opposite side of the cell is glass. The cell is nearly filled with water, which has been boiled to drive off the air in solution, otherwise air bubbles are liable to adhere to the cell wall and obscure the view. To demonstrate a shoot of normal urine, the cell is filled with water and placed behind the projector. The 2-oz.

Fig. 1.

syringe is filled with a concentrated saline solution, coloured yellow, and connected with the tube to the

* Mr. Trotter supplies the projector complete for £15; about one-tenth of the cost of similar apparatus provided by Continental makers.

Fig. 8.—A, translucent screen of tracing paper in metal disc 26 in. in diameter, upon which image from projector is thrown; B, metal plate which fits into the disc in front of the paper screen, and is used to illustrate the method of locating lesions in the bladder.

syringe. By suddenly squeezing $\frac{1}{2}$ oz. of the saline solution through the hole into the cell, an appearance is produced which, when represented on the screen, is exactly similar to what is seen when a urinary shoot occurs into the living bladder. The image at the back of the cell (Fig. 1) represents the orifice of the healthy ureter, when the bladder is distended with 7 oz. of solution. The mucous membrane is of a pale colour, and has only a few vessels ramifying on its surface. The lips of the orifice are rounded and slightly elevated. The ridge is moderately marked, and the opening is sharply defined, and the space between the lips is of a darker hue. The upper and lower angles are rounded and smooth. When the fluid is injected from the syringe the clear definition of the orifice is lost for a second or two, until the dense fluid mixes with the cell contents.

The mingling of the saline solution with the water produces the same appearance as the mixing of urine with the sterilized water in the bladder. You have now seen the appearance of shoots of healthy urine. Later on, by substituting coloured fluids and semi-fluids, I shall demonstrate to you the escape of pus, blood, and blood clots.

[Some of the more easily recognized diseases were then demonstrated, as will be explained in the next part.]

REFERENCE.

¹ *Glasgow Medical Journal*, 1883, vol. xx, p. 132.

(To be continued.)

THE SCIENCE COMMITTEE

OF THE

British Medical Association.

REPORT XCIV.

ANAESTHETICS AND RENAL ACTIVITY:

AN EXPERIMENTAL INVESTIGATION INTO THE EFFECTS OF $\frac{1}{2}$ PROLONGED CHLOROFORM AND ETHER NARCOSIS.

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(Concluded from page 614.)

PART II.—ETHER NARCOSIS.

EXPERIMENTS with ether were carried out in the same way as with chloroform. In the earlier series the urine was collected from the ureters, in the later from the bladder.

EFFECTS ON THE QUANTITY OF URINE.

Of previous observers, Kemp³³ found that the secretion of urine was early diminished, and finally stopped under free and continuous inhalation of ether. In the experiments of Buxton and Levy³⁴ the secretion of urine was slowed, but a complete suppression from the effects of ether was never witnessed. A temporary suppression, which did occur in certain cases was attributed to accidental traction on the ureter. My own earlier conclusions³⁵ (drawn solely from "ureter" experiments) were, that during its administration, ether causes an increased secretion of urine, followed after removal by a still greater outflow. One case of marked depression was treated as an exception. Further inquiry, however, has made it quite clear that both effects are usual—the increase representing an earlier and lighter influence, the decrease a later and more profound action.

Table IX gives the detailed effects upon urine secretion in both "ureter" and "catheter" series of experiments.

A glance at the table will show that the increased effect on urinary secretion is practically confined to the ureter group. In Experiments 2, 3, and 4 of this series both effects are demonstrated, the "decrease" being obtained by a fuller degree of anaesthesia. The latter are amongst the most recently performed of the ether experiments, and were undertaken to ascertain if both effects could be obtained in one and the same animal by varying the

degree of anaesthesia. Blood-pressure tracings of 3 and 4 are given later.

TABLE IX.—ETHER: EFFECTS ON THE QUANTITY OF URINE.

Experiment.	I.	II.	III.	IV.	V.
<i>Ureter Series.</i>					
1 ...	6.7	31.70	31.7	21.10	8.3
2 ...	11.4	(a) 14.65 (b) 8.30	63.0	17.65	—
3 ...	35.2	29.35 17.00	15.1	—	—
4 ...	10.6	27.90 4.35	9.4	9.70	—
<i>Catheter Series.</i>					
1 ...	7.7	18.90	7.7	4.00	4.5
2 ...	8.5	4.00	51.0	45.00	—
3 ...	278.0	23.50	130.0	66.00	—
4 ...	16.5	2.25	29.5	144.00	—
5 ...	12.0	2.00	55.0	55.00	—
6 ...	10.5	3.50	16.5	33.00	—
7 ...	14.5	8.00	11.0	20.50	26.0
8 ...	38.0	1.00	13.5	48.50	30.0
9 ...	15.5	10.00	32.0	79.00	44.0
10 ...	9.5	1.00	14.5	25.00	16.0

The periods are of two hours' duration, except in Experiment 1 of each series, where they are one hour each.

N.B.—In Ureter Experiments 2, 3, 4, the double columns during the anaesthetic period represent (a) the early; (b) the pronounced effect.

The averages per period, drawn from the four "ureter" experiments are:

I.	II.	III.	IV.	V.
15.99	(a) 24.4 (b) 7.6	29.8	12.11	8.3

The increase during the first stage of Period II amounted to 152.6 per cent.; the fall during the second stage brought the rate down to 46.65 per cent. of the normal.

In the "catheter" series, with the exception of the first experiment, all show during the anaesthetic period a very marked decrease of secretion. The drop in one case—namely, Experiment 3, was unusually great, as was also the rate of secretion during the normal period. In this case the animal had inadvertently got access to slops in which meat had been boiled, and drank freely a short time before the experiment was begun. This only transpired when the normal sample of urine was drawn off and found to be unusually great. It was decided, however, to proceed with the observations, in order to test the effect of ether under such conditions. The experiment, however, is treated as exceptional, and is not included in the following averages, which are drawn from the remaining eight "decrease" experiments in the series:

I.	II.	III.	IV.	V.
15.62	4.0	24.25	56.25	29.0

During Period II the rate of secretion dropped to 25.4 per cent. of the normal, and rose again in Period IV to 360 per cent. of that amount. The depression and reaction effects of ether are therefore more pronounced than those of chloroform. In several of the experiments the secretion of urine was stopped, or practically so, for considerable periods of time. In these it did not appear that the degree of anaesthesia was greater, though more prolonged, than that required as a rule for surgical operations on the human body. Observations in the later ureter experiments confirmed this. At a degree of anaesthesia just beyond the loss of conjunctival reflex, the urine frequently ceased to flow from the cannulae, and remained suppressed as long as the anaesthesia was kept up. The matter will be referred to again when the vascular effects are considered.

A preliminary note upon this effect in dogs was published by me last year.³⁶ Corresponding observations have also been carried out at my suggestion on the human subject by Dr. Harold Pringle, Mr. C. B. Maunsell, and Dr. Seton Pringle,³⁷ which fully bear out the results obtained on animals in the laboratory. This effect of ether—in suppressing urinary secretion—appears also to have been known to the late Mr. Lawson Tait, who refers to it in a short letter to the *Lancet*, vol. i, p. 988, 1897. It was likewise seen by Kemp, in his experiments on dogs. It is, I believe, less liable to occur when morphine has been previously given.