the crown, just underneath the surface of the ground, a number of long horizontal rhizomes emanate. These, though frequently mixed with liquorice to increase the yield, are not suitable for use. They have, however, an important use for purposes of propagation.

Liquorice root, when first collected, is fleshy and juicy, and is largely employed in this condition. For commercial purposes the roots are thoroughly cleaned and dried rapidly to prevent moulding. The Russian variety has its outer bark removed.

There are great differences of opinion concerning the relative quality of the two varieties. The correct view probably is, that Spanish liquorice is sweeter, while Russian liquorice, when powdered, is lighter in color and of finer appearance. Russian liquorice is rather more inclined to be free from bitterness, provided care be taken to excise all black, knotty, decayed pieces. If these be allowed to remain, even to a slight extent, they impart a marked bitterness to the powder.

Description.—*Spanish Liquorice.*—In long, cylindrical pieces, from 5 to 15 mm. (¼ to ⅝ in.) thick, longitudinally wrinkled, externally grayish-brown to dark brown, warty; internally tawny-yellow; pliable, tough; fracture coarsely fibrous; bark rather thick; wood porous, but dense, in narrow wedges; medullary rays linear; taste sweet, very slightly acrid.

The underground stem, which is often present, has the same appearance, but contains a thin pith.

Russian Liquorice occurs in large, usually crooked pieces, often several feet in length and 5 cm. (2 in.) in thickness, deprived of the outer bark, pale yellow without, internally of a lighter yellow than the Spanish and softer and of lower specific gravity, its cellular elements larger, its taste less sweet, and the wood frequently cleft. Any blackened, knotty, bitter portions should be removed before using.

Composition.—The most important principle is its peculiar sweet substance, *glycyrrhizin*, an amorphous, yellow, intensely sweet powder, soluble in hot water, but not in cold without the addition of an alkali. It is a glucoside, and may be resolved, by boiling with dilute hydrochloric acid, into an uncrystallizable sugar, and an amorphous, bitter substance, *glycyrrhetin*. It is said to be present in the root combined with calcium. Proportion about six per cent. There are also some sugar, three per cent. of asparagin, a variable amount of glycyramarin, a little resin and starch.

Action.—Liquorice has no physiological action beyond that of being slightly laxative. It is, like other sugars and syrups, soothing to the mucous membrane of the fauces, and hence much employed in coughs by itself, or as a vehicle or ingredient of cough mixtures. Syrups of liquorice and the ammoniated glycyrrhizin have been extensively used as vehicles to cover the bitter taste of quinine, which they do in an imperfect manner. The ammoniated glycyrrhizin may be rubbed up with the quinine in powder, or the quinine may be mixed with a syrup of liquorice at the instant of taking.

Administration.—Several preparations are official. Fluid extract (*Extractum Glycyrrhizæ Fluidum*, U. S. P.), in which the liquorice is exhausted with diluted alcohol and ammonia, the latter to make the active principle more soluble. The pure extract (*Extractum Glycyrrhizæ Purum*, U. S. P., so called to distinguish it from the *Extractum Glycyrrhizæ*, or crude Italian stick liquorice), in which the drug is exhausted with water and ammonia, and the percolate evaporated to a semi-solid consistence. It is useful for pill masses and as a vehicle; it is also an ingredient in the compound mixture of liquorice (*Mistura Glycyrrhizæ Composita*, U. S. P.), or old Brown Mixture, in which paregoric and wine of antimony are the active ingredients. *Glycyrrhizinum Ammoniatum*, U. S. P. (ammoniated glycyrrhizin, mentioned above), is prepared by extracting the liquorice with ammoniated water, precipitating the sweet principle with sulphuric acid, washing, redissolving in ammonia and water, precipitating and dissolving again, until it is sufficiently pure. It is in dark brownish-red, shining, brittle scales, of a very sweet, liquorice-like taste, and no odor, soluble in water and alcohol. Compound liquorice powder (*Pulvis Glycyrrhizæ Compositus*) is, properly speaking, a preparation of senna. Besides these, should be mentioned the commercial "stick," or "black liquorice," formerly imported on a large scale from many of the countries and islands of the Mediterranean, now chiefly manufactured in this country. It is chiefly used by children as a confection, but is also in extensive demand for coughs, colds, and sore throats.

W. P. Bolles.

LISSNER'S MINERAL SPRING.—Lewis and Clark County, Montana.

Post-Office.—Helena. Hotels.

This spring is located in Helena, about three hundred yards from the International Hotel, at the corner of Main and State streets. The spring gushes from the foot of a granite mountain, three hundred feet high, at the rate of about 20,000 gallons a day. A qualitative analysis by Messrs. Thomas Price & Son, chemists, of San Francisco, showed the presence of the chlorides, carbonates, and sulphates of lime, magnesia, soda, and potash. It is free from organic or vegetable matter. The water is used commercially and is recommended for indigestion, constipation, liver, kidney, and bladder troubles. We are unable to classify the water in the absence of a complete qualitative analysis.

James K. Crook.

LITHÆMIA. See *Gout.*

LITHIO-PIPERAZINE is a combination of piperazine and lithium which is soluble in water and is used in gout and the uric-acid diathesis in dose of 0.3–1.0 gm. (gr. v.–xv.) three times a day.

W. A. Bastedo.

LITHIUM.—I. General Medicinal Properties of Compounds of Lithium.—As lithium is closely allied to potassium chemically, so its salts exert practically the same kind of physiological influence as the corresponding salts of potassium. The only substantial differences are, *first*, the purely chemical one, that basic lithia forms with *uric acid* a salt much more soluble than the corresponding potassic compound; and, *secondly*, that clinically, in lithæmia and gout, speedier relief seems sometimes to follow from medication with salts of lithium than with those of potassium. But since the results reported have followed the employment of the remedy with the preconceived idea that such results must follow from theory, the clinical superiority claimed for lithium should be received with caution. There is no doubt, however, that the lithic salts are at least as efficient as the potassic, but then they have the disadvantage of being more expensive.

II. The Compounds of Lithium Used in Medicine.—These are the *carbonate*, *citrate*, *bromide*, *benzoate*, and *salicylate*. The first two only will be considered in this place. For the others, see respectively *Bromides*, *Benzoic Acid*, and *Salicylic Acid*.

Normal Lithium Carbonate: Li_2CO_3. The salt is official in the United States Pharmacopœia as *Lithii Carbonas*, Lithium Carbonate. It is a light, white powder, permanent in the air, odorless, having an alkaline taste and an alkaline reaction. It dissolves in 80 parts of cold and 140 parts of boiling water, but is freely soluble in carbonic acid water. It is insoluble in alcohol. Lithium carbonate behaves in a general way like potassium carbonate, except that, because of its feeble solubility in water, it is not locally so irritant. As an alkali it is remarkably potent, because of its chemically low combining number, and hence great saturating power in the neutralization of acids. Its use so far has been mainly as a substitute for potassic alkaline preparations in internal medication in gout and lithiasis. It is given in doses of from 0.30 to 1 gm. (gr. v.–xv.), several times a day, best administered in some effervescing water, since it is freely soluble in such liquids.

Normal Lithium Citrate: $Li_3C_6H_5O_7$. The salt is official in the United States Pharmacopœia as *Lithii Citras*, Lithium Citrate. It is a white powder, deliquescent on exposure to air, odorless, having a slightly cooling, faintly alkaline taste and a neutral reaction. It dissolves in 2 parts of cold water, and in 0.5 part of boiling water. In alcohol it is practically insoluble. It should be kept in well-stoppered bottles. Lithium citrate bears the same relation, in medicinal behavior, to the carbonate that potassium citrate does to potassium carbonate. It is pleasanter to the taste and more grateful to the stomach than the carbonate, but undergoes transformation to the carbonate after absorption into the blood. Constitutionally, therefore, it is the equivalent of the carbonate, and it is used internally in gout and uric-acid diathesis. The salt, it must be remembered, is not alkaline while under its own form, and hence would be useless as a local alkali for the direct neutralization of acid. Dose, from 0.65 to 2 gm. (gr. x.–xxx.), several times a day, in aqueous solution.

A pleasant way to administer the citrate is to prescribe the official preparation entitled *Lithii Citras Effervescens*, Effervescent Lithium Citrate. This preparation is a powder composed of the admixture, in dry powder, of 7 per cent. of lithium carbonate, 37 per cent. of citric acid, and 28 per cent., each, of sodium bicarbonate and sugar. On adding the powder to water the ingredients dissolve, whereupon the citric acid decomposes the carbonates with formation of lithium citrate and evolution of carbon dioxide gas in effervescence. The dose is a teaspoonful of the powder, to be taken in water and drunk during effervescence.

Edward Curtis.

LITHIUM-DIURETIN. See *Uropherin.*

LITHOLAPAXY—(Rapid Lithotrity with Evacuation), λίθος and λάπαξις (evacuation).

This operation, which has superseded the old method of lithotrity, and which successfully disposes of stones that could formerly be dealt with only by lithotomy, has been before the world for twenty-four years.

In January, 1878, Prof. Henry J. Bigelow [1] published his first paper introducing this procedure to the medical profession, and it was at once enthusiastically adopted by the surgeons of all countries.

The writer's association with Professor Bigelow in this branch of surgery lends authority to the description of the operation which follows:

Before the year 1878 lithotrity was performed by short sittings (a few minutes each), with intervals of several days between them. The débris, more or less finely pulverized, was passed with the urine.

If the expulsive power of the bladder was good, the voidance of the fragments was usually successfully accomplished. When, however, the bladder had lost its power, or when, owing to some obstruction, it could not thoroughly empty itself, the discharge of the fragments after crushing was an extremely uncertain matter.

Moreover, in a certain proportion of cases, especially when the stone was a hard one, or when the bladder was much inflamed, the crushing was followed by serious symptoms, with marked increase of the bladder inflammation, which not only put a stop to further crushing, but frequently went on from bad to worse and ended fatally.

This aggravation of symptoms after lithotrity was ascribed largely to the irritation of the bladder wall by the instruments; and operators tried to avoid trouble by making the sittings short, and by extreme gentleness in manipulation.

Sir Henry Thompson, then the English authority upon the subject of lithotrity, had recently stated it as his opinion that a sitting should not be prolonged beyond two or three minutes, and that stones requiring more than three or four sittings for their removal were not advantageously within the province of lithotrity.

Prior to this year (1878) there had been various attempts to remove by suction portions of the débris after crushing, and Clover's apparatus, consisting of a catheter and bulb, was sometimes used to aid a bladder in freeing itself. Such efforts at evacuation were, however, regarded as introducing special dangers into the operation of lithotrity, and writers upon the subject were practically unanimous in thinking that any serious attempt in this direction should be dispensed with, if possible.

In 1875, Professor Bigelow, having devised a more thorough evacuator than those previously in use, tried the plan of operating by a long sitting under ether, with the object of crushing the stone and completely removing the fragments at one operation.

The success of the first cases so treated showed that the previous dread of instrumentation had been to a great degree groundless, and that the presence of sharp angular fragments in the bladder after an operation was a source of more serious danger than that consequent upon the prolonged and skilful use of instruments which resulted in the complete removal of the stone.

These cases showed that, contrary to previous belief, the thorough evacuation of a large stone at one sitting could be accomplished without special danger, and in consequence of this success Professor Bigelow went on to perfect the apparatus which he described in his paper, published in January, 1878, and which he has since that time still further improved, until it has reached the forms which will be described farther on.

The operation of litholapaxy may be divided into two acts: (1) The comminution of the stone; (2) the evacuation of the fragments. We will first consider the instruments concerned in pulverizing the stone.

Lithotrites.—As has been said, lithotritists were formerly possessed with the idea that the bladder was an extremely sensitive organ, prompt to resent any irritation from the use of instruments, and that, therefore, only small stones, not requiring a great amount of manipulation for their comminution, should be crushed.

This belief, together with their failure to recognize the full size of the urethra, led the operators of those days to use instruments smaller and less powerful than the conditions allow, and than those which are now readily and safely employed, when the size and consistence of the stone make their use desirable.

The lithotrite now to be described was devised by Professor Bigelow. The modifications in its form are designed to enable it to meet the needs of the new operation.

It is made in various sizes,* of which the larger are very strong, and, though rarely necessary, enable the operator to deal with larger and harder stones than could be disposed of with the smaller instruments.

The *handle*, which is of hard rubber, is egg-shaped, and gives a better hold with more power than could be attained with the old wheel. By giving a full grasp to the hand it is far more comfortable and less fatiguing in a long operation.

The *lock*. Immediately below the handle is a revolving cylinder cap, which is attached to the screw guard and closes the lock by a mere rotation with the fingers of the right hand while it is grasping the handle.

So far as I know, this is the only lithotrite in which the lock is constantly under the control of the right hand. This arrangement gives the surgeon the great advantage of being able to lock and unlock the instrument indefinitely, and even to complete the operation without disengaging the hold of either hand. It thus saves time and strength, and lends greater accuracy to the manipulations.

The *blades*. In the female blade the rim is low and sharp, while the floor, especially at the heel, is high. A fragment readily falling upon this blade is firmly held by the rim while it is crushed.

The male blade is provided with a series of alternating notches, which expel the débris at the sides and prevent impaction.

In most lithotrites the dust is seriously impacted in the heel of the instrument. This difficulty is here met by raising the floor at the heel, so that no dust can lodge there. A large spur in the heel of the male blade also

* These correspond to Nos. 25, 27, and 30 of the French catheter scale.

drives the débris through a corresponding slot in the female blade.

The instrument is thus self-clearing and does not clog, so that when once introduced it can be continuously operated as long as fragments can be found to crush. Also, when it is withdrawn the jaws are not held open with impacted fragments of stone to lacerate the urethra. A good-sized instrument, fairly shut, occupies no more room in the urethra than a smaller one which must be withdrawn while partly open to be cleared of its débris.

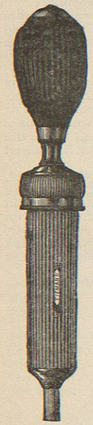


FIG. 3199.—Handle and Lock of Closed Lithotrite.

In a long operation this avoidance of the injury which would be caused to the urethra by the frequent withdrawal of a clogged instrument is a matter of the greatest importance.

The end of the female blade is bent over so as to offer a blunted extremity, which, as may be seen in Fig. 3202, slips along the roof of the urethra and is much less likely to injure it than was the sharp toe of the old lithotrites. This form does not interfere in the least with the catching of fragments in the jaws.

In the lithotrite that has been described the sharp rim upon the female blade is very efficient in holding the fragment which is being crushed. Occasionally, however, in spite of this, the stone constantly slips from between the blades. When this occurs the open lithotrite should be used.

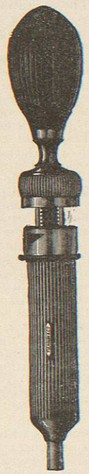


FIG. 3200.—Lithotrite Partly Open, showing the Cylinder Cap in connection with the Handle. The screw guard is seen as two rods alongside of the screw, reaching from the revolving cap to the cap of the lock. These slide through notches in the cap of the lock, and so connect it with the revolving cap that a twist of the latter turns the lock and so wedges up the screws.

This instrument adds to the usual sharp rim another even sharper at the edge of the opening which the male blade traverses. This arrangement of the fenestrated blade makes the operation much more agreeable to the surgeon. The fragment rarely slips, and as the blades approach each other the force required is constantly diminishing instead of increasing, as it does when the solid blade is used.

The inner edge can be quite sharp, as it is prevented from ever coming in contact with the mucous membrane by the width of the broad and flat female blade. It is essential, however, that the male blade should pass absolutely through the female blade and occupy the same level at the outlet; for quite a small portion of the walls of the opening will sometimes so support a fragment not wholly extruded that it will cling to the instrument and be dragged out, and so lacerate the urethra.

EVACUATOR.—This instrument may be, in general, described as consisting of a tube, an elastic bulb, and a receptacle for the fragments.

Tube. For convenience of description the tube may be divided into two parts—the movable part, or catheter, and the fixed part, which enters the bulb and is attached to it by a bayonet joint.

Catheter. A straight tube offers the least possible resistance to the passage of fragments, and is therefore the best. A slight curve at the extremity sometimes facilitates the introduction of the tube in a difficult case.

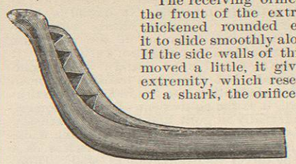


FIG. 3201.—Blades of Lithotrite, Open and Shut.

The receiving orifice should be on the front of the extremity, with a thickened rounded edge, to enable it to slide smoothly along the urethra. If the side walls of this orifice be removed a little, it gives a snout-like extremity, which resembles the head of a shark, the orifice occupying the position of the shark's mouth.

This form is advantageous; and in introducing such a straight tube the tip should be insinuated through the triangular ligament by rotation. The orifice should not be larger than the calibre of the tube, as it would then admit fragments which would be wedged higher up.

At the upper end of the catheter tube is a projecting wing, which facilitates the handling of the instrument. This wing is on the same side of the tube with the orifice, and is therefore a guide to its position.

The fixed portion of the tube connecting the catheter with the exhaust bottle extends obliquely upward to the centre of the bulb.

This tube is for convenience provided with a stopcock

FIG. 3202.—Diagram showing the Blade of the Lithotrite in the Urethra, Illustrating the Advantage of the Blunted Extremity.

just outside of the bulb, and if a second cock is attached to the upper end of the catheter, the patient and bedclothing can be kept dry when coupling and uncoupling these tubes.

It is, however, the portion of this tube which is within the bulb that is of especial importance. This part, which is simply a prolongation of the catheter up into the bulb, is perforated all around with small holes, the aggregate area of which is larger than the opening at the end of the tube.

When suction is applied the fluid from the bladder, mixed with fragments, rushes up through this tube into the bulb. When pressure is now made, and the water is forced back to the bladder, the greater part of it goes through the perforations in the tube, which afford not only the shortest road, but by virtue of their great area also the largest and freest outlet.

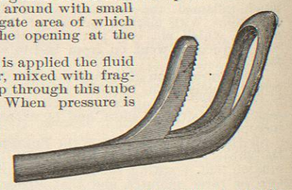


FIG. 3203.—Open-bladed Lithotrite, showing the Inner and Outer Edges of the Female Blade.

Thus the fragments enter the bulb easily, but are prevented by the strainer action of this tube from returning to the bladder. The simplicity of this contrivance speaks for itself. There are no valves to get out of order, and if any mucus clogs the lateral holes it can be easily removed.

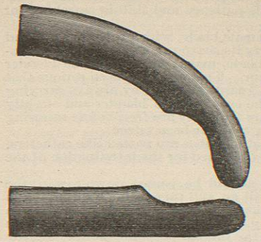


FIG. 3204.—Side View of the Extremities of a Curved and a Straight Tube.

The fragments which are thus caught and retained in the bulb naturally gravitate to the bottom of it, where they are received in the glass ball, or reservoir, which can be readily removed and emptied.

At the top of the bulb is an opening provided with a stopcock, to which a hose can be attached. Through this any air which finds its way into the apparatus can be at once expelled, and the amount of water in the bulb and bladder can be easily and quickly altered during evacuation without disconnecting the instrument—a matter of great importance, as an over-tense and a too-empty bladder are both to be avoided. One of the most important additions to the evacuator was the brace uniting the metal collar of the catheter with that of the glass receiver. This so steadies the catheter that it does not feel the movement of the bulb when compressed.

THE OPERATION.—The presence of a stone having been established, a large steel sound may be passed down through the urethra to make sure that there is no stricture or other obstruction. If a stricture is found it may be rapidly dilated with large sounds, or divulsed. A narrow meatus may be cut.

The urine should then be drawn with a catheter, and enough boric-acid solution should be introduced gently to distend the bladder and so keep its walls out of harm's way during the crushing of the stone. From six to ten ounces is usually a proper quantity.

An elastic-rubber tube may then be tied lightly around the penis close to the corona glandis, to prevent the escape of water alongside of the instruments. This serves the double purpose of keeping a known quantity of water in the bladder and of preventing the wetting of the patient and bed.

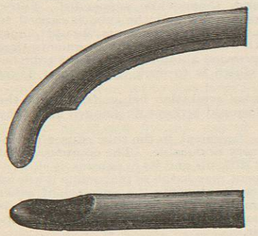


FIG. 3205.—Extremities of Tubes, showing the Opening.

Before each introduction of an instrument the urethra should be filled with liquid vaseline, from a syringe, in order to lessen injurious friction as far as possible.

To introduce the lithotrite properly the point should be carried with considerable gentleness through the constriction made by the rubber tube, and it then slips without difficulty through the movable urethra. After the beak passes below the pubis the handle should be brought to a vertical position, and the instrument will then drop, almost without assistance, by its own weight, until the point rests just in front of the triangular ligament. Traction upon the penis now effaces the depression made by the extremity of the instrument in the bulbous urethra, and if the handle is then brought down gently between the thighs of the patient, and at the same time the point is advanced in the axis of the body, the instrument enters the bladder.

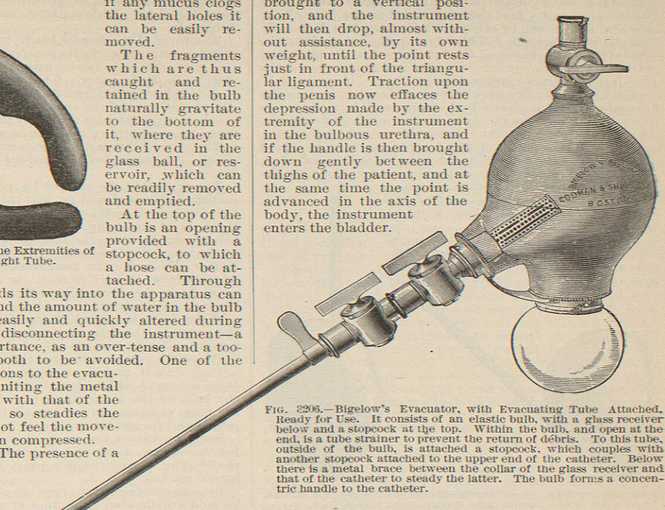


FIG. 3206.—Bigelow's Evacuator, with Evacuating Tube Attached, Ready for Use. It consists of an elastic bulb, with a glass receiver below and a stopcock at the top. Within the bulb, and open at the end, is a tube strainer to prevent the return of débris. To this tube, outside of the bulb, is attached a stopcock, which couples with another stopcock attached to the upper end of the catheter. Below there is a metal brace between the collar of the glass receiver and that of the catheter to steady the latter. The bulb forms a concentric handle to the catheter.

The places where difficulty may be met in a normal urethra are at the triangular ligament and at the prostate.

The point of the instrument may catch on the upper or lower edge of the comparatively rigid opening in the triangular ligament. If the handle is depressed before the beak of the instrument has been carried vertically down as far as it will go toward the rectum, the point is likely to catch against the upper edge of this opening; while, on the other hand, if the instrument is pushed too forc-

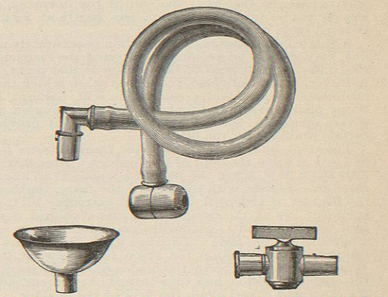
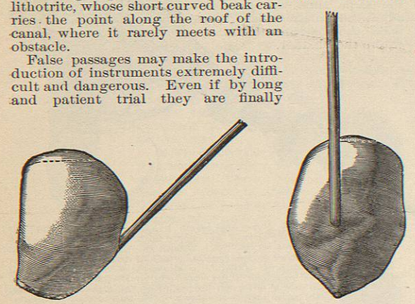


FIG. 3207.—Hose and Funnel to attach to Top of Bulb, and Stopcock for Upper End of Catheter.

ibly toward the sacrum, the lax, bulbous urethra is depressed below the aperture and the point catches on the lower margin. Practically, if the instrument catches at the triangular ligament it should be passed down with the beak hugging first the roof and then the floor of the urethra, and in one or other of these ways it will usually find its way through. The finger pressing against the convexity of the curve of the instrument in the perineum will often lift the point over the lower margin of the opening when it is catching there.

A similar difficulty may be met at the opening into the prostate. This happens but rarely, and is to be overcome by the same tactics. In case of much difficulty the finger introduced into the rectum serves as a good guide, and with it the point of the instrument may be lifted into the prostate when it is catching on the lower edge. An enlarged prostate is, as a rule, easily passed by the lithotrite, whose short curved beak carries the point along the roof of the canal, where it rarely meets with an obstacle.

False passages may make the introduction of instruments extremely difficult and dangerous. Even if by long and patient trial they are finally



FIGS. 3208 AND 3209.—Front and Side Views of a Plaster Cast of Bladder, with a Curved Tube Pressed Down into its Base.

passed, and the stone is comminuted and removed, the danger is not then over, for a serious swelling of the urethra, with retention of urine, is likely to follow, and under these circumstances the passage of a catheter is almost an impossibility.

To avoid this course of things, a catheter should, in such a case, be tied in at the end of the operation, and left in place until the urethra has, partly at least, recovered from the injury received.

A single false passage, if its position is accurately made out, may usually be avoided by carrying the instruments along the opposite wall of the urethra at that point. If, however, several of these pockets exist, in which the instruments are constantly caught, it will, perhaps, be a wiser plan to resort to lithotomy, which, though a more severe operation, has the great advantage of providing certain drainage for the bladder.

The stone and, subsequently, the fragments are found and seized upon the floor of the bladder. Figs. 3208 and 3209 show how, when the lithotrite stands at an angle of forty-five degrees with the axis of the body, the floor of the bladder is indented, so that the extremity of the instrument lies at the bottom of a funnel-shaped depression and fragments naturally gravitate into or close alongside of its jaws. Usually when the blades are opened in this position the stone falls between them. When this does not occur the blades should be opened in the upright position, and then turned over on one side or the other and closed along the floor of the bladder.

A stone may be too large to fall into the depression made by the instrument, and it may then be necessary to depress the handle before it can be seized. This sensation of having the stone above the sound or lithotrite sometimes leads to the belief that it is attached to the upper bladder wall when such is not the case.

The crushing of the stone should be done as thoroughly as possible at the first introduction of the lithotrite. This saves time and irritation to the urethra, and with the self-clearing instruments described above, much may be accomplished by a little patience and skill in searching for fragments.

The form of the female blade, with projecting end and width enough to carry its sharp rim away from close contact with the male blade, makes nipping of the bladder wall unlikely to occur. This accident is so serious that it should be further guarded against by always carrying the blades toward the centre of the bladder and slightly rotating, to make sure that they are free, before screwing down upon anything that has been seized.

The curved evacuating tubes are passed like catheters, much in the manner described for the introduction of the lithotrite.

The straight tube should be passed down toward the rectum as far as it will go, and then, being brought down to a horizontal position, it should be gently pushed up in the axis of the body. At the moment of bringing the tube down between the thighs, pressure should be made at the root of the penis to relax the suspensory ligament. Before advancing the instrument horizontally it is well to withdraw it very slightly, in order to disengage its point from the depression which it is likely to make in the bulbous urethra.

When there is a hitch at the triangular ligament, or at the prostate, the tube may usually be carried through by a rotation in the manner of a corkscrew.

When the tube has entered the bladder the bulb is connected with it, and on opening communication between them a gurgle will be heard, indicating the entrance into the bulb of the air contained in the tube. By means of the hose entering at the top of the bulb this air is expelled and its place supplied by water.

Some operators use evacuators which do not provide for the escape of this air, which is churned in and out of the bladder during the pumping, and is a source of some inconvenience.

In commencing evacuation the point of the tube should be held a little above the floor of the bladder. At every squeeze of the bulb the fragments are then thrown into commotion, and by the subsequent expansion are aspirated through the tube as they are flying about the bladder. If the opening were at first buried in the débris, it would be liable to be clogged by the fragments rushing in together and wedging. Later, when but little remains, the point of the tube should be carried to the bottom of the bladder to gather the remnants as they gravitate into the depression thus made.

The direction of the orifice of the tube should be occasionally changed, so that any side pockets may be thoroughly washed out. The pouch behind an enlarged prostate should be especially attended to in this way.

During the earlier part of the evacuation there should be no interval between the compression and expansion of the bulb. The object at this time is to set the fragments whirling and to catch them while suspended. Later, when the fragments are few and the tube is carried to the floor of the bladder, a few moments should elapse after compressing the bulb, to give the fragments time to settle into the depression about the end of the tube before the expansion which is to suck them into it, takes place.

When any particular aspiration brings fragments, the position of the tube should be kept unchanged until they cease to come.

The wedging of a fragment in the tube causes an obstruction which is very noticeable. The compression of the bulb is rendered difficult and its expansion is slow.

An angular fragment may lodge so that while it allows the passage of water, it prevents the entrance of other fragments. This condition may be suspected if there is a constant clicking against the tube and still nothing appears in the reservoir.

The usual point where fragments wedge is at the entrance to the tube. When one becomes thus fixed, it

may be dislodged with a stylet; and this is the safest method of disposing of it, although with care the tube may generally be drawn out with the fragment in it. This procedure, however, is not devoid of danger, for sharp projecting angles may lacerate the urethra, or the bit of stone may even remain sticking in the passage.

The tube may also be obstructed by the bladder wall, which is sometimes sucked into the orifice. The stoppage from this cause is usually not continuous, but the wall flapping against the opening gives a series of jerks to the instrument, which reminds one of the bite of a fish.

When this is felt the end of the tube should be moved to another part of the bladder, and if it then continues, it shows that the bladder is not sufficiently distended, and water should be added through the hose at the top of the bulb.

When for several minutes no fragments appear in the reservoir, the tube should be systematically moved about the bladder until every part has been explored. If no débris appears during this procedure, and there is no longer any clicking of fragments too large to pass, it may be concluded that the bladder is empty and the operation is completed.

Small particles of stone may be caught in folds and pockets of the bladder, and so may escape a thorough pumping. It is therefore wise before the patient passes from under observation to give another washing with the evacuator. This is of especial importance when an enlarged prostate or other obstruction to the flow of urine exists, as under these circumstances a fragment of stone if retained has little chance of being expelled by the natural efforts, and may serve as a nucleus for another calculus.

Strict aseptic precautions should be observed throughout the operation. The instruments should be thoroughly cleansed with a five-per-cent. solution of carbolic acid. The vaseline used for lubrication should be perfectly fresh, and may even contain a small quantity of eucalyptus oil as an additional precaution. The fluid used for the evacuator should have borax or boracic acid added to it, to sterilize it and to exert a soothing effect upon the bladder.

SIZE OF INSTRUMENTS.—A few words upon this subject may not be out of place, as much of the earliest and most persistent criticism of the operation was directed against the use of large instruments.

The advantage of using as large an evacuating tube as the urethra will readily admit is so evident as to need no argument.

Otis' measurements have shown that the average adult urethra has a calibre about 32 mm. in circumference, which corresponds with No. 32 of the French catheter scale. A tube one or two sizes smaller than a given urethra will usually pass with ease, and will give rise to no undue irritation.

The size of the lithotrite selected will depend largely upon the size and hardness of the stone. As the largest Bigelow lithotrite is No. 30 in the French scale, the operator will rarely be limited in his choice of instruments by the calibre of the urethra, except when this is unusually small.

A soft, small stone can be readily comminuted with a small lithotrite, and if the urethra is narrow it is, of course, an object not to pass larger instruments through it than are necessary. But if a large oxalate-of-lime or uric-acid calculus be found, its thorough reduction is greatly facilitated by the use of instruments strong enough easily to overcome the increased resistance.

Under these circumstances a large instrument works faster, more thoroughly, does not have to be introduced so often, and saves the strength of the surgeon.

This last point is of great importance, as the delicacy of hand so necessary in manipulations through the urethra is with difficulty maintained through a long operation, and yet it is even more necessary toward the close than it was in the beginning. *Arthur T. Cabot.*

[1] Am. Jour. Med. Sciences, January, 1878.

LITHOTOMY—(*λιθοτομία*, from *λιθος*, a stone, and *τεμνειν*, to cut) a cutting operation for the removal of a stone. This term is by usage applied merely to the removal of a stone from the bladder. When otherwise used, the different application is designated by a prefix (*e.g.*, nephrolithotomy).

Lithotomy is one of the oldest operations in surgery, and was formerly the only surgical procedure to be resorted to in cases of stone.

Early in the last century (1824) the crushing operation (lithotrity) was brought into recognized use by Civiale, and was widely adopted in the treatment of cases in which the stone was so small or so soft as to be easily pulverized.

In 1878, Bigelow introduced the operation of litholapaxy, and showed its applicability to stones of considerable size and hardness. So efficient has this operation proved itself that it leaves but a comparatively small number of cases to be treated by lithotomy.

For a brief discussion of the principles which should guide one to a decision between the crushing and the cutting operations in a given case, see under *Bladder*, page 799, of volume i. of this HANDBOOK.

SUPRAPUBIC LITHOTOMY.—In the first half of the last century the infrapubic routes for reaching the bladder were the only ones in general use. The great fear of the peritoneum and the high mortality resulting from urinary infiltration in the tissues of low vitality in front of the bladder led surgeons to regard the suprapubic route as too dangerous for use except under very exceptional circumstances. With the advent of the modern methods of aseptic and antiseptic surgery the dangers largely disappeared and the great advantages of reaching the bladder by this method have brought it again into prominence. At the present time, it has practically displaced all other methods of lithotomy, and the perineal operations are used only when some indication other than the removal of stone exists.

The suprapubic route enables the operator to do his work under the guidance of the eye and makes it possible thoroughly to examine the bladder and to discover and treat other complicating conditions.

As litholapaxy successfully disposes of stones of large size, it is now necessary to resort to a cutting operation only when a very large calculus is so tightly grasped in a contracted bladder that the lithotrite cannot be manipulated about it, or when other exceptional conditions exist which interfere with the crushing of the stones or which make a thorough inspection of the bladder necessary.

Thus, for the conditions under which litholapaxy is not the best procedure, the suprapubic operation fulfils the indications better than any of the perineal incisions.

Operation.—The relation of the peritoneum to the anterior wall of the bladder is the important anatomical consideration in this operation. With the bladder in a collapsed condition, the lower fold of the peritoneum lies at or near the upper border of the symphysis pubis. As distention of the bladder takes place, this fold rises until, when the bladder contains fifteen or twenty ounces, a distance of three or four inches separates it from the pubis. This leaves an unobstructed space through which the bladder may be entered without danger of opening the peritoneum. The production of such extreme distention as this is, however, unwise; but, as will be shown, the peritoneum can be easily avoided in other ways. Moreover, if the peritoneal cavity is opened by accident during the preliminary steps of the operation, it can readily be closed by suture and there is little or no danger of infection entering the abdomen. It is, nevertheless, wise to take precautions to avoid opening the peritoneum and to make the closure tight should this accident occur.

Preparation for any cutting operation for the removal of stone should include an attempt to render the urine as aseptic as possible and, by the use of water and if necessary diuretics, to bring the urine up to a satisfactory quantity. The administration of urotropin in doses of five to seven grains three times a day will tend to inhibit