Thesis
by
James Brins
A Litholyte

of

An Instrument

for

Discoloring Stone

in the

Urinary Bladder.

By

James Brind

31st March 1834
"The attempts which have been made, to dissolve Concretions in the bladder, have not succeeded as we might have expected. However, I am perfectly convinced, that they have not been often enough repeated, to enable us to find out and remedy those obstacles, which we are unable to foresee, and which frequently increase the difficulties of their application."

Bergius
Preface

E endeavoring to find a subject suitable for a thesis, the following suggested itself - The Removal of Calculi from the Urinary Bladder.

Remembering the ratio of mortality in lithotomy, and the limited applicability of lithotomy to cases of stone, let myself devise some means of removing calculi from the bladder by which the life of the patient might be less compromised than by either lithotomy or littestomy. It was not without considerable misgivings that I addressed myself to a subject of such importance and of so much difficulty. But while the difficulties of the undertaking often forbade my attempts, its importance to the suffering portion of humanity stimulated my efforts. Accordingly the means which suggested themselves, as most available were the injection into the bladder of chemical menstrua.
After the researches of Dr. Wallaston, it was not difficult to find appropriate solvents for the stone, but the difficulty to be overcome was how to inject into the bladder with impunity to the viscera, a menstruum sufficiently strong to have any considerable effect upon the stone. This was a difficulty which took me a considerable time to get over. At length the idea occurred to me, that by enclosing the calculi in a bag constructed of material capable of resisting the action of powerful solvents of calculi, and establishing a communication with this bag at tenua, by which menstrua could be injected upon the stone without coming into contact with either the walls of the bladder or of the urethra — by these means I conceived it possible to dissolve the stone in the bladder without compromising, in the least degree, the life or safety of the patient. But what substance could I find out
of which to construct the bag in order that it might be capable of fulfilling the condition required, viz. that of resisting the action of solvents of the calculus? After a little consideration I conceived India rubber to be of such a nature as admirably to fulfill the required condition, inasmuch as it was acted on by very few chemical reagents. Accordingly I set myself to a series of experiments to ascertain to what extent India rubber did resist the action of the various solvents for stone propounded by Dr. Wollaston. In this my success was such as to afford one reasonable hope that the idea was practicable. But no sooner was one difficulty overcome than new ones arose. How could such a pouch be constructed so as to shut in the stone, and isolate completely from the vital economy, the ingress of the solvent, both in its ingress into the bladder and in
its action on the Calculus, and also the debris of the stone in its expulsion from the bladder. This obstacle was not surmounted without the successive failure of many attempts. This difficulty solved, yet another sprung up viz. how to construct the canal for the injection of the solvent and another for the removal of the Calculous debris — and so to construct them that they, along with an apparatus for shutting and opening the pouch, could be packed into a tube whose calibre must correspond with that of the urethra. Besides these difficulties, numerous other ones of a minor character had to be encountered, which only disappeared after a considerable amount of time. All this labor I prosecuted under the impression that the idea was new — but indeed had I the means (being then in the country)
of ascertaining whether any thing had ever been done of a similar kind. During the last Christmas holidays, however, while finally arranging the materials for my thesis I found a paragraph in Dr. Willis's book on the best mode of stone, which gave me to understand, that Dr. Neil Arnott had devised a pouch made of gilded cloth with which he prepared to surround the stone in the bladder and into which to inject strong solvents — this passage surprised me not a little. I then for the first time became aware that the idea of the pouch was not new. When I found that I was preceded in this matter, I immediately endeavored to ascertain how far Dr. Arnott had anticipated me — and I hope it will be some apology for my ignorance of Dr. Arnott's invention when I add that in none of the large libraries in Edinburgh, such as
the University Library, the Advocate also, the Library of the Royal Medical Society could find a copy of Dr. Arnott's book wherein his invention was published—And also in some private libraries, sought for it in vain. 

I am therefore still in profound ignorance as to the construction of Dr. Arnott's apparatus. Whether it is superior or whether it is inferior to that which I am about to describe, I must leave to be determined by those who know, or who have the means of knowing, the nature of Dr. Arnott's apparatus.

As it is important that every instrument should have a name, I propose to describe the instrument for dissolving stone in the bladder under the name Litholyte, and the process of dissolving the stone Litholyse, from the Greek words λίθος a stone, and λύειν (λύω, λυτός) dissolve.
In all the long, dark catalogue of human sufferings, there are few diseases which claim more attention from the Surgeon, and few upon which he can bring his art to bear, with a less satisfactory result than stone in the urinary bladder. This is more especially true if the patient is beyond the middle period of life. For Lithotomy, the operation by which the stone is removed in the great majority of cases, is followed by serious risk to the patient. And it would seem, that no amount of surgical skill or dexterity is sufficient to cope with the danger of the operation to a patient who is advanced in years. For in the hands even of a Chedward the operator in such case is followed by a dreadful
mortality. Under twenty years of age, it is true, lithotomy is a comparatively safe operation; but after this period and as the patient advances in life, the mortality of lithotomy amounts up to an appalling ratio.

This unsatisfactory result of lithotomy has, from time to time, led surgeons to devise means whereby the calculus might be removed, without exposing the unhappy patient to the risks of lithotomy. The various means which have been devised, I do not intend to discuss at great length; nor do I mean to enter very fully into their respective merits. Alone to the danger of cutting for stone surgery has, during the last half century, inclined to seek in lithotomy a safer means for removing the calculus. Nor can it be said that this endeavor has been unattended with success, for in many cases the stone can be crushed in the
Bladder by mechanical means and the fragments removed without compromising the life of the patient—this undoubtedly is a great step gained. But when lithotripsy has dealt with all cases suitable for that operation a very large number of the majority must still be left over for lithotomy. Here, therefore, there is ample room and even necessity for some other agency to deal with these cases, especially in advanced years, in which lithotripsy is unsuitable.

The internal use of medicines as a remedy for stone has been weighed in the balance of practical utility and found wanting. But although the theory of Mrs. Stephen has been put to the wall—that stones in the urinary bladder may be dissolved by the internal administration of soap-ends—yet let not the world be grudged to her five thousand pounds; for to her I presume we are indebted for the
hint that certain medicines, though they dont dissolve the stone, yet do sometimes arrest its growth and render the bladder less impatient of its presence. — In regard to the use of internal medicines as a solvent for stone, I believe that the medical profession has long ago learned to sympathize with the following sentiment of Sir Astley Cooper: — "With respect to the medical treatment of calculi, when a person says to me "I think I can dissolve a stone by some chemical menstruum," my features which are more disposed to the visible than the spoken are apt to give way: I generally smile. — The menstrua employed for the purpose of dissolving stone in the bladder undergo so much alteration before they reach the cavity of the bladder, that they can have very little influence on a stone which is already formed. — May I can tell you more? — If I have very menstrua be injected directly on the surface of
a stone existing in the bladder the stone will still remain undissolved." I witnessed," adds Sir Astley, "an admirable case in the other hospital which was kept for a length of time under a dresser of mine who was very chemically disposed, and who thought he could dissolve the stone by the injection of the menstruum best adapted for that purpose. He did so for a long time, and taught the man to inject the menstruum into the bladder himself. I used to go and ask him, "Well, are you any better?" The man shook his head. After a time however, on my repeating the question he replied, "Yes Sir, I am better." Oh you are? said I. "How does that happen?" "Why Sir," said the man, "I have learnt to inject opium into my bladder, and this gives me great relief though I cannot say that anything I previously tried did me any good." The opium tranquillised him at first, but after a time it lost its influence, and
this man died of an ulcerated bladder.

In this passage, of course, Sir Astley's remarks have reference to a chemical substance so weak, that though coming into contact with the walls of the bladder, have no prejudicial effect upon it — he dreams not of the possibility of using any stronger solvent! — But there are many things new in surgery since Sir Astley lived and died. — If Sir Astley's feature became relaxed on the mention of "dissolving a stone in the bladder," who shall imagine the paroxysms that would have ensued if some one, "Chemically disposed," were to tell him, that by using a chemical substance, he could thrust Sir Astley's beloved finger into a man's perineum without causing a pang!! And it is but a few years since a distinguished French surgeon declared that a "cutting instrument" and pain were inseparably connected, and that the former could never be presented without the
latter; but Velpeau has tried to see the happy day when surgery pursues her humane mission without the drawback of accompanying agony.

And surely the abstraction of a Calculus from the Bladder without cutting need not, a priori be regarded as more objectionable than cutting without pain. But in all such questions a priori definition is unwise.

In his recently published and excellent work on Lithotomy and Lithotomist Mr. Thompson has the following sentiment which bears closely upon this subject—"If the stone is detected early, if discovered when it assumes the size of a bean or at most that of an almond, how often would it be necessary to lithotomize an adult? There can be no doubt that skill in diagnosis is greatly on the increase, and from this fact I may venture to foretell, without any pretension to the gift of prophecy, that year by year, the stone will be detected sooner"
and sooner still, and that therefore
pari passu lithotomy will become
less necessary and lithotomy
more applicable. Add to this the
fact that the unchangeable conditions
of anatomy leave little more to be effected
probably in the mode of removing stone
by the knife, while the improved appli-
cation of mechanics to lithotomy is
year by year perfecting the process.”

Granting that this is true, and that
the improved application of mechanics
to lithotomy is year by year perfecting
the process: Yet fancy it will take
more of the gift of prophecy than
Dr. Humpson seems endued with, to
foretell the number of years which must
elapse ere every patient comes to be
operated on before his stone has ex-
ceeded the size of a bean, or even of
an almond. But further, in regard
to lithotomy, I beg to remark that this
improved application of mechanics
is year by year perfecting the process.
I cannot conceive how, by the most
perfectly improved application of mechanics,
the grand risk in lithotritry, viz., that of prostate being lit up by the sharp fragments of the calculus, can be obviated. I am therefore confident in the opinion, that the means for the removal of stone can never arrive at perfection if the operation of lithotritry: for the laws of Mechanics are as unalterable as the laws of Anatomy. We cannot, by any application of Mechanics alone, do more than reduce the calculus into crude pieces more or less small. But by the action of Solvents the stone may be reduced to its ultimate atoms, whatever these may be, and so may be drawn from the bladder in a fluid state. This is the only perfect operation for the removal of Stone. Now the question arises: Is this attainable? I believe it is. And I hope I shall be able to show, that the attainment of this most desirable object is absolutely within our reach, by the means which I suggest.
Refer to Dr. Thompson's book. He has not been that the author, in the closing sentences of the work, gives expression to sentiments calculated to throw disparagement upon the whole question of solvents. "Chemical solvents," he says, "of some service in exceptional cases they undoubtedly are. But their special application is to the earlier stage of the calculous diathesis, antecedent to true stone formation; for the solution of those particles, which aggregated from the stone. For the action of solvents we require minute mechanical division of the material to be acted on."

On this subject the author speaks so vaguely that I can hardly say whether he means medicines derived internally by the mouth, or chemical menstrum injected into the bladder. If he means the former, I agree with him; but if he means the latter, I have leave to demur to his authority. I maintain that it is not necessary that calculi be in a state of minute subdivision in order to be acted on by
Chemical Solvents. Of course the

most important in Chemistry is aware

that the greater the subdivision of the

material the more swiftly does a

chemical solvent act upon it. For

the simple reason, that a greater

surface is exposed to the action of

the Chemical agent. But surely

Mr. Thompson knows as much of

Chemistry as to be aware, that there

is infinite difference between speedy

solution and insolubility. With

all deference therefore to the Author's

Authority, I maintain from the results

of experiments which I performed that

Calcium does not require minute sub-

division to render them capable of

solution by appropriate Chemical

agents. It is true they will not be

dissolved so speedily as though

they were pulverized; but this is

merely a matter of time. And after

all it will be found that it takes

a wonderfully short time to dissolve

an entire Calculus by an appropriate

solvent. I further complain of this
Most uncivilized manner in which Dr. Thompson elbowed out of his way the whole subject of dissolving stone in the bladder. No one I daresay finds fault with him for his loud praises of lithotrity, and when he yields reasons for a more favorable consideration of it he readily listen to him; but why Condemn Solvents with scarcely a hearing? It were better for that Dr. Thompson had finished his book and kept silence on the subject of Solvents, than that he should have prejudiced a question of so much importance, and Condemned it by ambiguous and "faulty praise." Other Authors of acknowledged Eminence did not act thus. A Committee of the French Academy of Science, in reporting upon a Communication of Mons. Otie, relative to the Solution of Urinary Calculi, after summing up the chief difficulties in the way of dissolving stone in the bladder, add, "We hope that these observations by showing the difficulties connected with solution may be
far from discouraging attempts, the success of which is so desirable; and that they may call forth new researches on this important question.

Bergelius in his Handbook says, 'The attempts which have been made to dissolve Concretions in the Bladder have not succeeded as we might have expected. However, I am perfectly convinced that they have not been often enough repeated to enable us to find out, and remedy those obstacles which we are unable to foresee and which frequently increase the difficulty of their application.'

Dr. Bence Jones speaking of the removal of Calculi remarks, "On the subject of injections I soon as yet offer but little. Excepting the history of what has been done, and some remarks which may occur to me; and the means which have been hitherto used have been generally so insufficient to accomplish the object, that the idea of effecting it with certainty is thought by most to be absurd,"
still the result is worthy of the utmost efforts of the Chemist to obtain."

Now proceed to describe the instrument which I propose for the removal of Calculi. I hoped at one time that I would have the Lithotyde constructed ere now or at least a model of it. But my other duties during the winter Season have prevented me from accomplishing this. Such a model would have been desirable as it would give a better idea of the nature of the instrument than a mere diagram or drawing however perfect.
Fig. I. The Pittolyte in position to receive the Calculus when the patient is turned on hands or knees.

a. The Externalsounds tube.
b. The India Rubber tube.
c. Branches of the Internal or Double tube.
d. The Butterfields button for shutting end of external tube.
e. Projecting border of India Rubber tissue for shutting the mouth of the pouch.
f. The Collar to which are secured by screws the vials, springs, and wires.
g. Mouth of double tube projecting a little distance into the pouch.

h. The Calculus below the Mouth of the pouch.
i. The Urethral Bladder.
Fig. II. The Double Tube, Watch Spring, Etc. etc.

a.a. The Square double tube.

a.b. The Collar for keeping the watch spring and wires in position.

b.b.b. The wires for shutting the pouch.

c. The stick which unites the watch springs.

d. The watch spring which runs along the bottom of pouch.

e.e.e. The watch springs which surround the mouth of the pouch.

Fig. III. Transverse Section of Pouch, etc.

a. Watch spring in bottom of pouch.

b.b. The border of India Rubber tinciue for shutting the mouth of the pouch.

c. The wires running along these borders.

d. The watch springs surrounding mouth of pouch.

Fig. IV. Transverse Section of Tube, etc.

a.a.a. The watch springs.

b. The wires.

c. The diaphragm plate which divides the one square tube into two triangular ones (this diagram is on an enlarged scale).

N.B. Around the collar a, which is nearest the pouch is to be some stuffing of India Rubber to enable it to fit accurately the internal tube to prevent the bladder being evacuated during the operation.
The lithotrite which is represented by the diagram fig. 1 consists essentially of two straight tubes and an India rubber pouch. Both tubes may be constructed of German silver, and their walls are to be as thin as is compatible with strength. The tubes are placed one inside the other. The external tube is round, and of length sufficient to reach the bladder per rectum, its diameter about 1/4 inch. The internal one is rectangular (Fig. 2) and is subdivided into two triangular tubes by a thin plate passing diagonally through its entire length. This is seen in the transverse section Fig. IV.c. The internal or double tube moves easily up and down within the external by the application of slight force. So the one end of the double tube is attached a pouch constructed of India rubber tissue so thin that it can be drawn up within the external tube. At the other end the double tube divides into two separate and distinct branches (Fig. I.a). Between the walls of the external
and internal tubes are vacant spaces (fig. I, a.) along their three of these spaces run match springs of small size which serve at the extremity of the tubes as a framework for the pouch. These match springs are kept in close apposition with the walls of the internal tube by three girdles one at each end and one intermediate (fig. I, b. & fig. II, a. & c.). The fourth space is occupied by two ends of a wire which serves to close the pouch after it has received the calculus (fig. II, b. & fig. III, b.).

As to the pouch, its mouth is surrounded by two of the match springs already mentioned which are united at their extremities by a link (fig. II, c.) the curve which these springs have receivedserve to keep the mouth of the pouch patent. The third match—spring of the same length as the others, but somewhat stronger, runs along the bottom of the pouch (fig. II, d. & III, a.) and keeps it distended. Its extremity is attached to the link that unites the other two. If this link is attached a button-shaped piece of gutta-percha (fig. I, d.) which when the pouch is drawn up into the external tube, accurately fits into the end of
the tube and facilitate its passage through the urethra.

Further, around the mouth of the pouch is a border of India Rubber tissue projecting forwards (Fig. I. E, Fig. III B). Its free margin ends in a loop along which runs an wax wire (Fig. III C.)—this arrangement is for shutting the pouch. When this is desired we draw up the extremity of the wire and fix them at f (Fig. I).—Thus the loose hanging border is stretched tight across the mouth of the pouch and completely shuts it enclosing the orifices of the double tube which projects a little distance into the pouch (Fig. I G.)

In the act of pulling these wires while shutting the pouch, we have to overcome some degree of elasticity in the India Rubber tissue and thus elasticity assists in opening the pouch when we push back the wires.

It will be seen from Fig. III A. D. A. that the rebate springs are not adjacent to the pouch, but pass between the layers of tissue so that the pouch can be enlarged.
or diminished at will according as
the springs are pushed forward or drawn
back. This arrangement will be found
especially convenient in shutting the mouth
of the pouch, because the two side springs
can be drawn back a little and so
lessen the tension which the wires would
otherwise exert upon the projecting border. Again,
by pushing forward the same springs they
would aid in opening the mouth of the
pouch.

In drawing back the pouch only the
external tube, the India Rubber tissue, is pressed
between the match springs, or the edge of the
tube and may possibly be apt to rupture.
To obviate this, a strip of some other material
such as animal membrane may be pasted
with solution of India Rubber along the ridge
corresponding to the match spring.

The one compartment of the double tube
is for the impress of the Solvent and the
other for the express of the debris. The
Solvent may be injected through one of
the tubes by means of an ordinary Syringe
made of Vulcainite or glass, constructed like
an Sorens Syringe. So that a Continuous
Stream of the Solvent may be kept playing upon the Calculus, or that form of Syringe invented by Hippia may be successfully employed for the same purpose.

The inside of the double tube must be either plated with gold, or coated with India Rubber to prevent them being eroded by the Solvent. The latter mode is the simpler, and will be found quite sufficient — A solution of India Rubber in Chloroform or some other Solvent, is injected through each compartment and this repeated several times leaves a sufficient coating inside the tubes. — The ends of the double tube near or the pouch would be better to be plated both externally and internally, as the Castor oil would be liable to be rubbed off by contact with the pouch itself.

So much for the Construction of the Hittolyte, now for its Mode of operation —

The Patient's Bladder has been sounded and is found to contain a Calculus. Let it be ascertained as
far as possible, from testing the urine, and from the patient's disease, what the Constitution of the Calculus is. This done, the patient's bladder, if not already moderately distended with urine is to be as distended with by the injection of tepid water. The patient is then to be placed on his back in the semi-recumbent position. The outside of the pouch is to be well oiled to facilitate its introduction, and then drawn up within the external tube, and the piston-punch button must accurately fit into the end of the tube so as to facilitate as much as possible the passage of the instrument through the urethra. As soon as the tube is felt to be fairly into the bladder the double tube is to be pushed forward thus causing the pouch to protrude and open inside the bladder with its mouth below as is represented in Fig. I. And while doing so the hand of the operator is to be a little depressed to ensure the passing of the mouth of the pouch above the stone. The pouch is con-

* the wires also are to be pushed forward so that the mouth of the pouch may be quite patent.
to which the double tube has entered the external one. The patient is now to be turned gently upon his elbows and knees, the operator meanwhile taking care that the instrument be not dislocated—the patient is now in the prone position. Consequently the bladder is turned upside down and the stone which before lay in the bottom of the bladder now tumbles into the pouch. If there is an enlarged prostate—or even though this does not exist—the prostate of the stone may be favoured by the operator having a forefinger in the rectum.

The mouth of the pouch is now to be shut by pulling the rives to a degree previously ascertained to be sufficient—the distance necessary being marked on the rives. The rives and rathes, springs are then to be secured by means of silver wires through the collar (Fig. 1). As make sure that the stone do not slip down between the wall of the bladder and the side of the pouch the bladder must not be distended too much with
water, but only to such a degree that this pouch, when extended, may be in contact with the walls of the bladder.

To make further sure that the stone in the pouch, a straight rod may be introduced through one of the compartments of the double tube, and the Kittletye could be held in a depending position so that if the stone is present it must of necessity be opposite the mouth of the tube - or still better, to give more room for introducing such a road, the diagonal diaphragm which divides the two tubes might be immovable so that it could be taken out and put in at will, and thus with the diaphragm out a pretty large sound could be introduced into the pouch. This also might throw some light upon the effec

tion of the Calculus. If, for example, it were found very rough there might be a presumption that it is mulberry Calculus and it would be of considerable importance to be able to diagnose this variety.

Another means of ascertaining whether the calculus were within the pouch, might be
tried vig. to endeavor to draw the point back into the tube - if a stone is in it, the point is withdrawn with facility; but if a stone is within it - it will be found impossible to withdraw it, yet in endeavoring to withdraw it there must not be much force used for fear of rupturing the pouch.

The stone being ascertained then to be within the pouch, and some clue existing as to its Constitution, the appropriate solvent is to be injected; for instance if the Calculus is composed of Urie acid be inject a very strong solution of Carotic Pottas. If again the Calculus is of the triple Phosphate formation or of the Carbonate formation be inject either Acetic acid or Hydrochloric acid in as concentrated a form as is necessary (Concentrated Hydrochloric acid has no effects upon the Carotic stone). But if no clue to the formation of the Calculi is better to begin with the Solvent for Urie Acid, as the great majority of Calculi in this Country are of Urie Acid
formation. If it be found that this solvent has no effect and this can be ascertained by testing the effluvia from the effluent tube then re-inject the solvent for phosphate earth which is the next most common formation. But if neither of these acts on the stone, it is presumed that it is of the oxalate of lime formation and here the solvent is Concentrated Hydrochloric Acid (Schaling). But we must not give up either of these solvents because they fail to act in a few minutes, it is must allow time to be for some time in contact with the stone. I should think that in a quater to half an hour, we are likely to ascertain whether the solvent is to do good in any particular case.

And no harm results from allowing the instrument to remain in for a few hours provided the patient's urethra has been accustomed previously to the use of an instrument, and this should always be. Of course if the urethra is constricted, bougie must be passed to it.

* This is perhaps the best solvent I have for oxalate of lime but it is far from being a satisfactory one.
Store it to its normal calibre before the Litholyte can be applied.

Such then is the Litholyte and such is Lithotripsy.

That Lithotripsy is, in the abstract, superior to Lithotomy, I suppose no one will deny. And as little will it be denied that it is superior to Lithotomy. But it may very properly be asked is all that we have said in favour to dissolving stones possible? Or may even be asked Can such an instrument as I have described be constructed? Will the Indian Rubber tissue of which the pouch is composed resist effectively the action of these powerful solvents that cannot be employed? And finally Are we in possession of solvents for all kinds of Calculi?

That such an instrument as the Litholyte can be constructed I think no one with the least knowledge of Mechanics can for a moment entertain any reasonable doubt; for the principle of its construction is of the simplest—
nature possible.

As to the India Rubber Pouch residing the action of the necessary solvent it must appeal to the proof afforded by the following experiments.

1. An India Rubber pouch, similar to those sold in toy shops as "balloons," was filled with the strongest Acetic Acid and remained so for twelve hours and after the slightest change was produced on the tissue of the pouch.

2. A similar pouch was filled with a very strong (the strongest which could be made) solution of Caustic Potass. An ounce of Potass was put into three drams or two of water. This powerfully corrosive solution had no effect whatever upon the India Rubber altho it remained in the pouch for twenty four hours.

3. A Calculus, supposed to be Urinary Acid combined with ash, was added to the Potass or the "balloon." In two hours it was reduced to a pulpy mass by the Alkali but there was not the slightest change produced in the pouch.
4. Concentrated Hydrochloric acid (p. gr. 1:16) remained in the pouch for 14½ hours and the tissue had undergone no perceptible change. The same held true in regard to dilute HCl.

5. A similar experiment was performed with Concentrated Nitric Acid (p. gr. 1:42) in an hour and a half the walls of the pouch had completely lost their elasticity. Had become hard and fragile.

6. But on diluting the Nitric Acid with an equal quantity of water the tissue was not much injured after the hour.

7. But lest the temperature of the human body should be found to affect the reaction of the Coalsnail + India Rubber, I added to 3 parts of water 1 part of HNO₃ put this into the pouch which was then placed in a water bath kept at 100°F. At the end of five hours the puncture made in the pouch was scarcely impaired either in strength or elasticity.

8. 10% HNO₃ and 2 of water, and the bath at 100°F. The condition of the tissue at end of two hours was same as preceding at end of five.
9. Sulphuric Acid Concentrated (Gp. Sn. 1.83) was put into the pouch and at the end of an hour and a half the tissue had lost none of its strength or elasticity. The diluted acid remained for a very long time and no effect was produced in the pouch —

These five substances HDO₃, HDO₃, HCl, H₃O and Aetic Acid dissolve almost all the known forms of Calculi, and only two of them in a Concentrated form have any effect in impeding the strength of the India Rubber tissue. These two are HNO₃ and H₂SO₄; but fortunately it is not necessary to use those in the Concentrated form. Their action as solvents will be found quite effective though diluted to such a degree as to have no effect upon the walls of the pouch.

The last question which I proposed cannot seem easy, he disposed of so satisfactorily.  viz. Have we a solvent for every kind of Calculus?  The Oxalate of Lime is a very insoluble salt in the shape of a Calculus, and no good solvent has yet been discovered.
for it. The only solvent which seems to have any effect upon it, and that after long digestion, is concentrated hydrochloric acid. This action upon it the calculus must be in a state of fine division (Schröder).

D.Schröder, speaking of the action of Carbonate of Soda, states in discussing the question of the urine acid formation, remarks, that "the effects of these salts are not confined to the urate alone; they are equally efficacious as solvents for Malate of Lime, Phosphate of Lime, and a property not sufficiently appreciated. The decomposition which takes place on digesting Malate of Lime in a solution of the Alkaline Carbonates has long been established, and I have ascertained by repeated experiments that the natural temperature of the body suffices to produce an interchange of principles so that Carbonate of Lime and Malate of Soda or Potash shall result. The two latter salts are soluble in water alone, the former in water impregnated with Carbonic Acid."

* Schröder in Urinals, Calculi 1842. P.123.
Dr. Renee Jones has made the following calculation relative to the composition of urinary calculi in this country. Among 1000 stones, there were

372 of Uric acid alone or mixed with small quantities of Urate of Ammonia and Oxalate or Phosphate of lime.
253 of Phosphatic Earths (fusible).
233 of Varying layers of Uric Acid Oxalate of lime or Phosphate Earth.
142 Oxalate of Lime.

Rapp has calculated that of 81 stones at Wurttemberg
22 were composed of Oxalate of Uric Acid alone.
34 in which Oxalate of lime was mixed with other substances, so that there were 56 Oxalate of lime therefore in the stone.
7 Uric Acid.
9 Uric acid mixed with Phosphatic salts altogether therefore there were only 16 of Uric acid forming out of 81.
7 Fusible.
1 Urate of Ammonia.
If Dr. Scharleng's observation is correct we need not despair of dissolving even the Oxalate of Simie Calculus by means of the Littolite. But if we had no solvent for this Calculus, this fact would be an objection against the use of the Littolite for this kind of Calculus forms but a small proportion of the Vesical Calculi commonly met with in this Country. It is otherwise however in some other Countries (see table on opposite page). Further if Littolgy were becoming a frequent operation for the removal of stone, the stimulus which this would give to research for appropriate Solvents would, I have little doubt, lead to the discovery of a more effective Solvent for the Oxalate of Simie Calculus.

It is not necessary for the success of Littolgy that the Calculus be dissolved at one sitting. If after several hours the patient feels fatigued the operation may be interrupted. The pouch to be care fully washed out with water, and if an acid has been used as a Solvent, an

*Scharling states that no diluted dissolve Oxalate of Simie Calculus after long digestion.
alkali much diluted must be injected for a little time— to make sure that the portion of stone which remains undissolved may not cause irritation when returned into the bladder.

I have only a few words to add in regard to solvents when I shall have time—

The very great difficulty of obtaining calculi has prevented me from making experiments to ascertain the effects of different solvents upon various kinds of calculi in their entire state. On this subject therefore I must rely upon the investigations of others. Ballantyne, Sohaly, and others who have written on this subject are generally agreed as to the following results.

I. Acetic Acid.

1. Dissolves Triple Phosphate.
2. Dissolves Carbonate with Effervescence.
3. Necoloring matter of urine acid calculus.
4. Dissolves urine oxide slowly.

II. Hydrochloric Acid. Dilute (1 HCl to 9 Aque)

1. Dissolves Phosphate of Lime.
2. Triple Phosphate.
3. Fusable Calculus.
4. Dissolve Carbonate of Lime otherwise.
5. Mulberry Calculus, either by boiling (which is inadmissible) or by long digestion.
6. If insoluble, Cystine.

III. Nitric Acid dilute (1 N. + 9 aqua)
1. Dissolve, Uric Oxide.
2. —— + decomposes Uric acid.
3. —— The Carbonate.
4. The Mulberry Calculus slowly.

IV. Caustic Potassa
1. Dissolve Uric Acid entirely. It is the special Elixir.
2. Dissolves Uric Oxide.
3. —— Cystine.
4. —— The Albumen of Mulbery Calculus when the powdered calculus is digested in a solution of it.

V. Carbonate of Potassa
Readily dissolves the Urate of Soda, of Potassa, and of Arumoniac. These are often solvents for the above substances, such as HCl, PO₄, and oxalic acid. But these are more limited in their action therefore not as important.
I have now done. And if what I have said leads to the lessening, in any degree, of the amount of human suffering, and if it is worthy of one who aspires to become a graduate of the University of Edinburgh, my object is gained.