Observations based on the probable mode of formation of urinary stone relative to its recurrence and prevention / by Reginald Harrison.

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RELATIVE TO ITS RECURRENCE AND PREVENTION.

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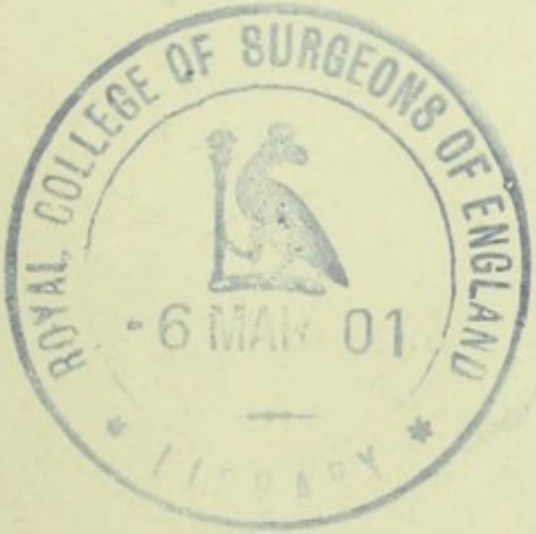

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OBSERVATIONS BASED ON THE PROBABLE MODE OF FORMATION OF URINARY STONE, RELATIVE TO ITS RECURRENCE AND PREVENTION.

In an article which appeared in THE LANCET[1] entitled "A Further Contribution to the Surgery of Stone in the Bladder" I endeavoured to illustrate how progressive this work had been during the latter period of the past century and how intimately this was associated with the general adoption of the method of operating which Bigelow originated in 1878 and which has since been known by the name of "litholapaxy." I then purposely left for further consideration the only feature connected with this class of operations which seemed to require amendment or improvement. I refer to the liability to recurrence, which is admittedly larger after crushing as compared with other methods for removing stone from the bladder, though the mortality of the former is considerably less. In the paper referred to there were 101 cases of stone operated upon by litholapaxy alone, in addition to other methods. Of this number there were six deaths, whilst in 23 cases there was recurrence in some degree. The average age of these 23 persons was a fraction under 63 years. Several of the recurrences only amounted to the formation of some phosphatic gravel mixed with tenacious mucus, which was readily removed by the washbottle and aspirator. 17 of these persons had considerable enlargement of the prostate, 12 had pouched bladders, and the same number were more or less dependent upon their catheters at the time of operation. In two cases it seemed probable that recurrence was due to fresh descents of stones from the kidney and their retention

[1] THE LANCET, Nov. 12th, 1892, p. 1250.

within the bladder by the large prostate. In one of the fatal instances recurrence was traceable to a pouched bladder complicated with neglected urethral stricture and chronic suppurative nephritis. Hence it may be inferred that though a stone is successfully removed by operation this does not necessarily imply that the original cause for its production has thus coincidently ceased to exist.

From these statements it seems clear that the class of cases where the tendency to recurrence is greatest and most difficult to deal with, subsequently to the primary operation, is that in which, before stone formed, the bladder was more or less functionally and structurally spoilt by the obstruction it had been submitted to by enlargement of the prostate. It is hardly necessary to enumerate atony or loss of muscular power to expel urine, pouching, trabeculation,and cystitis, as being amongst these commoner effects.

The liabilities in its application to this class of cases seem in some degree to discredit the crushing operation in the eyes of the profession and public. Mr. Cadge in 1886 referred to it in the following terms: "This seems a heavy indictment to bring against lithotrity, but I am afraid there is no gainsaying it, and if so, it would be wrong to pass it over or make light of it. Many of these relapses might be prevented if the patients would observe directions and persevere with treatment."[2] I shall endeavour to show in detail, later, how we may succeed in giving effect to the latter statement.

On the other hand, in otherwise healthy persons without these prostatic and other defects the liability to recurrence of calculus in the bladder after operation is slight, as was also shown in the previous paper, and may usually be accounted for by the unexpected descent of a fresh nucleus from the kidney in the form of a small urate or oxalate stone. This is a cause for recurrence which applies equally to lithotomy as well as to lithotrity, however performed.

The information we now mostly require relative to the removal of primary stone from the bladder under the conditions first mentioned of more or less permanent catheter-dependence and prostatic obstruction is not so much as to how quickly the operation can be effected, or how speedily convalescence follows, but as to what happens within the 12 months or thereabouts immediately succeeding it and concurrent with the abnormal states of the parts referred to.

[2] Hunterian Lectures, Royal College of Surgeons of England.

The object of my paper is relative to the former class of cases, from which the greater proportion of stone recurrences after operation are drawn, and to show what has been done recently to diminish this tendency in them, and upon what principle or lines the latter may now be successfully attempted. Thus may we hope to lessen this liability and so to increase proportionately the efficiency of treatment. For it seems to be a more reasonable proposal to endeavour to extend the scope of an operation attended with so much to recommend it and so small a mortality than to substitute a more serious proceeding. Though lithotomy may be necessary for special reasons connected with the size or hardness of a stone or for other considerations, I can hardly see how its mortality, apart from other drawbacks, is likely to be diminished in the future, having regard to the advanced age and enfeebled powers of the persons upon whom it is usually practised. A repeated litholapaxy or a substituted lithotomy are in no sense comparable in elderly or feeble people. I purpose, therefore, to deal with the class of cases noticed as being most prone to recurrence. I will arrange my remarks under three headings: (1) the local treatment of the bladder following litholapaxy; (2) preventive treatment based upon the mode in which it is assumed that urinary calculi are formed; and (3) some illustrative cases.

I.—The Local Treatment of the Bladder Following Litholapaxy.

For some time past I have acted on the rule of regarding all cases operated upon for stone as "suspicious" until a sufficient interval has elapsed to free them from this imputation. This, as I have urged, is the more necessary in cases where the normal functions of the bladder are impaired by prostatic obstruction. Here personal supervision should be carried on for a period after the individuals have passed from the hands of the operating surgeon into those of the usual medical adviser. Such observation should have reference to the fact that there is a time in the history of all stones forming in the bladder, as well as in others where the nuclei descend from the kidneys in the shape of small calculi, when they would have escaped through an ordinary adult catheter as used for normal dimensions. Hence when

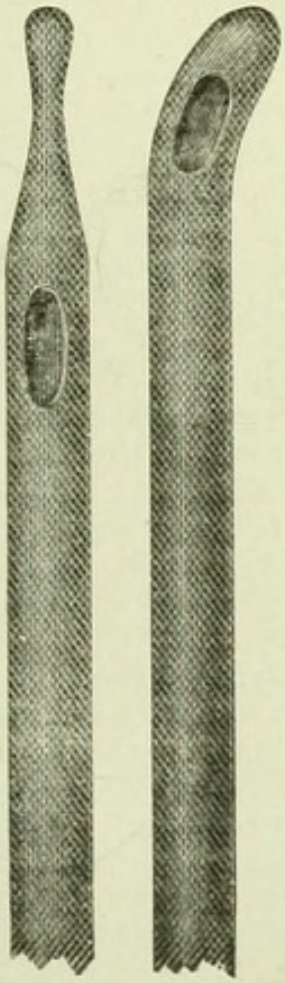
the condition of the urine after an operation remains abnormal, or unexpectedly becomes so, as indicated by appearance, smell, or microscopical examination, the bladder should be carefully attended to until such states are either explained or removed. Tentatively even under these circumstances, or for moving and withdrawing minute concretions or calculi, which would soon develop into larger stones, and before they have furnished full evidence of their presence, the bladder should be washed out as for exploration. Direct evidence of the necessity for this is often furnished

FIG. 1.

by the withdrawal of a number of small phosphatic concretions or other crystalline bodies which on examination with a magnifying glass may be seen arranging themselves so as eventually to form distinct conglomerations of calculous material. In the accompanying illustration (Fig. 1), which is copied from Sir Everard Home's Lectures (vol. vi.), minute crystals of uric acid may be seen held together by wavy shreds of mucus in course of consolidation by the process described by Rainey, and which will be again referred to later, of molecular coalescence. These are frequently met with and may be readily recognised. If not removed they

are the sure forerunners of stone. To effect their removal a suitable syringe and catheter are required. I have tried many kinds of the former and other apparatus used for washing out the bladder, but the best is a metal syringe made to fit various sizes of catheters. This should work easily, without jerking and with sufficient power for the purpose. The syringes I refer to are not liable to get out of

FIG. 2.



order and can be readily rendered aseptic and kept so. The best catheters are the larger-sized, smooth-bored, silk web ones, with an ample bevelled eye (Fig. 2). The larger the instrument the better, so long as it will enter the bladder without causing pain or too much tension. It is convenient to have the end somewhat funnel-shaped, so as readily and accurately to fit the conical nozzle of the syringe. For this purpose, until the patient is used to the passing of the

catheter, the urethra may be rendered less sensitive by the application of a 5 per cent. solution of cocaine with a Guyon syringe. For injecting, warm water—preferably soft water—answers the purpose very well. If the urine is offensive boric acid, sanitas, or a solution of permanganate of potash may be added. Whatever is used should be used freely. From two to four pints at one séance, or even more, may be injected in instalments once or twice a day, the object being to dislodge any concretions that pouches or sacs may contain and to obtain a perfectly clear return fluid. Hence the object should be to sluice the bladder rather than to wash it in the ordinary acceptation of the term. I have often found it answer to fill the bladder fairly full and then to cause the patient to lie or roll on his stomach. By this and such like devices concretions may often be got rid of in considerable quantities. In some cases, when the bladder is sacculated and to make doubly sure, it is well to wash out occasionally with the usual evacuator catheter and aspirator as used for removing débris after litholapaxy, which will also be found a test or sound as to the presence of any calculous concretion that may be unable to escape through the eye of an ordinary flexible catheter. By attention such as is here indicated the bladder becomes gradually less liable to form these concretions, as I shall show when I refer later to some illustrative cases.

Where the mucous membrane remains relaxed and spongy, as evidenced by an excess of mucus in the urine, which is often met with in bladders that have held stones for considerable periods, it is well, after the usual sluicing has been finished, to conclude the process by injecting, two or three times a week, a couple of ounces of a solution of silver nitrate (one grain to 12 ounces). This may be increased in strength provided it causes no pain. It is the best astringent for this purpose, but its utility is often marred by being used too strong. This quantity of the solution should be left in the bladder after it has been emptied of the water or lotion previously used. By this means, as illustrated in the previous article,[3] the process of molecular coalescence may be interfered with. It is not possible to indicate precisely how long the local measures described must be continued or how often repeated. The absence or presence of the symptoms referred to in individual cases should determine these points. I will therefore pass on to the second portion of my subject, which may be utilised concurrently with what has been described.

[3] The Lancet, Nov. 12th, 1898, p. 1250.

II.—Preventive Treatment having regard to the probable Mode in which Urinary Calculi are Formed.

It is stated, and no doubt with some truth, that the causation of stone is connected with processes of physiological chemistry as yet imperfectly understood. This may be so, but it must be a matter of common observation, considering the complex nature of stone-formation as it occurs in the human body, that advantage is not generally taken on more definite lines to abort the process and to render it inoperative. For it would seem that the more complex and precise are the conditions for a constructive act of this nature, the less likely is it to happen casually, whilst the more open is it to attack from the direction I have ventured to indicate. We may, for instance, be only imperfectly acquainted with all the changes connected with some delicate experiment, but none the less do we recognise how its failure may be effected.

It may be remembered that in 1851 Rainey [4] of St. Thomas's Hospital demonstrated a mode of making calculi artificially by what he described as molecular coalescence. The more recent works of the late Dr. Vandyke Carter [5] and Dr. W. M. Ord [6] tend to confirm and extend these views. It will not be necessary to refer to Rainey's experiments at length. From their study and repetition the following conclusions may be drawn in relation to the special object of this communication:—(1) that for the production of calculi artificially by molecular coalescence precision in regard to all details connected with it is required; (2) that success is dependent upon the sequence or concurrence of several factors or fixed conditions; and (3) that molecular coalescence as described by Rainey explains the formation of calculi in the human urinary apparatus.

[4] Precise Directions for Making Artificial Calculi. Transactions of the Royal Microscopical Society, vol. vi. On the Mode of Formation of Shells of Animals, of Bone, and of several other Structures, by a Process of Molecular Coalescence, demonstrable in certain Artificially formed Products (Churchill, London, 1858).

[5] The Microscopic Structure and Formation of Urinary Calculi (Churchill, London, 1873).

[6] On the Influence of Colloids upon Crystalline Form and Cohesion, with Observations on the Structure and Mode of Formation of Urinary and other Calculi (Stanford, London, 1879); also Transactions of the Royal Medical and Chirurgical Society, March 9th, 1875.

1. Apart from any theory of stone-formation it could hardly be supposed that there are two or more ways of concreting the constituting elements of a calculus any more than there are two ways of forming a gumma, an atheroma, or other pathological product. This consideration probably largely underlies our modern views of therapeutics. The difficulty in procuring this precision in the conditions necessary for the formation of stone and their concurrence doubtless explains the comparative rarity of the disorder relative to the population as well as various apparent anomalies connected with its geographical distribution. The following passage from Rainey indicates what has to be provided for in the laboratory. Less exaction than this could hardly be expected in the bladder or within an organised body.

> The process of artificial stone-making consists in introducing into a two-ounce phial, about three inches in height, with a mouth about one inch and a quarter in width, half an ounce, by measure, of a solution of gum arabic saturated with carbonate of potash. The specific gravity of the compound solution should be 1·4068, when one ounce will weigh 672 grains. This solution must be perfectly clear; all the carbonate of lime which had been formed by the decomposition of the malate of lime contained in the gum and also all the triple phosphate set free by the alkali must have been allowed completely to subside.

If a fixed medium is required for the formation of stone, and precision in regard, for instance, to specific gravity, to such circumstances as chemical reaction, temperature, rest, and movement, and possibly to other physical, chemical, or bacteriological details, it must be obvious how comparatively rarely these conditions can casually concur in the human body and how open one or other may be to disturbance. Such elaboration necessarily opens a field for reflection in the minds of those who have to regard this combination of events from a pathological point of view.

2. I do not think that it is sufficiently recognised that in the multitude of factors or conditions necessary for the formation of stone there is both wisdom and safety. Illustration is given of this by the following consideration. Assuming that eight or 10 grains of so insoluble a deposit as uric acid is daily excreted it would appear that there is not an individual in fair health who is incapable of forming a stone in a reasonable time provided that the other circumstances for concretion are favourable. If, for instance, a man in the habit of excreting 10 grains of uric acid a day were only to void half this with his urine and

concrete the remainder it is obvious that he might form a stone of this material alone, weighing not less than half an ounce, in something like 48 days.

It is hardly necessary to search for causes of excess in the excretion of uric acid when the natural amount, placed under favourable conditions, is capable of forming a stone of this weight in so short a time. If the production of stone were dependent upon a single link rather than upon a chain of them it is probable that these disorders would be far more common and general than they actually are. It would seem that hitherto we have almost exclusively paid attention to searching for causes of stone arising out of excesses of their characteristic ingredients rather than in studying other contributory conditions of the urine which are capable of bringing this about by the consolidation of that which is natural in the excretion. Extremes of uric acid, for instance, do not appear alone to influence the formation of this variety of stone. Its excess in the urine has not been shown to increase this liability in certain districts. The East Indian on his diet of milk and cheese, pulse, lentils, wheat, rice, and the like, as Mr. Freyer[7] pointed out, would appear not to suffer from excess of uric acid but from the power he possessed of converting all that a strictly non-nitrogenous diet can supply into stone.

The earliest stage of gravel and stone-formation as it may occur within the kidney or other portion of the urinary apparatus is well indicated in the following extract from a report on the urine of a person who from time to time suffered in this way: "A large number [of cells] yet remain unaccounted for, and these are believed to be derived from the superficial layer of the mucosa of the renal pelvis. Crystals of free uric acid are also present both singly and collected into microscopic masses. These facts taken together represent a conjunction of circumstances which, with the occurrence of hæmorrhage after exercise, seems to leave little room for doubt as to the correctness of diagnosis [calculus]." It is not unreasonable to suppose that the initial step of stone-making which is here demonstrated might without much difficulty be disturbed.

3. So far as the applicability of Rainey's views to the formation of human urinary calculi is concerned I will only quote the following passage from the late Dr. Vandyke

[7] Transactions of the Medical Society of London, vol. xx., p. 78.

Carter's work in support of it, as I am not aware that this has ever been denied.

> Regarding the probabilities of the case, it seems to me that the necessary conditions for the operation of molecular coalescence may at times well occur in the living human subject. Thus, an excess of mucus, perhaps altered in character, would furnish a colloid medium with which uric acid, the urates or oxalates, could combine in the manner described.[8]

On the assumption that Rainey's process explains the formation of stone as observed in man it would appear that molecular coalescence is capable of being disturbed or aborted by interference with the conditions indicated under the foregoing conclusions (1 and 2). This act differs essentially from what has already been attempted by dissolving stones after they have once formed. It is, however, not improbable that some remedies which have been in vogue for the latter purpose—for instance, those containing alkalies—owe their claims to this distinction by seeming to prevent further formations on the grounds which I am advocating without in any material way diminishing the size of that which had concreted prior to their use. Preventing construction and effecting dissolution represent two different processes.

There are some interesting points bearing on this subject connected with drinking-water as used for ordinary purposes as well as medicinally. No one, I think, can doubt the efficacy of such spas as Contrexéville, Wildungen, Vichy, and others that might be mentioned, relative to calculous affections. During a stay which I made at the first-mentioned place two years ago I was much struck with what others have also noticed. In some instances the volume of water taken in conjunction with the exercise no doubt favoured the expulsion of small calculi by the mechanical act of flushing the part containing them. In others, though it did not appear to diminish the amount of uric acid voided, it seemed to prevent it collecting into small masses of crystals—that is to say, the latter showed a tendency under the influence of the waters to isolate rather than to aggregate. This was a matter of common observation with some of the habitués of the place. It seemed likely that in this way the process of stone-forming might be interfered with in its initial stage. Shortly before I had been struck with

[8] Op. cit., p. 39.

Mr. Cadge's[9] observations on the absence of milk as a food for children in the eastern counties of England relative to the prevalence of stone. I then made some observations on the effects of hard water used for drinking purposes under these circumstances, and though they were somewhat crude some results were obtained which appeared to be significant. Various samples of urine obtained from persons using such water were found to contain increased amounts of mucus, which were most marked in children. This test has since proved useful in assisting to determine the suitability of some hard waters for drinking purposes. Where the amount of mucus thus deposited is excessive it may be taken as tending to indicate that the water in question is not desirable, especially in the case of persons liable to gravel and urinary deposits. In connexion with this it is interesting to note that a change in the water-supply of a district—for instance, the substitution of some distant reservoir for local wells—has been found to alter substantially the liability of the inhabitants so supplied to stone and gravel.

These considerations suggest that an increased quantity of urinary mucus may provide a colloid for molecular coalescence and to this extent furnishes a necessary factor for concretion. Nor are such influences as I have mentioned confined to the use of certain waters, for they will be found similarly associated with various articles both of food and medicine. For instance, I have known persons who had been in the habit of passing small urate and oxalate calculi, attended with more or less pain and other symptoms, who apparently ceased to do so after taking from time to time short courses of such drugs as turpentine, sandal, copaiba, and others that might be mentioned—in fact, from the use of almost anything that has a distinctive and special action on the urinary excretion. I do not wish to be understood as expressing a belief that such drugs could dissolve a stone, whether small or large, when once formed or wherever situated, but in numerous instances their use appears to have been followed by a cessation of these discharges without necessarily interfering with the natural or excessive elimination of uric acid in this excretion. The presence of certain constituents of these drugs is judged as merely interfering in some way with the concretion of the latter into stone. Thus, as stated, may be explained the action of certain remedies, patented and otherwise, which have gained, properly or

[9] The Etiology of Stone in the Bladder, British Medical Association, Norwich, 1874.

undeservedly, more or less notoriety in preventing the formation of stone and gravel. Some of these remedies which have come under my notice appeared to contain an ingredient which is admittedly capable of exercising some influence on the urine and may thus have been the means of disturbing a formative process in which this excretion was primarily implicated. Various alkaline salts formed the basis of some of them. A preparation called "Dutch drops" has for many years been a popular one.[10] It is stated to consist of "oil of turpentine, tincture of guaiacum, spirit of nitric ether, with oil of amber and cloves," the first ingredient being most likely the potent one in preventing crystalline concretion by molecular coalescence occurring as already suggested. Similarly the glycerine treatment[11] of renal concretions of uric acid may be explained.

An uncleanly condition of the urine, particularly of residual urine, where the individual is more or less dependent on the use of a catheter, is often a contributory cause of ammoniacal decomposition and the recurrence of stone after operation. I say a contributory cause of calculus, as some seem to doubt that a phosphatic stone can be formed without the presence of a nucleus upon which concretion can take place. Though this is frequently the case, it is not of universal application. Phosphatic calculi not rarely form in this way in the bladder, as in cases of advanced urethral stricture and sequential bladder changes, without any discoverable nuclei other than the concretion of the crystals of triple phosphate which the microscope readily discovers in abundance. The process of molecular coalescence is sufficient to explain this. Much may be done under these circumstances to prevent urinary decomposition by the use of the catheter and syringe as already referred to. Within the last few years improved means for sterilising the urine have also been largely and successfully employed. Effect is given to this on the same principle as milk, butter, and some food products liable to change under atmospheric and other influences are rendered more stable and less likely to undergo decomposition by containing certain proportions of boric acid or other innocuous antiseptics.

Some valuable drugs have been introduced for sterilising urine during its flow from the kidneys downwards and its storage in the bladder. Sandal wood, cubebs, and the like,

[10] Pharmacologia, fifth edition, 1822, by Dr. J. A. Paris, F.R.S.
[11] Medical Chronicle, January, 1900; and Brit. Med. Jour. (Abstract 137), 1900.

doubtless owe some of their medicinal properties to their effects as bactericides, but they are nauseous and uncertain in their action. Some years ago I drew attention to an easily soluble and digestible salt of boric acid which often answers admirably and is much used by itself or in combination for this purpose. It is prescribed in teaspoonful doses in a tumbler of water, and may be taken frequently under the name of the borocitrate of magnesia. Many people use it with as much freedom as they do common salt with their food, as beyond sterilising the urine imperceptibly it appears to have no other action. Salicylate of sodium, benzoate of sodium, benzoate of ammonium, hyposulphite of sodium, are also useful sterilisers, which may be prescribed separately or in combination. Lastly, I would mention amongst this group a more recent introduction, under the name of urotropine, which is a valuable addition to it, and has in some instances a remarkable power of clearing urine and keeping it so. It is stated that its action is due to liberating formalin when mixed with the urine. By such means as these it is possible in some degree to wash out and to disinfect the pelvis of the kidney and the ureter, which in cases of chronic prostatic obstruction is often required, as much as, or even more than, the bladder. Thus a contributory cause of stone may be averted.

Of the effects of a solution of silver nitrate in preventing molecular coalescence and the formation of stone no more striking evidence can be afforded than those instances referred to in my previous paper.[12] In those cases by the injection of a weak solution of this salt foreign bodies introduced into the bladder were prevented from becoming coated with phosphates. This has been utilised in practice in connexion with accidents arising from catheters where delay in removing broken portions from the bladder was unavoidable.

III.—Illustrative Cases and Remarks.

I shall endeavour to illustrate some of the foregoing remarks by cases in which recurrence of stone in the bladder after operation was successfully treated, mainly by local attention and partly by instances where other influences were brought to bear upon formations and reformations not

[12] The Lancet, Nov. 12th, 1898, p. 1250.

necessarily vesical in their nature nor requiring operation. Amongst the latter are included cases of renal gravel and stone, which may be said to form the largest proportion of urinary calculous affections. This will entail dealing with this aspect of the subject in two sections—viz.: (1) illustrations where the treatment was for the most part local; and (2) those where other influences were employed in aborting the stone-forming process.

1. Of the 23 cases of recurrence of stone referred to in my previous paper as having occurred after operation in elderly men, 12 patients are known to have had no further symptoms of recurrence for periods extending over from two to seven years. These persons were for the most part treated by local measures alone, as described in the earlier part of this paper, and as far as can be ascertained they have ceased to concrete stone. It has not been possible to follow up all the remaining cases, and but little reliable information can be ascertained about them. I am disposed to think that several of the patients have had no further recurrence, otherwise I should have heard of it. A few are hospital patients who cannot be traced. However, the 12 out of the 23 who are known to have remained well is a fair proportion for basing these remarks upon.

CASE 1.—The patient was a man, aged 79 years, whom I saw in 1890. He had a remarkable family history of stone, his grandfather, father, paternal uncle, and himself all having suffered in this way. A large prostate rendered the operation not an easy one. He had five recurrences, which were all treated by litholapaxy. The last occasion was in June, 1893, after which the process of washing out the bladder daily as previously described was commenced. Afterwards I sent him to take the waters at Harrogate, where he remained under the care of Dr. G. Oliver. Writing to me some months after this course he stated: "The urine is clear, acid, and free from deposit, and I am able to go about without my catheter in my pocket, a thing I never did for years past." He died at the end of 1898, without further recurrence, at the age of 87 years, having led an active life to within a few months of his death. My belief is that the local treatment and the sulphur waters effected the twofold objects desired in the manner suggested. The original calculus crushed was a triple phosphate weighing 53 grains, and those that recurred were of the same nature. The later

operations rarely detained the patient to the house for more than a few days. In this case the urine was so continually alkaline and ammoniacal that I finally tried the artificial induction of the lactic fermentation, apparently, as in other instances, with success in preventing the precipitation of the mixed phosphates. This was first suggested by the late Sir William Roberts,[13] the object being to bring about and maintain an acid reaction of the urine by overpowering the ammoniacal tendency until the bladder, so to speak, had time to return to a more normal condition.

CASE 2.—In this case a man, aged 60 years, was seen by me in 1890 with Mr. F. Grant. A phosphatic calculus weighing two drachms was removed by litholapaxy in March of that year. During that year and the subsequent year he suffered from several recurrences which required removal by the lithotrite and washbottle. This entailed his giving up an active professional life. In 1891 he commenced the systematic method of washing out described and has had no further return since. Writing to me in 1899 he says: "I still, however, go on with the washing out, as I should not feel safe without it, and it is no trouble." He has resumed his work as usual. As in the previous case, the patient told me that he had been frequently advised to submit to a lithotomy and bladder drainage. He remains quite well.

CASE 3.—In the following case, though no recurrence of the stone took place, it will be seen how this was probably averted. It was that of a man, aged 67 years, whom I saw in 1893 and from whom I removed a stone by litholapaxy weighing one drachm. There was some prostatic enlargement. By regularly washing out the bladder in the way described from time to time with a solution of boric acid, masses of shreddy mucus containing triple phosphate crystals were frequently removed. Under the use of silver nitrate solution these eventually disappeared. In 1898, in spite of attention of this kind, considerable difficulty was experienced by him in using his catheter by reason of further enlargement of the prostate, cystitis, and repeated attacks of epididymitis. Again his urine became largely charged

[13] A Case of Lactic Fermentation in the Bladder, with Suggestions for the Use of the Lactic Fermentation as a Counter-septic Agent in Cases of Ammoniacal Decomposition of the Urine, THE LANCET, Feb. 25th, 1893, p. 405.

with triple phosphates, and muco-crystal strings and concretion appeared imminent. In 1899 double vasectomy was performed. This permitted a more thorough irrigation of the bladder with the large-eyed catheter and syringe, and the urine speedily recovered its normal condition, and the patient was again able to resume an active outdoor life. In getting rid of the phosphates and the excess of mucus, in addition to the local means mentioned, the sterilisation of the urine for stated periods of a week or ten days, from time to time, greatly assisted in effecting this and securing an acid reaction of the urine. Thus the almost certain recurrence of stone was averted. The steriliser used consisted of urotropine and benzoate of ammonium, five grains of the former and 15 of the latter drug in an ounce of chloroform water, taken thrice daily after food.

It may be observed that where at the time of operation and subsequently, as the consequence of prostatic enlargement, patients are more or less dependent upon the catheter, the local treatment by washing out with suitable instruments for preventing re-formation of stone entails little or no additional inconvenience. Where prostatic complications of this kind do not exist, and there is no such dependence on artificial aid for withdrawing the urine, either at the time of, or subsequently to, the litholapaxy, the precautionary methods adopted are of the kind employed in the following case.

Case 4.—A man, aged 64 years, was operated upon by litholapaxy in January, 1897, when an oxalate-phosphate stone was removed weighing nearly two drachms. He was under observation for 10 days. In October, 1899, nearly three years afterwards, I again saw him with symptoms of stone, when about the same quantity of urate calculus was removed by litholapaxy, the patient remaining under observation for seven days. It seemed probable, from the entirely different character of the débris removed, that the latter stone was formed on the nucleus of a fresh descent from the kidney. There was no distinct symptom of renal colic, though those of vesical stone had been in existence for the previous two or three months. In the past year he has been tested once a month with the large-eyed catheter and syringe as described. For the next 12 months the test will only be applied every eight weeks, unless occasion arise to indicate its more frequent use. He takes, in addition to this, five minims of oil of turpentine every night for the first 10 days of each month, and some urotropine and benzoate of ammonium in a draught on the

following morning. The latter expedient is with the view of aborting any tendency to stone-formation taking place in the kidneys, where the nucleus of the vesical stones that were crushed came from. His prostate is somewhat enlarged and would probably trap any fresh descent from the kidney in the shape of a small urate or an oxalate calculus. For these reasons the double precaution has been now taken for the past year, and he is, as far as it can be judged, free from stone. Having regard to the past it will be desirable to continue these precautions in a modified degree for a year or so longer. Otherwise he is entirely independent of the catheter.

The cases which serve as the basis for these remarks were for the most part seen and dealt with in connexion with a record embracing my operations for stone during 1890–97. Since the last-mentioned date the views and practices here expressed and illustrated have had fuller effect given to them than in the previous series. The results, so far as they have gone during the three years ending with 1900, have tended to support their expression, as recurrences after operation have been less frequent, whilst the after-treatment of litholapaxy has been placed upon a more satisfactory basis. I have waited until a sufficient time has elapsed to speak with some assurance on these points.

I admit that it is difficult, if not well-nigh impossible in some instances, to give full effect to the mechanical details which are here described. Failures, therefore, must still follow and be expected, and it is these, however rarely they occur, that will make us turn occasionally to the old controversy—Would not a lithotomy have been better in the first instance? Possibly it might have been, but yet there remains something to weigh even against this. Individuality on both sides must receive some consideration in doubtful cases. The broader lines which govern the selection of lithotomy or lithotrity are in the majority of instances sufficiently obvious and applicable.

2. Passing to the second group of cases, which, for the most part, include voidable calculi and gravel voluntarily expelled by the act of micturition, formed and recurring independently of operations, I will offer a few illustrations as to how it seems probable that their construction may be interfered with. Reference has already been made to what has been observed at Contrexéville and elsewhere as tending to support this view, as well as to some indications following

the use of different kinds of drinking water which appear to be significant. This brings us more directly in touch with the administration of drugs for the purpose under consideration.

The formation and recurrence of stone and gravel, terms which are only used as broadly indicating extremes of concretion so far as size is concerned, are met with in (1) urines that are more or less foul or that show evidence of decomposition; and (2) urines that are apparently normal.

1. The signs of decomposition to which importance should be attached are twofold: (1) the presence in the urine of flocculent masses of mucus containing crystalline material which may be seen by the microscope or by the naked eye, or may even be recognisable by the touch; and (2) an abundance of triple phosphate crystals in the urine as determined by microscopical examination of the excretion. These suffice to indicate a liability to the formation of vesical stone which should not be neglected, more particularly in the case of persons who have already suffered from calculus or have undergone operation for it.

Apart from the employment of local measures, which were considered in an earlier part of this paper, modern therapeutics have added to our resources some important medicines which have already been referred to as sterilisers. Some of these may even be used with advantage as articles of diet, of which the borocitrate of magnesia is an example. Many instances might be quoted illustrating their power of removing those signs of urinary deterioration to which allusion is here made. It is not necessary to refer at greater length to them as they have already been named. By their internal administration in numerous instances the urine may be prevented from undergoing that kind of decomposition which enables certain products of the latter, by molecular coalescence, to form phosphatic stones of considerable size in a short time. I will pass on to say a few illustrative words relative to the second condition.

2. Urines that are apparently sound though excreted by individuals who are liable to suffer, not infrequently or lightly, from attacks of renal colic and stone, and are also exposed to some risk arising from the detention and increment of the latter in the bladder. These are the calculi which are usually of renal origin, and are best open to attack in the earliest stage of their formation. My attention was called some years ago to some cases of this kind

due to the descent of small calculi from the kidney downwards, when, after the paroxysm of pain was over, the patients were treated by various drugs which were supposed, with some reason, to be chiefly eliminated through this system.

CASE 5.—The first instance was that of a man who had been in the habit of passing uric acid calculi for several years before I knew him. Eight years ago I crushed and evacuated a small calculus for him which had failed to escape from his bladder. It was only a small stone and confined him in the house for three or four days. Prior to this he must have passed from time to time over 100 calculi of the same kind, though rather smaller, which I now have. I have seen him only once since, about four years ago, when he was in excellent health. With the exception of three or four somewhat similar calculi which were passed within a few weeks after the operation referred to eight years ago, he told me that he had seen no more. Further, he informed me that he attributed this not to any change in diet, but to his taking, on the advice of a friend, five minims of oil of turpentine night and morning for the first week of every month. When I saw him four years ago he told me that he had not changed his residence or his habits since the operation four years previously, but I think that he has done so since. I was struck at the time by this statement, but was disposed to regard it merely as a coincidence which could not be accepted without something more approaching a verification of the conclusion which the man had arrived at. However, I am disposed to think that there is something in it. If the conditions necessary for the formation of a stone in the kidney, or for that matter elsewhere, are fixed and unalterable, why should not the inference be correct? There is nothing irrational in the belief that this temporary addition to the man's diet, unpalatable as it might be to some, spoilt the process of stone-formation as another might favour it. Without pursuing this reasoning further I made use of the information thus given to me.

Trials have been made during the last three years with such drugs as sandal-wood oil, copaiba, cubebs, and turpentine, much on the same lines as those detailed in the case narrated. The cases in which these drugs were employed in this way were those of persons suffering from the passage of oxalate and urate concretions, commencing their use about the time when the paroxysms of pain con-

nected with the expulsion of these bodies were over. Care was taken to regulate the doses so as not to interfere with the digestion of the patient. A course of a week or 10 days every month was the period usually advised. The results were very satisfactory in many of the cases, the use of the drug selected apparently resulting in the cessation of further formation of calculous concretions. Sandal oil and oil of turpentine were the drugs which were found best adapted for this purpose. The following case, which occurred about the time I commenced these investigations, interested me as showing the way in which calculi could be influenced artificially.

CASE 6.—The patient was an adult male upon whom I operated by litholapaxy three years ago. He had a phosphatic stone in the bladder of about the size of a small pigeon's egg, the result of damage done to the bladder by a chronic urethral stricture. He was operated upon at St. Peter's Hospital under gas and ether administered by Mr. W. Braine. On washing the fragments of stone out of the bladder after crushing it was noticed that they were all of a deep blue colour. I was at a loss to explain this at the moment, and so were others who were present in the operating theatre. It turned out on further inquiry that for three weeks previously the patient had been taking for his bladder symptoms a medicine containing methylene blue. He made a good recovery.[14]

[14] It would be interesting to know, particularly in regard to further developments, if any observations have been made as to whether the colour of a urinary calculus, apart from the nature of its chemical composition, exercised an influence on the shadow cast by the x rays. For instance, if a black oxalate stone gave a more pronounced outline than a similar one of a lighter colour, such information would be of value. It occurred to me that if depth of colour intensified the shadow thus produced it was possible to bring this about artificially. In the case I have recorded I found that a white phosphatic stone was deeply stained blue by the patient having previously been treated by a course of methylene blue (tetramethylthionine chloride) for cystitis. I have seen other vesical calculi stained a deep indigo colour in this way. I have wondered whether different degrees of intensity observed in radiographs of oxalate of lime calculi in the kidney were explainable on this principle. If so, a practical point in aiding their diagnosis in this way is suggested. I venture to raise this question, as feeling the great importance of endeavouring to discover calculi in bladders distorted by enlarged prostates without the use of a sound, and for calculi in the urine passages which are inaccessible to the touch. A stone in the bladder when detected by the sound under these circumstances should be at the same time removed. This is not always convenient. A stone detected by radiography permits of a delay without detriment, or reflection upon the process employed.

In an interesting paper relating to stone formation Dr. Lindley Scott[15] has recently shown how oxalate of lime may be artificially resolved into other combinations and so be excluded in this form from the urine. Thus the formation of this kind of stone may be rendered inoperative.

It is hardly necessary to say in connexion with the tendency to the formation of urinary gravel and stone that morbid conditions of the excretion as indicated by an excess of normal constituents, or by the introduction of elements which are foreign to the urine, should as far as possible be dealt with on general principles which are sufficiently recognised and provided for. Excesses of urates and uric acid, for instance, as observed in the gouty, and the introduction into the urine of oxalates, cystin, and the like, are indications which will not be allowed to pass without special notice and attention. My contentions, however, are for the most part based upon proportions which may be normal.

I will briefly refer to two points connected with the processes of removing stone from the bladder which have a bearing upon the subject of recurrence.

In the first place every care should be taken, especially in the case of crushing operations, to remove all fragments of stone from the bladder. It should be remembered that the bladder of a man obstructed by an enlarged prostate in front of it, not uncommonly more closely resembles the section of a coarse bath sponge than the inside of a tea-cup. Thus the difficulties of clearing the former are considerably increased as compared with the latter. But the successful accomplishment of this is not often unattainable and should be first demonstrated to be so before crushing is put aside on this ground.

In the second place, care should be exercised, whether lithotomy or lithotrity is selected, to avoid introducing rough scar-tissue into the bladder. It is just as liable to cause stone concretion as any other foreign body. I illustrated this in the Surgical Section at the meeting of the British Medical Association in 1900. One reason for the success and comparative rarity of stone recurrence noted in earlier days by lithotomists who practised median and lateral lithotomy correctly was that they introduced no scar-tissue afterwards within the area of the bladder. When I was engaged in teaching pathology and surgery I had several opportunities

[15] Brit. Med. Jour., Oct. 13th, 1900.

of demonstrating what would seem to support this statement. I have more than once scraped off phosphatic concretions from the rough uneven inner scar of a suprapubic cystotomy.

In preparing this paper, the subject suggested itself from a critical examination of my own work, which was not unconfirmed by that of others who also possessed ample means of obtaining information. It appeared to me that the liability to recurrence after lithotrity, or litholapaxy as it is now called, was larger than it should be and might be reduced. And further, that the whole subject of stone-formation and recurrence, relative to prevention and treatment, was capable of being reconsidered and dealt with on more precise and definite lines. This, I think, will be admitted to be the case, and that in attempting to do so we may fairly hope where surgical interference proves necessary to extend the limits of the crushing operation rather than to curtail them.

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