

On the comparative advantages of lithotomy and lithotrity : and on the circumstances under which one method should be preferred to the other : being the dissertation for which the Jacksonian Prize for 1838 was awarded / to Edwin Lee.

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ON THE

COMPARATIVE ADVANTAGES

OF

LITHOTOMY AND LITHOTRITY,

AND ON

THE CIRCUMSTANCES UNDER WHICH ONE METHOD

SHOULD BE PREFERRED TO THE OTHER.



Being the Dissertation for which the Jacksonian Prize
for 1838 was awarded to

EDWIN LEE, M.R.C.S.,

Member of several of the Principal European Medical and Chirurgical Societies,
Author of a "Treatise of Some Nervous Disorders," "On Stammering
and Squinting, and the Methods for their Removal," &c.

"VIRES ACQUIRIT EUNDO."

LONDON:

J. CHURCHILL, PRINCES STREET, SOHO.

P R E F A C E.

This Dissertation would have been published earlier, but for my absence from England, and expectation that it would appear in the first volume of the Transactions of the Royal College of Surgeons; the publication of which, however, having been postponed, I was recommended by the Council to print it separately; but as I was desirous of diffusing information upon the subject among the bulk of the Profession, more generally than could have been done by means of a volume, I availed myself of the extensive circulation of the Edinburgh Medical and Surgical Journal, from the two last numbers of which it is reprinted, and can thus be offered to those who may be desirous of possessing it at a comparatively trifling price.

April, 1842,
170, North-street, Brighton.

ON THE
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Dissertation for which the Jacksonian Prize of 1838 was awarded to

EDWIN LEE, M. R. C. S.

Corresponding Member of the Medical and Chirurgical Societies
of Paris, Berlin, Naples, Florence, Bologna, Bordeaux,
Lyons, Marseilles, and Toulouse, &c.

(*From the Edin. Med. and Surg. Journal*, No. 150.)

COMPARATIVE ADVANTAGES OF LITHOTOMY AND LITHOTRITY.

Vires acquirit eundo.

I. A subject of greater importance, or one more interesting to the community at large, could scarcely have been selected from the whole circle of the science of surgery for a collegial prize essay, than a comparison between lithotomy and lithotritry, with a view to determine the superior applicability of the one operation over the other, in particular cases; especially as the greater number of the profession in Britain know as yet but little of the merits or demerits of the latter method of removing stones from the bladder, beyond the cases and statements too often partially given, which have from time to time appeared in print; and it is to be regretted that a long period must still elapse ere this operation can be so generally known and practised as to lead to a correct appreciation of its value. This can scarcely be the case, till it is included with other operations in the usual course of study, as in Paris, where the pupils not only have frequent opportunities of seeing the operation performed, but also of making themselves familiar with the instrumental manœuvres, by repeated trials upon the dead body, so essential before operating on the living, and without which the operator would have occasion to rue his temerity, from the supervention of accidents less attributable to the operation itself, than to its being improperly performed. Not that the performance of the operation, as at present simplified, presents any peculiar difficulty in most cases; neither does it require a long course of previous study, as many persons have been led to suppose; but that the simplest process often appears difficult till it is understood, and a certain degree of tact is required, which can only be obtained by practice.

My attention having been a good deal directed to lithotritry during the last five or six years,—my frequent visits to the continent within that period having afforded me opportunities of becoming acquainted with the methods of performing it, and of estimating its advantages—I was desirous of causing the operation to be better known and appreciated in England, and with this view, gave two years ago, some public demonstrations in London, and three of the larger provincial towns. The very flattering manner in which these were attended, afforded me an additional proof of the high interest attached by the profession to the subject, and that every opportunity would be gladly embraced of becoming better acquainted with this new means of removing one of the most distressing afflictions to which mankind is liable.*

To institute a comparison between lithotomy and lithotritry, and to

* This was written nearly three years ago—May 1841.

endeavour to point out the cases most suitable for either, presents, however, peculiar difficulties, inasmuch as though some cases may be pretty clearly defined, as being more especially adapted to one or the other operation, there will always be a great number of others, between which it would be impossible to draw a line of demarcation; and these will require considerable exercise of the surgeon's judgment in taking into account the peculiarities in individual cases, to enable him to determine, which of the two operations would offer the greatest likelihood of relieving the patient from his disease, with the smallest amount of present inconvenience, and the least risk of ulterior consequences; and it is not without great diffidence that I enter upon the inquiry. Previous, however, to offering an opinion on some of the circumstances which more especially appeared to indicate the one or other mode of operating, I shall briefly allude to some points respecting the nature of calculi and the condition of the urinary organs; and shall subsequently treat of lithotomy and lithotrity; confining myself as strictly as possible to such as are of a practical nature, and more immediately connected with the subject of the dissertation.

II. *Of calculi in the bladder, and the means of ascertaining their properties.*—A knowledge of the physical properties and chemical composition of the urinary concretions met with in the bladder, has become of much greater importance since the invention of lithotomy, than when cutting into the bladder was the only operation resorted to, whatever the nature of the foreign body to be extracted; as such knowledge will often serve to guide the surgeon in determining to which operation he should give the preference. It must be confessed, however, that the means which we possess are very insufficient to enable us to obtain accurate information on this head. Of these means, sounding is the only one which admits of our verifying with any approach to certainty the existence of stone in the bladder, and of judging of its physical properties; but the information furnished by the sound is very often exceedingly fallacious, not only as regards the number of the foreign bodies, their size, &c. but even with respect to their very existence. One surgeon will frequently feel, or imagine he feels, a stone in the bladder, while another would not be able to feel it, or would ascribe the sensation he experienced on sounding to other causes. In the common practice of sounding patients in a standing or recumbent position, it is often extremely difficult to detect a stone in the bladder, especially if it be small and lodged behind and beneath the prostate, which is of very common occurrence; more particularly if there should co-exist enlargement of this gland; and numerous cases are recorded, both in ancient and modern times, where surgeons of acknowledged ability have failed to detect stones in the bladder, even when they have been

as large as a hen's egg or larger. M. Leroy D'Etiolles mentions in his work,* a case where, on the first exploration of the bladder, no stone could be detected by the surgeon; on a second examination, a stone was felt, but was pronounced to be of small size; yet the bladder contained a calculus, weighing two ounces and a half, which was extracted after having been broken into pieces, by the recto-vesical operation, in consequence of which the patient died. The same author quotes another case from the practice of a surgeon, whose attention was specially directed to lithotrity, and who sounded a patient three times, without being able to feel a stone, notwithstanding the bladder contained one which weighed four and a-half ounces, and measured three inches in its longest diameter. Several analogous examples are related by M. Civiale in his *Parallele des divers moyens de traiter les Calculeux*. Mr Hodgkin has also stated a case (in the *London Medical and Surgical Journal* for October 1837) of a child, two years of age, who laboured under symptoms of stone, which, however, could not be detected by sounding through several examinations were made by experienced surgeons; yet, after the patient's death two calculi were found in the bladder, each of the size of a pigeon's egg. In a patient, who was sounded at the Hotel-Dieu, it was supposed that the bladder contained so large a stone, as not only to render lithotrity altogether inadmissible, but even to counter-indicate the performance of lithotomy by the perineum. All the assistants were of the same opinion as the surgeon, and the high operation was consequently performed by Dupuytren, who, after a period of twenty minutes, employed in seeking the stone, at length extracted one, the largest diameter of which did not exceed eighteen lines, its smallest diameter being only seven or eight. The patient died shortly after the operation. At the same hospital, a similar error occurred more recently. It was expected that the operation would present extraordinary difficulties, on account of the excessive size of the stone, and on the supposition that it could not be extracted entire, instruments were brought into the theatre, wherewith to break it; yet it fell out of itself through the incision in the soft parts, which had been made too large.† Several cases are also on record, where examination with the sound has misled surgeons of experience, inducing them to believe that a stone existed in the bladder, where such was not the case, and operations of lithotomy have consequently been uselessly performed. This occurred more than once to Cheselden, twice to Dupuytren, and, according to his own candid admission, four times to M. Roux. M. Civiale states that analogous instances have more recently occurred in the hospitals of Paris, Vienna, and Munich. Mr Crosse likewise operated on a patient, though uncertain of the

* De la Lithotripsie.

† Civiale, *Traité de l'affection Calculeuse*.

existence of stone; the bladder, in fact, contained no stone, but two large fungous masses, and several smaller ones. Another case is related by Mr Key in the Guy's Hospital Reports, where lithotrity was recommended, though it was subsequently ascertained that the bladder contained no stone.

Thus we see that reliance cannot always be placed on an examination of the bladder by the sound; even as far as concerns the presence or absence of calculi; still less on their size, density, and composition; though in many cases a tolerably near guess may be formed on these points, by the extent of surface traversed by the sound, laterally and from before backwards; by the weight of the stone when pushed on one side, by the kind of noise caused by striking it; as, if it be hard,—as of the oxalate of lime or lithic acid varieties,—a clear distinct sound will generally be emitted; while, should it be of the phosphatic variety, the sound on percussion will, in most instances, be dull, as when a piece of chalk is struck with a metallic rod. Were more care taken to sound patients in different positions than is generally done, especially with the pelvis raised higher than the abdomen and with the bladder in alternate states of fulness and emptiness, information of a more definite character might frequently be obtained even with a common sound; and still better by the employment of lithotritic instruments, which have in several instances served to detect stones and fragments in the bladder after the sound had failed in ascertaining their presence. For this purpose the curved instruments appear to me better adapted than the straight three-branched lithotrite of Civiale, inasmuch as the shortness of their curve admits of their being turned completely round in the bladder, and enables the surgeon to feel with the beak of the instrument foreign bodies lodged behind and beneath the prostate gland, which a common sound or a straight instrument like Civiale's would pass over, and leave undetected, especially in cases where there exists enlargement of this substance. In obscure cases a lithotritic instrument has, moreover, the advantage of ascertaining more accurately the size of the stone, as when this is seized the surgeon may always see by referring to the graduated scale near the handle, the exact diameter of the part embraced between the branches. With this instrument, also, the surgeon is better able to ascertain whether the bladder contain more than one stone, as, by moving the instrument in various directions with the stone in its grasp, it would in all probability strike against other stones if any existed; and if the stone were not hard, its composition might be known, or at all events, that of its outer layer, from the nature of the detritus adhering to the instrument after it is withdrawn. Explorations of the bladder, however, with lithotritic instruments are generally more painful than ordinary sounding, and are not always harmless;

being sometimes followed by symptoms of a serious and even of an alarming nature. Hence they are not to be recommended indiscriminately, but in doubtful cases may be of great service in affording the surgeon such information as may enable him the more readily to determine upon the operation to be preferred, and also after lithotrity, to ascertain that the bladder has been completely freed from the presence of the foreign body.

Examination of the urine and its deposits will sometimes throw considerable light upon the nature of calculi contained in the bladder; though the information obtained by this means can only be relied upon when confirmed by other circumstances. Thus when a person has been for some time in the habit of passing lithic acid gravel, and a calculus is subsequently detected, we may reasonably infer that it is of a similar composition, though, at the same time, it must be borne in mind that the prolonged sojourn of a foreign body in the bladder frequently induces pathological states in this viscus, by which the original nature of the stone is very much or altogether changed. In many stone-patients, however, the urine is to all appearance perfectly healthy, and does not deposit any sediment. Dr Prout indeed, states, with respect to the urine of stone-patients, *1st*, That the urine of persons who have a lithic acid calculus, is generally of a dark colour, of greater specific gravity than healthy urine, almost always depositing a red crystallized sediment, which is more abundant whenever pain and irritation exist. *2dly*, The mucus from the bladder is less abundant than when other kinds of calculi are present. *3dly*, Lithic acid calculi do not give rise to such formidable symptoms as other kinds, and may even remain in the bladder for a longer or shorter period without the existence of symptoms which would cause their presence to be suspected during the patient's lifetime. *4thly*, Calculi composed of the phosphates cannot exist long in the bladder, without producing all the symptoms of stone and general derangement of the health. *5thly*, The urine of patients with these calculi is abundant, of little density, and slightly opaque, somewhat analogous in appearance to whey, the phosphates being precipitated in the form of a pulverulent sediment mixed with a certain quantity of mucus; the urine becoming speedily decomposed on exposure to the atmosphere. *6thly*, The urine of persons who have an oxalate of lime calculus is generally clear and does not contain sand or gravel.

Other high authorities upon the same subject dissent from some of the preceding opinions. From the experiments made by Fourcroy, this distinguished chemist observed, and his observations have been recently corroborated by the investigations of M. Chevallier, that there is almost a total absence of uric acid in the urine of most stone-patients, indicating that the calculi formed are

composed of this substance. Dr Prout's opinion of the physical characters of the urine of persons who have lithic acid calculi is also different from that of Fourcroy and Chevallier, which shows the necessity of further investigation to elucidate these points. It is also well known that phosphatic and oxalate of lime calculi, as well as those composed of lithic acid, have in several instances been found in the bladders of individuals after death, when no symptoms had existed to indicate their presence.

The urinary calculi most commonly met with in practice are composed of uric acid, or urate of ammonia; of oxalate of lime; and of the ammoniaco-magnesian phosphates; several, however, having a mixed composition, or a nucleus of one substance, and superimposed layers of another substance. The proportion of uric acid calculi greatly exceeds that of the mulberry and phosphatic varieties, as will be seen by a table which I have annexed in the appendix. Oxalate of lime calculi are generally the hardest, heaviest, and most irregular on their surface. Some, however, of this composition are less hard than lithic acid ones, and are easily broken with a lithotritic instrument. Next in order with respect to hardness and specific gravity are uric acid calculi, while those composed of the phosphates are much lighter and more friable; occasionally so much so, as to fall to pieces in the bladder.

The great variety in the composition of urinary calculi, according as to whether they are of a similar nature throughout, or consist of different substances, as well as the varying proportions in which their elements are mixed together, render them very different in point of density. The majority are either soft and friable, or of moderate hardness, and may be crushed without the employment of much force. Some, though hard, are brittle, and though not easily broken by pressure, readily yield on being struck a sharp blow with a hammer or metallic instrument. Some, again, are much harder than others which have a similar chemical composition, which may depend upon the length of time the disease has existed upon the proportion of animal matter which binds the earthy parts together, &c. As M. Civiale has very justly observed, the erroneous impression which existed with respect to the great hardness of many calculi, is attributable to the circumstance, that the investigations to ascertain this point have been for the most part made on the dried specimens from museums, or which had long been removed from the body, and become hardened by exposure to the air; between which and the calculi existing in the humid medium of the living bladder, there exists a considerable difference in this respect.

With regard to uric acid or urate of ammonia calculi, which are the most common (those of pure uric acid being extremely rare) M. Civiale states in his work before-mentioned, that they

are divisible into two classes, according to the slowness or quickness of their development; some are smooth, polished, very hard and heavy, and increase very slowly in size; while others are rougher, light and friable, of a deep yellow colour; and acquire a considerable size in a short time.

In general, calculi of a similar composition throughout are hardest at their centre. When composed of different substances the nucleus is usually the hardest part, though, when a concretion is formed round a foreign substance accidentally introduced into the bladder, especially if it be soft or of vegetable nature, as a pea, piece of straw, of elastic gum catheter, &c., the central part is often less hard than the superimposed layers; such calculi, however, mostly consist of the phosphates, and are consequently soft and friable.

Of the Urinary Organs as connected with the question.—I purpose in this place merely to allude to a few points relating to the urinary organs, as I shall have occasion, subsequently, to consider some conditions of these parts, which more especially serve as indications in the choice of the operation to be preferred.

Though the majority of urinary concretions descend from the kidneys to the bladder, and there acquire a greater development, yet they sometimes remain impacted in the kidneys, or are arrested in their descent through the ureters till their progressive increase gives rise to such organic alterations as occasion the patient's death. It is only, however, after the foreign bodies have descended into the bladder that they can come within the scope of a surgical operation, and consequently the condition of the kidneys and ureters, although a matter of great importance in estimating the probable advantages and disadvantages of an operation, and in the choice of the method to be adopted, has less claim on the especial attention of the surgeon, than that of the bladder and urethra, which parts present considerable varieties in different individuals, requiring to be attentively considered when the greater applicability of lithotomy or lithotrity becomes a question.

The urethra, which in adult males is usually of from seven to nine inches in length, and of an average diameter of from two and a-half to three and a-half lines, is considerably narrower at some points than at others; more especially at the orifice, and the membranous portion, at which part a curve is formed by its being bound up to the arch of the pubis by the triangular ligament. This curve is much more decided in some persons than in others, which is of great importance when lithotrity is concerned, not only in an operative point of view, but also with respect to circumstances which may arise during the treatment. The dilatability of the canal is much restricted in some persons, and is very great in others, as shown by the little inconvenience occasioned when its

capacity is enlarged by bougies, gradually increasing in size, and by the spontaneous passage of moderate sized calculous concretions with the urine. The junction of the lining membrane with the skin at the orifice, and the firm texture of the *glans penis* prevent much dilatation at this part, so that in performing lithotrity it is often necessary to incise the aperture with a small *bistourie caché* to admit the lithotrite, which then passes very readily along the rest of the canal. This little preliminary operation is of so trifling a nature, and occasions so little pain that the patient is often not aware that it has been done. On account of the narrowness and comparative rigidity of the orifice of the urethra, small calculi and fragments which have passed along the rest of the canal are frequently arrested near it. The presence of the unyielding texture of the prostate, especially when enlarged or indurated, also presents a great impediment to the dilatation of the part of the urethra which it encloses; hence, in children and young subjects in whom this gland has not attained its full development, there is a much greater dilatability of the neck of the bladder, which circumstance renders laceration, and, consequently, urinary infiltration of the cellular texture, less liable to occur on the extraction of calculi by perineal lithotomy than in individuals more advanced in life. The extent to which the female urethra admits of dilatation is also doubtless attributable, in great measure, to its not being enclosed within an unyielding substance analogous to the prostate.

The form and capacity of the bladder present great varieties in patients with stone, and must in many cases influence the choice of an operation. In general, the bladder in females is more capacious than in males, and more so in its lateral than in its antero-posterior diameter, in consequence of the pressure of the uterus and rectum from behind. Many patients have a capacious bladder and can retain a large quantity of urine; while in others it is much contracted, and the urine is expelled almost as soon as secreted; hence the relative size of the stone with respect to the capaciousness of the bladder, is often a consideration of greater importance than its absolute size, especially when it is the surgeon's intention to perform lithotrity. Thus a stone which might be regarded as small or of moderate size in a healthy bladder of ordinary capacity, would be comparatively large in the bladder of a child, or of a person who had suffered much from the disease; and the cavity of whose bladder had in consequence become diminished. The thickness or thinness of the parietes of this viscus will require to be taken into account, and also, whether these states preceded the formation of the stone, or arose from the irritation produced by its presence. When hypertrophy of the bladder is caused by the repeated contractions from the irritation of

stone, its muscular fibres become exceedingly developed, and are sometimes collected in fasciculi, allowing the mucous membrane to protrude between them, forming pouches or herniæ, in which calculi may become lodged, and thus cause one of the most serious complications of the disease. Independently, however, of this cause, the mucous membrane of the bladder, instead of being smooth as in its natural state, is sometimes exceedingly irregular on its surface, forming projections or folds which render the detection of small stones or fragments a matter of great difficulty, and present an impediment to their being carried off with the urine. The Hunterian Museum contains a fine specimen of this state of bladder, the mucous membrane being in some parts exceedingly elongated. Mr Howship has also given in his work on the urinary organs, a representation of these folds of the bladder, extending transversely from one ureter to the other, and to the vesical orifice of the urethra, which state of the parts prevented the escape of the urine and caused the patient's death.

The vascular condition, and the degree of sensibility of the urethra and bladder, vary greatly in different individuals. In some persons very slight contact of a foreign body with the mucous lining of these parts induces bleeding, which occasionally occurs to a considerable extent from sounding, or even from the simple passage of a bougie. In most stone-patients, when the disease has existed for any length of time, the mucous membrane of the bladder is generally in a permanent state of congestion, and blood is not unfrequently effused from its capillary vessels, especially after exercise or other active bodily exertion. The parts in several individuals, though not exhibiting this tendency to bleeding, are yet so highly sensitive that the passage of an instrument along the urethra is attended with great pain, and is not unfrequently followed by fever, a state of nervous irritability, and other unpleasant consequences; while in some other persons the passage of the instrument into the bladder is scarcely felt, and does not occasion any inconvenience; hence, the chief reason why some suffer so severely from stone, while in other cases the patient is scarcely sensible of its presence, the disease often existing for a long period without giving rise to distinctive symptoms, and before its true nature is ascertained. This high degree of sensibility of the parts, caused by the contact of instruments, is often attendant only on the first few times of their introduction, and most frequently becomes diminished in proportion to the frequency of repetition; a circumstance highly advantageous as regards the repeated passage of the instrument in lithotrity; but this is not always the case, the reverse sometimes happening. The sensibility of the bladder is naturally the greatest about the internal orifice of the urethra, as evidenced by the acute pain occasioned by stones

being pressed against this part during micturition. The urethra and bladder are more sensible in children than in adults; and in females, especially when of a nervous or irritable habit than in males; but on the approach of old age the sensibility of these parts becomes more obtused unless it be excited by any morbid cause. These organs, in common with other internal parts, appear to possess in many cases a certain degree of latent sensibility. Some individuals who do not at the time suffer much inconvenience from mechanical irritation, subsequently experience, after a longer or shorter period, pain and other symptoms of increased irritability, as is not unfrequently seen after sittings of lithotrity, or the passage of bougies along the urethra in persons unaccustomed to undergo these operations. There exists also great difference in the contractile power of the bladder in different subjects, though sometimes weakened in children, yet in young subjects and adults this power is in general pretty energetic, but often becomes materially diminished in advanced age, giving rise to various degrees of torpor or paralysis. The presence of stone or other disease of the bladder frequently increases its contractile power, but when of long standing sometimes produces an opposite effect. It is also at times more developed in particular parts of the bladder by an irritating cause, and these partial contractions of the bladder are not unfrequently extremely embarrassing in operations for the stone; preventing its seizure and extraction, and in some instances obliging the operator to discontinue the attempts.

III.—OF LITHOTOMY.

It would be foreign to the purpose to treat here at length of the different operations of lithotomy. I therefore purpose restricting my remarks to such points as have a more immediate reference to the subject under consideration; premising that they are intended to apply more especially to the operations by the perineum, as the recto-vesical and hypogastric operations, which have each at different times been advocated by surgeons of eminence, are at the present day comparatively rarely practised, and then only in some particular cases. The first of these operations, which was so strongly advocated by Vacca, who published several cases of success, was at one period, in consequence of his recommendations, adopted by several surgeons in various parts of Europe; and its advantages were much insisted on in France by M. Sanson, who performed it on several patients. In many of the cases, however, which were reported as successful, a fistulous communication became established between the bladder and rectum, embittering the patient's life; and the very frequent occurrence of this accident, which was almost always irremediable, more than counterbalanced the advantages of the operation in other respects, and induced even Vacca

to abandon it ; as I was informed when at Pisa, the residence of this distinguished surgeon, that, in the last years of his life, he almost always had recourse to the lateral operation. M. Sanson has also, I believe, given up his predilection for it.

The high operation has also been repeatedly recommended by great authorities, as possessing superior advantages over the perineal operation, viz. that it is easier of performance, does not require that the patient should be bound ; that the textures divided are simpler and less in thickness ; that there is but little risk of hemorrhage ; that the bladder is cut into, at a part which is more free from irritation, while its neck and the prostate gland, which are so frequently the seat of irritation and morbid action, are spared ; whereas, on the other hand, in the lateral operation, the difficulties experienced are often very great ; blood-vessels of importance are not unfrequently divided, giving rise to serious bleeding ; and even when the bladder is cut into, there is often great difficulty in extracting the stone, in consequence of the unyielding nature of the textures. Thus, as far as the mere performance is concerned, the high operation would appear to be the preferable method, but the great liability to infiltration of urine in the cellular texture, in the neighbourhood of the wound, is the great drawback to its more general adoption, and is the most frequent cause of failure. In fact, the bladder, from being cut into at its superior part, loses its natural tension, and collapses, while the urine having no outlet at the lower part by which to pass away as soon as secreted, (as in the lateral operation,) collects, and is thus continually in contact with the wound. Though this may, to a certain extent, be prevented by the introduction of catheters and other means, it is only partially so ; for the contractile power of the bladder being more impaired by an incision at its upper part than at its neck, while that of the sphincter remains uninjured, the expulsion of the urine is rendered more difficult, even when assisted by artificial means. Another danger to which the high operation more particularly exposes, is inflammation of the peritoneum, from the contiguity of this membrane to the wound, which accident has been the occasion of death in numerous instances. These circumstances, and the unfavourable results that attended its performance a few years ago in some of the London hospitals, have caused this operation to be exclusively restricted in England to a few particular cases ; and even in France its application is considered by the majority of practitioners as extremely limited, though a few still prefer it as a general method. Of these, M. Souberbielle is said to be one of the operators whose practice is attended with most success ; but, according to some statistical returns, the average mortality among his patients would appear to be as large as one to between three and four, in persons at different periods of life.

The lateral operation, which is the one almost invariably performed in this country, is superseded in France in some cases by the bilateral operation, which has not, I believe, been performed in England, and of which, as it is less generally known, it may not be out of place to say a few words. Chaussier first conceived the idea of avoiding the consequences which result from an extensive incision or laceration of the cellular texture around the neck of the bladder, frequently attendant upon the extraction of calculi by the lateral operations, by incising both sides of the neck of the bladder, so as to admit the extraction of stones, even of large size, without the incision extending beyond the limits of the prostate gland, or, at all events, without extensive lesion of the surrounding cellular texture. Beclard also acted upon this idea, and performed the bilateral operation several times; but it is to Dupuytren that its introduction into practice was principally owing. This celebrated surgeon preferred it almost exclusively during the latter years of his life; and in consequence of the successful results which he was stated to have obtained, it was pretty generally adopted by many French surgeons. This operation is in fact a modification of Celsus' method of cutting upon the gripe, but, instead of the operator introducing his fingers into the rectum to fix the stone, a staff very much curved and deeply grooved is passed into the bladder; a semicircular incision is then made through the perineum, commencing midway between the tuberosity of the ischium and the anus at the right side, circumscribing this aperture, and passing an inch anterior to it, to terminate at the corresponding point on the left side; the membranous part of the urethra is then divided longitudinally, and the double-bladed *bistourie cachée* is introduced along the groove of the staff into the bladder, its concave surface being directed towards the pubis; when within the bladder, the bistoury is turned round so as to make its concavity front the rectum; the blades then being pressed out (to the extent previously regulated by a scale at the handle varying from six to twenty lines,) and the instrument being withdrawn, an incision is made in the neck of the bladder and prostate, of a form corresponding to that of the integuments.

The chief advantages of this operation are, that it is better adapted to the easy extraction of large calculi, especially in cases of deep perineum, than is the lateral operation; a way being made for the passage of the stone at the widest part of the inferior aperture of the pelvis; and, as the incision at the neck of the bladder would not, in most cases, extend beyond the circumference of the prostate, the risk of urinary infiltration is much diminished. It exposes less than the lateral operation to the danger of wounding important arterial branches, though in the bilateral as in the lateral operation, considerable bleeding may ensue from the division

of the veins about the neck of the bladder, especially in old persons ; and this is, perhaps, more likely to occur by the former than the latter method, as they would be divided to a greater extent. On the other hand, there is perhaps more likelihood in this than in the lateral operation, of the rectum being wounded, as this part, particularly in old people, is often considerably dilated. This accident may, however, generally be prevented by the previous exhibition of an enema, and by the operator's depressing the bowel with the forefinger of his left hand, while making the incisions ; but, even should it be cut, the wound would probably heal in most instances without trouble.

Some English surgeons, among whom is Mr Liston, recommend, when the stone is of large size, that the incisions through the integument and cellular texture should be made the same as in the lateral operation ; and, if the incision of the neck of the bladder on the same side be found insufficient to allow the extraction of the stone, then to incise the prostate on the opposite side ; thus combining the bilateral with the lateral operation. Where, however, the former appears to be indicated, I should conceive it would be better to perform it in preference to the above method, in which the outward wound being on one side, the traction in the removal of the stone must necessarily be made in that direction, and when a large stone is in the grasp of the forceps, would be more likely to occasion injury and laceration of the parts, than when the direction of the outward incision corresponded with that at the neck of the bladder. Besides, the majority of operators having once seized the stone, would not stop to make the second incision of the prostate, but would continue their attempts to extract it, and thus risk injuring the parts by the employment of an undue degree of force. In several trials which I have made on the dead body, and also in the demonstrations of this operation which I gave in England, the blades of the bistoury were expanded to the extent of from fourteen to eighteen lines, which admitted of the extraction of large stones from the bladder, and subsequent examination of the parts showed that the incisions had not extended beyond the limits of the prostate.

It is now ascertained, however, that the bilateral operation was not so successful as it was at first represented to be, and that as a general method is much less eligible than the lateral operation. Indeed, it is greatly to be regretted that so little reliance can be placed upon the statements made by several continental practitioners, with respect to the results of particular methods of treating diseases. I should be sorry to ascribe this circumstance to improper motives, or to a desire to mislead ; but the fact is too generally known by those who have seen much of continental practice, that many of the statements made, particularly by some

members of the profession in Paris will not stand the test of inquiry. Thus, with respect to the operation in question, it is stated in the *Dictionnaire de Medecine et Chirurgie*, that, of about seventy patients on whom Dupuytren performed it in hospital and in private practice, only six died ; while, on the other hand, M. Civiale states in his work already quoted, that, of thirty-two patients on whom this operation was performed by the same celebrated surgeon, eight died, three were incompletely cured, and only twenty-one were completely cured. A table, given in Dupuytren's large work on the bilateral operation, published after his death by his executors, also exhibits very different results from those in the *Dictionnaire de Medecine*, and may be considered as a fairer estimate of the average mortality from this operation, when skillfully performed. By this it appears that, of ninety-nine patients operated on, nineteen died, or nearly one in five. Of these patients about one-half were under twenty years of age, and no doubt, in a great number of these, there existed no organic lesions, and the stone was of small size ; so that these individuals were under the most favourable circumstances for undergoing any of the operations of lithotomy.

The lateral operation may then be considered as the one most applicable to the great majority of cases where lithotomy is required, and must be regarded in a very different light according to the circumstances under which it is performed ; both with respect to facility of execution, and as to its ultimate results. In favourable cases, and particularly in young subjects, the operation is generally terminated in a few minutes, not unfrequently in one or two minutes, and the patient is at once relieved of a disease, which, if left to itself, would occasion months or years of suffering, and cease only with his existence. After the operation, the wound in the bladder being at its lower part, the urine passes away readily ; the contractile power of the organ is not materially impaired ; there is comparatively little risk of the urinary infiltration or the peritoneal inflammation, to which the hypogastric operation so frequently exposes ; and in by far the greatest number of instances, the patient advances towards recovery without impediment. Notwithstanding these circumstances, however, the operation must always be regarded as one of the most painful and dangerous in surgery ; and, even when performed under the most favourable conditions, is fatal in a certain proportion of cases ; while in the less favourable instances, the dangers are increased manifold ; nor is there any operation which is at times so difficult of performance ; where such unexpected circumstances may arise to embarrass the operator, or which is more likely to be followed by consequences productive of failure. Some of the principal causes of the greater difficulties and dangers attending the same operation in certain cases, may be here briefly enumerated.

One chief cause of increased difficulty in performing the lateral operation consists in the greater thickness of the soft parts to be divided between the skin and the bladder, depending upon the quantity of adipose matter; upon muscular and prostatic development, or a thickened state of the coats of the bladder. The depth of the perineum from one or a combination of these causes, is often so great as to prevent the operator's finger reaching the bladder, thus depriving him of the great advantage he obtains from the sense of touch when operating upon subjects under puberty, in consequence of which several lamentable instances are recorded of the bladder not having been opened, the cutting instrument having passed between it and the rectum, either in consequence of its slipping from the groove of the staff, or where this instrument has not been properly introduced into the bladder, but has rested on the prostate; this part and the neck of the bladder being thus only partially divided, and the gorget or knife having been pushed on, has entered the subjacent cellular texture, without penetrating into the bladder itself; or if an aperture has been made in this viscus, it has been too small to admit the blunt gorget or forceps, without the parts being lacerated and contused in the attempts. Hence arises in these cases the advantage of instruments which divide the neck of the bladder and prostate from within outwards, as the *bistourie cachée*.

But even when a proper incision has been made into the bladder, the thickness of the perineum renders the seizure and extraction of the stone much more difficult, especially if there coexist induration and enlargement of the prostate gland, from behind which the stone cannot sometimes be dislodged; or if it be taken up by the forceps, and be not of small size, it frequently cannot be extracted without considerable effort, from the unyielding nature of the parts, thus risking laceration or contusion. Again, supposing the operation to have been performed, and the stone extracted without much difficulty, yet the depth of the perineum may be a cause of failure, in consequence of the great extent of surface of the wound exposed to the contact of the urine, producing, in some instances, extensive suppuration and sloughing of the cellular texture, which would be most likely to terminate fatally; especially if the patient had been previously in a bad state of health.

Another source of difficulty and danger, is where the stone is of large size, or if of moderate size, where the incision in the bladder is too small to admit of its extraction without the employment of force. From the employment of an undue degree of force in extracting the stone, there is more danger to be apprehended, than from any other cause, as when the parts are much injured in the attempts at extraction, the patient rarely survives.

In children and young men, however, when the efforts are made slowly and gently, the parts will generally admit of dilatation to some extent, and allow the passage of calculi, even of large size; but in many old persons, where the parts are indurated and rigid, they cannot be dilated, but would be lacerated by the operator's persisting in attempts to extract a stone disproportioned to the size of the wound. In similar cases it would be much preferable to enlarge the aperture by incising the prostate on the opposite side, than to risk the consequences likely to ensue from violence done to the parts. When, after this bilateral section of the neck of the bladder, the stone appears to be still too large to be extracted without risk of injuring the parts, it would be more advisable to break it either with the forceps or with a lithotritic instrument introduced by the wound, and to remove it piecemeal, than to exhaust the patient by forcible and unavailing efforts to extract it entire. Where, however, it is anticipated beforehand that the lateral operation would be attended with great difficulty, on account of the size of the stone, the bilateral operation would be more likely to be successful, for the reasons I have already stated.

Enlargement of the prostate gland is not only a source of difficulty, by its adding to the thickness of substance between the skin and the bladder, but also in the seizure of the stone by the forceps, especially when of small size, and lodged immediately behind this part. When there are several calculi in the bladder, though the operation is not necessarily more difficult of performance, there is always a greater degree of risk of one or more being undetected and left behind, particularly when the prostate is enlarged, and the perineum deep. In these cases, however, the great disposition to the formation of calculi must be taken into account, or the reputation of the operator would be frequently undeservedly compromised; as there is no doubt that in several of the cases where the surgeon has been blamed for having left a stone in the bladder; a fresh one has descended from the kidneys after the operation.

The occurrence of hemorrhage is an occasional cause of failure, and is one of the objections which have been most strongly urged against the lateral operation by professed lithotritists, and by the advocates of other methods of operating. A good deal of bleeding not unfrequently takes place, either at the time of the operation, or subsequent to it, and occasions considerable uneasiness to the operator, without any serious consequences supervening. When, however, it goes on to any great extent, it places the patient in imminent danger, though frequently more depends upon the state of the individual to support the loss of blood, than upon the quantity of blood lost. In many instances, the bleeding, to a certain extent, is beneficial, and the patient would, in all probabi-

lity, be the worse, if it were to be checked by artificial means. Some persons are much more predisposed than others to hemorrhage, which may occur when the operation has been in every respect properly performed. In some individuals the arterial branches are unusually large; in others, again, they possess but little contractile power, especially in such as have been weakened, or worn out by long suffering, or whose general health has been deteriorated by other causes. When this is the case, the loss of a comparatively small quantity of blood might be fatal, which in a stronger individual would be of no consequence. Some persons, though enjoying good general health, and young children, cannot bear the loss of a comparatively small quantity of blood, without danger; hence the necessity of attending to the state of the patient, and to the peculiarities of each case with reference to the amount of bleeding, and the indications for interfering to arrest it.

Great skill in the performance of the operation is not always a guarantee against the wounding of such branches of the pudic artery as ought not to be implicated; as, in a certain proportion of instances, they do not pursue their regular distribution, and consequently may cross the line of incision, and thus give rise to fatal hemorrhage, as happened in a case where the late Mr Shaw was the operator.

Alarming and even fatal hemorrhage occasionally occurs from the plexus of veins around the neck of the bladder, which are often enlarged in old people. This kind is perhaps more to be apprehended than arterial hemorrhage, not only because it mostly occurs in diseased and debilitated subjects, but because it cannot be arrested, either by ligature or pressure, which may frequently be done when an arterial branch is divided. The plugging of the wound, which has been recommended, may, it is true, arrest the bleeding for a time; but this plan not only occasions an accumulation of coagulated blood, but also, by the irritation it produces, gives rise, in most cases, to inflammation and suppuration, with retention of urine, &c. and thus is more likely to do harm than good. Repeated injections of cold water, or of a solution of alum, afford perhaps the most effectual means of arresting, without inducing subsequent inconvenience, deep-seated hemorrhage, whether arterial or venous.

Another danger of the lateral operation, which has also been urged as an objection against it, is that of the rectum being wounded by the cutting instruments. This accident may, it is true, occur now and then; as when the stone is large and the instrument has to be reintroduced to enlarge the incision, or when the part is unusually dilated, which is not unfrequently the case, in persons whose bowels are habitually constipated. The importance of this accident appears, however, to have been exaggerated. There

is no doubt that the rectum is sometimes wounded, without the circumstance being known, and the wound heals without inconvenience; for it by no means follows as a necessary consequence of this part being wounded, that the whole thickness of its coats should be cut through; and still less that a fistulous opening should remain.

After the incision has been made into the bladder, a source of difficulty not unfrequently arises to prevent the seizure of the stone and its extraction, from the forcible contraction of the bladder upon it, which the introduction of the forceps and attempts to find the stone tend to provoke. This impediment sometimes prolongs the operation considerably, and even occasionally prevents its completion; the danger being increased in proportion to the length of time occupied in the attempts, the patient being exhausted; and the parietes of the bladder bruised, and perhaps pinched or lacerated by the forceps. In these cases, by waiting a little while, the contractions of the bladder will often cease, and admit of the removal of the stone with facility; whereas, on the other hand, the repeated introduction of instruments, and the fruitless trials to seize the stone, when the surgeon is anxious to perform the operation quickly, without due regard to the difficulties he may encounter, will, in many cases, excite still more the contractility of the bladder, and thus prevent his attaining the desired object. Mr Crosse mentions in his work, a case where three-quarters of an hour were uselessly employed, in attempts with the forceps to find a stone, of the size of a pigeon's egg, which came out of itself, some time after they had been discontinued. This difficulty is sometimes experienced with respect to a small stone, upon which the bladder partially contracts, and which it encloses as in a cyst, thus preventing its being found, and leading to the belief of the operation having been performed when the bladder contained no stone; hence, the rule of never operating, unless the presence of the foreign body have been satisfactorily ascertained, by sounding immediately prior to the operation. To the same cause may be ascribed the occasional retention of a stone in the bladder, after one or more have been extracted. Dupuytren removed two calculi from a child by the bilateral operation; one of them was broken in the removal, and two fragments were retained in the bladder, one of which was subsequently extracted on the sixth day, and the other on the twelfth day after the operation.

Another not unfrequent source of failure, and of a fatal result after the lateral, as well as other operations for stone, is attributable to a diseased state of the urinary organs, or of other important viscera; or to such a deteriorated condition of the general health, as renders the patient unable to support the shock of so severe an operation. On this also, as well as on other accounts,

the chances are greatly in favour of children and young persons, in whom the presence of the stone is most frequently the only disease; or if other disease coexist, it is often a consequence of the existence of the stone, and subsides after its removal; whereas in those advanced in life, organic alterations of the kidneys, bladder, or other organs very frequently precede the formation of the foreign body; so that in them, textures already in a diseased state are often cut through in the operation, which cannot fail materially to increase the probabilities of an unfavourable result. Where disease of the thoracic or abdominal viscera exists it is mostly counter-indicative of an operation; but organic changes in the kidneys are often obscure; cannot be ascertained beforehand, and only become manifest after the performance of the operation, when too late to be remedied. When a predisposition to disease exists in any particular organ, it may be called into activity by lithotomy, which is also liable to give rise to phlebitis and secondary visceral abscesses. These consequences, however, are common to all capital operations, and to accidents which impart a severe shock to the system.

In the enumeration of causes which have the greatest influence on the results of lithotomy, one circumstance must not be omitted, viz. the condition of the patient's mind, as regards the operation. There is no doubt, however well it may be concealed by some, that the impression on the patient's mind, for several days or weeks beforehand, that he is about to be subjected to one of the most dangerous and painful surgical operations, cannot but produce on many a most prejudicial effect; and is one of the reasons why lithotomy is so much more successful in children and young persons who are not aware of what they are to undergo, or, if aware of the nature of the operation, are more apprehensive of the pain it may occasion than of its ultimate result. Occasionally the shock on the nervous system is such, that patients die shortly after the operation in a state of collapse, and in those who entertain a strong idea that they will not recover, the anticipations of a fatal termination are often verified. Hence it is a matter of the greatest importance before operating, to endeavour to bring the patient to a fit state of mind to support the operation without entertaining an exaggerated idea of its dangers, or of his being in an unfavourable condition.

The most frequent causes of death after lithotomy are, in the young, the occurrence of convulsions, febrile irritation, with cystitis or peritonitis, and hemorrhage; in persons advanced in life, nervous irritability, inflammation of the bladder, kidneys, or other internal organs; infiltration of urine, with consequent suppuration and sloughing of the cellular texture, and arterial or venous hemorrhage. To some of these I shall have occasion again to ad-

vert, when considering the applicability of lithotomy or lithotrity, to particular cases.

I have subjoined in the Appendix some statistical accounts of the results of lithotomy, performed in different localities and at different periods of life.

IV.—OF LITHOTRITY

No operation of importance, at its first introduction into practice, was more favourably received by the majority of the profession in France than lithotrity, from the time that its practicability was demonstrated, by the successful results which attended its first applications to the living subject. Some of the more zealous of its advocates, however, desirous of having it considered as a means of at once superseding lithotomy in the majority of instances, not only applied it in cases to which it was but ill adapted, and thus occasioned accidents not unfrequently attended with a fatal termination, but also took every occasion of sounding its praises in the public journals and in medical societies; adducing successful cases in support of their arguments; while the unsuccessful ones were too often kept in the back-ground, whence they were brought forward by others, who took a different view of the question; among whom were several surgeons of eminence, who, though they expressed themselves not opposed to lithotrity in the abstract, but only to its too indiscriminate adoption, were, in their anxiety to refute the statements of their opponents, perhaps too ready to lay to the account of lithotrity itself, many unfortunate consequences attributable to the operation being performed in improper cases or in an improper manner. Nor is there any other instance of an operation, which, from having been for centuries considered impracticable, has made so rapid a progress within so short a period. Even so lately as the publication of Mr Crosse's standard work on Urinary Calculi, which obtained the Jacksonian prize five years ago, this distinguished surgeon thus expressed himself with respect to lithotrity. "The construction of instruments for this operation is so complicated, and so much delicacy and tact are needed for their safe employment on the living subject, that they are scarcely employed by any, save those who dedicate their time and attention almost exclusively to the undertaking."

The above passage refers, however, to the straight perforating instruments; this method of performing lithotrity being most generally known in England at the time Mr Crosse wrote; but the improvements which have subsequently taken place, by the introduction of curved instruments into practice, have so far simplified the operation, as to render it comparatively easy of performance by any surgeon of moderate dexterity, after having accustomed himself to the use of the instruments by trials on the dead body.

The idea of breaking down calculi in the urethra, and even in

the bladder, with a view to their expulsion, appears to have been at different times entertained by individuals from a very early period. As, however, it is not my intention to enter into the historical details of lithotrity, I shall pass over the propositions of some of the older writers for performing this operation, and also the accounts of the work of Citeaux, Colonel Martin, and others, —who are said to have broken down, or filed away calculi within their bladders, previous to the present century,—in order to take a brief survey of the progress of lithotrity of late years, (without stopping to enumerate the various instruments which have been invented or proposed, and subsequently laid aside,)—before considering the advantages of the respective methods, and some of the consequences to which they may give rise.

The instrument proposed by Gruithuisen of Munich in 1813 was intended to seize and perforate calculi in the bladder, with a view of the more readily acting upon them by chemical solvents, and approaches nearest to the straight lithotrite of a more recent date. The merit of the invention of lithotrity, however, as methodically applicable to the living body, is unquestionably due to M. Civiale, who, unacquainted with the proposition of Gruithuisen, invented, so far back as 1817, an instrument intended to fix calculi in the bladder, while solvents were injected with a view of acting upon them; and although he shortly gave up the idea of dissolving calculi, his attention has been since almost unceasingly directed to the means of mechanically breaking them into portions, sufficiently small to pass away through the urethra. After various alterations in the construction of his instruments, he produced the three-branched lithotrite, with which the first operations on the living subject took place in 1823; and the following year, before the commissioners appointed by the Academie des Sciences, to examine and report upon the merits of the new method. The fortunate result of the cases, and the facility with which the operation was performed, induced the commission to make a report, most flattering to M. Civiale, and favourable to lithotrity, which from that period may be classed among the established operations in surgery.

The instruments of a somewhat similar form were at different times invented by some surgeons, especially MM. Amussat and Leroy, which were either not found to be applicable to the living body, or, having been used, were speedily laid aside; and Civiale's instrument continued to be almost exclusively used till about 1830, when two-branched instruments of a curved form were introduced into practice, by means of which some of the difficulties attendant upon lithotrity were removed, and the operation became more generally adopted by the profession, its performace having been previously restricted to a few persons.

The original idea of curved instruments to act upon urinary calculi appears to be due to Mr Elderton, of whose instrument there is a description in the *Edinburgh Medical Journal* in 1819. This was intended for the purpose of seizing the stone and filing it away, by a file passed along a groove in the superior branch. Sir A. Cooper's forceps for the extraction of calculi through the urethra, though not to be ranked among the lithotritic instruments, was of somewhat similar form, and was used for the first time on a patient in 1820. Four years later, a curved instrument, not very unlike the lithotrite of the present day, was constructed by Mr Weiss of the Strand, for the express purpose of breaking down calculi in the bladder, and was shown to Sir B. Brodie, who, however, considered its application unsafe, and it was consequently laid aside for some years. This instrument was subsequently shown to Baron Heurteloup, who is said to have taken from it the idea of his percussor. Be this as it may, Weiss's instrument acts by a screw, and the Baron is certainly entitled to the merit of introducing percussion into practice as a method of lithotrity. Another instrument of a curved form, acting entirely by pressure, and which was several times successfully employed, was invented by Mr Jacobson of Copenhagen.

The instruments employed of late years for breaking calculi in the bladder may then be ranked under four heads, *1st*, those with which the stone is first perforated with a view to diminish its force of cohesion, and then crushed; *2d*, instruments for breaking calculi by means of percussion; *3d*, those for effecting the same purpose by pressure; and *4th*, instruments by means of which percussion may be combined with pressure.

The instruments for perforating a stone in the bladder must necessarily be straight. Many persons, however, supposed till lately that the introduction of straight sounds into the male bladder was impracticable, or at least attended with great difficulty; but it is now generally known that straight instruments may be passed into the bladder in most cases, with nearly the same facility as curved ones. The three-branched instrument of M. Civiale is the only one of this kind applicable to the living subject; but, as it is now superseded by others, I need not enter into a description of it, or of this method of operating, which is at present scarcely ever employed, even by M. Civiale himself.

The kind of instrument used by Baron Heurteloup was constructed exclusively for breaking calculi by percussion. The original percussor was of large size, clumsy and formidable in appearance, and usually required the previous dilatation of the urethra, which is now dispensed with, except in some particular cases. It is not unlike a metallic sound, but the curve is shorter and more abrupt. It consists of two branches, the one sliding within

the other, so as to allow a separation between the extremities about three inches in extent. The teeth are very large, and on the same level on each branch, from which it results that the intervening spaces are considerably weaker. The more modern instruments, however, are much smaller in diameter, combine strength with lightness, and the arrangement of the teeth is such as to afford an equal degree of strength throughout. A percussor without teeth is also not unfrequently employed by Baron Heurteloup, especially when attacking small calculi or fragments.

A part of the apparatus formerly considered indispensable for this operation, is the rectangular bed, proposed by the Baron, by means of which the patient's pelvis may be raised above the level of his shoulders, in order that the stone may fall by its own weight to the most favourable part of the bladder for being seized. After the stone is in the grasp of the percussor, the bed also serves to fix the instrument firmly, and thus prevent the shock of the blows from the hammer from affecting the parietes of the bladder. This is effected by an iron appendage fixed to the end of the bed, the branches of which being approximated by a screw, hold the percussor between them, as in a vice.

In performing the operation, the patient is fixed upon the bed in a proper position, and a moderate quantity of fluid is injected through a silver catheter into the bladder. The percussor is then introduced, and the stone seized. The instrument is then fixed to the bed, and the operator holding it in his left hand, strikes its extremity with a small hammer, till the stone is felt to be broken, when the percussor is removed from the vice in order to take up the fragments, which are broken in a similar manner, either during the same or at subsequent sittings.

The rectangular bed is, however, at present scarcely ever used, except by the Baron himself, as its disadvantages were found by others to more than counterbalance its supposed advantages. Not to speak of the impossibility of obtaining it, except in large towns, and of the inconvenience of having a similar piece of furniture transported to the residence of patients, it tends to complicate the operation, and would in many cases, by its formidable appearance, have a most prejudicial effect on the patient's *morale*. It has, moreover, the serious disadvantage of being liable to cause injury to the bladder, either by the movements of the patient, or by the contraction of this organ forcing its parietes against the extremity of the instrument, which, when fixed to the bed, cannot of course yield. In fact, in such a case, the patient is as it were hooked on to the operating table by his bladder; and though those who advocate this method of operating represent in engravings the extremity of the percussor holding the stone in the bladder, in the centre of the fluid that has been injected, and consequently

far from its parietes ; yet those who have seen much of lithotrity are well aware that frequently only a small quantity of fluid can be introduced, either from the capacity of the bladder being diminished, or from the muscular contractions of this viscus, and also, that, from the last mentioned cause, a great part of the fluid injected is often expelled during the operation.

Most operators, therefore, even when employing percussion, prefer a common bed or sofa, and raising the pelvis by firm pillows placed beneath it. After the stone is seized, the instrument is held firmly in the operator's left hand, or, if sharper blows are required, it may be held by an assistant with a handle constructed for the purpose, which will be sufficient to prevent the shocks affecting the bladder ; at the same time the operator will be better able to ascertain the degree of resistance when contraction of the organ occurs.

Of the instruments which have been used for crushing calculi exclusively by pressure, I need only mention that of Mr Jacobson, without, however, entering into a description of it, as it possesses no material advantage over the more modern instruments which have superseded its use.

The instruments with which pressure may be combined with percussion are most usually employed at the present day, and are so perfectly constructed as to render their use much more easy and safe, in all the cases to which lithotrity is adapted. In form they resemble Heurteloup's percussor, of which they may be considered a modification ; and though their diameter need not exceed that of a large-sized bougie, they are made sufficiently strong to break the hardest urinary calculi. The concave branch slides freely within the convex one ; and thus admits of the employment of percussion, while by the addition of a screw at the handle, (acting by a fly in Weiss's, and by turning a button in Charriere's instruments) pressure may be applied. (See Plate I. Fig. 1 and 2.) The teeth are small in these instruments, and are close together ; the extremities of the branches are therefore as strong at one point as at another ; the force employed telling in great measure on the curve and straight part of the instrument. An important improvement has been effected within the last three or four years by Mr Weiss, at the suggestion of Mr Oldham, by which a serious inconvenience formerly attending the use of these instruments is obviated. This consists of an opening being made in the curved portion of the convex branch, which, without weakening the instrument, allows of the detritus being pressed through, as the stone is crushed, instead of becoming collected between and clogging the branches,—thus impeding their closure, and the consequent withdrawal of the instrument, which not frequently occurred before this improvement was made. In the curved instruments, however, used by

M. Civiale, there is no aperture for the passage of the detritus, which is prevented from collecting between the branches, by a few gentle taps being struck with a hammer on the extremity of the concave branch after the stone has been crushed by pressure. After every two or three blows, M. Civiale separates the branches a little with the thumb of his left hand while holding the instrument, in order to allow the detritus to fall out; and in several operations which I have seen him perform, there has not been any difficulty in withdrawing it, though this would be very likely to happen in less practised hands. The extremity of the branches of this instrument is of a much more flattened form than those in general use, which M. Civiale considers more advantageous, as a larger surface of the stone is embraced, and the fragments resulting from its fracture are less angular.

After a stone has been broken by one of the preceding methods, a greater difficulty is generally experienced in dealing with the fragments, each portion having to be seized, and broken sufficiently small to enable it to pass away through the urethra. In order to obviate this inconvenience, Mr Key very ingeniously caused to be added to the ordinary kind of lithotrite, a small net, which, when the instrument is open, is expanded by means of lateral wires. The net thus catches the larger fragments after the stone is crushed, instead of allowing them to fall into the bladder, and, being contracted by drawing the wires, replaces them within the grasp of the instrument, to be broken into small portions at one sitting. Though this apparatus has been successfully used by Mr Key, it is of too complicated a nature, and too likely to become deranged, and thus cause irremediable injury, ever to come into more general use. Even were it not exposed to these objections, it has, moreover, the great disadvantage of not allowing the surgeon to discontinue the operation, before the whole of the fragments are broken into pieces sufficiently small to pass through the meshes of the net, whatever be the state of the patient or the irritability of the parts; and it is well known by those who have paid most attention to the subject, that many of the accidents and dangers attendant on lithotrity are attributable to the sittings being too much prolonged, when the surgeon has been anxious to terminate the operation in one or two sittings.

There is in general no difficulty in seizing a stone in the bladder with the two-branched lithotrite, after a few trials have been made on the dead body. The pelvis having been raised by pillows placed beneath it, and the bladder moderately distended by the injection of tepid water, the lithotrite should be introduced and the stone felt for with its convex surface as in common sounding. By raising the handle, and consequently depressing the curved portion of the instrument to the floor of the bladder, the

stone will generally be pushed a little on one side. The lithotrite being then held steadily with the left hand, its concave branch should be drawn back with the right, and as the resistance is withdrawn, the stone, tending to revert to the medial line, will probably fall within the expanded branches. When the curved portion is not sufficiently depressed, though the stone be plainly felt, the attempt to seize it may fail, in consequence of the instrument being opened above it, as I have seen happen in several instances. If the stone should not fall within the branches, and is felt to lie on one side, it may generally be seized by rotating the beak of the instrument towards it, and even when lying behind an enlarged prostate, a stone may frequently be taken up by this means. As the shortness of the curve in these instruments admits of their being turned completely round, with but little pain or inconvenience, on the concave surface being presented downwards, and the inner branch being drawn back so as to open the instrument, the prostate is slightly advanced with it, thus very much facilitating the taking up of calculi, which would otherwise escape detection. When the stone is felt to be between the branches, it should be held firmly by the thumb of the operator's left hand pressing on the expanded portion of the handle, if percussion is to be employed, or by turning the fly or button when pressure is preferred; the screw being then tightened till the stone is broken, or, if much force be requisite, and the assistance of percussion be deemed advisable, the screw may be removed by turning the knobs of the button in one of Charriere's instruments transversely, (see Plate I. Fig. 2) and a few sharp blows struck with a hammer on the extremity of the instrument. When the stone is broken or is felt to have yielded, the screw may be again applied, and the branches of the instrument brought into contact with each other. In most cases, however, percussion may be dispensed with altogether, and in many a very slight degree of pressure by means of the screw suffices to reduce the stone to fragments. This method is considered by most unprejudiced persons conversant with the subject as infinitely preferable to percussion, as it is not so formidable an operation; is less abrupt in its action; does not require the assistance of a second person; is attended with less risk of injury to the parts, and breaks many calculi by gradually crumbling them down to a coarse powder or to small fragments, instead of at once dividing them into two or three larger portions, as mostly happens by percussion, which should be especially avoided when the bladder is much contracted, or where there is great irritability of the parts; but where the stone is hard and brittle, not yielding readily to pressure, percussion may be advantageously called in to its aid, and will in some cases very much facilitate the operation. When the stone is once broken its fragments may generally be

reduced to smaller portions by pressure alone; for which purpose it is frequently not even necessary to employ the screw, pushing the ends of the branches against each other with the hand being sufficient. For this part of the operation, as also for crushing small stones, the screw scoop and catheter forceps, (see Plate I. Fig. 4 and 5), constructed by Weiss, may often supersede the employment of the lithotrite. These instruments are also well calculated to remove small fragments or detritus lodged behind the prostate. Injections of the bladder, either through the last named instrument, or through a large silver catheter, constructed for the purpose, the eyes of which are of considerable diameter, will also very much facilitate the expulsion of detritus.

In favourable cases, after a sitting of lithotrity, the patient usually experiences some pain or uneasiness for a few hours, or a day or two, passes a little blood and some fragments or detritus with the urine. He is not necessarily confined to his bed during the treatment, and in many cases may attend to his usual avocations. Some patients have even walked to the operator's house and home again after the sitting is over, experiencing no further inconvenience than the passage of a bougie would occasion in others. In most persons the first sittings (supposing several to be necessary) are the most painful and more likely to be followed by unpleasant consequences, the subsequent sittings being generally attended with less inconvenience, as the parts become more accustomed to the stimulus of the instrumental manœuvres, and as the size of the foreign body becomes diminished. In some cases, however, the progress towards a favourable termination is retarded by the occurrence of one or other of the accidents which may ensue during the treatment, rendering the result doubtful, and which at an earlier period was so frequently a cause of failure.

I shall here briefly notice the accidents most likely to occur, even when lithotrity has been properly performed, and in suitable cases. It is not uncommon after a sitting of lithotrity, especially if it have been too much prolonged, for a degree of inflammation of the urethra, attended with discharge, to occur, as sometimes happens even from the mere passage of a bougie or sound. By rest, however, attention to diet, the use of diluents, &c. it mostly subsides in a few days, and is attended with no further inconvenience than that of occasioning the suspension of the operation. The same may be said of inflammation of the testicles, which also sometimes occurs, especially if they be not properly supported. A slight degree of fever very commonly attends the first sittings of lithotrity, but usually subsides within twenty-four hours. In some instances, however, it may continue for a longer period, and may even run high or assume an intermitting character, being sometimes accompanied with alarming symptoms of nervous irrita-

bility. These accidents are not necessarily in proportion to the severity and difficulties of the operation ; but they may also occur when the sitting has been attended with but little pain, and when the stone has been easily broken, especially if, from the comparative freedom from pain, the surgeon has been induced to prolong the sitting by attempting to do too much at once. Other accidents to which lithotrity may give rise, are bleeding from the urethra or bladder, (though seldom to an extent productive of much inconvenience ;) pain at the neck of the bladder with irritability of the organ ; inflammation of the prostate and abscess, which may cause retention of urine. These are sometimes attributable to the strain on the parts in consequence of the urethra being forcibly straightened by the introduction of and manœuvres with a straight inflexible instrument, and hence are more liable to happen when the curve of the urethra is naturally greater than usual, or when it has become so from enlargement of the middle lobe of the prostate.

Another serious accident peculiar to lithotrity, and of more frequent occurrence, is the arrest of fragments in some part of the urethra. The portion of this canal enclosed by the *glans penis* being generally narrower than other parts, fragments which have been expelled as far as the *fossa navicularis*, are frequently arrested at this point, whence they may generally be removed by a blunt hook passed behind them, or by crushing them with a forceps constructed for the purpose. When, however, this cannot be effected, the incision of the orifice of the urethra with the uretotome will be necessary ; indeed, as I have before stated, this incision is sometimes required previous to the operation, in order to admit the lithotrite. Other parts of the urethra at which portions of calculi are most likely to be arrested, are the point opposite the bulb, and the membranous part where the canal is narrowed by the suspensory ligament. By introducing a straight full-sized bougie or sound as far as the obstacle, the fragment will in many cases be expelled on the patient's endeavouring to make water as soon as the instrument is withdrawn. Should this not succeed, the fragment may generally be pushed back into the bladder, to be broken at a subsequent sitting. Of the instruments invented for breaking calculi or fragments in the urethra, when they can neither be expelled nor pushed back into the bladder, the ingenious one lately constructed by Mr Weiss appears well calculated for the purpose. It consists of two elastic blades enclosed within a canula. When the canula is drawn back the blades open by their own elasticity, and separate the parietes of the urethra, enabling the operator the more readily to pass them on either side of the fragment which is thus fixed between them by advancing the canula, and is broken down by rotating a central rod with a head

resembling the perforator in Civiale's three-branched instrument. (See Plate I. Fig. 6.)

The stoppage of fragments in the urethra, and the consequent dangers to which it gives rise, are fortunately of less frequent occurrence in those persons who are most likely to be subjected to lithotrity, viz. adults and persons advanced in life, than they would be in young subjects, in whom the urethra is very narrow; while, from the comparative absence of resistance in the textures, the neck of the bladder is more dilatable; yet, notwithstanding, it is more common than the other accidents which occasionally ensue.

Retention of urine sometimes supervenes upon a sitting of lithotrity, either from the irritation caused by the arrest of fragments in the urethra; from this passage being obstructed by coagulated blood; from spasmodic action at the neck of the bladder; from atony of the organ, or enlargement of the prostate gland; but it mostly admits of being removed by the catheter, or by the employment of antiphlogistic and sedative remedies.

A high degree of irritability of the bladder, marked by frequent desire to make water, increase of the pain, and other symptoms, is occasionally induced by lithotrity. This may go on to inflammation, attended with great constitutional irritation, and a copious secretion of mucus, and is most likely to occur in young subjects, or in those of an irritable habit, where the sittings have been too much lengthened, or where the stone is exceedingly hard, or of large size, requiring many sittings for its removal. The presence of sharp angular fragments of some kinds of calculi is also a cause of cystitis in some cases. Cystitis is the most formidable accident to which lithotrity may give rise, and the most likely to prove fatal. A degree of chronic inflammation, however, accompanied with discharge of mucus, but without pain or much constitutional disturbance, is not unfrequent, and subsides after a short time by repose, and the use of appropriate remedies. In some cases where a state of chronic inflammation, with copious secretion of mucus, had previously existed, the discharge has diminished, and the inflammation has subsided, during the treatment, after a few sittings of lithotrity, probably in consequence of the bulk of the foreign body being lessened; but, whatever be the cause, experience has shown that this result not unfrequently occurs.

The irritation caused by lithotrity sometimes extends to the kidneys, producing pain in the lumbar region, bloody urine, and other symptoms of these organs being affected. When there is reason to believe in the existence of a diseased state of the kidneys, previous to operating, the sittings should be very short, and repeated at longer intervals, after all irritation has subsided. Pressure should be employed to break the stone in preference to percussion,

and the patient should be restricted to repose, a bland diet, and the use of mucilaginous drinks, and tepid baths, as should also be the case whenever there is reason to apprehend the supervention of any of the preceding accidents.

Thus we see, that while in some cases lithotrity will relieve a patient from his disease in one, two, or three sittings, with but little pain or interruption of his ordinary avocations, yet that in others, this operation, even though it may terminate successfully, is attended with considerable pain, requires many sittings before the stone is got rid of, obliges the patient to confine himself to his room, or to bed during the treatment, and is liable to induce one or more of the accidents which I have enumerated. As, however, lithotrity is every year making greater progress towards perfection, we may reasonably indulge the hope that the sphere of its application will become more extended ; and that, as the cases to which it is adapted come to be better discriminated, the accidents to which it exposes will be proportionately diminished.

Having in the preceding remarks touched upon some points of practical interest connected with lithotomy and lithotrity, and having briefly noticed the advantages and inconveniences of the different methods of performing these operations, I next proceed to the inquiry as to the cases in which the one or other operation is most applicable.

(To be continued.)

ON THE
COMPARATIVE ADVANTAGES
OF
LITHOTOMY AND LITHOTRITY,

AND ON THE CIRCUMSTANCES UNDER WHICH ONE METHOD
SHOULD BE PREFERRED TO THE OTHER ;

BEING THE
Dissertation for which the Jacksonian Prize of 1838 was awarded to

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ON THE
COMPARATIVE ADVANTAGES OF LITHOTOMY
AND LITHOTRITY.

V.—OF THE CIRCUMSTANCES UNDER WHICH LITHOTOMY
OR LITHOTRITY SHOULD BE PREFERRED.

AT an earlier period of the history of lithotritry, the opinion was very generally entertained, that from the difficulties which attended this operation, and the length of time required to be devoted to its study, its performance must be restricted to special operators, as was once the case with respect to lithotomy; and though this opinion has fortunately been disproved by lithotritry having become so far simplified as to render it practicable by the generality of surgeons, like any other operation, many still consider that it should be limited to a few particular cases, and that lithotomy must continue to be most suitable to by far the greater number; the latter operation being the rule applicable to all cases, and the former the exception. The preference to be accorded to one or other of these operations has been repeatedly made the subject of discussion in medical journals and societies; and in the debates of the Academie de Medecine, about five years ago, may be seen the opinions (which some have since seen reason to alter) of the most eminent French surgeons; though it is to be regretted that these discussions were not always conducted with that freedom from prejudice, and absence of party feeling which should

especially characterize a scientific inquiry of such importance to the community at large. The subject was likewise ably treated by M. Blandin in his Prize Essay, notwithstanding the short time allowed for its composition; as also by MM. Leroy, Segalas, and others in their works, and more recently by M. Civiale, who in his *Parallele* enters fully into the consideration of the different points connected with both operations, with greater impartiality than might, *a priori*, have been expected from one who had for so long a period devoted his attention to lithotrity, of which he may be considered the inventor and principal promoter. In England also the question has been examined in a special work by Mr King, though at a time when lithotrity was much less general than at present. The works of Messrs Heurteloup and Belinaye were also published at a less advanced period of this operation, and more particularly refer to the method of percussion than to lithotrity as at present usually practised. Mr Key and several other surgeons have likewise published in the medical periodicals their opinions respecting the merits and demerits of lithotrity, as compared with lithotomy; though, from the difficulty of correctly ascertaining the results of the former operation, (in consequence of many of the unsuccessful cases not being made public), it will probably be long ere sufficient data will be obtained to enable the profession to form a just comparison between them.

It is not without attentive consideration of the arguments which have been brought forward on both sides, and of the cases which have fallen under my own observation, that I am induced to express my opinion as to the circumstances under which one of these operations should be preferred to the other. Considerable difficulty and uncertainty must, however, exist in defining the limits to which either operation should be restricted; though at the same time, there are certain cases, in which most unprejudiced persons, conversant with the subject, would at once declare lithotrity to be the most eligible method, and certain other cases in which lithotomy is more evidently indicated. Where both operations appear to offer equal probabilities of success, and the operator is doubtful which to recommend, the most prudent course would probably be to prefer lithotrity, as, in the event of unfavourable circumstances arising to prevent the completion of the operation, it might be given up, and recourse might be had to lithotomy as soon as the patient was in a fit state to support it. The two operations having in this respect some analogy with those for cataract, where, when couching is performed and does not succeed, vision is not destroyed, and the patient has still the chance of being relieved by a repetition of the operation, or by extraction at a subsequent period; whereas, if this latter method be at first resorted to, though it may be the most effectual means of removing the impediment

at once, yet if it fail, the use of the eye will, in all probability, be irremediably lost; so with regard to the breaking up a stone in the bladder, if it should not succeed, the failure would not, except in a few cases, be fatal; and the patient might undergo with advantage another operation; whereas, if lithotomy be performed and fail, it almost necessarily induces the patient's death. Several instances have occurred in which patients who had been subjected to lithotrity were subsequently cut for the stone, and recovered; on the other hand, some of these patients died after the operation, which was not unlikely to have happened, even if lithotrity had not been attempted; though it cannot be denied that the failure of lithotrity would frequently place the patient in a less favourable condition for supporting lithotomy, not only with respect to the local condition of the parts, but also as far as his general state of health and moral are concerned.

Lithotrity may be considered as more especially suited to adults whose general health is good, and whose urinary organs are free from any other disease than the presence of stone; in whom the bladder is moderately capacious, not preternaturally irritable, and contains a single stone of small size, (as not exceeding the size of a filbert), and not excessively hard. A patient in whom these conditions are met with may be regarded as being under the most favourable circumstances for the operation, which in all probability would require but few sittings for its completion, without the occurrence of any of the more serious accidents which sometimes attend it. Nor are the instances in which all these propitious circumstances are united at all unfrequent; a large proportion of stone patients who apply to the surgeon for relief have, in fact, no disease but the stone, the presence of which is frequently not even manifested by the symptoms, but only becomes evident on sounding. It is true that a person under similar conditions is also in a very favourable state to undergo lithotomy, and would most probably recover; yet it must be borne in mind that, even in the most favourable cases, the mortality from lithotomy is great; that it is an operation of a most painful nature, and one of which patients entertain so great an apprehension, as not unfrequently to have a prejudicial effect on the result; that unexpected difficulties may arise during the operation, and accidents may supervene, compromising the patient's life; and that, even if every thing were to go on well, the patient must still be almost entirely confined to his bed, till the complete healing of the wound. Few surgeons, therefore, conversant with both operations, would hesitate in a similar case to recommend lithotrity; and even were the surgeon disposed to prefer lithotomy, many patients would decline adopting his recommendation, and would very likely apply to others whom they might think better able to cure them, without subjecting them to so formidable an operation.

Adults and elderly people, in other respects in the same conditions as those above specified, but in whom the stone is of larger size, as of a walnut, or from ten to fifteen lines in diameter, may also be considered in a favourable state to undergo lithotrity, though, of course, less so than when the stone is of smaller size. If, instead of one moderate sized stone, the bladder contain two or three small ones, the patient is not in a more unfavourable state, as he would be no worse than if he originally had a larger stone, which, after a sitting or two of lithotrity, had been broken into as many portions. Even when the bladder contains several stones, lithotrity may still be applied, if there be no other counter-indicating circumstances, and the stones be of small size, though, if there was reason to believe they were numerous, lithotomy would perhaps be the preferable operation, on account of the length of treatment required by lithotrity, and the existence of so many cases of irritation, superadded to that of the frequent introduction and manœuvring of instruments. Here, however, the degree of irritability of the parts and other circumstance must be taken into the account to guide the surgeon in his choice, as, though he may be aware that the bladder contains more than one stone, he cannot always be as certain that it contains several. In these cases, also, the tendency to the re-formation of calculi must not be lost sight of. This, indeed, would be one reason for preferring lithotrity, if other circumstances were not unfavourable to its employment, as a patient in whom this predisposition is strongly manifested would, even after lithotomy, very likely require another operation ere long, and this could not, like lithotrity, be repeated several times in the same person. A case of this kind occurred in France, in a M. Poterlet, who underwent five operations for the stone. Lithotrity was first performed on this patient by M. Heurteloup in 1826; it was repeated by M. Amussat in the course of the following year; the disease returned a third time, and the patient, considering that the preceding operations had left some fragments in the bladder, resolved to undergo lithotomy. The lateral operation was accordingly performed by M. Amussat. The bladder being perfectly emptied, a fresh stone, however, formed, and the patient has since undergone lithotrity for relapses.

The cases of Baron Zach, and of M. Baboin are illustrative of the successful application of lithotrity, when the bladder contained numerous calculi. According to M. Civiale, who was the operator on these occasions, the bladder of the former patient contained about forty calculi; and so little inconvenience was experienced from the operation, that after each sitting the surgeon and patient were accustomed to sit down together to breakfast. It is obvious, however, that if, in such a case, the calculi were of great density, or there existed much constitutional or local irritability,

lithotrity would be attended with considerable risk, as a long period must necessarily be required for the treatment, and, should any unpleasant symptoms arise, they would be less likely to be combated with success, than in the more simple cases; and that, consequently, lithotomy, by which the whole of the foreign bodies might be at once removed, would be much preferable and afford the greatest chance of recovery. Where, however, circumstances exist to prevent the adoption of lithotomy, or to render its performance more than usually hazardous, the mere number of calculi (especially if moderately friable, and if the irritability of the parts be not very great), need not be as a positive counter-indication of lithotrity.

Lithotrity has been objected to in these as also in the simpler cases where the bladder only contains one stone, on the grounds that one or more of the calculi or fragments are liable to be left behind, after the operation is terminated. This, it is true, has occurred in several instances, and in some patients who were supposed to have been cured, but who afterwards died of the disease, an examination of the parts has exhibited the formation of fresh calculous depositions around the fragments of calculi which had been broken by lithotrity. Where also the sittings of lithotrity are obliged to be suspended for any length of time, the fragments very often become covered with a fresh coating of the phosphates. One of the first patients lithotritised at the Hotel-Dieu, a short time after he had been dismissed as cured, returned as ill as before, though when he left the hospital he had none of the symptoms of stone, nor could any remains of the foreign body be detected on sounding. This accident, though more likely to happen, is not peculiar to lithotrity, but may also occur after lithotomy, where the bladder contains several calculi, or where a stone is broken in attempting to extract it. When, however, after proper explorations of the bladder, no more calculi or fragments can be felt, it is fair to conclude that none exist. Even should any escape detection by being lodged in a fold of the bladder or otherwise, lithotrity should not bear the blame, as it can only attack what is tangible, and in many of the cases, where a calculus is again felt in the bladder some time after the performance of lithotomy or lithotrity, and the patient was considered to be cured, it is just as likely, or more so, to be the result of a subsequent descent from the kidneys, particularly when there have been several calculi, which indicates the great predisposition to their formation.

At all events, whether this be the case or not, the patient is seldom in a worse condition for supporting a repetition of lithotrity than at first, as in the instance of M. Poterlet, above quoted, and of several other individuals, on whom the operation has been repeatedly performed, on account of the re-formation of calculi.

When the stone is of considerable hardness, but of small size, lithotrity is applicable with great prospect of success, and, if there be no counter-indicating circumstances, should generally be preferred to lithotomy. The hardness of the stone (if it be small) need not, as formerly, prevent the performance of the operation, which will, in these cases, often be facilitated by the assistance of percussion, though the present improved instruments are able to break, by means of the screw, the hardest urinary calculi, without the danger of their giving way. When, however, there is reason to believe, that the stone is of larger size, as above twelve or fifteen lines in diameter, and that it is at the same time of great density, lithotrity would be attended with much more risk, and lithotomy would, in most cases, be the preferable method, especially if the symptoms of the disease be severe, and there exist much irritability of the bladder, on the passage of instruments. The hardness of a stone, though very unfavourable for lithotrity, is not so for lithotomy, but rather the reverse, as, when once the bladder is opened, it would be more easily extracted than a softer one, which might break by the pressure of the forceps, and would necessitate their more frequent introduction, with the risk of a portion being left in the bladder.

In proportion to the increased size of the stone beyond a certain point, as from twelve to fifteen lines in diameter, (due regard being always paid in estimating this circumstance to the relative capacity and irritability of the bladder) the case is more unfavourable for lithotrity, which is altogether unsuitable to very large calculi. In some cases, however, of large calculi (as of the size of a hen's egg) chiefly composed of the phosphates, and consequently more friable, lithotrity might still be preferred to lithotomy, which, in these cases, is not unfrequently counter-indicated; or its performance is attended with the greatest risk, on account of the diseased state of the urinary or other organs; consequently lithotrity, though performed under very disadvantageous circumstances, would afford the best chance of relieving the patient of his disease, and should be had recourse to, if the condition of the patient admitted of its application, with a likelihood of success.

The smaller, therefore, and the more friable the stone—other circumstances being the same—the more favourable is the condition of the patient for lithotrity. Some calculi are so soft as to break on the slightest touch, or fall to pieces spontaneously, forming a sort of mortar in the bladder. For these the lithotrite need not be used, as they would be better removed by the scoop catheter and injections of the bladder.

Thus far I have considered the preference to be given to lithotomy or lithotrity, chiefly as regards the foreign body to be acted upon; but the condition of the parts most implicated in these

operations, viz. the urethra and bladder, is a consideration of equal, if not of superior importance. Formerly, when straight instruments of a considerable diameter were used, it was frequently requisite to dilate the urethra for some time previously, in order to admit of their introduction, which circumstance, together with the canal being kept longer on the stretch during the instrumental manœuvres, was at times productive of serious consequences; and though the risk of these has been materially diminished by the improved construction of the instrument, yet a narrow urethra is a very unfavourable circumstance in a person about to undergo lithotrity, both on account of its rendering the operation more difficult, and also from its preventing the free escape of fragments, which must necessarily be broken into smaller portions, than in a person with a wider urethra, and consequently more sittings would be required for this purpose. The same may be said of partial narrowing of the urethra by stricture, which, though in many instances capable of being, in great measure, removed beforehand, and consequently need not counter-indicate lithotrity, when other circumstances are favourable to its employment, is yet a very unpleasant complication, and predisposes to the arrest of fragments in the passage the more readily, on account of the part between the stricture and the bladder being generally more dilated in persons who have long laboured under this disease. When co-existing with stricture, other states unfavourable for lithotrity are met with, as a largish or hard stone; a contracted or diseased state of the bladder; great irritability on the passage of instruments, or enlargement of the prostate; lithotomy would, in most cases, be preferable, and if successful would at once relieve the patient of his stone; and at the same time of the stricture, which may very possibly have occasioned the formation of the foreign body, by preventing the escape of gravel, which, in a healthy state of the urethra, might have passed away without difficulty.

In those persons whose urethra is more closely bound up to the *symphysis pubis*, the arch being higher than usual, the curve at the membranous portion is much increased, and is also more abrupt than in others. In such a case, lithotrity may induce some of the consequences to which I have before alluded, from the forcible straightening of the parts by an inflexible metallic instrument being repeatedly introduced and maintained in the passage for a longer or shorter period. It has been stated by some, that this objection cannot apply to the curved instrument, at present in use; but it must be remembered, that the curved part is exceedingly short, and is entirely within the bladder during the operation; while that part of the instrument occupying the neck of the bladder and the rest of the urethra is perfectly straight. Although, therefore, this obstacle may not be so great as to prevent

the adoption of lithotrity, yet the operation would be attended with more pain than in ordinary cases; and if the stone were hard or of large size, and consequently likely to require many sittings for its removal, or if the introduction of the instrument were attended with much difficulty, and gave rise to symptoms of an alarming nature, it would probably be most prudent not to repeat the attempt, but to have recourse to lithotomy; if the state of the patient were such as to render this operation practicable with the probability of advantage. If, however, it were deemed advisable to proceed with lithotrity, the sittings should be short, and only repeated after the irritation from each had subsided.

Enlargement of the prostate, especially of its middle lobe, is also a common cause of increased curvature of the urethra, and may exist to such an extent as to render lithotrity impracticable with safety. When the enlargement is on one side, or exists only in a moderate degree, it need not counter-indicate the operation, though its performance would be rendered more difficult, particularly as regards the seizure of fragments, to the escape of which the enlarged prostate presents a great impediment, and more especially if there should, at the same time exist, as is not unfrequently the case, a state of atony of the bladder. On the other hand, enlargement of the prostate is also an unfavourable circumstance as regards lithotomy, not only on account of the difficulty of the operation being greater from the increased depth of substance between the skin and bladder, and of an incision being made through a part which is the seat of morbid alteration, but also because this state is not unfrequently complicated with disease of other organs, and occurs in old people in whom lithotomy is fatal in so large a proportion of cases; hence it is a greater object to avoid lithotomy in elderly persons, than in healthy adults, in whom there is less likelihood of its failure, particularly as, from the diminished irritability of the parts commonly attendant on advanced age, lithotrity is in general better borne than in younger subjects.

A contracted and thickened bladder is also a very unfavourable complication, as far as any operation is concerned. Lithotomy would be attended with great risk from the division of textures in a state of disease, and from their probable injury in extracting the stone. Lithotrity also, though perhaps in a similar case the preferable operation of the two, would have to be performed at a great disadvantage, on account of the bladder being able to contain only a small quantity of fluid, and of the instrument necessarily coming into contact with its parietes; but when the stone is large in comparison with the diminished capacity of the bladder, this operation would be less admissible, and lithotomy would probably offer the greatest chance of success. If the other indications should

lead the surgeon to adopt lithotrity, and the first sittings were well borne, the probabilities would be greatly in favour of its success; but if the symptoms should become more severe, with increased irritability of the parts, and fever, it would be most prudent not to persevere with the operation, but to have recourse to lithotomy, as soon as the patient was in a fit state to support it. Some persons in whom this course has been pursued have done well, without appearing to have been placed in a worse state, by the previous trials of lithotrity.

When the symptoms of stone are very severe, the irritability of the bladder being high, and its contractions frequent, they would in many cases be increased by the attempts at lithotrity, which would be in some inadmissible, unless the irritability could be allayed by opiate injections, or other appropriate means. If, notwithstanding the existence of an irritable state of the parts, lithotrity be considered preferable to lithotomy, on account of the small size of the stone, and the likelihood of removing it in two or three sittings, each sitting should be much shorter than under other circumstances, and should not be repeated till the disturbance caused by the preceding one had subsided; tepid baths and other sedative remedies being employed after each sitting. It not unfrequently happens, however, that the irritability of the bladder, even when considerable at first, becomes materially lessened, after two or three sittings of lithotrity, as the bladder becomes more accustomed to the presence of the instrument; but here the surgeon must proceed with great caution, and, as it were, feel his way; for if, instead of subsiding, the symptoms should increase, and fever, or nervous irritation, should supervene, the operation had better be given up, and recourse be had to means calculated to tranquillize the local or constitutional disturbance. In some instances, the first sitting or two are well borne; but a high state of irritability of the bladder subsequently supervenes, to which the presence of fragments of some calculi appears to contribute, and which may also depend upon the sittings having been too much prolonged.

If, combined with great irritability of the bladder, there is continued pain in the hypogastric region, with fever, and mucous secretions,—if, in fact, there exists a subacute inflammation of the organ, lithotrity would manifestly be improper, and would aggravate the symptoms; but if this state appeared to be produced and kept up solely by the presence of the stone, and consequently not capable of being relieved by therapeutic means, the performance of lithotomy would be the most likely means of alleviating the symptoms, and would afford the patient the best chance of recovery; for, though the likelihood of success would, of course, be very materially diminished by so unfavourable a complication, yet

I have seen some cases where, notwithstanding the existence of fever, and symptoms of cystitis, the operation was performed, and the patients recovered. One of these, of which I took notes at the time, occurred in a boy on whom Professor Walther operated in the hospital at Munich, notwithstanding there existed symptoms indicative of a high state of inflammation of the bladder, which antiphlogistic measures failed to relieve; the patient being much emaciated and worn out by pain and sleepless nights. After the removal of the stone, which was of small size, the symptoms subsided as if by enchantment; the patient slept soundly at night, which he had not done for weeks before; and advanced towards recovery without any impediment.

A chronic state of inflammation of the mucous membrane, unaccompanied by much pain or irritability of the bladder, but attended with a copious secretion of ropy mucus, (the *catarrhus vesicæ* of old people), when combined with the presence of stone, although an unfavourable complication, is, in most cases, better suited for lithotrity than for lithotomy, particularly when the stone is of small size, as in these cases; being frequently chiefly composed of the phosphates, it is soft, and easily reduced to minute fragments. It not unfrequently happens, that the quantity of mucous secretion is diminished after two or three sittings of lithotrity;—probably from the diminution of the size or the weight of the stone by the process. When this is the case, the operation may be persevered in with great prospect of success; but should the quantity of mucus increase, and the bladder become irritable, the operation should be suspended, or altogether abandoned, with a view to the performance of lithotomy at a later period. When, however, it is deemed best, from existing circumstances, to proceed with lithotrity, the sittings should be short, and at long intervals.

A degree of inflammation of the bladder is occasionally induced by lithotrity, where none previously existed, even when the operation has been properly performed, and in proper cases; and may either depend upon the great susceptibility of the patient, the operation being attended with unexpected difficulties, or upon the nature of the stone, and the bladder being irritated by its fragments. In such a case, the operation should be discontinued, if many fragments still remained.

A condition of the bladder opposed to that of preternatural irritability, viz. atony or paralysis, is not unfrequently met with in old persons, and was at one time considered to counterindicate lithotrity, on account of the inability of the bladder to expel the fragments and detritus. Combined with atony of the bladder, there is often a considerable increase of its capacity in consequence of its being distended by the accumulated urine. The symptoms

of stone are also in general much less severe, frequently very obscure, and, where paralysis of the bladder has preceded the formation of the foreign body, are sometimes absent altogether, the existence of the stone not being discovered till it has attained a large size, which usually occurs much more rapidly under these circumstances, on account of the urine being retained longer and giving rise to deposition of the phosphates. Here the peculiarities in individual cases will require to be attentively considered, in order to enable the surgeon to decide upon the most preferable mode of operating, or whether any operation be advisable; as, when paralysis of the bladder exists, the generally diminished vitality of the system or disease of other parts, might render a too active surgical interference prejudicial. When an operation is determined upon, and there is a large stone or several stones, or an enlarged prostate, which would impede the removal of the fragments, lithotomy would be preferable. In those cases, however, where the atony of the bladder is less complete, and the patient still possesses the power of voiding some urine at stated intervals, though he may not be able to empty the bladder, lithotrity would offer great probability of success, the diminished irritability which so commonly attends impaired muscular contractility, being in favour of the operation, which would be less painful and less likely to be followed by accidents; nor would the fluid injected be forced out, as often happens under other circumstances, and consequently the parietes of the bladder would be less likely to be injured by the instrument. The repeated injection, especially of cold water, is serviceable in these cases by removing the accumulated mucus, and frequently tends to restore the tone of the bladder, the contractile power of which is also sometimes increased by the stimulus of the instrumental manœuvres. Small fragments and detritus may be removed by the scoop or catheter forceps, constructed by Weiss, or by injecting water into the bladder with some force, through a full-sized silver catheter with large eyes. In these cases also, lithotrity offers a means of getting rid of the foreign body, when lithotomy would be counterindicated by disease of the kidneys or other parts; by disorder of the general health, &c. When lithotrity is performed under these circumstances, M. Civiale insists strongly upon the sittings not being long-continued, which is the more likely to happen, as, from the comparative absence of pain, the operation is generally well borne, and the surgeon is deprived of a monitor, which, if present, would warn him when to desist; and, according to the same high authority, the prejudicial effects of the sittings having been too much prolonged, would not fail to be evidenced, not so much by local symptoms, as by the supervention of a state of low fever, constitutional irritation, impaired digestion, and general health, which would frequently terminate the patient's life.

The coexistence of stone with abscess, ulceration, or fungous growths of the bladder, as evidenced by the general state of the patient's health, the frequent passage of blood, purulent matter, or portions of fleshy substance with the urine, is generally considered so absolutely to counterindicate any operation, that I need not do more than allude to these morbid states. Blood or purulent matter in the urine may, however, come from one of the kidneys, from abscess of the prostate, or of the perineum, or from the surface of the urethra, and an operation for the removal of the stone may nevertheless be practicable with advantage. In these cases the surgeon must be guided by the concomitant circumstances in his choice of the method to be adopted.

When disease of one or both kidneys is known to exist, few persons would recommend lithotomy, as it would be attended with but slender chances of success, for, even were the patient to survive the operation, the existing disease would in all probability be aggravated, and cause his death at no distant period. In some cases of this description, lithotrity might be had recourse to with advantage, the shock to the constitution being comparatively small, and the irritation from this operation being less likely to extend to the diseased organ.

Having thus noticed some of the conditions which appear to indicate when one or other of the operations should be preferred, as far as the stone itself and the organs principally implicated are concerned, I must not omit, before concluding, to allude to the state of other organs, and the general condition of the patient, which must often exercise great influence on the choice of the operation, and in enabling the surgeon to determine whether either could be performed with a prospect of advantage.

The existence of organic disease of important parts, even when not immediately tending to shorten life, is generally considered a sufficient reason for abstaining from the performance of any serious operation, especially of lithotomy, which, by the shock imparted to the system, would not fail in most instances to aggravate the existing disease, and even render recovery from the immediate effects of the operation extremely doubtful. Hence many patients with stone who at the same time laboured under chronic disease of the abdominal or thoracic viscera, bronchial irritation, asthma, &c. were, previous to the invention of lithotrity, condemned to retain the stone in their bladder, and to endure the suffering from this disease, without a prospect of its removal. Such persons may now reasonably indulge the hope of a cure by means of lithotrity, with comparatively little risk, when other circumstances admit of its application, as, except where there exists much constitutional or local irritability, the effects of lithotrity are mostly confined to the parts implicated, and are not generally extended to distant or-

gans, when the operator is careful to suspend the operation should any unpleasant symptoms arise, till they have subsided.

The same remark may apply to those persons in whom, though there be no evident disease of any important organ, the general health is materially impaired, either by a residence in tropical climates, or other causes, and in whom there consequently exists a great predisposition to disease, which would very likely be called into activity by the performance of a capital operation. In the majority of such cases lithotomy, though not so strongly counter-indicated as when there is actual disease, would yet be attended with great risk, and would be less advisable than lithotrity; particularly if other circumstances be in favour of this operation. In some persons, however, even when the symptoms of stone are not severe, a deranged state of the general health, and digestion, with feverishness and restlessness, depends upon the presence of the foreign body, and would be rectified on its removal; while the irritation from lithotrity, especially if many sittings were required, would be likely to be prejudicial. In such a case, therefore, lithotomy would be the preferable method if other circumstances did not preclude its adoption.

I have already adverted to the prejudicial effects which may ensue from the undue degree of apprehension entertained by some patients of lithotomy, which most persons are aware, if it do not succeed, will probably cause their death. So great is the dread of some patients of lithotomy, that they are induced to bear their sufferings, and tamper with the disease for a long period, till the stone has attained a large size, or till morbid alterations supervene, which either preclude an operation for their relief, or render its performance much more hazardous. To such persons the less formidable operation of lithotrity might often be proposed, without exciting their fears in the same degree, and at an early stage of the disease, when its removal would be comparatively safe and easy. In some instances, where the patients were particularly apprehensive of lithotrity, but found after two or three sittings that it was not so formidable as they supposed; and after seeing some fragments pass away with but little inconvenience, their minds became much more easy as to the result, which had the happiest effect in improving their general condition, and raising their spirits. In order, however, to prevent the despondency that might arise, in the event of any unfavourable circumstances supervening, it would be advisable on the part of the surgeon, not to lead the patient to think too lightly of the operation, but to intimate that it is sometimes necessary to suspend the sittings for a time, without any harm necessarily resulting from the delay.

When treating of the nature of calculi, as regards the operation best adapted for their removal, I alluded to the calculous deposi-

tions formed around a foreign substance accidentally introduced into the bladder from without ; and although these cases are rare, they occasionally become the subject of operation. The substances most likely to be left in the bladder, and to form the nucleus of a calculus, are, portions of elastic gum or wax bougies, of catheters, or of lithotritic instruments, when these have been badly constructed and an undue degree of force has been used in operating. Vegetable matters, as pieces of wood, straw, peas, &c. are occasionally introduced into the bladder, especially by females. It cannot always be known, however, what is the nature of the foreign body, when it has been passed by the patients themselves, as they are generally reluctant to give any information on the subject ; but, when it can be ascertained that it is a soft or friable vegetable substance, lithotrity would in most cases be the preferable operation, as the concretions formed around such nuclei are mostly composed of the phosphates, and the operation has been successfully performed in some similar cases. On the other hand, should a portion of an instrument, or any other hard substance have been left in the bladder, lithotrity would generally be of little avail ; and lithotomy should be performed as early as possible, as the longer it is delayed the larger would be the calculus, and the risk of a diseased state of the bladder greater. It is not always, however, an easy matter to find and extract the foreign body after the bladder has been opened ; particularly if its shape be long and narrow. In an operation performed by one of the most skilful surgeons of Paris, at which I was present some months ago, considerable difficulty was experienced in extracting the foreign body by the lateral operation, which lasted a long time. The calculous deposition had in this instance, formed around a piece of tobacco pipe, about two inches and a-half in length, which was repeatedly seized by the forceps in a direction transverse to the wound, which occasioned the difficulty in its removal.

The remarks, which I have hitherto made, have more especially reference to the selection of an operation in adult males, or those above puberty ; but a very large proportion of stone cases, especially in hospital practice, occur in young children, or those below the age of ten or twelve years. In these subjects few persons would recommend lithotrity as a general method, as it is attended with great inconvenience and risk, on account of the narrowness of the urethra, which would necessarily require the instruments to be of a slighter construction, while there would not be a proportionate friability of the stone, which, in children, is mostly of the lithic acid or oxalate of lime varieties. On this account, also, the treatment must be longer than in adults, as the fragments would require to be broken smaller to enable them to pass away ; and, owing to the textures at the neck of the bladder being less

resisting, this part is in children more dilatable, and would admit the entrance of portions of stone too large to pass through the rest of the canal. There are, besides, other objections to lithotrity in children, as the greater degree of susceptibility of their nervous system, and of irritability of the parts, which would render the repeated introduction and action of instruments in the bladder liable to be attended with serious consequences. On the other hand, all the conditions are most favourable for lithotomy in young subjects, and it is successful in the great majority of instances, the stone being frequently removed in two or three minutes, while the symptoms (which are generally induced by its presence, and not dependent upon previously existing disease), most usually subside after the removal of their cause. The operation being comparatively easy of performance, owing to the trifling depth of the perineum, which enables the operator readily to reach the interior of the bladder with his finger, and generally to touch the stone, is also a principal cause of success; added to which, the patient's moral constitution is not disagreeably affected, with respect to the result of the operation, as is often the case in adults. Hence, it is obvious that in general lithotomy is in an especial manner the operation best adapted to children affected with stone; yet, even under the most favourable circumstances, the operation is fatal in a certain proportion of cases, which may be seen from the tables in the appendix, so that even in children lithotrity may be the preferable operation in some instances, as when the stone is small and likely to be destroyed in two, three, or four sittings, and where there is not much irritability of the parts on the introduction of instruments. It has been several times performed on children with success, both in England and abroad; but I am not aware that in any instance it has been attended with a fatal result. Of the cases which have come to my knowledge, the youngest patient on whom lithotrity was performed was forty months old. M. Segalas was the operator on this occasion, though few persons would be inclined to follow his example on so young a subject. In proportion, however, as the patient approaches nearer to puberty, lithotrity might be performed with greater prospect of advantage.

Stone cases in females being of rare occurrence compared with their frequency in males, the question relative to the operation to be preferred in them resolves itself into a very narrow compass. In fact, the shortness, width, and great dilatability of the urethra in women, admits of the passage or extraction of calculi, which in the other sex would require an operation of lithotomy or lithotrity for their removal; and when one of these operations becomes necessary, the surgeon will not experience much difficulty in determining to which the preference should be given. Lithotomy, though attended with comparatively little difficulty or danger in

females, is so frequently followed by incontinence of urine, or fistula, that it would seldom be advisable to prefer it to lithotrity, which, from the simpler disposition of the female parts, in general, admits of easy application, and would be little likely to be followed by the more serious consequences to which I have adverted. At the same time, it must be borne in mind, that in many women, as in children, there is much greater susceptibility of the parts and of the nervous system than in men; and when this is the case, the action of lithotritic instruments may be followed by high local, or constitutional irritation, which might render a repetition of the sittings, not without danger. When, therefore, combined with this condition, there exists a large or hard stone, attended with severe symptoms, and which would be likely to require many sittings of lithotrity, it would be preferable at once to remove it by lithotomy.

From a consideration of all the preceding circumstances, the following conclusions may be deduced :

1stly, That lithotomy is still, in the present state of the art, the operation most suited to the majority of cases of stone in the bladder; inasmuch as about one-half of the number of stone patients consist of children to whom, with a few exceptions, it is more particularly adapted.

2dly, That, as far as adults and elderly persons are concerned, lithotrity is most applicable to an equal, if not to the greater, number of cases.

3dly, Lithotrity is preferable in the great majority of female patients.

4thly, Other circumstances being favourable, lithotrity is more especially suited to calculi of small size, even when hard.

5thly, Lithotrity is less applicable than lithotomy to most cases, where the bladder contains several calculi, especially if they be hard.

6thly, Lithotomy is the preferable, and often the only admissible operation, in cases of large calculi; as also in those cases where the stone, though only of moderate size, is yet of considerable density, and irregular on its surface, as in the oxalate of lime variety.

7thly, When there exists much irritability of the urethra and bladder, which cannot be allayed by preparatory treatment, lithotomy would be the preferable operation; especially if the irritability appeared to be chiefly dependent upon the presence of the stone.

8thly, Lithotrity is applicable in some states of deranged health, or disease of parts, which would counterindicate lithotomy, or would render its performance most likely to be attended with failure.

9thly, The degree of pain from the performance of lithotrity is not great in many cases, and is mostly diminished after the first sittings; but, on the other hand, in some instances, the operation is very painful, and the pain becomes increased in subsequent sittings, though, perhaps, never so acute in lithotrity as in lithotomy, yet, as the pain in the latter operation lasts only for a few minutes, whereas in the former it recurs, though less in degree, on each sitting, the patient frequently suffers by lithotrity a greater amount of pain.

10thly, The duration of the treatment is generally longer by lithotrity than by lithotomy, though sometimes it is shorter; and after the stone has been removed by the latter operation, the patient, though confined to his bed, may, during the greatest part of the period, be considered as convalescent; whereas, when lithotrity is performed, there is always a risk, so long as any fragments remain in the bladder, of circumstances arising to prevent the completion of the operation, and the patient cannot be regarded as out of danger.

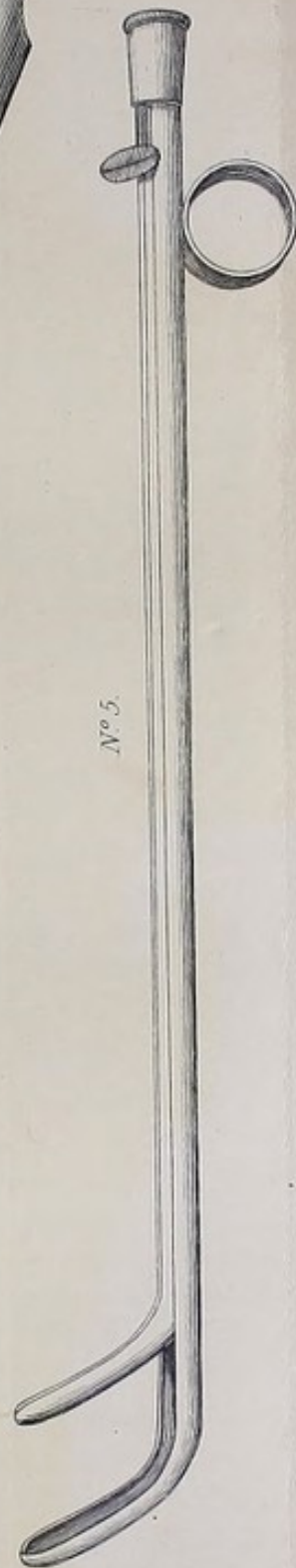
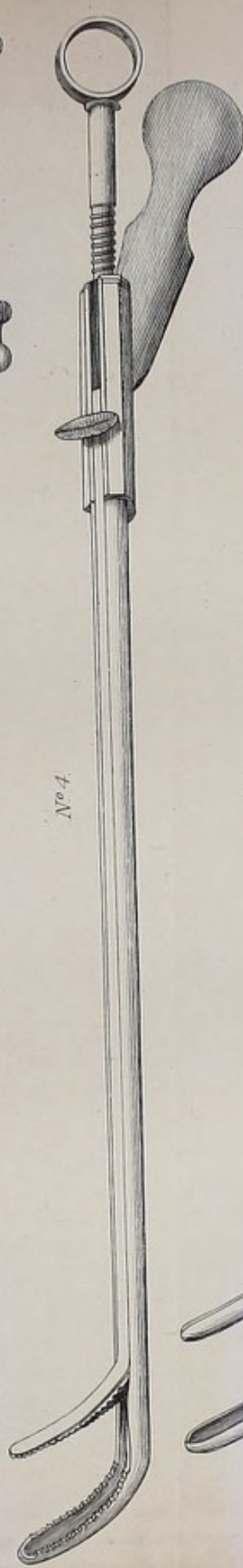
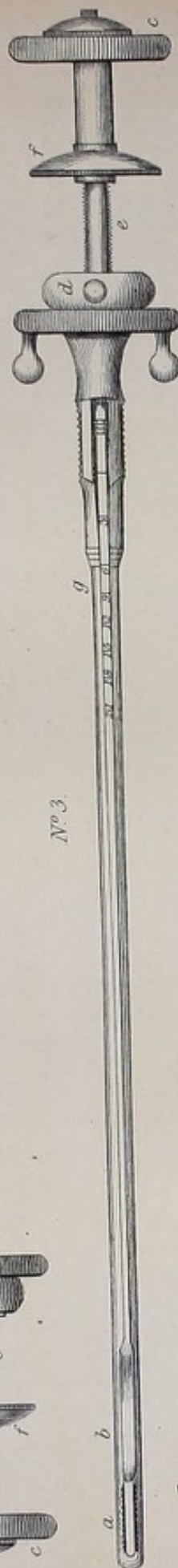
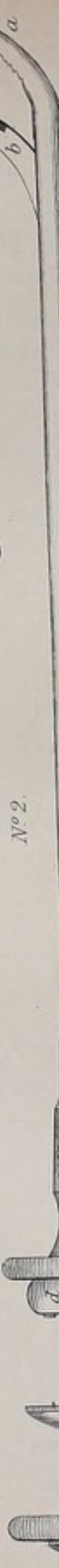
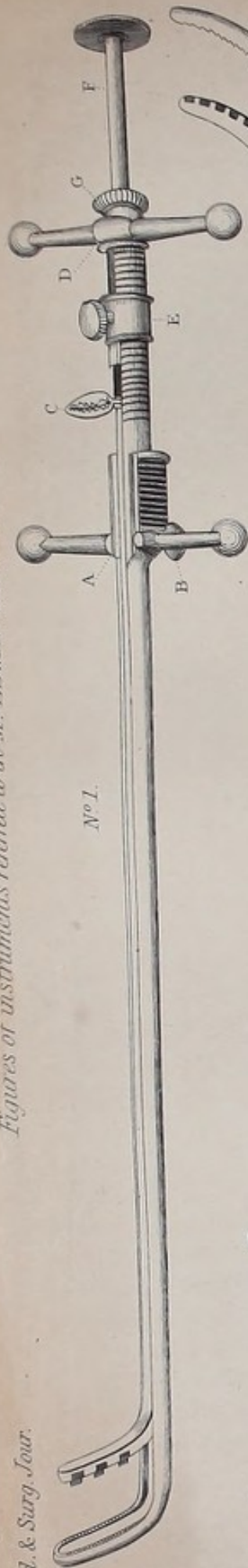
11thly, When lithotrity is applicable, the method by pressure is, in the great majority of cases, infinitely superior to that by percussion.

12thly, Lithotrity exposes more to the risk of a relapse than lithotomy, on account of the greater probability of a portion of stone having escaped detection, and remaining in the bladder after the operation.

Lastly, Sufficient data do not as yet exist whereon to form any accurate estimate of the average amount of failure, and mortality after lithotrity; the accounts hitherto furnished being of a very contradictory nature; some representing lithotrity as more successful in its results than many slight operations; others stating the number of failures to be very great. The circumstance of several unsuccessful cases, which were not adverted to by the operators, having been subsequently brought to light, both in England and on the continent, tends very much to discredit some of the statements of success which have been made; though, as far as the results are concerned, much must depend upon the operators being accustomed to the use of the instruments, and knowing when to desist from persevering in the attempts; as also upon the selection of proper cases. It is, however, satisfactory to know, that, since the instruments have become more simple and perfect in their construction, and the operation better understood by the generality of practitioners, the proportion of failures is much less than at an earlier period.

APPENDIX.—The following few cases are selected, in order to illustrate some points connected with lithotrity; the difficulties

Figures of instruments referred to in M^r. EDWIN LEE'S ESSAY.





which sometimes arise, and the occasional causes of failure. I might have added others, both from what has fallen under my own observation, and also from other sources, which would have represented lithotrity in a much more favourable light ; but a repeated narration of simple and successful cases, where no circumstances have occurred materially to retard recovery, would have been but little instructive ; and I therefore prefer to notice such as are more interesting in a practical point of view.

I have subjoined some statistical accounts of the average mortality after lithotomy, in different localities ; and have commented upon the difference which exists in this respect between England and the continent.

ILLUSTRATIVE CASES OF LITHOTRITY.

Simple case ; cure in one sitting.—A member of the Chamber of Deputies, aged 53, had laboured under symptoms of stone for a year. The urethra and bladder were healthy, and not very irritable. The stone, which was judged to be about the size of an almond, was crushed without difficulty by M. Civiale, with the curved lithotrite, and the fragments were also broken in the same sitting. The detritus passed away readily ; the patient suffered but little pain from the operation. No subsequent sittings were required, and he returned to the country cured, a month after his arrival in Paris.

Cure in one sitting by Jacobson's Instrument.—M. C. had suffered during eight months from symptoms of stone, and on sounding, several small calculi were detected. After a few days preparatory dilatation of the urethra, Jacobson's instrument was introduced, and some of the calculi were crushed. Several fragments and small calculi passed away after the operation, and on a subsequent examination, no remains of stone could be felt. This patient was not apprised that the operation was about to be performed, but thought the instrument was passed in order to examine the bladder, and when it was withdrawn, inquired of the operator if he thought lithotrity applicable to his case.

Large and hard Stone.—The Count de L——, who had a hard stone in the bladder, measuring thirteen lines in its long diameter, was lithotritized by M. Amussat, in February 1834, by the method of percussion. No unpleasant symptoms ensued, and a second sitting took place four days afterwards, which lasted ten minutes ; several fragments being broken. The urine, which was tinged with blood after the first sitting, was perfectly clear after the second and subsequent ones, which were also attended with less pain and inconvenience than the first. The fragments passed away readily ; and as no remains of stone could be felt in examining the

bladder, the Count was enabled to resume his usual avocations, and to take all sorts of exercise without inconvenience.

Irritability of Urethra and Bladder, &c.—F. H., aged 46, had been subject to attacks of pain in the region of the kidneys, from 1814 till 1832, and had, during the latter part of this period, experienced symptoms of stone, the existence of which was verified by sounding; but there was extreme irritability of the parts on the passage of the instrument. The urethra was, however, dilated by the use of elastic gum bougies, and the irritability became, in some degree, allayed. M. Amussat then made an exploration of the bladder with the lithotrite, which was followed by an attack of fever with nervous symptoms, and prevented the operation from being attempted till eight days afterwards, when the stone was seized and broken by percussion into several fragments. After the third sitting, the patient was seized with an attack of piles and general weakness. The bladder had also lost its energy, and could not expel the fragments. A long interval was consequently requisite between each sitting, but after several sittings the stone was destroyed, and the patient felt himself in better health than he had done for twenty years before.

Abscess of prostate, and retention of urine. Relapse.—M. D. aged 71, had laboured under stone in the bladder for a period of two years, when lithotrity was performed with the three-branched straight instrument. The stone, about the size of a walnut, was broken at the first sitting, though the bladder contracted strongly, and expelled the fluid which had been injected. At the second sitting considerable difficulty was experienced in the introduction of the instrument, inflammation and abscess of the prostate gland supervened, causing retention of urine, which was relieved by the abscess bursting into the urethra. After a month's interval, the operation was repeated, though it was still requisite to draw off the urine with the catheter, through which the detritus of the stone came away. When the patient had undergone six sittings, no remains of stone could be felt; but at the expiration of six months, a fresh one was detected, which was also broken, and the fragments extracted by instruments. M. D. enjoyed good health during the two subsequent years, though the retention of urine remained. (Leroy D'Etiolles.)

In all probability these accidents would not have occurred, if this patient had undergone the operation after the introduction of curved instruments into practice.

Complicated and unfavourable Case.—The Chevalier del Turco, aged 60, was operated upon by M. Civiale in Florence in 1835. He had long laboured under stricture of the urethra, and was in the constant habit of using bougies. In 1833, vesical catarrh, and other symptoms of a peculiar character supervened,

which increased to such an extent as to render walking or the motion of a carriage insupportable. At the time of M. Civiale's arrival, the patient had not quitted his bed for more than four months, which circumstance rather surprized him, as, from the letter he had received, he expected to find the patient in a more favourable condition. The friends, however, avowed that they had considered it necessary to represent the case in a favourable light, in order to induce M. Civiale to come to Florence and undertake it. There also existed enlargement of the prostate; a muco-purulent secretion from the bladder; a severe bronchial affection, with irregular and intermitting pulse, feverishness, sleepless nights, loss of appetite, great debility, emaciation and dejection of mind. These circumstances appeared to render an operation inadmissible, and though, on examination, the stone was considered to be of small size, yet the bladder was exceedingly irritable, and its internal surface irregular. Some of the first surgeons of Florence had declared lithotomy to be inapplicable with a prospect of success; and that if the case were left to itself, the patient could not long survive, so that lithotrity was proposed as a last and extreme resource. The first sitting, on the 21st of April, was very short, but the stone was broken with the curved lithotrite. The patient having suffered less than he anticipated, and some fragments having passed through the catheter, tended to raise his spirits, and to give the operator greater hopes of a successful result. A second sitting took place on the 30th, without any other inconvenience than the arrest of a fragment in the urethra, which was pushed back into the bladder. Two other sittings took place on the 2d and 4th May, which passed off as favourably as the others. The urine afterwards became clearer, and the local suffering much alleviated. Fragments and detritus were occasionally arrested in the urethra, but were displaced without difficulty, either by means of injections, or by being pushed back into the bladder. The patient underwent three other sittings on the 6th, 8th, and 11th, which were very short, and attended with less pain and inconvenience on each repetition. On the 15th, he was able to quit his room and take exercise in a carriage, and on the following day no remains of stone could be felt in the bladder.*

Portion of an Instrument left in the Bladder; Lithotomy after Lithotrity in a Child.—The patient was a boy aged 4 years. The stone was broken with facility, but at the third sitting a portion of the instrument was observed by the operator to have been broken off and left in the bladder. He was, however, so fortunate as to be able to extract it with a fresh lithotrite. A

* "Parallele des divers moyens de traiter les calculeux."—When at Florence last year, I learned that, after M. Civiale's departure, this patient had a recurrence of the disease, and was again lithotritized with success.

fragment of calculus afterwards became arrested in the urethra, and considerable difficulty was experienced in pushing it back into the bladder. The bilateral operation was subsequently performed, and was attended with success.

Cystitis consequent upon exploration of the bladder. Mr M., aged 60, of a nervous and irritable temperament, had laboured under symptoms of stone during three years, when an examination of the bladder was made with a common sound, which detected a stone, but which was attended with considerable pain, and irritability. A subsequent examination of the lithotrite was succeeded by fever, high nervous irritation, and inflammation of the bladder; the urine being expelled frequently, with great pain, and containing a large quantity of muco-purulent matter. This state continued during several months, the patient retaining the stone, as there was no prospect of his being able to undergo lithotrity with advantage.

Cystitis with fatal result from attempts at Lithotrity.—A young man, aged 19, was operated upon at the Hospital Beaujon, with the three branched perforating instrument. On the first attempt the stone could not be seized, and considerable pain was occasioned. A second trial was even attended with more pain than the first, and was equally unsuccessful in seizing the stone. Shivering, fever, pain in the hypogastric region, and other symptoms of cystitis supervened, and the patient died on the fourth day. On examination the bladder was found to be considerably inflamed, particularly about its neck, and contained a mulberry calculus of the size of a walnut.

This case was evidently not at all adapted for lithotrity, and least of all by the method of perforation. Had lithotomy been performed in all probability the result would have been different.

Fatal result from attempt at Lithotrity.—The presence of a stone in the bladder of M. P. was ascertained by sounding, but a subsequent attempt to seize it with Heurteloup's instrument failed; and a high degree of irritability of the bladder supervened, which terminated in inflammation, and caused the patient's death in fifteen days.

Fatal result of Lithotrity.—Lecomte experienced such serious nervous symptoms after the first trial of lithotrity that he died on the third day. (Larrey's Report of Cases.)

Violent Contractions of Bladder. Lithotomy after Lithotrity, with fatal result.—M. R. had experienced symptoms of stone for several years, and at length placed himself under the care of M. Civiale, in order to undergo lithotrity. The stone was seized at the first sitting, though not without difficulty. The three next sittings were altogether fruitless, the stone could not be seized, and M. Civiale gave up the case. M. Leroy was called in some

time afterwards, and found the stone to be about twenty lines in diameter, the bladder hypertrophied and contracted, and the prostate greatly enlarged. These unfavourable circumstances, and the case having been given up by M. Civiale, would have determined M. Leroy not to undertake the treatment by lithotrity; but, yielding to the patient's earnest wishes, he performed the operation; a strong solution of opium having been previously injected into the bladder. Though this was found to be altogether useless in preventing the contractions which expelled the fluid on the introduction of the lithotrite, which was so strongly grasped that it could not be moved in the bladder, and after a short period was withdrawn, the stone not having been seized. At a subsequent sitting, undertaken by M. Heurteloup, the stone was seized, but the instrument could not be made to act upon it, and the patient suffered considerably; yet, notwithstanding these reverses, he was not discouraged, and again supplicated M. Leroy to repeat the operation. This he declined doing, and recommended lithotomy, as the patient's sufferings had become intolerable. This operation was consequently performed, and a quantity of pus escaped from an abscess in the prostate, at the moment of incising the neck of the bladder. The symptoms were not relieved by the extraction of the stone, and the patient died twelve days after the operation. The stone was of an oval shape, from eighteen to twenty lines in diameter, and had only been perforated once by the lithotrite. The prostate gland was nearly the size of an orange, and the parietes of the bladder nearly three lines in thickness.

From the disease of the parts, and the size of the stone, this was evidently one of the cases least adapted to lithotrity, especially the method by perforation.

Lithotrity on a female.—A woman, aged 28, who had suffered from stone for eight months, was lithotritised by M. Breschet, with the curved instrument, on the 15th October 1837. The sitting was not attended with much pain, and several fragments subsequently passed away. At a second sitting the stone was again broken without difficulty, and the pain was less than before the operation; on the 2d November a third sitting took place, which was attended with no inconvenience, and was succeeded by the expulsion of several fragments. On examination two days afterwards no remains of the stone could be felt.

Lithotrity on a boy; arrest of fragments; long duration of treatment.—A boy aged 13, had suffered from stone for some years, and was also subject to nephritic pains, which were sometimes very acute. His urine was often milky and loaded with mucus. Two calculi about the size of large almonds, were detected in the bladder by an examination, and, as the patient and his friends strongly objected to lithotomy, lithotrity was performed by M. Civiale,

with a three-branched instrument of a size proportioned to the age of the patient. The sittings were repeated every second day, and, from the size and hardness of the stones, their number was greater than was anticipated. Fragments were also frequently retained in the membranous portion of the urethra, whence they were removed with considerable pain and difficulty. After four months treatment the patient was completely cured.

It is obvious, that, though in this case lithotomy would have been the preferable operation, lithotrity would have required much less time, if performed at a period when curved instruments were used.

Lithotrity on children ; arrest of fragments in the urethra, &c.—A boy aged 4 years, was lithotritised at the Hospital de la Faculté with the three-branched instrument. The stone was nearly an inch in diameter, and though brittle required six sittings for its removal. The fragments stuck several times in the urethra, and occasioned a good deal of suffering. The patient, however, was completely cured.

Another boy had suffered from symptoms of stone for more than one year. On examination a stone of about the size of a filbert was felt in the bladder, and partially engaged in the urethra. After having been pushed back into the bladder, it was crushed with the lithotrite. A fragment became arrested the next day in the urethra, and occasioned acute pain. A similar accident recurred two days afterwards, and great difficulty was experienced in pushing back the portion of stone into the bladder. The indocility of the patient prevented any subsequent introduction of the instrument, so that in all probability the stone remained.

In another young patient, 3 years old, the stone was only three or four lines in diameter. It was crushed in one sitting, and the fragments passed away without inconvenience.

A little girl, 3 years old, had laboured for more than two years under symptoms of stone. On examination a stone was detected, which was supposed to consist of phosphate of lime. The operation was performed by M. Segalas, though not without difficulty, as the child was very intractable ; the contraction of the bladder expelled the fluid, injected and prevented the instrument from being opened. The stone was destroyed in ten sittings.

Deranged general health ; catarrhus vesicæ, &c.—A gentleman, aged 74, had for years laboured under symptoms referred to the bladder, without being characteristic of stone ; but on examination, at least two calculi of a certain size were ascertained to exist in the bladder ; and the patient arrived in Paris in May 1835, greatly debilitated, suffering much, and with frequent inclination to make water. The urine was fetid, and contained a large quantity of mucus. He was feverish, and did not sleep at

nights, and the urethra was very irritable. After his health had been improved by tonics, and the irritability of the bladder lessened by bougies, lithotrity, of which the patient was very apprehensive, was performed by M. Civiale, the three-branched instrument being used. The first sitting was short, and only one of the calculi was broken. No accident supervened; a large quantity of detritus passed away, and the patient's fears were very much lessened. Four or five other sittings sufficed to remove the calculi. After the first few days of the treatment, the *catarrhus vesicæ* diminished, and at last ceased entirely, and the patient's general health improved in proportion as his anxiety became less.

Complicated and unfavourable case; numerous calculi.
—One of the most interesting cases in which lithotrity was performed is that of M. B., operated upon in 1831 by M. Civiale, who has given the details of the case in his "Parallele." This gentleman was 66 years of age, and had laboured during four years under bronchial disease, and attacks of *catarrhus vesicæ*, which increased in intensity on each succeeding occasion, the urine being purulent, fetid, and bloody. The bladder was examined by sounding, and the existence of stone ascertained. The patient consequently came up to Paris from Lyons, in order to undergo lithotrity. An exploration of the bladder indicated the presence of several small calculi, and, though it caused but little pain at the time, was succeeded by swelled testicle, increased pain, and mucous secretion from the bladder, nausea, and slight fever. The remedies employed relieved the general symptoms, but the urine continued to be loaded with a brownish fetid secretion, and the bladder had not the power of emptying itself. Injections through a catheter three times a day with tepid water rendered the urine clearer; the urethra, however, continued exceedingly irritable, and sometimes contracted on the instrument, so as to prevent its passage. On the 4th December, the three-branched lithotrite was introduced, and some of the calculi were crushed, none of them being larger than a bean. No inconvenience ensued, but only a small proportion of the fragments of the crushed calculi came away, owing to the loss of tone of the bladder. On this account, after the subsequent sittings, the fragments were extracted, one by one, with an instrument, though not without considerable pain and difficulty, arising from the irritability of the urethra. By the middle of May eighty-two entire calculi, and twenty-five or thirty after having been crushed, were removed. They were all composed of uric acid. The patient's health gradually improved, and injections of cold water restored the contractile power of the bladder, so that on the 21st of May, he was able to return to Lyons, in a most satisfactory state.

Unsuccessful Case.—The Comte d'A. was considered to be in a very favourable state for lithotrity, which was accordingly performed by the method of percussion. Far from complaining of pain during the first sittings, the patient used to say that the sound of the blows from the hammer upon the instrument was most agreeable to his ear. After the sixth sitting, however, the pain became so intense, that the patient was tormented with continual tenesmus, and could neither retain his feces nor his urine. His sufferings continued till his death, after which calculi were found both in the bladder and kidneys.

Failure of Lithotrity; subsequent Lithotomy.—A lad, aged 17, was sent from the country to Paris to undergo lithotrity. Although the parts were very irritable, the stone hard, and not of small size, he refused to submit to lithotomy, to which he was strongly urged by his surgeon, M. Velpeau. Lithotrity was consequently performed at La Charité. The sitting was attended with a good deal of pain, and was followed by fever and nervous irritation. Two or three fragments passed away, and showed that the stone was composed of oxalate of lime. Several other sittings took place at long intervals, though with no advantage, being generally followed by serious symptoms, and the arrest of fragments in the urethra, so that the operation was given up. The patient was afterwards lithotomised, and recovered.

In similar instances, the cause of failure cannot be fairly ascribed to lithotrity; but to the case not being at all adapted for the operation.

Tables exhibiting the proportionate composition of urinary calculi.

The composition of 141 calculi, analysed by M. Chevallier of Paris was as follows:

Uric acid, and urate of ammonia,	-	121
Phosphate of lime,	- - -	8
Ammoniac-magnesian phosphate,	- - -	7
Phosphate and oxalate of lime,	- - -	1
Uric acid and phosphate,	- - -	3
Oxalate of lime,	- - -	1

In 32 other calculi, analysed by the same chemist, the proportion was:—

Uric acid, or urate of ammonia,	- - -	20
Phosphatic,	- - -	2
Phosphate with nucleus of uric acid,	- - -	2
Uric acid and phosphate,	- - -	5
Phosphate mixed with carbonate,	- - -	1
Oxalate of lime,	- - -	2

The analysis of 64 others exhibited the following composition.

Uric acid, and urate of ammonia,	- - -	52
Phosphate of lime,	- - -	6

Ammoniaco-magnesian phosphate,	-	4
Oxalate of lime,	-	2

The following shows the composition of 100 calculi passed by the urethra, which, not having remained long in the bladder, accounts for the small proportion of the phosphatic varieties.

Uric acid, or urate of ammonia,	-	72
Uric acid and oxalate of lime,	-	9
Oxalate of lime,	-	14
Triple phosphate and fusible,	-	4
Carbonate of lime,	-	1

The proportion of uric acid calculi would appear to be less in England, which may possibly depend on the difference of climate and mode of living. Thus in the Guy's Hospital collection, the uric acid calculi are stated to be in the proportion of 22 to 87; in the Norwich collection, as 66 to 181; in that of Manchester, as 71 to 187, without including 39 others composed of uric acid and phosphate. In Hunter's and Sir E. Home's collections, they are as 61 to 150; in the Bristol collection, as 73 to 218. It may be said that, as these entire calculi had not been analysed, their interior composition could not be known. But Dr Prout, who analysed 823 calculi, found that the uric acid ones were not much above a third of the whole, viz. 294, of which 98 were almost pure uric acid; 6 uric acid with a little oxalate of lime; 43 uric acid with a little phosphate; that 113 consisted of oxalate of lime, 3 of cystic oxide, and 202 of the phosphates; while 186 were of the alternating kind.

Table of results of the bilateral operation on persons at different periods of life, from Dupuytren's work, published after his death.

Sex.	Age.	Number of operated.	Died.	Cured	Average Mortality.
Males.	1 to 10 years.	19	1	18	1 in 19
	10 20	5	1	4	1 5
	20 30	3	1	2	1 3
	30 40	2	1	1	1 2
	40 50	3	0	3	0 3
	50 60	2	1	1	1 2
	60 70	4	4	0	4 4
Fe- males.	10 20	1	all cured.		
	30 40	1			
	40 50	2			
Total. from 1 to 70 years,		42	9	33	1 in $4\frac{1}{2}$

This operation, performed by other Parisian surgeons, was attended with about the same average mortality as above. Thus of 89 patients, 19 died and 69 recovered, the proportion being about 1 in $4\frac{2}{3}$. It will be seen that, as in the lateral operation, the number of deaths is small in children under ten years of age, and very great in advanced life.

Average mortality after Lithotomy in England and France.

—Dr Yelloly, in his statistical table of 649 operations, performed at Norwich, states the proportion of deaths on the whole, as about 1 in 7, and as 1 to 14 in children under fourteen years of age. The table of 704 operations performed in the same town, given in Mr Crosse's work, shows that 93 were fatal cases, or less than 1 in 7. At Leeds there were 28 fatal cases in 197 operations, being about the same proportion as at Norwich. At Bristol, however, the mortality is greater. According to Mr Smith's table, given in the *Medico-Chirurgical Transactions* for 1821, being 79 in 354 operations, or one in $4\frac{5}{8}$; notwithstanding nearly half the number were patients under ten years of age, in whom the mortality appears to have been unusually large, viz. 1 in $4\frac{1}{8}$, which is difficult to be accounted for.

According to the valuable statistical tables appended to M. Civiale's recent work,* it appears that, from 100 operations of lithotomy, performed at the Hotel Dieu between 1808 and 1830; of which 32 were operated by the bi-lateral, 12 by the recto-vesical, and the rest by the lateral method; there resulted 28 deaths; being more than 1 in 4, though nearly half the patients were children. At La Charité, the mortality is considerably greater; 70 patients were operated from 1806 to 1831; and the number of fatal cases amounted to 35 or one-half. Among these patients, however, there were only five children, the rest being adults and old people. Another statement shows the result of 190 operations performed by various Parisian surgeons. Of these patients, 106 died, being more than half, and, notwithstanding the greater number were old men, the recoveries were more frequent in them than in the others. Thus there were 21 children; 10 of whom died; but of 59 adults 39 died; while of 102 old people, only 62 died.

Another account states that, of 1002 patients at various periods of life, on whom lithotomy was performed in the Parisian hospitals, 323 died, or little less than 1 in 3.

Again, of 2368 patients on whom operations for the stone were performed in hospital and private practice in France; 1264 of whom were children, and 93 women, 374 died, or about 1 in $6\frac{1}{2}$ of the whole; while 109 relapsed or were incompletely cured. If, from the whole number, we deduct 314 patients lithotritised, (304 of whom were said to be cured), and 50 whose calculi were extracted by the urethra, (48 of whom were cured), we shall have remaining 2004 who were cut for the stone, of which number, 362 died, making an average mortality of about 1 in $5\frac{1}{2}$.

Another statistical account, quoted by the same distinguished surgeon, demonstrates that, of 4672 operations of lithotomy, (lateral, bi-lateral, hypogastric, and recto-vesical,) performed in dif-

* "De l'Affection Calculeuse."

ferent parts of Europe, excluding England, 968 were followed by death, being 1 in $4\frac{4}{5}$.

I think I may aver, without fear of contradiction, that, among an equal number of patients subjected to lithotomy in the British isles, the average mortality would be found to be much less considerable than that exhibited by the above statements of the result of this operation abroad; as in fact, may be considered proved by the Norwich, Leeds, and Bristol tables. It would seem difficult to assign a reason why the success should be greater in this country than on the other side of the channel, as the French are in general not less skilful operators than the English. But my opportunities have enabled me to ascertain that the ratio of mortality, not only after lithotomy, but also after other operations, is much greater on the continent (especially in hospital practice), than in England. This circumstance, I have no hesitation in ascribing to patients being with us, brought into a better state, by attention to their general health, &c. to support an operation, before they are subjected to it; and also to the superior after-treatment pursued in England; by which the consequences so frequently causing failure on the continent, are prevented, or remedied. The contrast between the mortality after lithotomy on the continent and in the British dominions, is illustrated in a table which M. Civiale has given, to show the average mortality according to the age of the patients. Thus, from 540 operations of lithotomy, performed on children, in different parts of the continent, there ensued 109 deaths, or 1 in $4\frac{3}{4}$, and 33 incomplete cures. Of 430 individuals between fourteen and sixty years, 104 died, and 51 were incompletely cured. Of 200 persons above sixty years of age, 123 (near five-eighths) died, and 19 were incompletely cured. The same table includes the result of 16 cases of lithotomy, performed in Ireland, which are as follow. In 12 children no deaths and only two incomplete cures from incontinence of urine; 3 adults—all cured; and one old man, also cured. These may, it is true, have been all favourable cases; and that, in sixteen other cases, the deaths might be in greater proportion to the cures; as it is not unfrequently the case that an operator has a succession of successful cases, and in another series of patients that several failures occur; but it is just as likely, on the other hand, that the greater amount of success is to be attributed to the causes which I have specified.

Explanation of the Engravings of the Lithotritic instruments most frequently employed.

No. 1. Lithotrite constructed by Weiss. A. the cross handle, which may be removed by loosening the screw B; C. the thumb-piece, by which the inner branch may be moved backward and forward. D. the screw with a fly handle which, being turned round, forces the collar E upon the

moveable or inner blade, and crushes the stone. F, the percussion rod, the flat end of which, being struck with the hammer, forces the inner blade forwards upon the stone.

No. 2. Lithotrite constructed by Charrière, by which also, percussion or pressure may be employed. *a.* convex fixed branch; *b.* concave moveable branch; *c.* round handle of screw; *d.* button with knobs turned transversely, so as to allow the concave branch to slide freely backwards and forwards within the convex one, thus serving for percussion; *e.* the screw; *f.* expanded portion of handle whereon to apply the thumb while holding the instrument with the stone in its grasp.

No. 3. Front view of the same instrument, showing the aperture in the extremity of the convex branch, to allow the escape of detritus, (also seen in Weiss's instrument) and the knobs on the button turned perpendicularly, as a fixed point for the screw, for the employment of pressure; also *g.* the graduated scale of lines to indicate the diameter of the stone when seized.

No. 4. The screw scoop for breaking small calculi and fragments.

No. 5. The catheter forceps for the removal of fragments and detritus. The blades are hollowed out for the purpose of containing the fragments, and of allowing injections to be made.

No. 6. New instrument, as well as the two former constructed by Weiss, for breaking fragments lodged in the urethra. A, the central rod, the branches of which are represented expanded on the canula; B, being drawn back; C, head of the perforator.